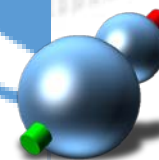




TEXAS ADVANCED COMPUTING CENTER

WWW.TACC.UTEXAS.EDU



MegaMol™

Software-Defined Visualization Updates

IXPUG SC18 BOF

November 15, 2018

PRESENTED BY:

Chris Johnson – SCI @ Univ. Utah

Paul Navrátil – TACC @ Univ. Texas

Valerio Pascucci – SCI @ Univ. Utah

Guido Reina – VRC @ Univ. Stuttgart

Intel Visualization Center of Excellence @ TACC

TACC Intel Visualization CoE Mission

- Leverage TACC resources (human, hardware, software) to develop human and software capital for Software-Defined Visualization algorithms and applications
- Focus on applications for advanced computing challenges where TACC has leadership
 - In situ visualization for massive data simulation
 - Virtual- and Augmented- Reality for enhanced data analysis
 - Machine Learning to improve image quality and visualization performance
- Distribute findings to TACC, Intel and broader community

TACC Intel VCoE Participants – 2018



Dr. Ayat Mohammed
Post-Doctoral Researcher
Virginia Tech



João Barbosa
Graduate Research Asst
Computer Science
University of Texas



Jakub Hendrich
Visiting Scholar
Czech Technical Univ - Prague



Islam Akef Ebeid
Visiting Scholar
School of Information
University of Texas

TACC Intel VCoE Projects - 2018

OSPRay-powered DisplayWall – Joao Barbosa

OpenSWR Performance Study – Joao Barbosa, Intel, Kitware

Galaxy Asynchronous Ray Tracing – Greg Abram, Paul Navratil

Adaptive Acceleration Techniques – Jakub Hendrich

Towards Automatic Color Alignment –

Paul Navratil, Ayat Mohammed (w/Francesca Samsel)

Simple, Single-Point Head and Eye-Tracker Registration – Islam Akef Ebeid



IXPUG In Situ Visualization Hackathon Report

IXPUG In Situ Vis Hackathon 2018

- Held at Argonne National Laboratory
 - Joe Insley and Silvio Rizzi – site co-chairs
 - Paul Navrátil and Jim Jeffers – co-chairs
- Twenty-one international participants
 - Good mix of new and returning participants
 - Argonne National Lab
 - Cambridge University
 - Intel Inc
 - Intelligent Light Inc
 - Kitware Inc
 - Los Alamos National Lab
 - Lawrence Livermore National Lab
 - Loyola University - Chicago
 - Oak Ridge National Lab
 - Texas Advanced Computing Center
 - University of Chicago
 - University of Stuttgart
 - University of Wyoming
- Ten+ tiger teams
 - Conduit + LibSim + ADIOS
 - HACC + Sensei
 - GR-CHOMBO + Catalyst
 - MegaMol + Sensei / ADIOS
 - MPAS-Atmosphere
 - Nek5000 + Sensei
 - Quantum Chem + Sensei
 - Simulated villi cells + MegaMol + OSPRay
 - Sparq + Sensei + LAMMPS
 - VPIC + Catalyst



Intel Visualization Center @ SCI



Intel PCC: Modernizing Scientific Visualization and Computation on Many-core Architectures

Valerio Pascucci, Ph.D.

John R. Park Inaugural Endowed Chair

Director, Center for Extreme Data Management

Analysis and Visualization

Faculty, Scientific Computing and Imaging Institute

Intel Visualization Center

Chris Johnson, Ph.D.

Director, Scientific Computing and Imaging Institute

Distinguished Professor of Computer Science

Adjunct Professor of Physics and

Biomedical Engineering



Intel OSPRay at the museum of science in Paris

Intel PCC: Modernizing Scientific Visualization with In Place and In Situ Ray Tracing on Many-core Architectures

Scientific Computing and Imaging Institute: World leader in scientific visualization

Intel centers at SCI: involving 4 faculty, 4 postdocs, 7 students, 2 scientists

IPCC for “Modernizing Scientific Visualization with In Place and In Situ Ray Tracing on Many-core Architectures”

- PIs: Valerio Pascucci, Martin Berzins
- Applying OSPRay to visualization and HPC production in practice (i.e., Uintah, VisIt)
- Visualization analysis research: IO, topology, multifield/multidimensional (ViSUS)
- Staging Intel resources for both the Vis Center and IPCC.
- Preparing for exascale on DOE A21 via early science program
- Optimizing next-gen Navy weather codes for Intel KNL and beyond

Intel Vis Center at Utah

- PIs: Chris Johnson, Ingo Wald (Intel)
- Large-scale vis and HPC technology on CPU/Phi hardware (OSPRay)
- Students: Mengjiao Han
- Postdoc: Feng Wang



Synergistic Projects

CEDMAV: UofU Center for Extreme Data Management Analysis and Visualization (director Valerio Pascucci): vis, IO, HPC, and analysis

- ViSUS: disk-out-of-core streaming visualization PDX IO infrastructure (S. Kumar, S. Petruzza)
- Topological analysis (i.e., massively thread-parallel Morse-Smale complexes on KNL)

Uintah: DOE PSAAP II efficient coal boiler simulation (Phil Smith, Utah ICSE) and DOE INCITE computational awards (Martin Berzins)

- **350M hours for 2016 — the largest single open-science computational effort in the nation -extended to 430M hours**
- Students: John Holmen

A21 Exascale Early Science Program (Martin Berzins)— large scale combustion problem –development of runtime systems and raytracing combustion kernel on Stampede 2 and Theta.

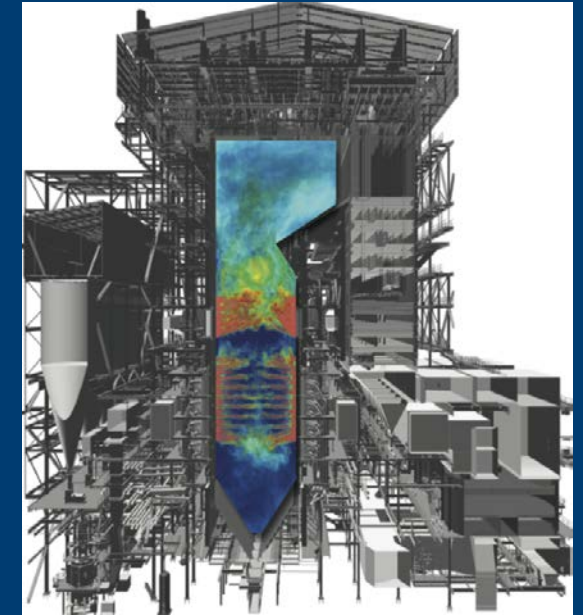
- Students: John Holmen

NEPTUNE: OpenMP Optimization of Navy NWP codes (Martin Berzins)

- Readiness for exascale via OpenMP and algorithmic improvements for KNL and beyond
- Students: T.A.J. Ouermi (“TAJO”)

ALCF-Intel-Vis Collaboration with Argonne National Laboratory:

- Mike Papka (director of ALCF), Joe Insley (ALCF vis lead), Silvio Rizzi (ALCF vis staff)

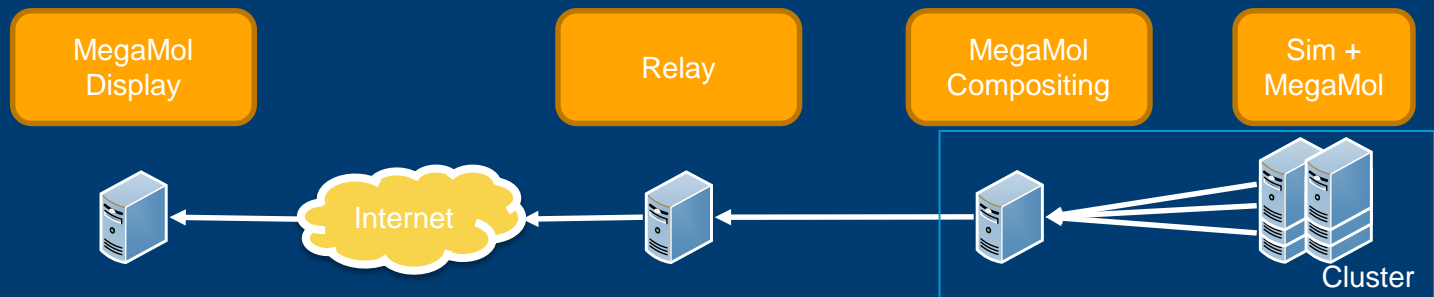
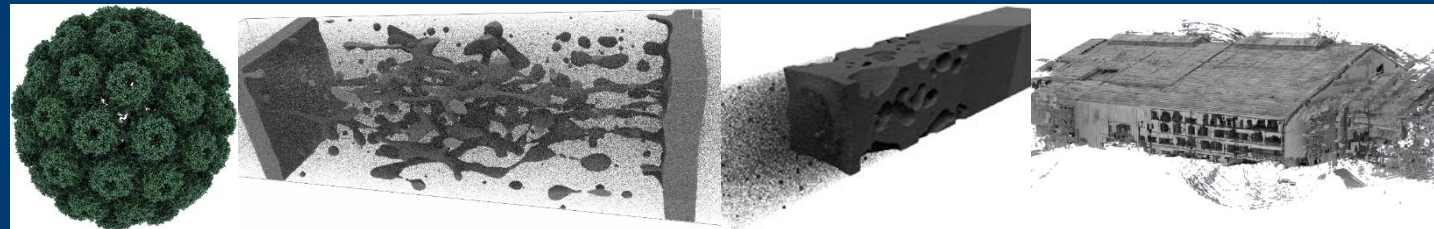
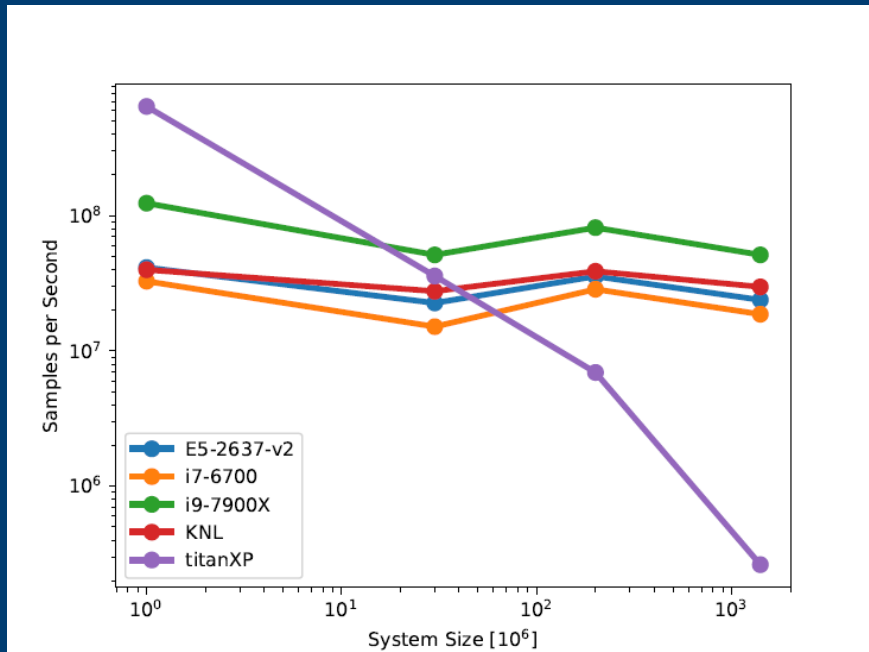


MegaMol @ University of Stuttgart



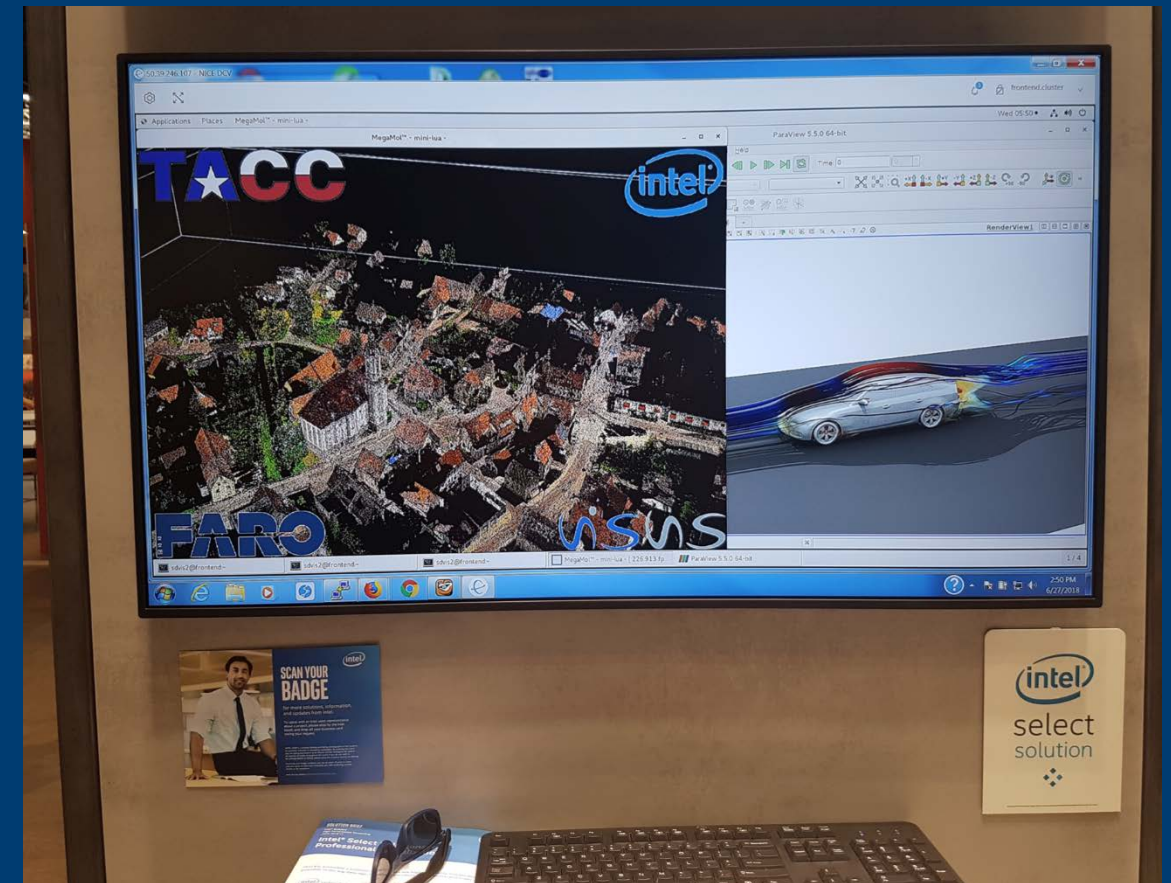
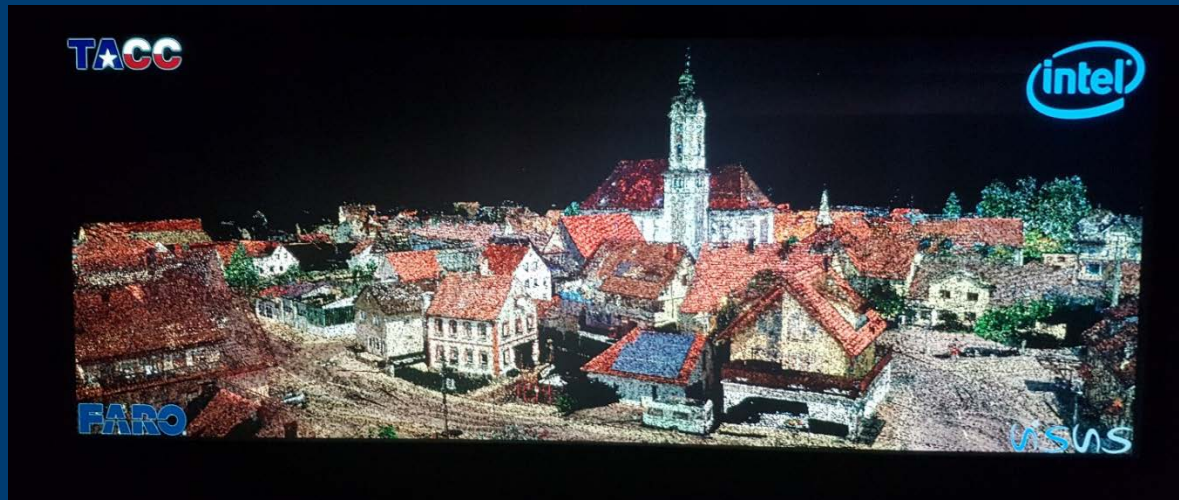
MegaMol – IPCC for Vis at Stuttgart, Germany

- Extending GPU-centric framework to SDVis for in situ and HPC
 - Improved Scalability especially for large data sets
 - Asymmetric MegaMol execution: individual node roles in MPI world



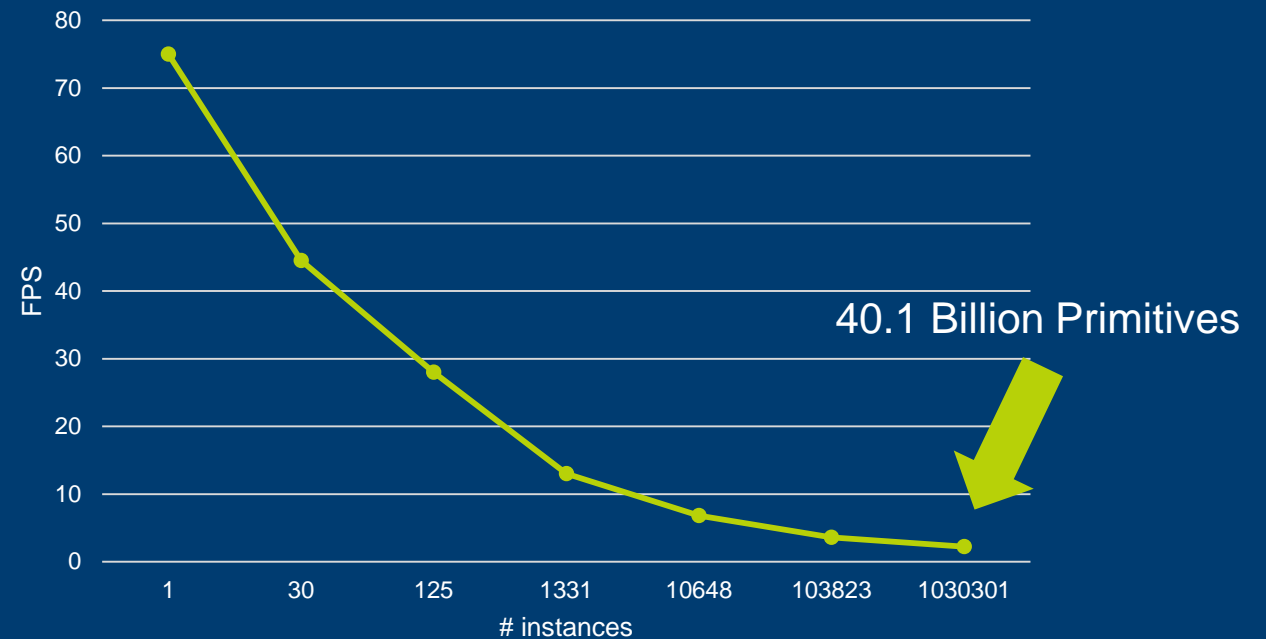
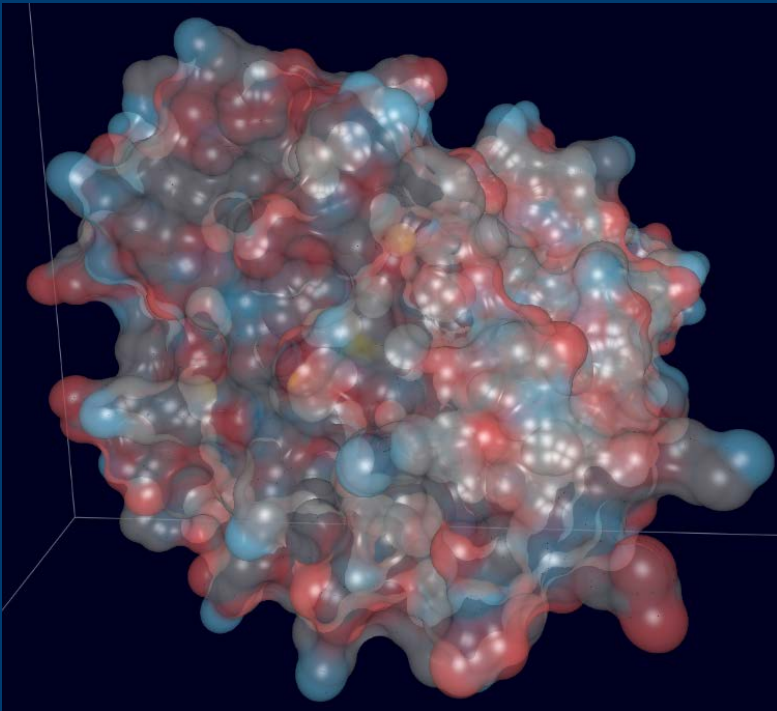
MegaMol – IPCC for Vis at Stuttgart, Germany

- Showcase in situ remote
- Showcase in situ at Select Solution Launch



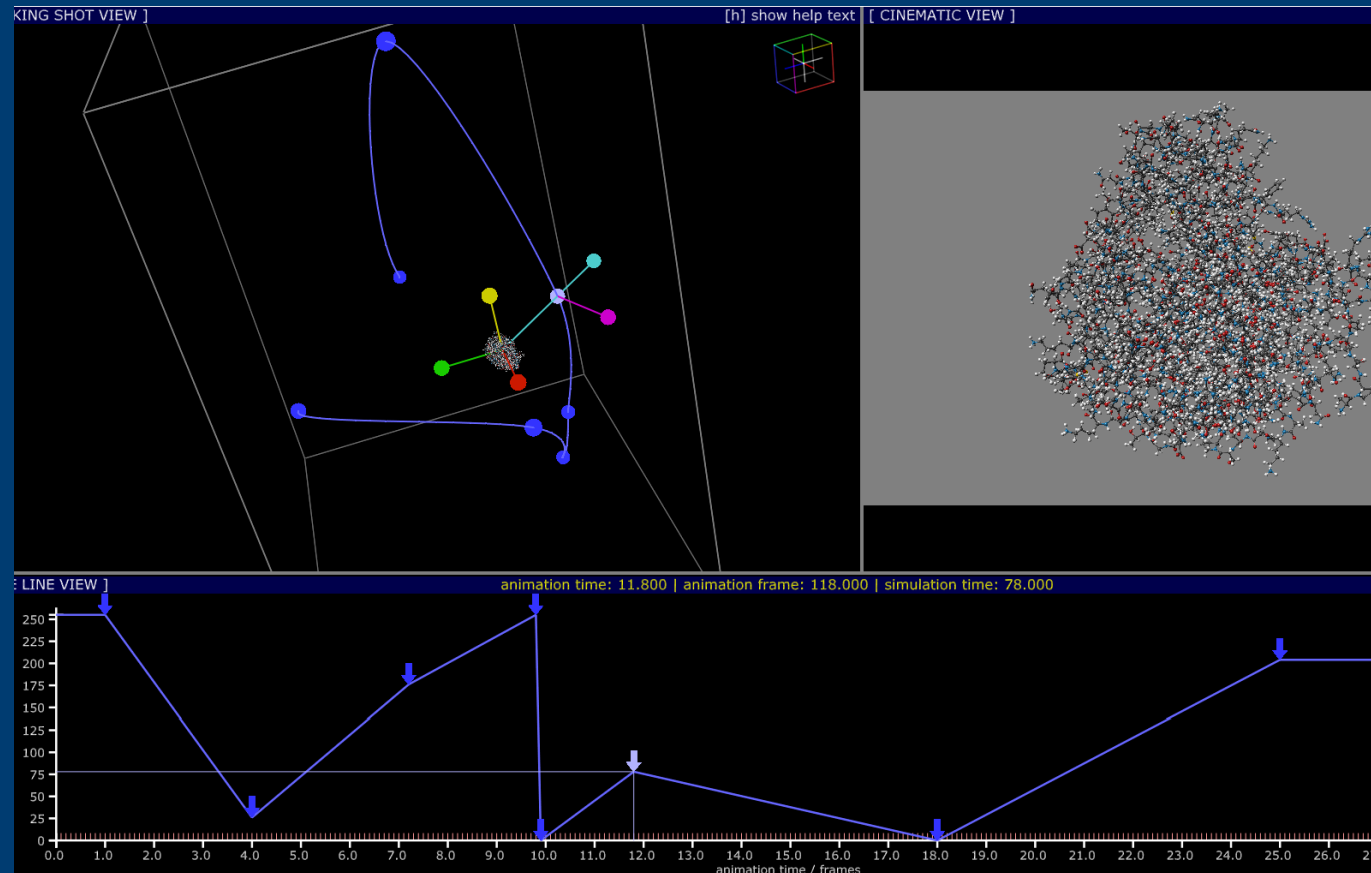
MegaMol – IPCC for Vis at Stuttgart, Germany

- New OSPRay geometry: Solvent Excluded Surface for Biochemistry
 - Example: 1AF6 (10k Atoms) -> SES 38954 primitives
 - Instancing performance on i9-7900X



MegaMol – IPCC for Vis at Stuttgart, Germany

- Animation GUI and distributed offline offload rendering



Thank you!
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