STELLAR EVOLUTION

by
Coordinators of Raggruppamento Scientifico Nazionale 2

Giornate INAF del RSN2 – Napoli, 13-15 January, 2026

Characterization of chemical and physical properties of stars with different initial chemical composition and mass, from their formation to their end (quiescent or explosive)

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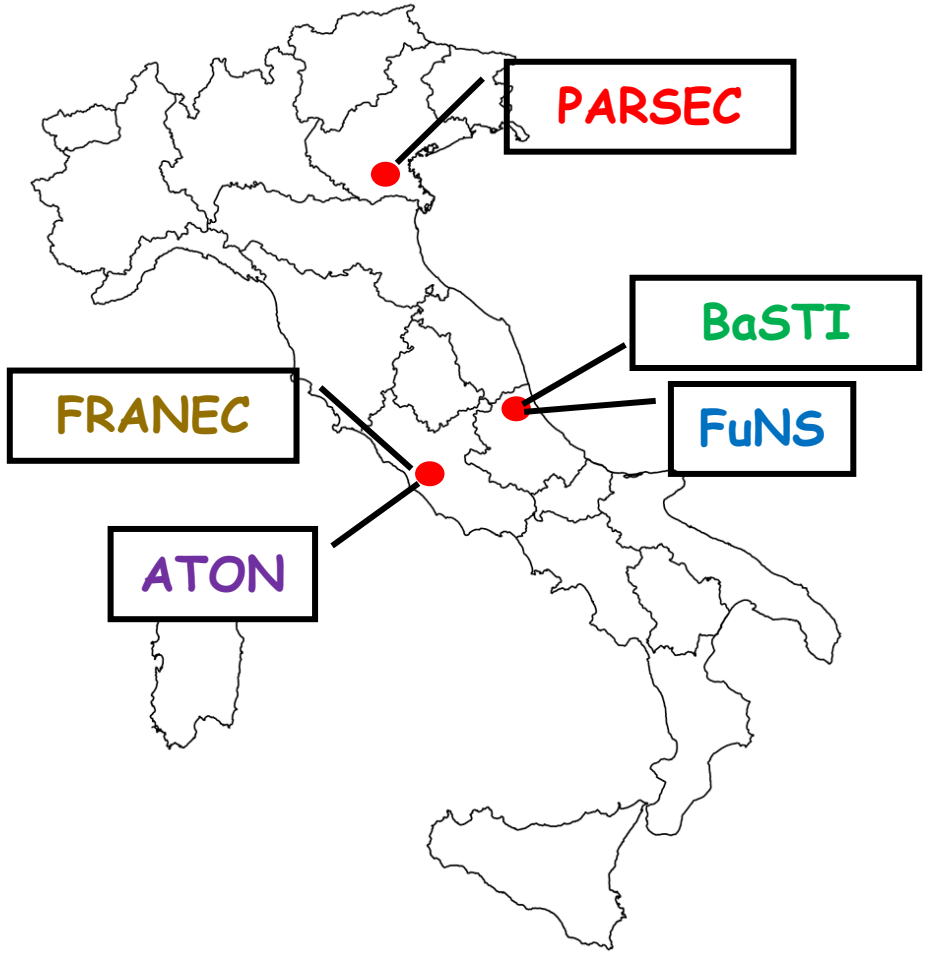

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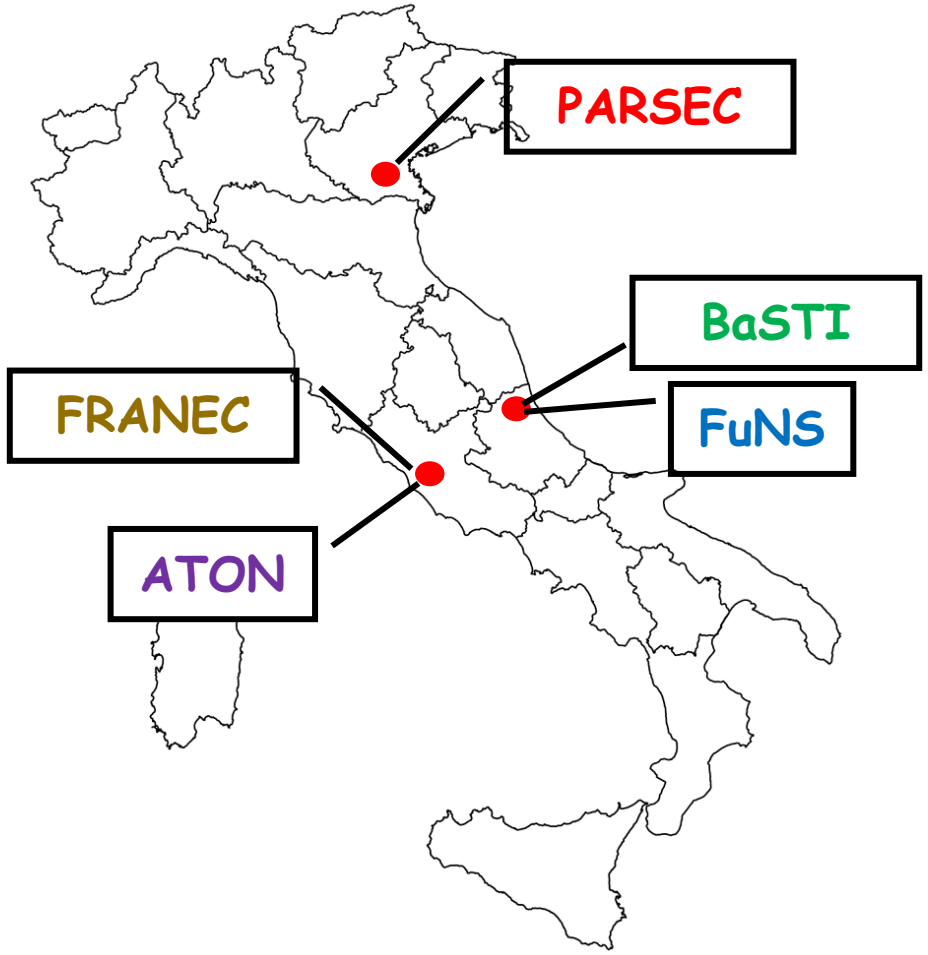
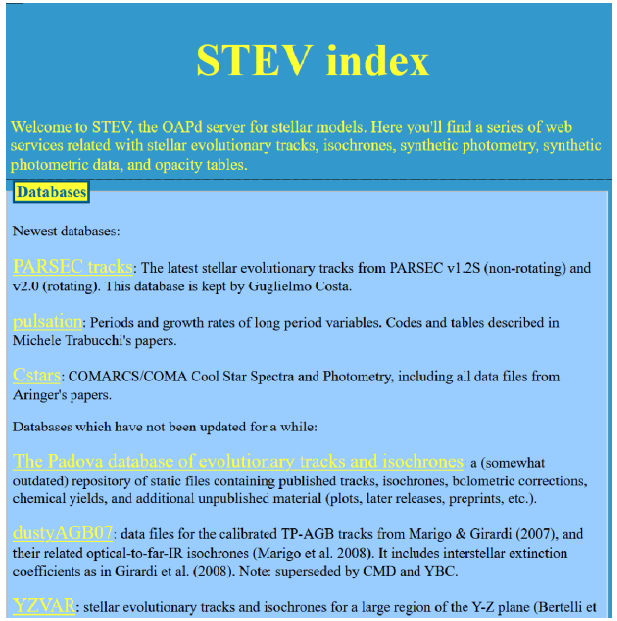


Comparison between models from different codes provides the most reliable estimate of uncertainties on stellar observables.



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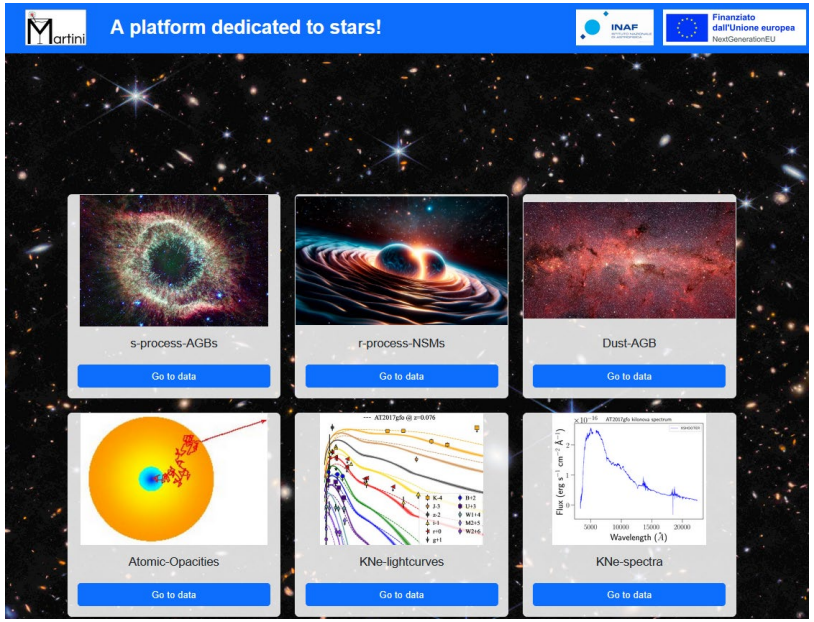
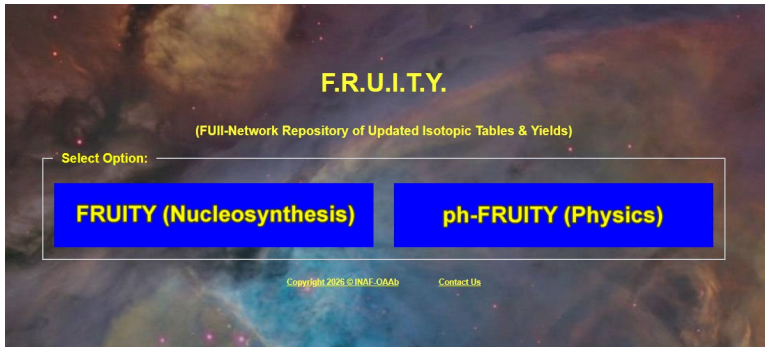
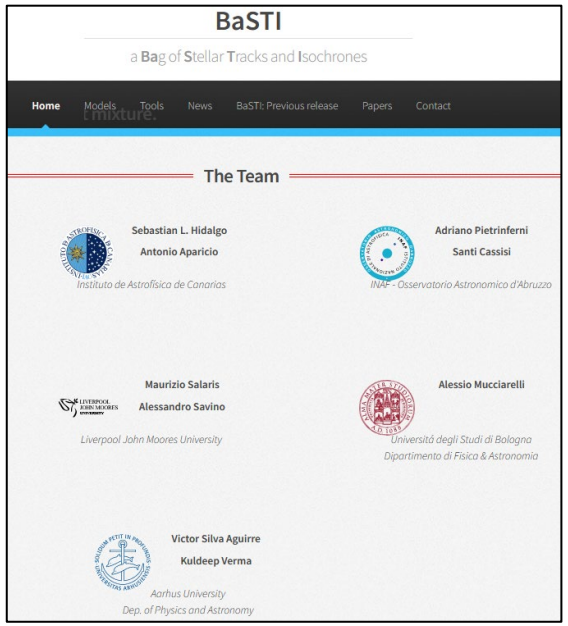


https://martini.oa-abruzzo.inaf.it/



http://fruity.oa-teramo.inaf.it/

https://orfeo.oa-roma.inaf.it/



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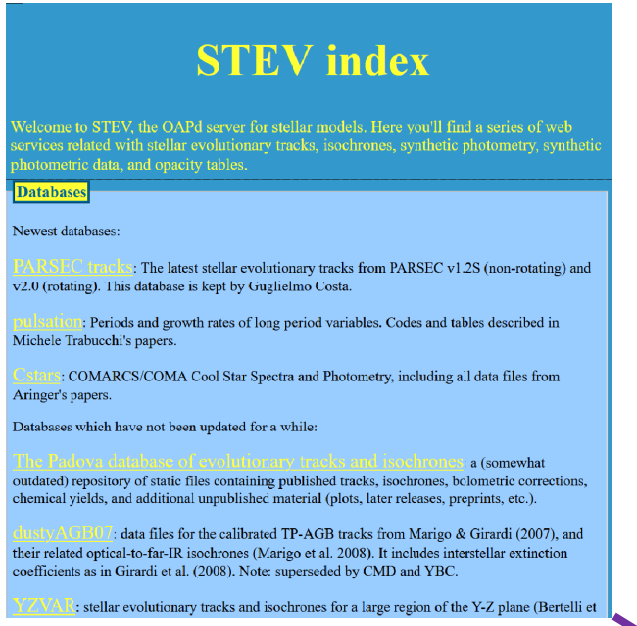

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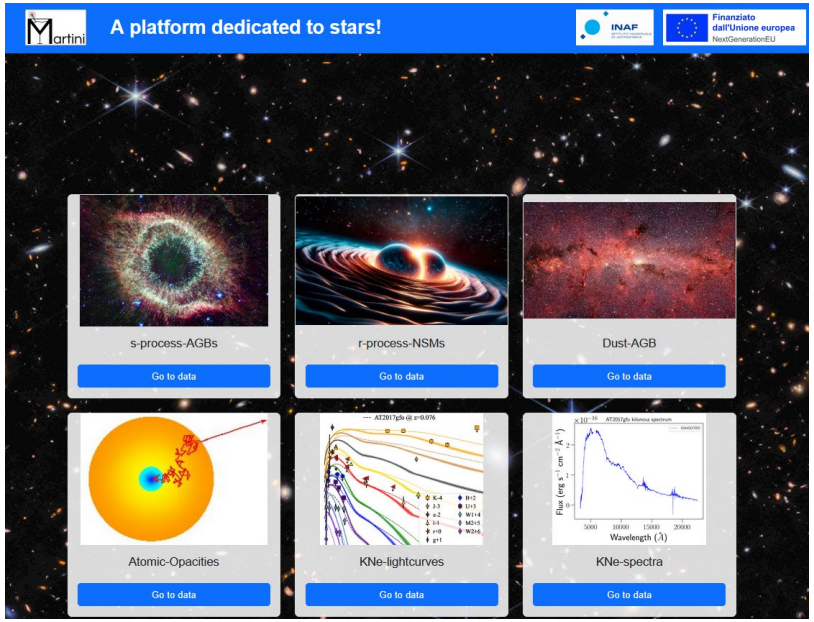

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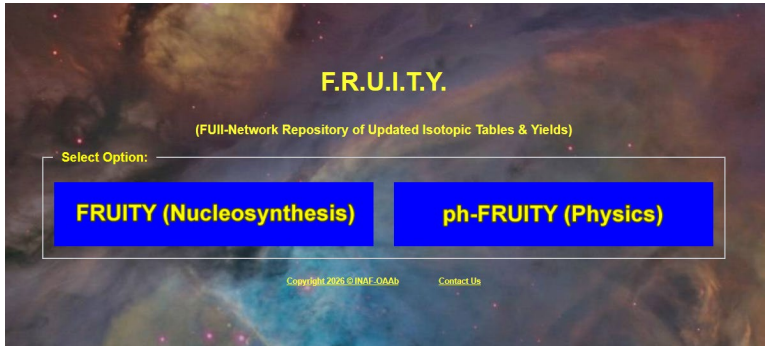

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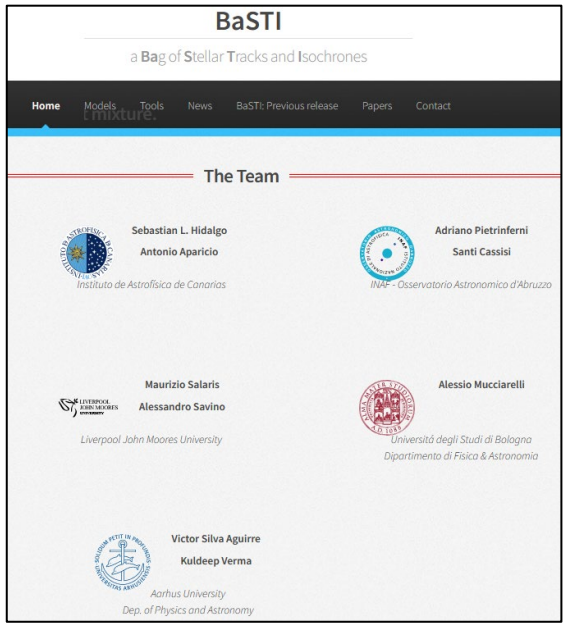

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Population synthesis study
Galactic chemical evolution
Surface Brightness Fluctuations

Improving Physical Inputs

- Improving nuclear cross sections evaluation at astrophysical relevant energies

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GIANTS Collaboration

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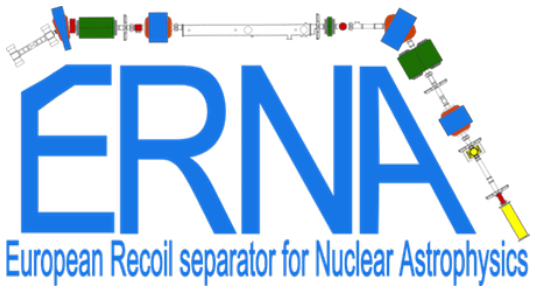

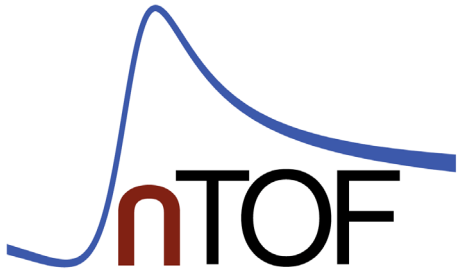

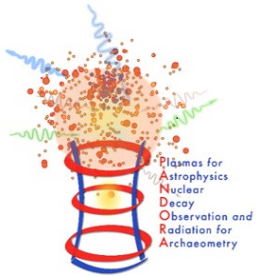

- Improving the treatment of stellar angular momentum evolution

Rotation affects:

T and ρ distribution

Chemical profiles

Improving Physical Inputs

- Improving nuclear cross sections evaluation at astrophysical relevant energies

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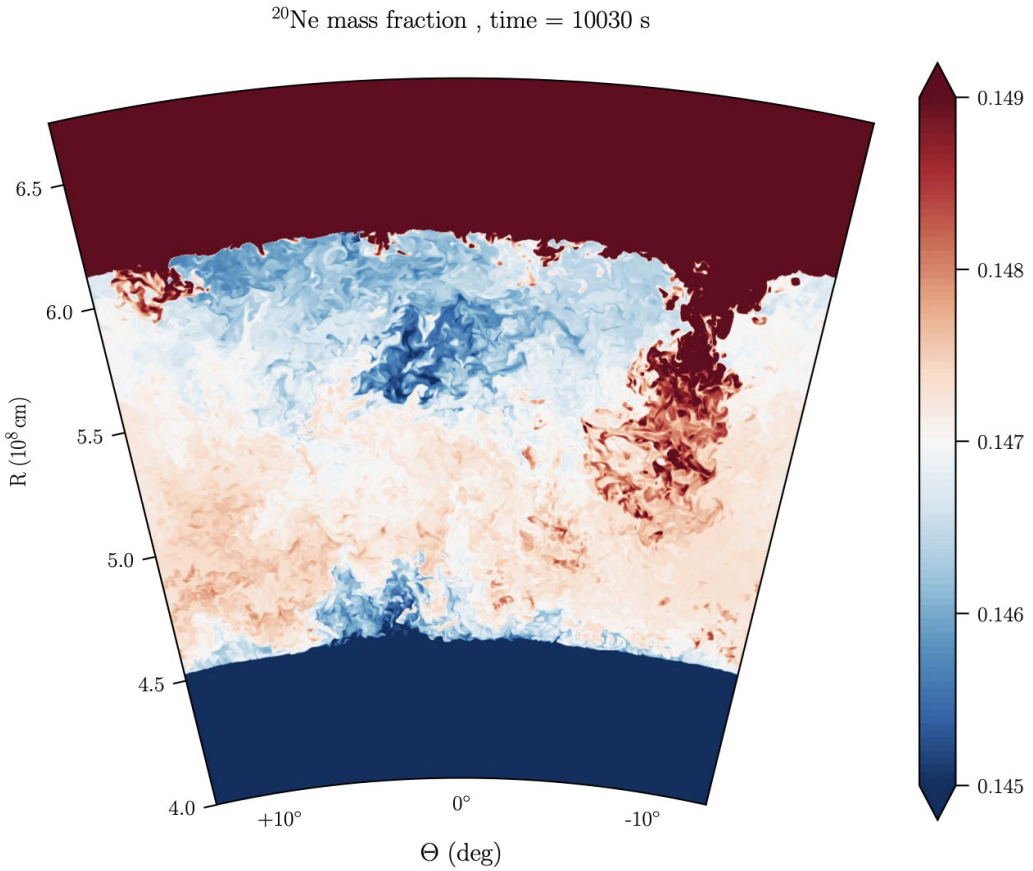
Chemical profiles

Asteroseismic observations

Improving Physical Inputs

- Developing 3D evolutionary models

Rotation and convection are intrinsically multidimensional phenomena



Improving Physical Inputs

- Developing 3D evolutionary models

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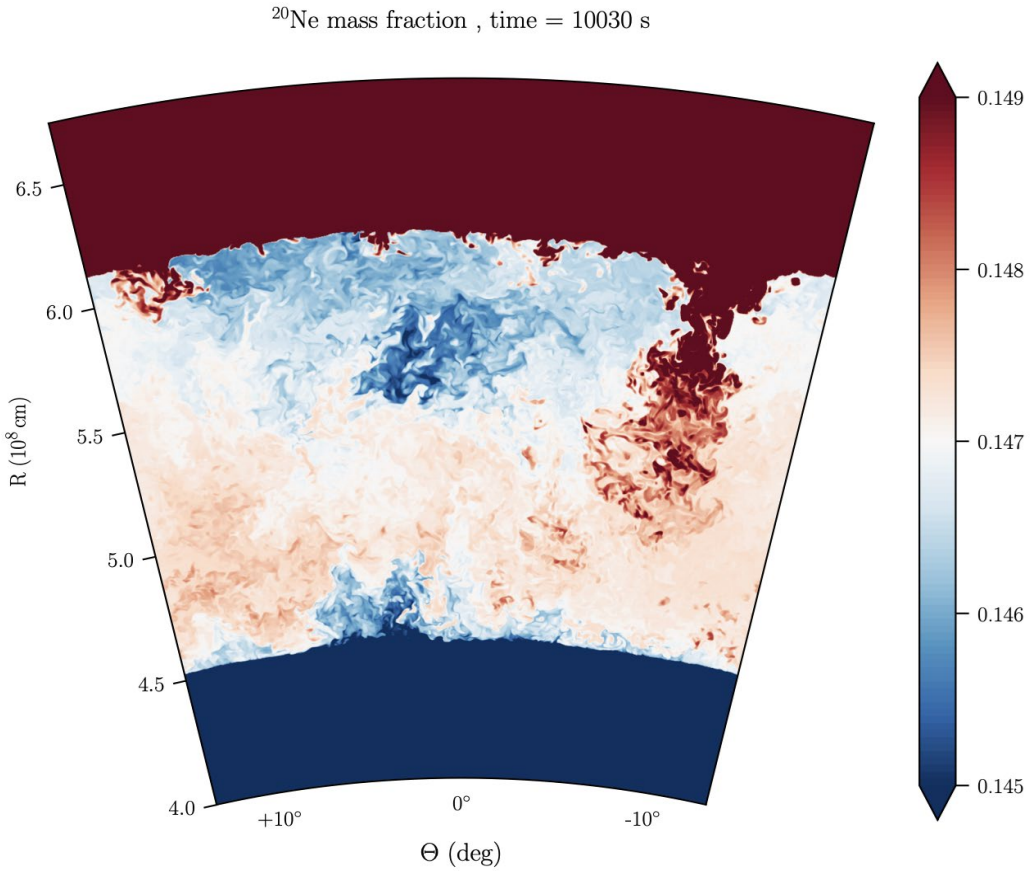
National Centre for HPC, Big Data and Quantum Computing



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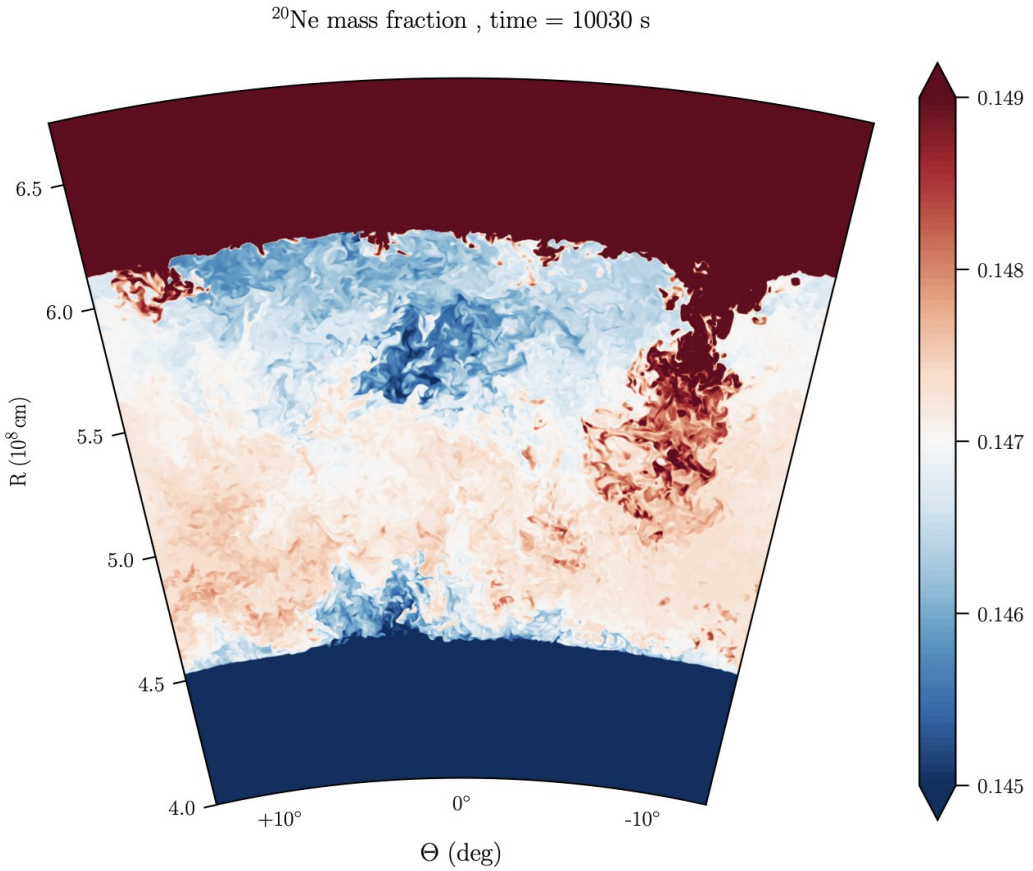

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3D simulations will be used to inform 1D model

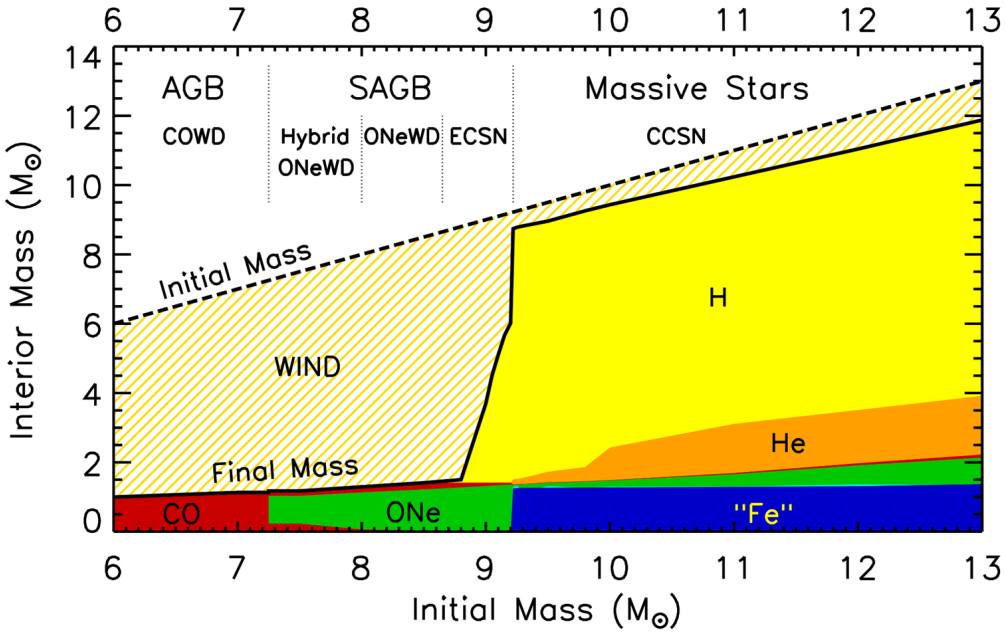
More accurate 1D computation

Improving Physical Inputs

- Understanding the physical mechanisms driving mass loss in different evolutionary phases

Initial-to-final mass relation

Yields from stars in the full range of mass



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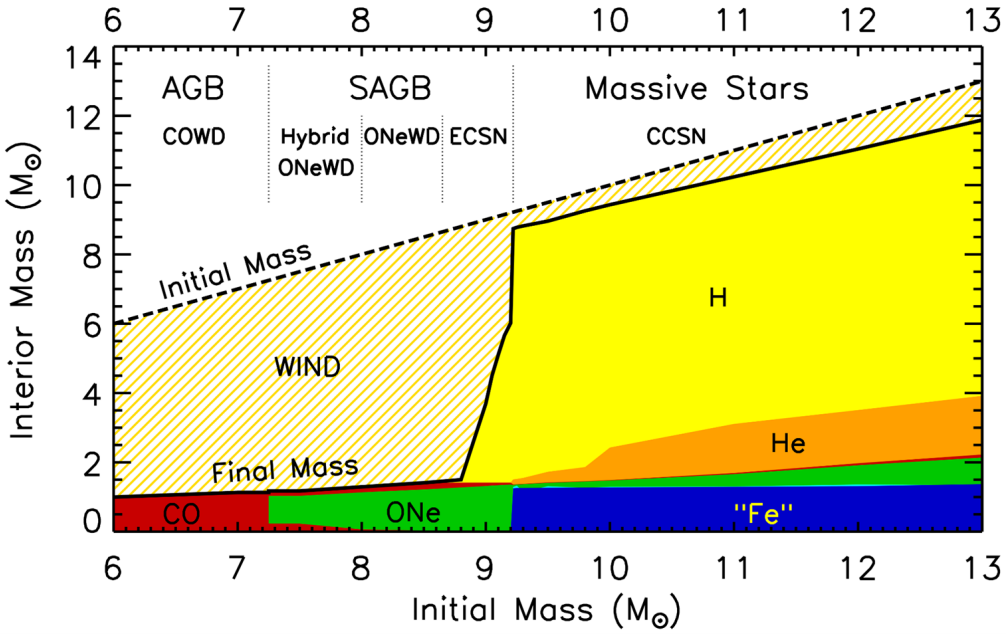
➔ *Chemical evolution of galaxies*



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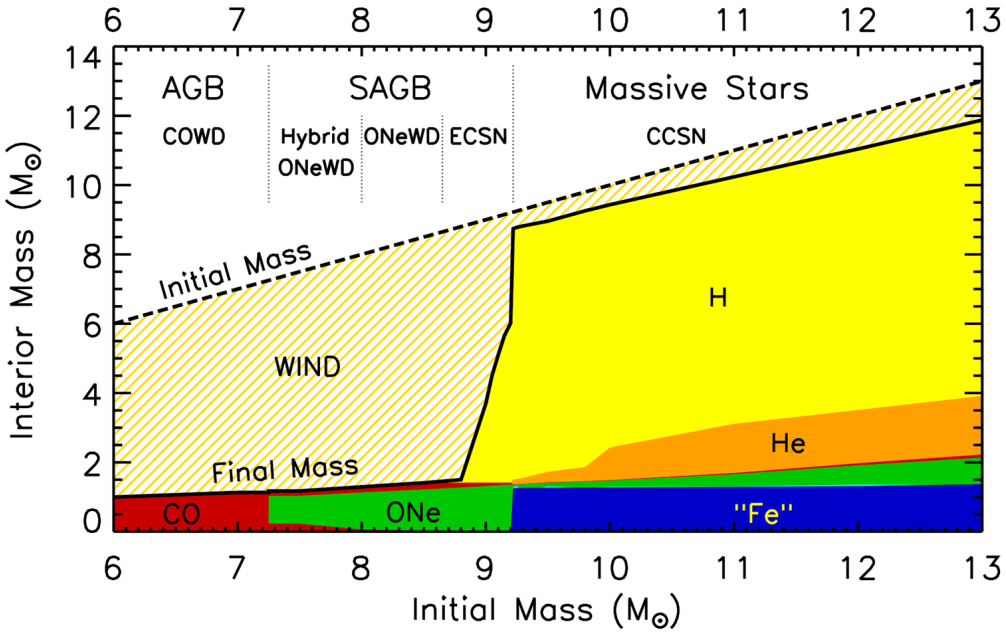

IR, millimeter and radio observations of AGB and RGB stars, pulsating stars, O-type stars in MS

UV and X observations of material around exploding massive stars

JWST, ALMA, SKA, ELT, Spitzer, VLT, Rubin-LSST, SOXS, NTE, Athena

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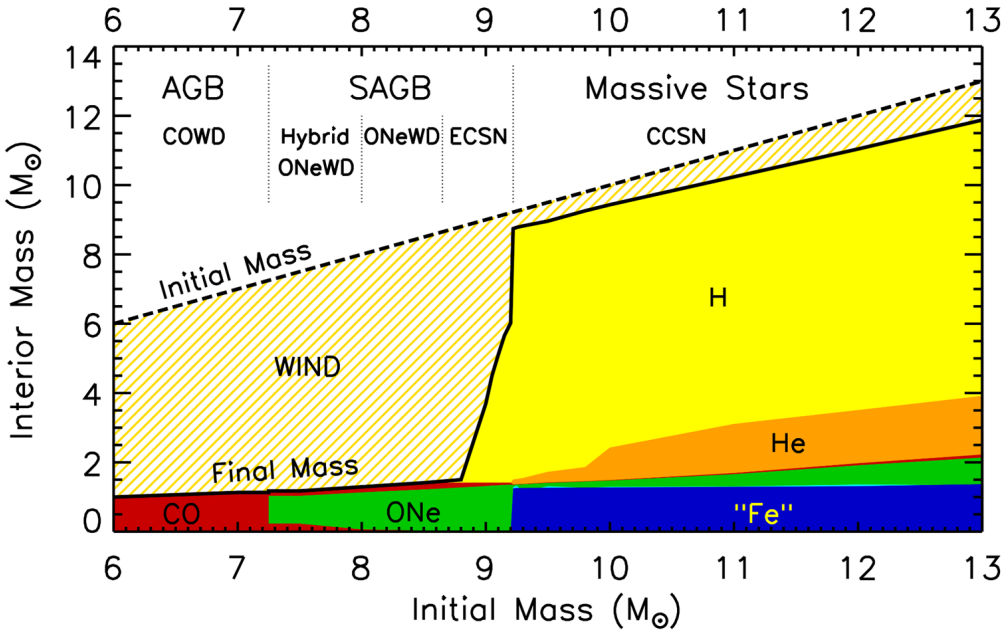

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Improving dust formation codes on the base of observations of dusty environments

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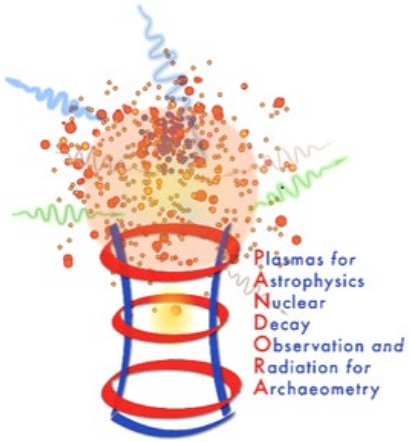
Improving Physical Inputs

- Improving the description of stellar atmosphere

Optical properties of highly ionized species

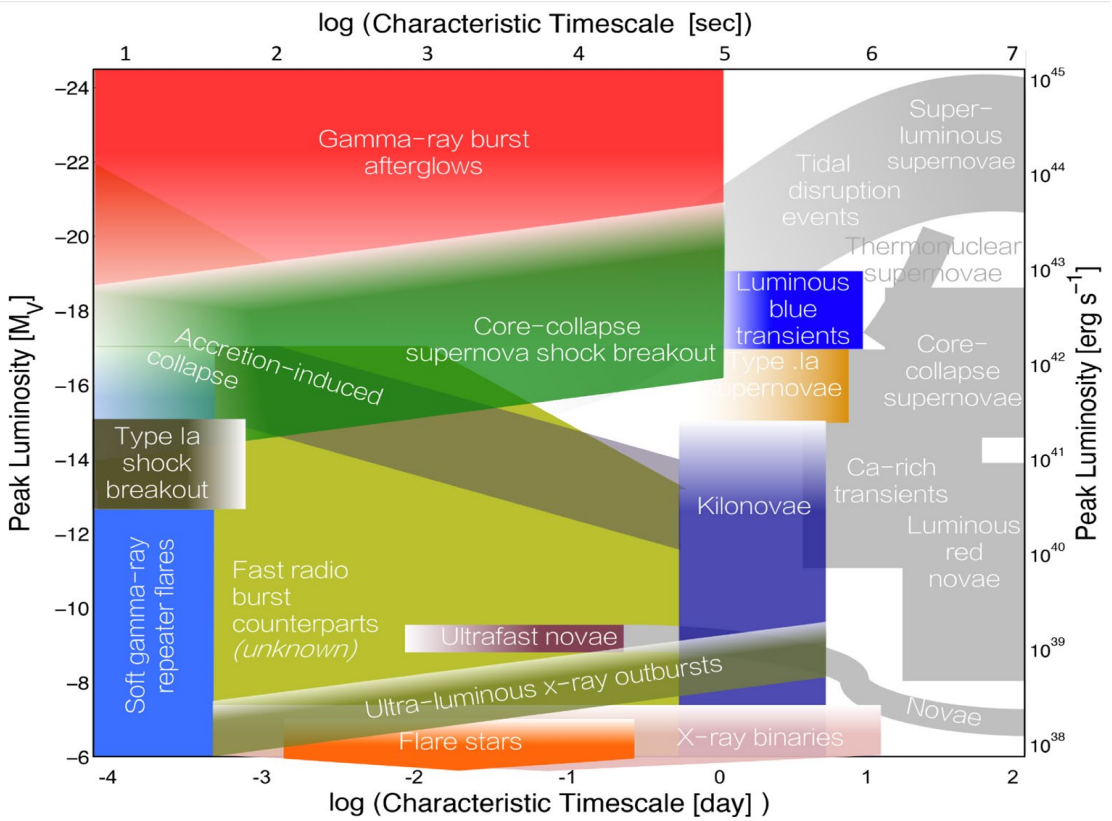


Evaluation of more accurate boundary conditions for stellar models

Future Challenges

Large synoptic surveys, such as Rubin-LSST, will discover new classes of transient phenomena

- What progenitors?
- Physical properties
- Explosive nucleosynthesis
- Variability in binary systems



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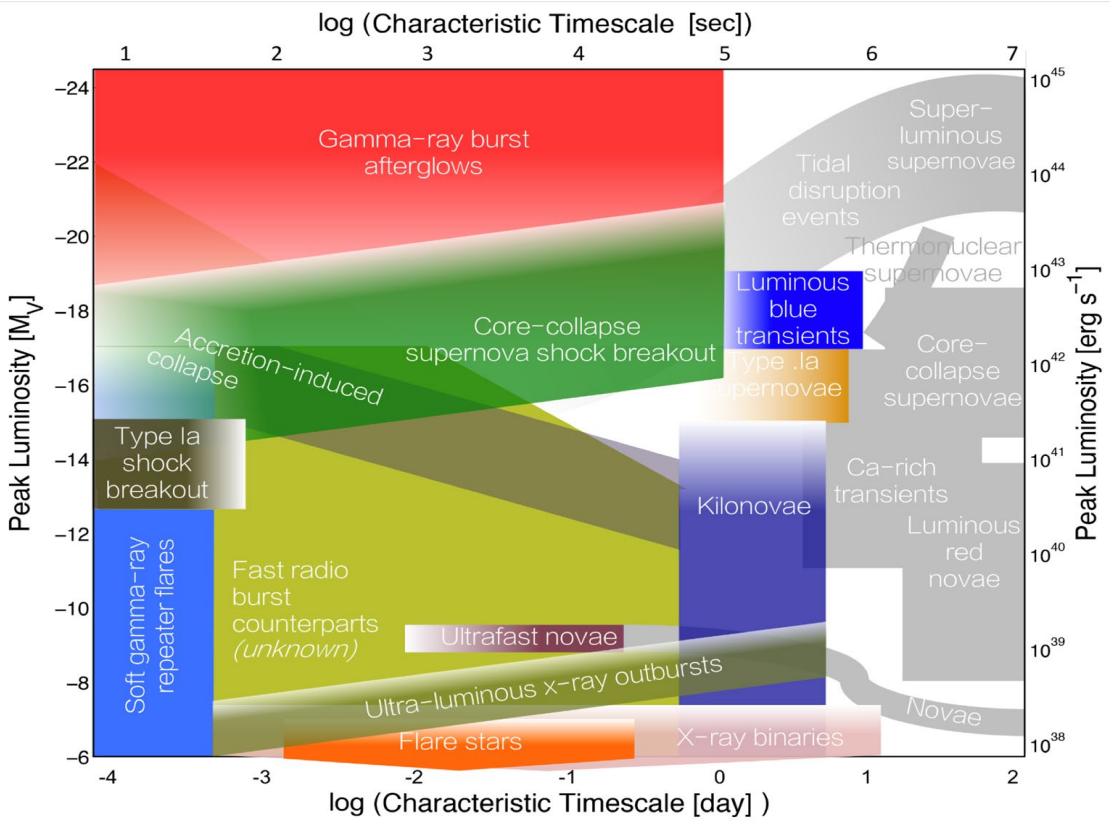

Future instrumentations

- Probing the reionization epoch

ALMA

MWA MURCHISON WIDEFIELD ARRAY

HERA Hydrogen Epoch of Reionization Array The Search for COSMIC DAWN

SKA SQUARE KILOMETRE ARRAY

MeerKAT **ASKAP**