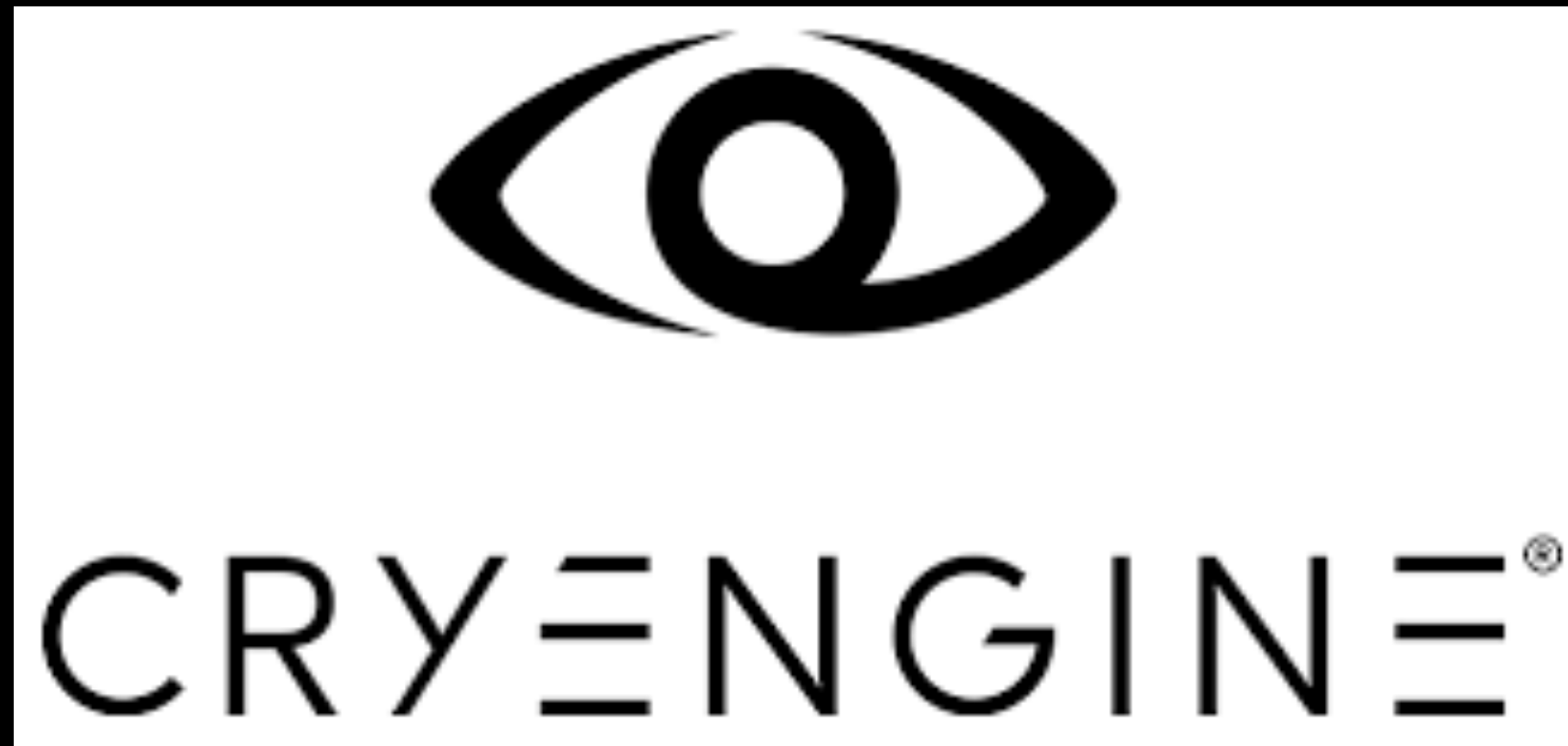


A Road to 3D for Everyone

Florian Hoenig



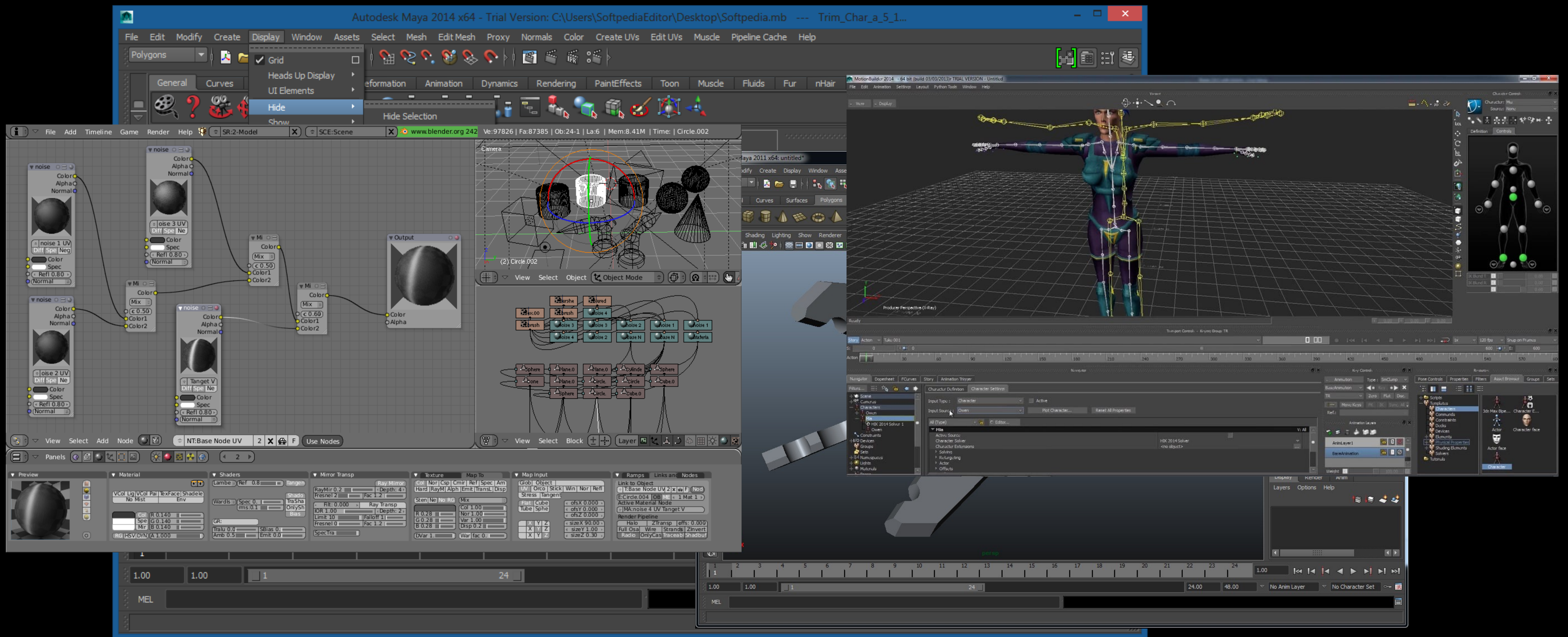
Goal: I want to make a good looking 3D game...



Positive Surprise: Do not need to write my own engine.

However

Content Creation Tools



I had to think

But in Minecraft creating is easy...

Just make a higher resolution Minecraft?



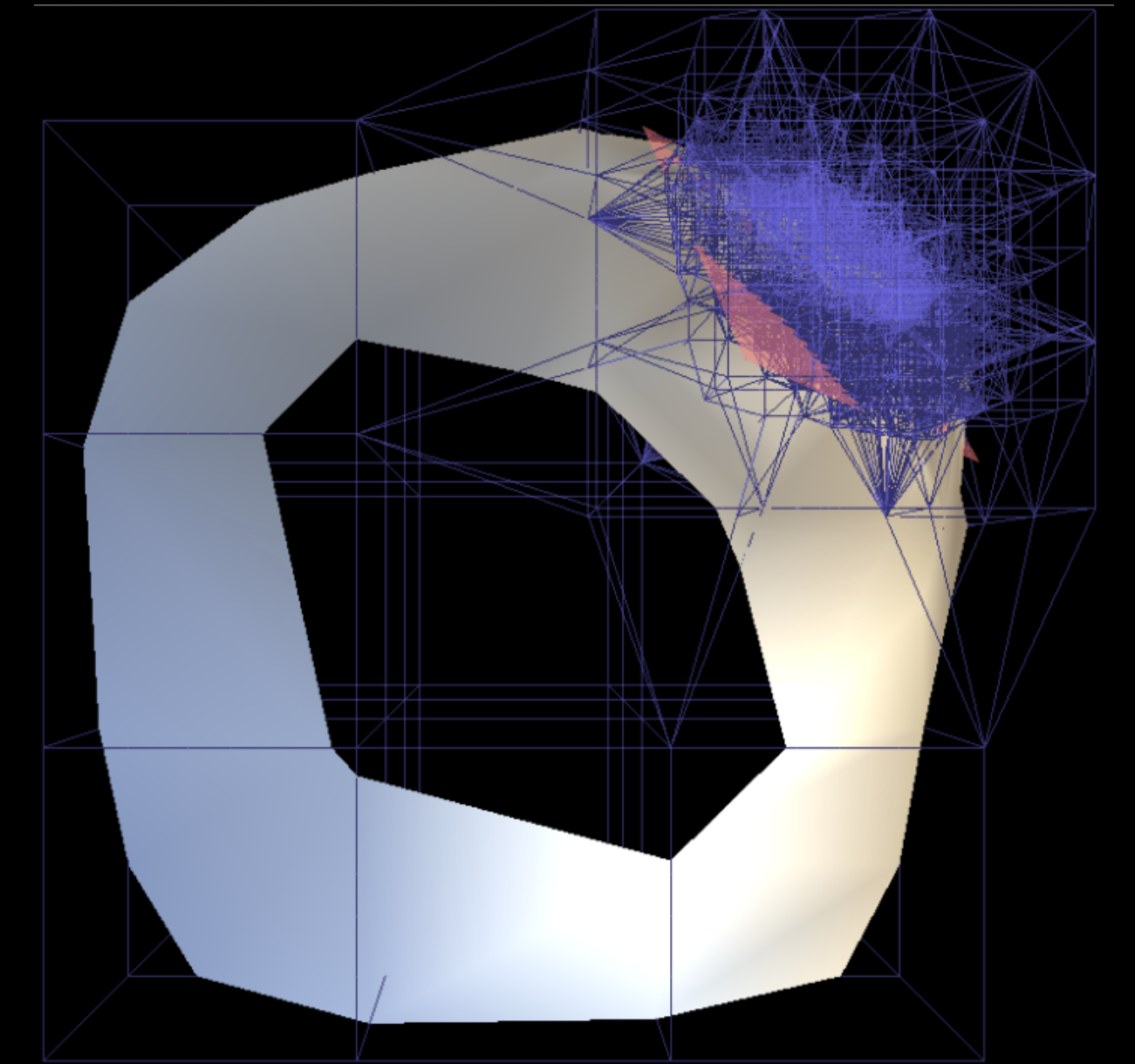
Goal: ~~make a 3D game~~

Goal: Create a World

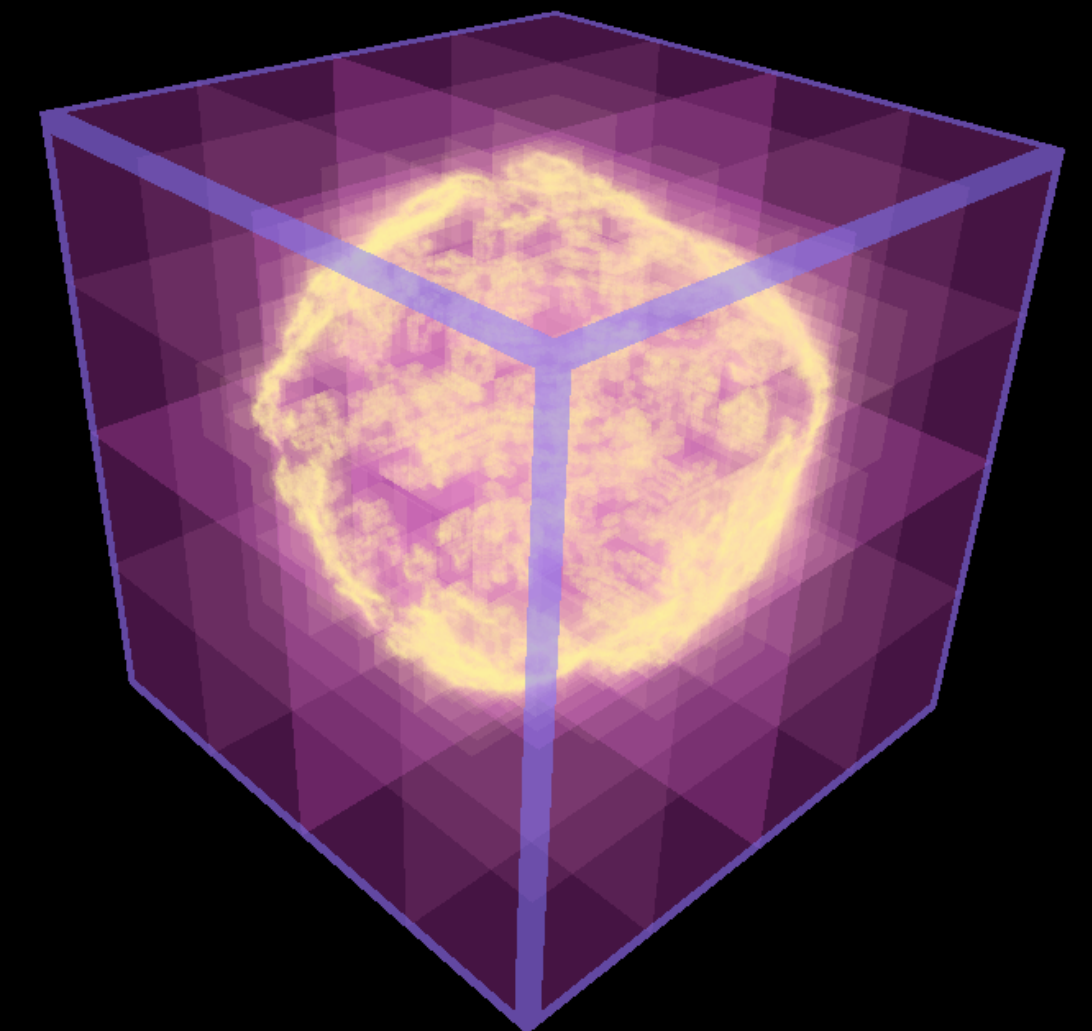
Engine 1

Engine 1

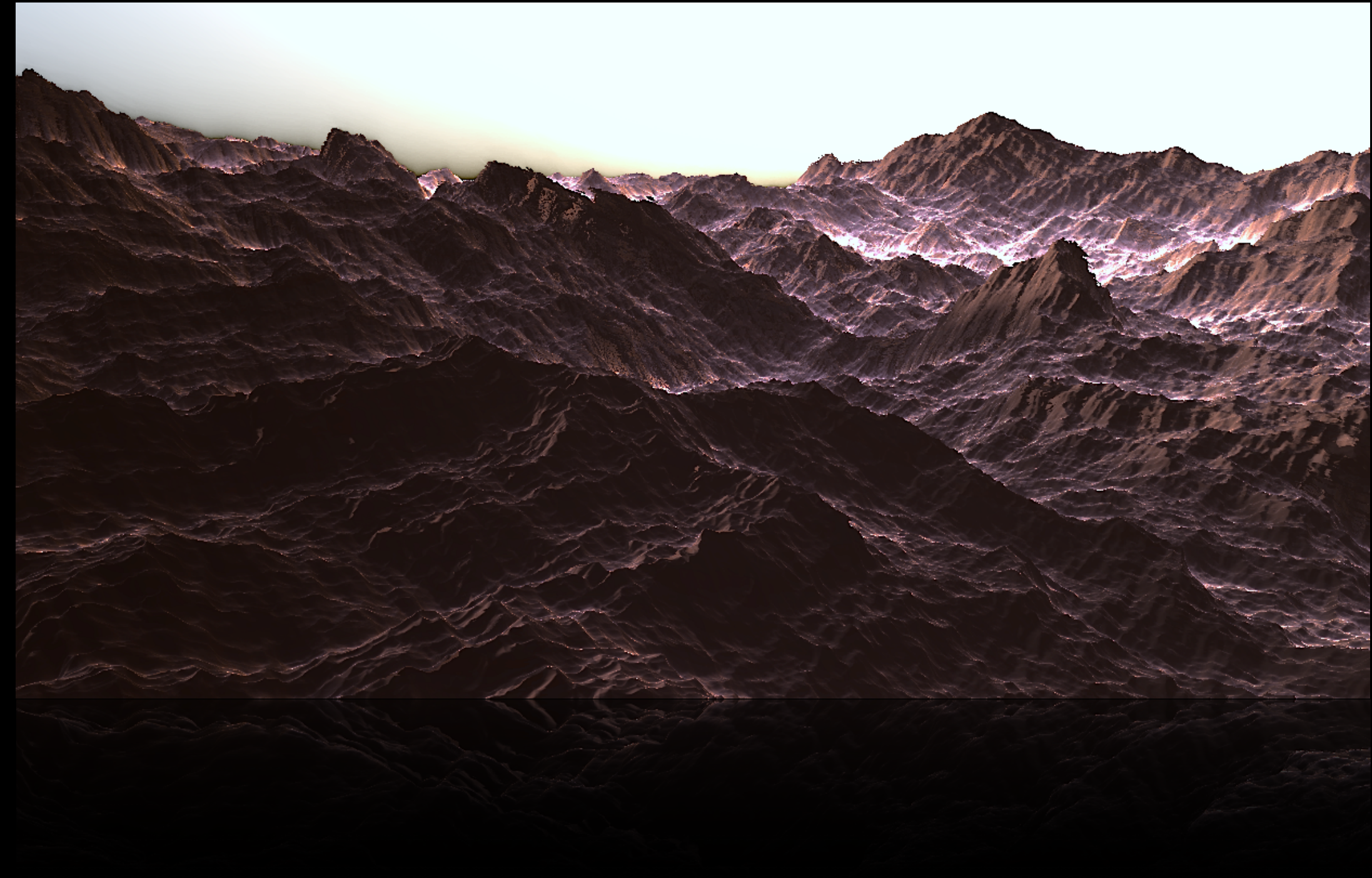
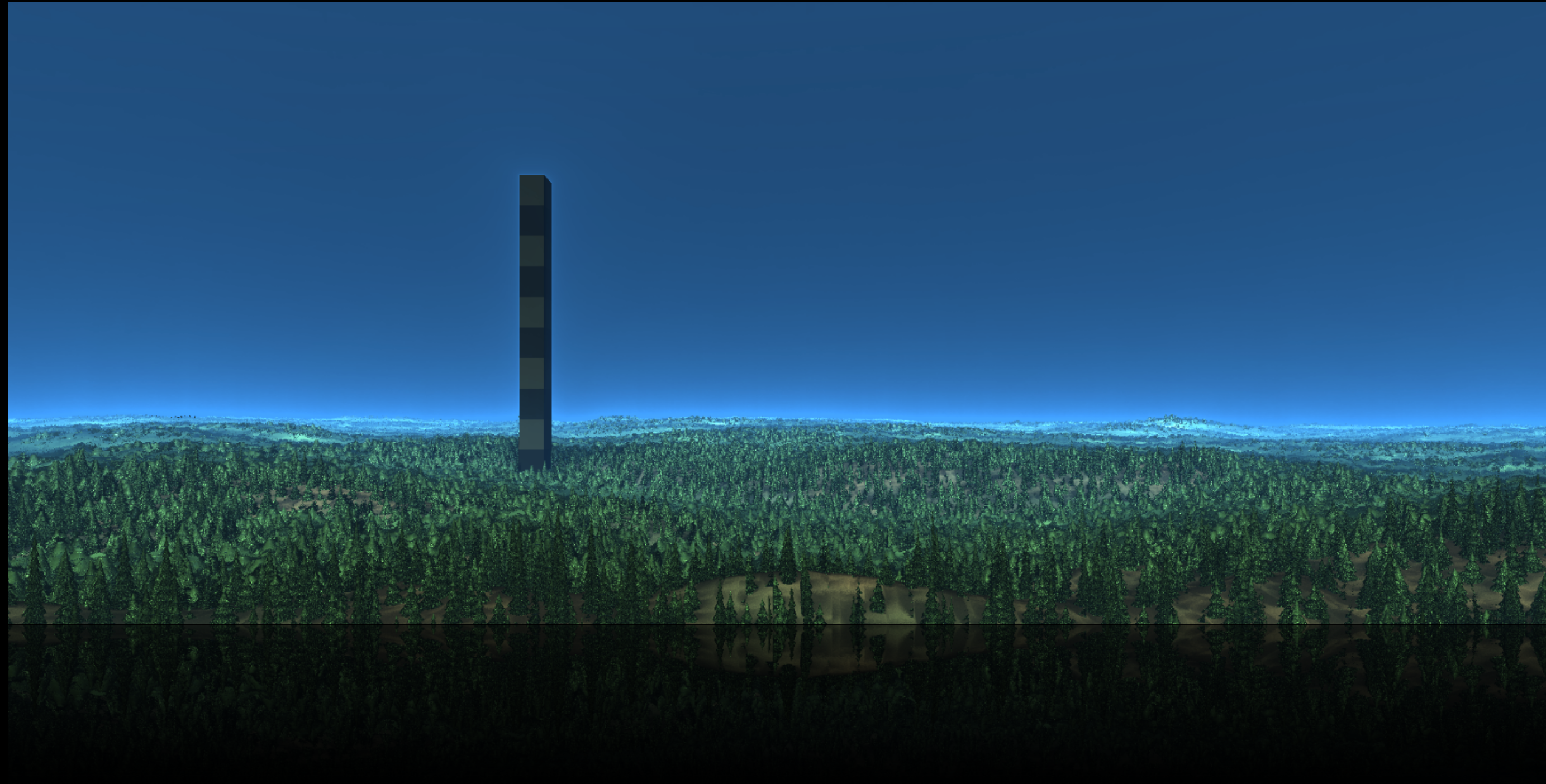
- Planet = $||p|| - \text{crazynoisefunction}(p)$
- Put inside an Octree data structure evaluated on the CPU
- Generate triangles by: building octree dual on CPU and running Marching Cubes on it.
- Some cubes are pyramids to deal with seams.
- As camera moves, the hashed Octree is refined down to 21 levels.



Marching Cubes on Octree Dual



Meanwhile



~~Goal: make a 3D game~~

Goal: Create a World ✓

Goal: Create a dynamic world

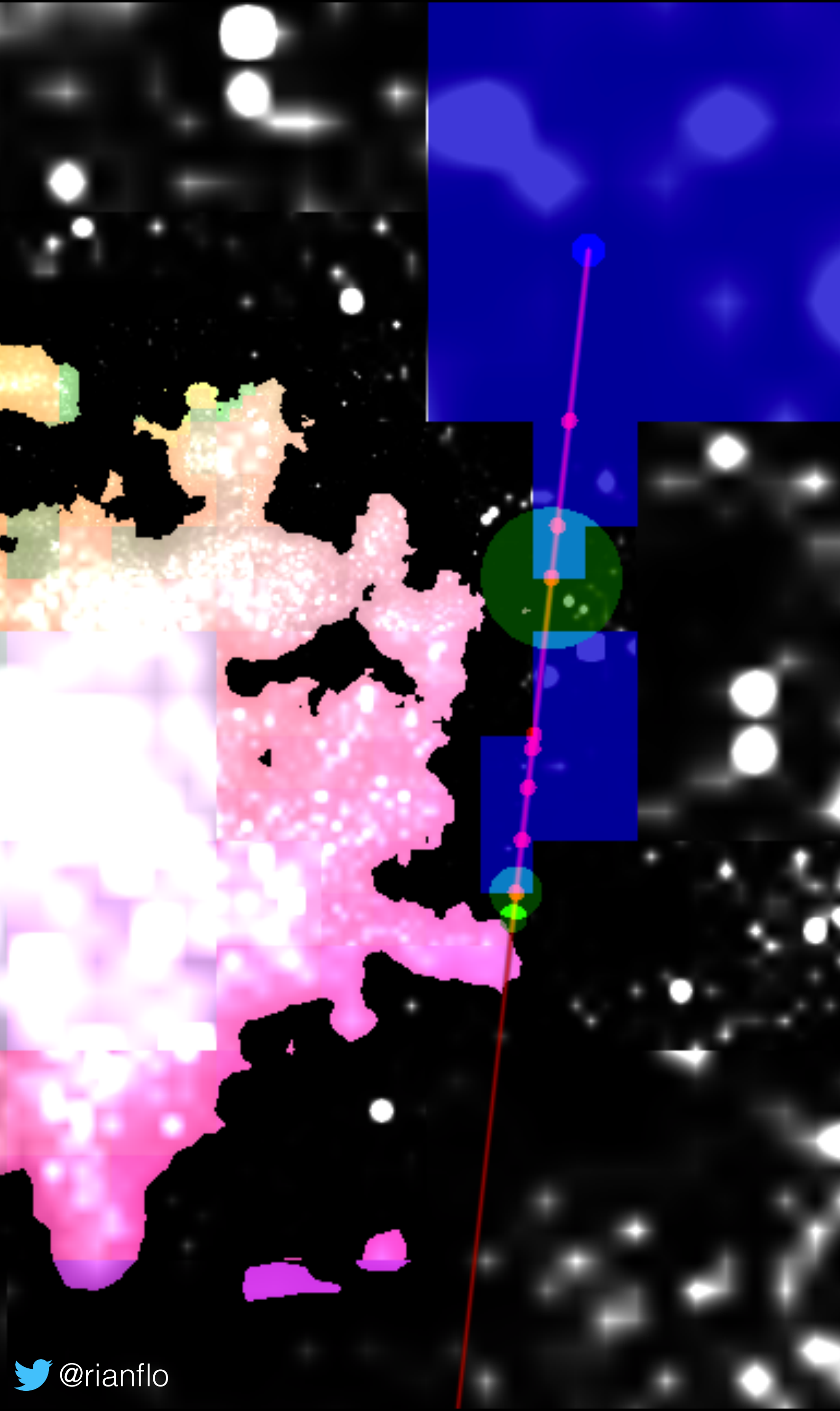
Engine 2

Raytracing the planet volume directly

Engine 2

How does it work?

- Sparse Hierarchical Distance Field (8-bit scalar) at $\sim 16M^3$ voxel resolution.
- Hybrid raytracing in *world space* using 64-bit fixed-point arithmetic on GPU.
- $O(1)$ and actual 1.5 memory reads for findLeaf (avg. across primary rays per frame).
- 60 FPS on a GTX 750Ti @ 720p
- For me: impossible without having moved to CUDA



Fun Modeling



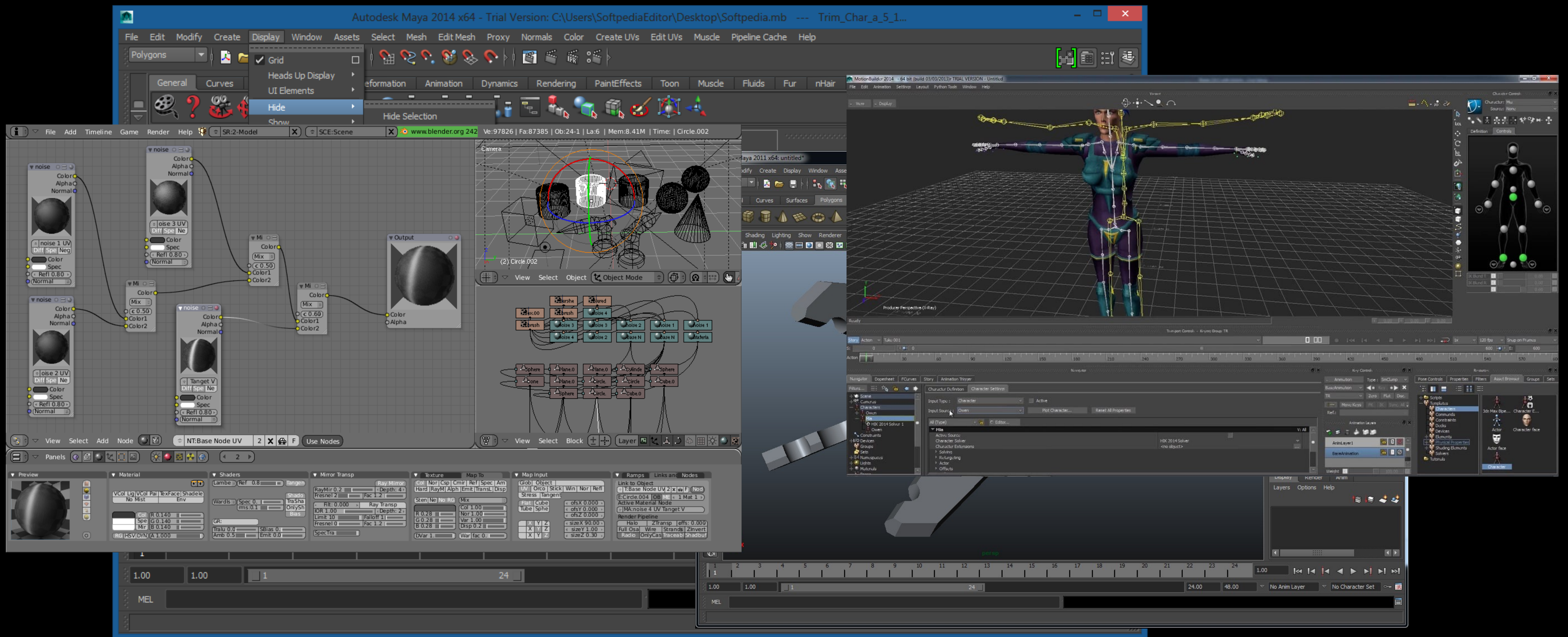
~~Goal: make a 3D game~~

Goal: Create a World ✓

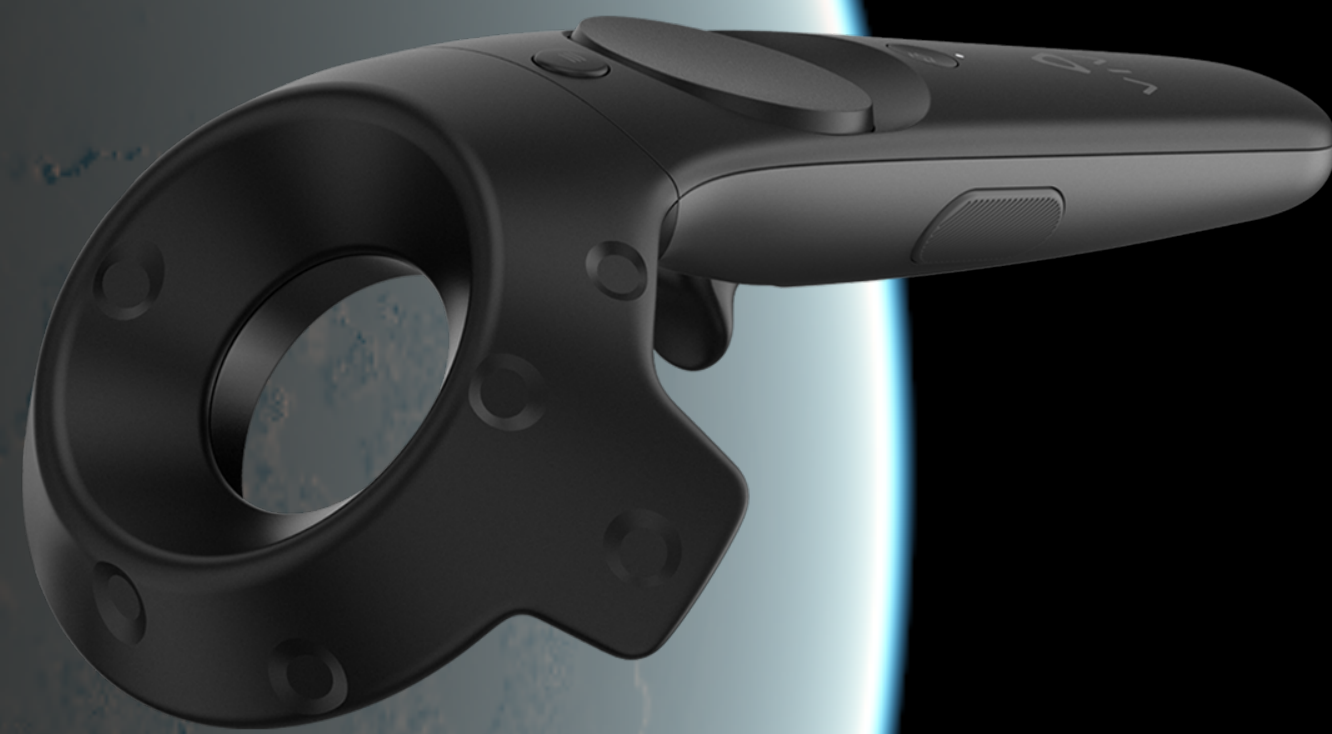
Goal: Create a dynamic world ✓

still with mouse and keyboard 🙄

Back to 2D Interface Design?



A short while later...



- VR with high quality tracked controllers
- Opportunity to re-imagine interfaces
- Volume Tech = robustness
- VR = intuitive
- Add them up = success!

Goal: make a 3D game

Goal: Create a World ✓

Goal: Create a dynamic world ✓

Goal: Create a 3D play space for VR



Goal: make a 3D game

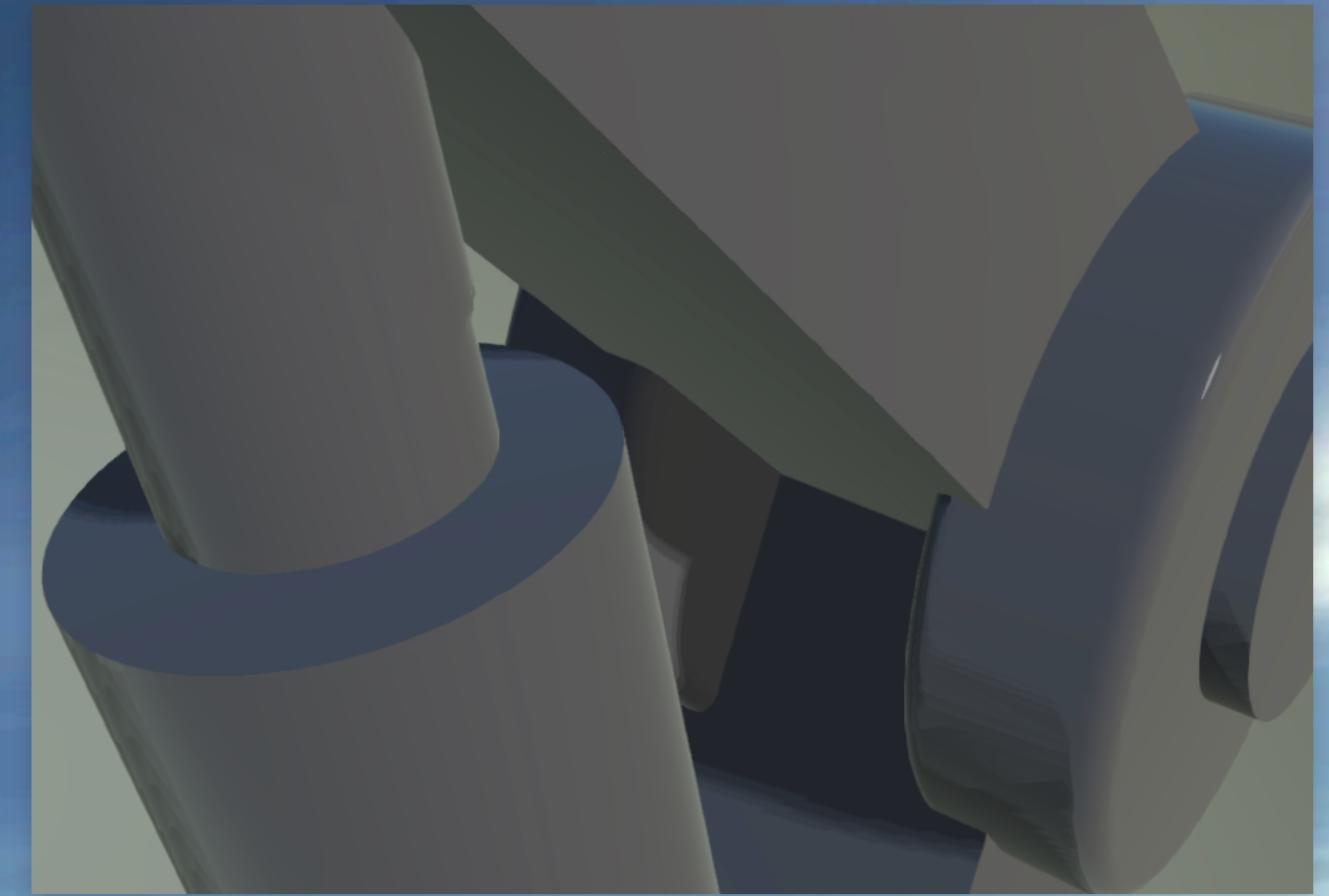
Goal: Create a World ✓

Goal: Create a dynamic world ✓

Goal: Create a 3D play space for VR ✓

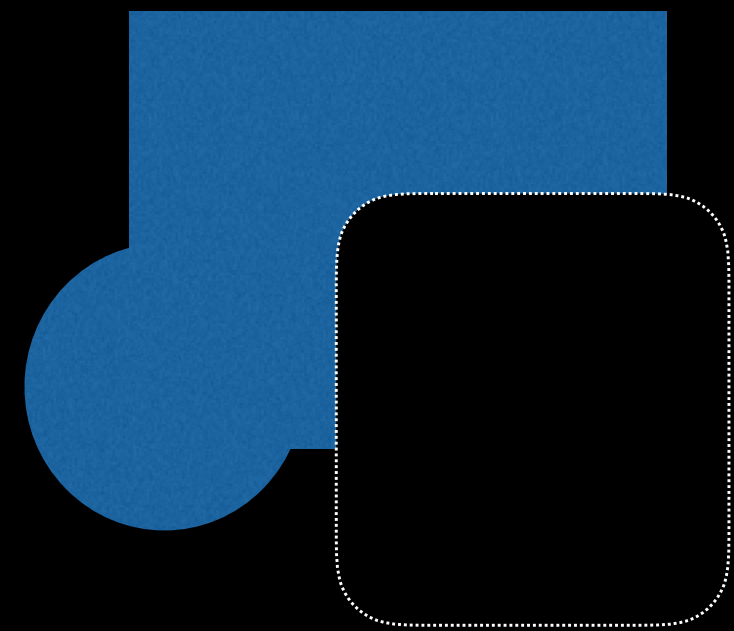
Goal: play += practical

Sharp Edges

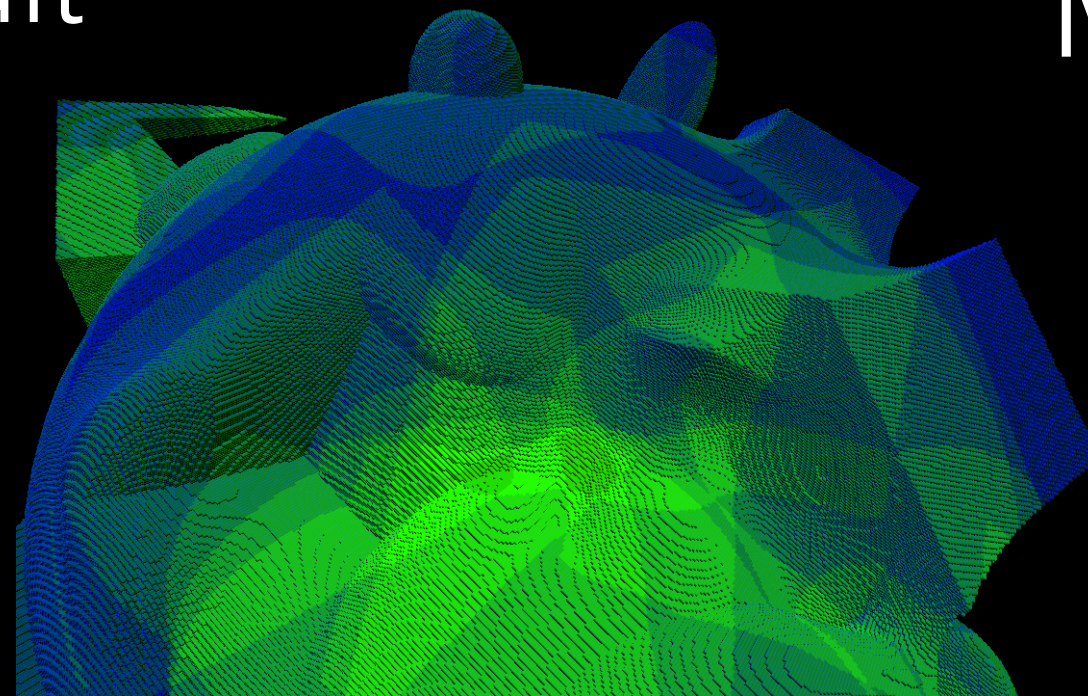
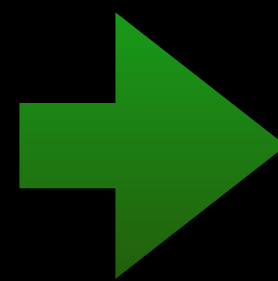


How it works

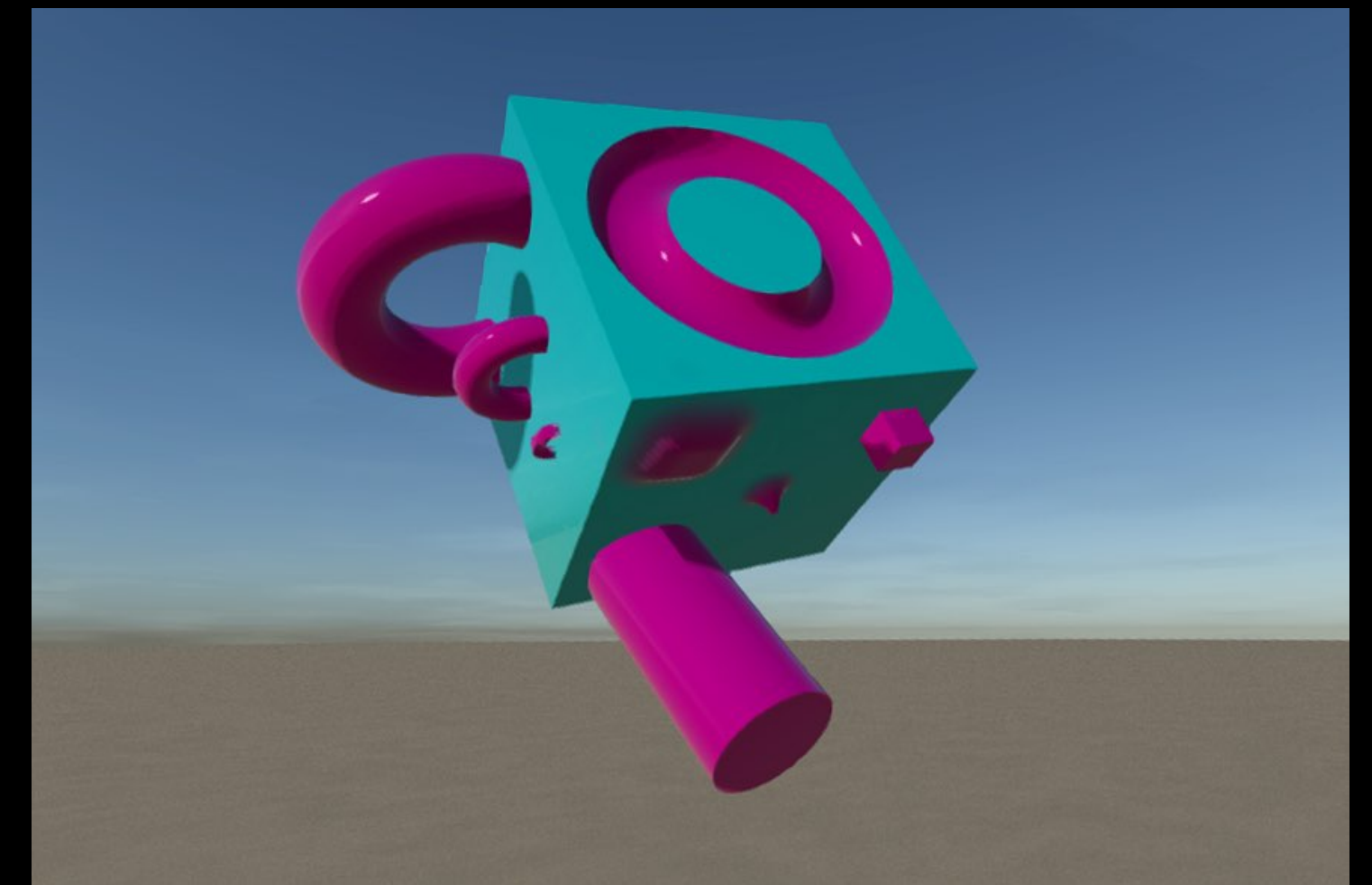
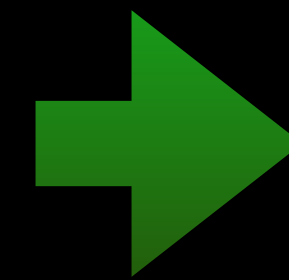
Compared to planet tech: store and evaluate functions directly



Cull on edit



Meshing



List op boolean ops,
additive, subtractive,
hard and smoothly
blended

Deferred with Physically
Based Shading

Goal: make a 3D game

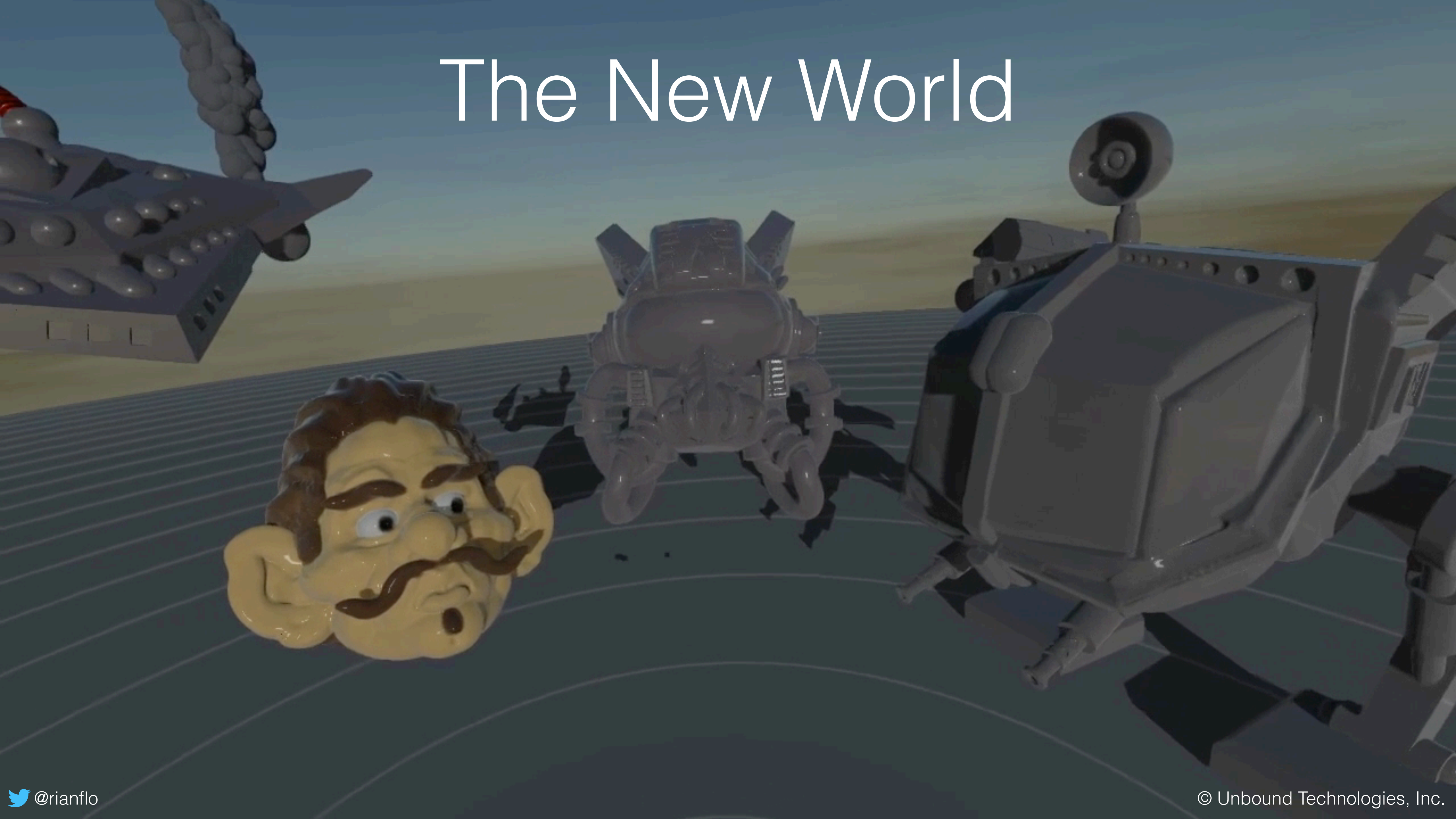
Goal: Create a World ✓

Goal: Create a dynamic world ✓

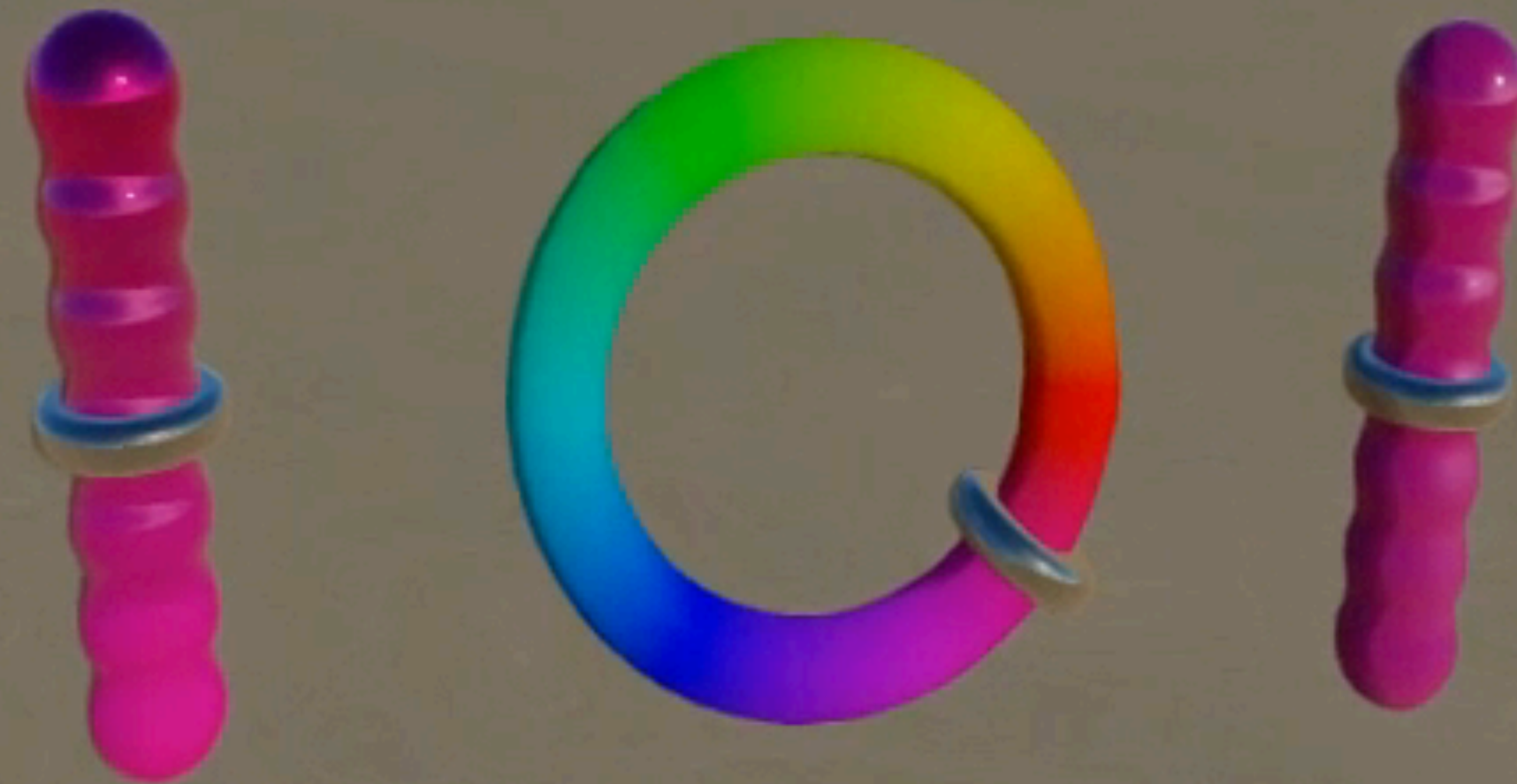
Goal: Create a 3D play space for VR ✓

Goal: play += practical ✓

The New World

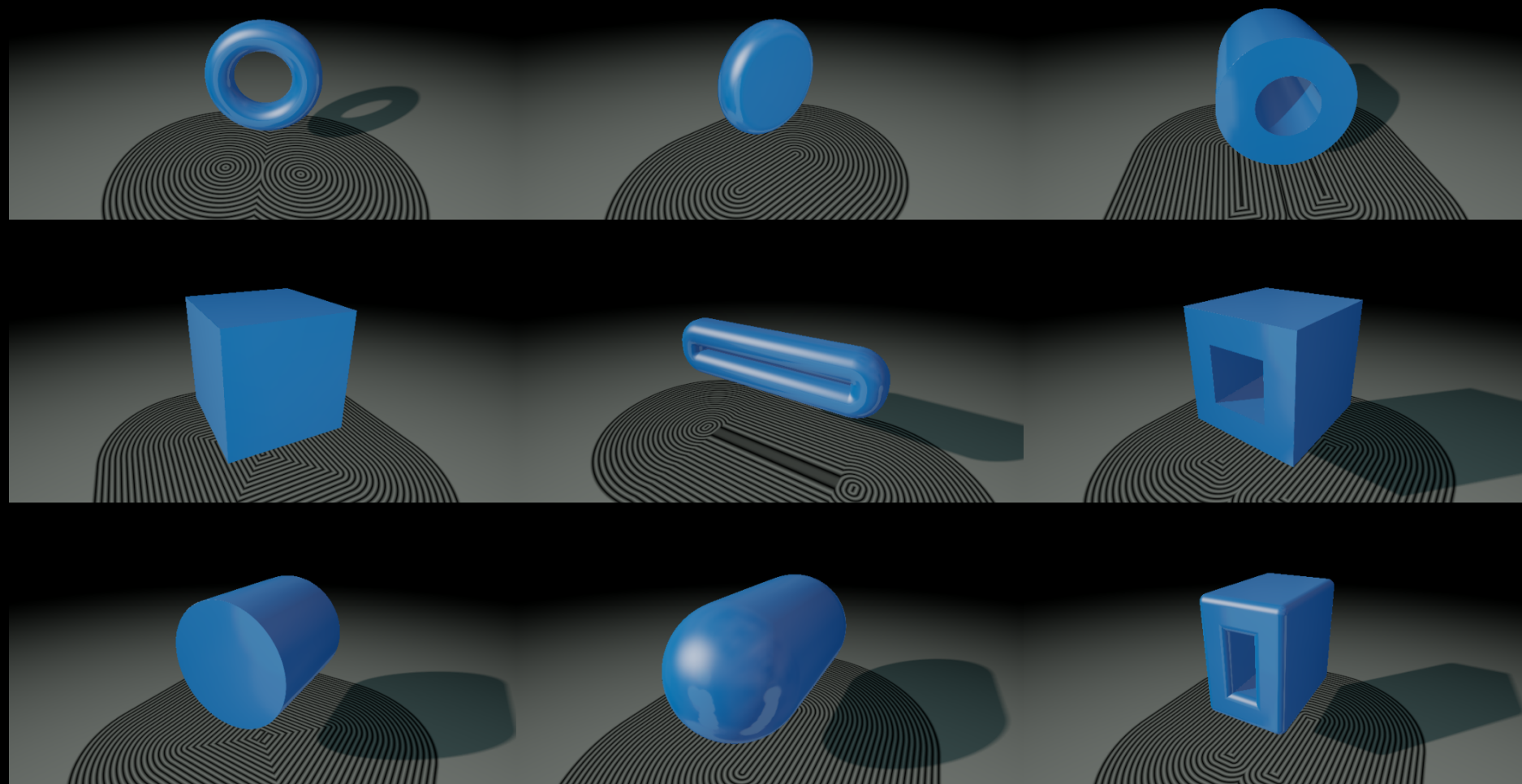


Created from within



A Single Primitive

```
float sdSuperprim(vec3 p, vec4 s, vec2 r)
{
    vec3 d = abs(p) - s.xyz;
    float q = abs(length(max(d.xy + r.x, 0.0))
        + min(-r.x, max(d.x, d.y)) + s.w) - s.w;
    return length(max(vec2(q, d.z) + r.y, 0.0))
        + min(-r.y, max(q, d.z));
}
```



Can be reconfigured: Box, Sphere, Torus, etc.

GPU friendly: No divergent code when evaluating.

Very Compact: The stored representation for the mech model below is about 50KB. The complete model fits in the L1 cache of a GPU.

Credit and huge thank you to:
Leonard Ritter (@paniq)

What else?

As a product:

- Initially a modeling experience for SteamVR and HTC Vive, but:
- Not long-term focused on modeling only. Also not limited to game development
- Collaboration: Invite a friend to the space and collaborate in real-time over the Internet
- We are exploring many use cases: Architectural walk-throughs, 3D printing design, a story board for animated movies, ...

Please also check out: Oculus Medium and Media Molecule's Dreams

Goal: make a 3D game

Goal: Create a World ✓

Goal: Create a dynamic world ✓

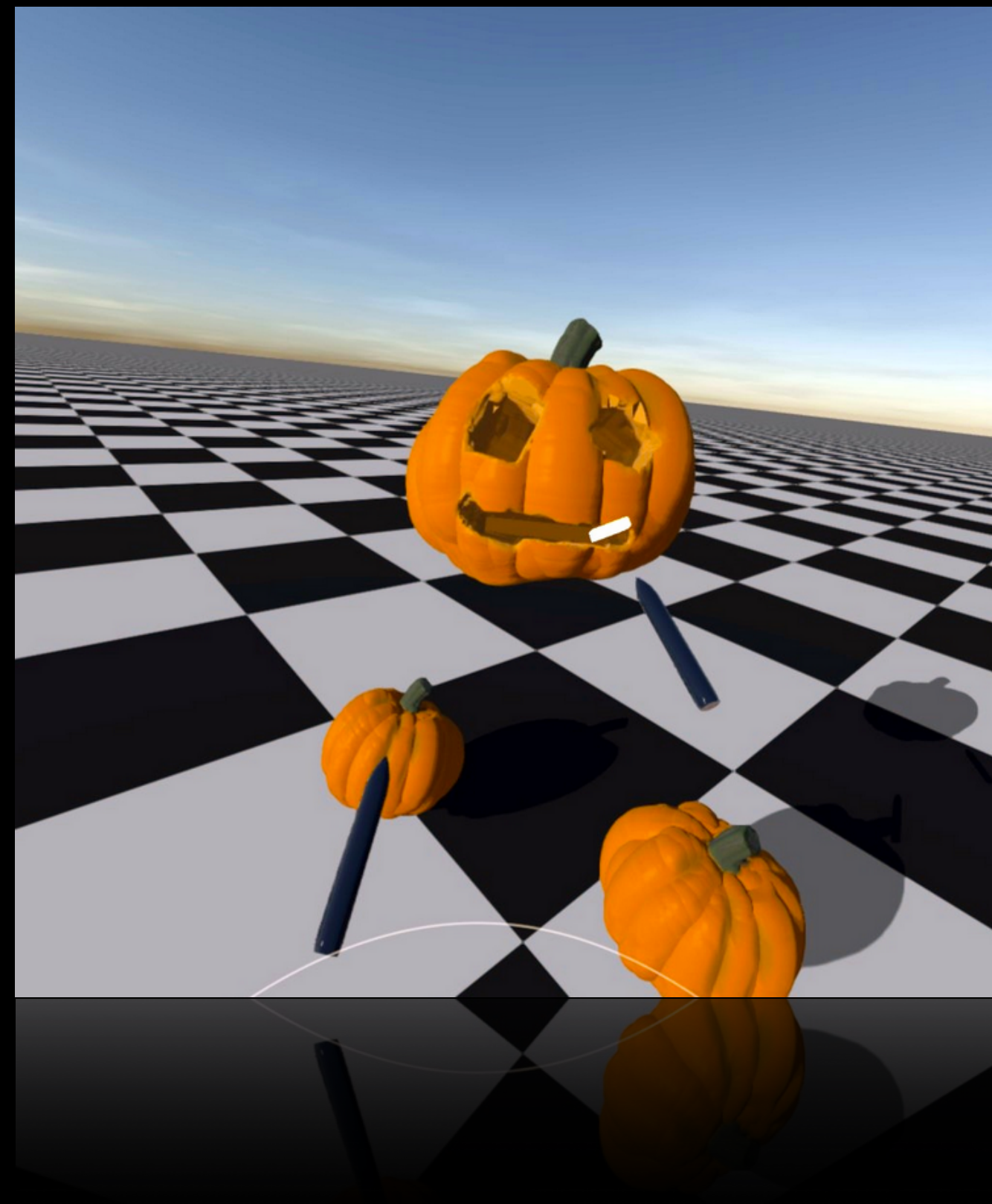
Goal: Create a 3D play space for VR ✓

Goal: play += practical ✓

Goal: For Everyone

A Road to 3D for Everyone

- Volume tech + VR controllers is indeed a great success
- Already possible on GPUs today.
- Will increase in expressiveness.
- Enabling new opportunities for many areas and applications.



Goal: make a 3D game

Goal: Create a World ✓

Goal: Create a dynamic world ✓

Goal: Create a 3D play space for VR ✓

Goal: play += practical ✓

Goal: For Everyone ✓

Not Quite



~~**Goal:** make a 3D game~~

Goal: Create a World ✓

Goal: Create a dynamic world ✓

Goal: Create a 3D play space for VR ✓

Goal: play += practical ✓

Goal: For Everyone ✗

Goal: Computational Aesthetics

Thank you!

Get in touch

fhoenig@unbound.io

<http://unbound.io>



@unbound_io



**AVAILABLE
THIS MAY**
Early Access