26.10.18 Editors - Properties Editor - Particle Properties Tab - Physics panel

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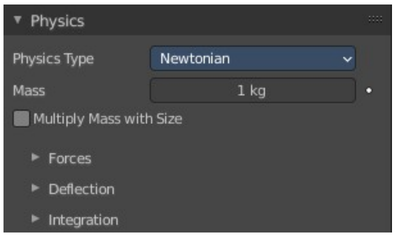
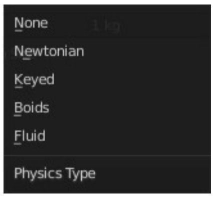
Physics Panel

The movement of particles can be controlled and influenced in various ways. Physics is one of it.



Physics Type

The kind of physics to influence the particles.

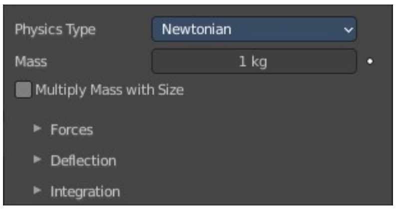


Physics Panel - Physics type None

The particles are created, and remains at their creation point.

This physics type does not have further settings.

Physics Panel - Physics type Newtonian



Particles are influenced by gravity.

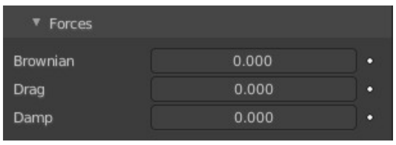
Mass

Specify the mass of the particles.

Multiply Mass with Size

Causes larger particles to have larger masses.

Forces subpanel



Brownian

Specify the amount of Brownian motion. Brownian motion adds random motion to the particles based on a Brownian noise field.

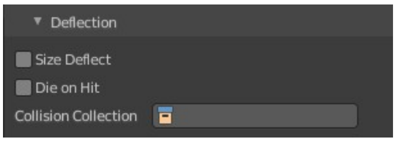
Drag

A force that reduces particle velocity in relation to its speed and size (useful in order to simulate air drag or water drag).

Damp

Reduces particle velocity (deceleration, friction, dampening).

Deflection subpanel



Size Deflect

Use the particle size in deflections.

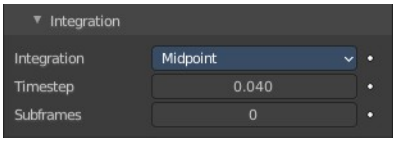
Die on Hit

Kill particle when it hits a deflector object.

Collision Collection

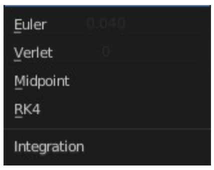
If set, particles collide with objects from the collection.

Integration subpanel



Integrators are a set of mathematical methods available to calculate the movement of particles. The following guidelines will help to choose a proper integrator, according to the behavior aimed at by the animator.

Integration



Euler

Also known as “Forward Euler”. Simplest integrator. Very fast but also with less exact results. If no dampening is used, particles get more and more energy over time. For example, bouncing particles will bounce higher and higher each time. Should not be confused with “Backward Euler” (not implemented) which has the opposite feature, the energy decrease over time, even with no dampening. Use this integrator for short simulations or simulations with a lot of dampening where speedy calculations are more important than accuracy.

Verlet

Very fast and stable integrator, energy is conserved over time with very little numerical dissipation.

Midpoint

Also known as “2nd order Runge-Kutta”. Slower than Euler but much more stable. If the acceleration is constant (no drag for example), it is energy conservative. It should be noted that in example of the bouncing particles, the particles might bounce higher than they started once in a while, but this is not a trend. This integrator is a generally good integrator for use in most cases.

RK4

Short for “4th order Runge-Kutta”. Similar to Midpoint but slower and in most cases more accurate. It is energy conservative even if the acceleration is not constant. Only needed in complex simulations where Midpoint is found not to be accurate enough.

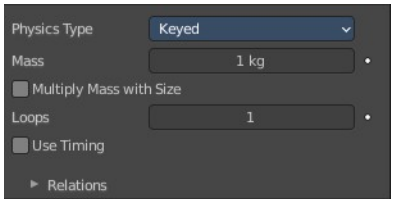
Time step

The amount of simulation time (in seconds) that passes during each frame.

Sub frames

The number of simulation steps per frame. Sub frames to simulate for improved stability and finer granularity in simulations. Use higher values for faster-moving particles.

Physics Panel - Physics type Keyed



The path of Keyed particles is determined between particles of any two (or more) particle systems. This allows the creation of a chains of systems to create long strands or groovy moving particles. Basically the particles have no dynamics but are interpolated from one system to the next each frame.

To setup Keyed particles you need at least two particle systems in the Keys list.

Mass

Specify the mass of the particles.

Multiply Mass with Size

Causes larger particles to have larger masses.

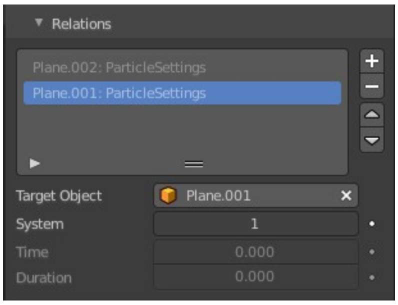
Loops

Sets the number of times the entire Keys list is repeated. Disabled if Use Timing is enabled.

Use Timing

Specify the timing for each key independently, using the Time and Duration options. By default, the Use Timing option is deactivated, and the particles will pass through all keys for a time equal to its lifetime. A shorter lifetime means faster movement. The lifetime will be split equally between the keys, this may lead to varying particle speeds between the targets.

Relations sub tab



Particle Targets list

A list of the available particle systems. You need at least two.

Drag Handler

The two vertical lines at the end is a handler with which you can expand the list.

Search Field

You can expand a search field at the bottom of the list. Type in your term and hit enter to filter for your term.

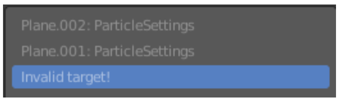
Invert

Exclude the search term instead of searching for it.

Sort by Name

Sort the List by name.

New Particle Target



Add a particle target. You need to specify the object that contains the particle system, which can be done below. Empty particle targets are marked as Invalid target!

Move Up Target / Move Down Target

Move the selected particle target up or down in the list.

Target Object

Choose the target object that contains the particle system.

System

The index of the particle system on the target object.

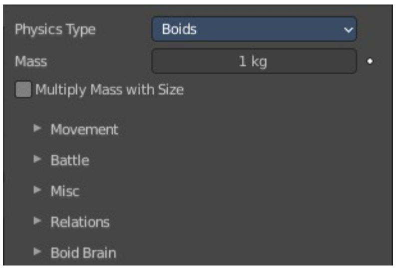
Time

Becomes active when Use Timing is activated. The start time.

Duration

Becomes active when Use Timing is activated. The duration.

Physics Panel - Physics type Boid



Boids particle systems are controlled by a limited artificial intelligence, which can be programmed to follow basic rules and behaviors. They are ideal for simulating flocks, swarms, herds and schools of various kind of animals, insects and fishes or predators vs. preys simulations. They can react on the presence of other objects and on the members of their own system. Boids can handle only a certain amount of information, therefore the sequence of the Boid Brain rules is very important. In certain situations only the first three parameter are evaluated.

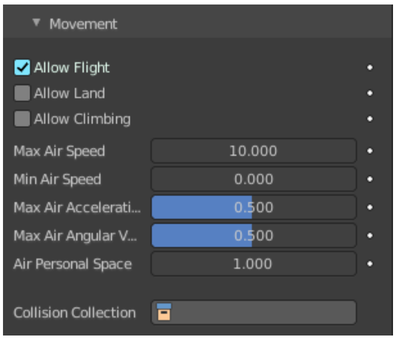
Mass

Specify the mass of the particles.

Multiply Mass with Size

Causes larger particles to have larger masses.

Movement subpanel



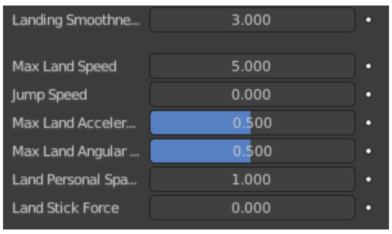
Boids try to avoid objects with activated Collision. They try to reach goal objects, and fly from “predators” according to the Boid Brain settings.

Boids can have different physics depending on whether they are in the air, or on land (on collision object).

Allow Flight

Allow boids to move in the air.

Allow Land



Allow boids to move on land. Activating this setting will reveal further sliders.

Allow Climbing

Allow boids to climb goal objects.

Max Air Speed

Set the Maximum velocity in the air.

Min Air Speed

Set the Minimum velocity in the air.

Max Air Acceleration

Lateral acceleration in air, percentage of the max velocity (turn). Defines how fast a boid is able to change direction.

Max Air Angular Velocity

Tangential acceleration in air, percent 180 degrees. Defines how much the boid can suddenly accelerate in order to fulfill a rule.

Air Personal Space

Radius of boids personal space in air. Percentage of particle size.

Landing Smoothness

How smoothly the boids land.

Max Land Speed

Set the Maximum velocity on land.

Jump Speed

Maximum speed for jumping.

Max Land Acceleration

Lateral acceleration on land, percent of max velocity (turn). Defines how fast a boid is able to change direction.

Max Land Angular Velocity

Tangential acceleration on land, percent 180 degrees. Defines how much the boid can suddenly accelerate in order to fulfill a rule.

Land Personal Space

Radius of boids personal space on land. Percentage of particle size.

Land Stick Force

How strong a force must be to start effecting a boid on land.

Collision Collection

Only collide with objects in this collection.

Battle subpanel

Health

Initial boid health when born.

Strength

Maximum caused damage per second on attack.

Aggression

Boid will fight this time stronger than enemy.

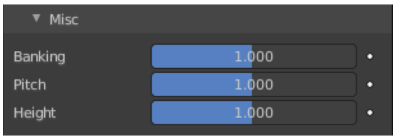
Accuracy

Accuracy of attack.

Range

Maximum distance of which a boid can attack.

Misc subpanel



Banking

Amount of rotation around velocity vector on turns. Banking of 1.0 gives a natural banking effect.

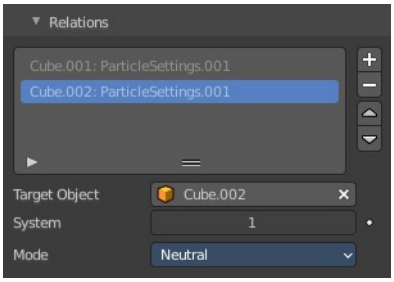
Pitch

Amount of rotation around side vector.

Height

Boid height relative to particle size.

Relations subpanel



Boid particles can react with other particle systems. This list allows you to select other objects with their particle systems.

Deflection

Boids will try to avoid deflector objects according to the Collision rule's weight. It works best for convex surfaces (some work needed for concave surfaces).

Force Fields

As other physics types, Boids is also influenced by external force fields.

In addition, special Boid force fields can be used with the Boids physics. These effectors could be predators (positive Strength) that boids try to avoid, or targets (negative Strength) that boids try to reach according to the (respectively) Avoid and Goal rules of the Boid Brain.

Particle Targets list

A list of the available particle systems.

Drag Handler

The two vertical lines at the end is a handler with which you can expand the list.

Search Field

You can expand a search field at the bottom of the list. Type in your term and hit enter to filter for your term.

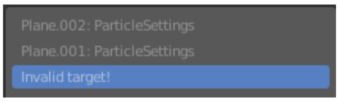
Invert

Exclude the search term instead of searching for it.

Sort by Name

Sort the List by name.

New Particle Target



Add a particle target. You need to specify the object that contains the particle system, which can be done below. Empty particle targets are marked as Invalid target!

Move Up Target / Move Down Target

Move the selected particle target up or down in the list.

Target Object

Choose the target object that contains the particle system.

System

Index of the Object's particle system as set in the list view in the particle panel.

Mode

Enemy

Setting the type to Enemy will cause the systems to fight with each other.

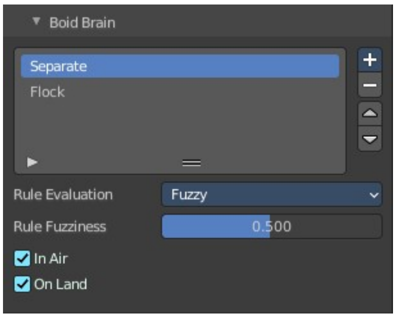
Friend

Will make the systems work together.

Neutral

Will not cause them to align or fight with each other.

Boid Brain subpanel



The Boid Brain panel controls how the boids particles will react with each other. The boids' behavior is controlled by a list of rules. Only a certain amount of information in the list can be evaluated. If the memory capacity is exceeded, the remaining rules are ignored.

The rules are by default parsed from top-list to bottom-list (thus giving explicit priorities), and the order can be modified using the little arrows buttons on the right side.

List of Rules

The list of the current rules.

Search Field

You can expand a search field at the bottom of the list. Type in your term and hit enter to filter for your term.

Invert

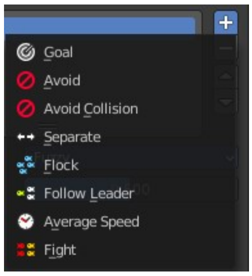
Exclude the search term instead of searching for it.

Sort by Name

Sort the List by name.

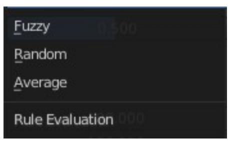
Add Boid Rule

A list of the available boid rules. Each rule has different settings.



All rules

Rule Evaluation



There are three ways to control how rules are evaluated:

Average

All rules are averaged.

Random
A random rule is selected for each boid.

Fuzzy
Uses fuzzy logic to evaluate rules. Rules are gone through top to bottom. Only the first rule that affect above the Rule Fuzziness threshold is evaluated. The value should be considered how hard the boid will try to respect a given rule (a value of 1 means the Boid will always stick to it, a value of 0 means it will never). If the boid meets more than one conflicting condition at the same time, it will try to fulfill all the rules according to the respective weight of each.

Note! A given boid will try as much as it can to comply to each of the rules it is given, but it is more than likely that some rule will take precedence on other in some cases. For example, in order to avoid a predator, a boid could probably “forget” about Collision, Separate and Flock rules, meaning that “while panicked” it could well run into obstacles, e.g. even if instructed not to, most of the time.

Rule Fuzziness
The fuzziness for the rule evaluation method Fuzzy.

In Air
The current rule affects boids while they are flying.

On Land
The current rule affects boids while they are not flying.

Goal Boid Rule

Seek the goal.

Object
Specifies the goal object. If not specified, Boid force fields with negative Strength are used as goals.

Predict
Predict target’s movements.

Avoid Boid Rule

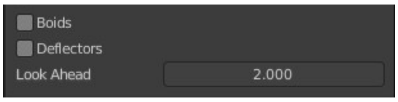
Avoid “predators”.

Object
Specifies the object to avoid. If not specified, Boid force fields with positive Strength are used as predators.

Predict
Predict target’s movements.

Fear Factor
Avoid object if danger from it is above this threshold.

Avoid Collision Boid Rule



Avoid objects with activated Deflection.

Boids
Avoid collision with other boids.

Deflectors
Avoid collision with deflector objects.

Look Ahead
Time to look ahead in seconds.

Separate Boid Rule

Boids move away from each other.

Flock Boid Rule

Copy movements of neighboring boids, but avoid each other.

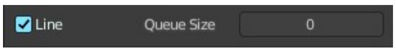
Follow Leader Boid Rule

Follows a leader object instead of a boid.

Object
Pick the leader object.

Distance
Distance behind leader to follow.

Line
Follow the leader in a line.



Queue Size
How many boids that are allowed to follow in a line.

Average Speed Boid Rule

Maintain average velocity.

Speed
Percentage of maximum speed.

Wander
How fast velocity’s direction is randomized.

Level
How much velocity’s Z component is kept constant.

Fight Boid Rule

Move toward nearby boids.

Fight Distance

Attack boids at a maximum of this distance.

Flee Distance

Flee to this distance.

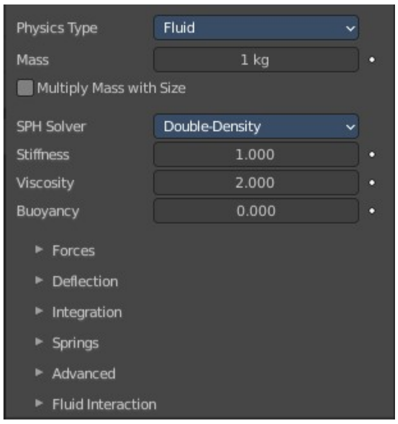
Remove Boid Rule

Remove the boid rule from the list.

Move Up / Move Down Boid Rule

Move the boid rule up or down the list.

Physics Panel - Physics type Fluid



Fluid particles are similar to Newtonian particles. But the particles are influenced by internal forces like pressure, surface tension, viscosity, springs, etc. The range goes from liquids to slime, goo to sand and wispy.

Mass

Specify the mass of the particles.

Multiply Mass with Size

Causes larger particles to have larger masses.

SPH Solver

Smoothed-particle hydrodynamics (SPH) is a computational method used for simulating fluid flows. It is a mesh-free Lagrangian method where the coordinates move with the fluid.

Double density

An artistic solver with strong surface tension effects. Reveals the Spring sub panel.

Classic

A more physically accurate solver.

Stiffness

How incompressible the fluid is.

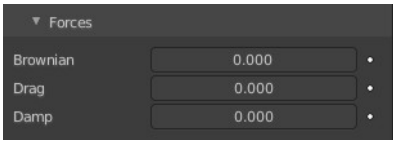
Viscosity

Linear viscosity. Use lower viscosity for thicker fluids.

Buoyancy

Artificial buoyancy force in negative gravity direction based on pressure differences inside the fluid.

Forces subpanel



Brownian

Specify the amount of Brownian motion. Brownian motion adds random motion to the particles based on a Brownian noise field.

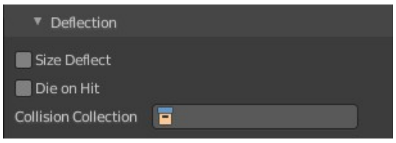
Drag

A force that reduces particle velocity in relation to its speed and size (useful in order to simulate air drag or water drag).

Damp

Reduces particle velocity (deceleration, friction, dampening).

Deflection subpanel



Size Deflect

Use the particle size in deflections.

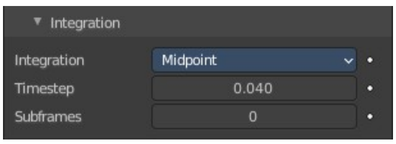
Die on Hit

Kill particle when it hits a deflector object.

Collision Collection

If set, particles collide with objects from the collection.

Integration subpanel



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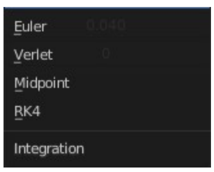
Integration



Euler

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Verlet

Very fast and stable integrator, energy is conserved over time with very little numerical dissipation.

Midpoint

Also known as “2nd order Runge-Kutta”. Slower than Euler but much more stable. If the acceleration is constant (no drag for example), it is energy conservative. It should be noted that in example of the bouncing particles, the particles might bounce higher than they started once in a while, but this is not a trend. This integrator is a generally good integrator for use in most cases.

RK4

Short for “4th order Runge-Kutta”. Similar to Midpoint but slower and in most cases more accurate. It is energy conservative even if the acceleration is not constant. Only needed in complex simulations where Midpoint is found not to be accurate enough.

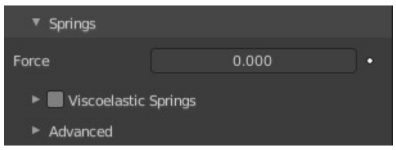
Time step

The amount of simulation time (in seconds) that passes during each frame.

Sub frames

The number of simulation steps per frame. Sub frames to simulate for improved stability and finer granularity in simulations. Use higher values for faster-moving particles.

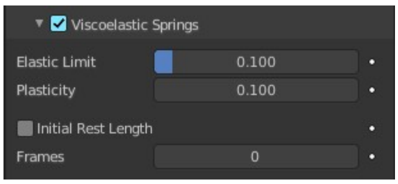
Springs Subpanel



Force

Spring force.

Viscoelastic Springs



Use viscoelastic springs instead of Hooke’s springs.

Elastic Limit

How much the spring has to be stretched/compressed in order to change its rest length.

Plasticity

How much the spring rest length can change after the elastic limit is crossed.

Initial Rest Length

Use initial length as spring rest length instead of 2 × particle size.

Frames

Create springs for this number of frames since particle’s birth (0 is always).

Advanced

Rest Length

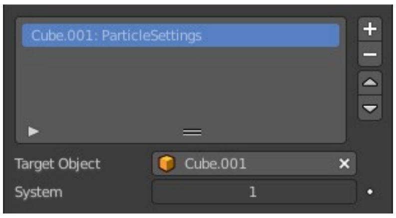
Rest length of springs. Factor of particle radius. Checkbox sets this to be a factor of 2 × particle size.

Factor Rest Length

Spring rest length is a factor of 2* particle size.

Fluid Interaction

Add a particle system to interact with the fluid.



Particle Targets list

A list of the available particle systems.

Search Field

You can expand a search field at the bottom of the list. Type in your term and hit enter to filter for your term.

Invert

Exclude the search term instead of searching for it.

Sort by Name

Sort the List by name.

Target Object

Choose the target object that contains the particle system.

System

The index of the particle system on the target object.