Nucleosynthesis in classical novae: nuclear physics and astrophysics uncertainties

Spencer Reyno
Saint Mary's University

Canadian Astroparticle Summer Student Talk Symposium
August 12th, 2026

Saint Mary's University
SCIENCE

Classical Novae

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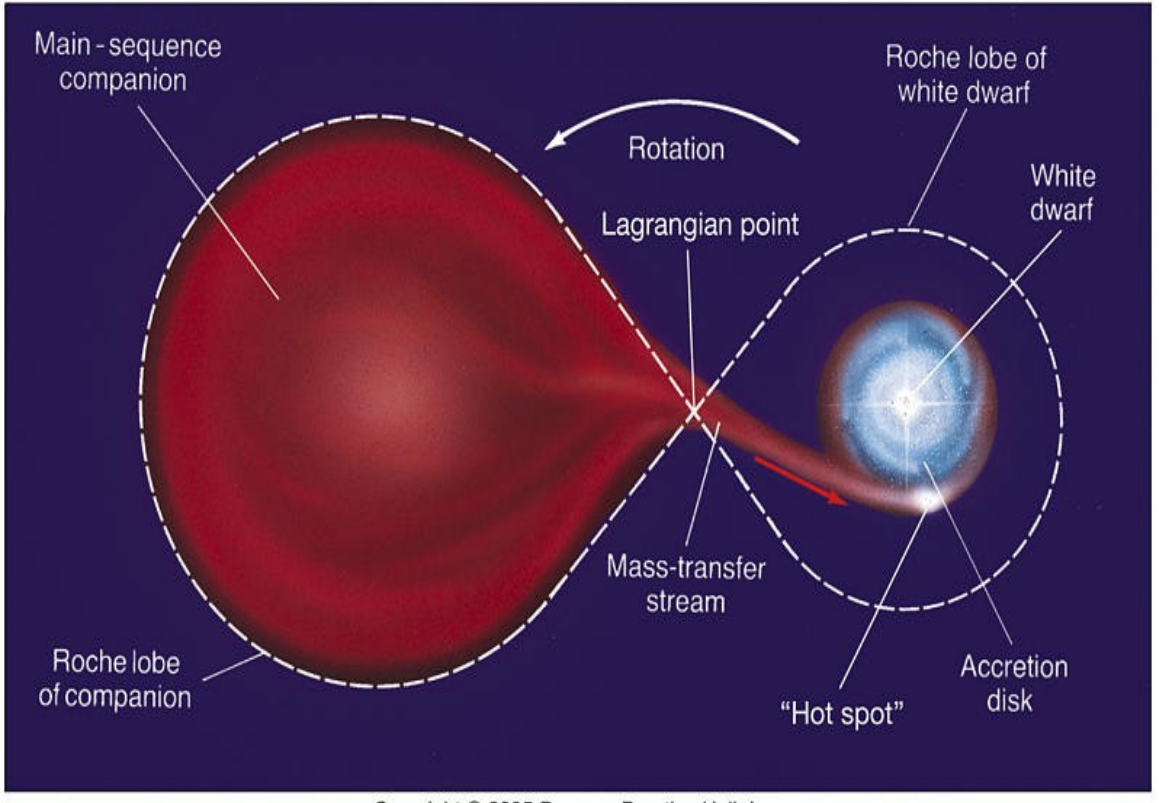
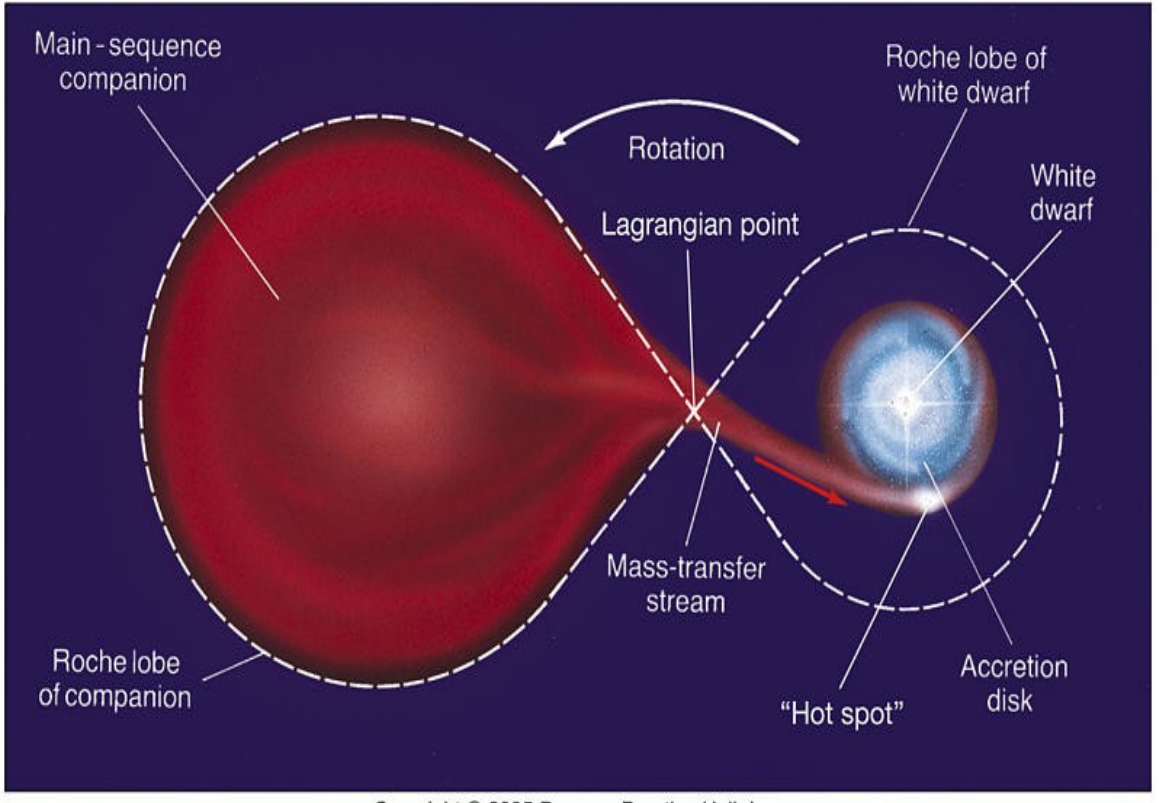


Classical Novae

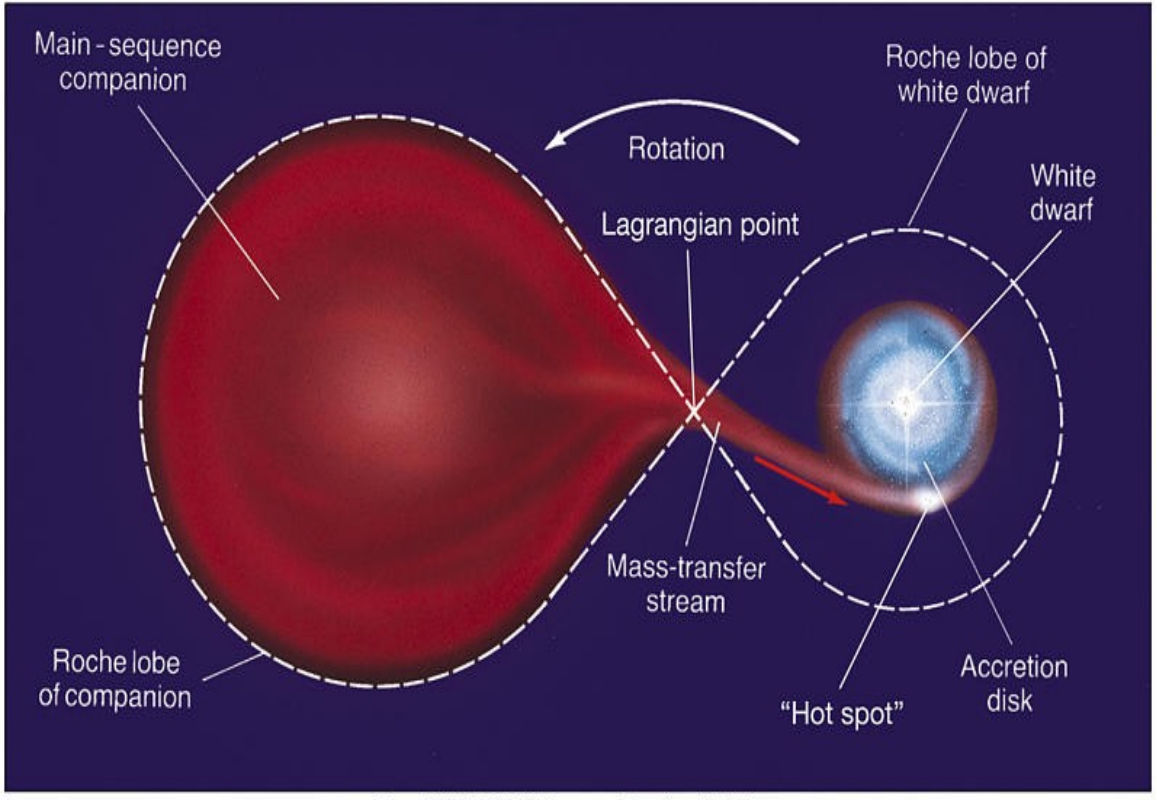
- White dwarf and non-degenerate companion



Classical Novae

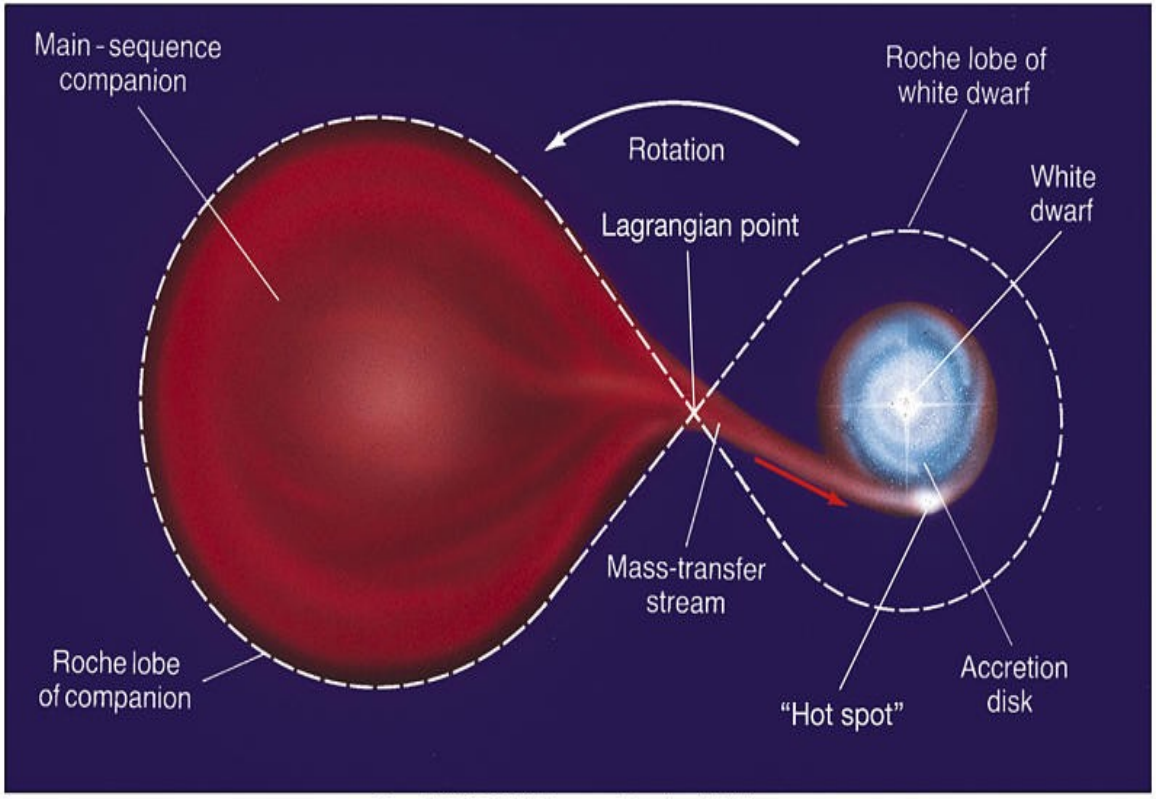
- White dwarf and non-degenerate companion

- Surface material from non-degenerate companion accretes onto white dwarf



Classical Novae

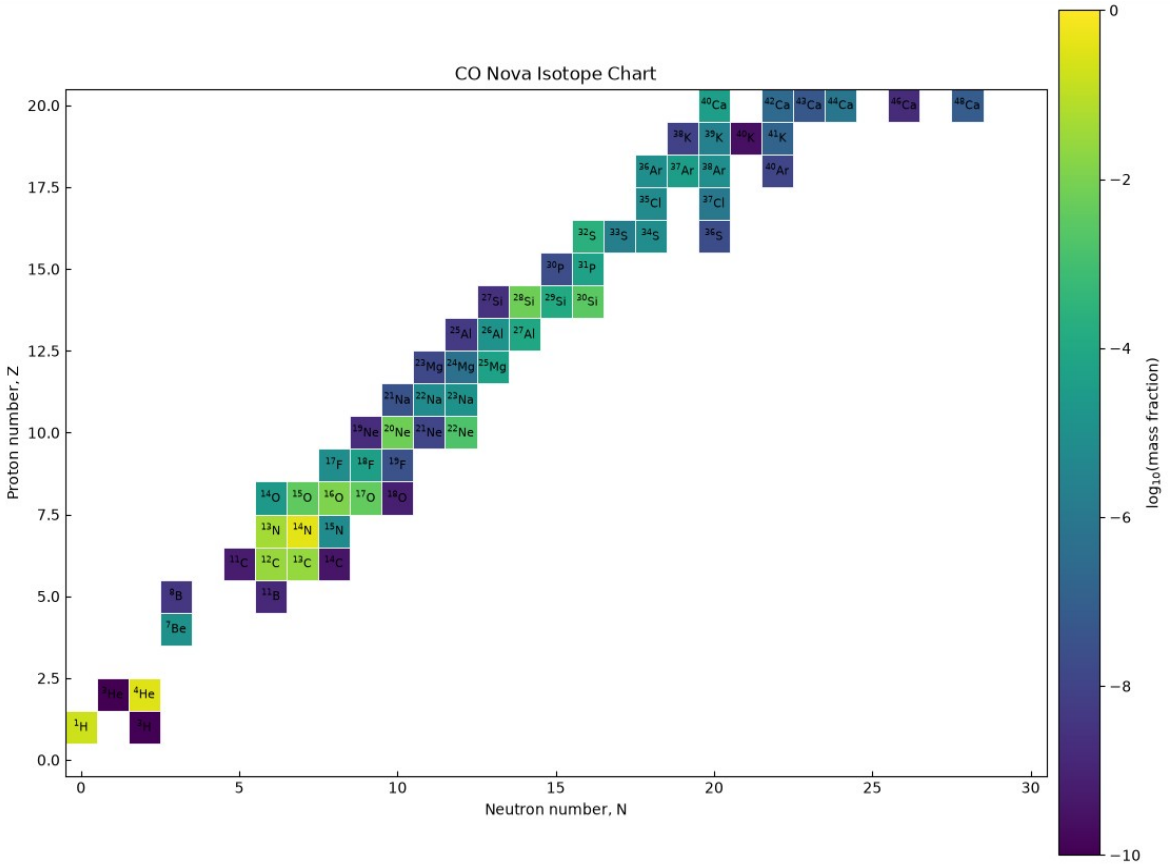
- White dwarf and non-degenerate companion
- Surface material from non-degenerate companion accretes onto white dwarf
- Thermonuclear runaway (TNR) occurs, and matter is expelled



L. Chomiuk, B.D. Metzger & K.J. Shen, Annu. Rev. Astron. Astrophys. 59, 391 (2021)
M. F. Bode & A. Evans, "Classical Novae", CUP (2008)

Classical Novae

- Nuclear reaction network present



Classical Novae

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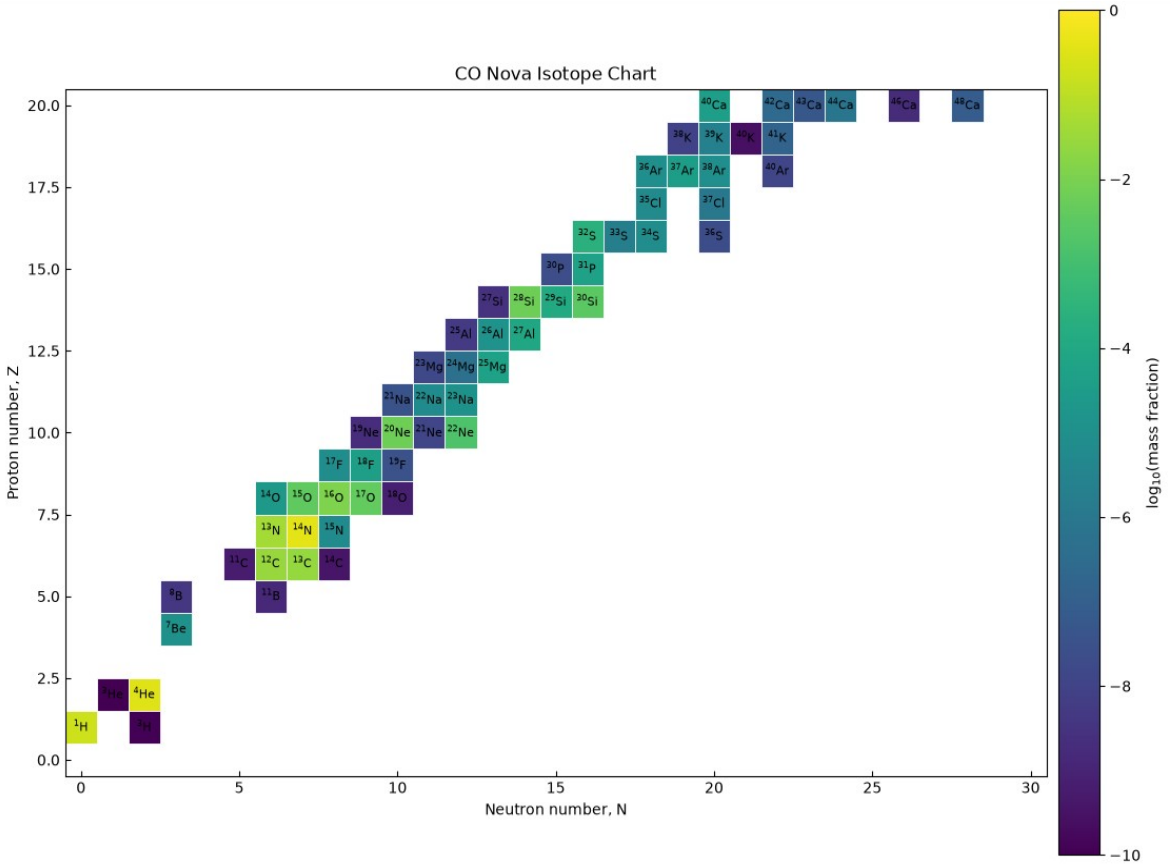
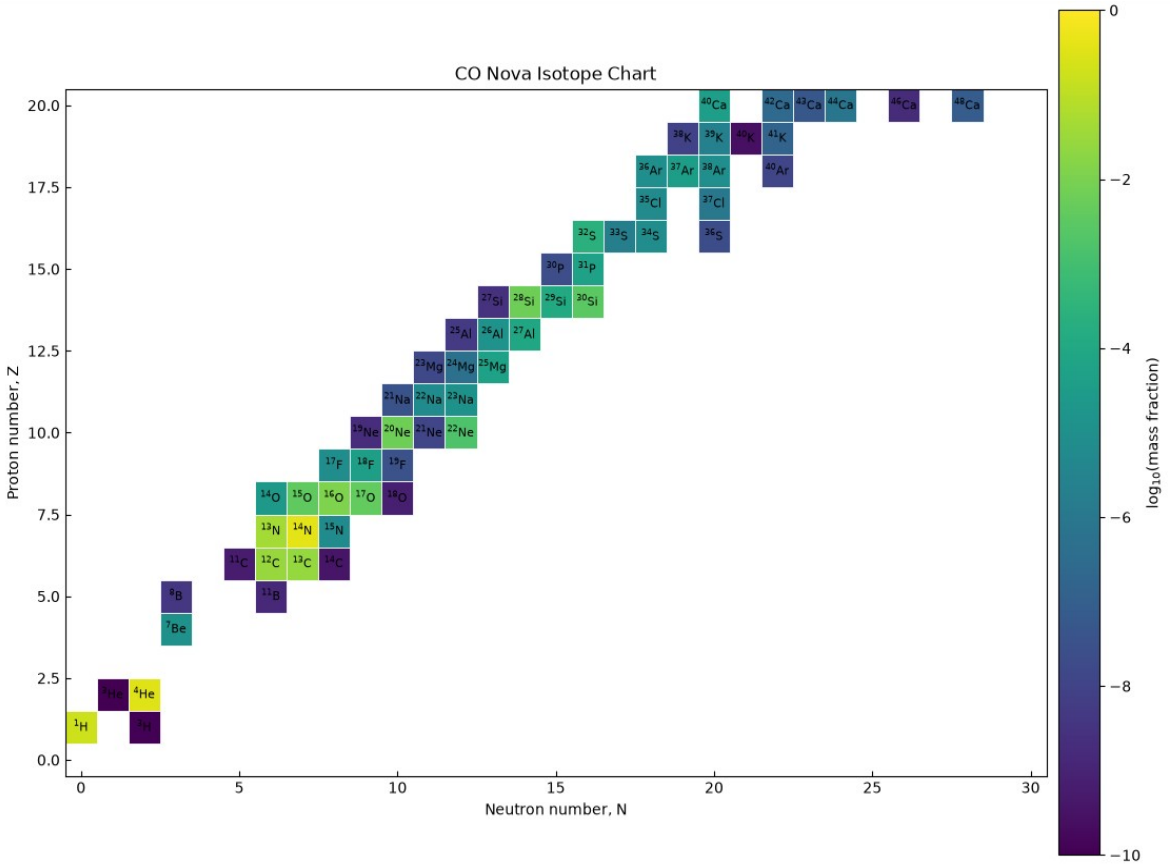
- Isotopes up to Z=20 (Ca) produced



Classical Novae

- Nuclear reaction network present
- Isotopes up to Z=20 (Ca) produced
- Rare radioactive isotopes included



CO vs. ONe Novae

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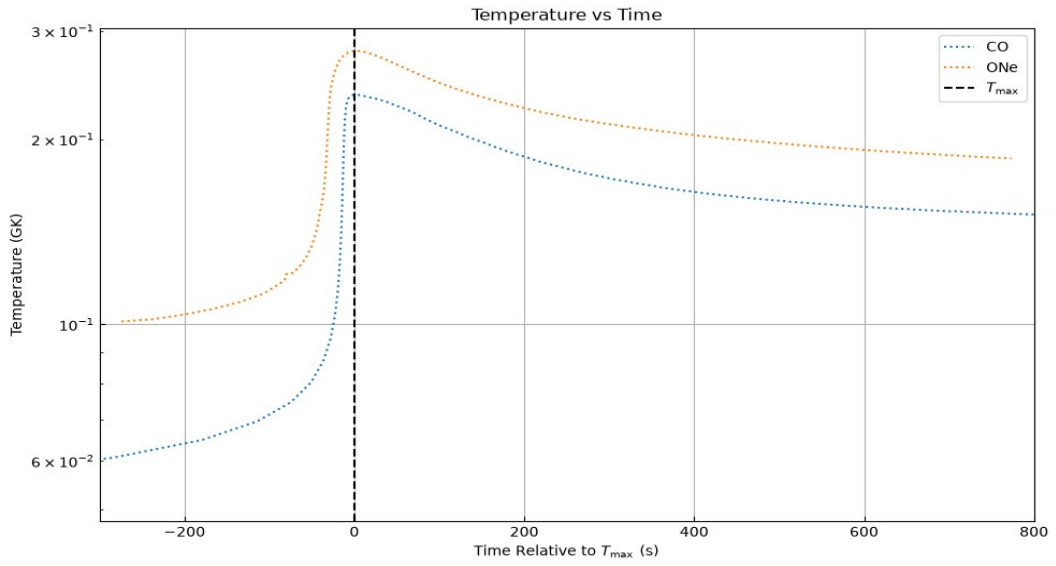

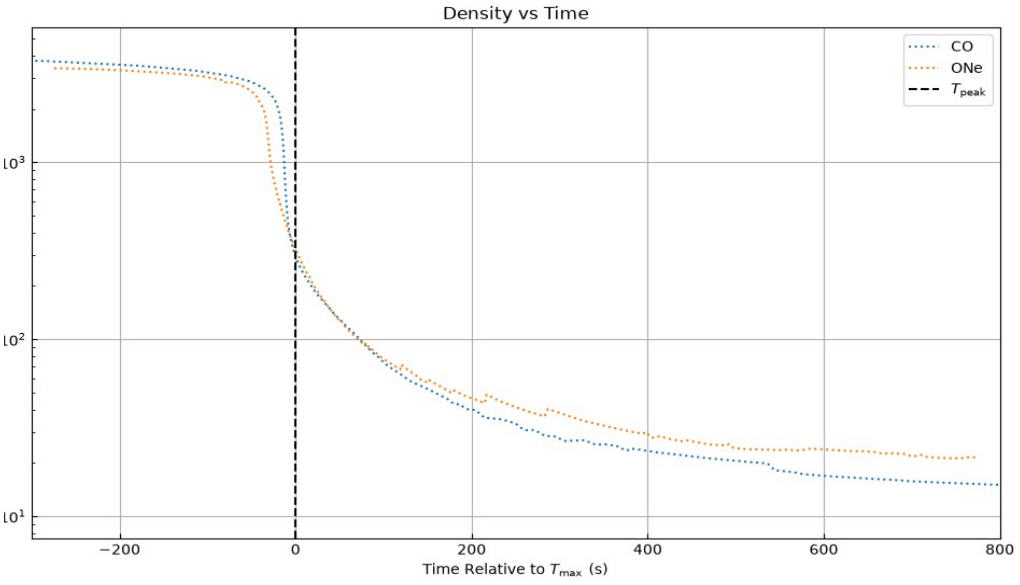

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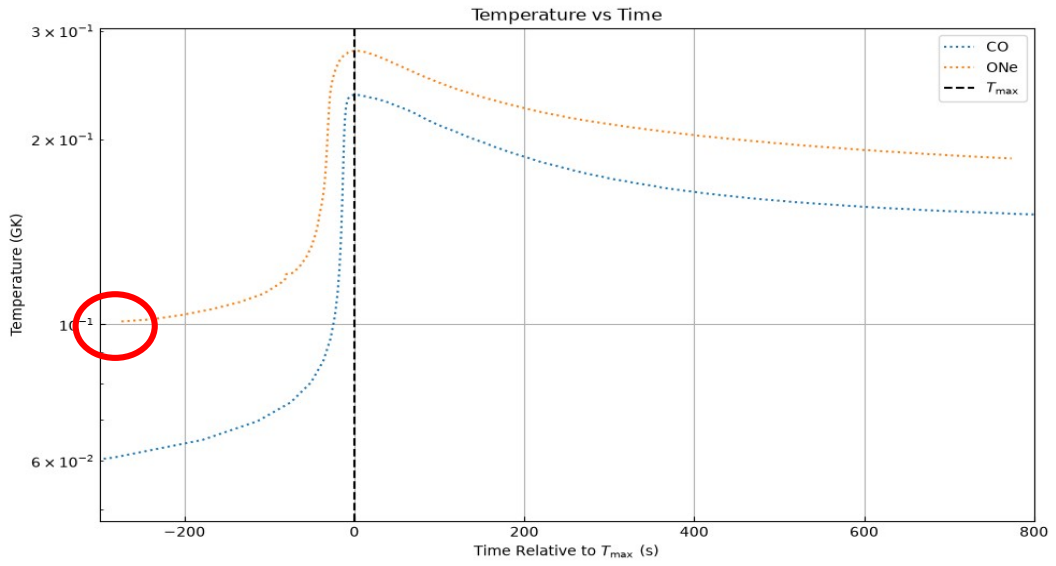

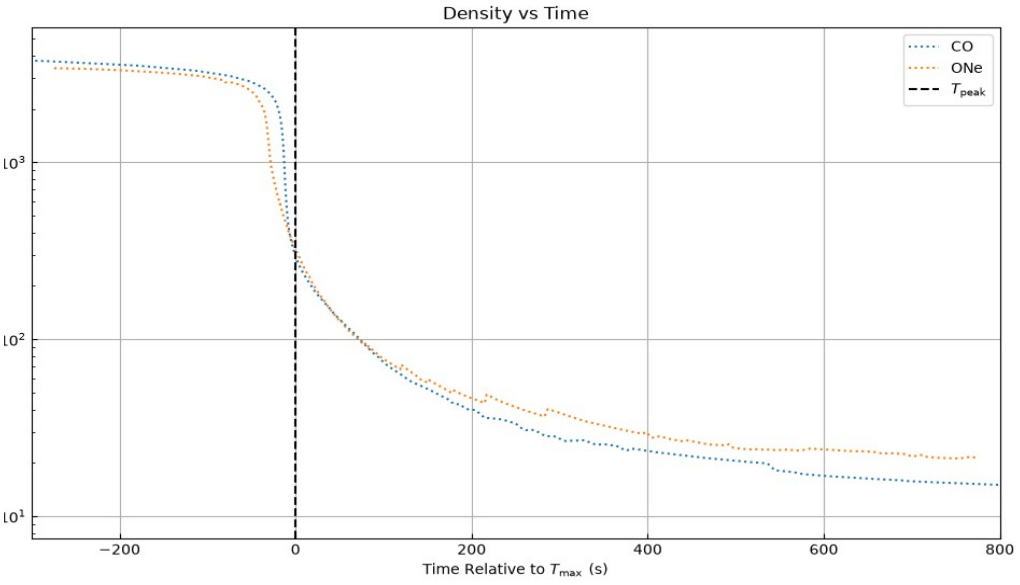

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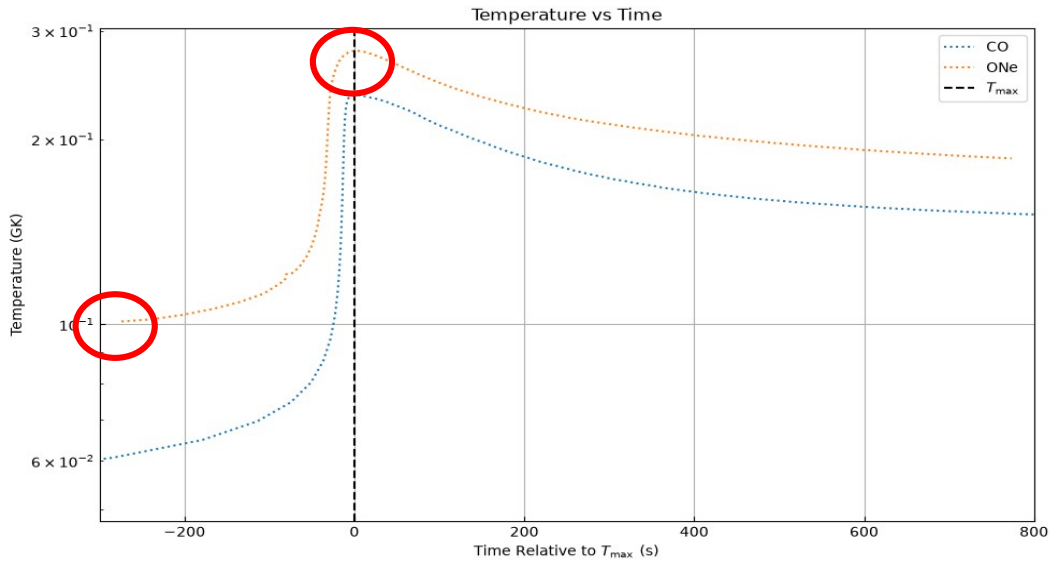

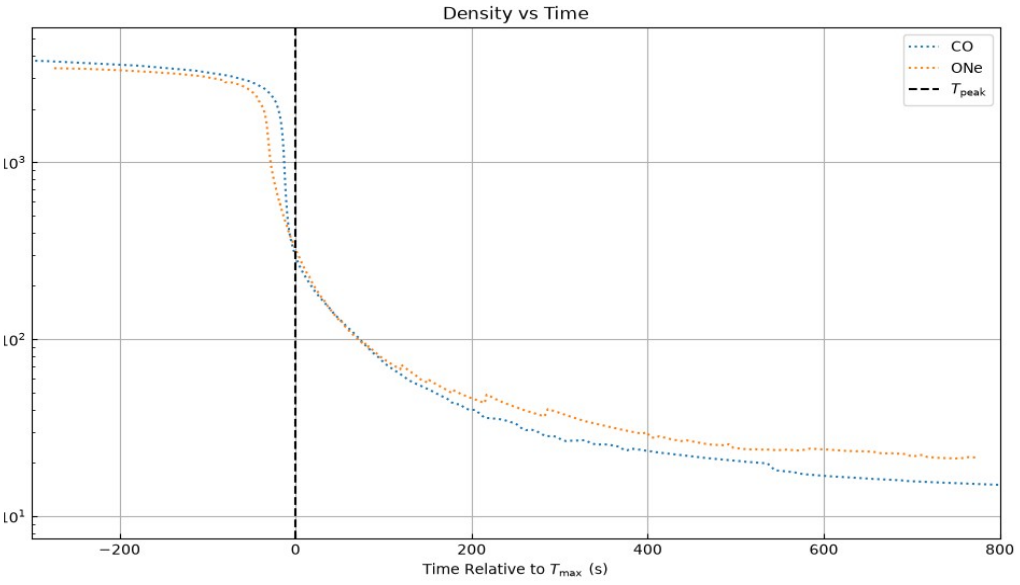

Solar Abundance Ratios

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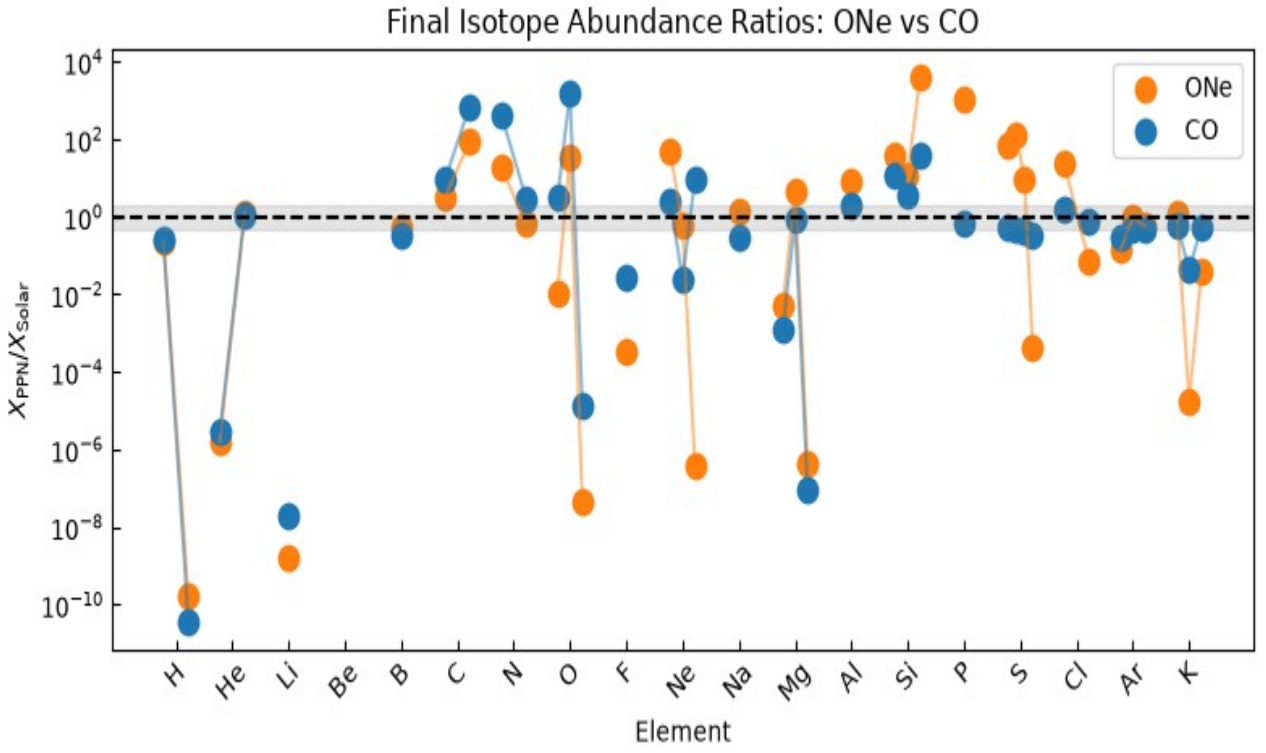

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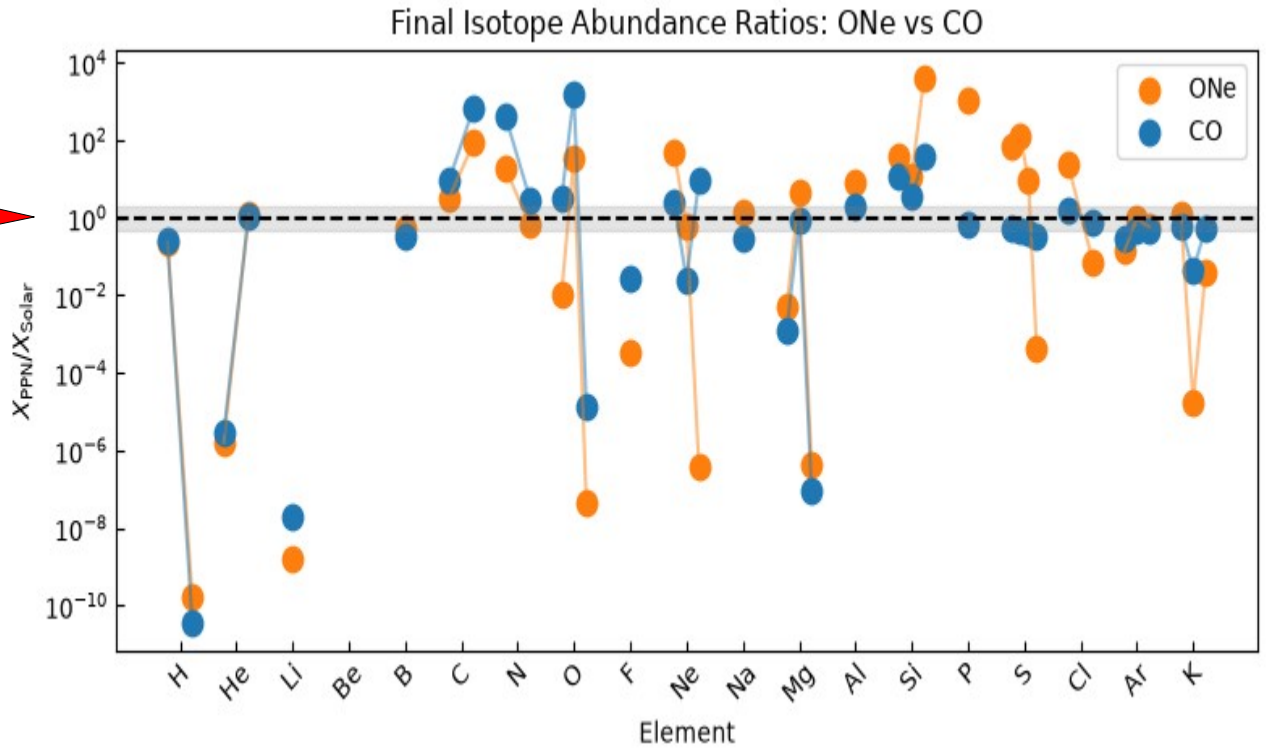

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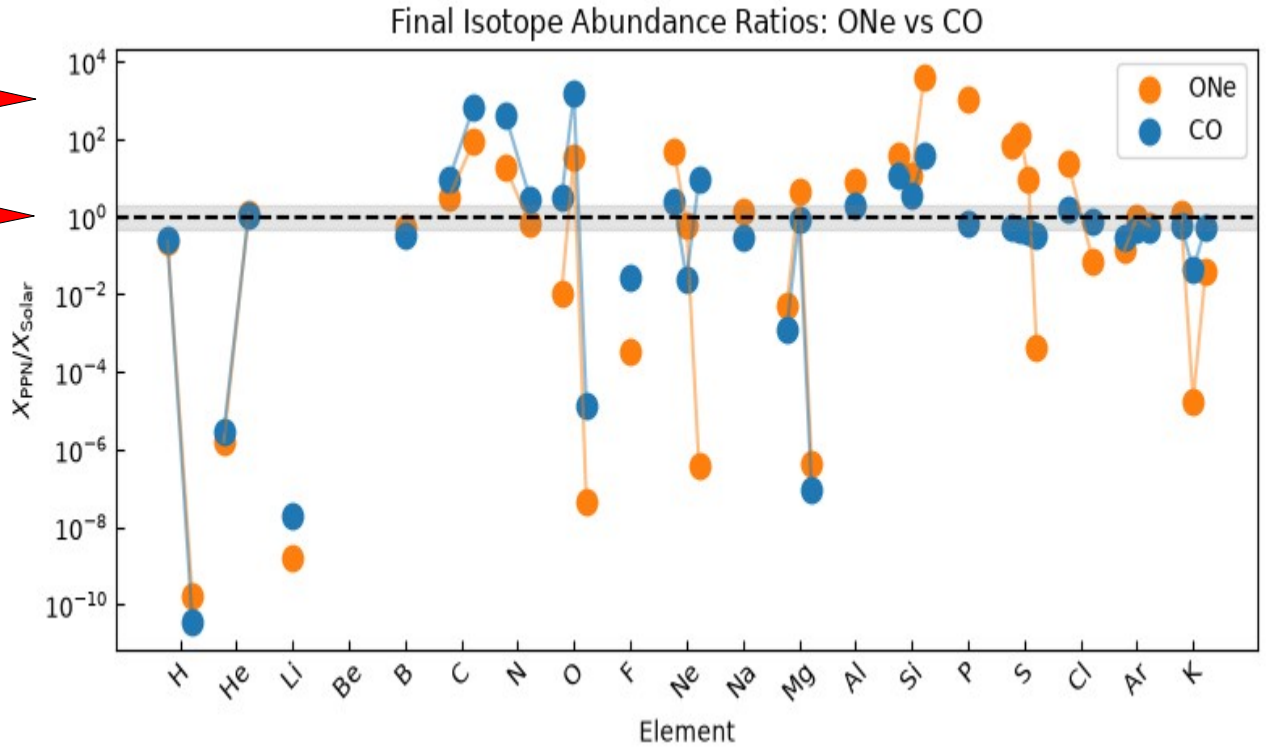

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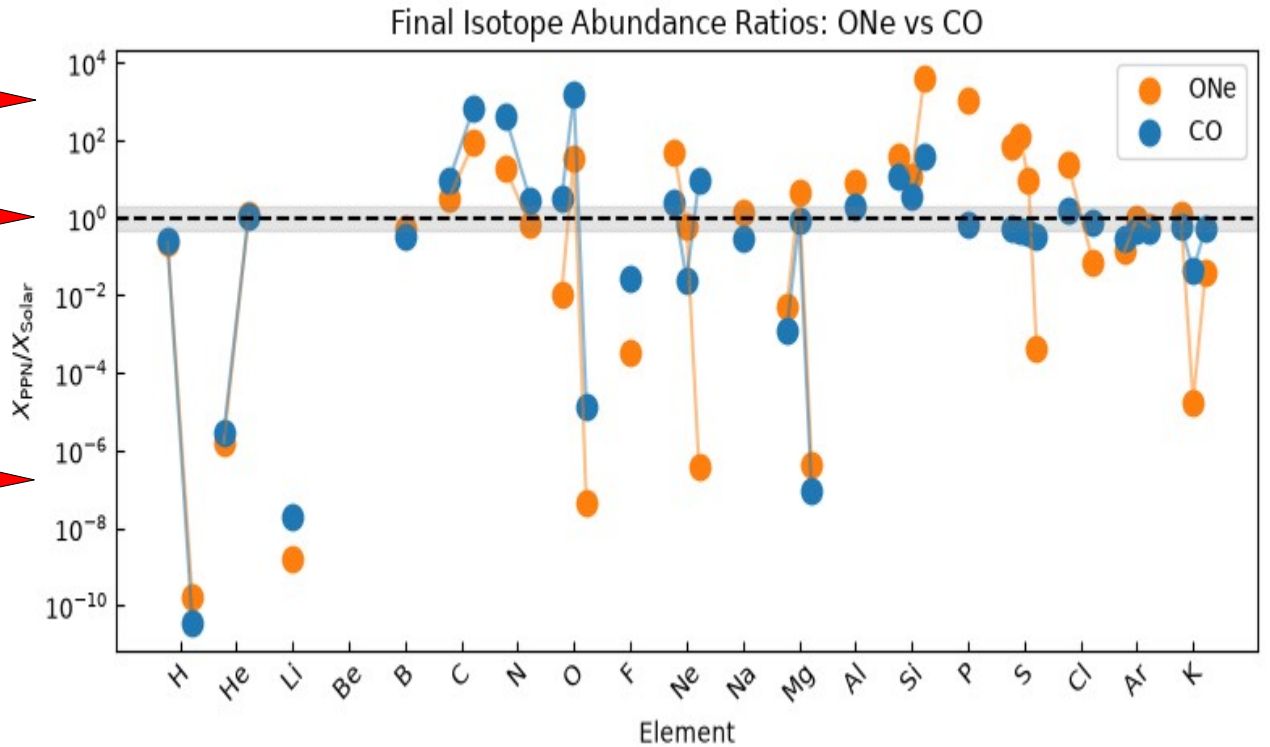

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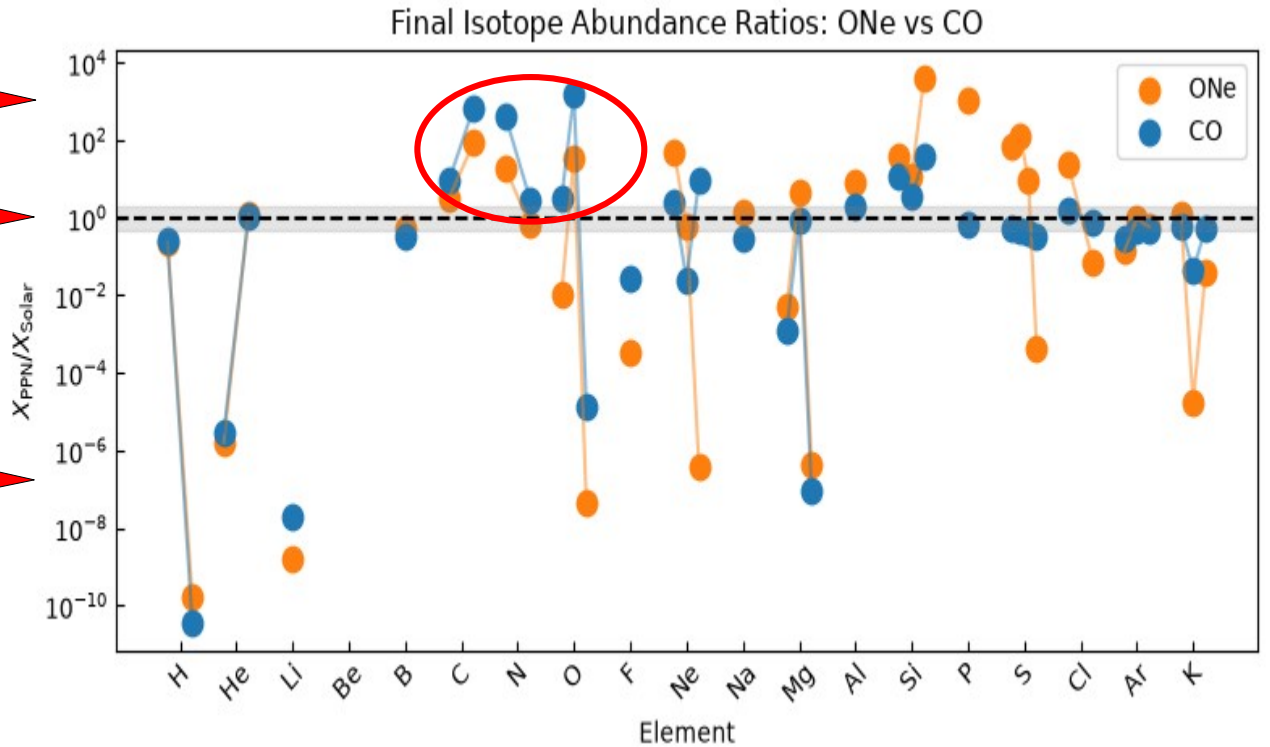

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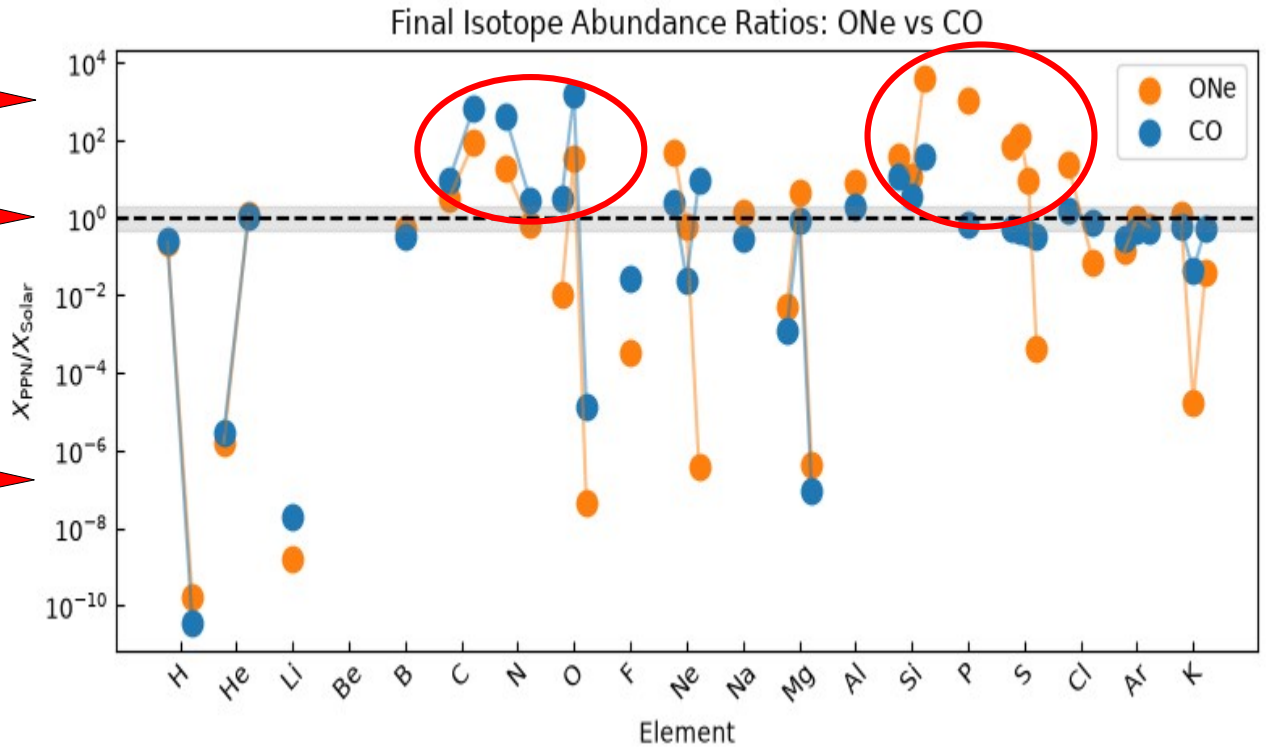

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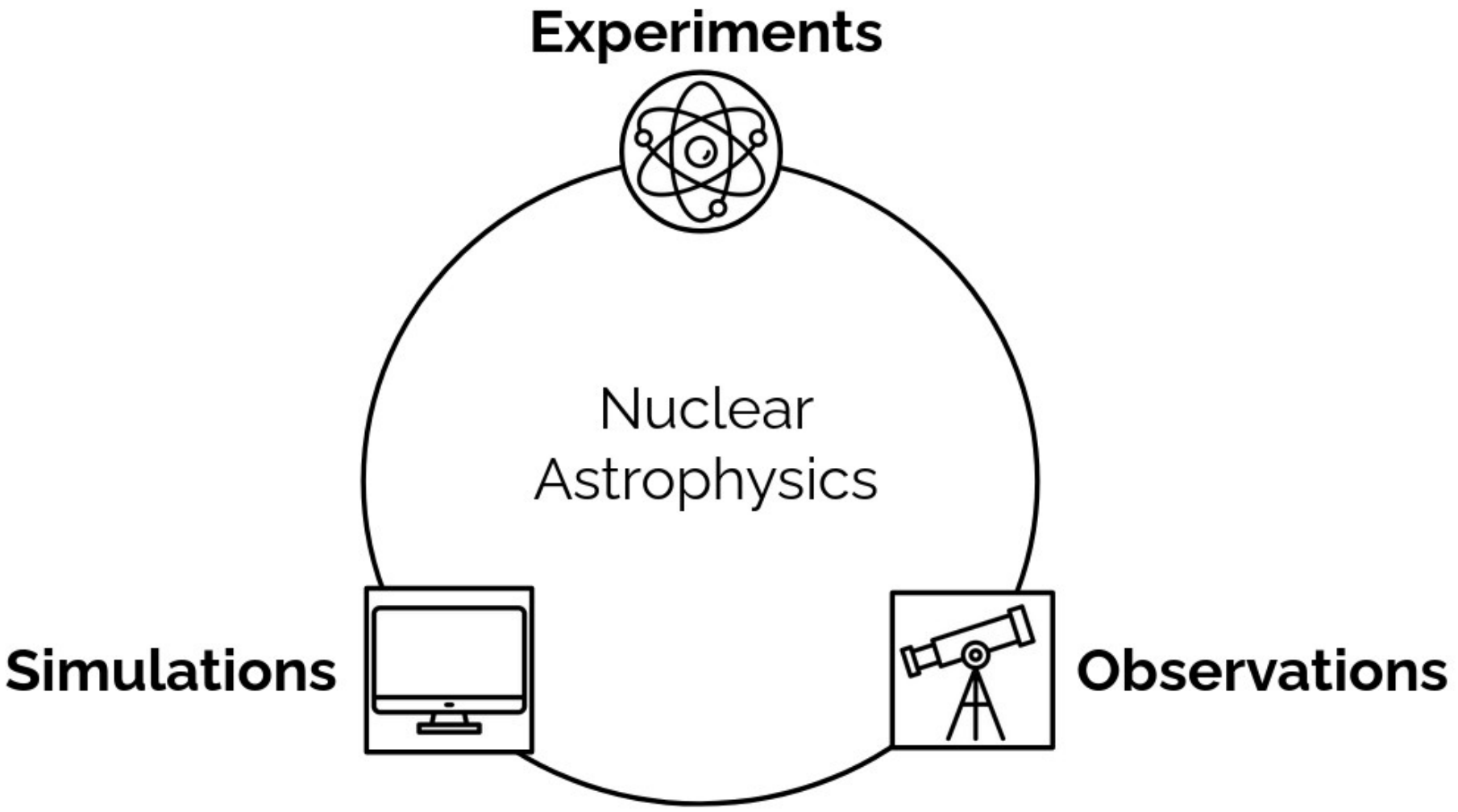
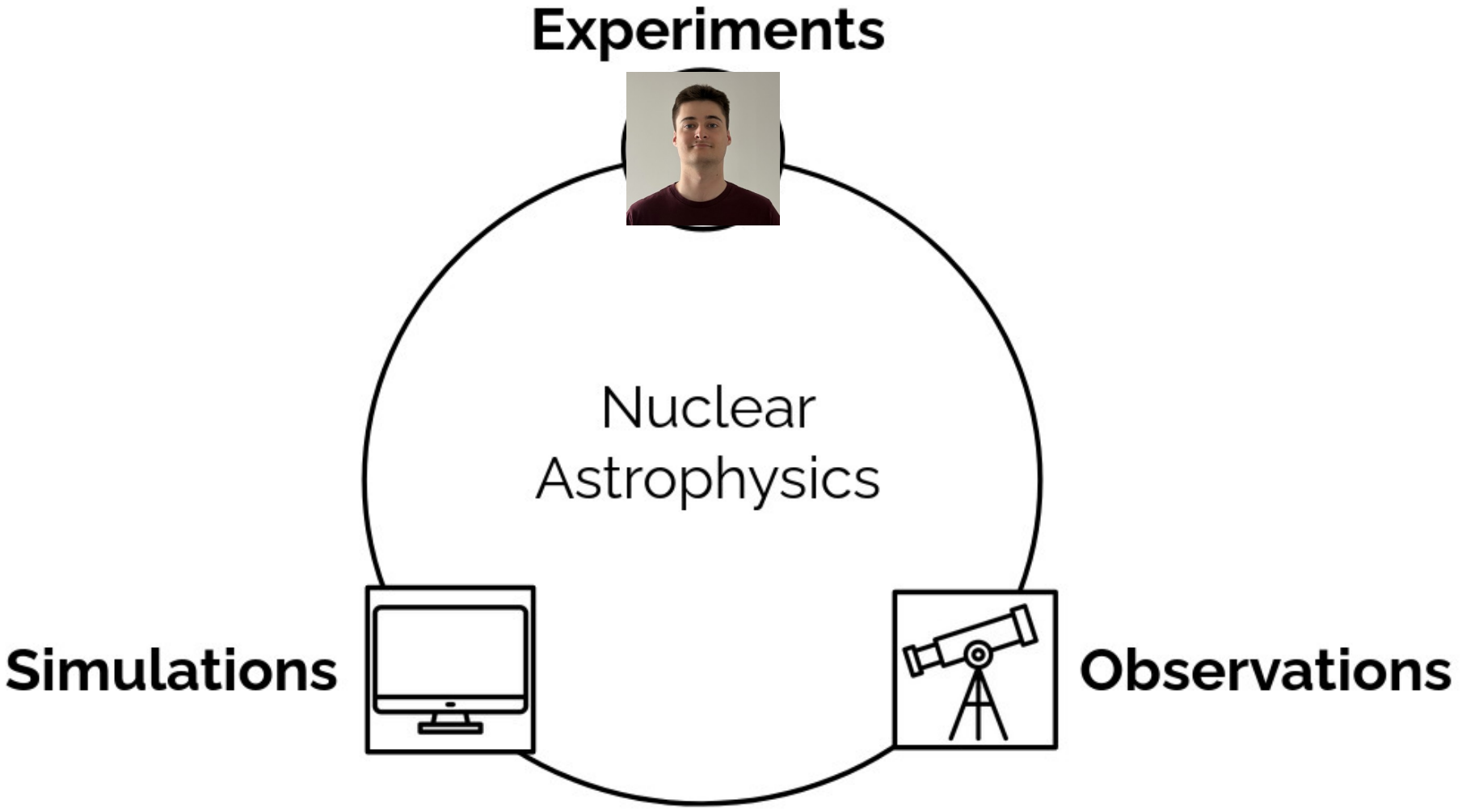


Image credit: Thanassis Psaltis



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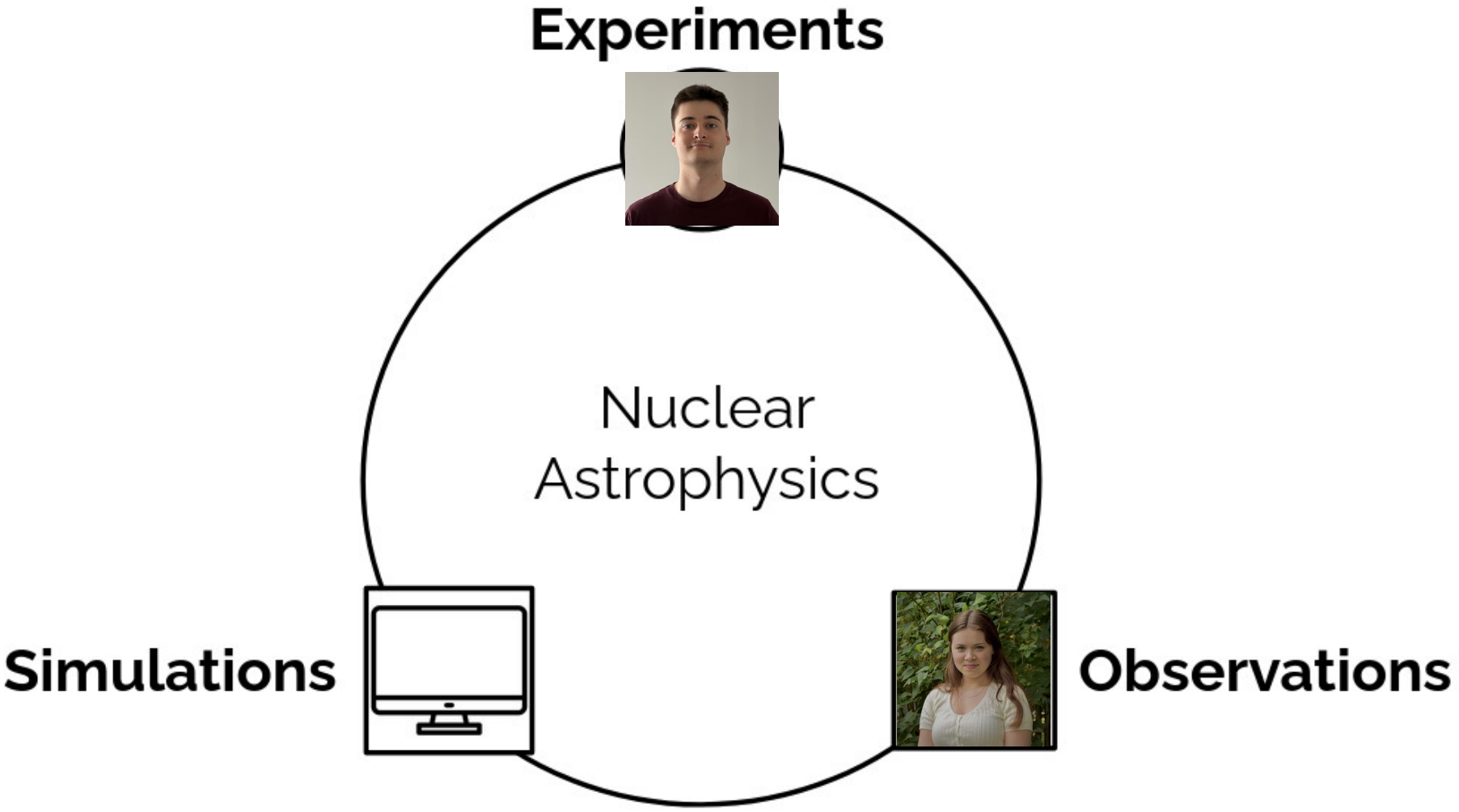

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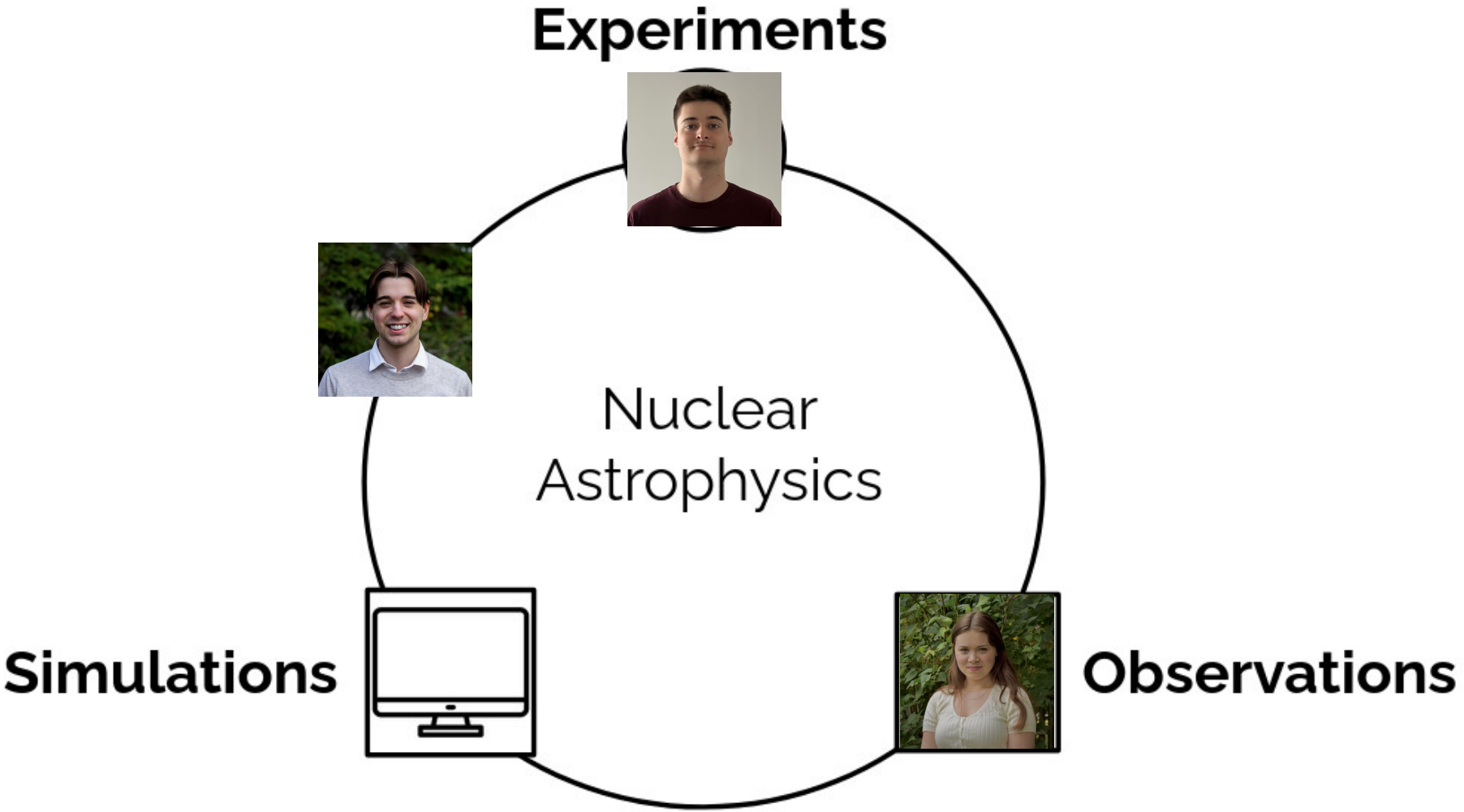

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Reaction Rate Uncertainties

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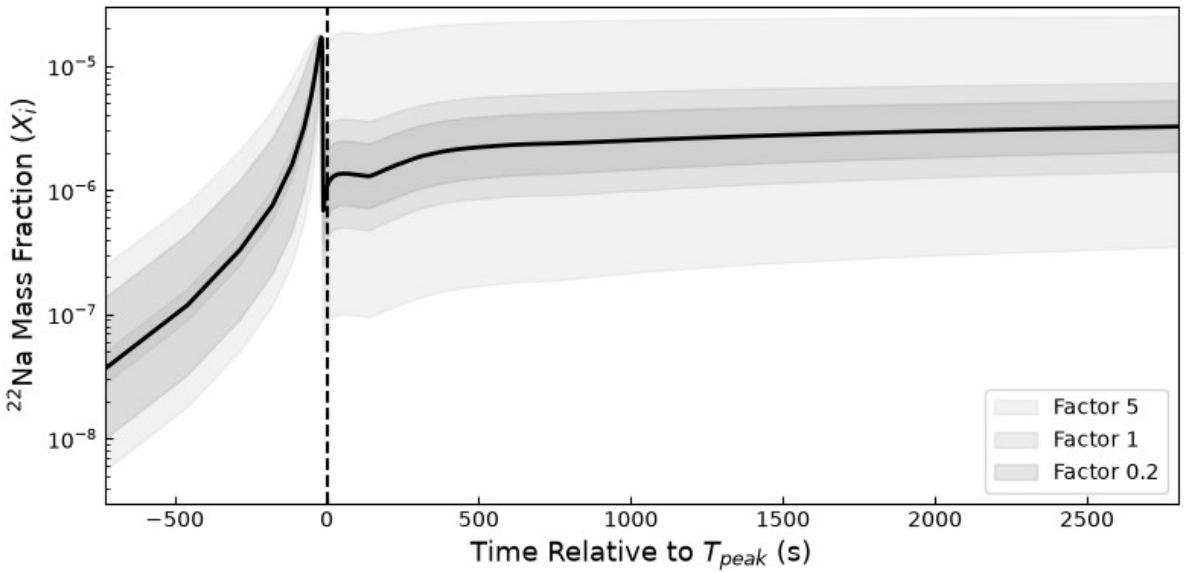

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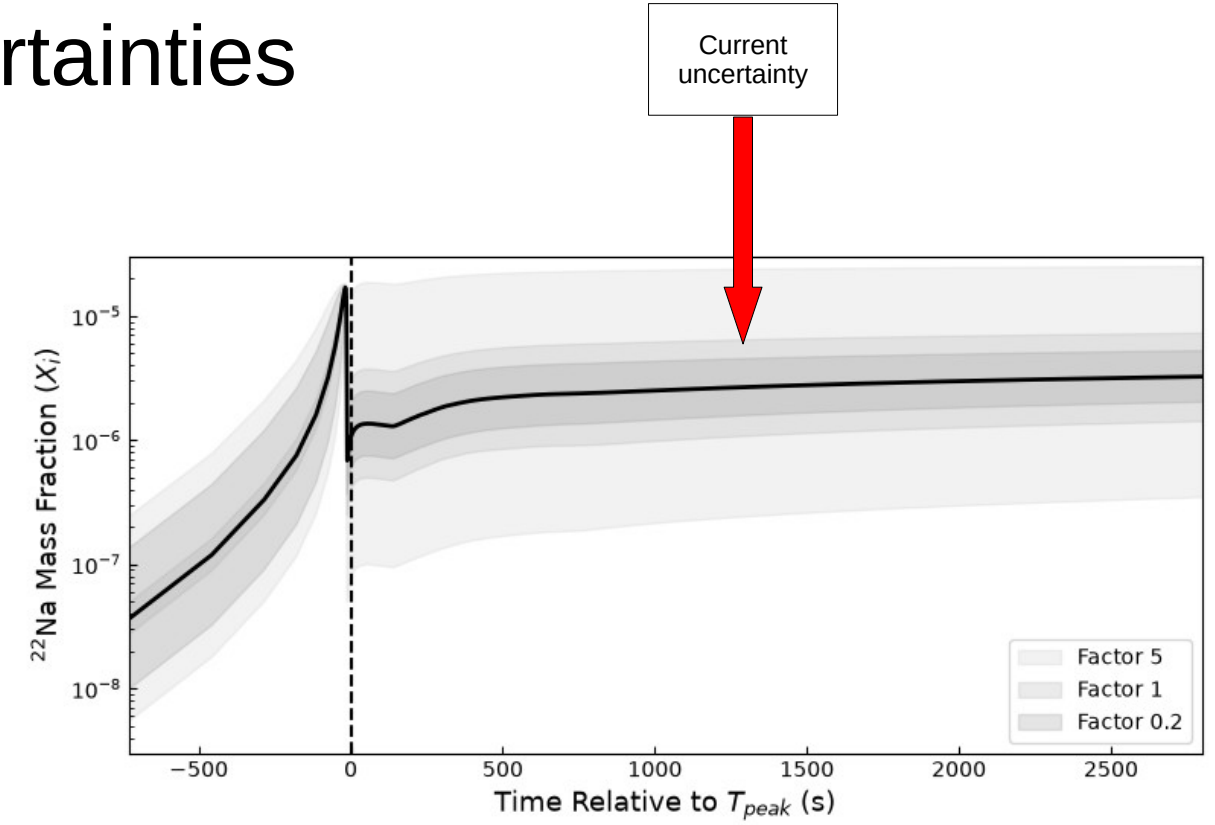

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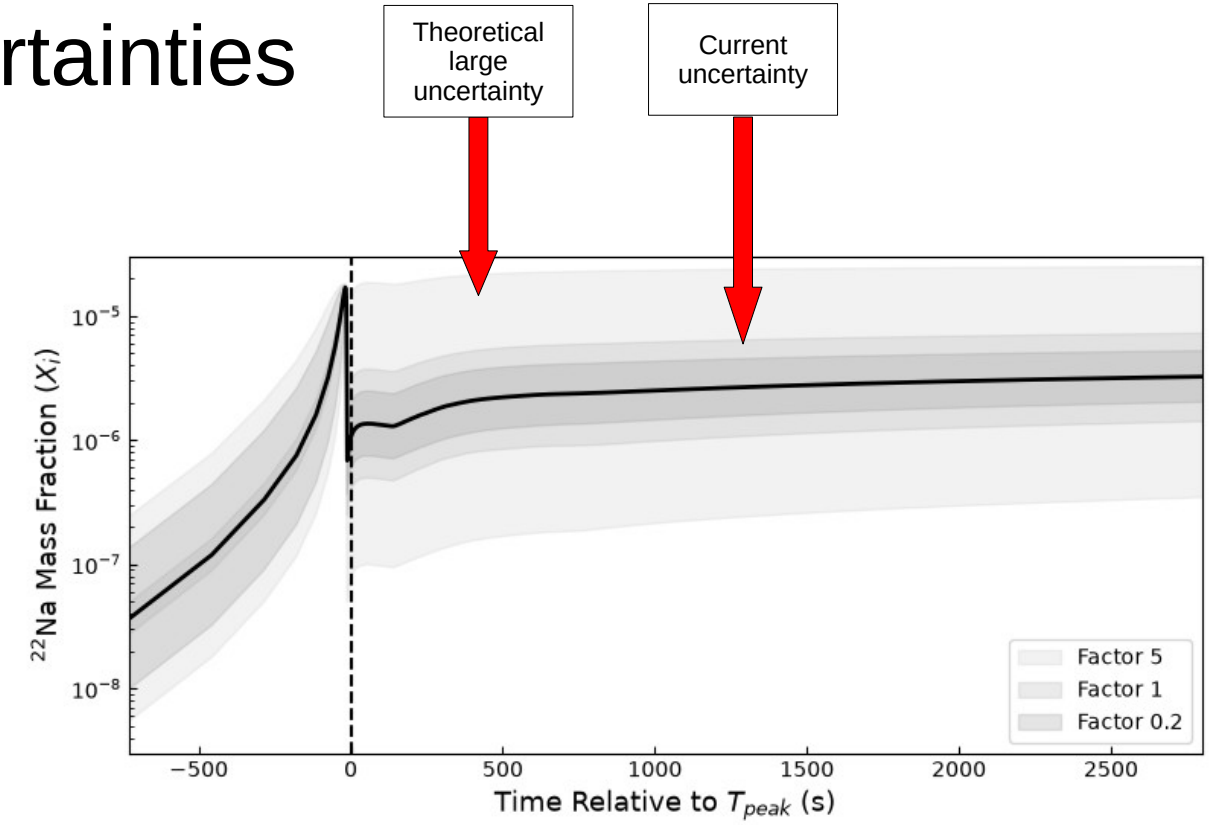

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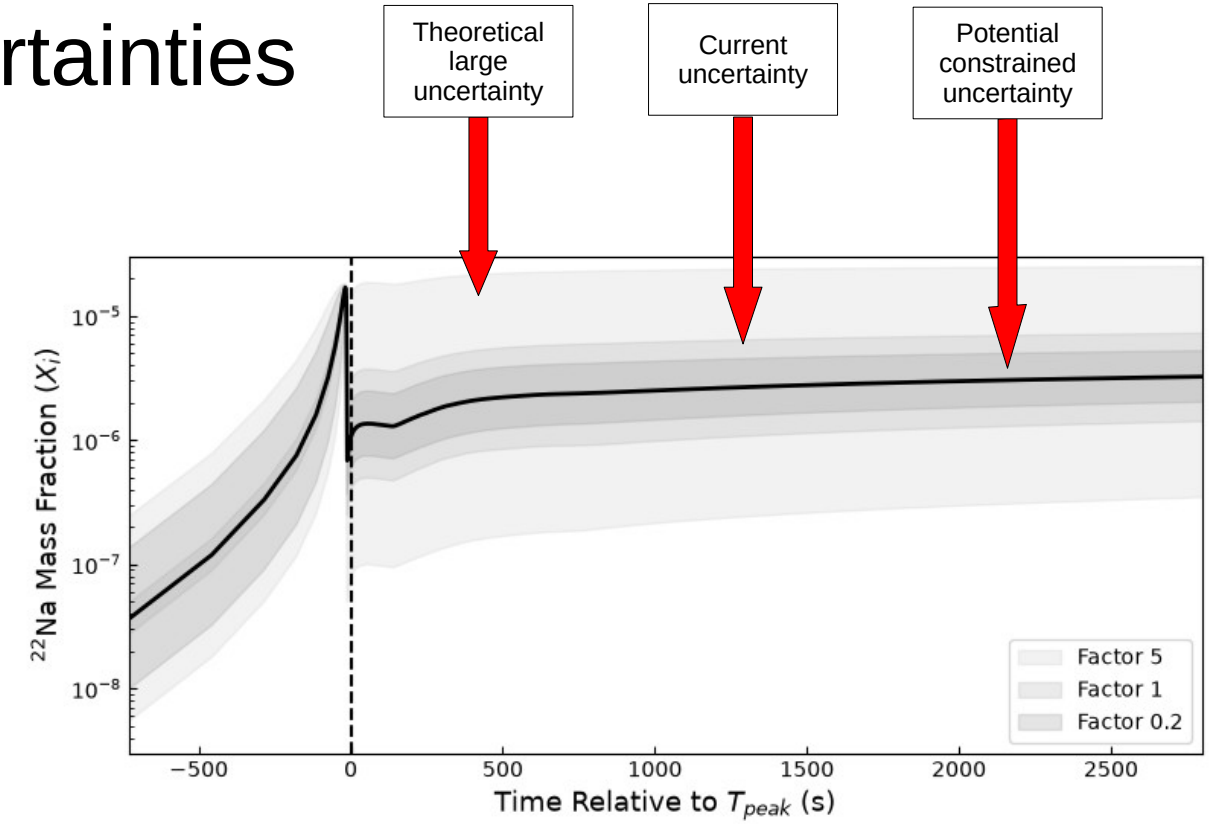

C. Iliadis et al., Astrophys. J Supp. Ser. 142,105 (2002)

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^{22}Na

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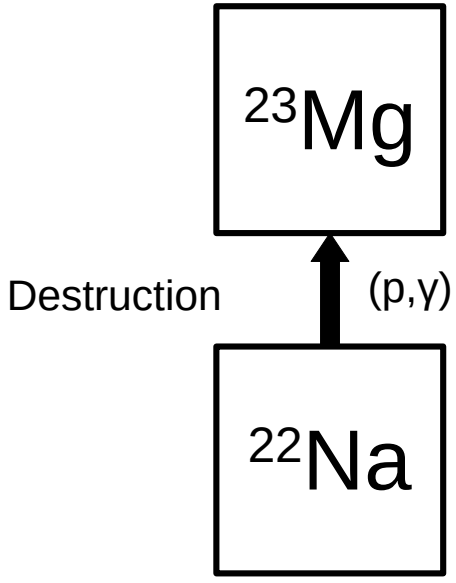

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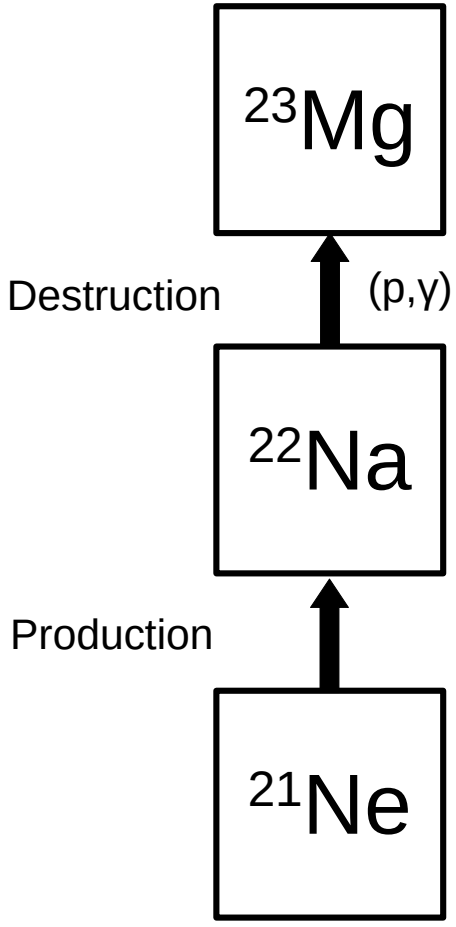

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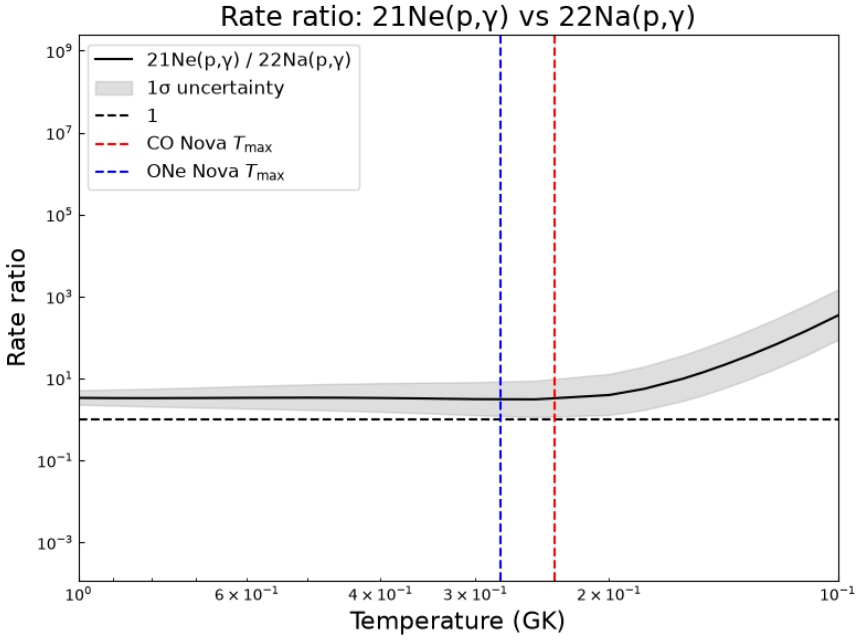

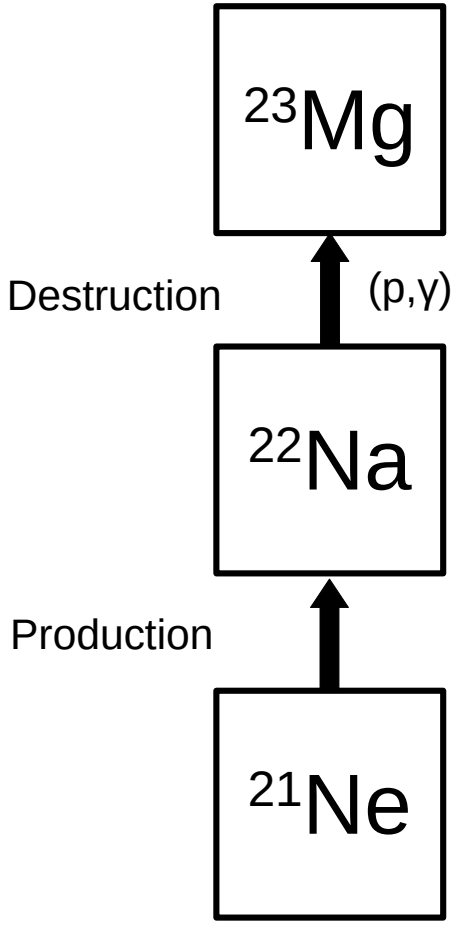

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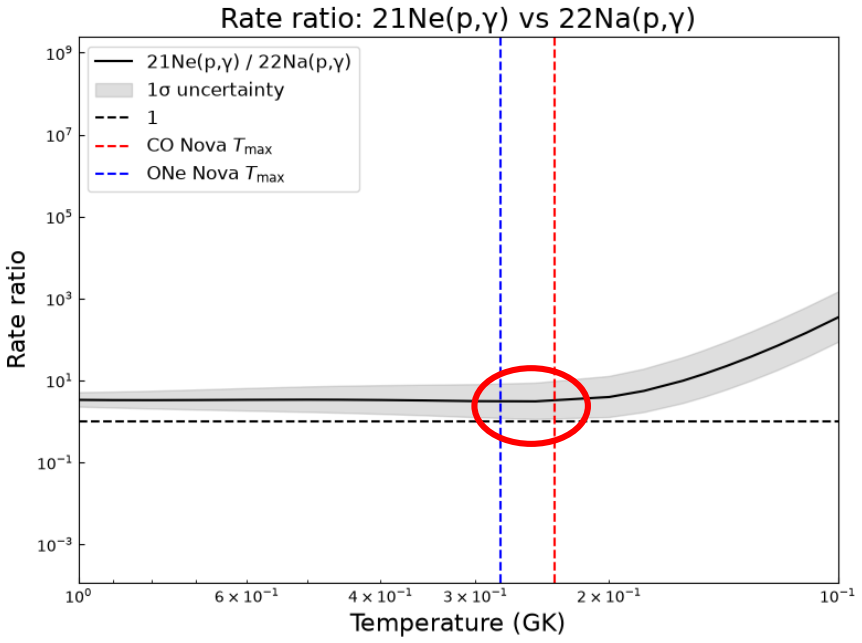

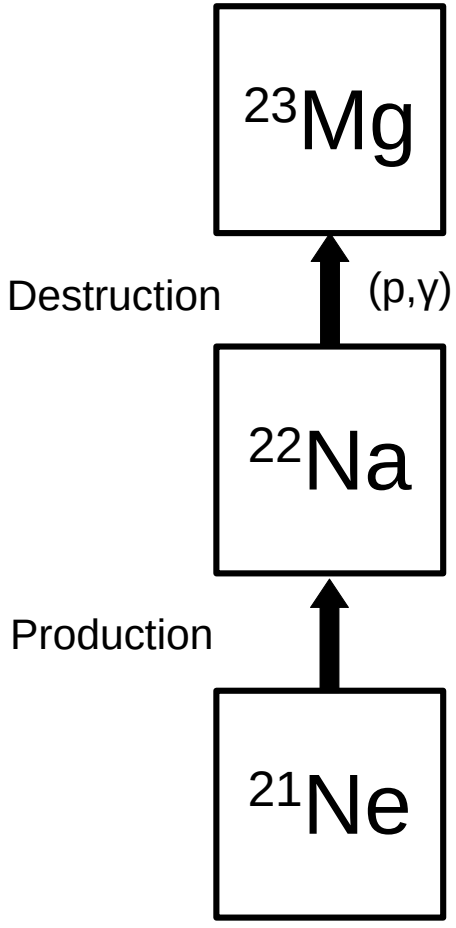

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C. Iliadis et al., Astrophys. J. Supp. Ser. 283, 17 (2026)

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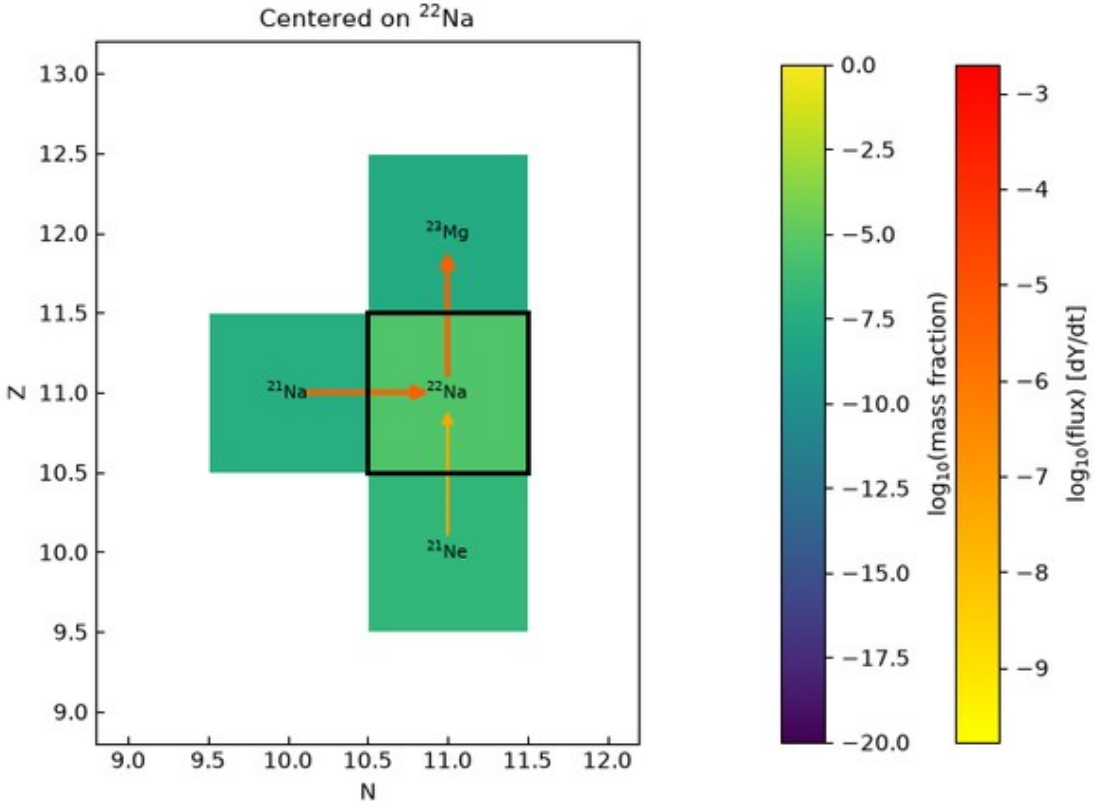
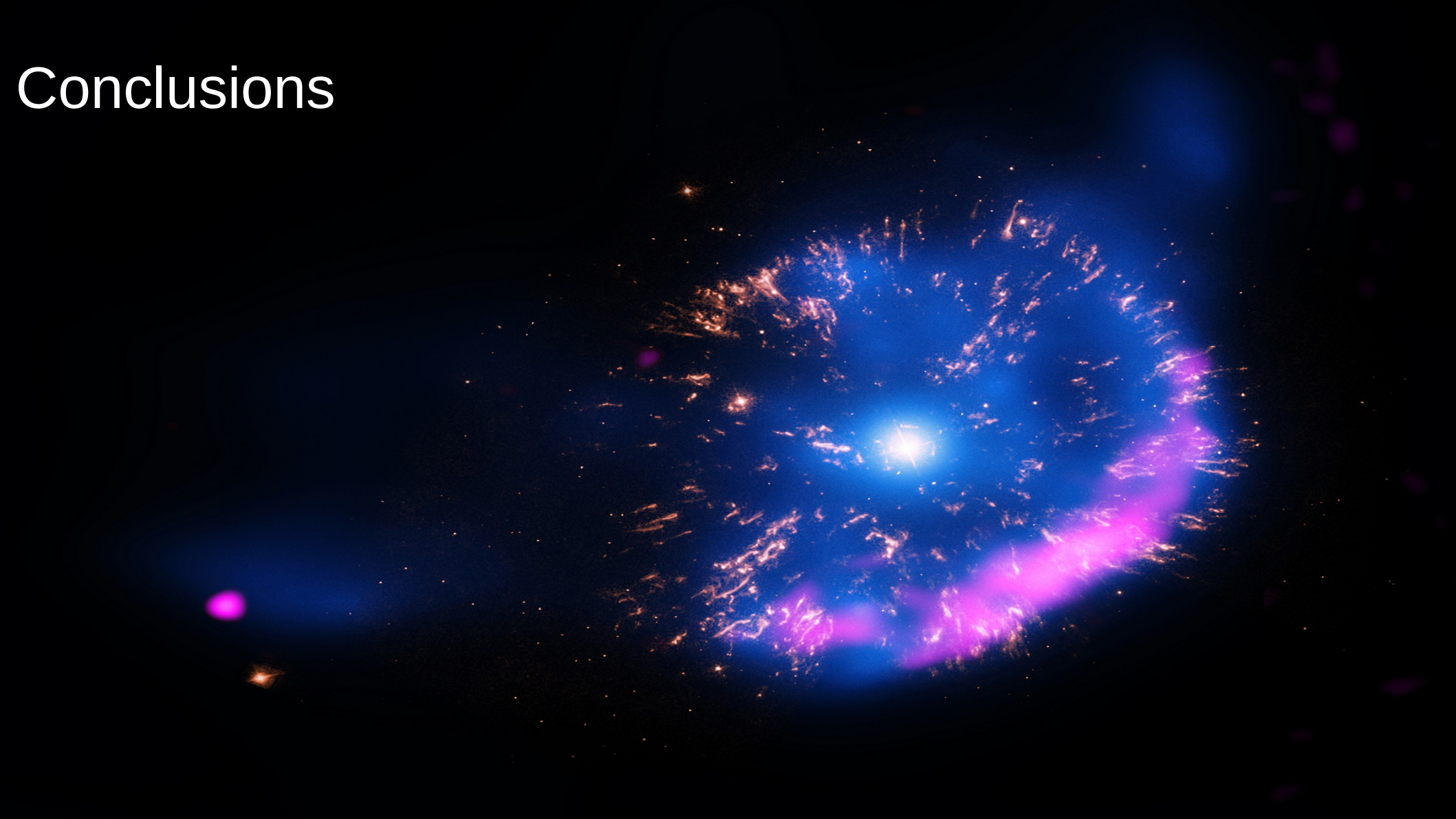


C. Iliadis et al., Astrophys. J. Supp. Ser. 283, 17 (2026)

Conclusions



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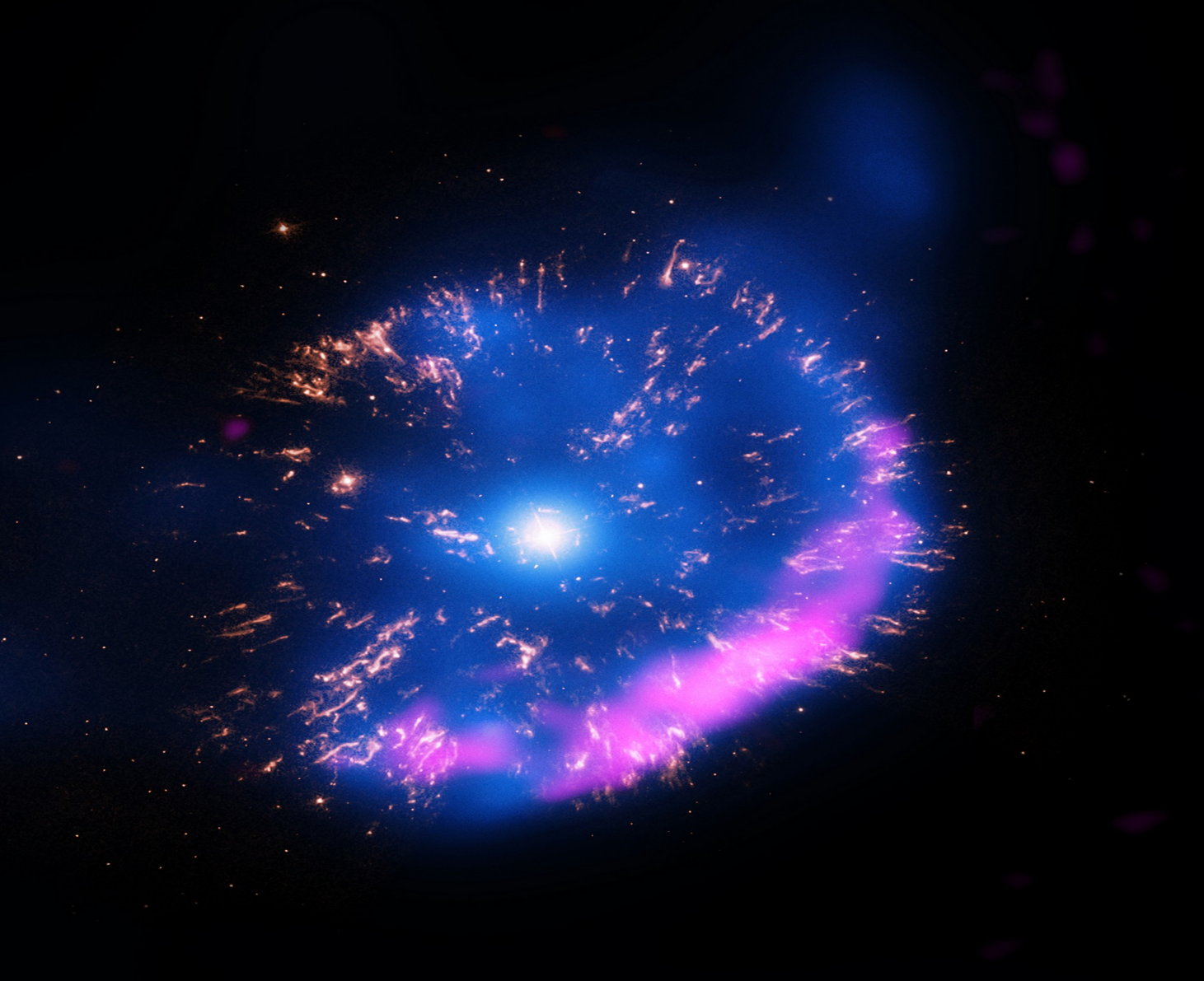
- We must reproduce these reactions experimentally to constrain their uncertainties



Future Work

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- COSI gamma-ray telescope expected to launch in 2027

J.A. Tomsick et al., Proceedings of Science 444, 745 (2023)

Acknowledgements

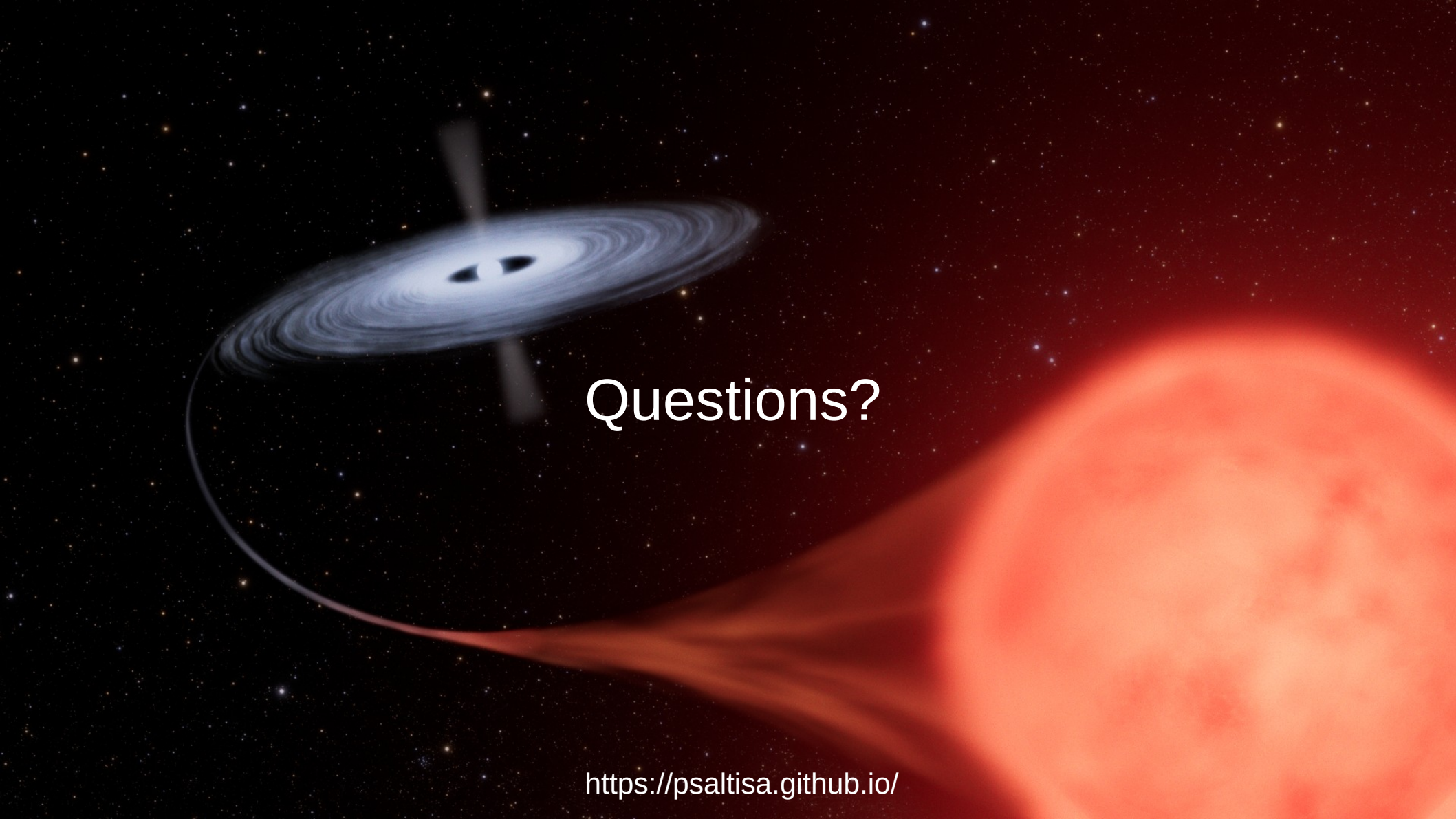
Thanassis Psaltis

Shane Gervais

Saint Mary's University

NUGRID

CINP ICPN


Questions?
https://psaltisa.github.io/