



March 21-25, 2022
San Francisco, CA

How To Think Like A Scripted Particle

#GDC22



“Who even are you?”

Phillip James
Senior FX Artist – Firewalk Studios



The Conundrum

Why should I use scripted particles to make FX?

It doesn't have all the modules I'm used to.

It takes longer to get set up.

The Tech Demos I've seen are way beyond what I need for my game.

Scripted Particle tools seem like they're just for controlling lots of tiny GPU particles.



Scripted Particles

- They've always been there, hiding behind the modules and the sliders.
- Puts you in full control over how particles spawn and simulate.
- Allows for linking and manipulation of external data.
- “With great power comes great responsibility.”

Scripted Particles Overview

On Spawn: Runs once when particle spawns

- Initialize variables that the particle needs to simulate
- Read incoming data once
- Create custom parameters
- Assign coefficients

On Update: Runs every tick after spawn

- Modify variables over time/life
- Read incoming data every tick
- Use coefficients to modify behavior
- Run custom timers

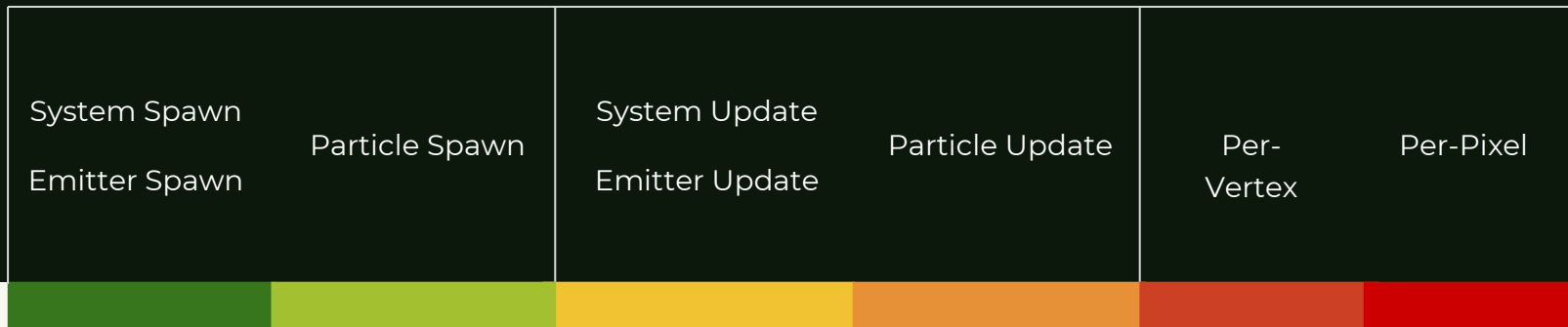
General Expense

Frequency:

Once

Per-Tick

Per-Tick



Least Expensive

Most Expensive

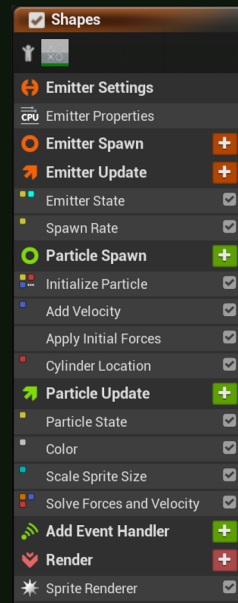
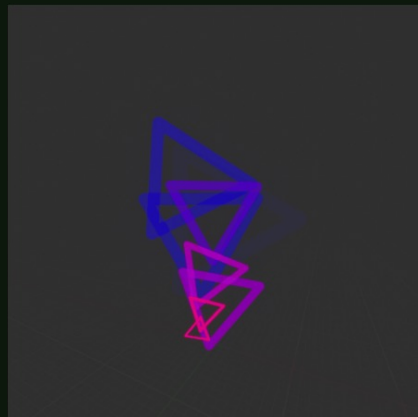
Common Parameters - Example #1

On Spawn

- Lifetime
- Color
- Size
- Velocity
- Rotation
- Position
 - Draw Position

On Update

- Lifetime
- Color
- Size
- Velocity
- Rotation
- Position
 - Draw Position



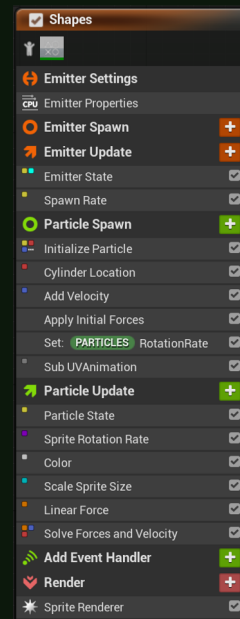
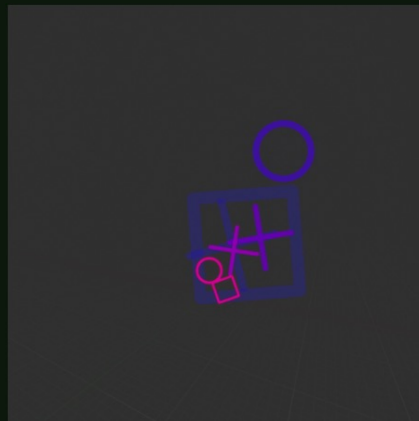
Common Parameters - Example #2

On Spawn

- Lifetime
- Color
- Size
- Velocity
- Rotation
- Position
- Draw Position

On Update

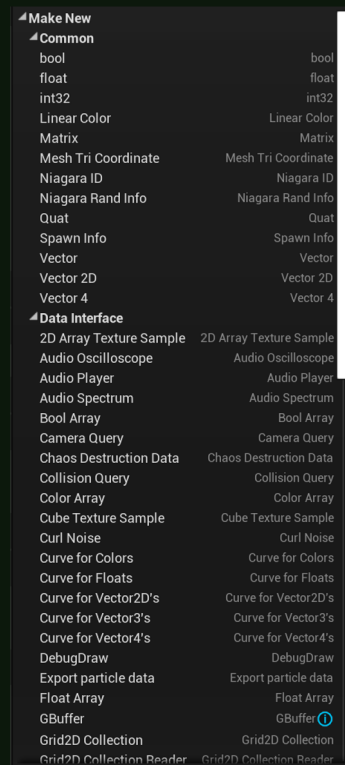
- Lifetime
- Color
- Size
- Velocity
- Rotation
- Position
- Draw Position



Input Data

Common External User Defined Data

- Float
- Vector
- Bool
- Float 4 (Vector4 / Linear Color)



Leveraging Input Data - Examples

Float

- Size of Character / Object
- Radius of Explosion
- Duration of AOE

Vector

- Velocity of Object
- Location of Bone / Character
- View Vector

Bool

- 1st / 3rd Person Switch
- Ally / Enemy Switch
- Condition Switch for Timers

Float 4 (Vector4 / Linear Color)

- Per-Instance Color



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Practical Applications

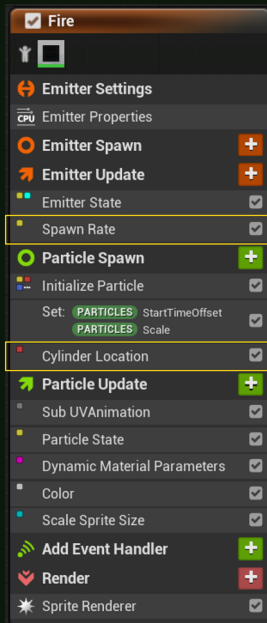
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1. “ I want to let design change the radius of my effect ”

What can we use?

- Any Particle Type
- Input Float
- Custom Parameters
 - Spawn Rate
 - Position
 - Weighted Distribution



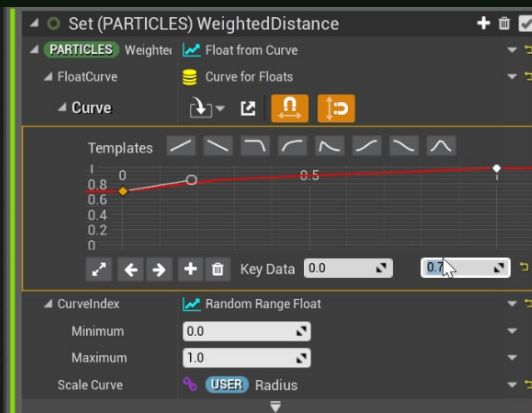
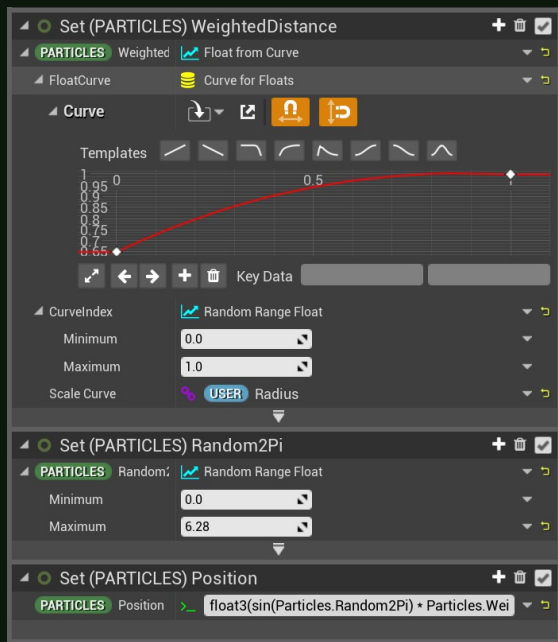
SpawnRate $\text{floor}(\text{User.Radius} / 25) + 1$

Cylinder Radius **USER** Radius



1. “ I want to let design change the radius of my effect ”

Weighted Distribution



Formula

$\text{float3}(\sin(\text{Rand2pi}) * \text{RandDistance}, \cos(\text{Rand2pi}) * \text{RandDistance}, 0.0)$

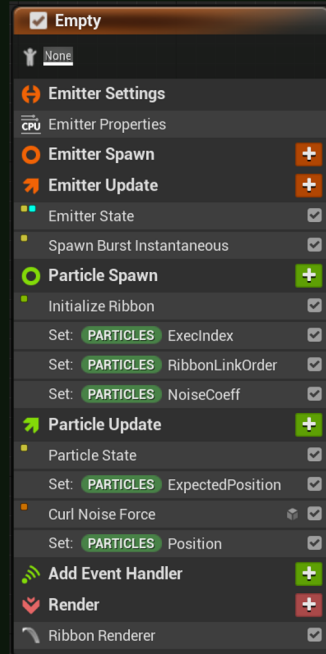
Niagara Specific Example

$\text{float3}(\sin(\text{Particles.Random2Pi}) * \text{Particles.WeightedDistance}, \cos(\text{Particles.Random2Pi}) * \text{Particles.WeightedDistance}, 0.0)$

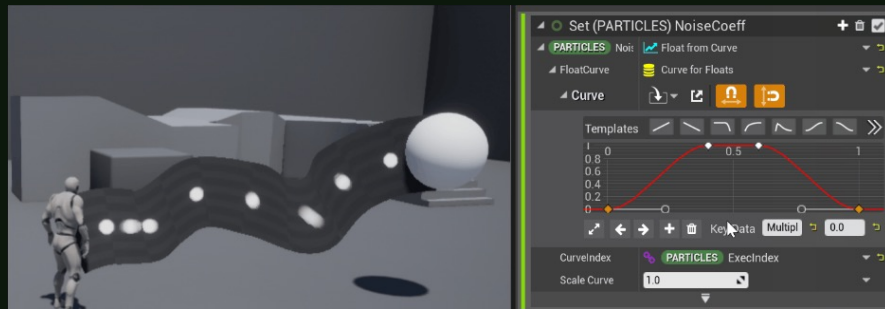
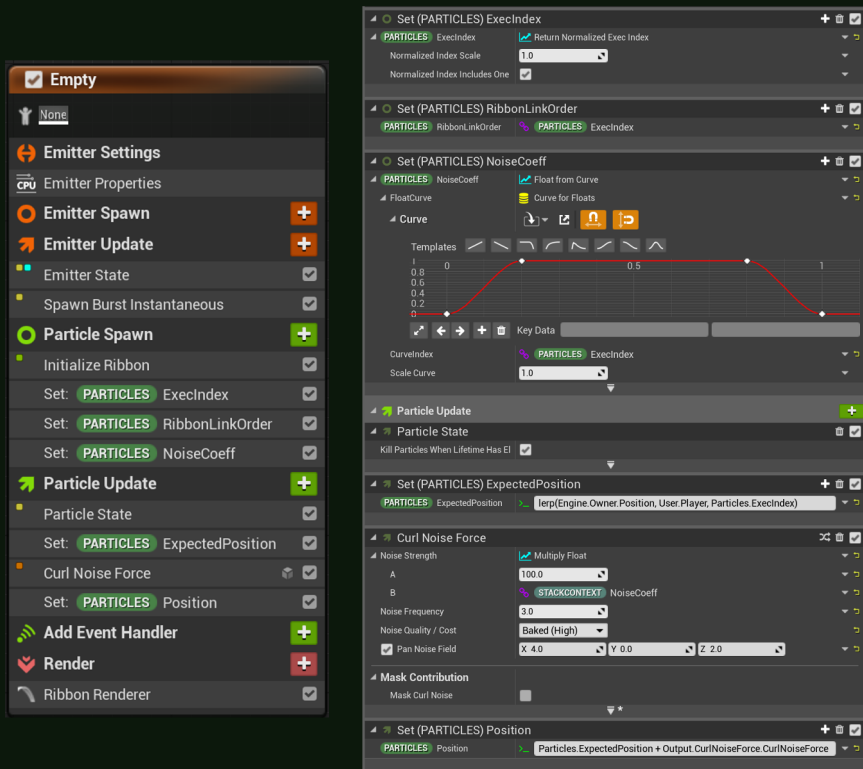
2. “ I want to connect an electric effect between two characters ”

What can we use?

- Ribbon/Beam
- Two Vectors
 - System and Character Positions
- Spawn Coefficient
 - Lerp Between Start and End
 - Curve Base Pinning / Arc
 - Custom UVs
- Material Parameters



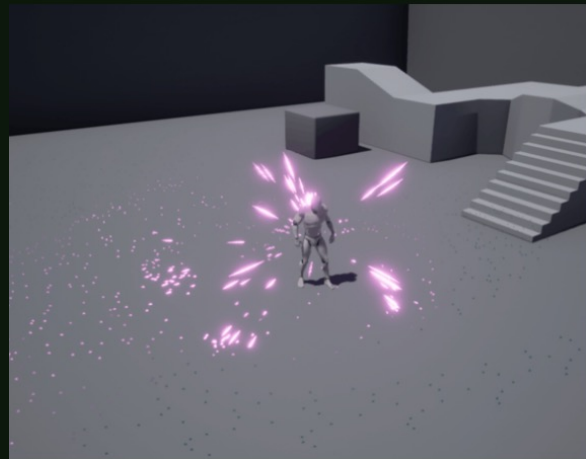
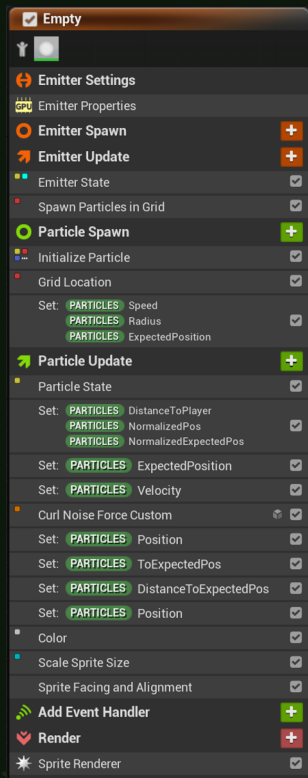
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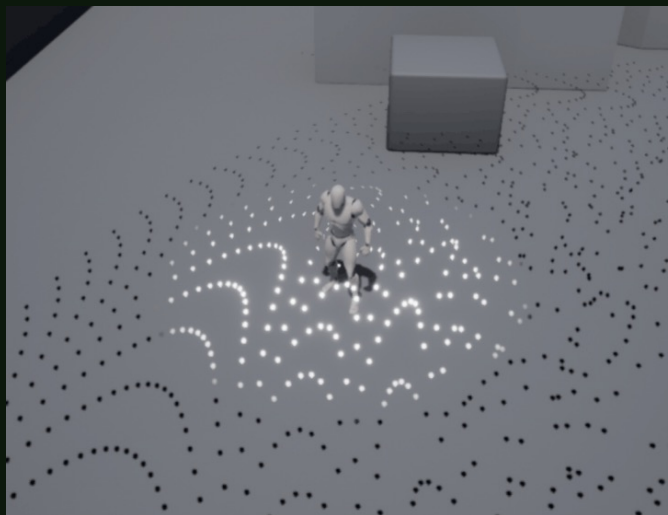
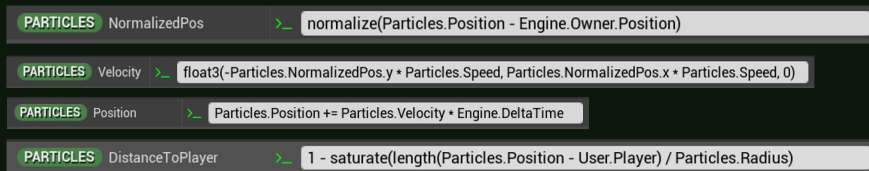
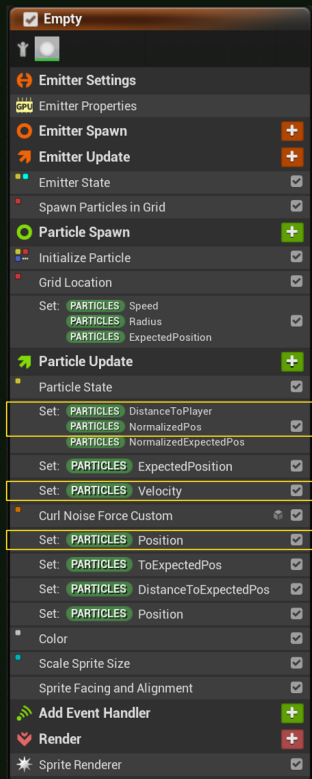
3. “ I want my effect to react to the player walking through it ”

What can we use?

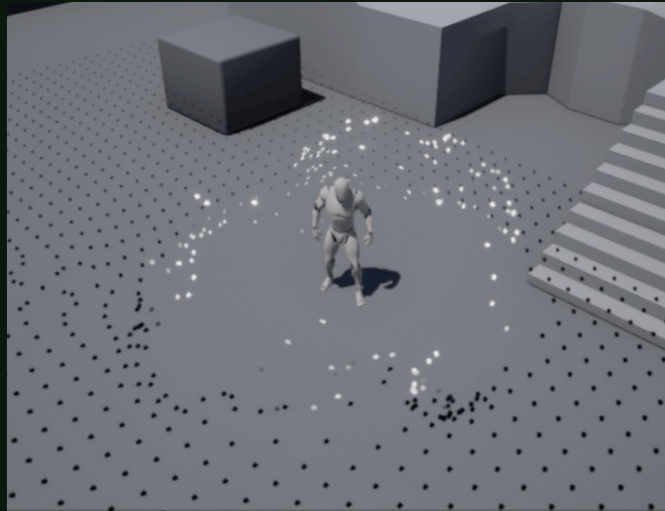
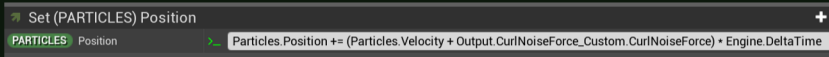
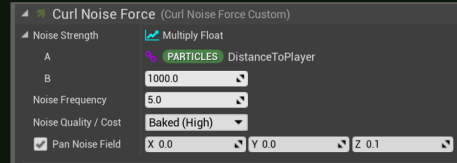
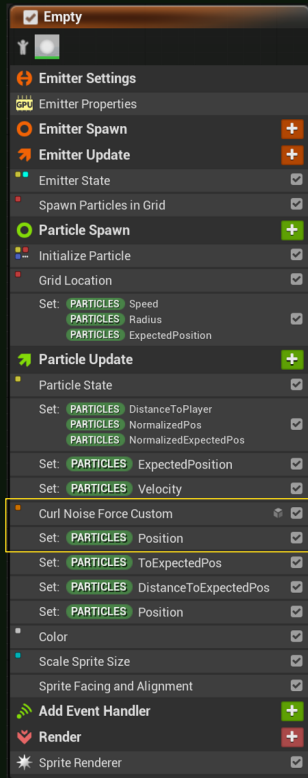
- Any Particle Type
- Particle Position and an Input Vector
- Custom Position and Velocity
- Material Parameters



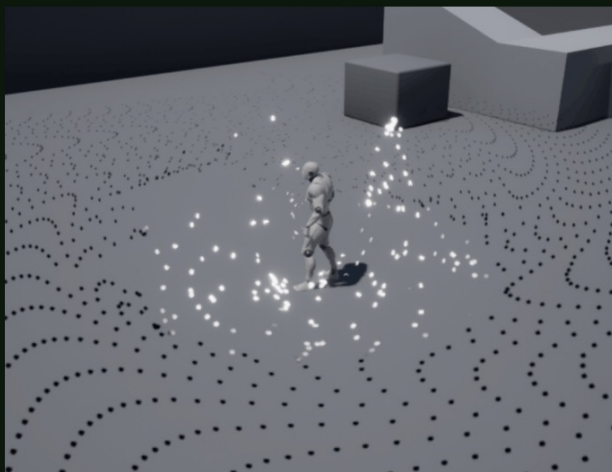
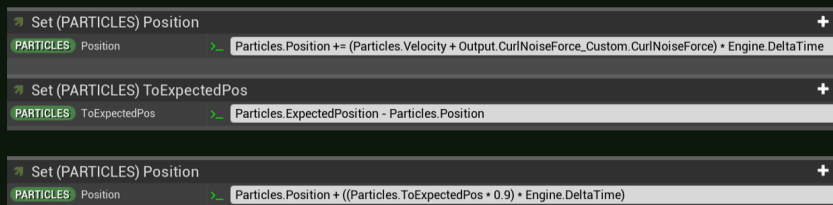
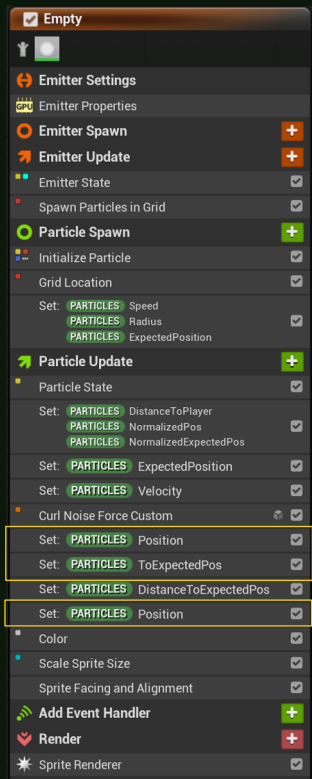
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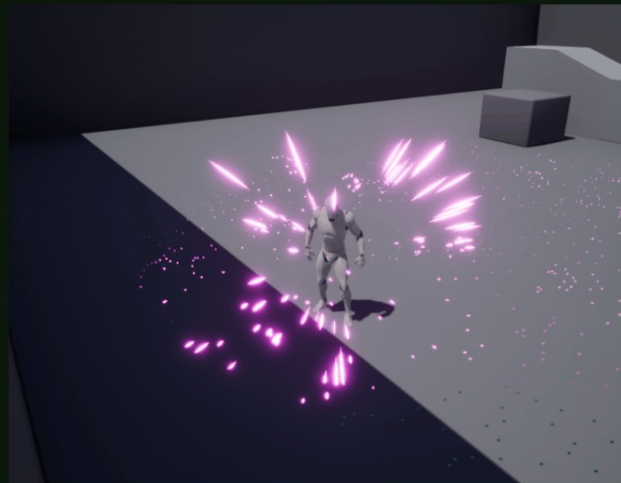
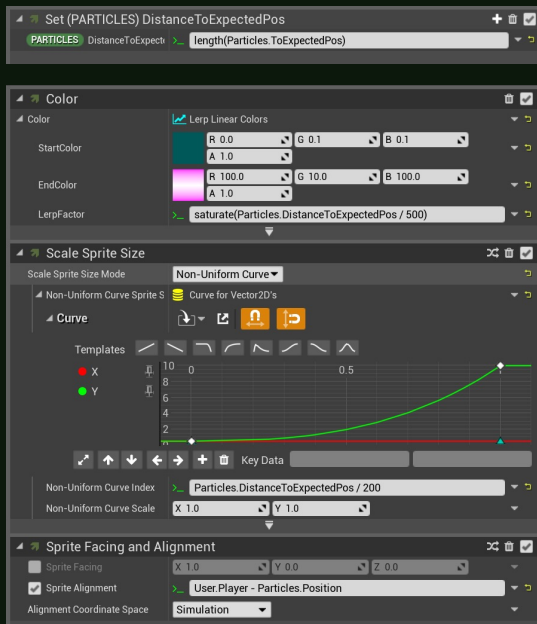
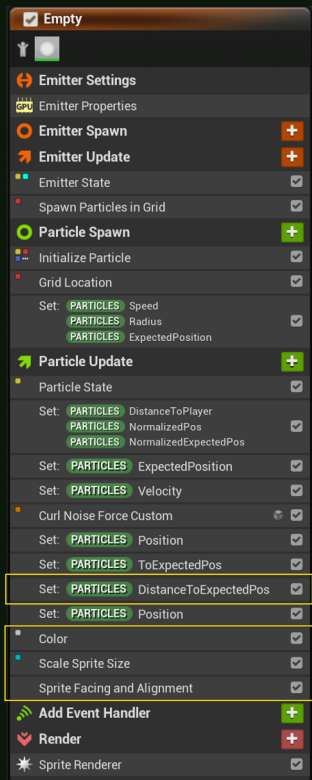
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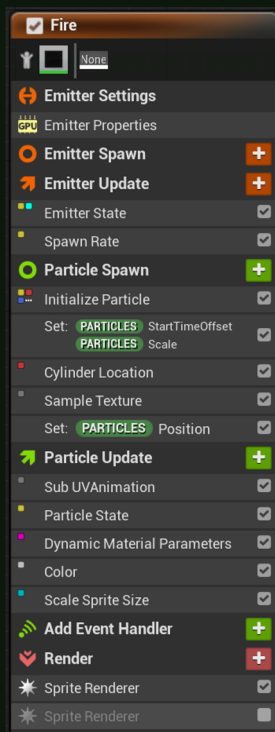
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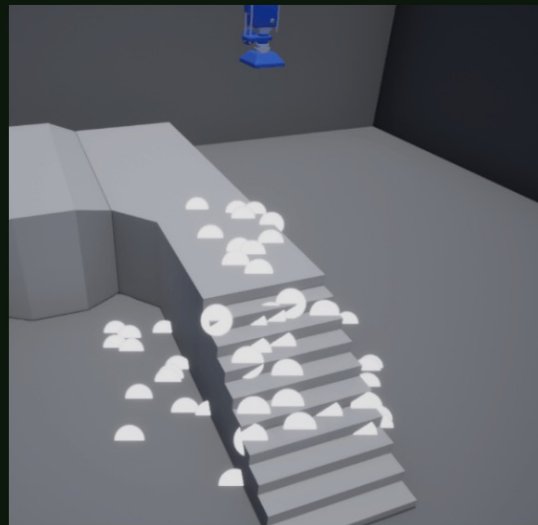
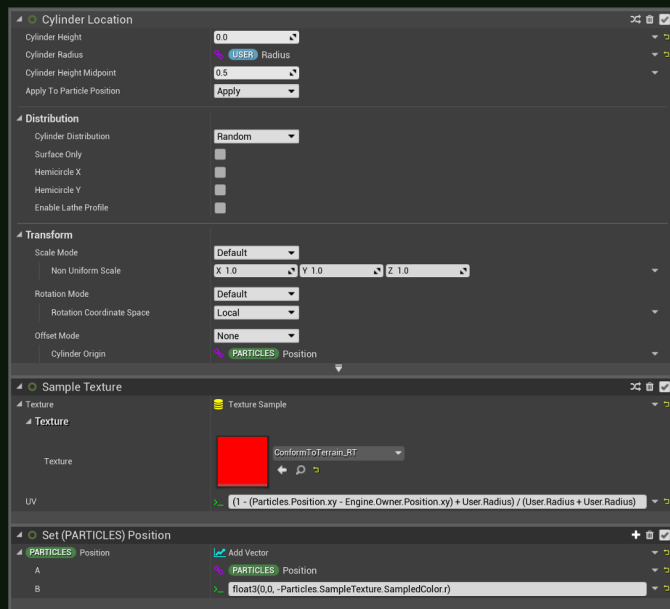
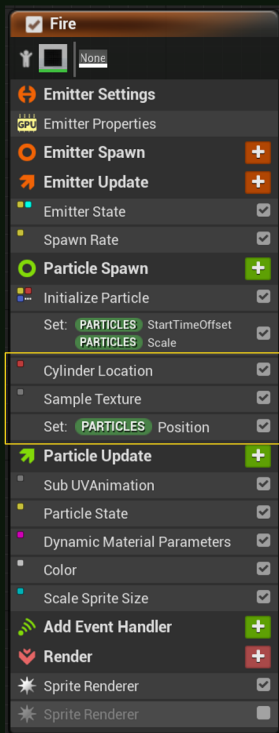
4. “ I want to conform my particles to the terrain but I don’t have distance fields in my game ”

What can we use?

- Any Particle Type
- Input Render Target
- Position Based UV Sample
- Position Offset



4. “ I want to conform my particles to the terrain but I don’t have distance fields in my game ”

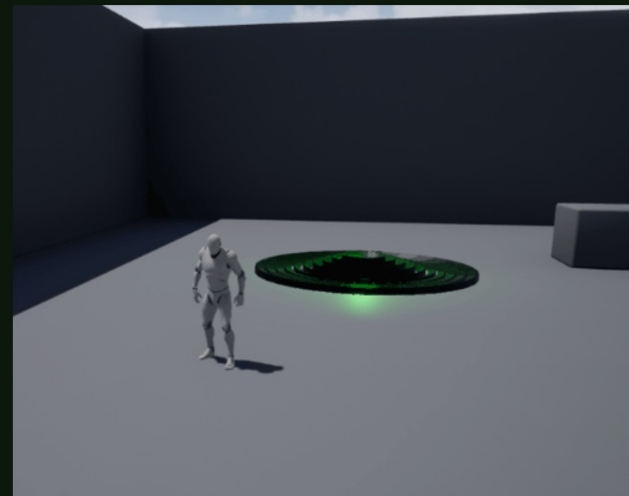
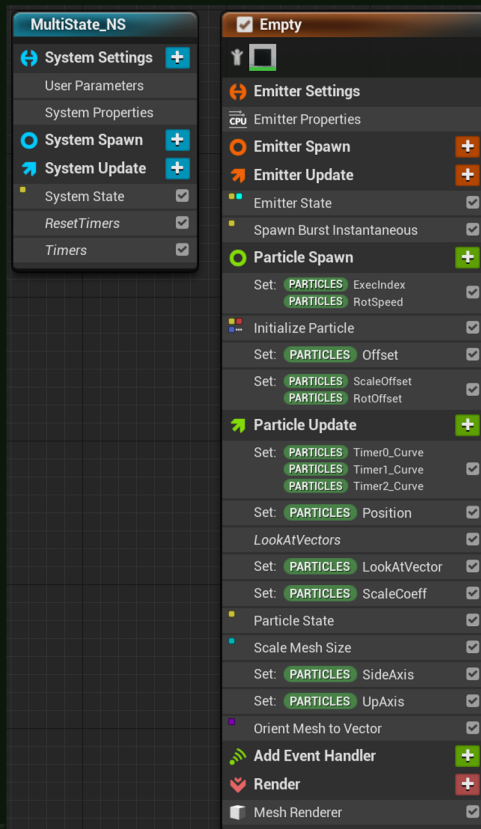


$$UVSample = (ParticleLocalPosition + SpawnRadius) / (SpawnRadius \times 2)$$

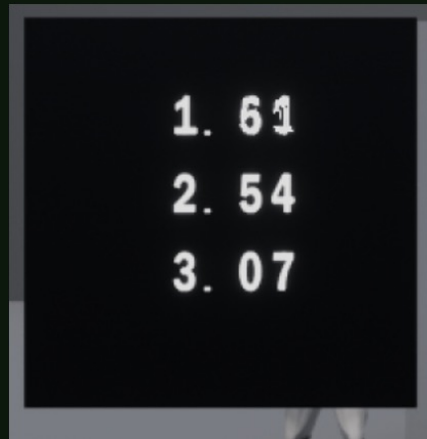
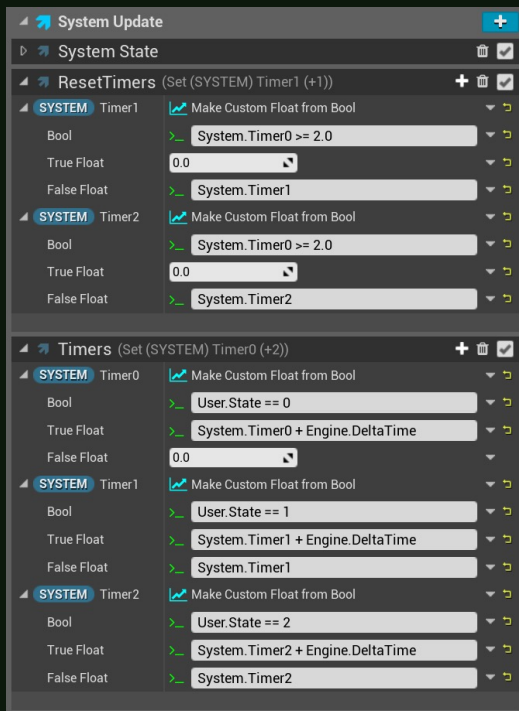
5. “ I want to build multiple states into a single effect ”

What can we use?

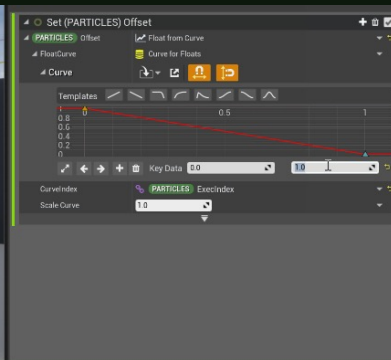
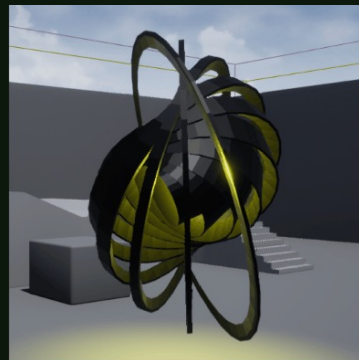
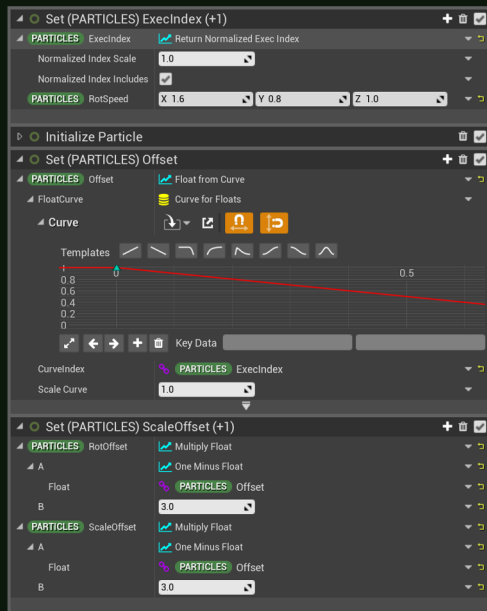
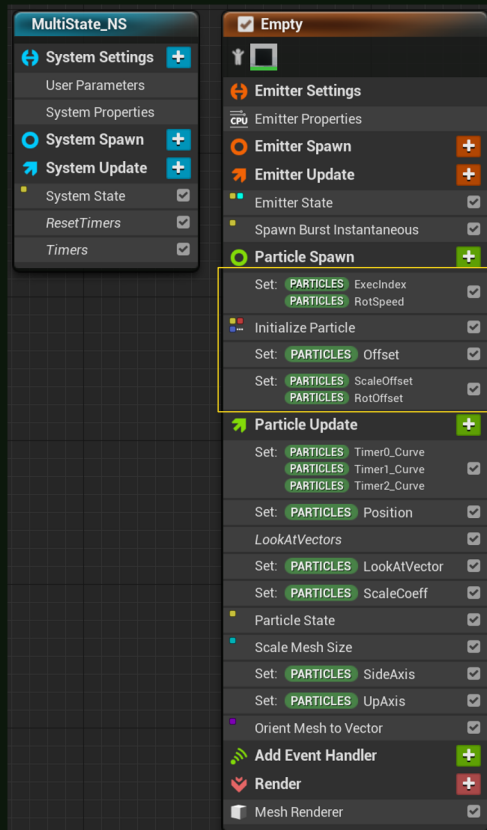
- Any Particle Type
- Input Float / Int / Bool
- Custom Conditional Timers
 - Curves Sampled By Timers
- Any Number of Custom Parameters and Inputs



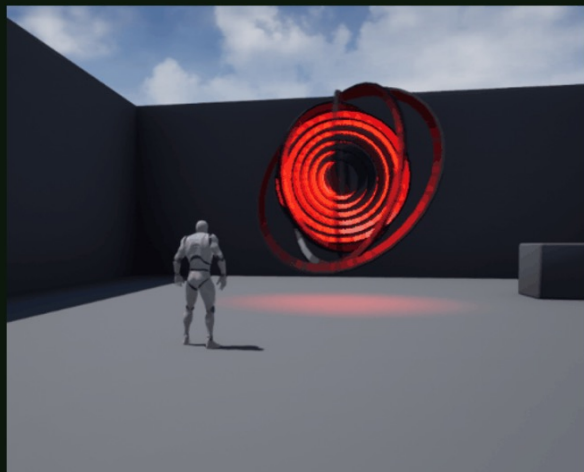
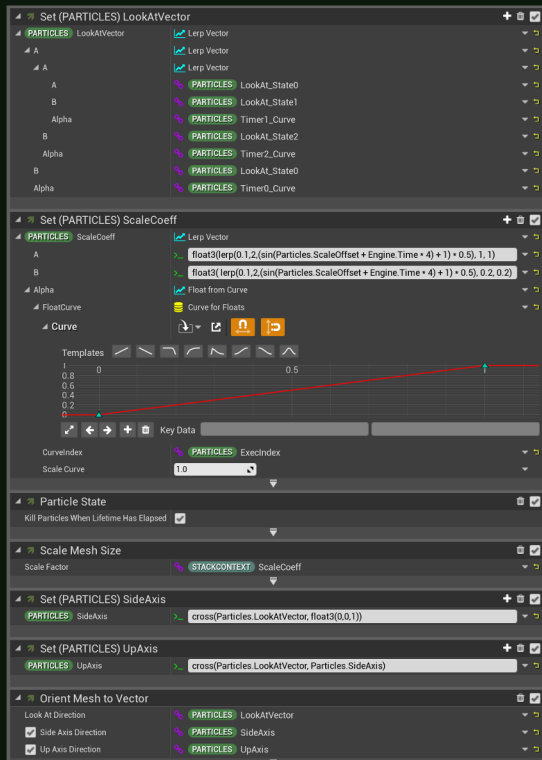
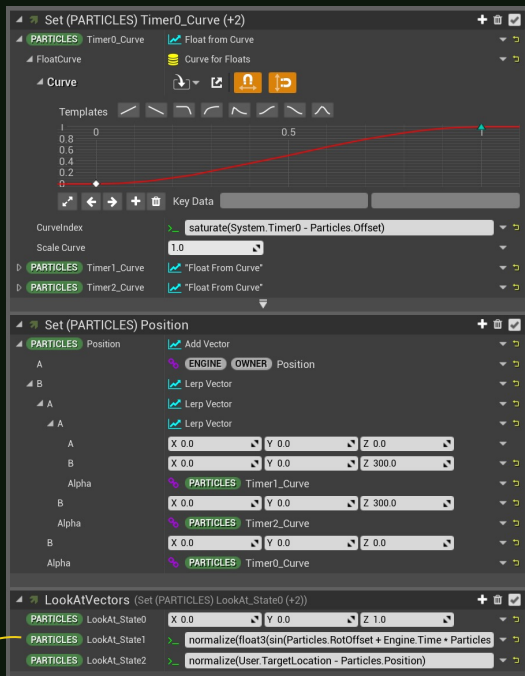
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Thank You!

LinkedIn: www.linkedin.com/in/phillipjamesFX

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