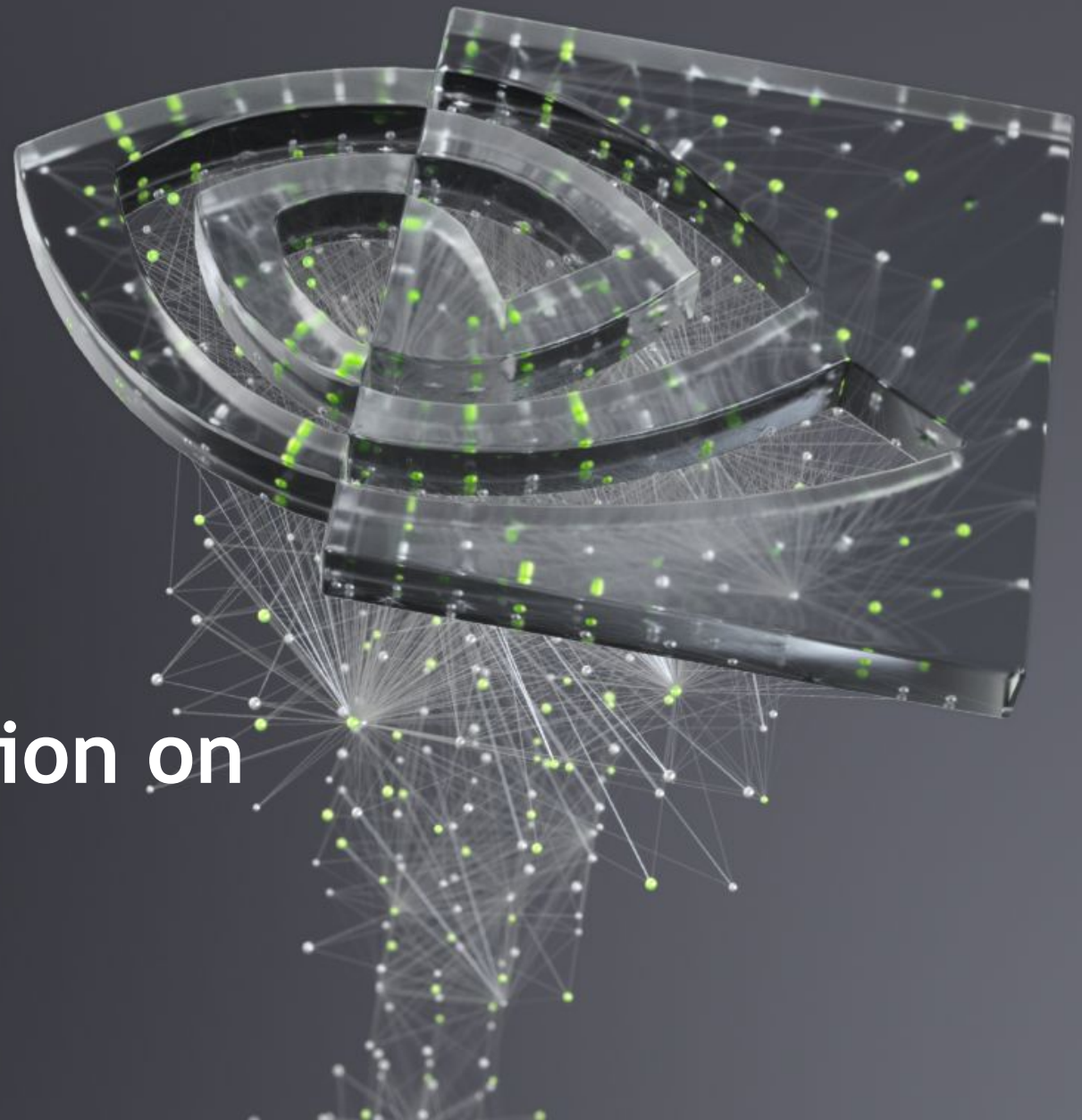


# Scientific Visualization on NVIDIA GPUs

Nick Leaf <nleaf@nvidia.com>, April 28th 2021

# AGENDA

## Overview

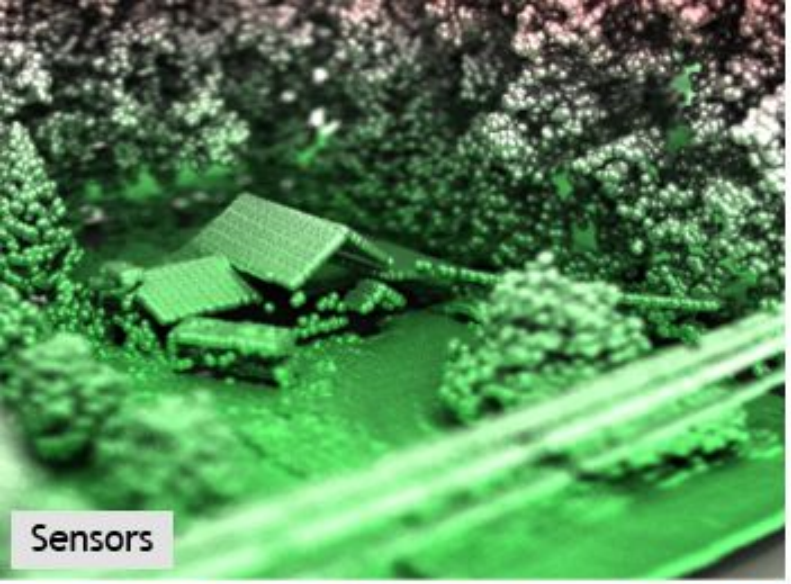
High-level view of visualization on NVIDIA GPUs

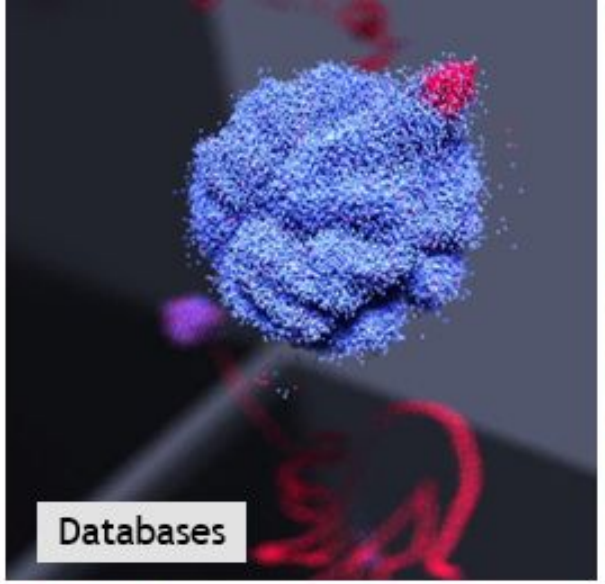
## ParaView + OptiX, IndeX

Demo of ParaView with the OptiX path tracing backend and IndeX volume rendering plugin

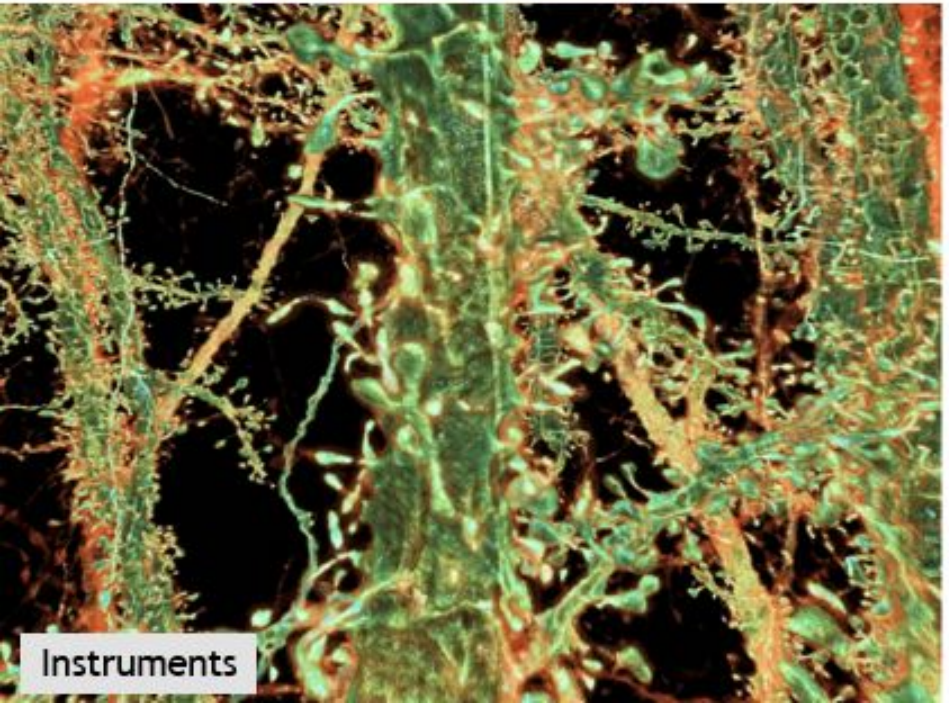
## Omniverse

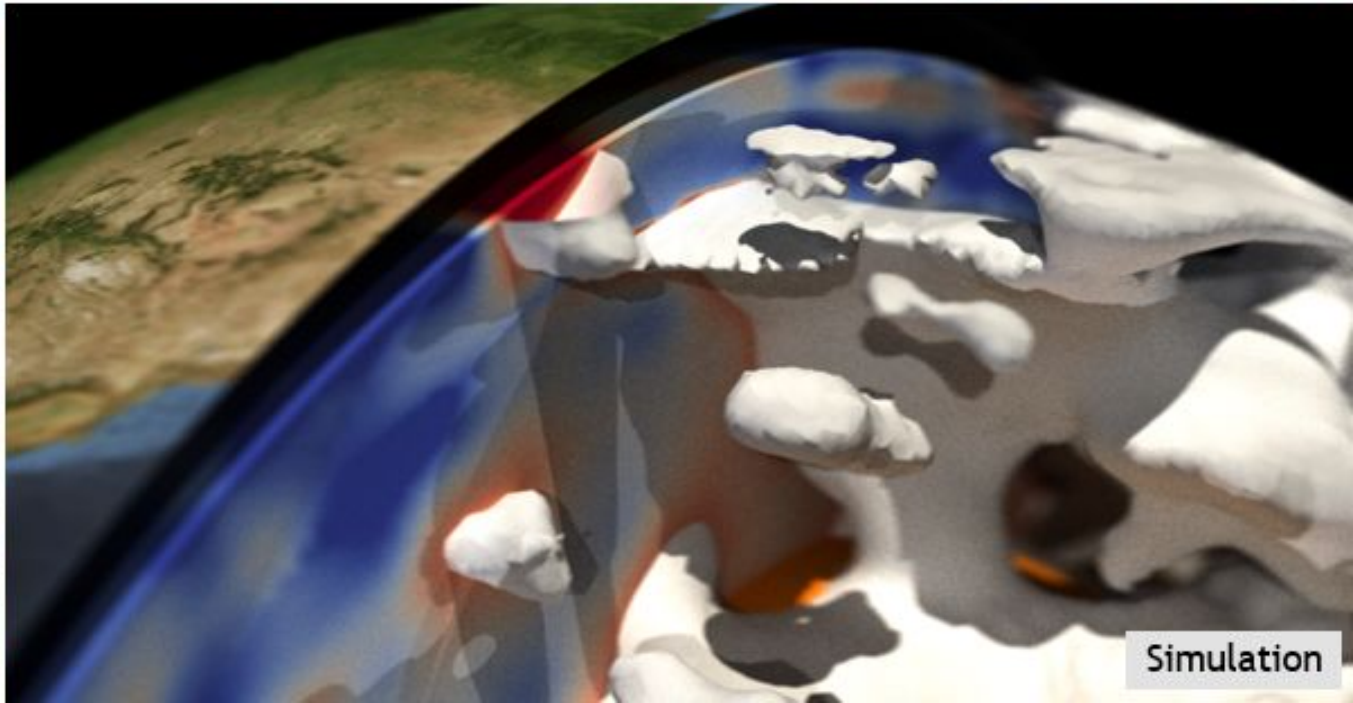
Introduction to USD, NVIDIA Omniverse, and demo of the Omniverse ParaView connector


Sensors


Databases


Simulation


Instruments


Simulation

# Purpose of Visualization

## Discovery/Analysis

Specialized audience

Performance over fidelity

Short iteration times (milliseconds to minutes)

Render frequently

ParaView/Catalyst, VisIt/libSim, Matlab, Jupyter, ...

## Presentation

Targets broad audience

“Cinematic visualization”: advanced lighting, effects

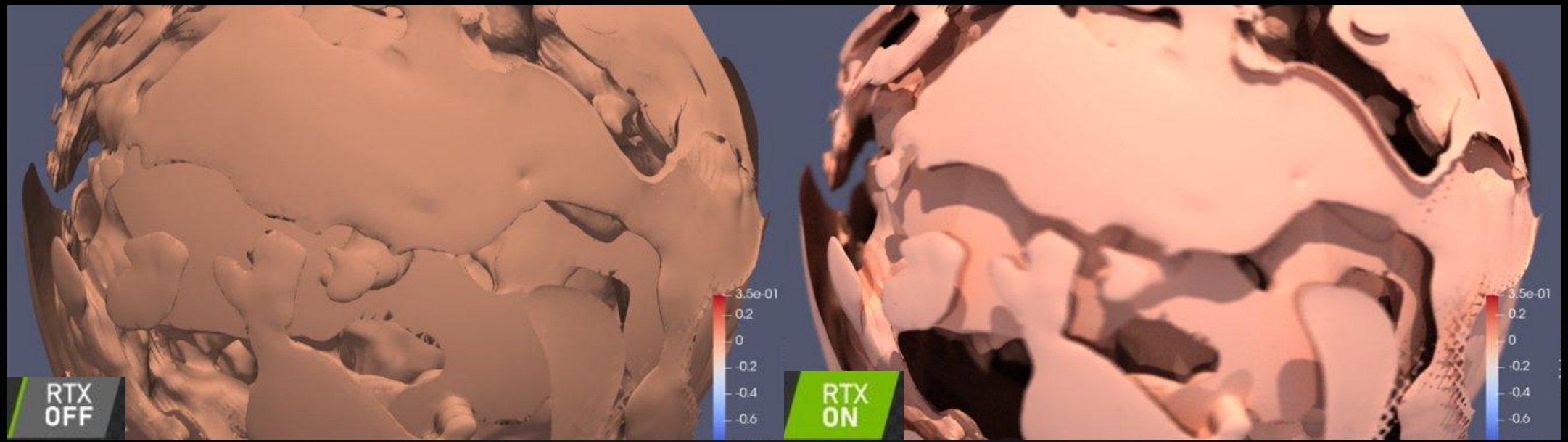
Long iteration times (hours or days)

Render only for publication / communication

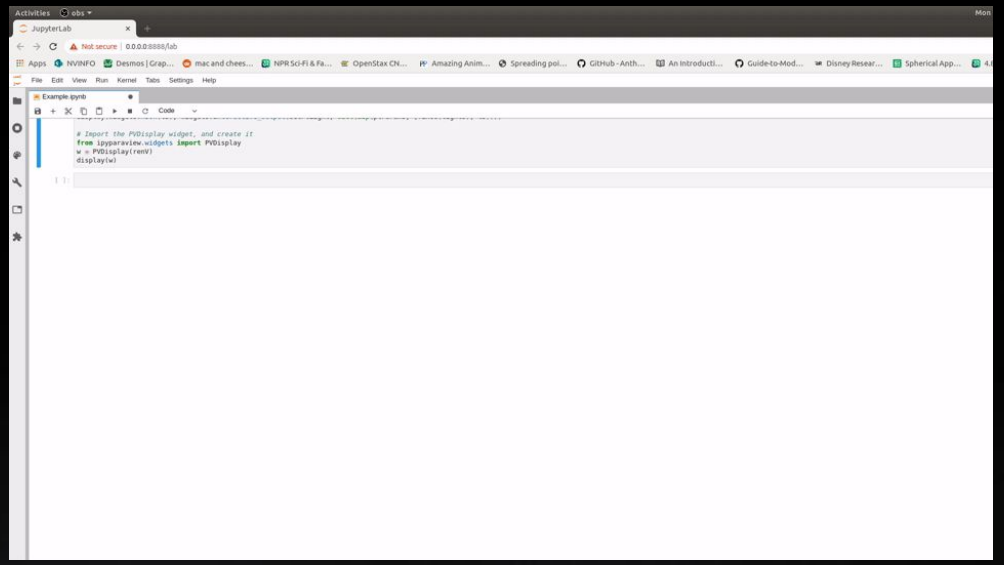
Maya, Houdini, Blender, ...

# NOT JUST PRETTY PICTURES

Advanced rendering enhances perception




SC20 Covid Video




# Visualization in Jupyter

iPyParaView

- ParaView within Jupyter
- GTC '20: S22111 (free, registration required)
- https://github.com/NVIDIA/ipyparaview

node-rapids

- GPU-accelerated javascript rendering
- GTC '21: S31955 (free, registration required)
- https://github.com/rapidsai/node-rapids

# ParaView

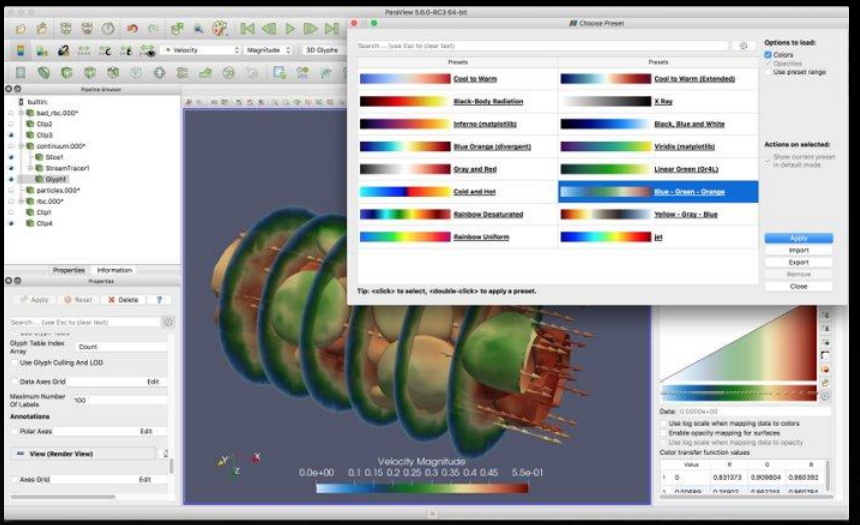
## Open Source, VTK-Based Data Analysis & Visualization

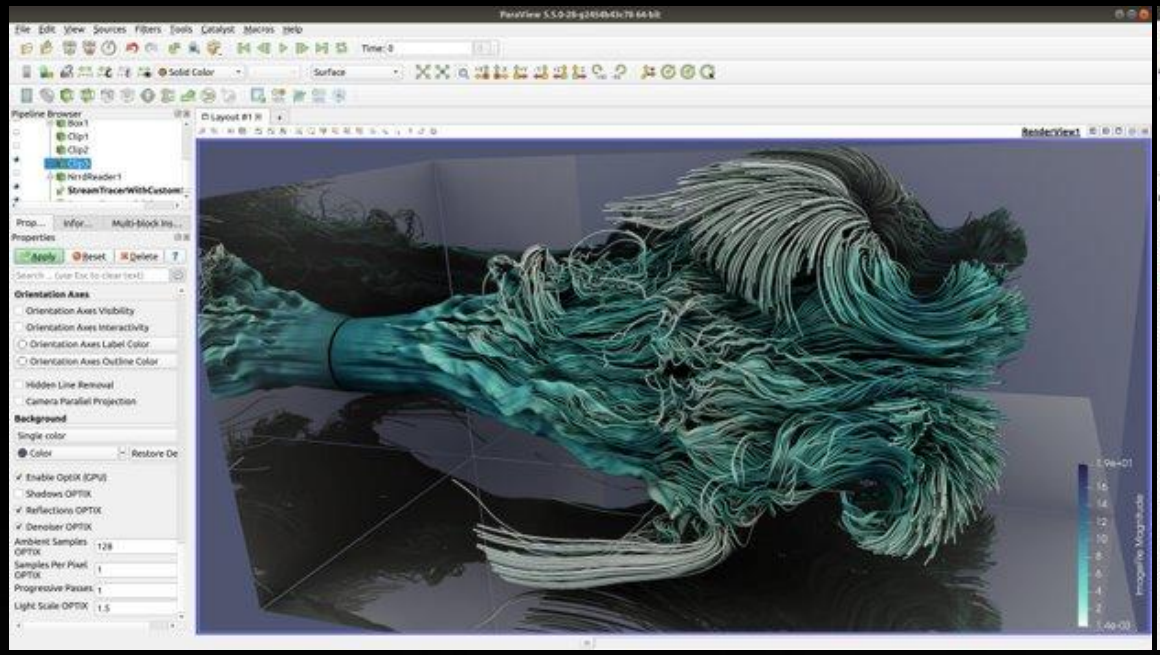
Data ingestion: wide array of readers for scientific file formats

Filtering: isosurfacing, clipping, streamlines, etc.

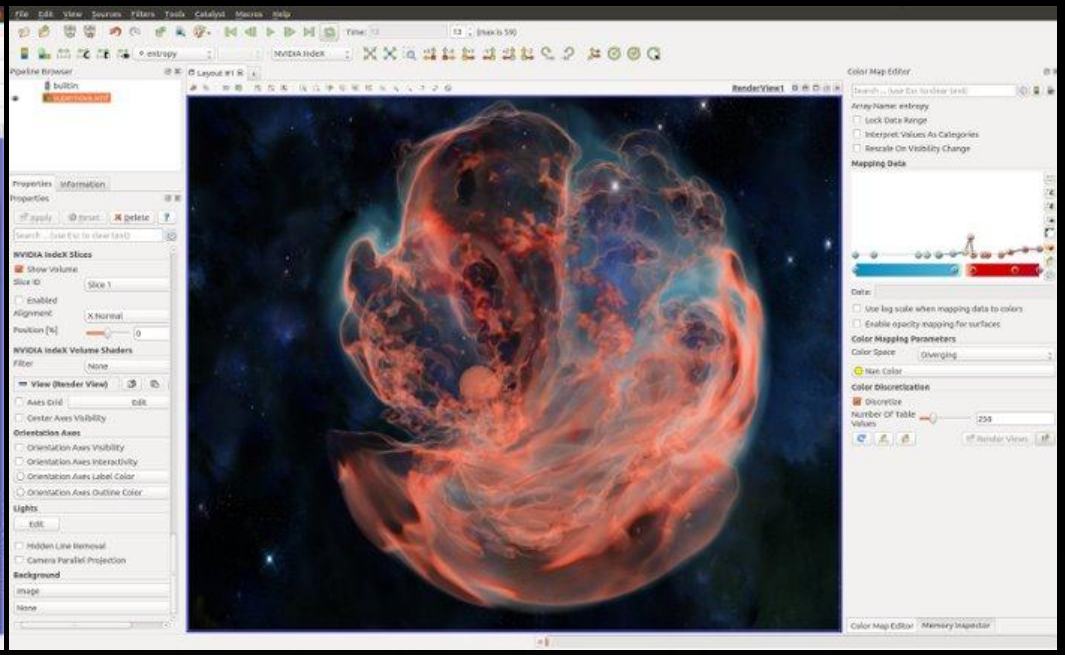
Scalability: multi-node scalability via MPI

Rendering: software and hardware-accelerated OpenGL backend



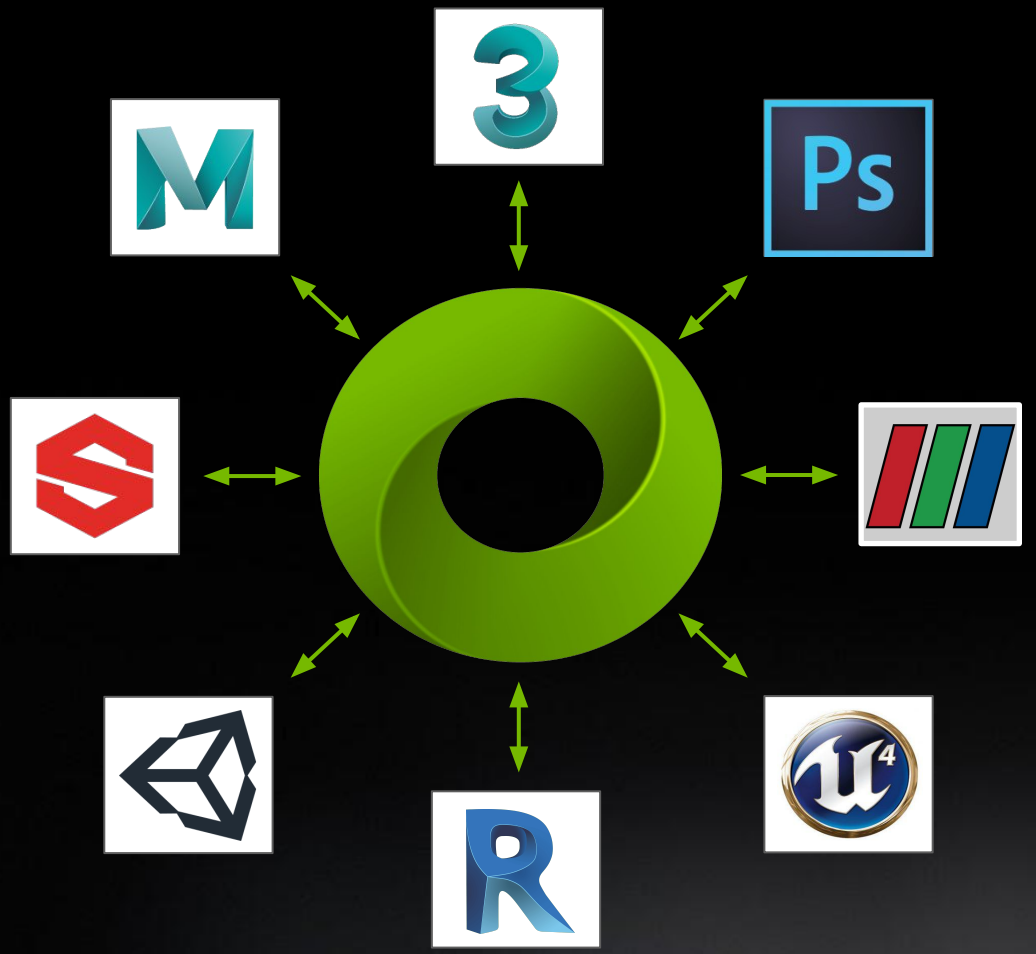


NVIDIA OptiX path-tracing backend via VisRTX



NVIDIA IndeX volume rendering plugin


Demo: ParaView
+ OptiX, IndeX




# USD

## Universal Scene Description

Open source API and format for complex scene description

USD is becoming the HTML of 3D virtual worlds

OMNIVERSE

| CONNECT | NUCLEUS | KIT SDK | SIMULATION | RTX RENDERER |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Connection SDK / Plugins | Core Services / On Prem / Cloud | Framework / Editor / Apps | Physics / AI / Animation / Behavior | Realtime / Scalable / Accurate / MDL |

# ParaView Connector for Omnivserse

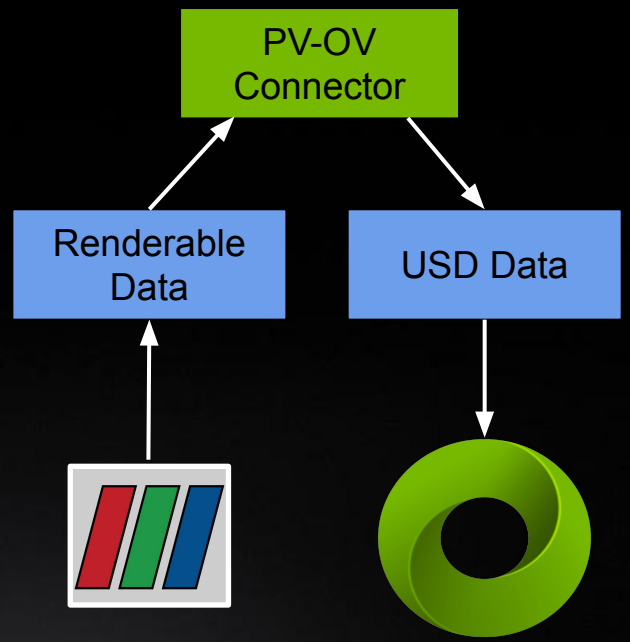
Enabled via a ParaView plugin

Connects to Nucleus to provide data to Omniverse (or output USD to disk)

Representation only--no source or intermediate data

Node-parallel: distributed data condensed to single USD

Headless/offline capable: ship data to Nucleus via a ParaView python script




Demo: Omniverse and the
ParaView connector

# Getting Started

Get Omniverse: https://www.nvidia.com/en-us/omniverse/

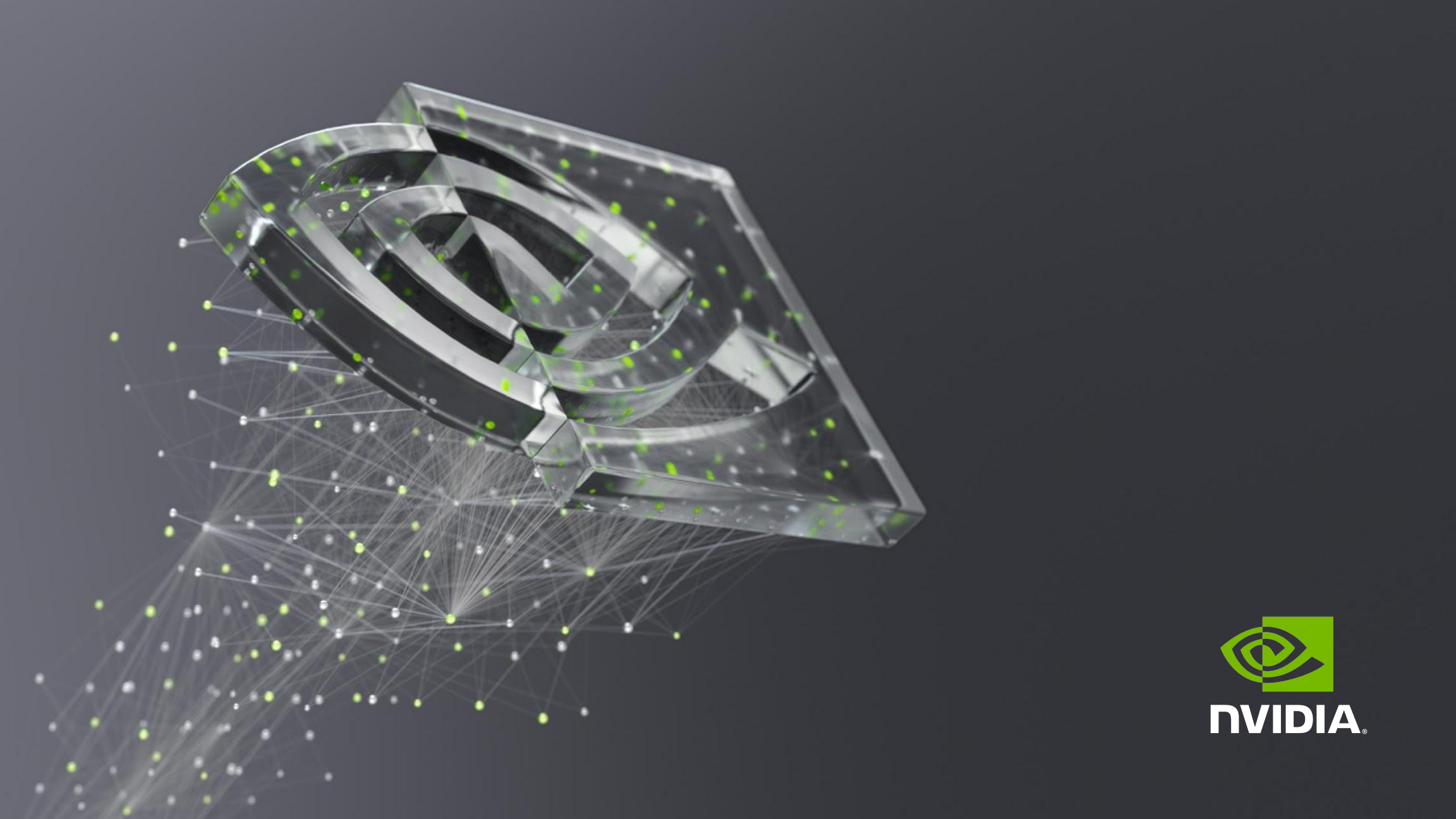
ParaView Connector can be installed via the Omniverse Launcher

ParaView Connector documentation: https://docs.omniverse.nvidia.com/con_connect/con_connect/paraview.html

GTC ‘21 sessions:

S23572: Cinematic Scientific Visualization with the Omniverse ParaView Connector

S33132: Introduction to USD


NVIDIA