SNe Ia Simulations with CASTRO

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Type Ia Supernovae
Type Ia Supernovae

• Violent explosions of white dwarfs
  - Carbon-oxygen WD accretes from a companion
  - Chandrasekhar limit of \(1.38 \, M_\star\)
  - Total energy of \(1 - 2 \times 10^{44}\) joules

• Standard candles
Very well-determined maximum absolute magnitude as a function of the shape of the light curve.
SNe Ia Simulations

Modeling of very diverse scales and physics

- Ignition
- Flame propagation
- Transition to detonation
- Full star models
- Light curve and spectra
Computational Astrophysics Consortium

• DOE-SciDAC-2
• LBNL (PI: John Bell)
• UCSC (PI: Stan Woosley)
• UCB
• Stanford
• LLNL
• LANL
• SUNYSB
CASTRO

• Compressible hydrodynamics
• Self-gravity
• Multi-group flux-limited diffusion radiation
• Reaction network
• Level set method for front tracking
• Subgrid model for turbulence
<table>
<thead>
<tr>
<th>CASTRO</th>
<th>FLASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsplit hydro schemes</td>
<td>Operator split scheme</td>
</tr>
<tr>
<td>Refinement in space and time</td>
<td>Purely spatial refinement</td>
</tr>
<tr>
<td>Array of grid patches of variable size</td>
<td>Octree of fixed-size patches</td>
</tr>
<tr>
<td>Multi-group radiation diffusion</td>
<td>None</td>
</tr>
</tbody>
</table>
Scaling Behavior of ScalingTest Problem on franklin.nersc.gov

Scaling of CASTRO
Visualization
Visualization tools

- Amrvis
- VisIt
- Amira
- OpenDX
- ParaView
- OpenDX
- IDL