WP9 - Mass Spectrometry Network

Report Summary

ChETEC-INFRA 4th General Assembly

The goal of WP9 is to connect

- High precision isotope analyses of physical samples
- Nucleosynthetic models of different stars

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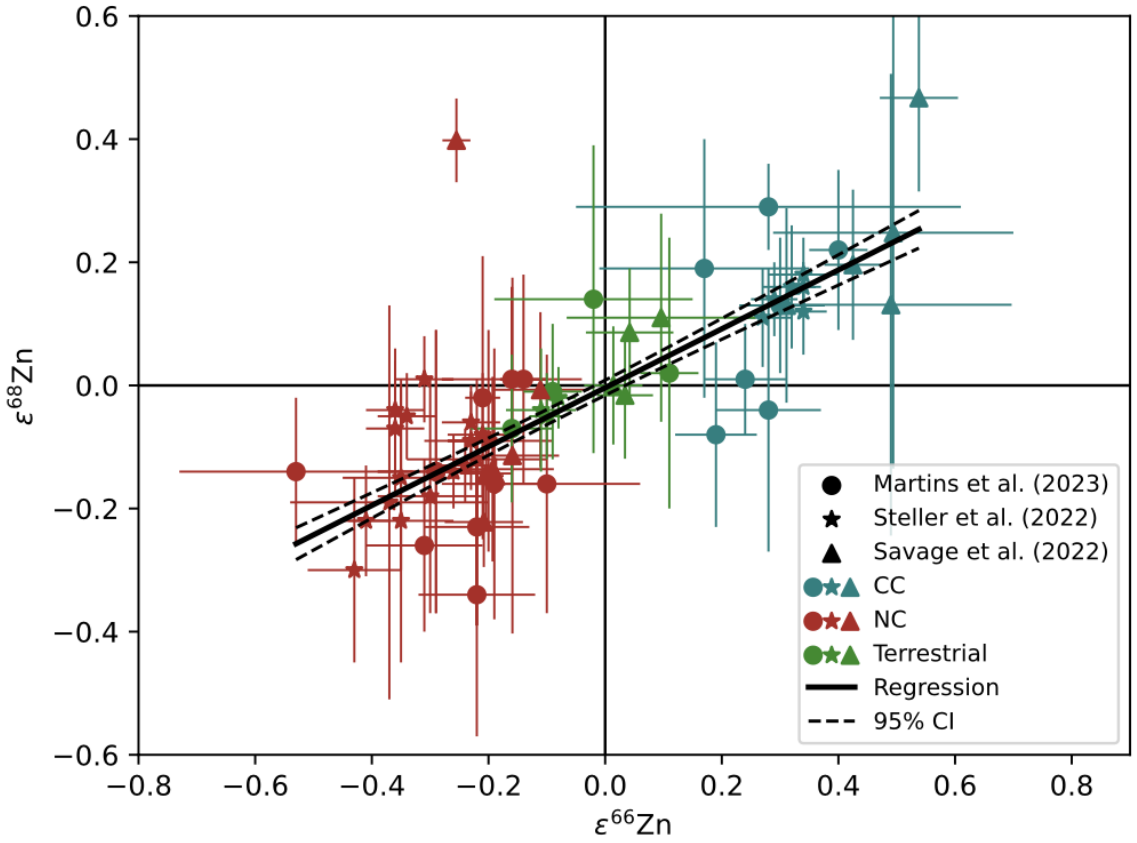
Zn isotope variation in meteorites



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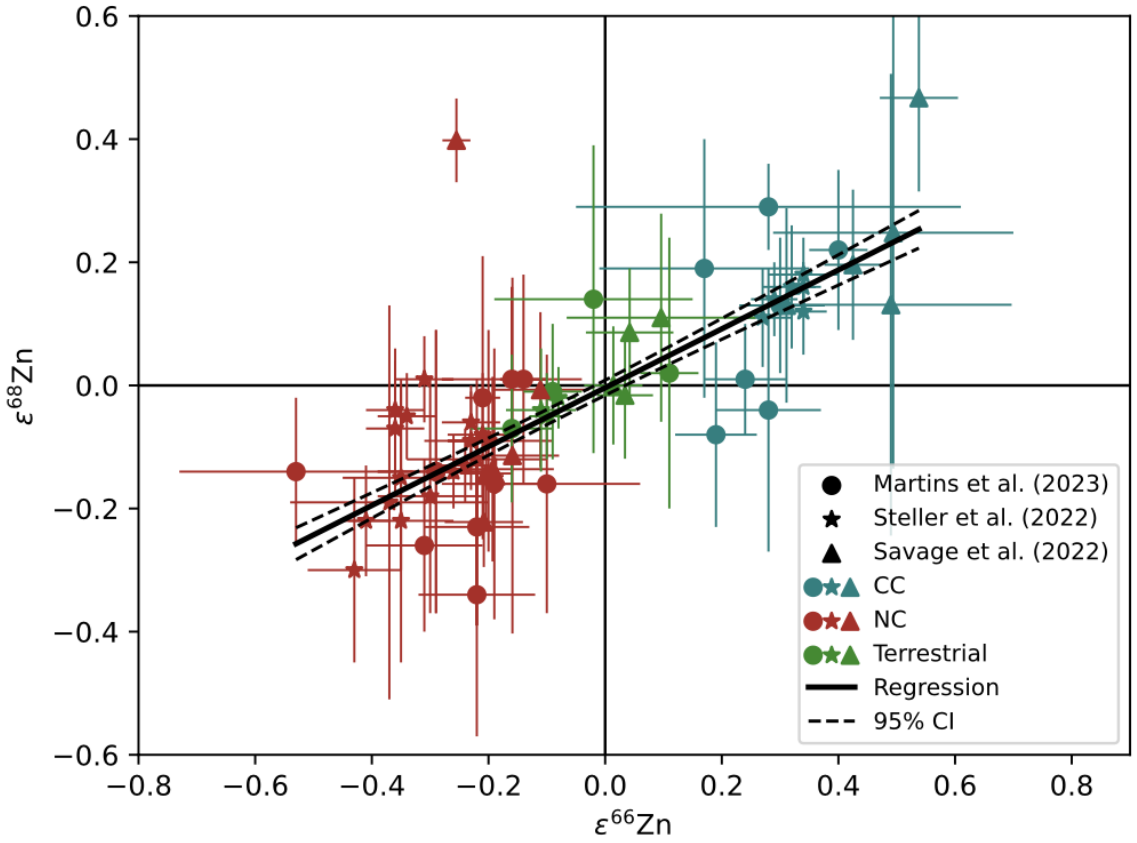
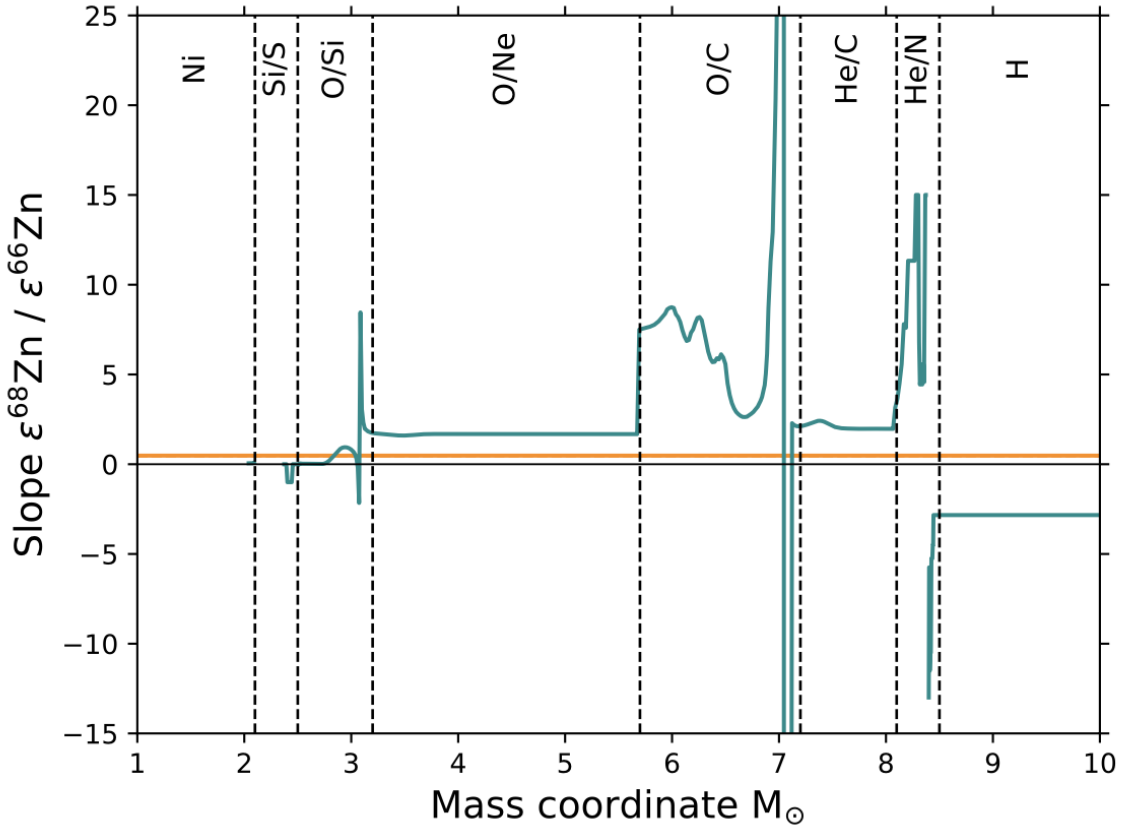


Zn isotope nucleosynthesis in core-collapse SNe



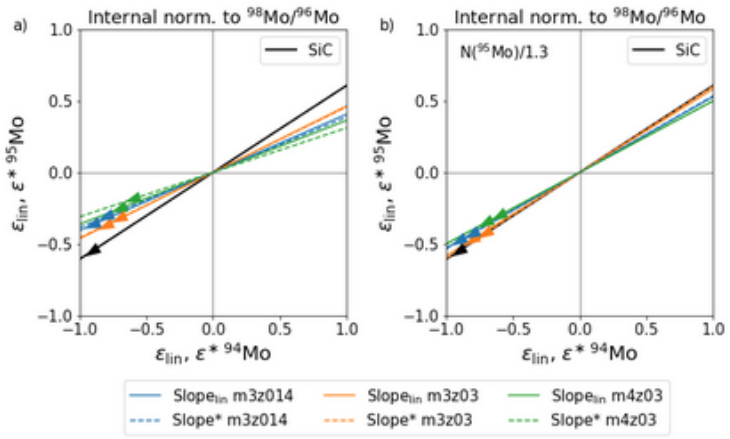
Summary of deliverables

D9.1 ☑	Basic skeleton of open-source computational algorithm to translate predictions from stellar yields into units and representations from laboratory analysis of meteorites published on github or project web page	WP9	17 - MTA CSFK	Websites, patents filling, etc.	Public	12
D9.2	Basic skeleton of open-source computational algorithm to predict expected variations to be seen in Solar System materials, as carried from stardust grains, including nucleosynthesis and dust condensation on project web page	WP9	17 - MTA CSFK	Websites, patents filling, etc.	Public	24
D9.3 ☑	Online database of stable isotope anomalies in bulk meteoritic materials published on project web page	WP9	30 - ETH Zürich	Websites, patents filling, etc.	Public	30
D9.4 ☑	Extension of database into implantation of ionised noble gases into dust grains	WP9	32 - UHULL	Websites, patents filling, etc.	Public	36
D9.5	Online example database generated representing nuclear astrophysics models predictions of correlations between stable/stable and radioactive/stable abundances of specific isotopes.	WP9	9 - IPGP	Websites, patents filling, etc.	Public	36
D9.6	Basic skeleton of open-source computational algorithms to produce, transport and incorporate radioisotopes in Earth materia	WP9	17 - MTA CSFK	Websites, patents filling, etc.	Public	42

D9.1 – month 12

Created by Mattias Ek

Translation of Stellar Yield Predictions for Comparison with the Laboratory Analysis of Meteorites



A git repository with a Jupyter notebook providing the tools to translate predictions from stellar yield calculations into the units and representation obtained from laboratory analysis of meteorites.

The repository is available on GitHub.

Focus on the s process in AGB stars

Published by Lugaro, Ek et al.

D9.1 – month 12

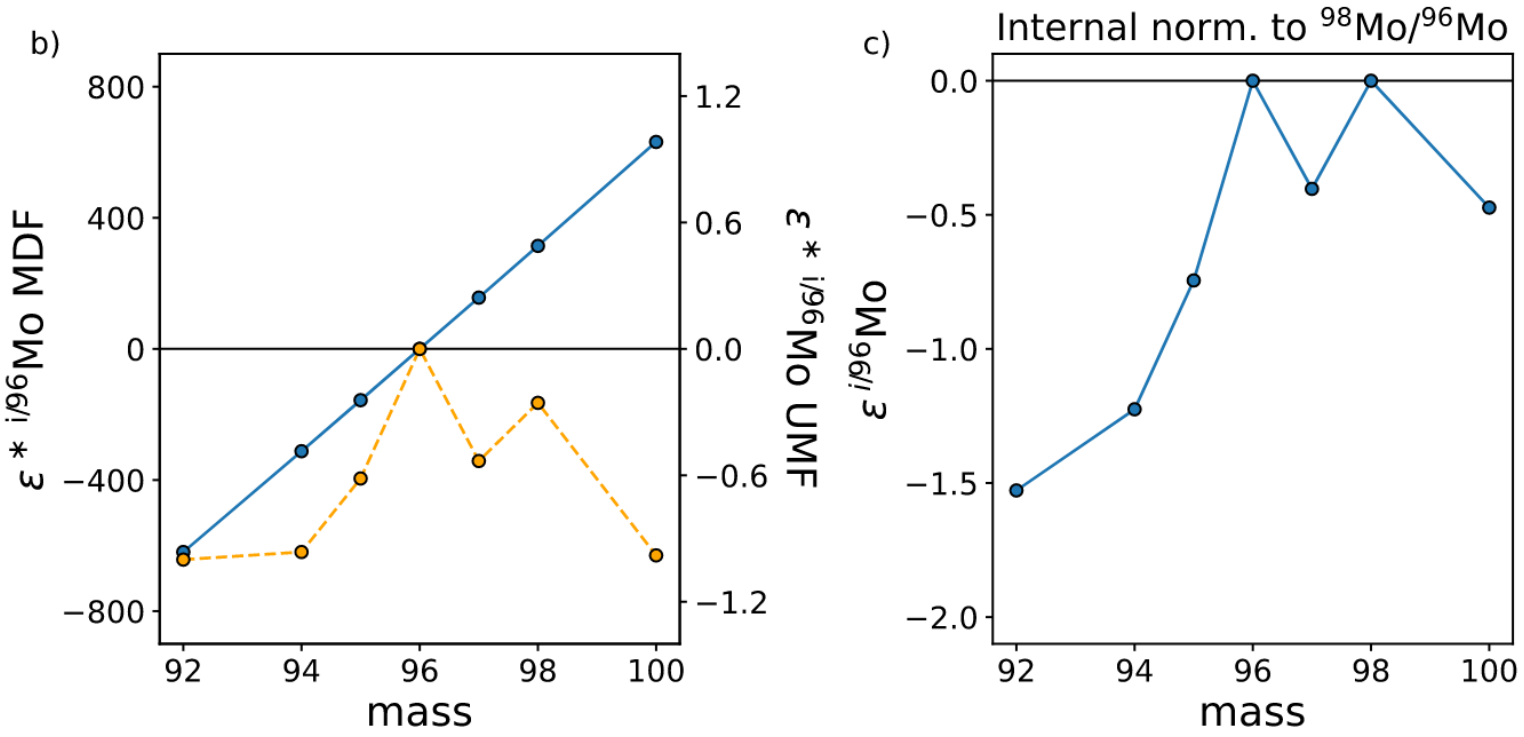
Eur. Phys. J. A (2023) 59:53
https://doi.org/10.1140/epja/s10050-023-00968-y

THE EUROPEAN PHYSICAL JOURNAL A

Regular Article - Theoretical Physics

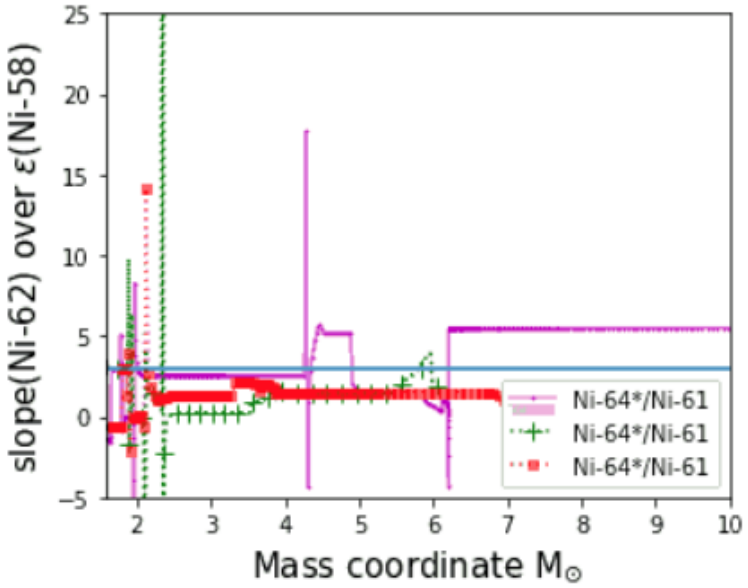
Representation of *s*-process abundances for comparison to data from bulk meteorites

Maria Lugaro[1,2,3,4,a], Mattias Ek[5], Mária Pető[1,2], Marco Pignatari[1,2,6], Georgy V. Makhatadze[7], Isaac J. Onyett[7], Maria Schönbächler[5]



D9.2 – month 24

Stellar Interpretation for Meteoritic data and PLotting – SIMPLE



SIMPLE is an open-source algorithm to translate predictions from sets of core-collapse nucleosynthesis models into quantities which allow for a comparison with meteoritic anomalies.

The code is available on the NuGrid GitHub repository (www.nugridstars.org), and can also be used online as a Jupyter notebook at https://astrohub.uvic.ca/chetec/.

Focus on core-collapse supernovae (18 models available from 6 different sets)

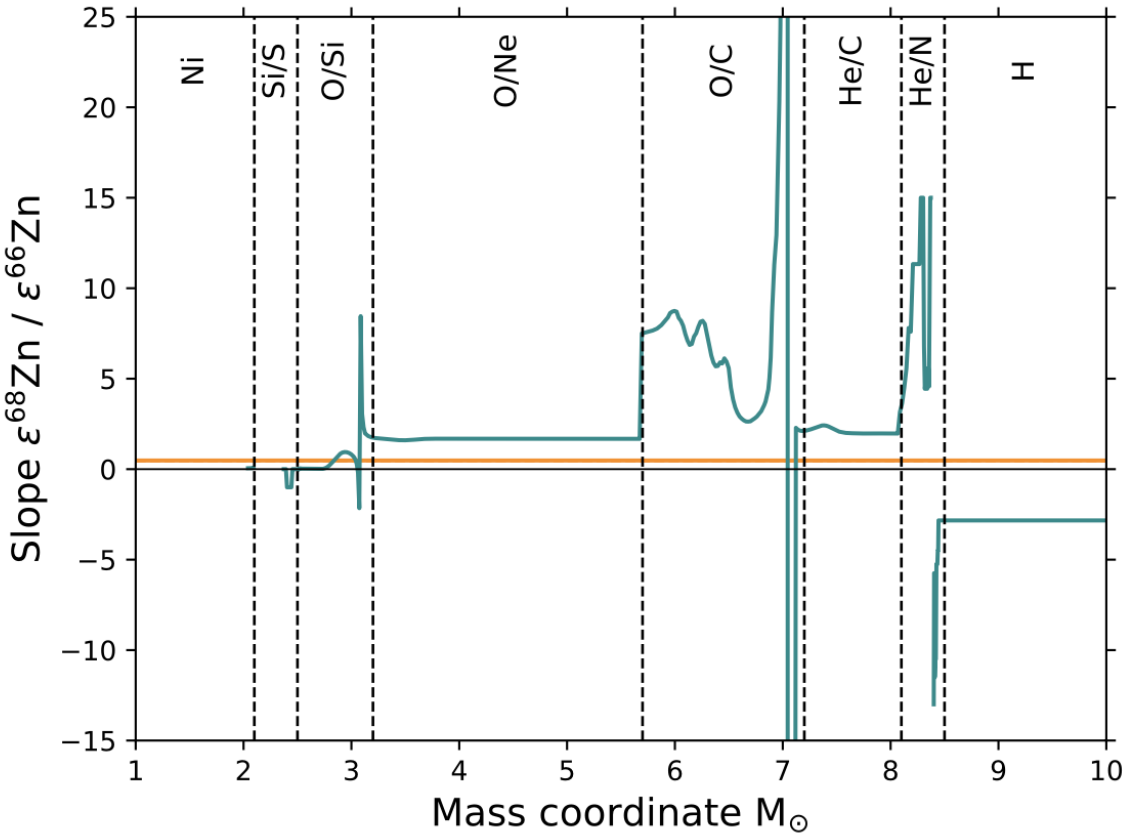
Created by Marco Pignatari, Mattias Ek, Georgy Makhatadze, Gábor Bálazs; Paper in prep. by Pignatari et al. ApJS

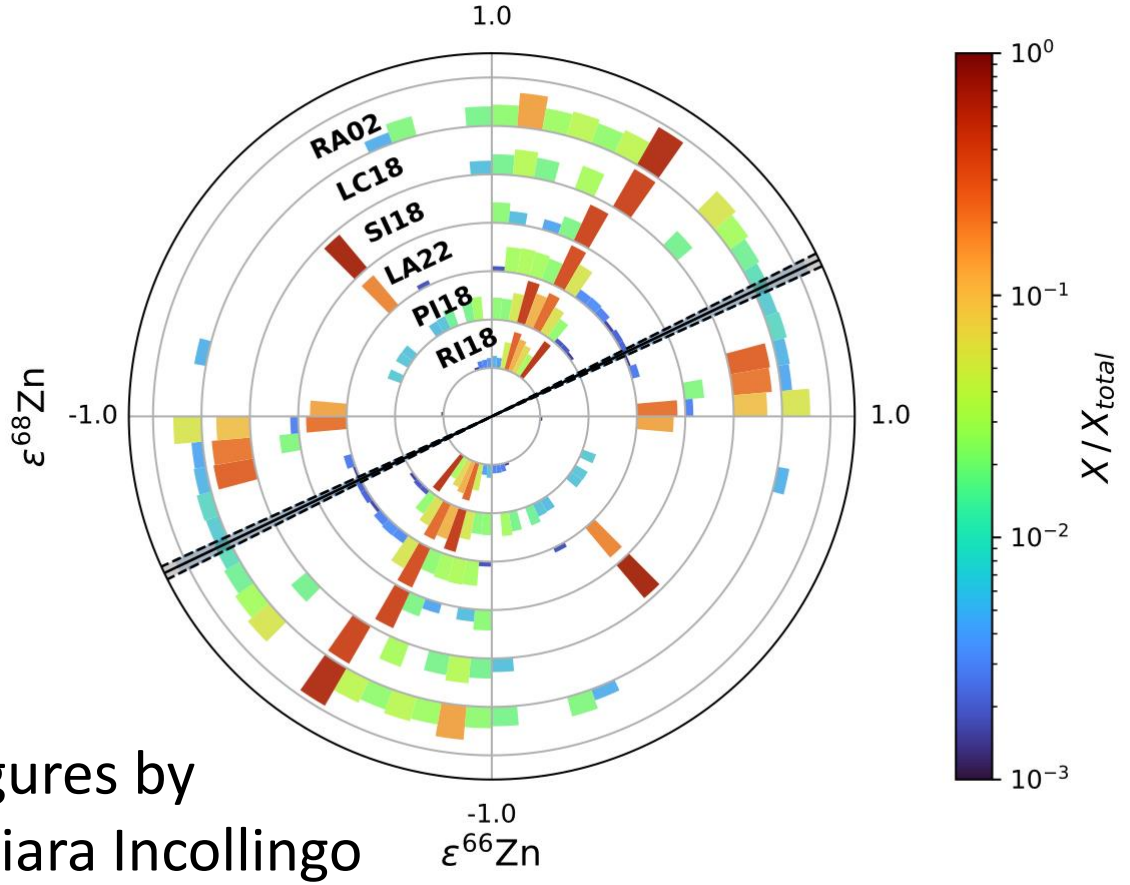
D9.2 – month 24

Draft version May 24, 2024
Typeset using LaTeX **twocolumn** style in AASTeX631

Stellar Interpretation of Meteoritic Data and Plotting (SIMPLE): Isotope Mixing Lines for Seven Sets of Core-Collapse Supernova Models

Marco Pignatari,[1,2,3] Georgy V. Makhatadze,[4,1,2] Mattias Ek,[5] Gábor G. Balázs,[1,2,6] Alessandro Chieffi,[7] Carla Frolich,[7] Chris Fryer,[7] Falk Herwig,[7] Incollingo Chiara,[5] Thomas Lawson,[3] Marco Limongi,[7] Thomas Rauscher,[7] Lorenzo Roberti,[1,2] Maria Schönbächler,[5] Andre Sieverding,[7] Reto Trappitsch,[7] and Maria Lugaro[1,2,8,9]

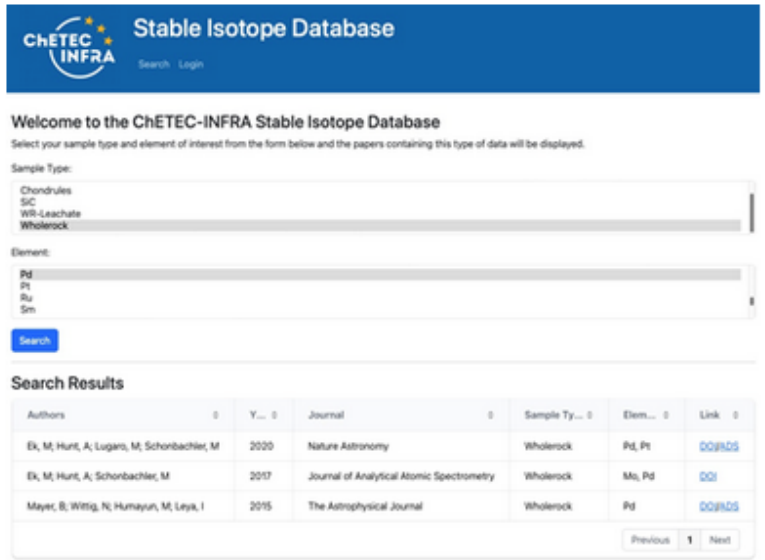




Figures by
Chiara Incollingo

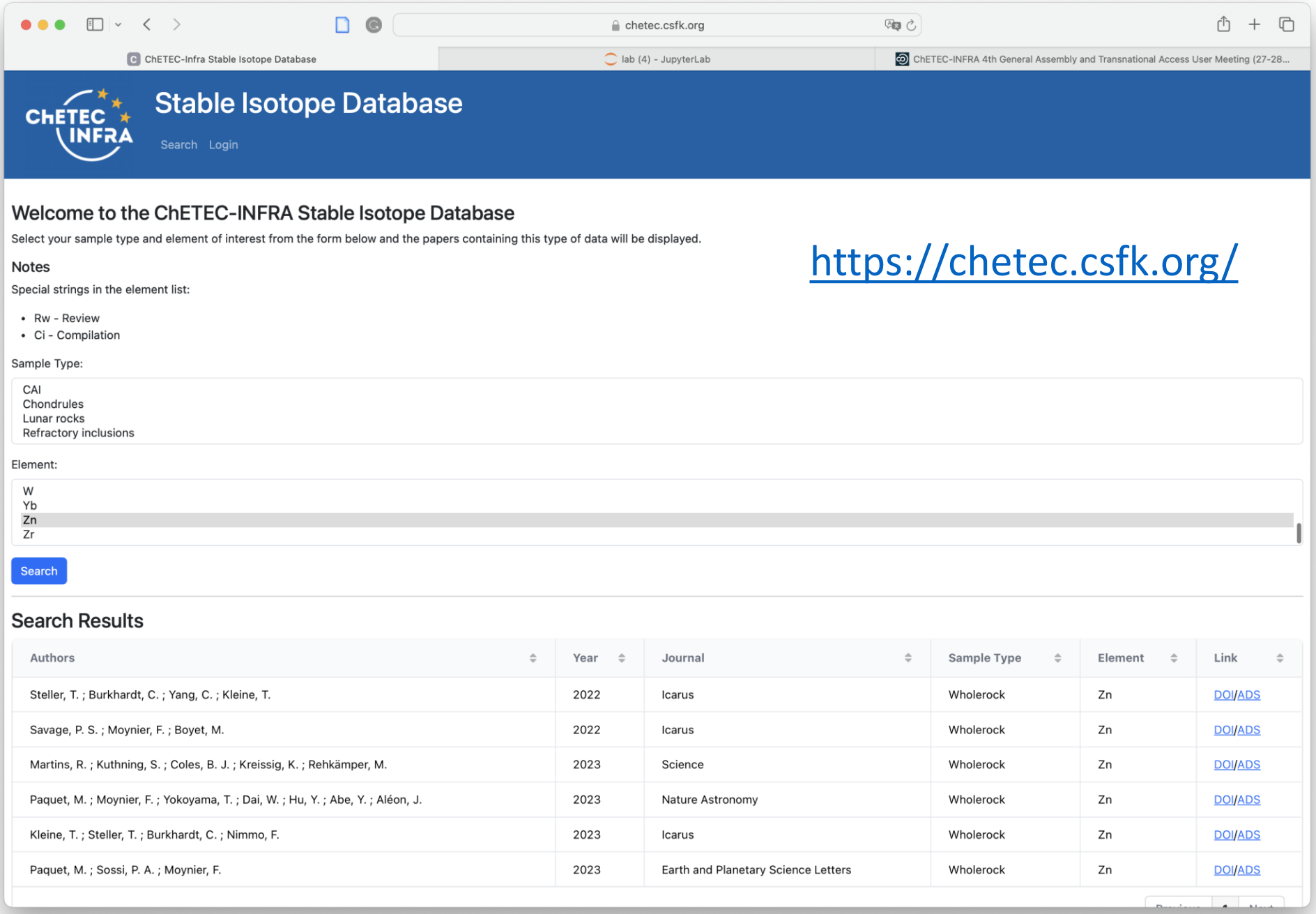
D9.3 – month 30

Created by Mattias Ek
Supported by the CSFK IT staff
Filled by Mattias Ek, Zsófia Stermeczky, Gábor Bálazs, Maria Lugaro (work in progress)



The stable isotope database contains a list of papers that have published mass-independent isotope variations, also known as nucleosynthetic anomalies, in meteorites. The database can be searched for elements and sample types of interest. – It is available here.

D9.3 – month 30

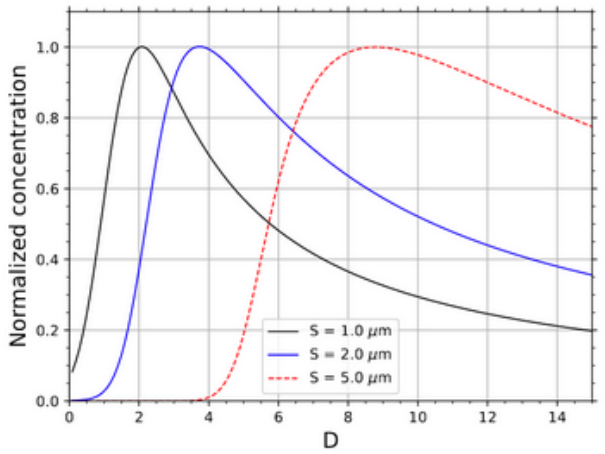


https://chetec.csfk.org/

D9.4 – month 36

Created by Marco Pignatari

Implantation Of Noble Gases In Grains – IONGIG



In order to build a database with predicted (implanted) isotopic abundances for different grain sizes to compare with grain measurements, we developed a new python tool – the IONGIG framework, or Implantation Of Noble Gases In Grains framework – to follow the implantation of ionized noble gases into dust grains.

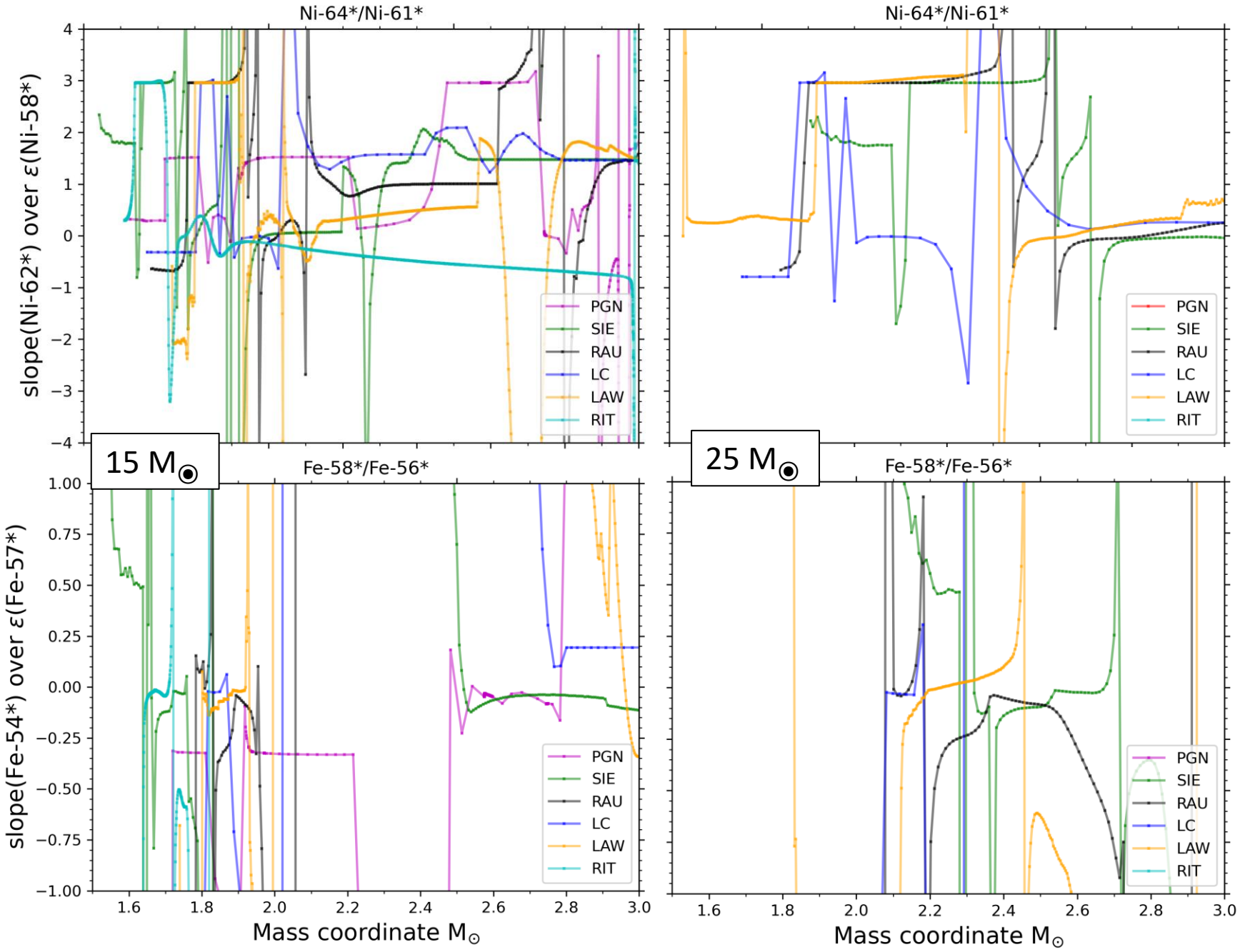
IONGIG is made available as a public repository on GitHub.

Normalized gas concentration obtained from the Multiple Grain Model (MGM based on Verchovsky et al. 2003 PASA), following gas implantation into grain populations of varying diameter D for three representative implantation range values S.

D9.5 – month ~~36~~ 42

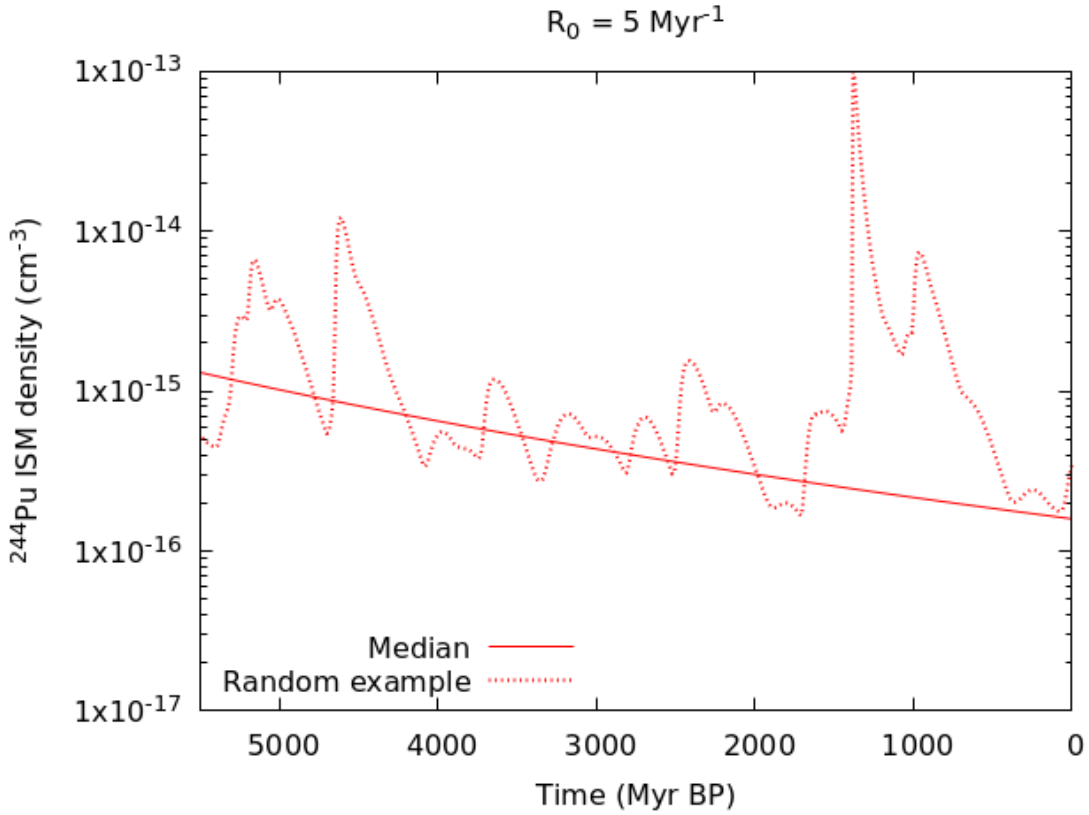
Figures for database to be created using SIMPLE by Gábor Bálazs and Maria Lugaro

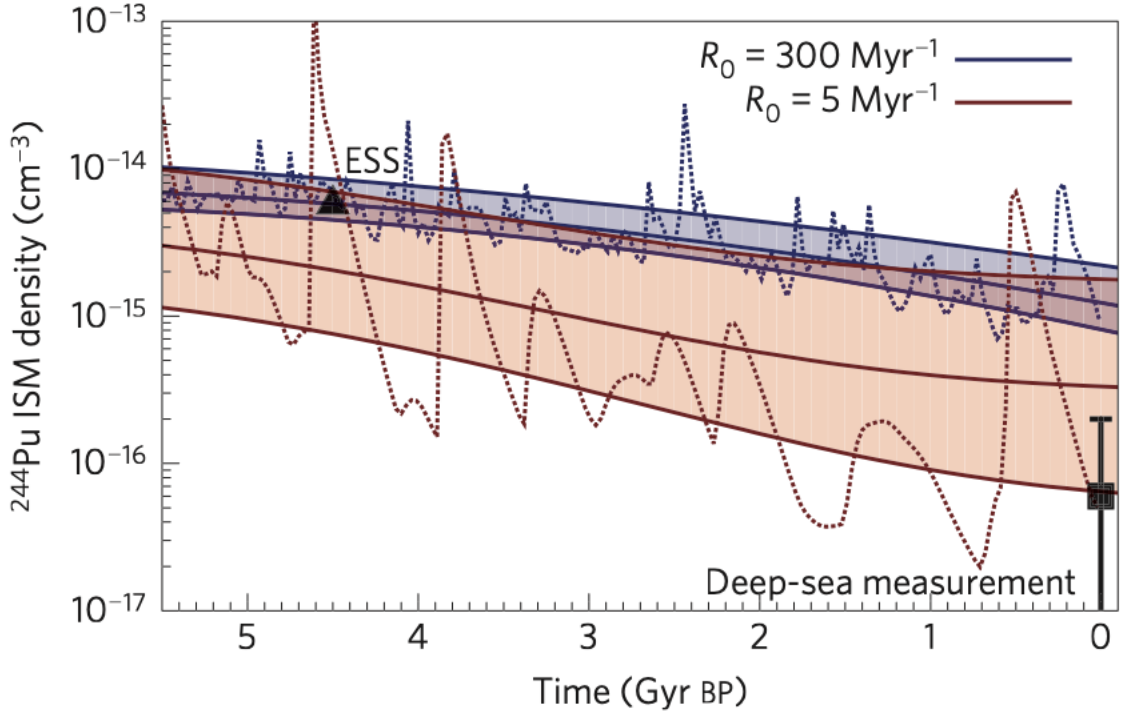
To go on Zenodo repository connected to the SIMPLE Paper in prep. by Pignatari et al. ApJS



D9.6 – month 42

Created by Zsófia Stermeczky and Andrés Yagüe Lopéz





Hotokezaka et al. (2015).

Evolution of the ^{244}Pu interstellar medium density obtained from the D9.6 C++ code based on the diffusion model of Hotokezaka et al. (2015).

Work in progress

Summary

- D9.1 mathematical transformation from stellar yields to meteoritic bulk rock data (s-process example): delivered + paper published 2023
- D9.2 compare core-collapse supernova yields to meteoritic bulk rock: data delivered + paper in prep. for 2024-2025
- D9.3 database of papers of meteoritic data: delivered (work ongoing to fill the database)
- D9.4 code for implantation of noble gases into grains: delivered
- D9.5 database of results from D9.2 to be delivered together with the D9.2 paper
- D9.6 distribution of radioactive nuclei in the interstellar medium via diffusion: in progress