Galaxies and Stars: Bridging the Expanse

Sean C. Lewis

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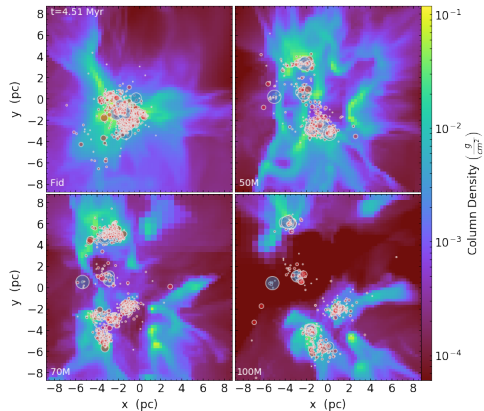
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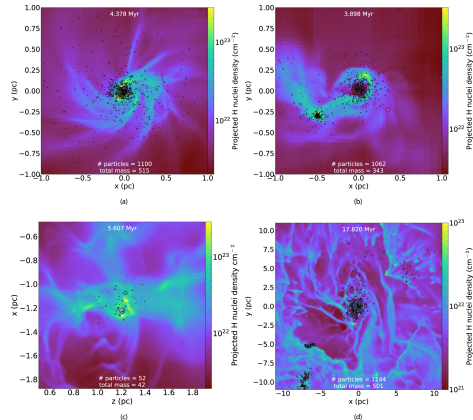
Torch
And Its Next Steps

- Couples N-body, stellar evolution, and feedback in `AMUSE` with self-gravitating magnetized gas in MHD code `FLASH`.

- Resolved dynamics of stars and gas; study star cluster formation within collapsing GMCs.

Torch
And Its Next Steps
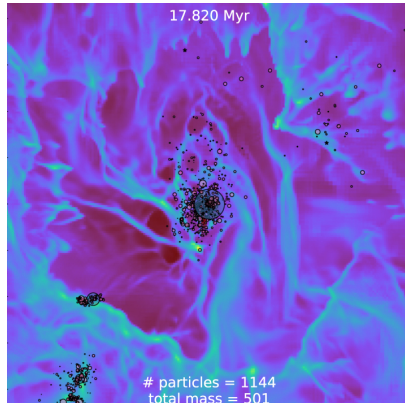

Lewis et al. (in prep)

Wall et al. 2020

Clouds in Reality and... Not

NASA; Carina Nebula

Wall et al. 2020

The Big Problems
Resolution & Initial Conditions

- Self consistent galactic scale simulations with resolution down to sub-tenth parsec scales and include Nbody individual stellar dynamics and individual stellar feedback all at once? A little tough.

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Resolution & Initial Conditions

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- Creating our own isolated clouds from scratch? "Creative liberties..."

Stars From "Realistic" Clouds

- Clouds that formed under the influence of galactic dynamics.

- Track dynamics and feedback of individual stars.

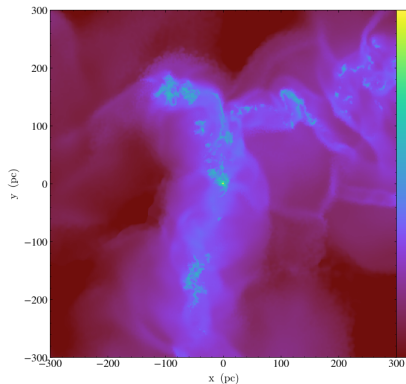- High resolution to quantify star-gas interactions.

Clouds from Galactic Simulations
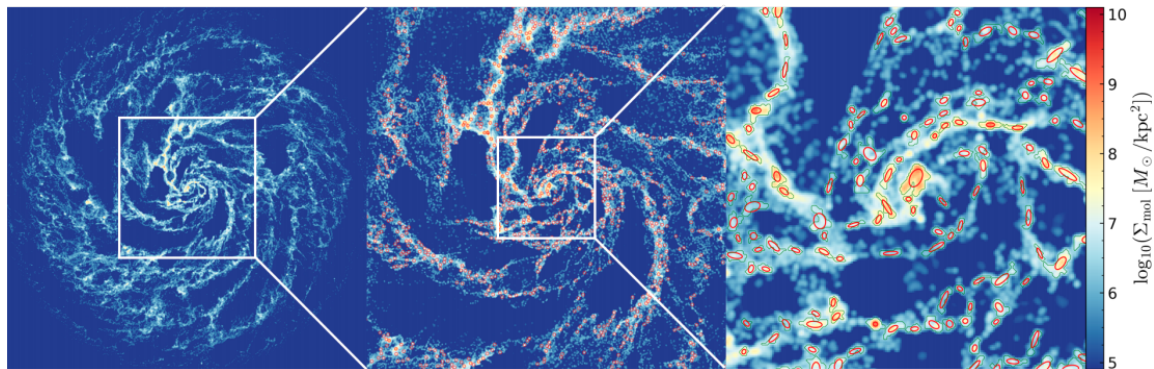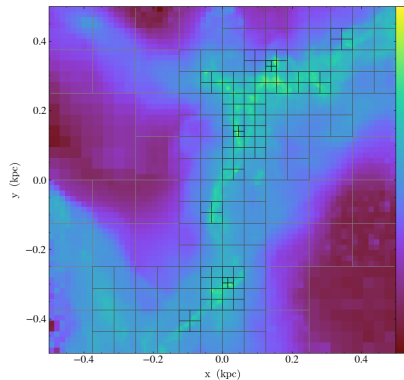

GMC identification [Li, H. et al. 2020]

From AREPO to FLASH

(1st attempt)

Cloud from raw AREPO data
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Cloud-in-cell mapping onto AMR
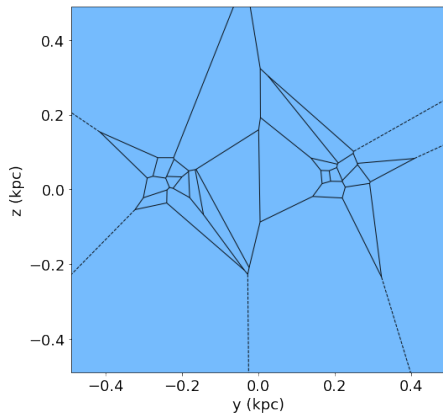FLASH grid

Voronoi Mesh to AMR Grid

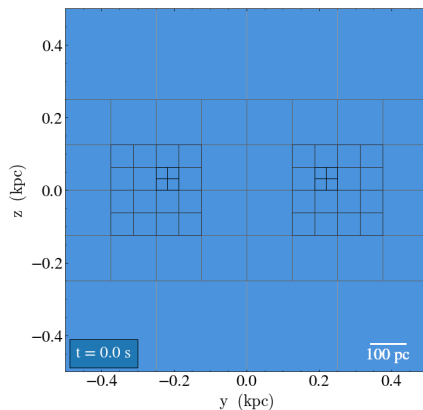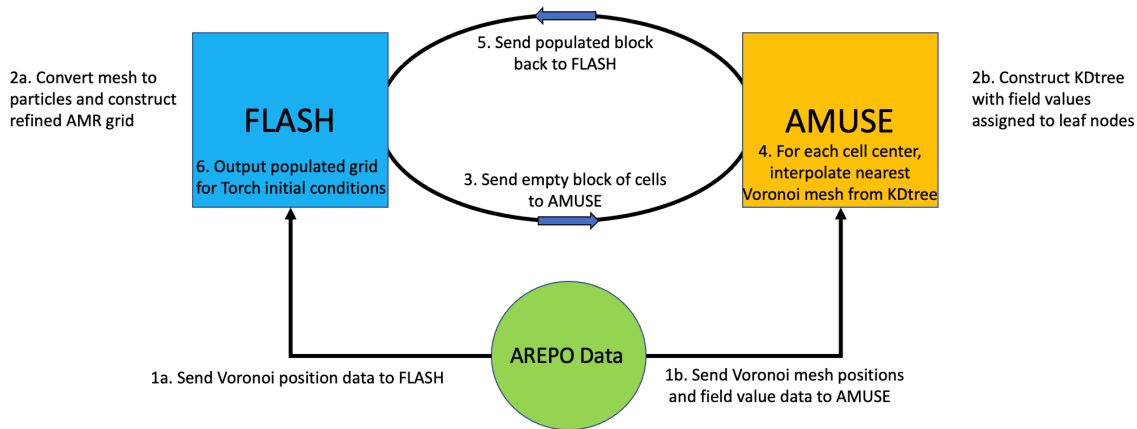Figure: Voronoi mesh from 20 points

Figure: AMR grid from 20 points

VorAMR: Logic path

2a. Convert mesh to particles and construct refined AMR grid

FLASH

6. Output populated grid for Torch initial conditions

5. Send populated block back to FLASH

3. Send empty block of cells to AMUSE

AMUSE

4. For each cell center, interpolate nearest Voronoi mesh from KDtree

2b. Construct KDtree with field values assigned to leaf nodes

AREPO Data

1a. Send Voronoi position data to FLASH

1b. Send Voronoi mesh positions and field value data to AMUSE

VorAMR: The Big Wins

- Significantly expands Torch's horizon and "completes" Torch.

- Opens wide avenue of collaboration; code bases do not have to be exclusive!

- More accurate visualizations (no more estimating Voronoi meshes as SPH kernels in `yt`).