

Members of Structured Grid Effort (LBNL)

- Ann Almgren – AMReX
- Hans Johansen – Chombo
- Daniel Martin – Chombo
- Robert Saye -- Algoim



U.S. DEPARTMENT OF
ENERGY

Office of
Science



Structured Mesh Area -- Summary

- Core software:**
 - Algoim
 - AMReX
 - Chombo

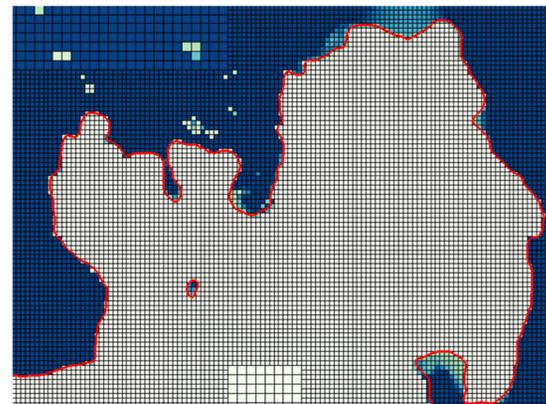
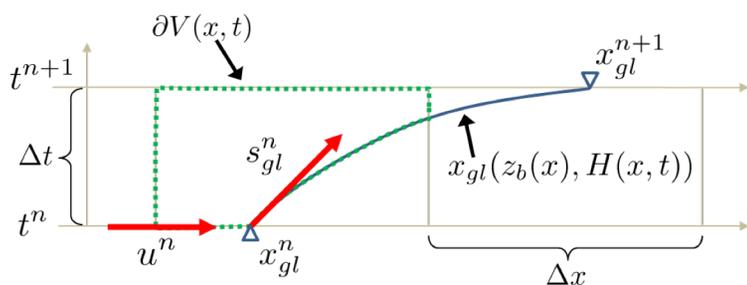
- Connections to SciDAC-4 Partnerships:**
 - TEAMS (MAESTRO -- astrophysics)
 - ProSPect (BISICLES -- ice sheet modeling)
 - COGENT
 - ComPASS (QuickPIC – accelerator modeling)

- Non-SciDAC Engagement**

- Strategy / Synergistic Activities**

SciDAC Partnerships -- ProSPECT

- ❑ Improved solver performance for BISICLES Ice Sheet models through algebraic multigrid solvers in Chombo (see slide in Linear Solvers)
- ❑ Embedded Boundary/Multifluid approach to modeling grounding lines
 - Location of transition from grounded to floating ice is dynamically important
 - Space-time formulation: Development case implemented in 1D
 - Extension to 2D in progress



SciDAC Partnerships -- COGENT

- Working with COGENT collaborators in the FES Atom partnership to support the transition to 5D computations, including Chombo support for non-conforming multiblock mapped grids.

SciDAC Partnerships -- ComPASS

QuickPIC is a highly efficient, fully parallelized, fully relativistic, three-dimensional particle-in-cell code for simulating particle or laser beam driven wakefield acceleration.

(<https://plasmasim.physics.ucla.edu/codes/quickpic>)

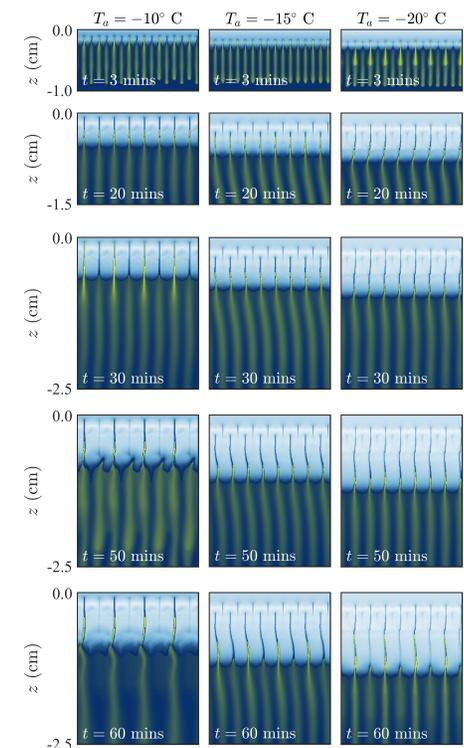
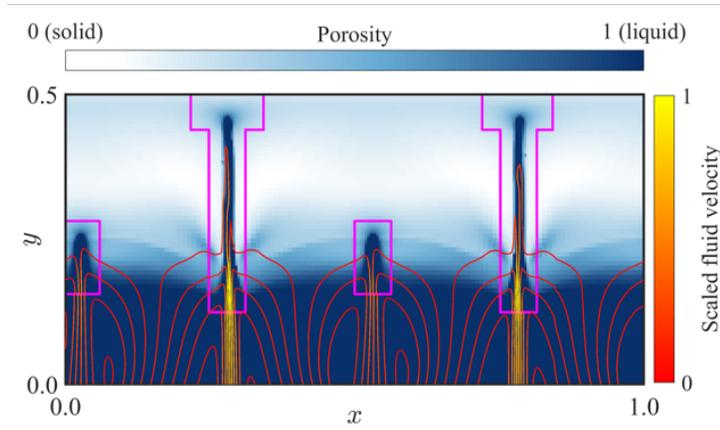
As part of the HEP ComPASS project, mesh refinement – both static and adaptive – is being added to QuickPIC to enable faster, more efficient simulation

FASTMath support provides source code and expertise to enable quick prototyping of multilevel algorithm and eventual optimization on new HPC architectures of the multilevel algorithm in the context of QuickPIC

Non-SciDAC Engagement

□ Chombo-based model for binary alloy solidification (sea-ice formation)

- AMR for brine-rejection channels
- Extension of existing AMR incompressible Navier-Stokes capability
- Collaboration with the University of Oxford (UK)
- Parkinson, Martin, et al (JCP, submitted)



Additional Structured Mesh Activities

- **AMReX:**
 - Implemented native version of **Algoim** algorithm in order to
 - Remove additional dependencies (e.g., blitz)
 - 1.7x speedup

- **Synergistic Activities (see later sessions):**
 - AMReX + SUNDIALS
 - AMReX + hypre
 - ATPESC 2019 – new AMReX tutorials as well as coupled examples with SUNDIALS & PETSc

- **Software strategy (see RAPIDS session):**
 - Collaborative exercise with RAPIDS
 - AMReX used as prototype for facilities engagement exercise