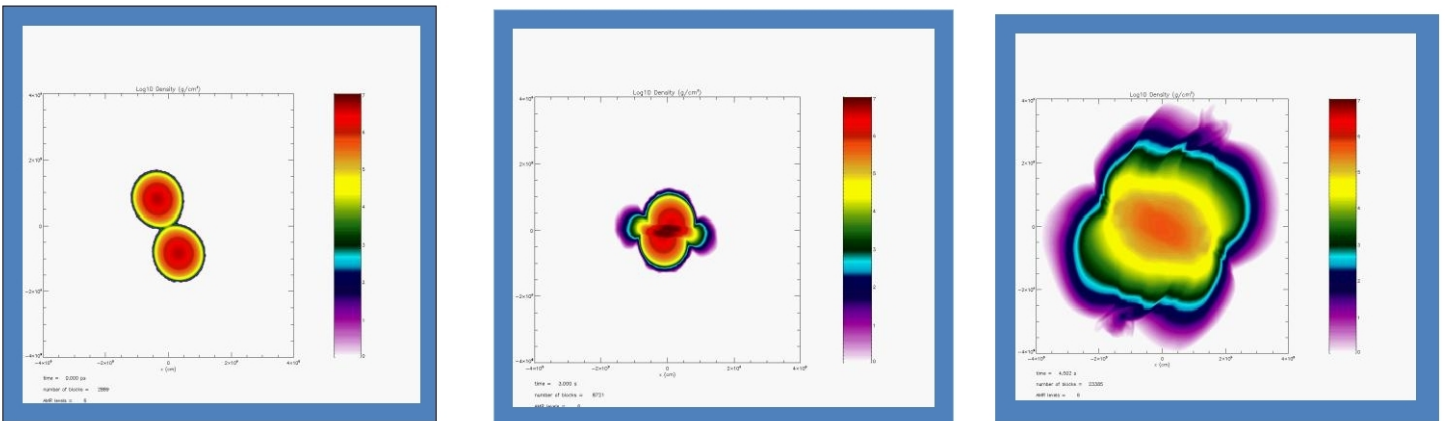
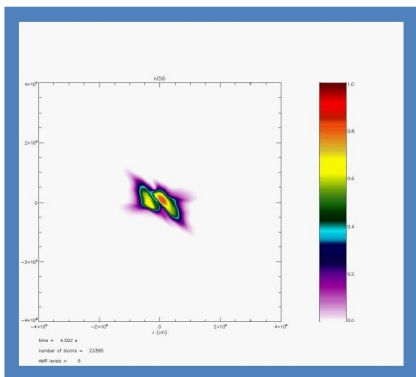


## Off-center Collisions of two White Dwarfs: A Type Ia Supernova Progenitor Scenario

We conduct 3D simulations of off-center collisions between two white dwarfs (WD) to explore the possibility of such events being part of the overall Type Ia Supernovae (SNIa) population. In particular, we investigate collisions of carbon-oxygen white dwarfs of various mass combinations and impact parameters using a combination of Lagrangian and Eulerian computational techniques. Pre-collision, the white dwarfs are evolved using SNSPH, an implementation of Smooth Particle Hydrodynamics (SPH), which ensures that the angular momentum of the system is conserved. At the point of contact between the WDs, the results are mapped onto FLASH, an Eulerian adaptive-grid code which is adept at capturing shock structures. Preliminary results indicate 0.0 - 0.5 solar masses of  $^{56}\text{Ni}$  and about 0.2 solar masses of unburned carbon and oxygen, making such collisions a candidate for producing sub-luminous supernovae, such as SN 1991bg, SN 1992K, and SN 2005bl.



*Fig 1. Density snapshots of the collision between 2 0.64 solar mass white dwarfs starting with an impact parameter  $b=1$  WD radius. Left: Initial conditions at  $t = 0$  s Middle: At  $t = 3$  s the white dwarfs are colliding and nuclear burning is taking place. Right: At  $t = 4.5$  s a supernova explosion has occurred and the remnant is in a free expansion phase.*



*Fig 2. Mass fraction of  $^{56}\text{Ni}$  at  $t=4.5$ s*

Contact:

Themis Athanassiadou,  
Arizona State University,  
whawley@gmail.com

Researchers:

Themis Athanassiadou (ASU)  
Wendy Hawley (ASU)  
Cody Raskin (LBNL)  
Mark Richardson (ASU)  
Frank Timmes (ASU)