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Sandia National Laboratories

SDAV, Dax, Cosmology, and Stuff

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Quick Overview of Dax

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- Goal: Reduce challenges of writing highly concurrent algorithms
  - "Everybody who learns concurrency thinks they understand it, ends up finding mysterious races they thought weren't possible, and discovers that they didn't actually understand it yet after all." –Herb Sutter
- Algorithms written as "worklet" implementations
  - Safe efficient access. Hazards and conflicts not possible.
  - Provides high level visualization building blocks (field calculation, interpolation, geometry generation, neighborhood finding, etc.).
  - Template metaprogramming builds customized scheduling for arbitrary function parameters.
- Device Adapter simplifies porting across different hardware
- Array Handle interface directly with arbitrary memory layout

N-Body Cosmological Simulations

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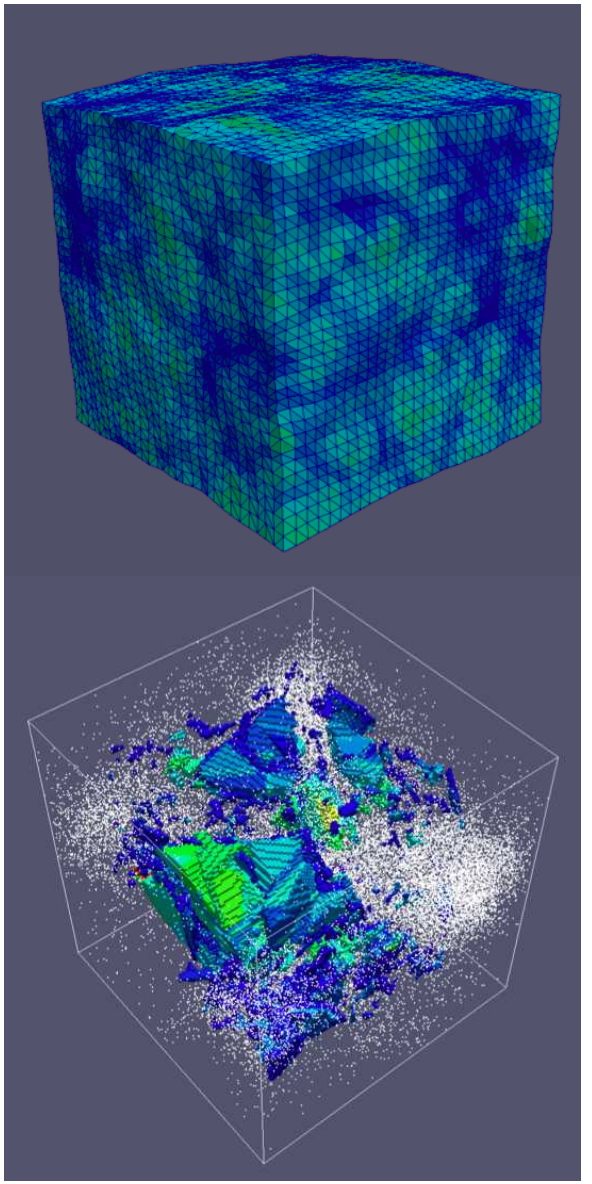
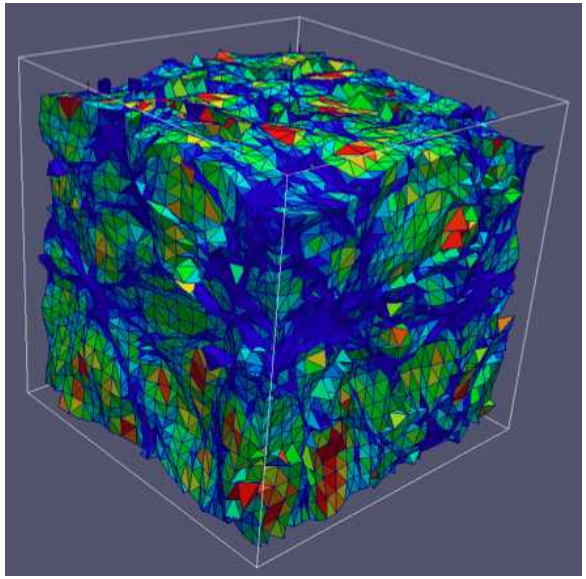
Simulation starts with tetrahedral grid derived from structured mesh.



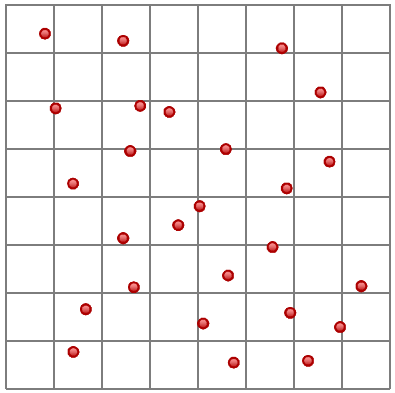


Vertices advect as particles. Mesh elements deform, fold, and intersect.

Intersecting tetrahedra form regions of multiple “streams” of flow. Intersection counts determine features.

Counting Intersecting Tetrahedra

Search structure is a regular grid of buckets with a list of intersecting tetrahedra for each bucket.



Parallel operation identifies bucket index for each probe point.

6	56	21	42	57	33	12	0	18	

Indices are sorted to identify groups of probe points in the same bucket.

	41	42	42	42	42	42	42	42	43	

Intersection Counts

For each probe in a group in parallel perform an intersection test with all triangles in bucket and count.

Classify with GPU/Dax Assistance

- Dax tetrahedralizes mesh and finds tets containing probes
  - More operations to follow.