# Simulation of paintball shot

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- Initial project idea:
  Paintball shot on wall
- Final project:
  Paintball shot on simple objects

# Video

# Expected challenges

- OpenGL
  - showing simple objects
- SPH solver
  - time to make it work as expected

# Approach

- SPH solver
- Collision handling with axis aligned boundary boxes

# Why?

- SPH solver
  - splashes and droplets
- Collision handling with axis aligned boundary boxes
  - lately attacket
  - risk of heavy time investition

# Low level

- C++ 11
- Eigen
- OpenGL
  - GLSL (OpenGL Shading Language)
  - GLM (OpenGL Mathematics)

# High level

1. Shot with gravitation
2. Collision detection
3. On impact the SPH simulation starts

## General difficulties

- general code debugging
- parameter tuning
- coordinates: simulation space $\leftrightarrow$ window space

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## Specific difficulties

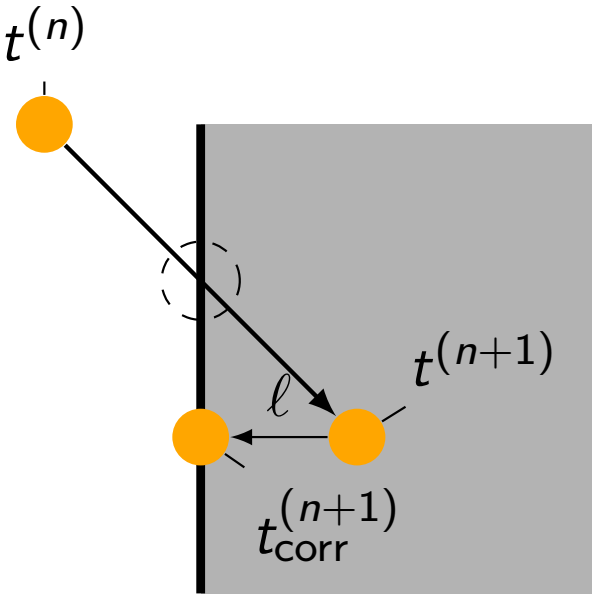
- many particles behaving like a ball
- particles pushed and trapped inside object
- sticky paint on object with given resolution

# Tricks

- many particles behaving like a ball
  - $\rightarrow$ particle-particle forces ignored before collision
- particles pushed and trapped inside object
  - $\rightarrow$ projection further than on surface
- sticky paint on object
  - $\rightarrow$ velocity dependent trace on object

# Particles pushed and trapped inside object

naive method



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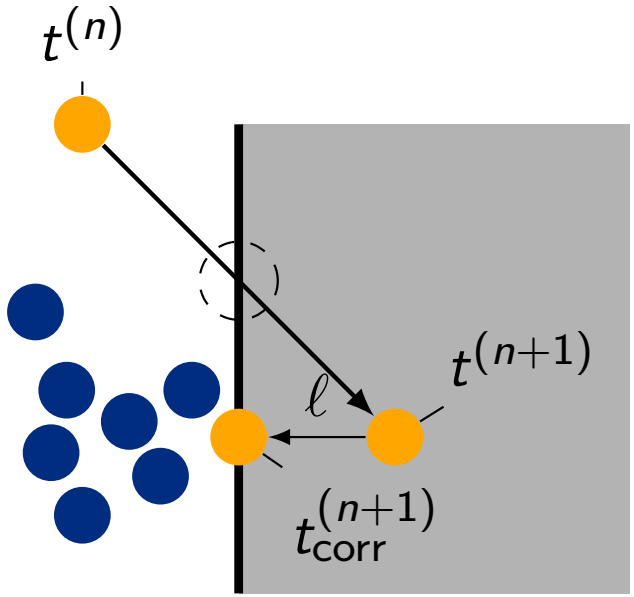

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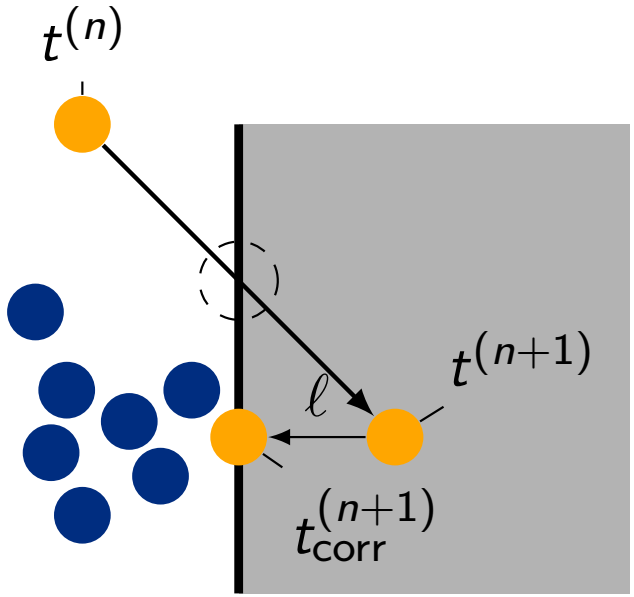
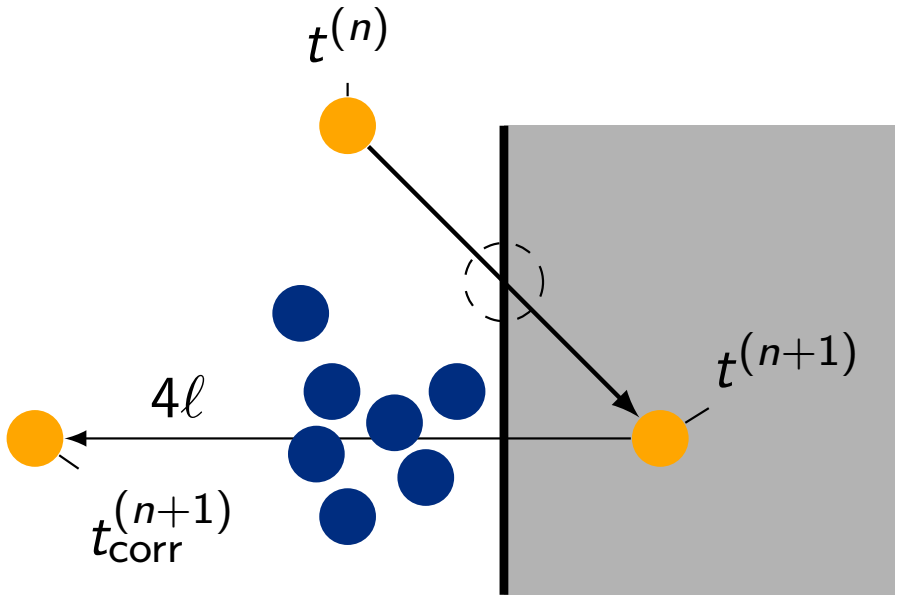



our method

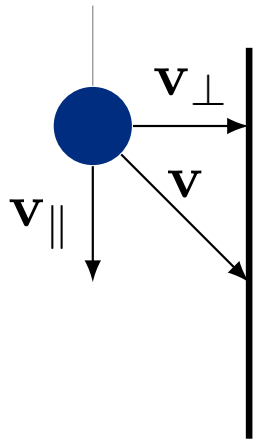


# Sticky paint on object

## Trace handling

### Velocity split

SPH particle




### Resulting trace

$\mathbf{v}_\parallel = 0$
$|\mathbf{v}|$ big

$\mathbf{v}_\parallel \neq 0$
$|\mathbf{v}|$ big

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# Demonstration

## Performance

- Real time simulation for simple objects (500 vertices)
- For complex objects substantionally slower

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## Limitations

- resolution and number of collision objects
  - $\rightarrow$ bottleneck collision handling
- number of particles
  - $\rightarrow$ bottleneck SPH simulation

## What we learned

- OpenGL
- Blender

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## What we would do different

- Start collision handling earlier