

Introduction

Methods

Evolution

Further
work

Impact of Resolution on Double-Detonation Models for Type Ia Supernovae

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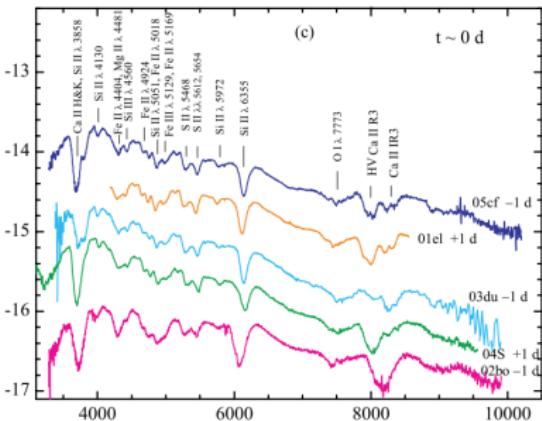
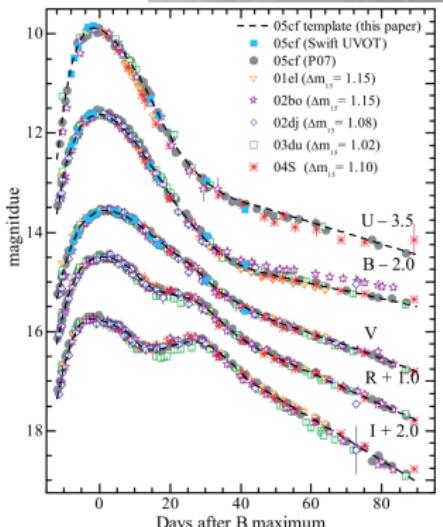
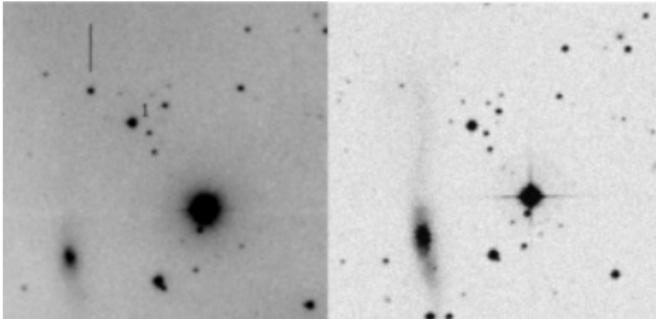
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2022ApJ...937....2R



SN Ia (2005cf)(2009ApJ...697..380W)

Introduction
Methods
Evolution
Further work



Formation Mechanisms

Introduction

Methods

Evolution

Further
work

Name	Companion	Material
Chandrasekhar (M_{Ch})	Deg/Non-Deg	H or He
near-Chandra (nearCh)	Deg	He
Double WD (DWD)	Deg	He, C, O, Ne

Introduction

Methods

Evolution

Further
work

Property Ranges

White dwarf size/mass	$\sim 5000\text{km}$, $\sim 1.0M_{\odot}$
Envelope size/mass	$\sim 2000\text{km}$, $\sim 0.1M_{\odot}$
Temperatures	10^6 to 10^{10} K
Densities	10^{-2} to 10^6 g · cm $^{-3}$
Pressures	10^{17} to 10^{27} dyne · cm $^{-2}$
Detonation timescale	~ 1.0 s
Detonation speeds	10^7 to 10^9 cm · s $^{-1}$
Rayleigh Number	$>10^{11}$

Introduction

Methods

Evolution

Further
work

Hydro PPM solver for the compressible Euler equations.

EoS updates hydrodynamic or thermodynamic ones as required by **Hydro** and **Burn**, respectively (Helmholtz free-energy tables).

Grid uses an adaptive mesh refinement (AMR) criteria to increase the resolution of the simulation where needed (2000ApJS..131..273F)

Burn calculates burning energy release for a given network of species. 13 alpha isotope network used. (1999ApJS..124..241T)

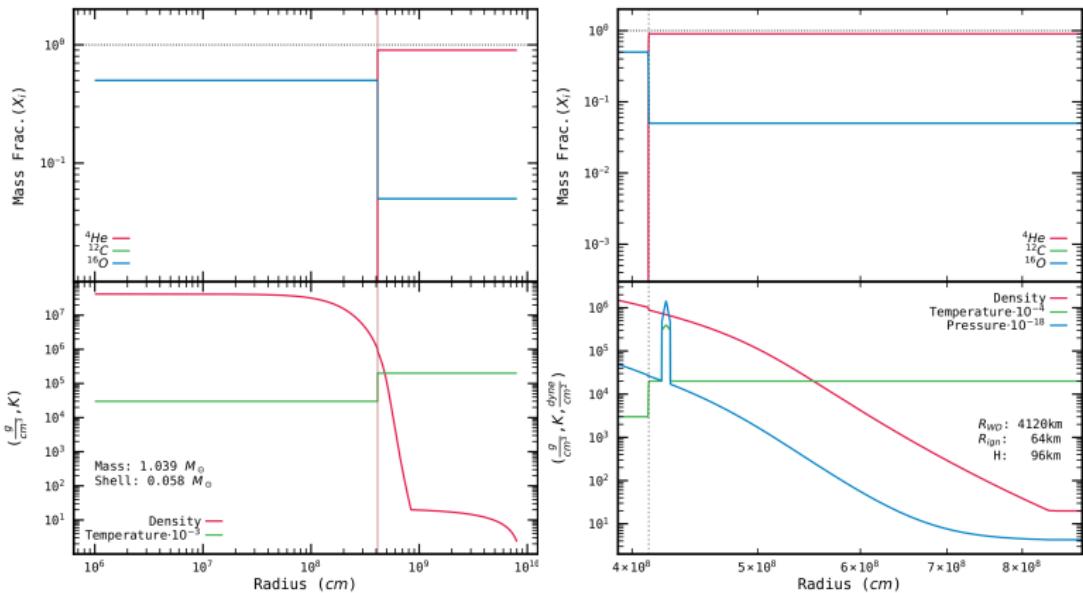
Gravity Poisson equation equation solver for the simulation density field via a multipole expansion, yielding an external field for the **Hydro** module. (8 moments)

Introduction

Methods

Evolution

Further work



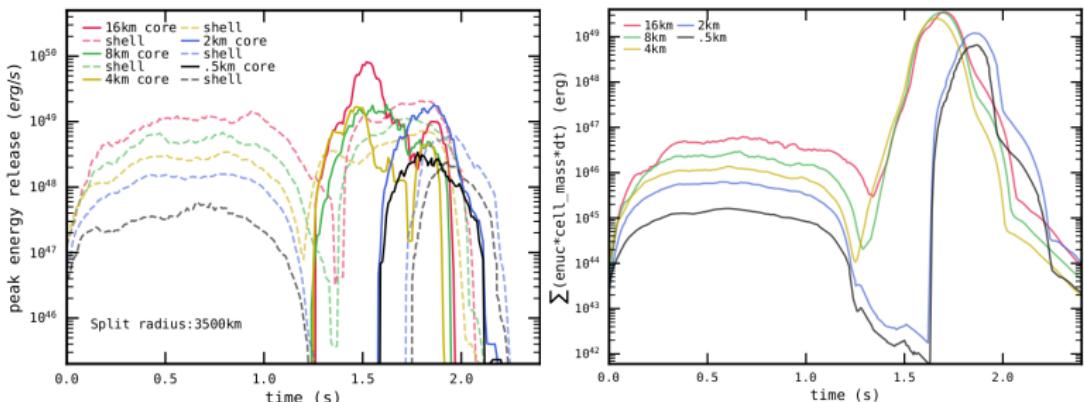
Overall Dynamics

Introduction

Methods

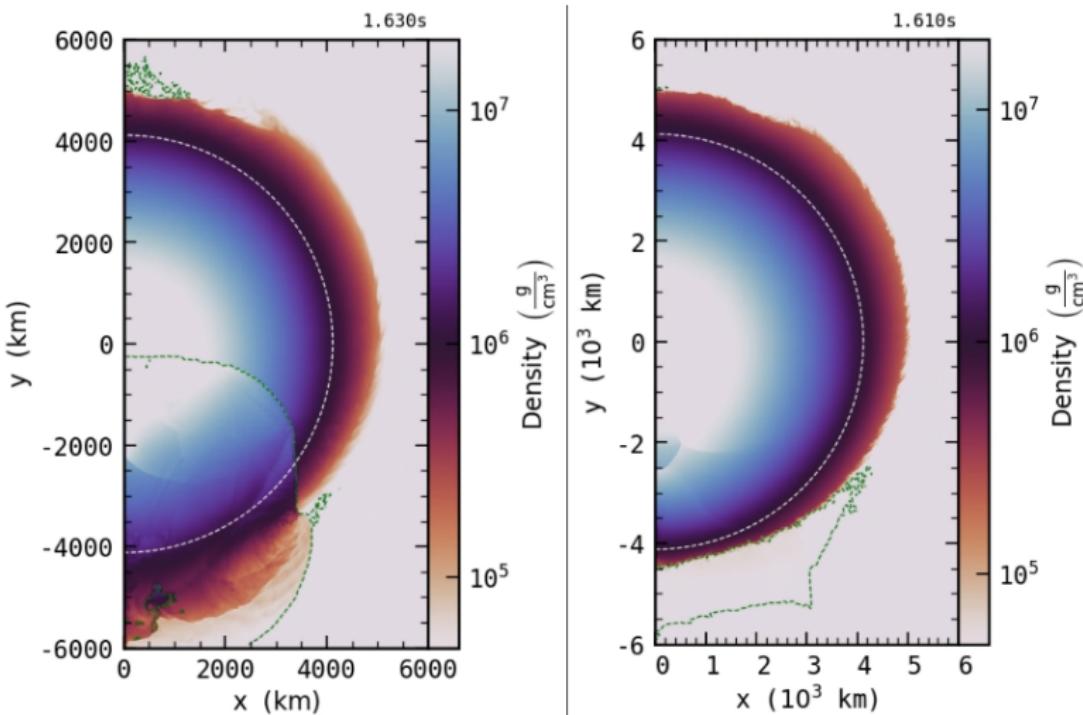
Evolution

Further
work



Overall Dynamics

Introduction
Methods
Evolution
Further work

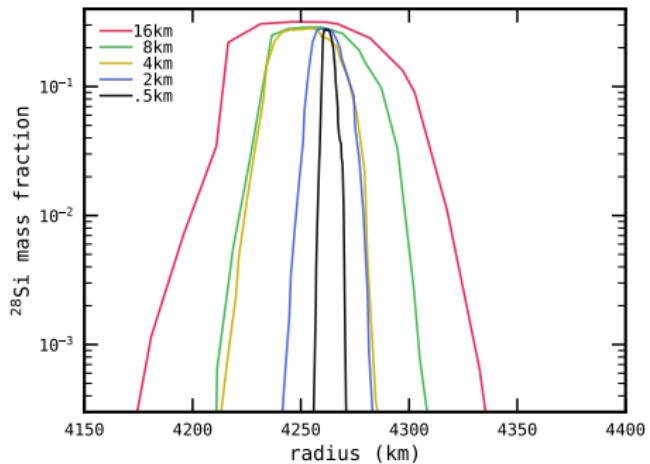


Introduction

Methods

Evolution

Further
work



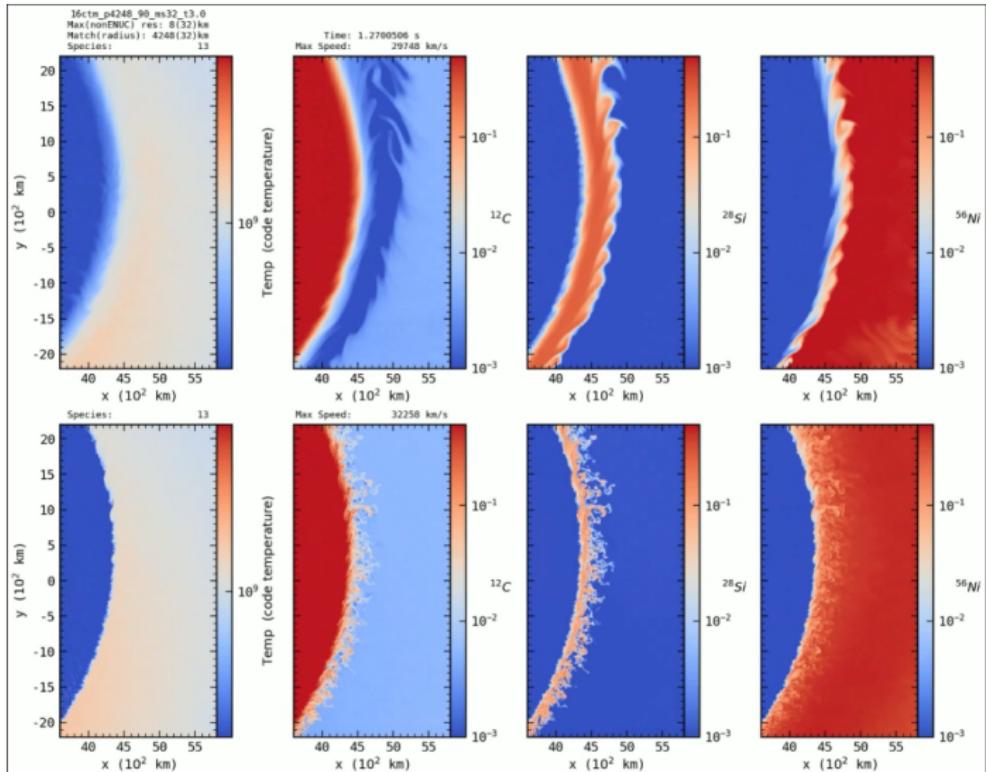
Equatorial Mixing

Introduction

Methods

Evolution

Further
work



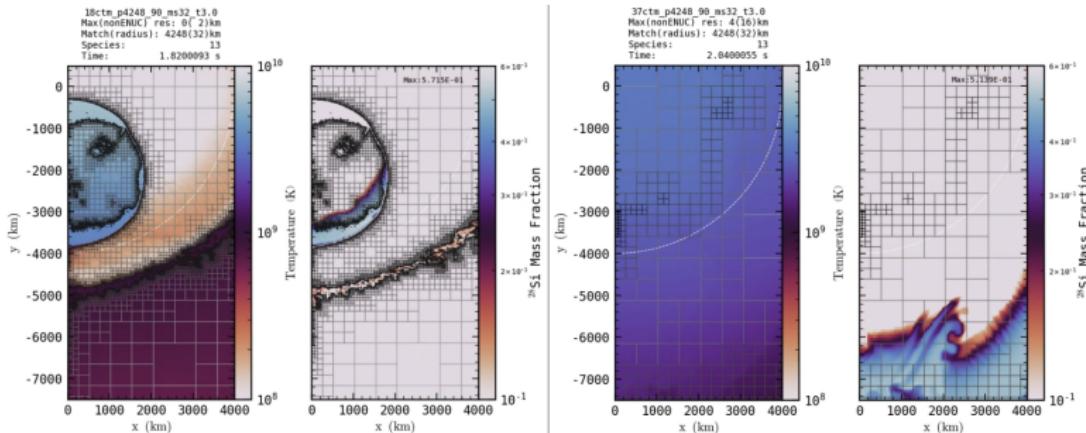
Antipodal Behaviour

Introduction

Methods

Evolution

Further
work

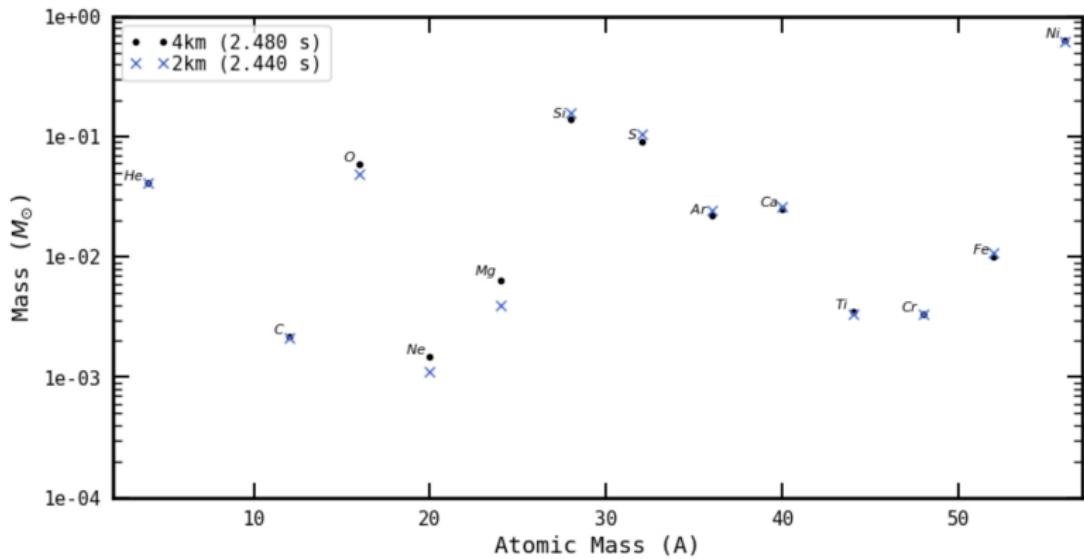


Introduction

Methods

Evolution

Further
work

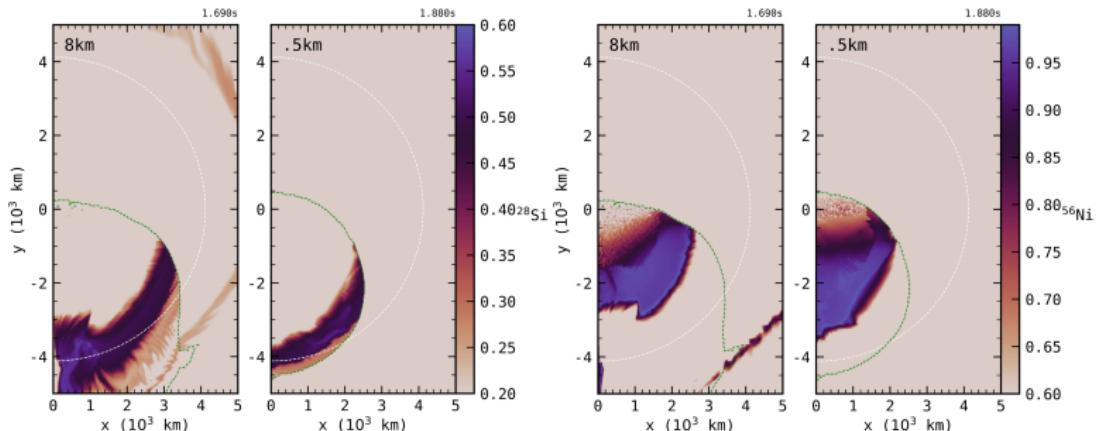


Introduction

Methods

Evolution

Further
work



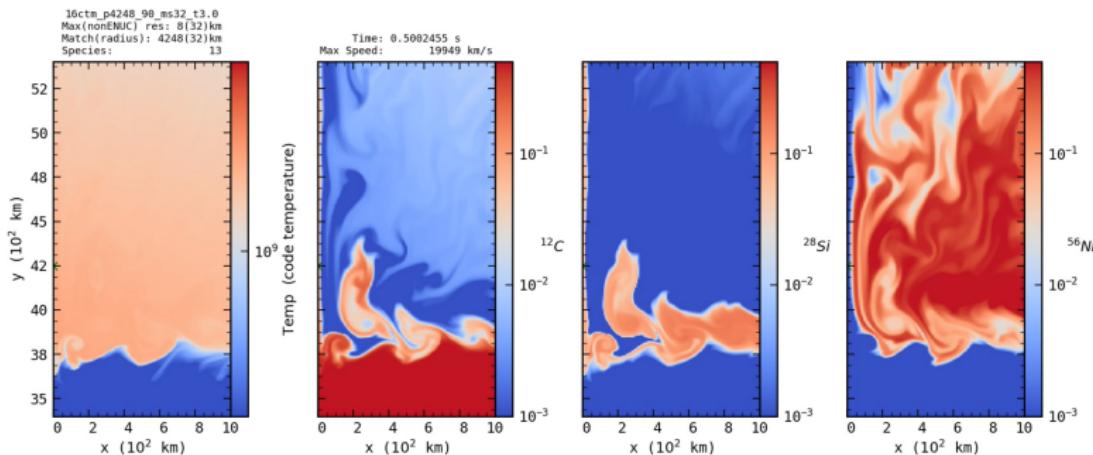
Yield Distribution

Introduction

Methods

Evolution

Further
work



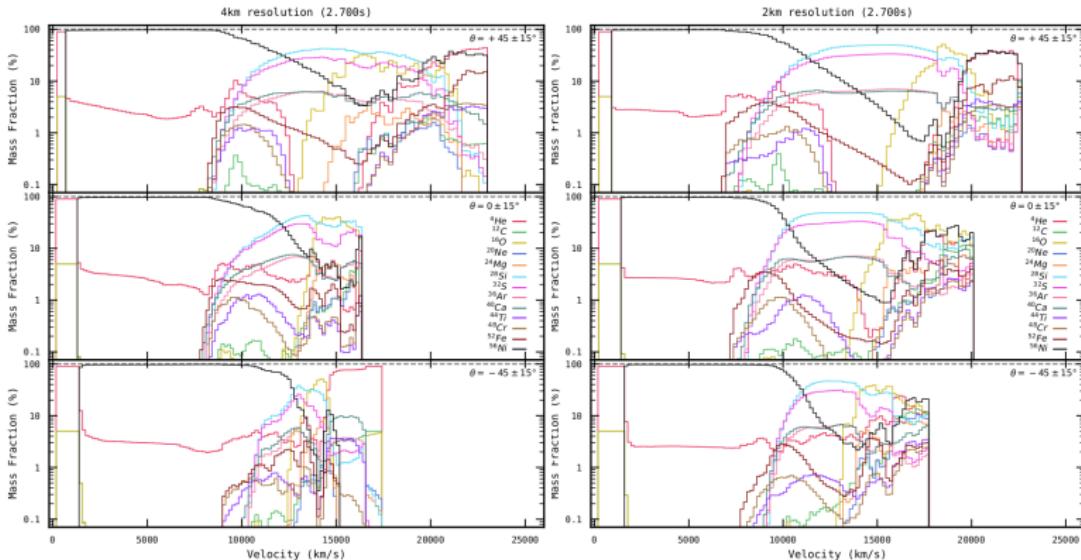
Yield Distribution

Introduction

Methods

Evolution

Further
work

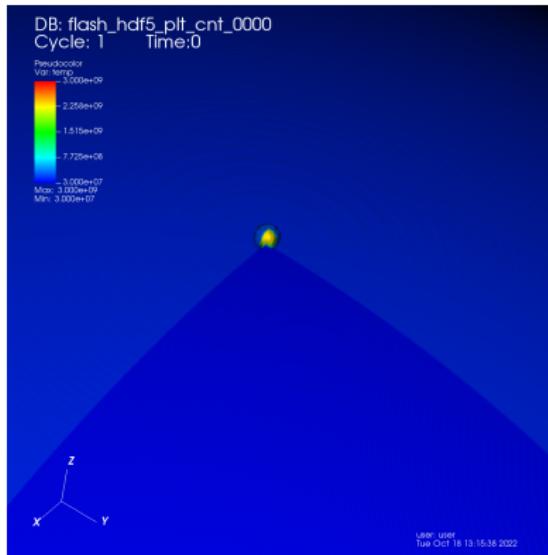


Introduction

Methods

Evolution

Further
work



1D says 1km (Katz 2019ApJ...874..169K)

SPH says maybe? (Gronow 2021A&A...649A.155G: 30km resolution with mixed results)

SNIa DDet Resolution

Introduction

Methods

Evolution

Further
work

Thank You!

Introduction
Methods
Evolution
Further work

