

# Particle Flow

## **Learning Objectives**

**After completing this chapter, you will be able to:**

- *Understand the Particle Flow system*
- *Work with the Particle View window*
- *Create event driven particle systems*
- *Understand events and actions (tests and operators)*



## INTRODUCTION

The Particle Flow is an event-driven particle system available in 3ds Max. In this system, the behavior of the particles is controlled by operators, events, and tests that you can combine in a group using the **Particle View** window. You can group these operators to create events and then can connect them using wires. In the particle system the particles flow from one event to another using tests. For example, you can conduct a test to check whether a particle has acquired a certain speed, color, or age. Once the particle passes an event, it moves to the next wired event. In this chapter, you will create various particle effects using Particle Flow.

## PF SOURCE PARTICLE SYSTEM

<b>Menu bar:</b>	Create > Particles > Particle Flow Source
<b>Command Panel:</b>	Create > Geometry > Particle Systems > Object Type rollout > PF Source

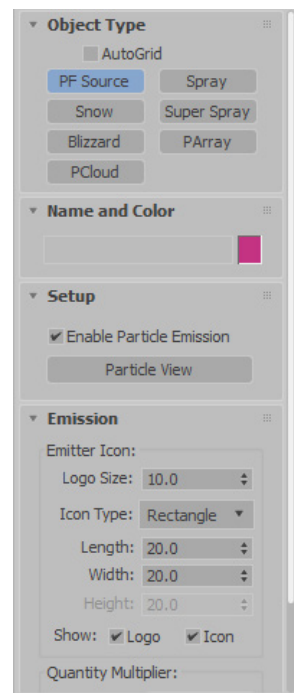
The **PF Source** particle system is used to simulate various particle effects such as fire and water. To create a **PF Source** particle system, choose the **PF Source** tool from **Create > Geometry > Particle Systems > Object Type** rollout in the **Command Panel**; the **Name and Color**, **Setup**, **Emission**, and **System Management** rollouts will be displayed, as shown in Figure 17-1. In the Top viewport, press and hold the left mouse button, drag the cursor diagonally, and then release the left mouse button; an emitter will be created in the Top viewport. Next, right-click in the viewport to exit the tool. You can change the shape and size of the emitter by using the options/parameters/attributes available in the **Emission** rollout. The emitter created will not be visible at the time of rendering.

Choose the **Play Animation** button from the animation playback controls; the emission of particles from the emitter will start, refer to Figure 17-2. The arrow sign indicates the direction of movement of the particles. Now, choose the **Modify** tab in the **Command Panel**; various rollouts will be displayed. These rollouts are discussed next.



### Note

*The direction of movement of the particles depends on the viewport in which the emitter is created.*



**Figure 17-1** The **PF Source** tool in the **Object Type** rollout

## Setup Rollout

The options in this rollout are used to toggle the visibility of particles. In this rollout, the **Enable Particle Emission** check box is selected by default. If you clear this check box, the emitter will not emit particles. Alternatively, choose the **Particle View** button from the **Setup** rollout; the **Particle View** window will be displayed. Next, choose **Edit > Turn Off All** from the menu bar of the **Particle View** window, refer to Figure 17-3. The options in this window will be discussed later in the chapter.

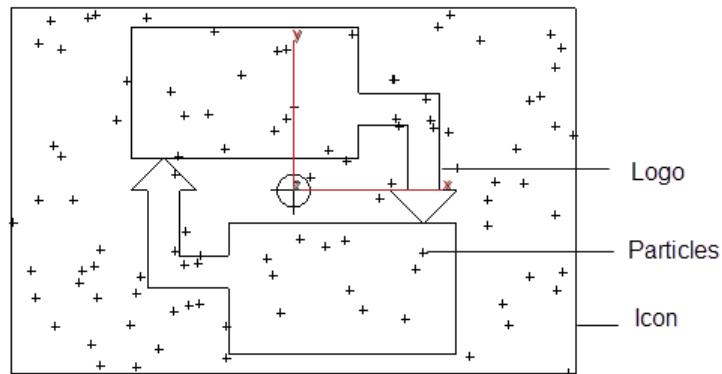


Figure 17-2 The Particle emitter

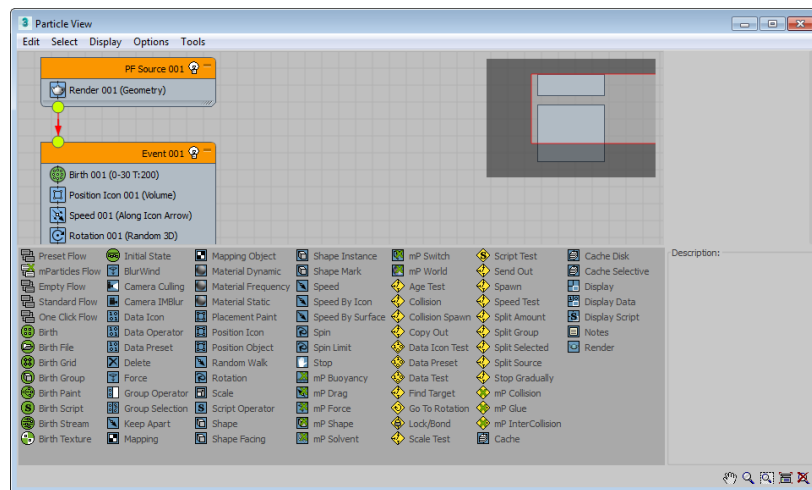


Figure 17-3 The Particle View window

## Emission Rollout

The options in this rollout are used to adjust the size and appearance of the Particle Flow icon in the viewport, refer to Figure 17-4. In addition to this, you can set the quantity of the particles to be emitted in the viewport and on rendering. This rollout has two areas: **Emitter Icon** and **Quantity Multiplier**. These areas are discussed next.

### Emitter Icon Area

The options in this area are used to specify the size and shape of the Particle Flow icon. The options in the **Emitter Icon** area are discussed next.

#### Logo Size

The **Logo Size** spinner is used to specify the size of the Particle Flow logo.

### Icon Type

The options in this drop-down list are used to specify the basic geometry of the source icon. By default, the **Rectangle** is selected in this drop-down list. The other options in this drop-down list are **Box**, **Circle**, and **Sphere**. The options displayed below this drop-down list change according to the option selected in it. For example, if you select the **Box** option from the **Icon Type** drop-down list, then the **Height** spinner below the **Width** spinner will be activated, refer to Figure 17-4.

### Length

The **Length** spinner is used to specify the length of the icon. This spinner is available only if you select the **Rectangle** or **Box** option from the **Icon Type** drop-down list. If the **Circle** or **Sphere** option is selected from the **Icon Type** drop-down list, the **Diameter** spinner will be displayed wherein you can specify the diameter of the **Circle** or **Sphere**.

### Width

The **Width** spinner is used to specify the width of the icon. This spinner will be available only if you select the **Rectangle** or **Box** option from the **Icon Type** drop-down list.

### Height

This spinner is activated only if the **Box** option is selected in the **Icon Type** drop-down list and is used to specify the height of the icon.

### Show

This group consists of two check boxes: **Logo** and **Icon**. By default, both are selected, and therefore, the icon and logo is displayed in the viewport. On clearing the **Logo** check box, the logo will be hidden in the viewport and on clearing the **Icon** check box, the geometry of the icon will be hidden in the viewport. This option affects only the viewport display but not the particle system.

## Quantity Multiplier Area

The options in this area are used to specify the percentage of the particles that will be displayed in the viewports and on rendering. This area has two spinners: **Viewports %** and **Render %**. These spinners are discussed next.

### Viewport %

This spinner is used to set the percentage of total number of particles displayed in the viewport. By default, its value is 50.0 but can range from 0.0 to 10000.0.

### Render %

This spinner is used to set the percentage of total number of particles displayed while rendering. By default, its value is 100.0 but can range from 0.0 to 10000.0.

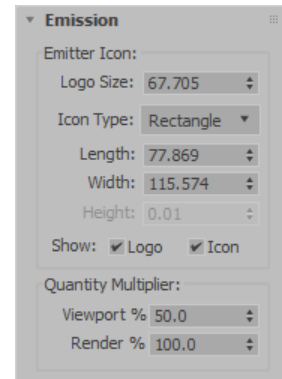


Figure 17-4 The *Emission* rollout

## Selection Rollout

The options in this rollout are used to select particles in the viewport. This rollout has sub-object levels and areas: **Select by Particle ID**, **Get From Event Level**, and **Select by Event**, refer to Figure 17-5. These are discussed next.

### Sub-object Level

There are two sub-object levels of the **PF Source** tool: **Particle** and **Event**. To select the **Particle** and **Event** sub-object levels, press 1 and 2, respectively.

#### Particle Sub-object Level

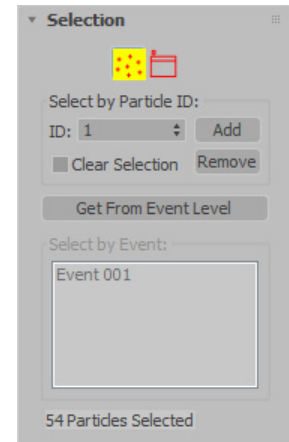


This sub-object level is used to select the particles and regions in the viewport.

#### Event Sub-object Level



This sub-object level is used to select all the particles in a particular event.



*Figure 17-5 The Selection rollout*

## Select by Particle ID Area

The options in this area are used to add and remove the particles from the viewport by using their IDs. Each particle has a unique ID number. The options in this area are activated when you select the **Particle** sub-object level.

### ID

The **ID** spinner is used to select a particle by using its assigned **ID** number. You can select only one ID number at a time.

### Add

This button is used to add a particle to the selection by specifying the **ID** number in the **ID** spinner

### Remove

This button is used to remove the particle with the specified ID.

### Clear Selection

This check box is used to clear all the particles from the viewport except the particles with the ID specified in the **ID** spinner. You need to choose the **Add** button to view the particle with the specified **ID** in the viewport.

## Get From Event Level

The **Get From Event Level** button is used to convert the selection of the **Event** sub-object level into the **Particle** sub-object level. This button is enabled only when the **Particle** sub-object level is selected.

## Select by Event Area

This area is used to display all events in a flow and highlights the event list of the selected flow of the particles.

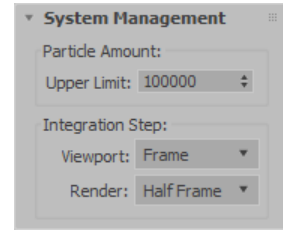


### Note

*The number of particles selected in the viewport is displayed at the bottom of the **Select by Event** area.*

## System Management Rollout

The options in this rollout are used to define the upper limit of the number of particles to be emitted in a system and determine the overall accuracy of the Particle Flow in the viewport and while rendering. This rollout has two areas: **Particle Amount** and **Integration Step**, refer to Figure 17-6. These areas are discussed next.



*Figure 17-6 The System Management rollout*

### Particle Amount Area

The option in this area is used to define the amount of particles to be emitted in the viewport and render. This area consists of the **Upper Limit** spinner. This spinner is discussed next.

#### Upper Limit

This spinner is used to define the maximum number of particles to be emitted in a Particle Flow system. By default, the **Upper Limit** spinner is set to 100,000 and it ranges from 0 to 1,00,00,000. You should avoid using large values in the **Upper Limit** spinner as it results in poor system performance.

### Integration Step Area

In this area, the Particle Flow updates the particle system at every integration step by applying action to the particles in its event. This area has two drop-down lists: **Viewport** and **Render**. These are discussed next.

#### Viewport

The various options in this drop-down list are used to define the integration step for animation playback in the viewports. By default, the **Frame** option is selected, which specifies one calculation per animation frame. The other options available in this drop-down list are **Half Frame**, **1/4 Frame**, and **1/8 Frame**.

#### Render

The options in this drop-down list are used to define the integration step at render time. By default, the **Half Frame** option is selected, which is two calculations per animation frame. The other options available in this drop-down list are **Frame**, **1/4 Frame**, **1/8 Frame**, **8 Ticks**, **4 Ticks**, **2 Ticks**, and **1 Tick**. There are 4,800 ticks in a second, which means that according to NTSC video rate of 30 frames per second, there will be 160 ticks per frame.

**Note**

*Sometimes the behavior of particles in the viewport fails to match with that of the render due to the difference in the options selected in the **Viewport** drop-down list and the **Render** drop-down list in the **Integration Step** area. Set same values in the **Viewport** and **Render** drop-down lists in the **Integration Step** area to make particles behave in the same manner in the viewport as well as in rendering.*

## Script Rollout

The options in this rollout are used to run a script for the particle system at every integration step or after each frame's final integration step. This rollout has two areas: **Every Step Update** and **Final Step Update**, as shown in Figure 17-7. These areas are discussed next.

### Every Step Update Area

The options in this area are used to examine the script at the end of each integration step. This can be done only if all the actions and events have been calculated and the particles have reached their respective places.

The **Every Step Update** script is used to set up history-dependent properties of the particle such as speed, spin, and so on. With history-dependent properties, it is necessary to calculate the script at every integration step.

This area has two check boxes: **Enable Script** and **Use Script File**, and two buttons, namely **Edit** and **None**.

#### Enable Script

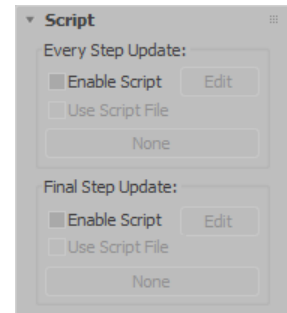
The **Enable Script** check box in this area when selected runs a script in memory at each integration step. By default, a script is carried out which defines the particle speed and direction, and guides the particles to move in a wavy path. To invoke the default script, choose the **Edit** button next to the **Enable Script** check box. Note, you need to choose the **Enable Script** check box to activate the **Edit** button.

#### Edit

This button is used to invoke the **MAXScript Editor** window with the default script namely the Every Step Update Script. You can edit this script. By default, the **Use Script File** check box is cleared. So, when you choose the **Edit** button, the **PF Source 001: Every Step Update Script** window will be invoked, refer to Figure 17-8. If the **Use Script File** check box is selected and you choose **Edit** button, the **Open File** dialog box will be displayed, refer to Figure 17-9.

#### Use Script File

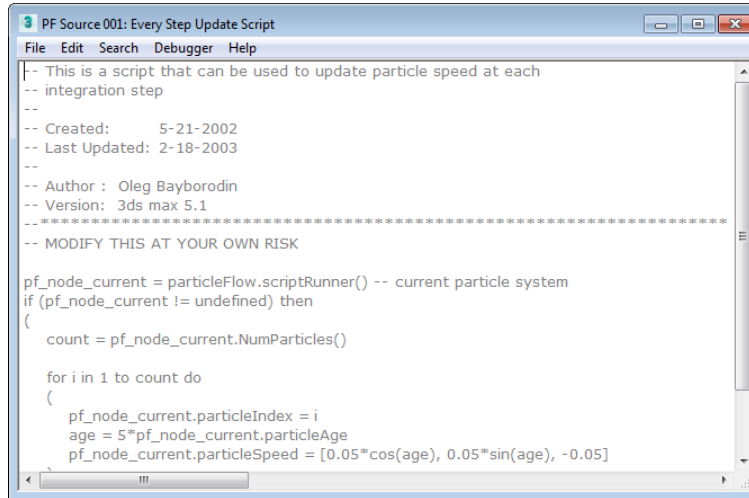
The **Use Script File** check box in this area is used to run a loaded script file from the drive. To load this file, you need to choose the **None** button below the **Use Script File** check box.



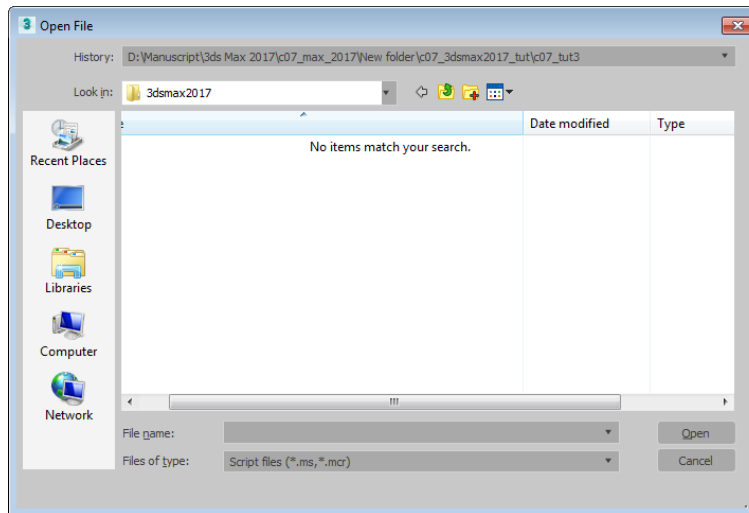
**Figure 17-7** The **Script** rollout

### None

When you choose this button, the **Open** dialog box is displayed. Navigate to the desired location and select the script. After loading the script, the name of the script file appears in place of the **None** button. You can also modify the loaded script.



*Figure 17-8 The PF Source 001: Every Step Update Script window*



*Figure 17-9 The Open File dialog box*

### Final Step Update Area

The options in this area are used to examine each frame in the viewport or in the render output after the last integration step has taken place. The Final Step Update script is used to set up history-independent properties. The options in this area are discussed next.

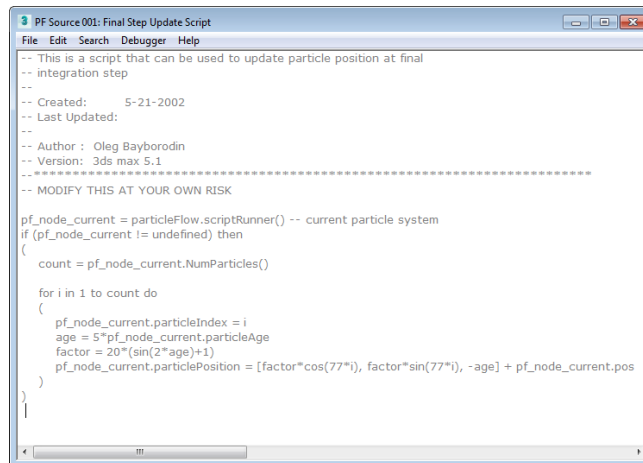


### Enable Script

The **Enable Script** check box in this area, when selected, runs a script in memory after the last integration step. This script defines the particle speed and direction and guides the particles to move in a bulb-shaped path. To invoke the script, choose the **Edit** button next to the **Enable Script** check box. You need to choose the **Enable Script** check box to activate the **Edit** button.

### Edit

This button is used to invoke the **MAXScript Editor** window with the default script, the Final Step Update Script. You can also make changes in the **Final Step Update Script** window. By default, the **Use Script File** check box is clear. So when you choose the **Edit** button, the **PF Source 001: Final Step Update Script** window will be invoked, refer to Figure 17-10. If the **Use Script File** check box is selected and you choose the **Edit** button, the **Open File** dialog box will be displayed, refer to Figure 17-9.



*Figure 17-10 The PF Source 001: Final Step Update Script window*

### Use Script File

The **Use Script File** check box in this area when selected runs a loaded script file from the respective drive. To load the script file, you need to choose the **None** button below the **Use Script File** check box.

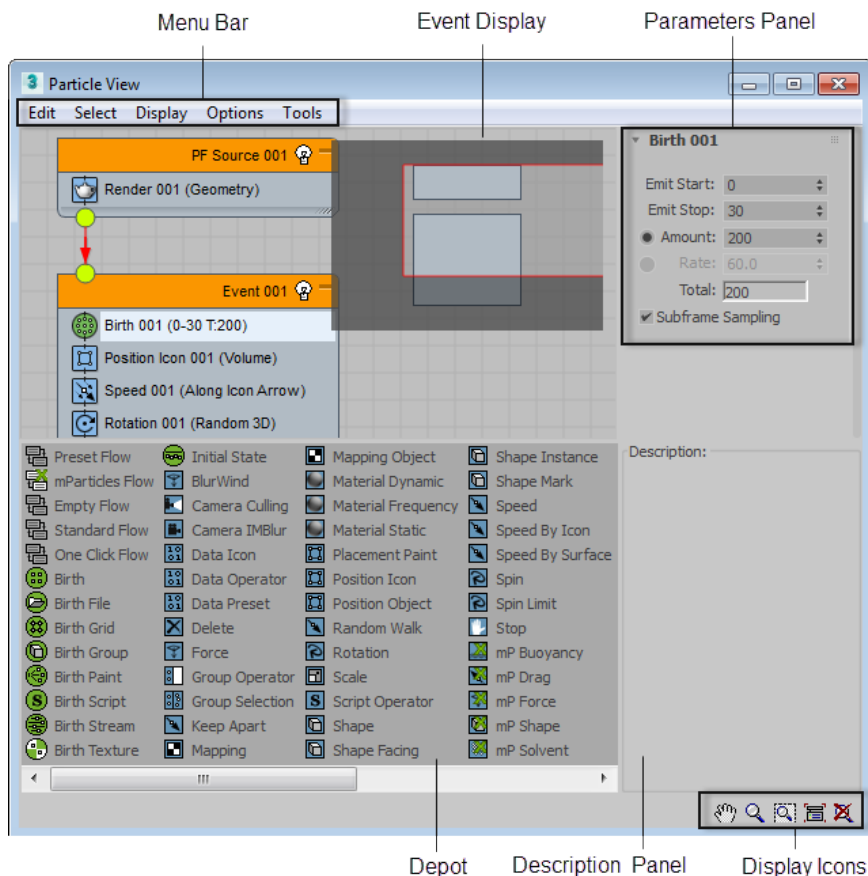
### None

The **None** button in the **Every Step Update** area is used to invoke the **Open** dialog box. Navigate to the desired location and select the script. You can also modify the loaded script. After you load a script, the name of the script file appears in the place of the **None** button.

## PARTICLE VIEW WINDOW

<b>Command Panel:</b>	Create > Geometry > Particle Systems > Object Type rollout > PF Source > Setup rollout > Particle View
<b>Keyboard:</b>	6

The **Particle View** window is the main interface used for setting up a particle system. To open the **Particle View** window, choose **Create > Geometry > Particle Systems > Object Type > PF Source** tool from the **Command Panel**. In the Top viewport, press and hold the left mouse button, drag the cursor diagonally, and then release the left mouse button; an emitter will be created and various rollouts will be displayed in the **Command Panel**. Next, right-click to exit the tool. In the **Setup** rollout, choose the **Particle View** button; the **Particle View** window will be displayed, refer to Figure 17-11.



*Figure 17-11 The Particle View window*

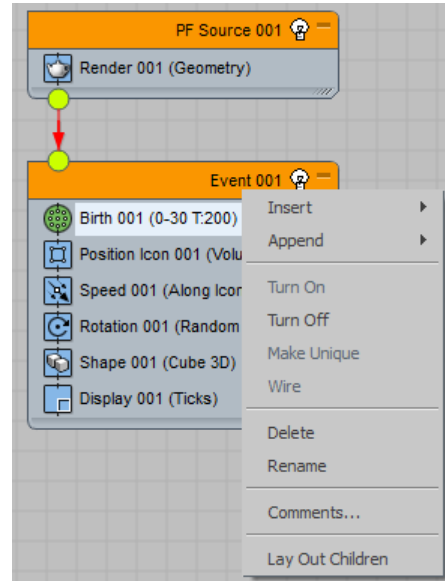
The **Particle View** window consists of different components, namely **Menu Bar**, **Event Display** area, **Depot** area, **Parameters** panel, **Description** panel, and **Display** tools, refer to Figure 17-11. These components are discussed next.

## Menu Bar

The menu bar is located at the top of the **Particle View** window and it contains various pull-down menus. These pull-down menus are **Edit**, **Select**, **Display**, **Options**, and **Tools**.

## Event Display Area

The main area in the **Particle View** window is the **Event Display** area. This area consists of event diagrams that defines the Particle Flow. The Particle Flow consists of global and local events wired together. Events contain multiple operators and tests known as actions. The global event represents **PF Source** and affects the entire Particle Flow. The local event affects only the particles in the current event. The operators are used to manage particle parameters and the tests are used to determine the movement of particles related to events. On right-clicking an action or an event in the **Event Display** area, a shortcut menu containing various options will be displayed, refer to Figure 17-12. The functions of these options depend on where you click or what is highlighted, or both. The most commonly used options are discussed next.



*Figure 17-12 The shortcut menu*

### Insert

The **Insert** option is used to insert the selected action to the point you right-click on. This option is available only when you right-click over an event or an action.

If you right-click on an action and then insert an action, the inserted action replaces the old one. If you right-click above or below an action, the new action is added to the event at that location. If you right-click over an event, the action is inserted at the first available position.

### Append

The **Append** option is used to insert the selected action at the end of the event. This option is available only when you right-click over an event or an action.

### Turn On

The **Turn on** option is used to turn on the event or action.

### Turn Off

The **Turn off** option is used to turn off the event or action.

## Parameters Panel

The **Parameters** panel is used to edit the parameters of the actions in the **Particle View** window. It consists of different rollouts, spinners, drop-down lists, and radio buttons. This panel appears on the right side in the **Particle View** window. If the **Parameters** panel is not visible, activate it by choosing the **Parameters** option in the **Display** menu.

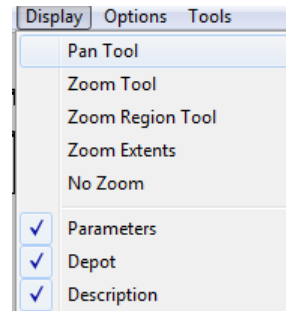
## Display Tools

The Display tools are located at the bottom-right corner of the **Particle View** window. These tools are used to pan and zoom the **Event Display** area. Note that these tools are also present in the **Display** menu of the menu bar in the **Particle View** window, refer to Figure 17-13. These tools are discussed next.

### Pan Tool



This tool is used to move around the **Event Display** area. When you choose this tool, the mouse cursor changes into a hand icon. You can also pan in the **Event Display** area by holding and dragging the middle mouse button. To deactivate this tool, choose the **Pan** tool once again from the Display tools set or right-click in the **Event Display** area.



**Figure 17-13** The Display tools in the **Display** menu

### Zoom Tool



This tool is used to zoom in and out the **Event Display** area. When you choose this tool, the shape of the cursor changes to a magnifying-glass icon. You can zoom in and out the **Event Display** area by dragging the middle mouse button upward or downward. To deactivate this tool, choose the **Zoom** tool once again from the Display tools set or right-click in the **Event Display** area.

### Zoom Region Tool



This tool is used to zoom a particular region in the **Event Display** area. When you choose this tool, the shape of the cursor changes into a magnifying glass. Choose this tool and press and hold the left mouse button. Next, drag the cursor in the **Event Display** area particularly on the region that you want to zoom in. To deactivate this tool, choose the **Zoom Region** tool once again from the Display tools set or right-click in the **Event Display** area.

### Zoom Extents



This tool is used to zoom the entire Particle Flow in the **Event Display** area.

### No Zoom



This tool is used to zoom the entire Particle Flow to the default value in the **Event Display** area.

## Depot

The **Depot** area is used to store the Particle Flow actions. If the **Depot** area is not visible, activate it by choosing the **Depot** option from the **Display** menu. It is like a library which stores Particle Flow actions: **Flow**, **Operator**, and **Test**, refer to Figure 17-14. Drag these actions from the **Depot** area to the **Event Display** area to build particle system setup.

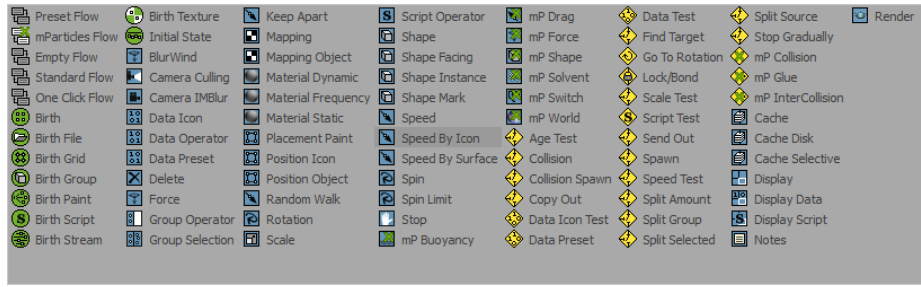


Figure 17-14 The *Depot* area with Particle Flow actions

## Description Panel

The **Description** panel is used to display the description of the actions when selected in the **Depot** area. The **Description** panel is located at the right side of the **Depot** area in the **Particle View**. If the **Description** panel is not visible, activate it by choosing the **Description** option from the **Display** menu.

## CREATING PARTICLE FLOW DIAGRAM

A Particle Flow diagram is like a flowchart that represents the process of Particle Flow with the help of steps and their order.

To create the Particle Flow diagram in the **Event Display** area, press and hold the left mouse button on **Standard Flow** in the **Depot** area and then drag it in the **Event Display** area; a Particle Flow diagram will be created in the **Event Display** area. The actions in the Particle Flow diagram consists of operators and tests.

To create a new event in the **Event Display** area, press and hold the left mouse button on the operator in the **Depot** area and then drag and drop it on the **Event Display** area. You can replace an existing operator in the event or append a new one. To replace an existing operator with the new one, press and hold the left mouse button on the new operator in the **Depot** area and then drag the cursor to the operator that needs to be replaced; a red line will appear on the operator in the event and the new operator will replace the existing operator. To append a new operator in the event, press and hold the left mouse button on the new operator in the **Depot** area and then drag the cursor below the operator where you need to add the new operator; a blue line will appear on the operator in the event and the new operator will be added to the event.

If you drag an action to an existing event, it will be added to the existing event and will function depending on whether a red line or a blue line appears when you drop it on the event. If a red line appears, the new action will replace the underlying action. If a blue line appears, the action will be added to the list.

Choose an action in the event to edit its parameters in the **Particle View** window. The **Parameters** panel appear on the right side in the **Particle View** window. If the **Parameters** panel is not visible, choose the **Parameters** option from the **Display** menu.

A test can be wired to an event in the **Event Display** area by dragging the gray dot that is at the left of the test into the event input. You can also wire the global event to the local event by connecting the source output on the bottom of the global event to the event input.

## MANIPULATING ACTIONS AND EVENTS

The events and actions can be toggled, copied, moved, and deleted from the **Event Display** area by right-clicking and using the options in the shortcut menu. Choose the bulb icon next to the event name in the title bar and click to toggle an event. When you deactivate an event, its operators and tests are also deactivated. The event items do not affect the particle system and appear gray in the event list. The Particle Flow will pass to the downstream event if the above event is deactivated.

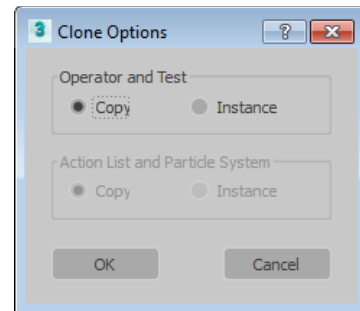


Choose the operator icon in the event and click to toggle the operator. If the operator is inactive, it will not affect the particle system and will appear gray in the event list. If you toggle an instanced operator, it will not affect its other instance operator.

Choose the test icon and click either on the left or right side of it to make a test result true or false. The test icon changes to green check mark for true, and to red cross for false.

Choose the colored circle at the right of the **Display** operator and click to change Particle's color using the **Color Selector: Display XXX** dialog box displayed.

To copy an action or event, select it and press and hold SHIFT; the shape of the cursor will change. Next, drag the item to a new location in the **Event Display** area. When you release the mouse button, the **Clone Options** dialog box will be displayed, refer to Figure 17-15. Select the desired radio button in the **Operator and Test** area and choose the **OK** button. In the **Clone Options** dialog box, the **Action List and Particle System** area is not active, as shown in Figure 17-15. All instanced actions or events have same properties. If you change the value of one instance item, the value of other instance also changes. For example, when you select an instanced item in the **Event Display** area, all of its other instances will be highlighted in a light gray color. Copied actions can have different properties. Even if you change the value of one copied item it does not affect the value of the other copied item.



**Figure 17-15** The *Clone Options* dialog box

If you want to select multiple items in an event in the **Event Display** area, drag the cursor on them, or press and hold CTRL and select them one by one. To move the event or an action in the **Event Display** area, drag the title bar of an event or the icon of any action. You can also scale the width of an event by placing the cursor on its right edge and then dragging it toward left or right. If you want to move an event or an action to a new location, select it and then move it anywhere in the **Event Display** area. When you drag an event to a new location, the **Display** operator will automatically move with the event. If you want to delete an event, action, or wire, select it in the **Event Display** area and press DEL.

## UNDERSTANDING PARTICLE FLOW ACTIONS

The **Depot** area has a library which stores the Particle Flow actions. These actions are Flow, Operators, Tests, and mParticles and are discussed next.

### Flow

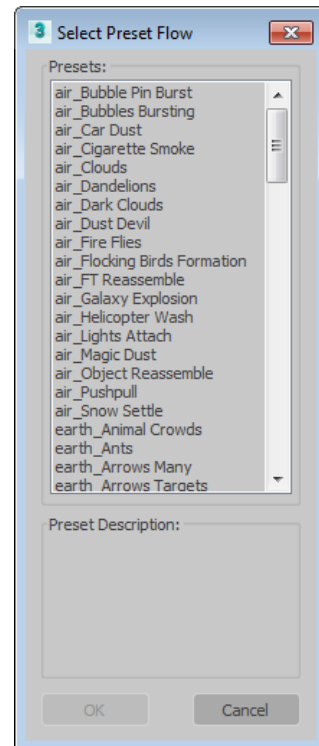
The Flow is a set of actions used to create different types of particle system setups in the initial stage of the Particle Flow. To use a flow, select and drag it from the **Depot** area to the **Event Display** area. There are different kinds of flows: **Preset Flow**, **Empty Flow**, **Standard Flow**, and **One click Flow**. These flows are discussed next.

### Preset Flow

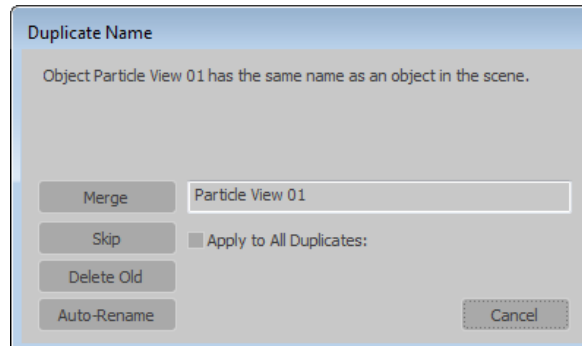
**Preset Flow** is used to merge the previously saved Particle Flow setup to the current scene. Choose the **Preset Flow** action and drag it to the **Event Display** area; the **Select Preset Flow** dialog box will be displayed, refer to Figure 17-16. The **Select Preset Flow** dialog box has a set of parameters where you define the lists of the current presets in the system and displays the description for the selected preset. If you have any Particle Flow setup, it will be displayed in the **Presets** area of this dialog box. If you want to use any setup, select it from the **Presets** area of this dialog box and then choose the **OK** button; the **Duplicate Name** dialog box will be displayed, refer to Figure 17-17. The options in the **Duplicate Name** dialog box are used to merge a previously saved Particle Flow setup to the selected scene. The merged flow can be used as an event within the current flow or as a starting point for a new particle system.

### Empty Flow

**Empty Flow** is used to create the initial stage for the particle system in the **Event Display** area. **Empty Flow** consists of a single global event which further contains the **Render** operator. To create the initial stage for the particle system, press and hold the left mouse button on **Empty Flow** and then drag it to the particle system in the **Event Display** area. Next, choose **PF Source 001** in the **Event Display** area, various rollouts will be displayed on the right side of the **Event Display** area in the **Parameters** panel. Here you can specify the properties of the flow. These rollouts are same as those of the **PF Source** particle system rollouts that have been discussed earlier.



*Figure 17-16 The Select Preset Flow dialog box*



*Figure 17-17 The Duplicate Name dialog box*

## Standard Flow

**Standard Flow** is used to create the initial stage of the Particle System where the global event is wired to the local event. The global event consists of the **Render** operator and the local event consist of the **Birth**, **Position**, **Speed**, **Rotation**, **Shape**, and **Display** operators. Press and hold the left mouse button on **Standard Flow** and then drag the cursor to the particle system in the **Event Display** area. When you choose **Standard Flow** in the **Event Display** area, various rollouts will be displayed in the **Parameters** panel. **Standard Flow** has the same operators that are created while adding the PF source icon to the viewport.

## One Click Flow

**One Click Flow** is used to create the initial stage for the particle system using the Maya nCache files from the cache memory. It has a set of operators such as **Birth File**, **Material Static**, **Shape**, and **Display**. Press and hold the left mouse button on **One Click Flow** and then drag the cursor to the particle system in the **Event Display** area. Choose the **Birth File** operator from the flow and then choose the **Select File** button from the **Parameters** panel; the **Open** dialog box will be displayed. The options in this dialog box are used to import the Maya nCache files.

## Operators

The operators are Particle Flow actions that are used to manage particle parameters such as scale, speed, rotation, and shape. When combining the operators to the events, the attributes of particles are defined over a given period of time. Drag the operator to the particle system in the **Event Display** area to combine it with the event. There are two groups of operators in the **Depot** area. The operator icons are usually blue in color. However, the **Birth** operators has green colored icons. The first group contains operators such as **Birth**, **Rotation**, **Spin**, **Scale**, and so on. These operators directly affect the particle behavior, such as birth rate, life span, rotation, scale, and so on. The second group contains utility operators such as **Cache**, **Display**, **Notes**, **Render**, and so on. The operators of both theses groups are discussed next.

## Birth

The **Birth** operator is used to create particles within the Particle Flow system. The **Birth** operator is the first operator in every event that is connected to the global event. It is always at the beginning of the local event. If the **Birth** operator is positioned anywhere in the **Event**



**Display** area, the Particle System does not connect it with other items in the **Event Display** area. The **Birth** operator cannot be inserted in a local event that already has a **Birth** operator. You can wire multiple **Birth** operators if they are in multiple parallel events in the Particle Flow.

## Birth Paint

The **Birth Paint** operator is used to create particles with the **Particle Paint** helper. To do so, choose **Create > Helpers** in the **Command Panel**. Next, select **Particle Flow** from the drop-down list located below it and then choose the **Particle Paint** tool from the **Object Type** rollout. Now, drag the cursor in the viewport, the **Particle Paint** helper will be displayed, as shown in Figure 17-18. The **Particle Paint** helper places particle seeds on an object with the defined pattern and timing. The **Birth Paint** operator creates particles from these seeds by setting parameters in the **Birth Paint** rollout, which defines particle position, rotation, mapping, and selection status.

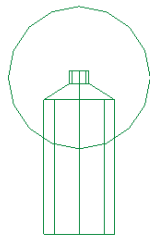
## Birth Script

The **Birth Script** operator is used to create particles within the Particle Flow system using the Birth Script in the **MAXScript Editor** window.

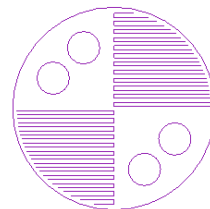
## Birth Texture

The **Birth Texture** operator is used to create particles from the animated texture by calculating the time, location, and scale of the particles. The texture applied to the object should be white or of a brighter color to create the particles.

To work with the **Birth Texture** operator, press and hold the left mouse button on the **Birth Texture** operator and then drag the cursor to the **Birth** operator in the event in the **Event Display** area. Next, replace the **Birth** operator with the **Birth Texture** operator of the particle system in the **Event Display** area. On doing so, the **Birth Texture** icon is created in the viewport, refer to Figure 17-19.



*Figure 17-18 The Particle Paint helper*



*Figure 17-19 The Birth Texture icon*

## Initial State

The **Initial State** operator is used to define the initial stage for a new event. It uses the snapshot of another particle system or other events as a starting point.

## Camera Culling

The **Camera Culling** operator is used to reduce the geometry load in the viewports and in rendering by filtering out all particles outside the camera frustum.

## Camera IMBlur

The **Camera IMBlur** operator is used to adjust the particle speed before passing the data for image motion blur in the displayed viewport or renderer.

## Delete

The **Delete** operator is used to delete or remove particles from the particle system once their function in the animation is completed.

## Force

The **Force** operator is used to control the motion of particle to simulate the effects of wind, gravity, and other effects. The forces which simulate effects with the **Force** operator are **Displace**, **Drag**, **Gravity**, **Motor**, **PBomb**, **Push**, **Vortex**, and **Wind**.

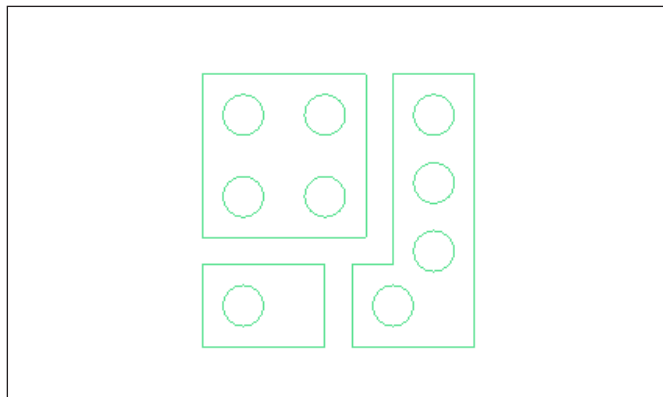
## Group Operator

The **Group Operator** operator is used to link an external event to the Particle Flow diagram specified by one or more **Group Selection** operators. The **Group Operator** operator can be added to an event that has to be linked with the Particle Flow but the particles are not separated from the event.

## Group Selection

The **Group Selection** operator is used to specify any number of groups of particle according to the location, age, speed, and size of the particle.

To work with the **Group Selection** operator, press and hold the left mouse button on the **Group Selection** operator and then drag the cursor to the **Event Display** area. This creates the **Group Selection** icon in the viewport, refer to Figure 17-20. Alternatively, the **Group Select** tool can also be chosen from **Create > Helpers > Particle Flow** in the **Command Panel**.



*Figure 17-20 The Group Selection icon*

## Keep Apart

The **Keep Apart** operator is used to apply the forces to particles so that they are separated and do not collide with each other. The particles are controlled by speed and acceleration values.

## Mapping

The **Mapping** operator is used to attach the UVW mapping to the entire surface of the particles.

## Mapping Object

The **Mapping Object** operator is used to assign maps to the particles by using mapping values of the nearest reference objects from the particles.

## Material Dynamic

The **Material Dynamic** operator is used to assign the material IDs to the particles that can change during the event. It also assigns a different material to the particles based on their material IDs.

## Material Frequency

The **Material Frequency** operator is used to assign material to the particles in an event by distributing the relative frequency of each sub-material that appears on the particles.

## Material Static

The **Material Static** operator is used to assign material to the particles that remain constant throughout the event.

## Placement Paint

The **Placement Paint** operator is used to define the position, rotation, and mapping of the particles with the help of the **Particle Paint** helper.

## Position Icon

The **Position Icon** operator is used to define the initial position of the particles to be emitted from the emitter.

## Position Object

The **Position Object** operator is used to emit the particles from any other object or objects in the scene.

## Rotation

The **Rotation** operator is used to rotate the particles. The rotation of the particle can be static or dynamic. The static rotation is applied once when the particle enters the **Rotation** operator. In the dynamic rotation, the rotation value changes according to the change in Particle Flow item rotation over a period of time.

## Scale

The **Scale** operator is used to scale the size of the particles during an event.

## Script Operator

The **Script Operator** operator is used to modify the properties of particles within the Particle Flow system using MAXScript.

## Shape

The **Shape** operator is used to define the 2D and 3D shapes of the particles in the viewport and in the render. The shape of the particles can have any form such as geometric primitives, alphanumeric characters, and musical notes.

## Shape Facing

The **Shape Facing** operator is used to create particles in a simple square polygon shape that has mapping coordinates and are oriented toward the camera, the viewport, or the object.

## Shape Instance

The **Shape Instance** operator is used to create the particles as the instances of a reference object in the scene. The reference object's animation can be synchronized with the particle events.

## Shape Mark

The **Shape Mark** operator is used to create the particles of rectangular or box shape, when it comes in contact with another object in the scene.

## Speed

The **Speed** operator is used to specify the speed of the particles and their direction. When you create a new flow in the **Event Display** area, this operator is there in the first event by default. The position and orientation of the Particle Flow icon controls the direction of movement of the particles.

## Speed By Icon

The **Speed By Icon** operator is used to define a non-rendering icon that controls the particle speed and direction.

## Speed by Surface

The **Speed By Surface** operator is used to specify the speed and direction of the particles with objects in the scene. The **Speed By Surface** operator also provides options that are used to control the speed by materials.

## Spin

The **Spin** operator is used to spin the particles in an event.

## Stop

The **Stop** operator is used to halt the movement and spinning of the particles immediately.

## Cache

The **Cache** operator is used to record and store particle states in the system memory for faster playback. This is particularly useful with large or complex Particle Systems.

## Cache Disk

The **Cache Disk** operator is used to store the cache in a disk file separately from the Max file.

## Cache Selective

The **Cache Selective** operator is used to store the cache like the Cache operator. However, you can exclude certain types of data from the cache.

## Display

The **Display** operator is used to control the appearance of the particles in the viewports.

## Notes

The **Notes** operator is used to add a comment to an event.

## Render

The **Render** operator is used to control the rendering of the particles. It controls the form that particles will take on rendering. It also controls the conversion of the particles to individual mesh objects for rendering purpose.

## Tests

The tests in the Particle Flow are used to determine whether the particles satisfy one or more than one conditions. If particles satisfy a particular condition, then they are sent to another event. When a particle passes a test, it is called as test true. The qualified particles are passed to another event by wiring the test to the event. If the particles don't pass the test, then the test is called test false. The Particles will remain in the event and will go through the conditions repeatedly until they pass the condition and qualifies for the next event. If the test is not wired to another event, all the particles remain in the existing event. There can be several tests in an event. The first test checks all the particles in the event and the remaining test functions only when they qualify the given tests. Some of the tests also function as operators if they are not wired to any other event.

All the tests are grouped together in the **Depot** area in the **Particle View** window and are listed in an alphabetical order. These tests are discussed next.

## Age Test

The **Age Test** test is used to specify the age limit of particles in an event.

## Collision

The **Collision** test is used to detect the collision of particles with one or more deflectors. It also determines the speed of the particle when they collide with the deflectors.

## Collision Spawn

The **Collision Spawn** test is used to create new particles from existing ones, which collide with one or more deflectors.

## Copy Out

The **Copy Out** test is used to make one or more copies of each particle and then send them to the next event. It is similar to the **Spawn** test, which is discussed later in the chapter.

**Find Target**

The **Find Target** test is used to send particles to a specified target. When the particles reach the target, they are transferred to the event which is wired to the **Find Target** test.

**Go To Rotation**

The **Go To Rotation** test is used to test the smooth transition in the current rotation value of the particle to the value specified by the next rotation operator.

**Lock/Bond**

The **Lock/Bond** test is used to lock the particles to the objects and keep them locked even when the object animates.

**Scale Test**

The **Scale Test** is used to test the particle scaling.

**Script Test**

The **Script Test** is used to test particle conditions using MAXScript.

**Send Out**

The **Send Out** test is used to send all particles to the next event if the test is true or retain all the particles in the current event if the test is false.

**Spawn**

The **Spawn** test is used to create new particles from the existing ones. The spawned particle has the same position, orientation, and the shape as that of its parent particle. It gives particle a different speed and scaling factor.

**Speed Test**

The **Speed Test** is used to check the speed, acceleration, or rate of circular travel of the particles.

**Split Amount**

The **Split Amount** test is used to send the specific number of particles to the next event and keep all remaining particles in the current event.

**Split Selected**

The **Split Selected** test is used to split the particles according to the particle's selection status.

**Split Source**

The **Split Source** test is used to split the particles according to their parent particle.

**Stop Gradually**

The **Stop Gradually** test is used to slow down the linear and rotational speed of the particles and then stop them gradually. When the test stops the particles are sent to the next event.

## mParticles

The mParticles provide flexibility to the standard Particle Flow system. With the help of the MassFX simulation, the mParticles can be used to create more refined, realistic physics simulations, and real-world effects such as storm, wind, rain, hail, and so on. It also binds the particles together and creates collision between the particles and other objects.

All the mParticles actions are grouped together in the **Depot** area in the **Particle View** window. These are discussed next.

### mParticles Flow

The **mParticles Flow** is used to create a simple Particle Flow setup that is wired to a MassFX simulation. To view the simulation, choose the **Play Animation** button from the time control tools.

### Birth Grid

The **Birth Grid** operator is used to create particles and place them in a grid like structure as a volume.

### Birth Group

The **Birth Group** operator is used to create particles from a reference object. The particle will emit from the reference object and also inherit the position and orientation of the reference object.

### Birth Stream

The **Birth Stream** operator is used to create particles and defines their positions and speed.

### mP Buoyancy

The **mP Buoyancy** operator is used to simulate the behavior of particles in a liquid. A particle rises and sinks in the liquid depending on the relative densities of the particle and the liquid.

### mP Drag

The **mP Drag** operator is used to slow down the simulation of the particles by applying the **mParticles Force** operator.

### mP Force

The **mP Force** operator is used to define the forces that influence the particles during simulation.

### mP Shape

The **mP Shape** operator is used to specify the particle shape required for collision during simulation.

### mP Solvent

The **mP Solvent** operator is used to remove bindings created by the **mParticles Glue** test.

### **mP Switch**

The **mP Switch** operator is used to control the adjustment of simulation animation by defining events containing this operator as kinematic as opposed to dynamic.

### **mP World**

The **mP World** operator is used to connect the particles of the current event to a specific simulation world as a helper in the scene. After you make the connection, that helper's settings affect all particles in the event.

### **mP Collision**

The **mP Collision** test is used to create collisions between particles and standard objects applied with the **PFlow Collision Shape (WSM)** Modifier.

### **mP Glue**

The **mParticles Glue** test is used to bind the particles to each other.

### **mP InterCollision**

The **mP InterCollision** test is used to track interparticle collision and send particles to other events based on the collision information.

## **TUTORIALS**

Before starting the tutorials, you need to download the *c17\_3dsmax\_2017\_tut.zip* file from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2017: A Comprehensive Guide*

Extract the contents of the zipped file and save them in the *Documents* folder.

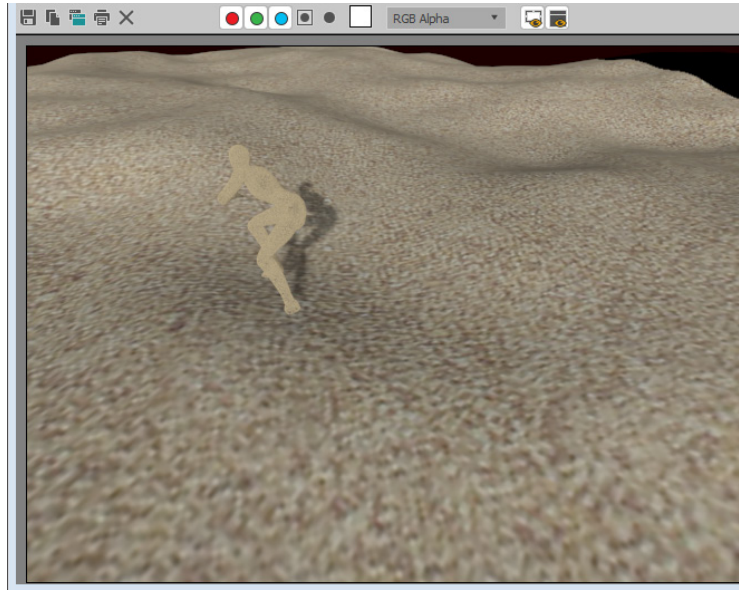
### **Tutorial 1**

In this tutorial, you will create a scene with sandman dispersing in sand, as shown in Figure 17-21. **(Expected time: 35 min)**

The following steps are required to complete this tutorial:

- a. Create the project folder.
- b. Open the file.
- c. Create the Particle Flow source.
- d. Add operator to the Standard Flow.
- e. Create an SDeflector.
- f. Animate SDeflector space warp icon.
- g. Create a New Event.
- h. Create forces for the particles.
- i. Add new operator and test to the Event.
- j. Create deflector and collide particle with it.
- k. Play the simulation.
- l. Save and render the scene.





*Figure 17-21 The sandman dispersing in sand*

### Creating the Project Folder

1. Create a project folder with the name `c17_tut1` at `|Document|3dsmax2017`, as discussed in Tutorial 1 of Chapter 2.
2. Open the Windows Explorer and then browse to the `c17_3dsmax_2017_tut` folder. Next, copy the `desert_texture.jpg` file from this folder to `|Documents|3dsmax2017|c17_tut1|sceneassets|images`.

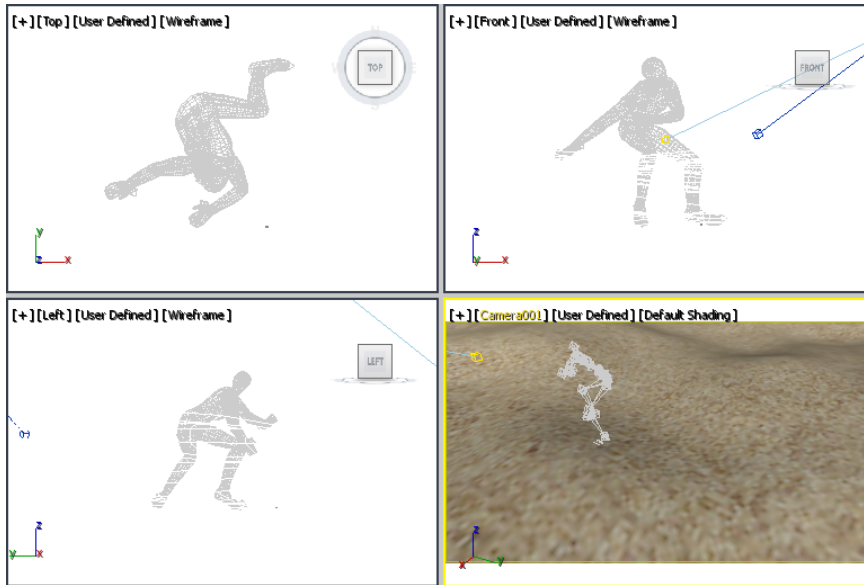
### Opening the File

1. Choose **Open** from the **Application** menu; the **Open File** dialog box is displayed. In this dialog box, browse to the location `|Documents|c17_3dsmax_2017_tut` and select the `c17_tut1_start.max` file from it. Choose the **Open** button to open the file, refer to Figure 17-22.



#### Note

When opening the start file, if the **File Load: Gamma & Lut Settings Mismatch** dialog box is displayed, choose the **Adopt the File's Gamma & Lut Settings?** radio button and then choose the **OK** button. Also, if the **File Load: Units Mismatch** message box is displayed, choose the **OK** button.



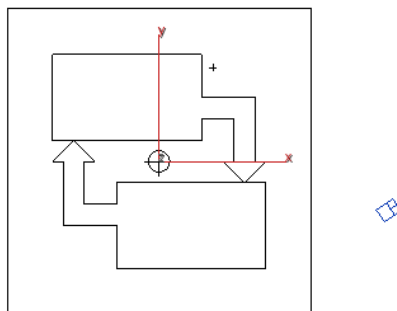
*Figure 17-22 The c17\_tut1\_start.max file displayed*

2. Choose **Save As** from the **Application** menu; the **Save File As** dialog box is displayed. Browse to the location `\Documents\3dsmax2017\c17_tut1\scenes`. Save the file with the name `c17tut1.max` at this location.

## Creating the Particle Flow Source

In this section, you will create a Particle Flow source using the **PF Source** tool.

1. Activate the Top viewport. Choose **Create > Geometry** in the **Command Panel**. Select the **Particle Systems** option from the drop-down list below the **Geometry** button. Choose the **PF Source** tool from the **Object Type** rollout; various rollouts are displayed in the **Command Panel**.
2. In the Top viewport, press and hold the left mouse button and drag the cursor from one point to another; and then release the left mouse button; the PF Source icon is created in viewports for the PF Source Particle System, as shown in Figure 17-23.



*Figure 17-23 The PF source icon*

3. Make sure the PF Source icon is selected in the viewport and choose the **Modify** tab in the **Command Panel**; various rollouts are displayed. In the **Emission** rollout, set the value **5** in the **Viewport %** spinner in the **Quantity Multiplier** area.

## Adding Operators to the Standard Flow

In this section, you will add operators to the **Standard Flow** in the **Particle View** window.

1. Choose **Graph Editors > Particle View** from the menu bar; the **Particle View** window is displayed. Alternatively, press 6 to display this window. In the **Event Display** area, the **Standard Flow** is displayed, as shown in Figure 17-24.
2. Select the **Birth 001 (0-30 T:200)** operator in **Event 001**; the **Birth 001** rollout is displayed on the right side of the **Event display** area. Set the value **0** in the **Emit Stop** spinner in the **Birth 001** rollout. In the **Amount** spinner, set the value **100000**.
3. Press and hold the left mouse button on the **Position Object** operator in the **Depot** area and then drag the cursor to the **Position Icon 001 (Volume)** operator in **Event 001**; a red line appears on the **Position Icon 001 (Volume)** operator. Next, release the left mouse button; the **Position Object 001 (None)** operator replaces the **Position Icon 001 (Volume)** operator.
4. Select the **Position Object 001 (None)** operator in **Event 001**; the **Position Object 001** rollout is displayed on the right side of the **Event display** area. In this rollout, select the **Lock On Emitter** and then **Animated Shape** check boxes. Next, in the **Emitter Objects** area, choose the **By List** button; the **Select Emitter Objects** dialog box is displayed. Select the **Sandman\_skin** from the list and choose the **Select** button; the **Sandman\_skin** is added to the **Emitter Objects** area, as shown in Figure 17-25.
5. Delete the **Speed 001 (Along Icon Arrow)** and **Rotation 001 (Random 3D)** operators from **Event 001**.

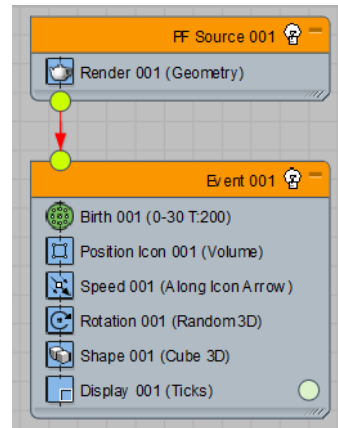


Figure 17-24 The Standard Flow

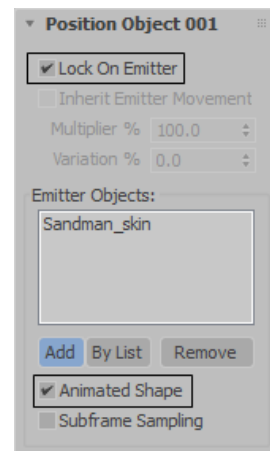
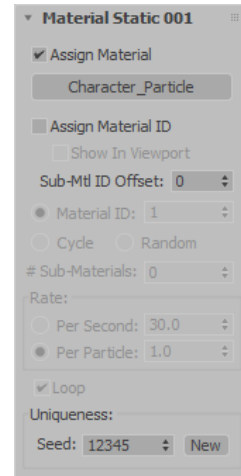


Figure 17-25 The *Sandman\_skin* added to the *Emitter Objects* area

6. Select the **Shape 001 (Cube 3D)** operator in **Event 001**; the **Shape 001** rollout is displayed on the right side. In this rollout, select the **Sphere 20-sides** option from the drop-down list on the right side of the **3D** radio button. Next, set the value **1.5** in the **Size** spinner. Select the check box preceding the **Scale %** spinner and set the value **40**.

in the spinner. Also, set the value to **10** in the **Variation %** spinner and select the **Generate Mapping Coords.** check box.

7. In **Event 001** of the **Event Display** area, right-click below the **Display 001 (Ticks)** operator; a shortcut menu is displayed. Choose **Insert > Operator > Material Static** from the shortcut menu; the **Material Static 001 (None)** operator is inserted below the **Shape 001 (Sphere 20-sides 3D)** operator.
8. Select the **Material Static 001 (None)** operator in **Event 001**; the **Material Static 001** rollout is displayed on the right side of the **Event Display** area. Choose the **None** button below the **Assign Material** check box; the **Material/Map Browser** dialog box is displayed. In the **Sample Slots** rollout, select **Character\_Particle (Standard)** and choose the **OK** button; the **Character\_Particle** label is displayed on the **None** button, as shown in Figure 17-26.
9. Select the **Display 001 (Ticks)** operator in **Event 001**; the **Display 001** rollout is displayed on the right. In the **Type** drop-down list, select the **Geometry** option.



*Figure 17-26 The **Character\_Particle** label displayed on the **None** button*

## Creating an SDeflector

In this section, you will create an SDeflector to collide with the particles.

1. Make sure the Top viewport is activated. Choose **Create > Space Warps** in the **Command Panel**. Select the **Deflectors** category from the drop-down list below the **Space Warps** button. Next, choose the **SDeflector** tool from the **Object Type** rollout.
2. In the Top viewport, press and hold the left mouse button, drag the cursor from one point to another and then release the left mouse button; the SDeflector space warp icon is displayed in viewports.
3. Make sure the SDeflector space warp icon is selected. Next, choose the **Modify** tab in the **Command Panel** and set the value **400** in the **Diameter** spinner in the **Display Icon** area of the **Basic Parameters** rollout.

## Animating SDeflector Space Warp Icon

In this section, you will animate SDeflector Space Warp icon such that the particles flow along with the SDeflector Space Warp icon.

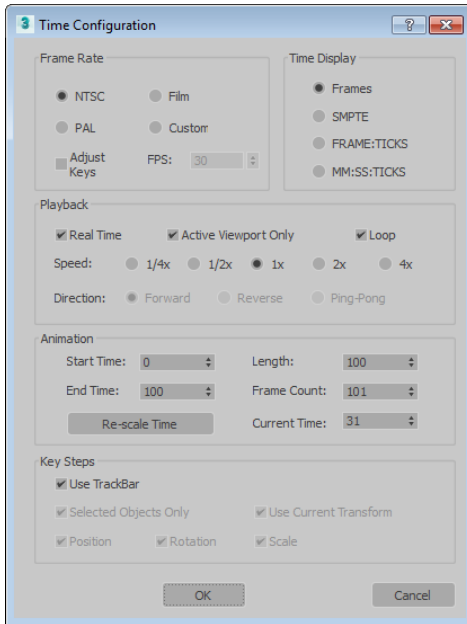
1. Choose the **Time Configuration** button at the bottom of the 3ds Max interface; the **Time Configuration** dialog box is displayed, as shown in Figure 17-27. In the **Animation** area of this dialog box, set the value **250** in the **End Time** spinner and press the ENTER key; the number of frames increases in the track bar. Choose the **OK** button to exit the dialog box.

2. Make sure the Top viewport is activated and select the **SDeflector 001**. Make sure frame is set to **0** in the timeline and then choose the **Toggle Auto Key Mode** button to turn on the animation mode.
3. Now, right-click on the **Select and Move** tool in the **Main Toolbar**; the **Move Transform Type-In** dialog box is displayed. In the **Absolute:World** area, set the value **96.116** in the **X** spinner, **41.498** in the **Y** spinner, and **336.499** in the **Z** spinner; the **SDeflector 001** is transformed to the set position. Now, choose the **Set Key** button.
4. Move the time slider to frame **60** by entering the frame number in the Current Frame (Go to frame) spinner and choose the **Set Keys** button in the animation keying controls; the same transform value is set at frame 60.
5. Move the time slider to frame **250** by entering the frame number in the Current Frame (Go to frame) spinner and in the **Absolute:World** area of the **Move Transform Type-In** dialog box, set the value **88.617** in the **X** spinner, **41.498** in the **Y** spinner and **167.648** in the **Z** spinner. Now, choose the **Set Key** button to turn off the animation mode. Close the **Move Transform Type-In** dialog box.
6. In the **Particle View** window, right-click on the **Display 001 (Geometry)** operator; a shortcut menu is displayed. Choose **Append > Test > Collision** from the shortcut menu; the **Collision 001 (None)** test is added below the **Display 001 (Geometry)** operator.
7. Select the **Collision 001 (None)** test in **Event 001**; the **Collision 001** rollout is displayed on the right side in the **Particle View** window. In this rollout, choose the **By List** button in the **Deflectors** area; the **Select Deflectors** dialog box is displayed. Select the **SDeflector 001** from the list and choose the **Select** button; the **SDeflector 001** is added to the **Deflectors** area. Next, in the **Test True If Particle** area, select the **Continue** option from the **Speed** drop-down list available below the **Collides** radio button.

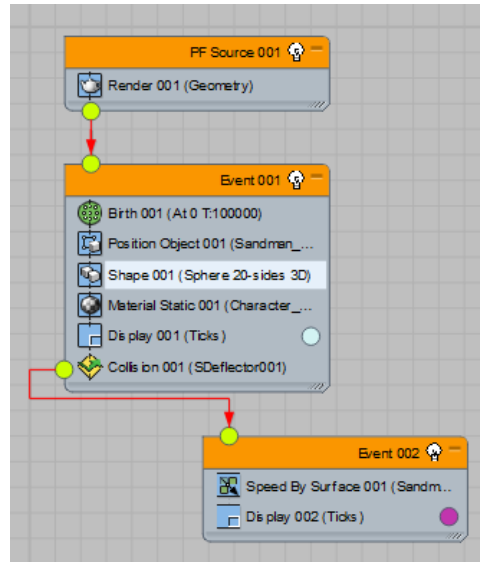
## Creating a New Event

In this section, you will create a new event so that the emission of particles starts from the sandman after the deflector collides with it.

1. Drag the **Speed By Surface** operator from the **Depot** area to the **Event Display** area; the **Event 002** is added to the **Event Display** area and the **Speed By Surface 001 (None)** operator is displayed in **Event 002**.
2. Select the **Speed By Surface 001 (None)** operator in **Event 002**; the **Speed By Surface 001** rollout is displayed on the right of the **Event Display** area. In the **Speed** and **Variation** spinners, set the values **310** and **28**, respectively. Next, in the **Surface Geometry** area, choose the **By List** button; the **Select Surface Objects** dialog box is displayed. Select the **Sandman\_skin** from the list and choose the **Select** button; the **Sandman\_skin** is added to the **Surface Geometry** area.
3. Now, connect the **Collision 001 (SDeflector001)** test to **Event 002** in the **Event Display** area by dragging the gray dot that is at the left of the test to the event input, as shown in Figure 17-28.



*Figure 17-27 The Time Configuration dialog box*



*Figure 17-28 The Event 002 wired to the Collision 001 test*

## Creating Forces for the Particles

In this section, you will create force to control the movement of the particles.

1. Switch from the Top viewport to the Bottom viewport. Choose **Create > Space Warps > Forces** in the **Command Panel**. Next, choose the **Wind** tool from the **Object Type** rollout and then press and hold the left mouse button and drag the cursor in the Bottom viewport. Next, release the left mouse button; the wind space warp icon is displayed.
2. Choose the **Modify** tab in the **Command Panel** and set the values in the **Parameters** rollout of the **Wind001** space warp as follows:

**Force** area  
Strength: **50**

**Wind** area  
Turbulence: **2**                      Scale: **3**

**Display** area  
Icon Size: **72**

3. Switch from the Bottom viewport to the Top viewport and then choose the **Zoom Extents All** tool to view *Wind001* in the viewports.
4. Make sure *Wind001* is selected. Now, right-click on the **Select and Move** tool from the **Main Toolbar**; the **Move Transform Type-In** dialog box is displayed. In the **Absolute:World**

area, set the value **86.044** in the **X** spinner, **33.995** in the **Y** spinner, and **384.713** in the **Z** spinner; *Wind 001* is moved to the set position. Close the **Move Transform Type-In** dialog box.

Next, you need to apply gravity to the particles using the Gravity space warp.

5. Choose **Create > Space Warps > Forces** rollout in the **Command Panel**. Choose the **Gravity** tool from the **Object Type** rollout.
6. Press and hold the left mouse button and drag the cursor in the Top viewport. Next, release the left mouse button; the **Gravity** space warp icon is displayed with the name *Gravity001*.
7. Make sure *Gravity001* is selected and right-click on the **Select and Move** tool from the **Main Toolbar**; the **Move Transform Type-In** dialog box is invoked. In the **Absolute:World** area, set the value **108.229** in the **X** spinner, **44.613** in the **Y** spinner, and **0** in the **Z** spinner; *Gravity001* is moved to the set position. Close the **Move Transform Type-In** dialog box.
8. Choose the **Modify** tab in the **Command Panel** and set the values in the **Parameters** rollout of the **Gravity** space warp as follows:

**Force** area  
Strength: **0.8**

**Display** area  
Icon Size: **41.0**

Next, you need to connect the gravity and wind space warps to the **Force** operator.

9. In the **Particle View** window, right-click on the **Display 002 (Ticks)** operator; a shortcut menu is displayed. Choose **Insert > Operator > Force** from the shortcut menu; the **Force 001** operator is inserted below the **Speed By Surface 001 (Sandman\_skin)** operator.
10. Select the **Force 001 (None)** operator in the **Event 002**; the **Force 001** rollout is displayed on the right in the **Parameters** panel. Next, in the **Force Space Warps** area, choose the **By List** button; the **Select Force Space Warps** dialog box is displayed. Select the **Gravity001** and **Wind001** from the list and choose the **Select** button; the **Gravity001** and **Wind001** are added to the **Force Space Warps** area, as shown in Figure 17-29.



## Adding New Operator and Test to the Event

In this section, you will add more operators and tests to **Event002**, so that the particles are visible at render time.

1. Press and hold the left mouse button on the **Shape** operator in the **Depot** area and then drag this operator to **Event 002** below the **Force 001 (Gravity001 + 1)** operator; a blue line appears below the **Force 001** operator. Next, release the left mouse button; the **Shape 002 (Cube 3D)** operator is displayed below the **Force 001 (Gravity001 + 1)** operator in **Event 002** of the **Event Display** area.
2. Select the **Shape 002 (Cube 3D)** operator in **Event 002**; the **Shape 002** rollout is displayed on the right in the **Particle View** window. In this rollout, select the **Sphere 20-sides** option from the drop-down list on the right side of the **3D** radio button. Next, set the value **2** in the **Size** spinner. Select the check box preceding the **Scale %** spinner and set the value **50** in the spinner. Set the value **20** in the **Variation %** spinner and select the **Generate Mapping Coords.** check box.
3. Press and hold the left mouse button on the **Material Static** operator in the **Depot** area and then drag the cursor on **Event 002** below the **Shape 002 (Sphere 20-sides 3D)** operator; a blue line appears below the **Shape 002 (Sphere 20-sides 3D)** operator. Next, release the left mouse button; the **Material Static 002 (None)** operator is displayed below the **Shape 002 (Sphere 20-sides 3D)** operator in **Event 002** in the **Event Display** area.
4. Select the **Material Static 002 (None)** operator in **Event 002**; the **Material Static 002** rollout is displayed on the right of the **Event Display** area. Choose the **None** button below the **Assign Material** check box; the **Material/Map Browser** dialog box is displayed. In the **Sample Slots** rollout, select **Character\_Particle (Standard)** and choose the **OK** button; the **Character\_Particle** label is displayed on the **None** button.

Next, you need to add rotation, spin, and direction to the particles. To do so, you will add the **Rotation** operator, the **Spin** operator, and the **Split Amount** test before the **Material Static (Character\_Particle)** operator.

5. Drag the **Rotation** operator from the **Depot** area to **Event 002** below the **Shape 002 (Sphere 20-sides 3D)** operator as discussed in the above steps. Select the **Rotation 001 (Random 3D)** operator in the **Event 002**; the **Rotation 001** rollout is displayed on the right. In the drop-down list available in the **Orientation Matrix** area, select the **World Space** option. Set the values in the **X**, **Y**, and **Z** spinners as **-90**, **90**, and **1**, respectively.
6. Now, drag the **Spin** operator from the **Depot** area to **Event 002** below the **Rotation 001 (World Space)** operator as discussed in the above steps. Select the **Spin 001 (Random 3D 360)** operator in **Event 002**; the **Spin 001** rollout is displayed on the right. In the **Spin Rate** spinner, set **299**, and in the **Variation** spinner, set **20**. In the **Spin Axis** area, select the **Speed Space Follow** option from the drop-down list. Now set the value of the **X**, **Y**, and **Z** spinner to **1**.

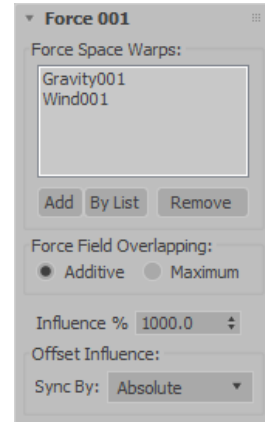


Figure 17-29 The **Force 001** rollout

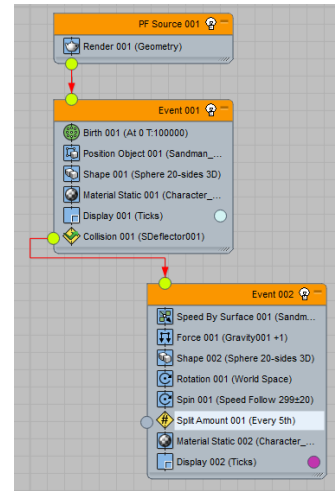


- Now, drag the **Split Amount** test from the **Depot** area to the **Event 002** below the **Spin 001 (Speed Follow  $299 \pm 20$ )** operator as discussed in the above steps, refer to Figure 17-30. Select the **Split Amount 001 (50%)** test in **Event 002**; the **Split Amount 001** rollout is displayed on the right. In the **Test True For** area, select the **Every Nth Particle** radio button and set the value **5** in the **N** spinner located below it.

## Creating Deflector and Colliding the Particles

In this section, you will create a deflector to prevent the particles moving beneath the ground.

- Make sure the Top viewport is activated. Make sure that **Create > Space Warps** is chosen in the **Command Panel**. Select the **Deflectors** option from the drop-down list below the **Space Warps** button. Next, choose the **Deflector** tool from the **Object Type** rollout.
- In the Top viewport, press and hold the left mouse button, drag the cursor from one point to another; and then release the left mouse button; the deflector space warp icon is displayed in viewports.
- Make sure the deflector space warp icon is selected. Next, choose the **Modify** tab in the **Command Panel**. Set the value **3000** in the **Width** spinner and **2000** in the **Length** spinner in the **Parameters** rollout.
- Now, right-click on the **Select and Move** tool from the **Main Toolbar**; the **Move Transform Type-In** dialog box is invoked. In the **Absolute:World** area, set the value **98.042** in the **X** spinner; **38.558** in the **Y** spinner; and **4.698** in the **Z** spinner; the **Deflector 001** is transformed to the set position. Close the **Move Transform Type-In** dialog box.
- Drag the **Collision** test from the **Depot** area to **Event 002** below the **Split Amount 001 (Every 5th)** test as discussed in the above steps. Select the **Collision 002 (None)** test in **Event 002**; the **Collision 002** rollout is displayed on the right. Next, in the **Deflectors** area, choose the **By List** button; the **Select Deflectors** dialog box is displayed. Select the **Deflector 001** from the list and choose the **Select** button; the **Deflector 001** is added to the **Deflectors** area. Next in the **Test True If Particle** area, select the **Stop** option from the **Speed** drop-down list located below the **Collides** radio button.
- Select the **Display 002 (Ticks)** operator in **Event 002**; the **Display 002** rollout is displayed on the right. In the **Type** drop-down list, select the **Geometry** option.



**Figure 17-30** The **Split Amount 001** test added to the **Event 002**

Now, the Particle Flow has been created, refer to Figure 17-31.

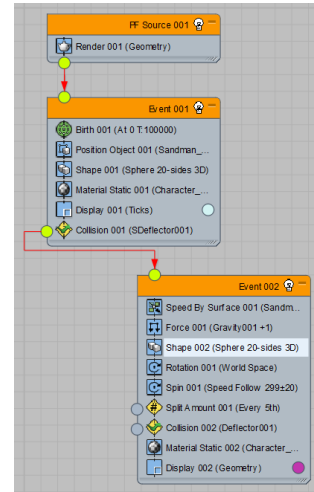
### Playing the Simulation

Activate the camera viewport and choose the **Play Animation** button to play the animation from the **Animation Playback Controls**. After playing the entire animation choose the **Play Animation** button again to stop the animation.

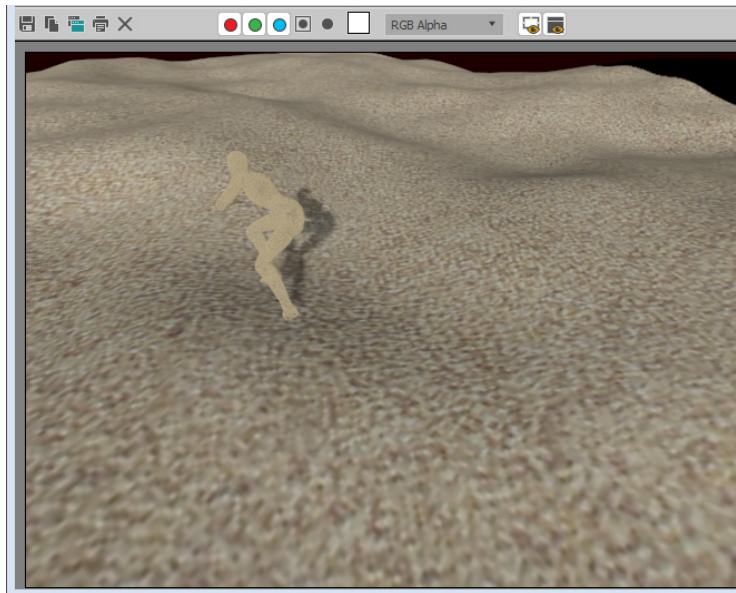
You will notice that the particles are now emitting from the character, refer to Figure 17-32.

### Saving and Rendering the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image sequence by downloading the file *c17\_3dsmax\_2017\_rndr.zip* from [www.cadcim.com](http://www.cadcim.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2017: A Comprehensive Guide*



**Figure 17-31** The Particle Flow



**Figure 17-32** The Particles emitting from the character

1. Choose **Save** from the **Application** menu.
2. Choose the **Render Setup** tool from the **Main Toolbar**; the **Render Setup: Default Scanline Renderer** dialog box is displayed. In this dialog box, the **Common** tab is chosen by default. Also, various rollouts are displayed in the **Common** tab.

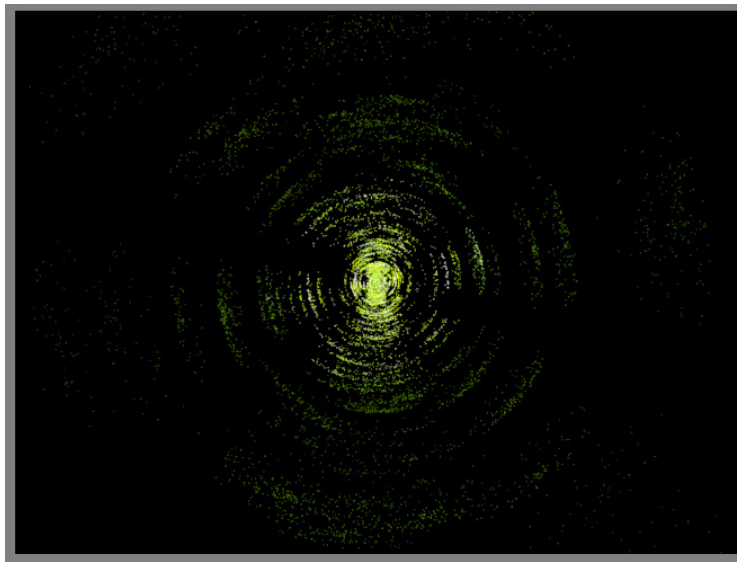
3. In the **Common Parameters** rollout, select the **Active Time Segment** radio button in the **Time Output** area.
4. Make sure the **Custom** option is selected in the drop-down list in the **Output Size** area.
5. In the **Render Output** area, choose the **Files** button; the **Render Output File** dialog box is displayed. Enter a name for the file in the **File name** text box and then select the **AVI File (\*.avi)** file type from the **Save as type** drop-down list and specify the location of the file in the **Save in** text box. Next, choose the **Save** button; the **AVI File Compression Setup** dialog box is displayed. Accept the default settings and choose the **OK** button to exit the dialog box.
6. Make sure that the **Quad 4 - Camera001** option is selected in the **View to Render** drop-down list at the bottom of the **Render Setup: Scanline Renderer** dialog box. Next, choose the **Render** button; both the **Camera001, frame#** window and the **Rendering** dialog box are displayed showing the rendering process.

After the completion of the rendering process, the final output of the animation is saved at the specified location in the \*.avi format. You can view the final output of the animation by opening the corresponding \*.avi file.

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## Tutorial 2

In this tutorial, you will create a scene in which particles animate with sound, as shown in Figure 17-33. **(Expected time: 30 min)**



*Figure 17-33* Particles being emitted as the sound is played at frame 118

The following steps are required to complete this tutorial:

- a. Create the project folder.
- b. Open the file.
- c. Assign audio controller to the Object.
- d. Assign sound to the animation.
- e. Create the PF source icon.
- f. Add functions to the Particle View window.
- g. Create Forces for the particles.
- h. Generate more Particles from the existing one.
- i. Create new event.
- j. Add material to the Particle.
- k. Play the animation
- l. Save and render the scene.

### Creating the Project Folder

1. Create a project folder with the name *c17\_tut2* in the *3dsmax2017* and then save the file with the name *c17tut2*, as discussed in Tutorial 1 of Chapter 2.
2. Open the Windows Explorer and then browse to the *c17\_3dsmax\_2017\_tut* folder. Next, copy the *Sound.wav* file from this folder to *|Documents|3dsmax2017|c17\_tut2|sceneassets|sounds*.

### Opening the File

1. Choose **Open** from the **Application** menu; the **Open File** dialog box is displayed. In this dialog box, browse to the location *|Documents|c17\_3dsmax\_2017\_tut* and select the *c17\_tut2\_start.max* file from it. Choose the **Open** button to open the file.
2. Choose **Save As** from the **Application** menu; the **Save File As** dialog box is displayed. Browse to the location *|Documents|3dsmax2017|c17\_tut2|scenes*. Save the file with the name *c17tut2.max* at this location.

### Assigning Audio Controller to the Object

In this section, you will assign audio to the objects so that they can animate with the audio.

1. Choose the **Time Configuration** button at the bottom of the screen; the **Time Configuration** dialog box is displayed. In the **Animation** area of this dialog box, set the value **720** in the **End Time** spinner and press the ENTER key; the number of frame increases in the track bar. Choose the **OK** button to exit the dialog box.
2. Activate the Front viewport and select *Equalizer 1* object and right-click on it; a quad menu is displayed. Choose the **Curve Editor** option from the quad menu; the **Track View - Curve Editor** window is displayed.
3. In this window, make sure the **Scale** option is selected in *Equalizer 1* and right-click on it; a quad menu is displayed. Choose the **Assign Controller** option; the **Assign Scale Controller** dialog box is displayed. In this dialog box, select **AudioScale** from the list displayed and choose the **OK** button; the **Audio Controller** dialog box is displayed.

- In this dialog box, choose the **Choose Sound** button; the **Open Sound** dialog box is displayed. Navigate to default file and choose the **Open** button; the location of the file appears in place of **<none>** label.

- In the **Target Scale** area, set the values in the spinners as given next:

X: 400

Y: 600

Z: 400

- In the **Sample** area, set the value **5** in the **Oversampling** spinner, refer to Figure 17-34. Next, choose the **Close** button to close the dialog box.

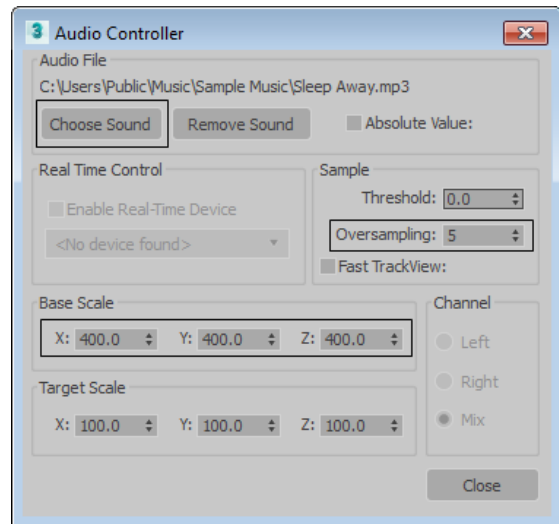
- Next, select *Equalizer 2* from the Scene Explorer and Repeat steps 2, 3 and 4. Now, in the **Target Scale** area, set the values in the spinners as given next:

X: 600

Y: 1000

Z: 600

In addition, set 12 in the **Oversampling** spinner. Choose the **Close** button to close the dialog box.



**Figure 17-34** The value of the **Oversampling** spinner set to **5** in the **Audio Controller** dialog box

- Now, select *Equalizer 3* and right-click on it; a quad menu is displayed and repeat steps 2, 3 and 4. Now, in the **Target Scale** area, set the values in the spinners as given next:

X: -500

Y: -700

Z: -500

Next, choose the **Close** button to close the dialog box.

- Next, select *Equalizer 4* and right-click on it in the Front viewport; a quad menu is displayed and repeat steps 2, 3, and 4. Now, in the **Target Scale** area, set the values in the spinners as given next:

X: -700

Y: -1200

Z: -700

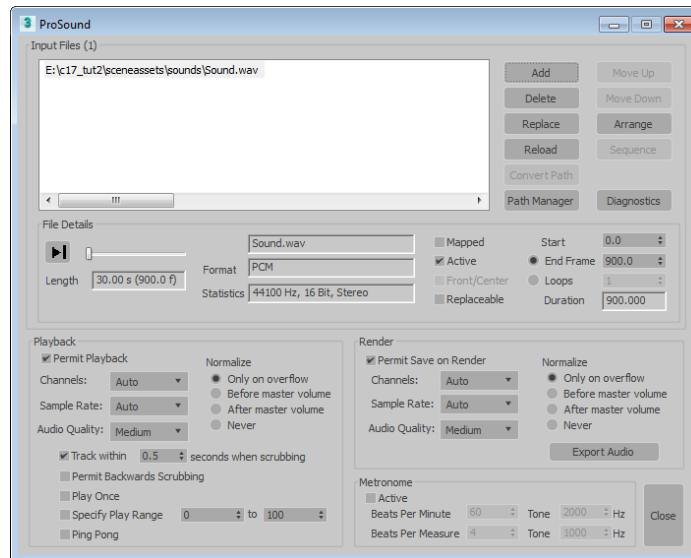
Choose the **Close** button to close the dialog box. Minimize the **Track View - Curve Editor** window.

- Next, choose the **Play Animation** button to play the animation. After, playing the entire animation, choose the **Play Animation** button again to stop the animation.

## Assigning Sound to the Animation

In this section, you will assign the sound to the animation so that the sound is audible and matches the animation.

1. Choose **Customize > Preferences** from the menu bar; the **Preference Settings** dialog box is displayed. In the dialog box, choose the **Animation** tab and then choose the **Assign** button in the **Sound Plug-In** area of this tab; the **Choose Sound Plug-In** dialog box is displayed. Now, select **ProSound** from the list and choose the **OK** button. Close the **Preference Settings** dialog box.
2. Choose **Graph Editors > Track View - Dope Sheet** from the menu bar; the **Track View - Dope Sheet** window is displayed. In this window, double-click on the **Sound** option; the **ProSound** dialog box is displayed. Click on the **Add** button located at the top right corner; the **Open** dialog box is displayed. Select **Sound** from the list in the **File name** and then choose the **Open** button; the name of the sound file along with its path is displayed in the **Input Files (1)** area. Next, close the **ProSound** dialog box by choosing the **Close** button, refer to Figure 17-35.



*Figure 17-35 The ProSound dialog box*

Now, choose the **Play Animation** button to play the animation; the sound is audible with the animation.

## Creating the PF Source Icon

In this section, you will create the PF Source icon

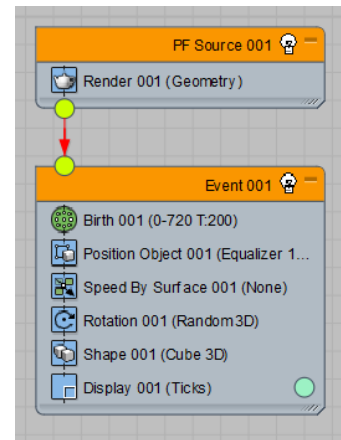
1. Active the Top viewport. Choose **Create > Geometry** in the **Command Panel**. Next, select the **Particle Systems** option from the drop-down list displayed below the **Geometry** button. Choose the **PF Source** tool from the **Object Type** rollout; various rollouts are displayed in the **Command Panel**.

2. In the Top viewport, press and hold the left mouse button, drag the cursor from one point to another, and release the left mouse button; the emitter is created for the PF source Particle System.

## Adding the Operator to the Particle View Window

In this section, you will add operators to the Particle Flow in the **Particle View** window.

1. Select **Graph Editors > Particle View** from the menu bar; the **Particle View** window is displayed. Alternatively, press 6 to open it. In the **Event Display** area, **Standard Flow** is displayed.
2. Select the **Birth 001 (0-30 T:200)** operator; the **Birth 001** rollout is displayed in the **Parameters** panel. In this rollout, set the value of the **Emit Stop** spinner to **720** and select the radio button at the left of the **Rate** spinner.
3. Press and hold the left mouse button on the **Position Object** operator in the **Depot** area and then drag the cursor to the **Position Icon 001 (Volume)** operator in the **Event 001**; a red line appears on the **Position Icon 001 (Volume)** operator. Next, release the left mouse button; the **Position Object 001 (None)** operator replaces the **Position Icon 001 (Volume)** operator.
4. Select the **Position Object 001 (None)** operator; the **Position Object 001** rollout is displayed on the right side. In the **Position Object 001** rollout, select the **Lock On Emitter** check box. In the **Emitter Objects** area, choose the **By List** button; the **Select Emitter Objects** dialog box is displayed. Select **Equalizer 1**, **Equalizer 2**, **Equalizer 3**, and **Equalizer 4** and choose the **Select** button; Equalizer 1, Equalizer 2, Equalizer 3, and Equalizer 4 are displayed in the **Emitter Objects** area. Next, select the **Animated Shape** check box.
5. Press and hold the left mouse button on the **Speed By Surface** operator in the **Depot** area and then drag the cursor to the **Speed 001 (Along Icon Arrow)** operator in the **Event 001**; a red line appears on the **Speed 001 (Along Icon Arrow)** operator. Next, release the left mouse button; the **Speed By Surface 001 (None)** operator replaces the **Speed 001 (Along Icon Arrow)** operator, refer to Figure 17-36.
6. Select the **Speed By Surface 001 (None)** operator; the **Speed By Surface 001** rollout is displayed on the right side. In the **Speed by Surface 001** rollout, set the value to **10** in the **Variation** spinner. In the **Surface Geometry** area, choose the **By List** button; the **Select Surface Objects** dialog box is displayed. Select **Equalizer 1**, **Equalizer 2**, **Equalizer 3** and **Equalizer 4** from the list and choose the **Select** button. Also, in the **Direction** area, set the value **10** in the **Divergence** spinner.



*Figure 17-36 The Speed by Surface 001 (None) operator in the Event Display area*



7. Next, select the **Rotation 001 (Random 3D)** operator in **Event 001**; the **Rotation 001** rollout is displayed on the right side. In the **Orientation Matrix** area, select the **Speed Space** option from the drop-down list. Set the value in the **X**, **Y** and **Z** spinners as **1**, **0.5** and **0.5** respectively. Set the **Divergence** spinner value to **10**.
8. Select the **Shape 001 (Cube 3D)** operator in **Event 001**; the **Shape 001** rollout is displayed on the right side. Select the **Star 6-point** option from the drop-down list next to the **3D** radio button. Set the value **20** in the **Size** spinner. Now, select the check box located before the **Scale %** spinner and set the value **50** in this spinner. In the **Variation %** spinner, set the value **20**. Also, select the **Generate Mapping Coords** check box.
9. Select the **Display 001 (Ticks)** operator in **Event 001**; the **Display 001** rollout is displayed on the right. Select the **Geometry** option from the **Type** drop-down list. Also, minimize the **Particle View** window.

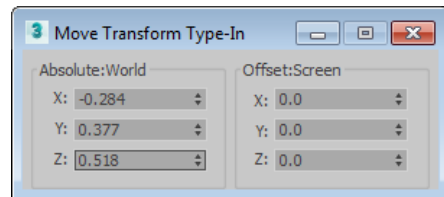
## Creating Forces for the Particles

In this section, you will create force so that you can control the movement of the particles.

1. Activate the Top viewport. Choose the **Drag** tool from **Create > Space Warps > Forces > Object Type** rollout in the **Command Panel**.
2. Press and hold the left mouse button and drag the cursor from one point to another in the Top viewport. Next, release the left mouse button; the Drag space warp icon is displayed.
3. Make sure *Drag001* is selected and right-click on the **Select and Move** tool from the **Main Toolbar**; the **Move Transform Type-In** dialog box is displayed. In the **Absolute:World** area, set the value **-0.284** in the **X** spinner, **0.377** in the **Y** spinner, and **0.518** in the **Z** spinner, as shown in Figure 17-37; *Drag001* is moved to the defined position. Close the **Move Transform Type-In** dialog box.
4. Choose the **Modify** tab in the **Command Panel** and set the values in the **Parameters** rollout of the Drag space warp as follows:

**Timing** area  
Time off : **720**

In the **Damping Characteristics** area, clear the **Unlimited Range** check box.



**Figure 17-37** The *Move Transform Type-In* dialog box

Set the following Linear Damping parameters below the **Linear Damping** radio button:

X Axis: <b>1</b>	Range: <b>50</b>	Falloff: <b>500</b>
Y Axis: <b>0</b>	Z Axis: <b>0</b>	

**Display** area  
Icon Size: **38**

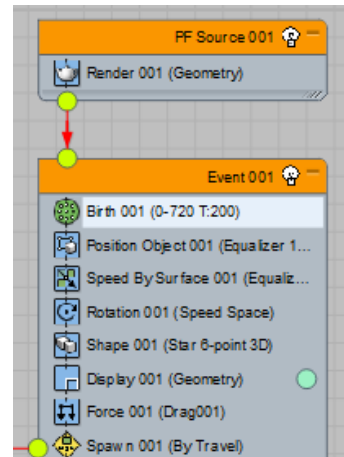


5. Maximize the **Particle View** window and select the **Display 001 (Geometry)** operator. Next, right-click on it; a shortcut menu is displayed. Choose **Append > Operator > Force** from the shortcut menu; the **Force 001 (None)** operator is added below the **Display 001 (Geometry)** operator.
6. Select the **Force 001 (None)** operator in **Event 001**; the **Force 001** rollout is displayed on the right in the **Parameters** panel. Next, in the **Force Space Warps** area, choose the **By List** button; the **Select Force Space Warps** dialog box is displayed. Select *Drag001* from the list and choose the **Select** button; *Drag001* is added to the **Force Space Warps** area. Next, in the **Offset Influence** area, select the **Particle Age** option from the **Sync By** drop-down list.

## Generating more Particles from the Existing Ones

In this section, you will generate more particles from the existing one by using the **Spawn** test.

1. Make sure the **Force 001 (Drag001)** operator is selected and right click; a shortcut menu is displayed. Choose **Append > Test > Spawn** from the shortcut menu; the **Spawn 001 (Once)** test is added below the **Force 001 (Drag001)** operator, as shown in Figure 17-38.
2. Select the **Spawn 001 (Once)** test in the **Event Display** area; the **Spawn 001** rollout is displayed on the right side. In the **Spawn Rate And Amount** area, select the **By Travel Distance** radio button. Next, set the value **10** in the **Variation %** spinner. Select the **Particle Age** option from the **Sync By** drop-down list. Next, in the **Speed** area, set the value of the **Variation %** spinner to **1**. In the **Size** area, set the value of **Scale Factor %** and **Variation %** to **50** and **10**, respectively.



*Figure 17-38 The Spawn test in Event 001*

## Creating New Event

In this section, you will create a new event so that the particle are emitted and visible in rendering.

1. Press and hold the left mouse button on the **Shape** operator in the **Depot** area and then drag the cursor to the **Event Display** area. Next, release the left mouse button; **Event 002** is created and the **Shape 002 (Cube 3D)** operator is displayed under **Event 002** in the **Event Display** area.
2. Select the **Shape 002 (Cube 3D)** operator in **Event 002**; the **Shape 002** rollout is displayed on the right of the **Event Display** area. Select the **Star 6-point** option from the drop-down list next to the **3D** radio button. Set the value **20** in the **Size** spinner. Now, select the check box preceding the **Scale %** spinner and set the value in this spinner to **50**. In the **Variation %** spinner, set the value to **20** and select the **Generate Mapping Coords** check box.
3. Connect the **Spawn 001 (By Travel)** test from **Event 001** to **Event 002** in the **Event Display** area by dragging the gray dot that is at the left of the test, to the input of **Event 002**, as shown in Figure 17-39.

4. Select the **Display 002 (Ticks)** operator and right-click; a shortcut menu is displayed. Choose **Insert > Operator > Scale** from the shortcut menu; the **Scale 001 (Overwrite Once)** operator is inserted below the **Shape 002 (Star 6-point 3D)** operator.

5. Select the **Scale 001 (Overwrite Once)** operator; the **Scale 001** rollout is displayed on the right of the **Event Display** area. In the **Type** drop-down list, select the **Absolute** option. Next, in the **Scale Factor** area, set the value to **80** in the **X %**, **Y %**, and **Z %**, respectively. In the **Scale Variation** area, set the value **25** in the **X %**, **Y %**, and **Z %** spinners and then select the **Towards Minimum** option in the **Bias** drop-down list.

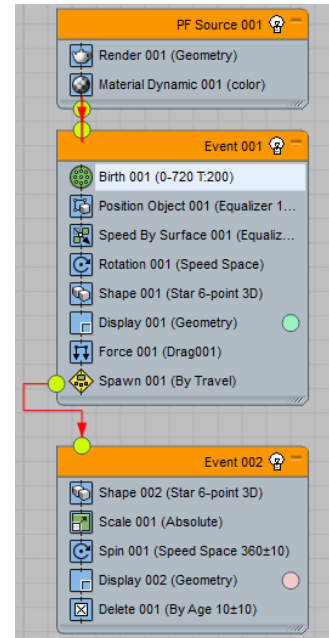
6. Right-click in the area between the **Scale 001 (Absolute)** operator and the **Display 002 (Ticks)** operator; a shortcut menu is displayed. Choose **Insert > Operator > Spin** from the shortcut menu; the **Spin 001 (Random 3D 360)** operator is inserted below the **Scale 001 (Absolute)** operator.

7. Select the **Spin 001 (Random 3D 360)** operator; the **Spin 001** rollout is displayed on the right. Next, set the value **10** in the **Variation** spinner. Now, in the **Spin Axis** area, select the **Speed Space** option from the drop-down list and set the value **1**, **0.5**, and **0.5** in the **X**, **Y**, and **Z** spinners, respectively. Set the value of the **Divergence** spinner to **10**.

8. Select the **Display 002 (Ticks)** operator in **Event 002**; the **Display 002** rollout is displayed on the right. In the **Type** drop-down list, select the **Geometry** option.

9. Make sure the **Display 002 (Geometry)** operator is selected and right-click; a shortcut menu is displayed. Choose **Append > Operator > Delete** from the shortcut menu; the **Delete 001 (All)** operator is added below the **Display 002 (Geometry)** operator.

10. Select the **Delete 001 (All)** operator; the **Delete 001** rollout is displayed on the right. Next, in the **Remove** area, select the **By Particle Age** radio button and set the value **10** in the **Life Span** spinner.



*Figure 17-39 The Spawn test linked Event 001*

## Adding Material to the Particles

In this section, you will add material to the particles.

1. Select the **Render 001 (Geometry)** operator in **PF Source 001** and right-click; a shortcut menu is displayed. Choose **Append > Operator > Material Dynamic** from the shortcut menu; the **Material Dynamic 001 (None)** operator is added below the **Render 001 (Geometry)** operator.

2. Select the **Material Dynamic 001 (None)** operator; the **Material Dynamic 001** rollout is displayed on the right. Next, choose the **None** button below the **Assign Material** check box; the **Material/Map Browser** dialog box is displayed. In the **Sample Slots** rollout, select **Color (Standard)**. Choose the **OK** button to close the **Material/Map Browser** dialog box; the **Color** name is displayed on the **None** label. Also, the **Material Dynamic 001 (None)** operator changes to the **Material Dynamic 001 (color)**, refer to Figure 17-40. Next, close the **Particle View** window.

## Playing the Animation

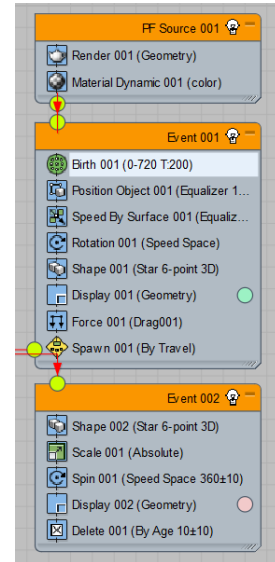
Activate the camera viewport. Next, choose the **Play Animation** button from the animation playback controls to play the animation.

You will notice that the particles are animated with colors, refer to Figure 17-41.

## Saving and Rendering the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image sequence by downloading the file *c17\_3dsmax\_2017\_rndr.zip* from [www.cadcim.com](http://www.cadcim.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2017: A Comprehensive Guide*

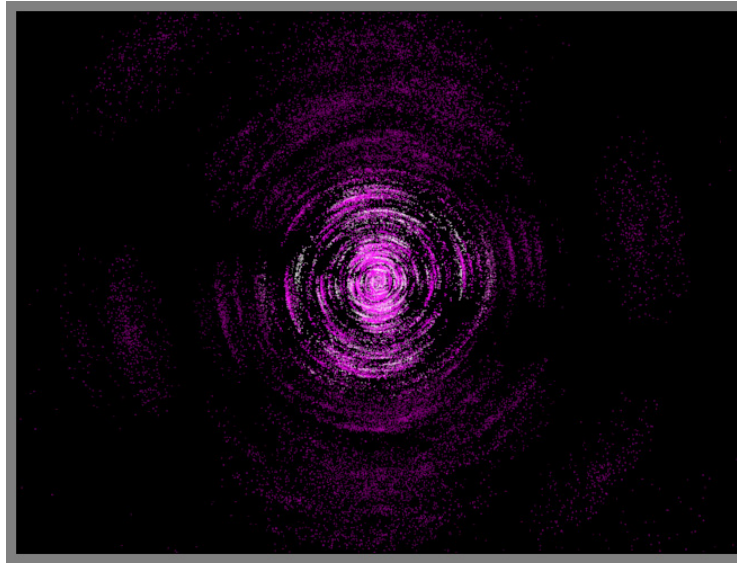
1. Choose **Save** from the **Application** menu.
2. Choose the **Render Setup** tool from the **Main Toolbar**; the **Render Setup: Scanline Renderer** dialog box is displayed. In this dialog box, the **Common** tab is chosen by default. Also, various rollouts are displayed in the **Common** tab.
3. In the **Common Parameters** rollout, select the **Active Time Segment** radio button in the **Time Output** area.
4. In the **Output Size** area, choose the **640x480** button.
5. In the **Render Output** area, choose the **Files** button; the **Render Output File** dialog box is displayed. Enter a name for the file in the **File name** text box and then select the **AVI File (\*.avi)** file type from the **Save as type** drop-down list. Next, choose the **Save** button; the **AVI File Compression Setup** dialog box is displayed. Use the default settings and choose the **OK** button to exit the dialog box.
6. Make sure that the **Quad 4 - Camera001** option is selected in the **View** drop-down list at



**Figure 17-40** The **Material Dynamic** operator in **PF Source 001**

the bottom of the **Render Setup: Default Scanline Renderer** dialog box. Next, choose the **Render** button; the **Camera001, frame#** window and the **Rendering** dialog box are displayed showing the rendering process.

After the completion of the rendering process, the final output of the animation is saved at the specified location in the \*.avi format. You can view the final output of the animation by opening the corresponding \*.avi file.



*Figure 17-41 Particles animating on frame 259*

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## Self-Evaluation Test

Answer the following questions and then compare them to those given at the end of this chapter:

1. Which of the following spinners appears in the **Emission** rollout when the **Circle** or **Sphere** option is selected from the **Icon Type** drop-down list?
  - (a) **Length**
  - (b) **Width**
  - (c) **Height**
  - (d) **Diameter**
2. Which of the following buttons is used to convert the selection from the **Event** sub-object level into the **Particle** sub-object level?
  - (a) **ID**
  - (b) **Remove**
  - (c) **Get from Event level**
  - (d) **Add**

3. Which of the following rollouts is used to adjust the size and appearance of the Particle Flow icon in the viewport?
- (a) **Selection** (b) **Emission**  
(c) **System Management** (d) **Script**
4. Which of the following areas is used to examine each frame in the viewport or render output after the last integration step has taken place?
- (a) **Script** (b) **Every Step Update Area**  
(c) **System Management** (d) **Final Step Update Area**
5. The \_\_\_\_\_ area in the **Particle View** window displays all Particle Flow as the particle diagram setup and runs all events and actions in a Particle System.
6. The \_\_\_\_\_ is used set initial stage for the Particle System using the Maya nCache files from the cache memory.
7. The **Preset Flow** is used to merge a saved Particle Flow setup with current scene. (T/F)
8. The **Keep Apart** operator is used to define a number of groups of particles according to the location, age, speed, and size of the particle. (T/F)
9. The tests in the Particle Flow are used to determine whether particles satisfy one or more conditions. (T/F)

## Review Questions

Answer the following questions:

1. Which of the following check boxes when selected runs a script in memory at each integration step?
- (a) **Enable Script** (b) **None**  
(c) **Use Script File** (d) **Edit**
2. Which of the following operators is used to attach the UVW map to the entire surface of the particles?
- (a) **Material Dynamic** (b) **Remove**  
(c) **Material Static** (d) **Mapping**
3. Which of the following flows consists of a single global event which further contains the **Render** operator?
- (a) **Preset Flow** (b) **Empty Flow**  
(c) **Standard Flow** (d) **One Click Flow**

4. Which of the following tools is used to zoom a particular region in the **Event Display** area?
- (a) **Zoom Region Tool** (b) **Pan Tool**  
(c) **Zoom Tool** (d) **Zoom Extents**
5. The \_\_\_\_\_ operator is used to define the material to the particles in an event and list the relative frequency of each sub-material that appears on the particles.
6. The \_\_\_\_\_ operator is used to record and store particle states in the system memory.
7. The \_\_\_\_\_ test is used to define the collision of the particles with one or more deflectors in the Space Warps.
8. The **Find Target** test is used to define the smooth transition of the rotation value of the particle from the current rotation value to the specific value over the specified period of time. (T/F)
9. The **Spawn** test is used to create new particles from the existing ones. (T/F)
10. The **Split Selected** test is used to split the particle according to the particles selection status. (T/F)

## EXERCISE

The rendered output of the scene used in the following exercise can be accessed by downloading the *c17\_3dsmax\_2017\_exr.zip* file from [www.cadcim.com](http://www.cadcim.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2017: A Comprehensive Guide*

### Exercise 1

Create a scene in which the simulation of leaves is done using the Particle Flow, refer to Figure 17-42. **(Expected time: 30 min)**



*Figure 17-42 Leaves simulation*

### Answers to Self-Evaluation Test

1. d, 2. c, 3. b, 4. d, 5. **Event Display**, 6. One Click Flow, 7. T, 8. F, 9. T