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LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

Let's Get Moving: Adding Physics to glTF

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Agenda

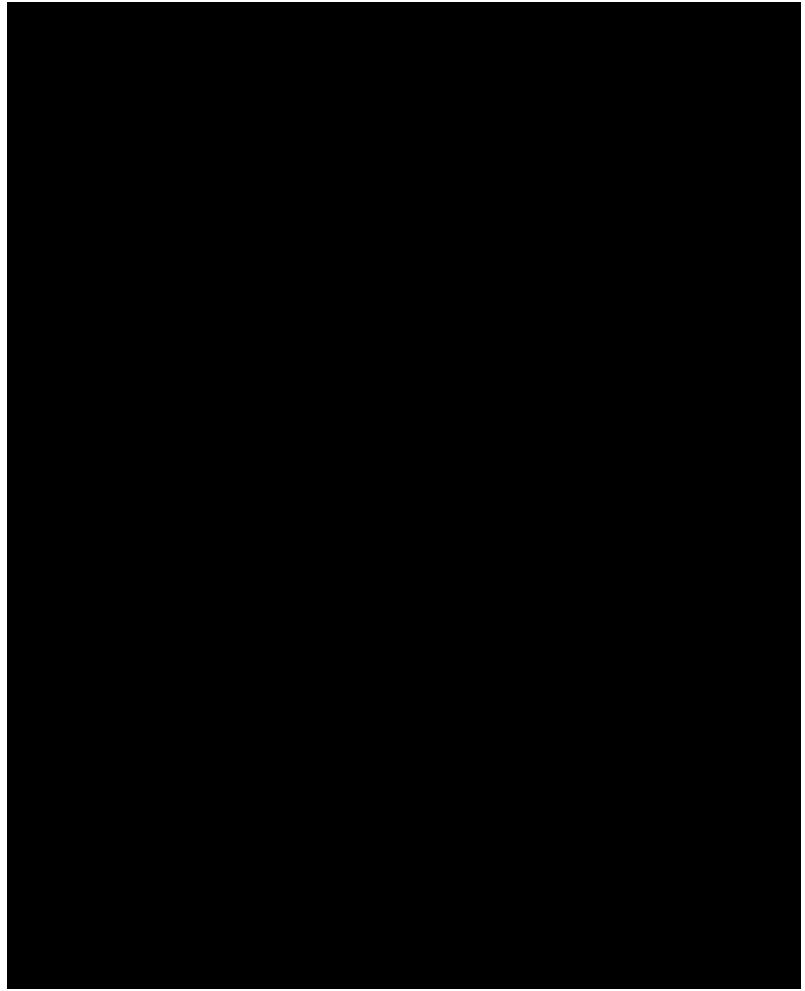
- **Why physics in glTF?**
- **What physics in glTF?**
- **How**
  - Collision geometry
  - Motions
  - Materials
  - Joints
  - Filters
- **When?**

glTF principles

- Innovate on pervasive deployment of proven technology
- Precise specification and open-source tooling for multi-vendor consistency
- Enable cloud, desktop and mobile (native and web)
- Pure file format – no mandated run-time behavior
- Optimize for run-time use cases
- Be a cooperative distillation target for authoring formats

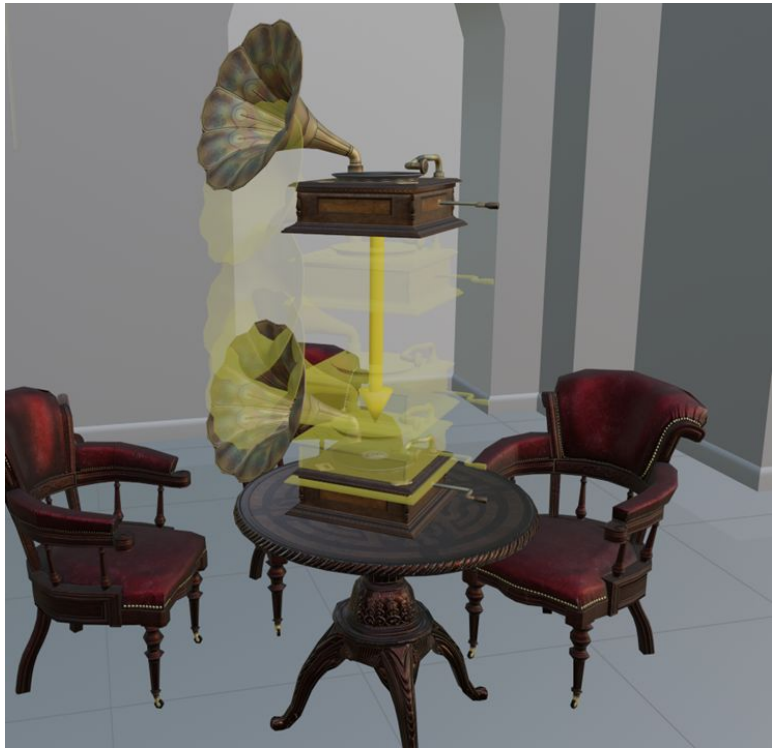
Why Use Physics?

- Provides procedural animation
- Makes scenes more interesting, believable, and dynamic



Why Use Physics?

- **Enables scene understanding**
  - Possible with render geometry, but much more efficient with physics



What Physics?

- **Currently focused on rigid bodies**
  - Broad agreement on concepts used by simulators today
  - Only using shared concepts
- **Would like to tackle deformables**
  - Harder! Much less alignment between implementations.

Collision Shapes

- **glTF contains only triangles**
- **Simulators prefer convex shapes**
  - Explicit interior and exterior
  - One convex shape approximates many triangles

Collision Shapes

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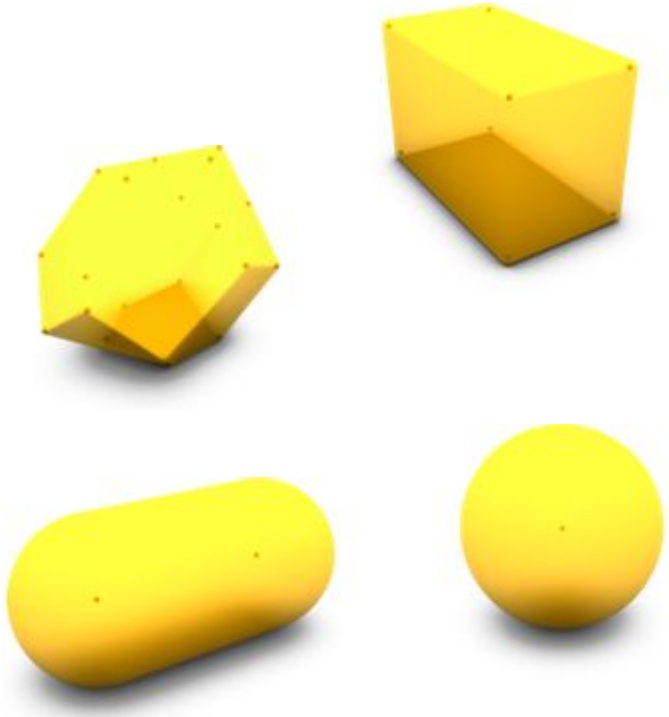
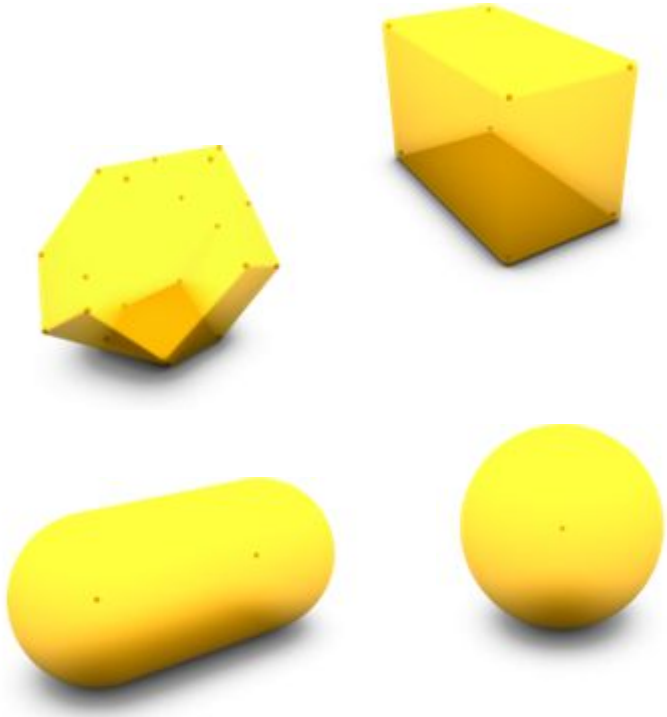
Collision Shapes

- Sphere
- Capsule (tapered/non-tapered)
- Cylinder/Cone
- Box
- Convex hull
- Triangle mesh



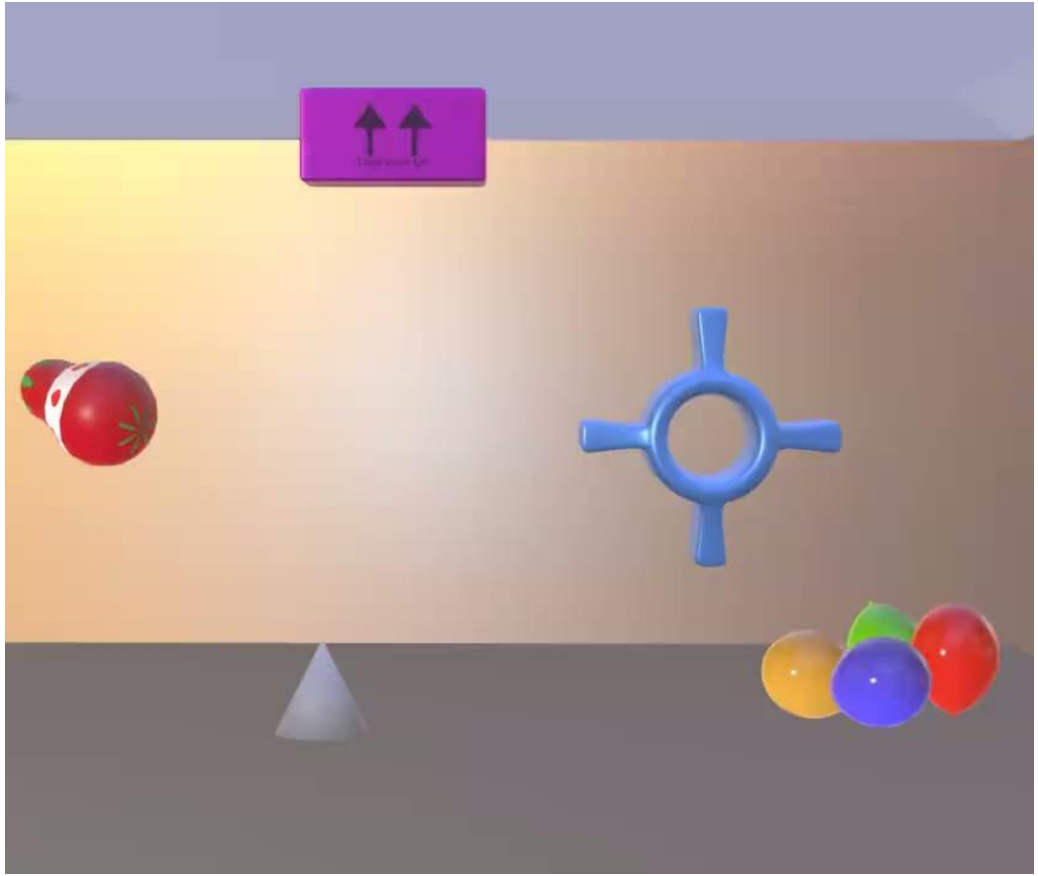
Collision Shapes

```
"colliders": [
        {
            "type": "convex",
            "convex": { "mesh": 4 }
        },
        {
            "type": "box",
            "box": { "size": [1, 1, 1.5] }
        },
        {
              "type": "sphere",
             "sphere": { "radius": 0.25 }
        },
        {
             "type": "capsule",
           "capsule": {
                 "radiusTop": 0.25,
                    "radiusBottom": 0.31,
                 "height": 0.5
             }
```



Motions

- **Properties necessary for movement of bodies**
  - Mass
  - Inertia Tensor
  - Center of mass
  - Initial velocity
- **Gravity factor**
  - Not realistic, but useful

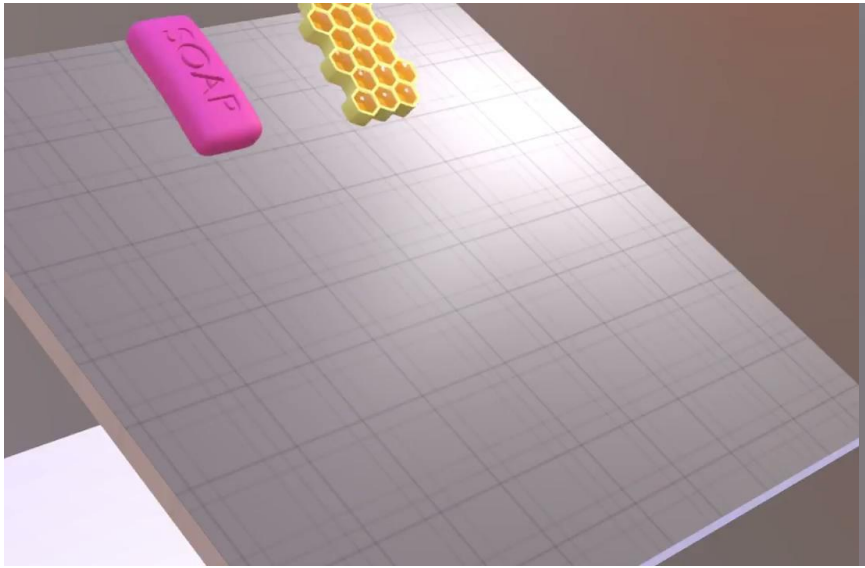


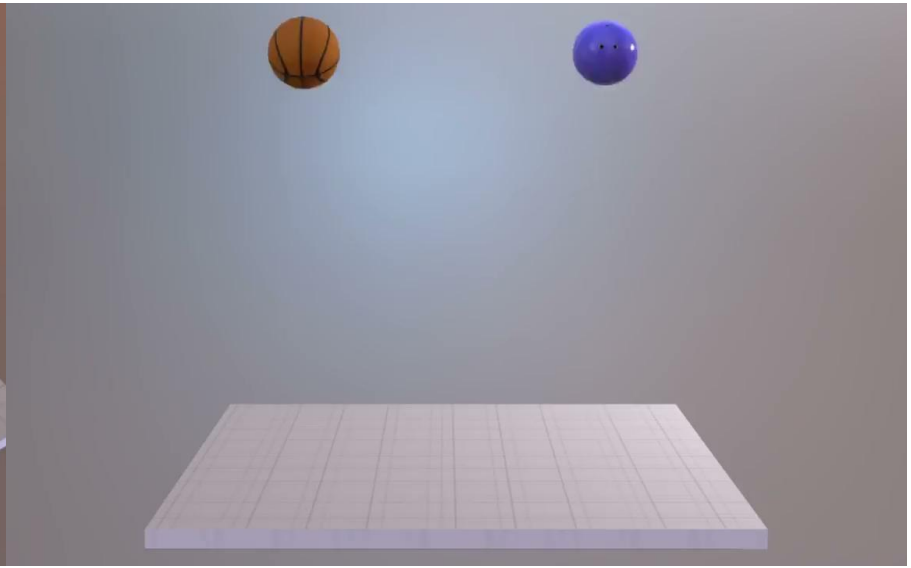
Motions

```
{
    "name": "A Node With a Rigid Body"
    “mesh”: 2,
    "extensions": {
        "MSFT_rigid_bodies": {
            "motion":  {
                “mass” : 0.125,
                “centerOfMass”: [0, 0.15, 0],
                “linearVelocity”: [5, 0, 0]
            },
            “collider”: {
                “collider”: 5,
                “material”: 7
            }
        }
    }
}
```

Physics Materials

- Different materials need different collision response
- Simple friction and restitution model





Joints

- **Connect bodies together**
- **Generic 1D/2D/3D limits**
  - Compose to build hinges, prismatic, etc.

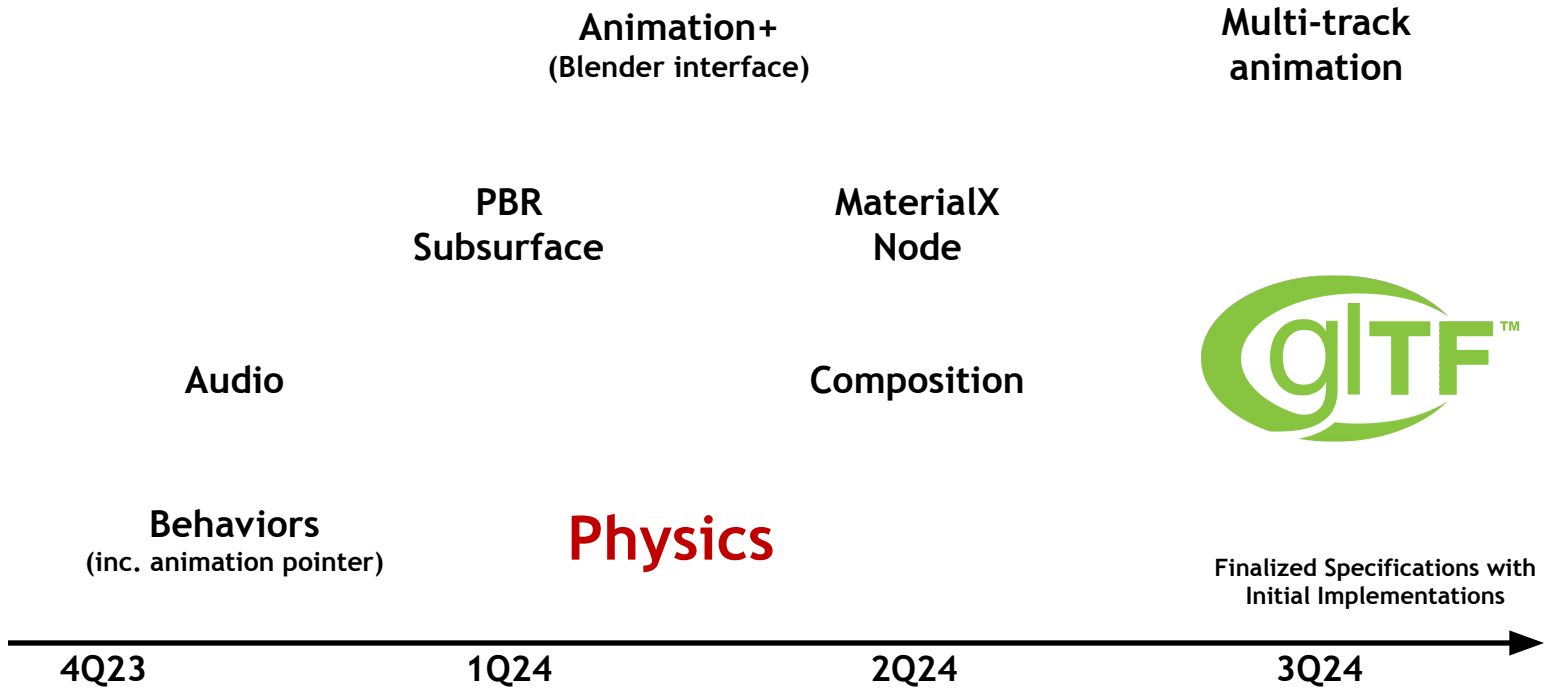
Joints

```
{
   "limits": [
      {
         "linearAxes": [ 0, 1, 2 ],
         "min": 0,
         "max": 0.1
      },
      {
         "angularAxes": [ 0 ],
         "min":-1.1,
         "max":1.1
      },
      {
         "angularAxes": [ 2 ],
         "min":0,
         "max":0
      },
   ]
},
```

Filtering

- Not physically realistic, but useful!
- Required for constrained systems
- Application-specific use-cases
- Optimization

Short Term glTF Roadmap



Get Involved!

- **Current extension, discussion, and samples**
  - https://github.com/eoineoineoin/glTF_Physics
  - Public discussion for previous 10 months
- **Any organization is welcome to join Khronos to influence the glTF Roadmap**
  - https://www.khronos.org/members/ or email memberservices@khronosgroup.org
- **More information on any Khronos APIs**
  - https://www.khronos.org/

Thanks to Eoin Mcloughlin for this amazing presentation!

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