Radiation hydrodynamics simulation of Black Widow Pulsar using Castro

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AMReX

- Adaptive mesh refinment library
- MPI + OpenMP parallelization
- Visualization with yt is supported

In Castro:

- Nested hierarchy of logically rectangular grids
- Simultaneous refinment in space and time



Credit: Almgren et. al. 2010

Castro

Castro is an AMR code that solves the compressible hydrodynamic equations for astrophysical flows.

- General equation of state and nuclear reaction networks
- Self gravity
- Gray and multigroup flux limited diffusion radiation
- Supports 1-d, 2-d and 3-d



Credit: Almgren et. al. 2010

- Open Source
- Regression tests

Credit: Katz et. al. 2016. Merging white dwarfs (VIDEO)

GPU Efforts

AMReX

- Iterator loops over boxes
- Passes data pointer to a Fortran kernel function
- Box state data can use a CUDA allocator
- Iterator handle data motion
- Compute kernels do work on data already in device

Hydrodynamics

- Castro mini app (StarLord), just Hydro
- New solver MOL
- Approach using CUDA managed memory
- Microphysics
 - OpenACC for loops over zones
 - Ported VODE to CUDA Fortran

Black Widow Pulsar

milisecond pulsar + ablating companion star



Credit: X-ray: NASA/CXC/ASTRON/B.Stappers et

- al.; Optical: AAO/J.Bland-Hawthorn & H.Jones
- Castro's gray-radiation solver



- More exploratory studies
- Implement a Gray radiation solver based on a two-moment approach with M1 closure
- Multigroup radiation

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