Visualization of Jet Impingement and Ignition in a Piston-Cylinder Chamber

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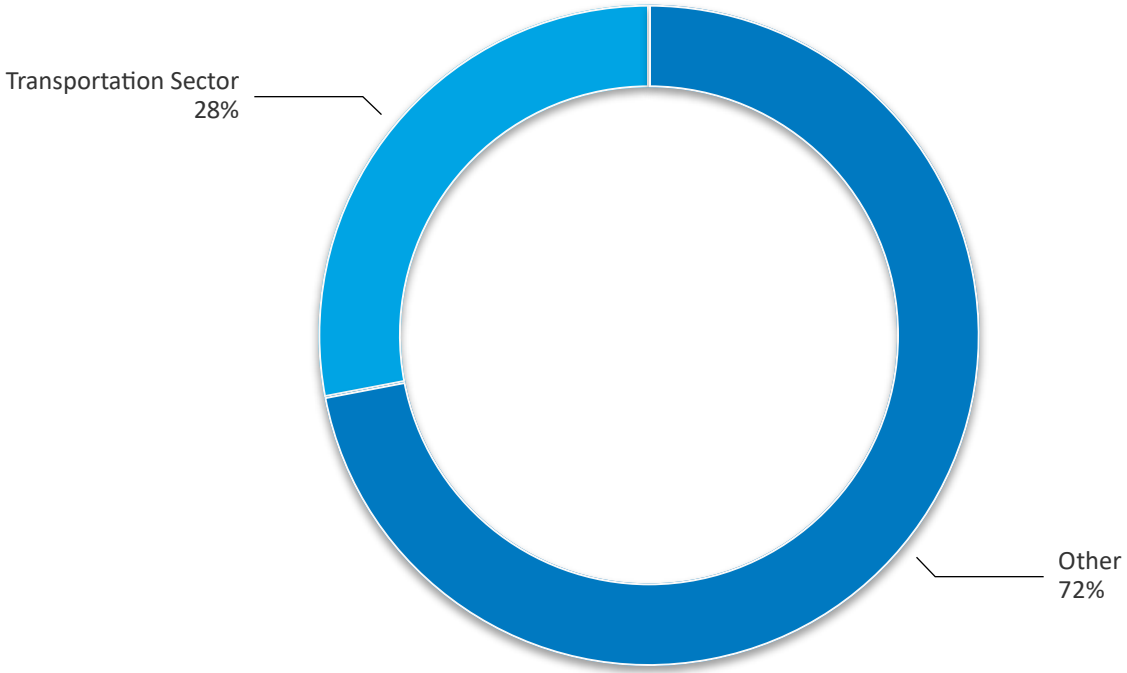
- Shashank Yellapantula
- Kenny Gruchalla
- Ray Grout

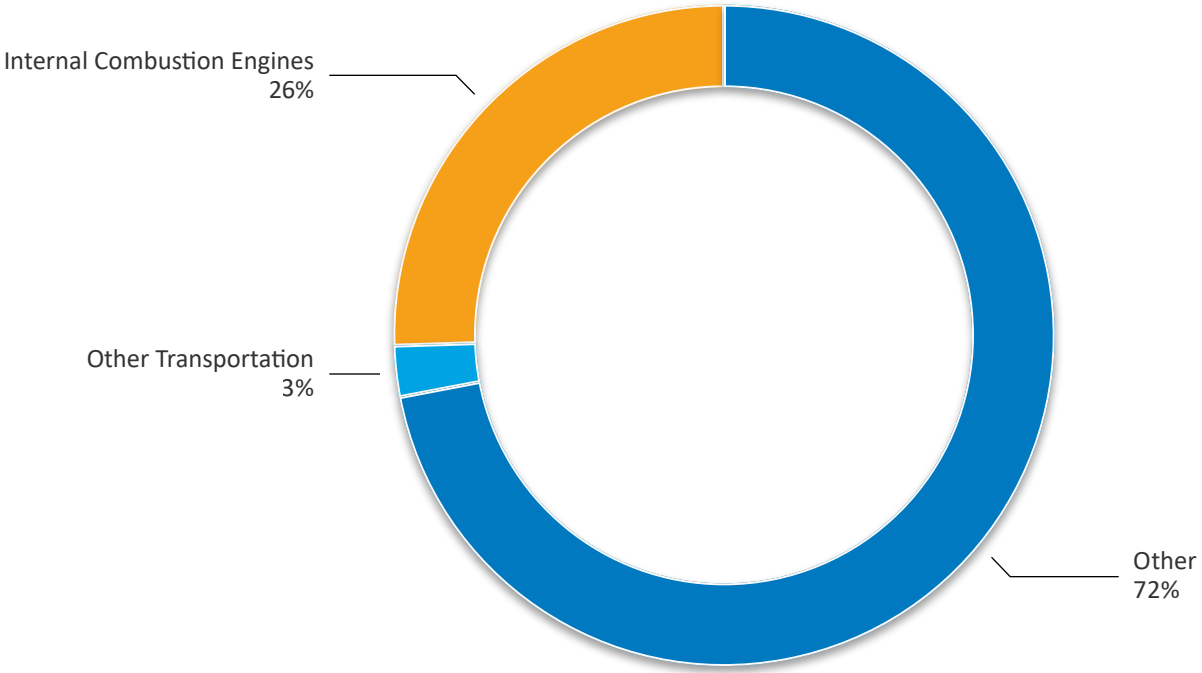
e-Energy ‘21

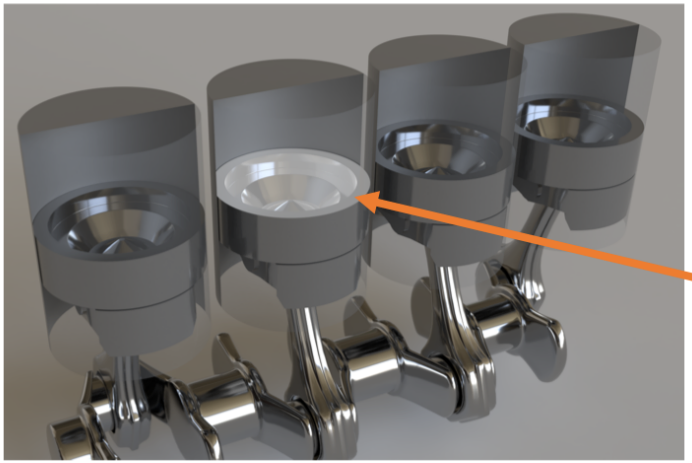
NREL/PR-2C00-80390

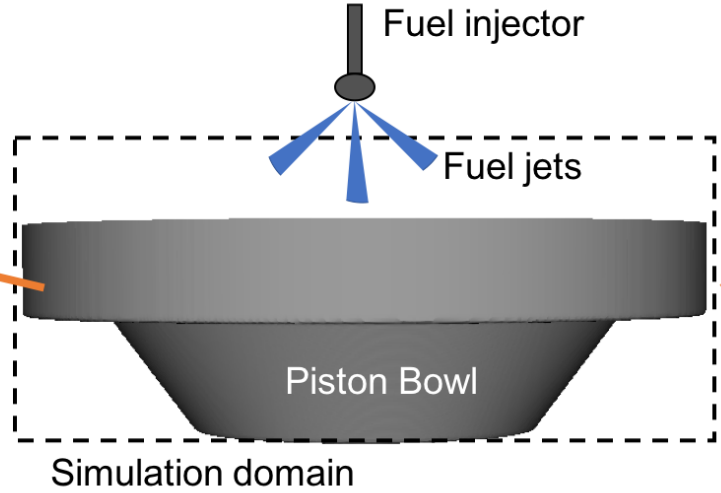
US Energy Use
2019

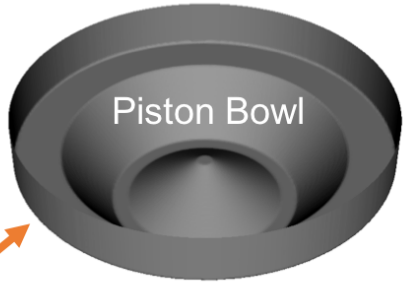


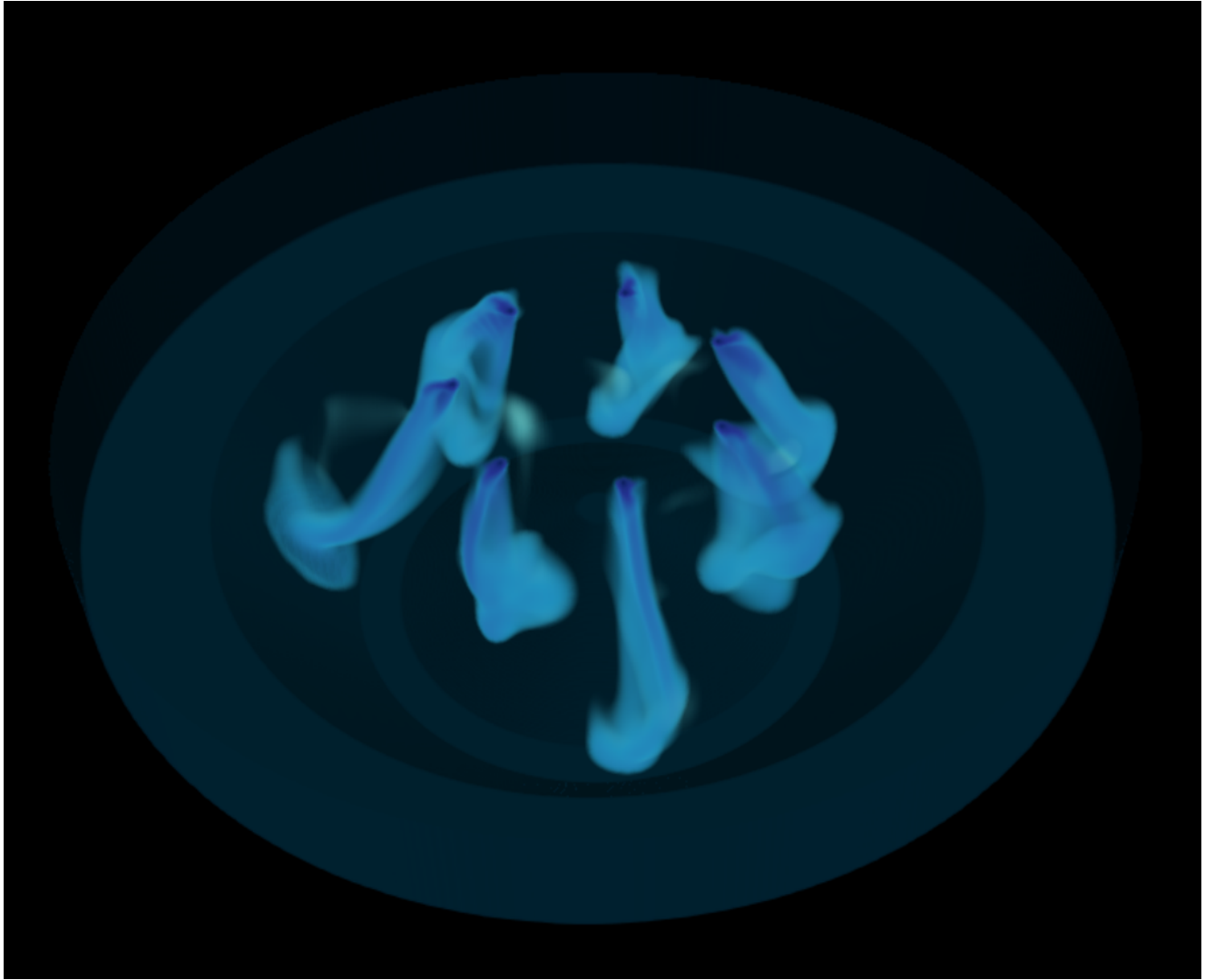
US Energy Use
2019

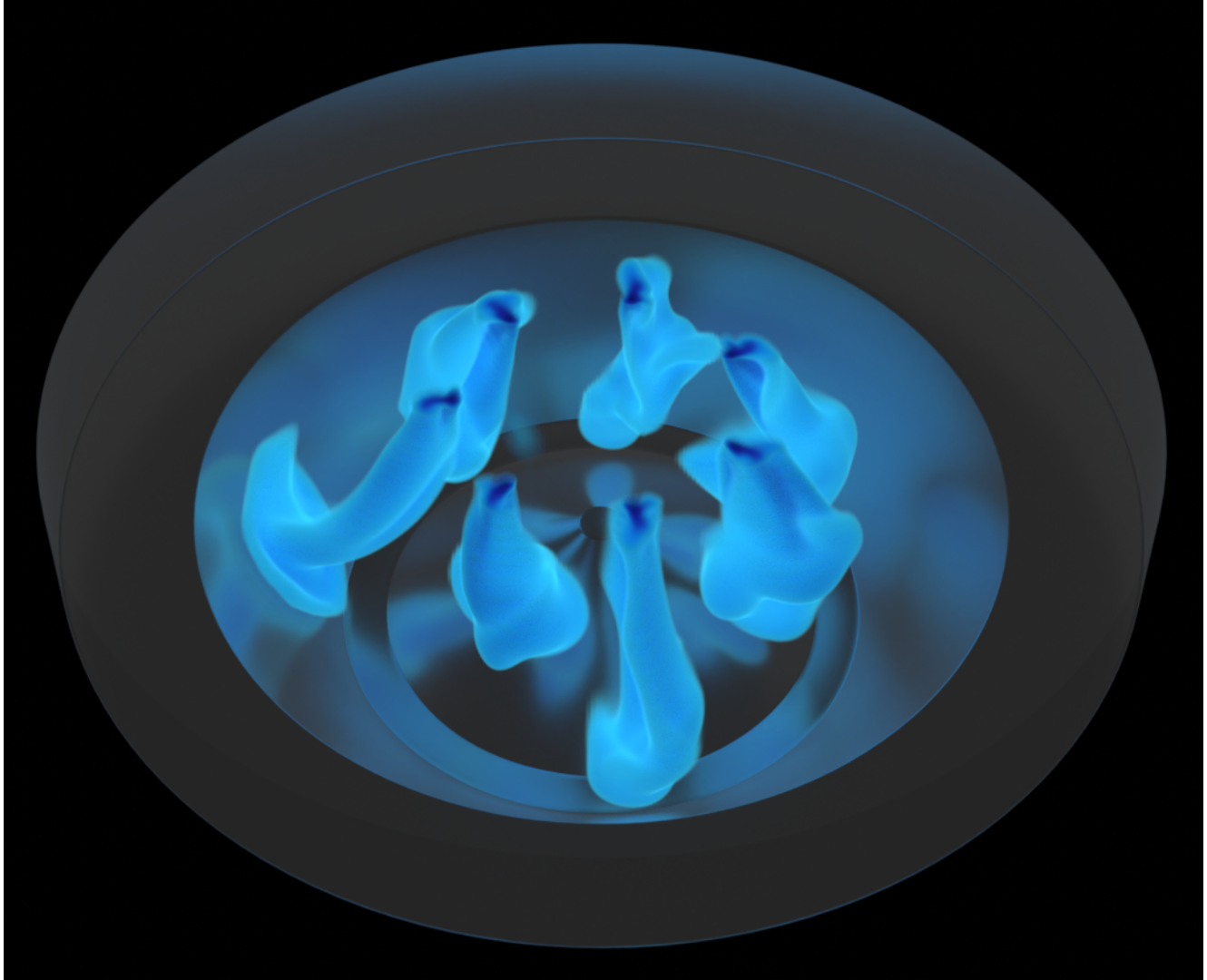


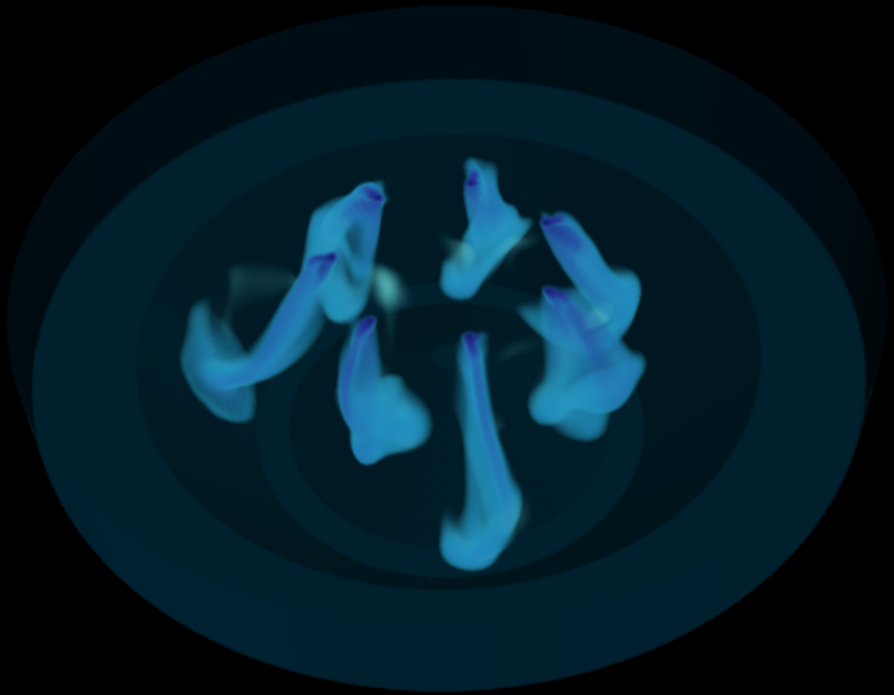


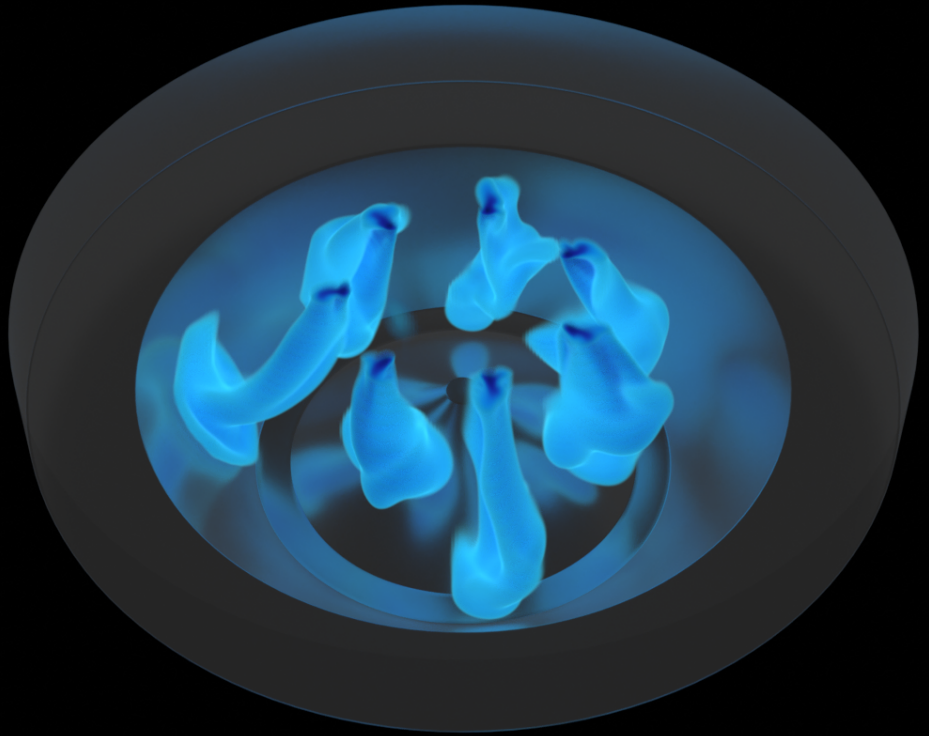

Fuel injector
Fuel jets
Piston Bowl
Simulation domain

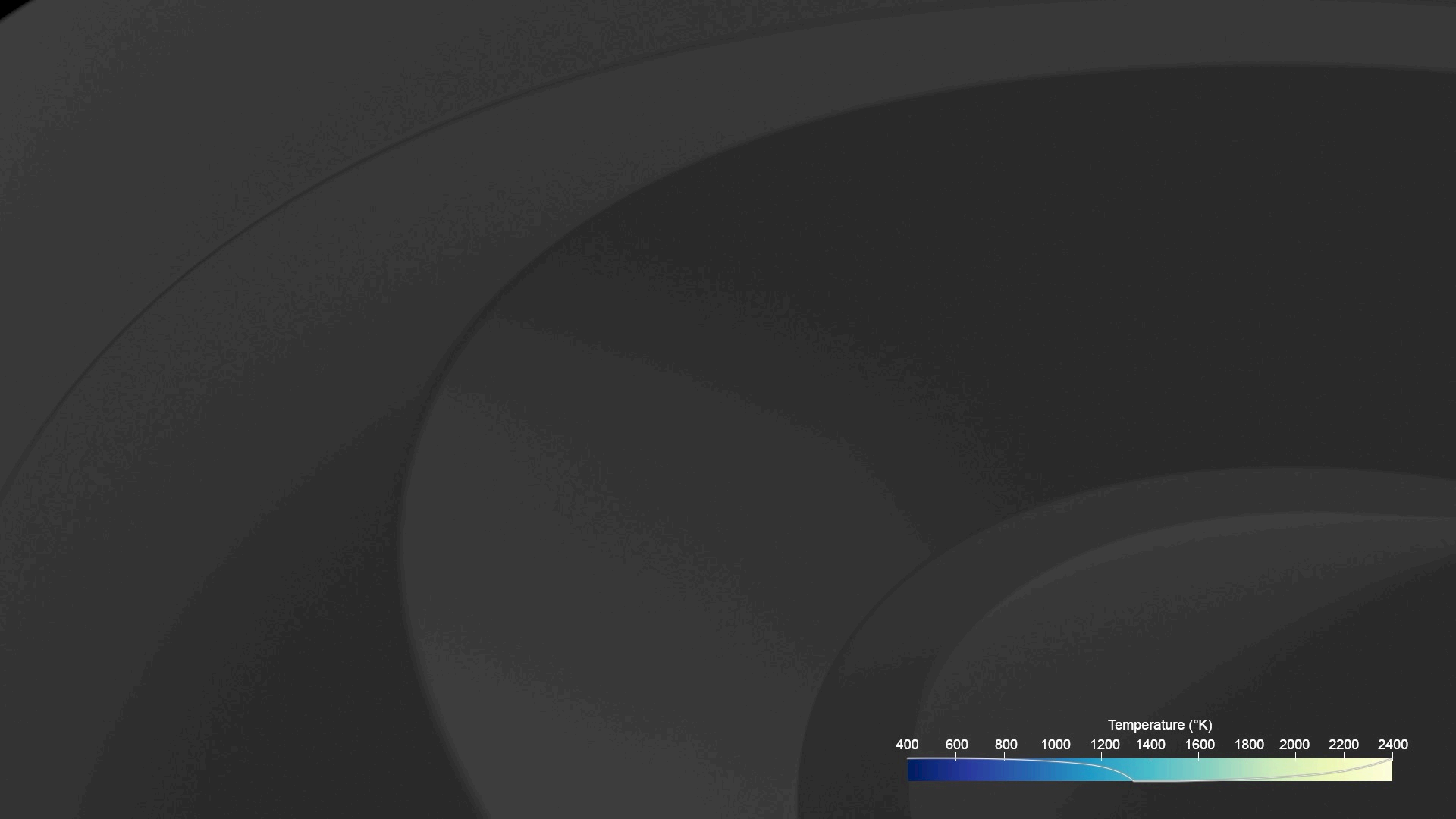

Piston Bowl







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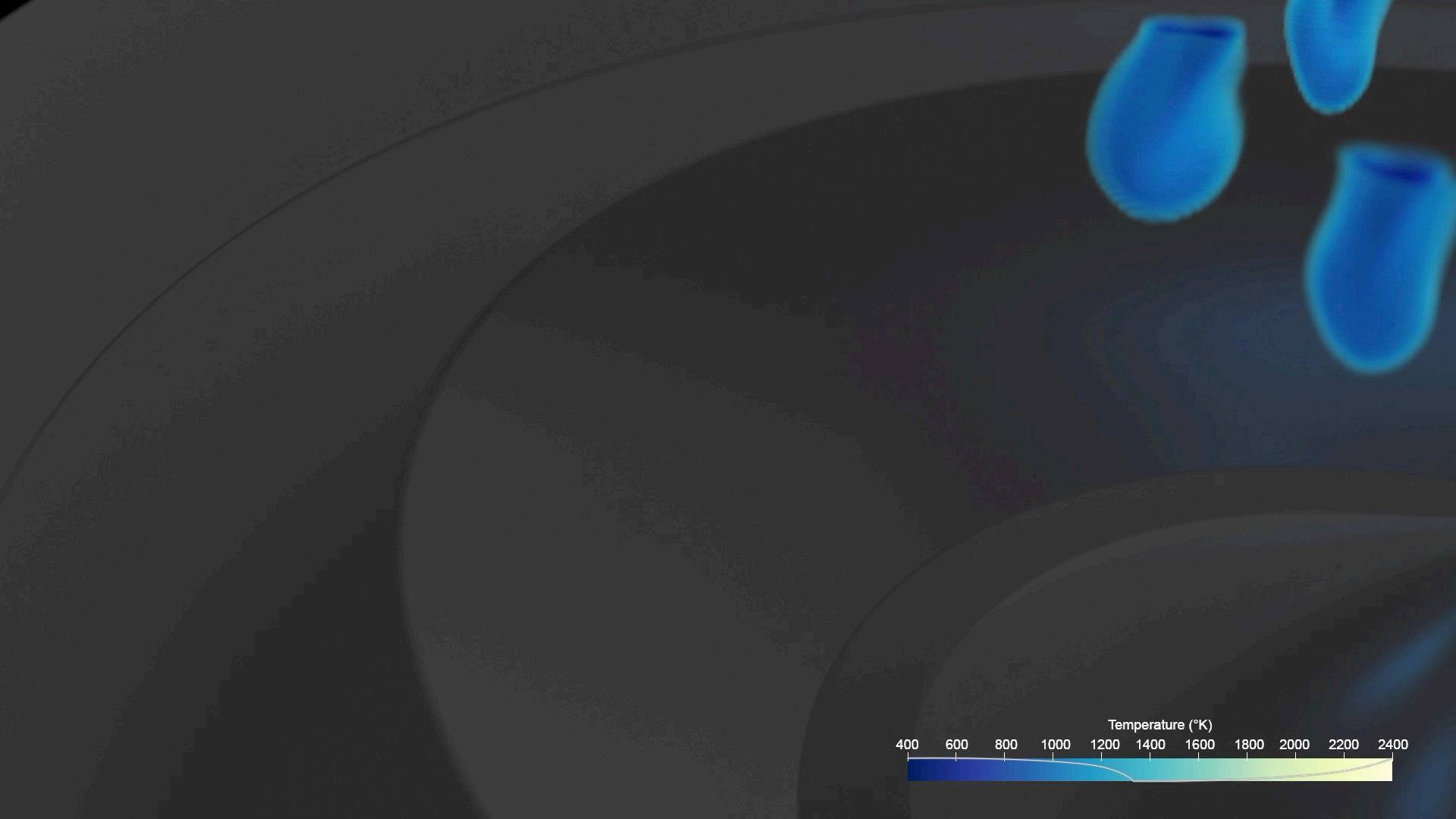
1000
1200
1400
1600
1800
2000
2200
2400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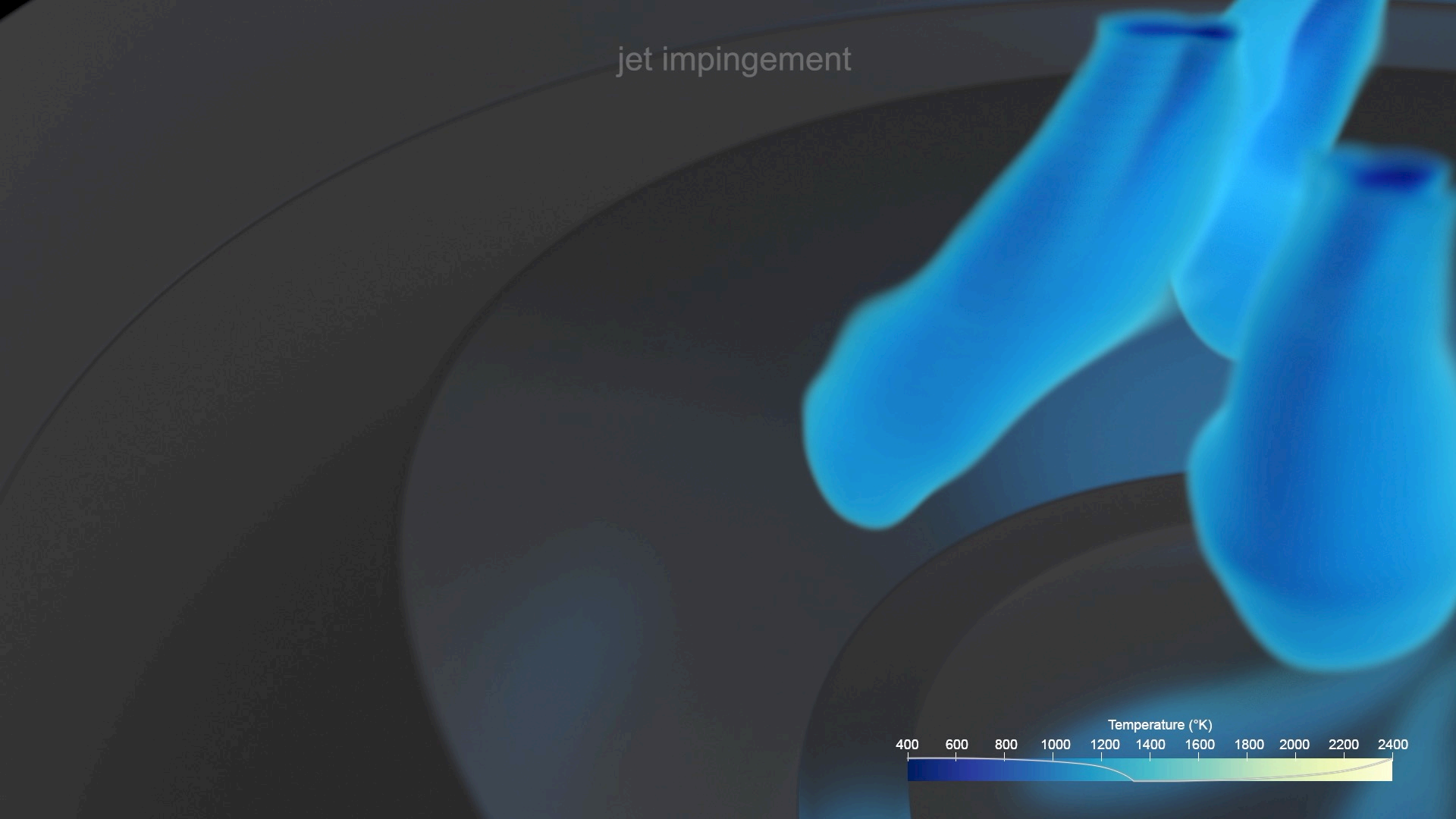
jet impingement
Temperature (°K)
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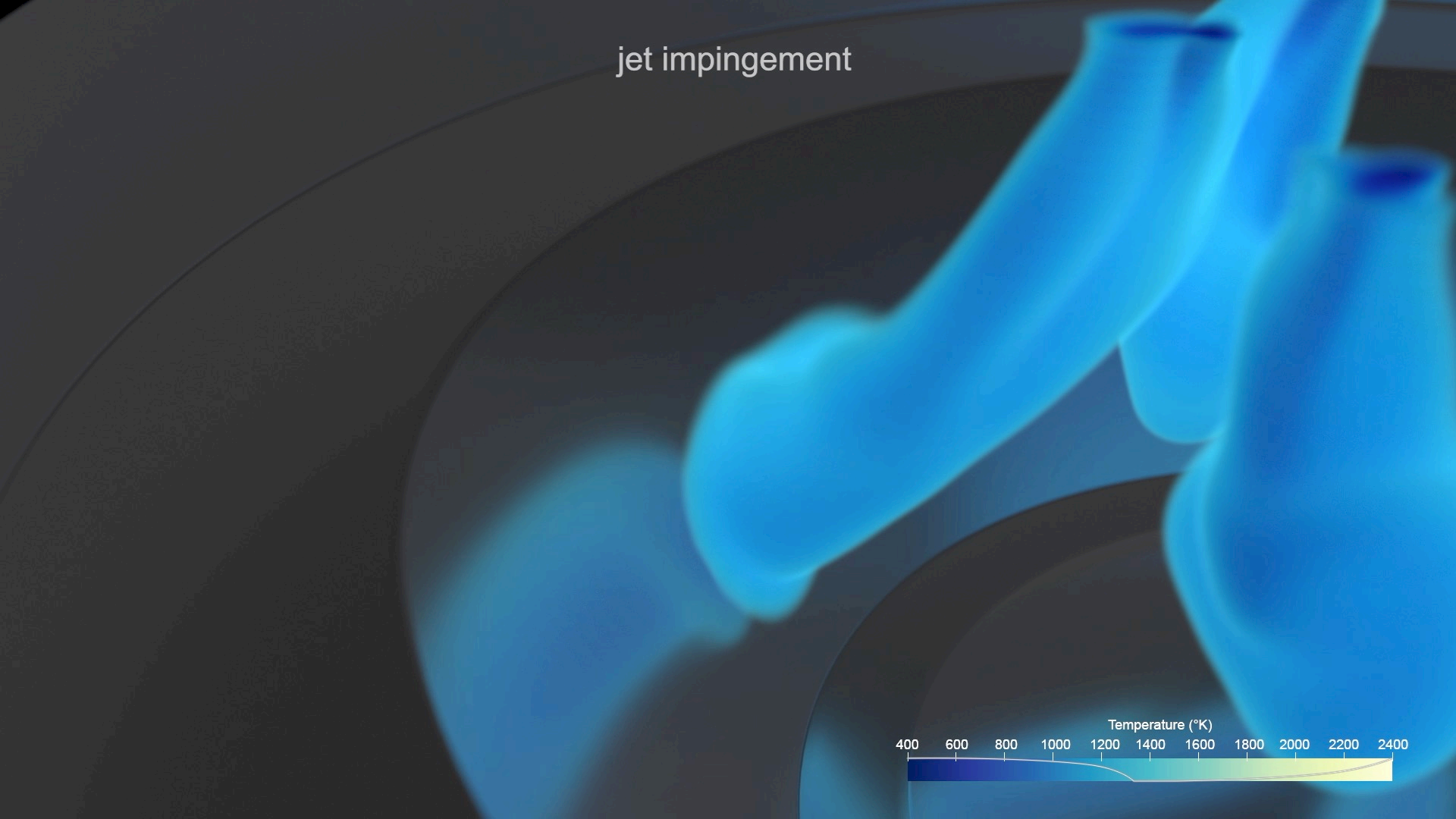
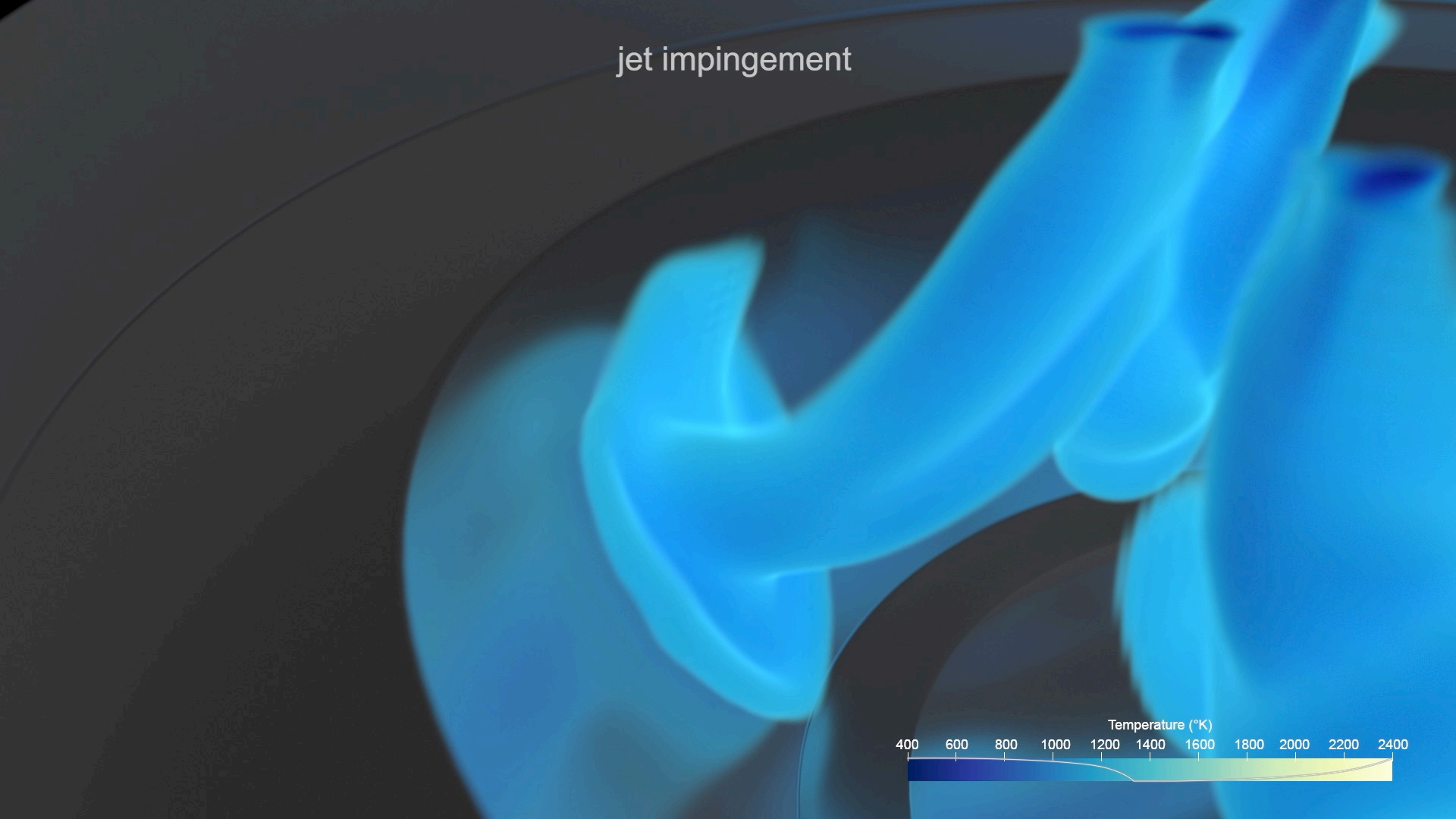
jet impingement




jet impingement
Temperature (°K)
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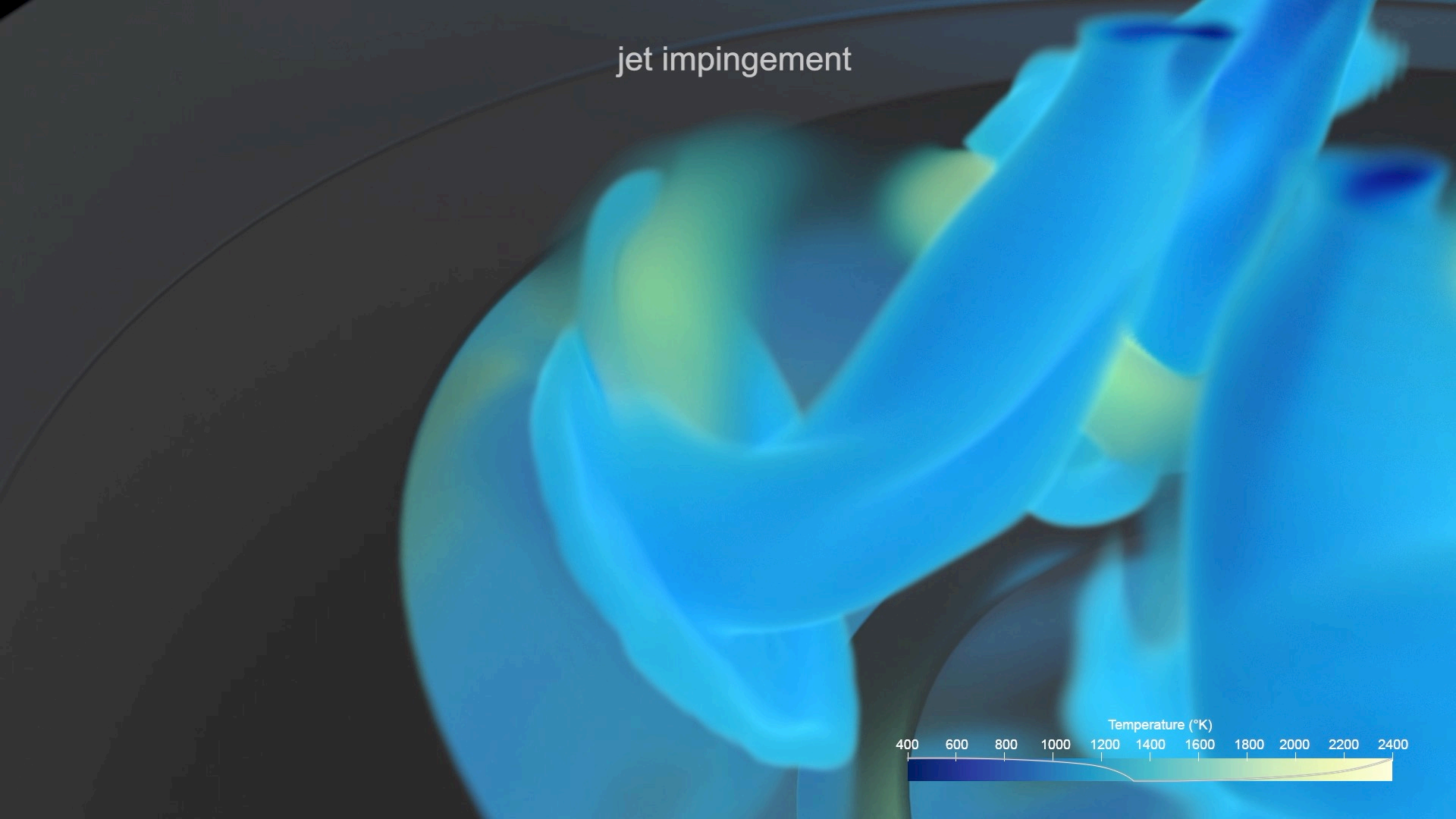

jet impingement
Temperature (°K)
400 600 800 1000 1200 1400 1600 1800 2000 2200 2400

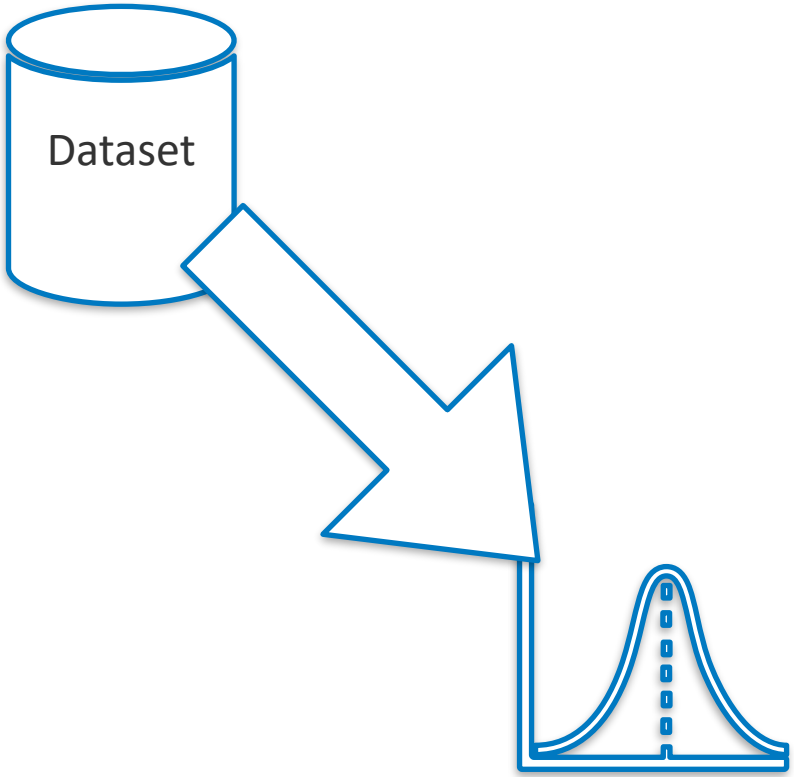
Cinema Rendering

- Reflections provide better sense of jet + geometry relations
- Physically modeled volume rendering provides:
  - More controls/more dimensions for transfer functions
  - More ways for researchers to tease out components within features

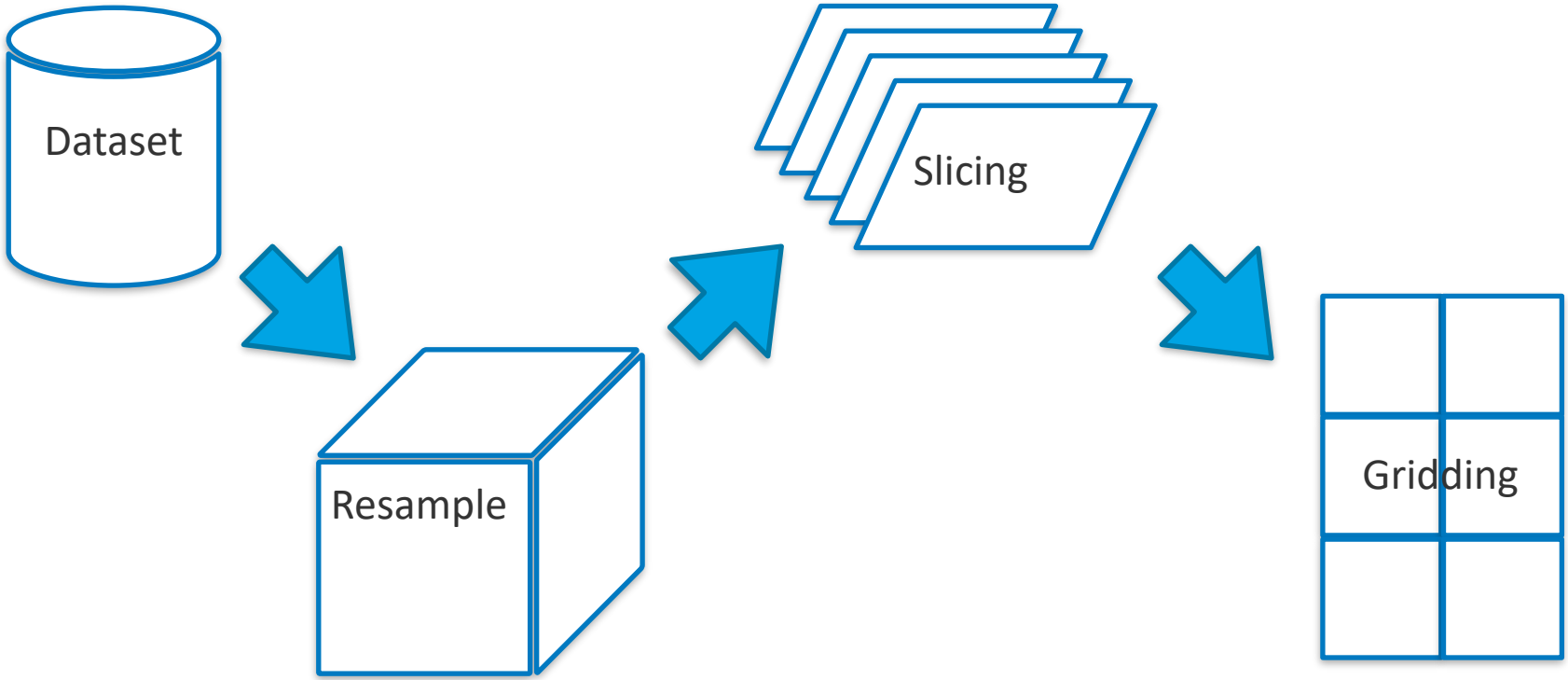
Drawbacks

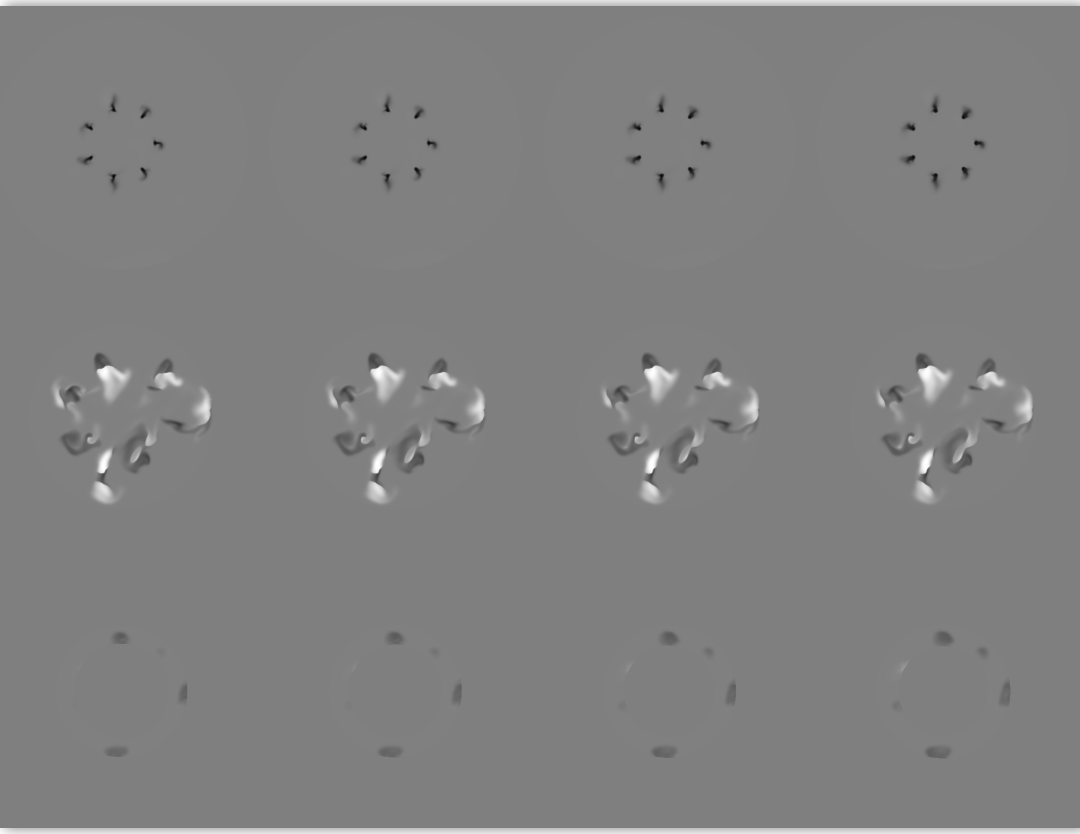
- Cinema rendering rare in scientific packages
  - More computationally expensive
  - Hard to scale
  - Data needs to be translated!

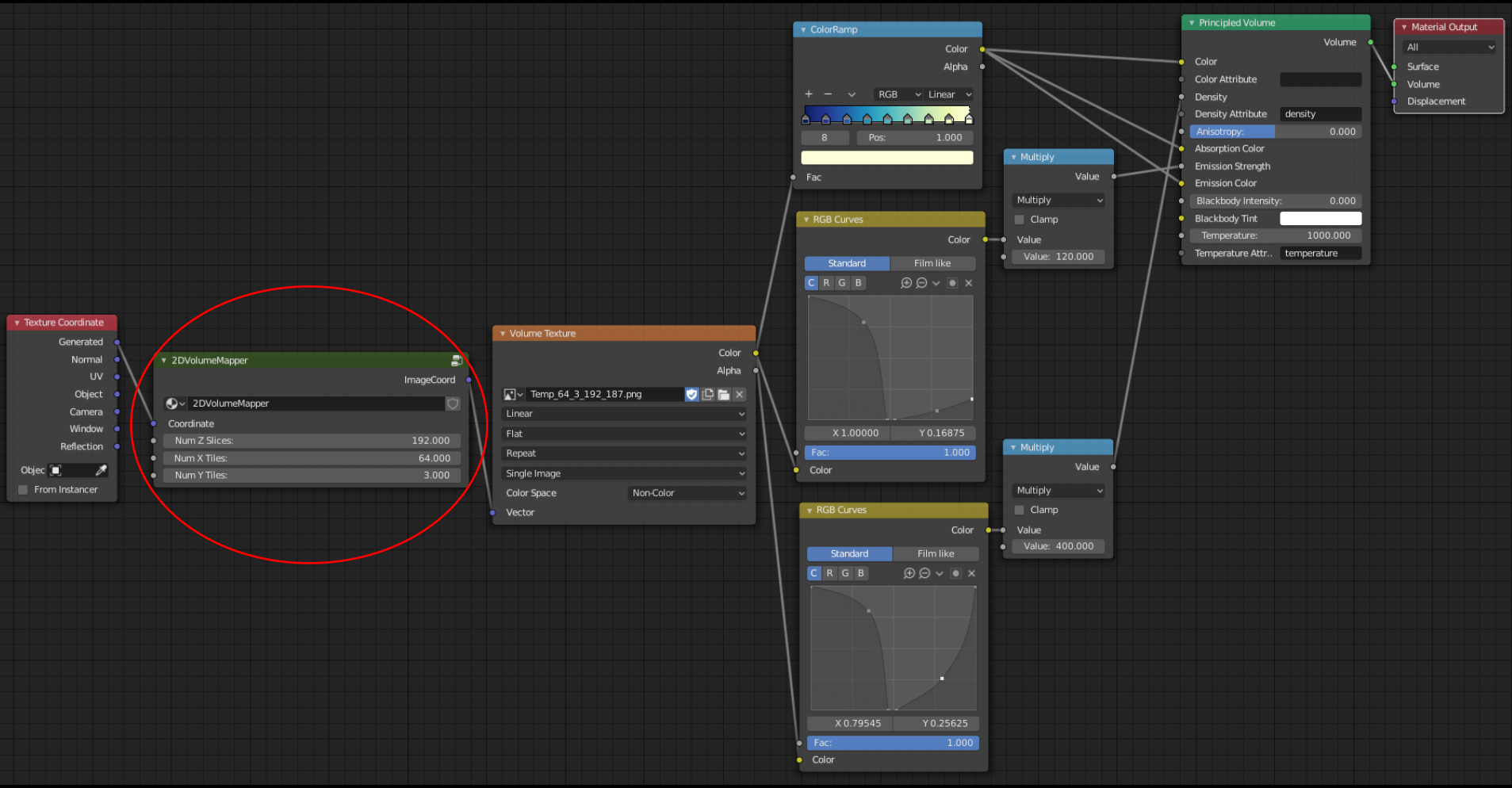
- Sample to uniform grid
- Blender support for external formats immature
- Solution
  - Leverage Blender's shader system



Process



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Reflection
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ImageCoord
2DVolumeMapper
Coordinate
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Num X Tiles: 64.000
Num Y Tiles: 3.000
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Linear
Flat
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Vector
ColorRamp
Color
Alpha
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Fac
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Fac: 1.000
Color
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C R G B
X 0.79545 Y 0.25625
Fac: 1.000
Color
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Value
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Clamp
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Value: 120.000
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Multiply
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Principled Volume
Volume
Color
Color Attribute
Density
Density Attribute density
Anisotropy: 0.000
Absorption Color
Emission Strength
Emission Color
Blackbody Intensity: 0.000
Blackbody Tint
Temperature: 1000.000
Temperature Attr.. temperature
Material Output
All
Surface
Volume
Displacement

Conclusion

- Worth it!
- Features starting to get more uptake
- More research into cinema rendering for scientific data needed!
- Better Blender pipeline

Q & A

www.nrel.gov

https://youtu.be/75CSgrxL-Bk

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