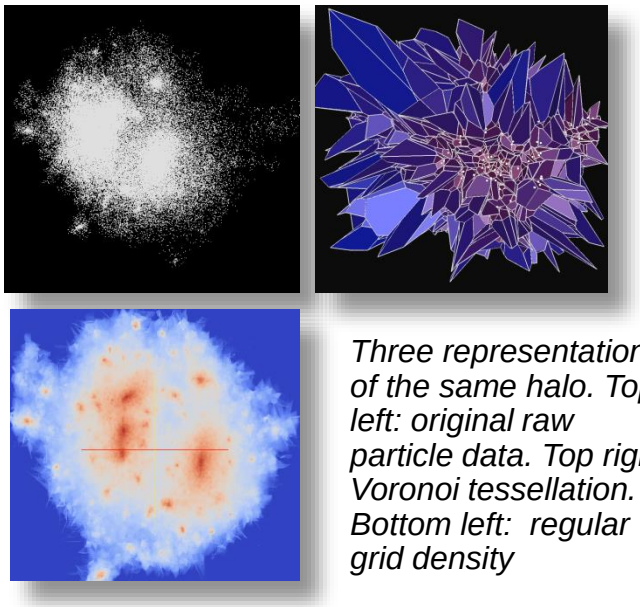
# Meshing the Universe: In Situ Voronoi and Delaunay Tessellation

## *Objectives*

- Parallelize computational geometry algorithms and deploy in cosmology simulations at scale
- Transform sparse point cloud data into a continuous field (tessellation) that can be interpolated everywhere
- Use tessellations to extract knowledge about features
- Enable improved regular grid sampling

## *Impact*

- Identification of large-scale structures such as halos and voids
- Quantification of structures via Minkowski functionals
- Time-varying statistics of structures
- Improved accuracy of regular grid density estimation
- In situ performance



*Three representations of the same halo. Top left: original raw particle data. Top right: Voronoi tessellation. Bottom left: regular grid density*

## *Accomplishments*

- Developed open-source parallel *tess* library
- Deployed tess in cosmotools framework with Kitware including plugin to Paraview
- Included parallel netCDF file format reader and writer in collaboration with Northwestern University
- Published in situ scalability in HACC cosmology code
- Developed parallel regular grid 3D and 2D density estimator

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Tom Peterka, Juliana Kwan, Adrian Pope, Hal Finkel, Katrin Heitmann, Salman Habib (ANL), George Zagaris, Berk Geveci (Kitware), Wei-keng Liao (NU)

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