

# The Impact of Nuclear Reaction Rate Uncertainties on the Evolution of Core-Collapse Supernova Progenitors

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# Conclusions

- Explore properties of core-collapse supernova progenitors with respect to uncertainties in thermonuclear reaction rates

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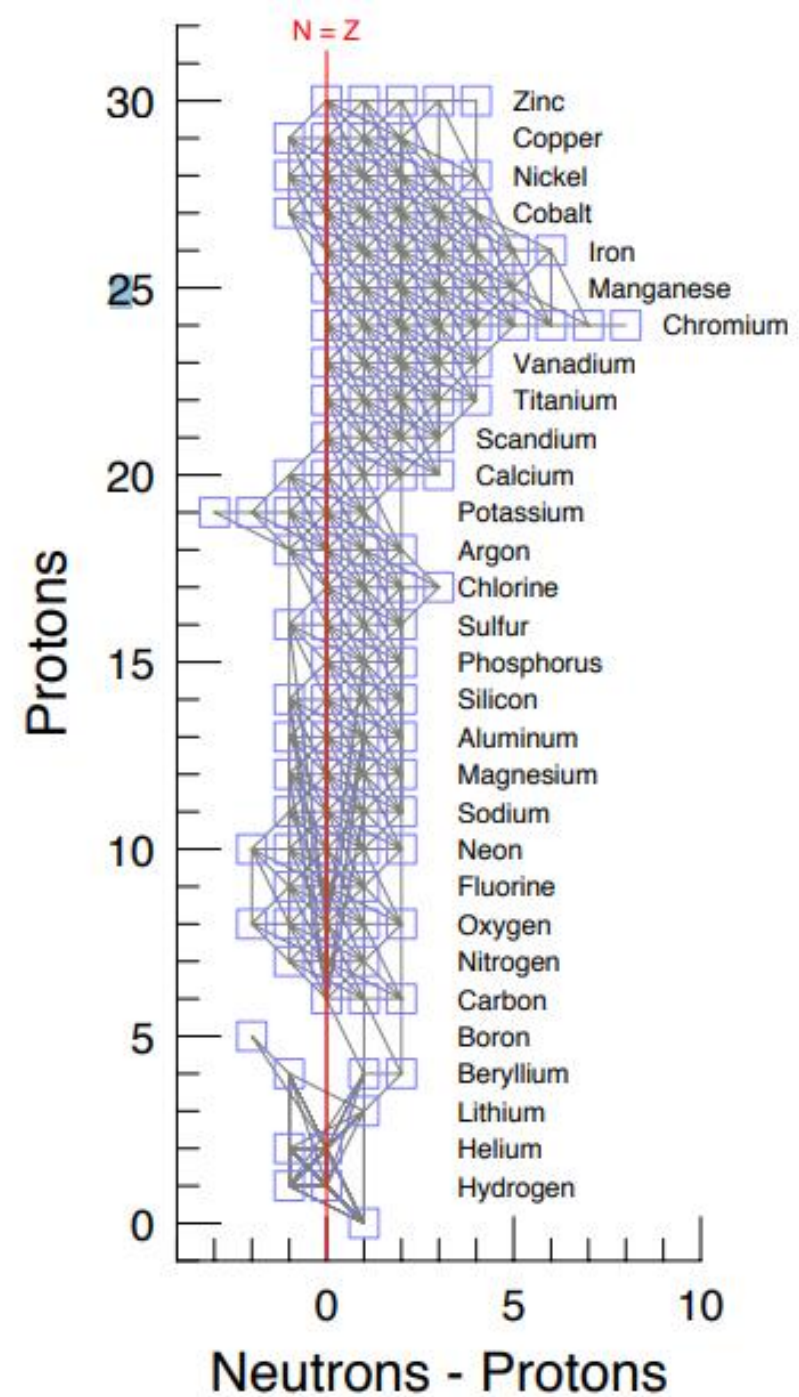
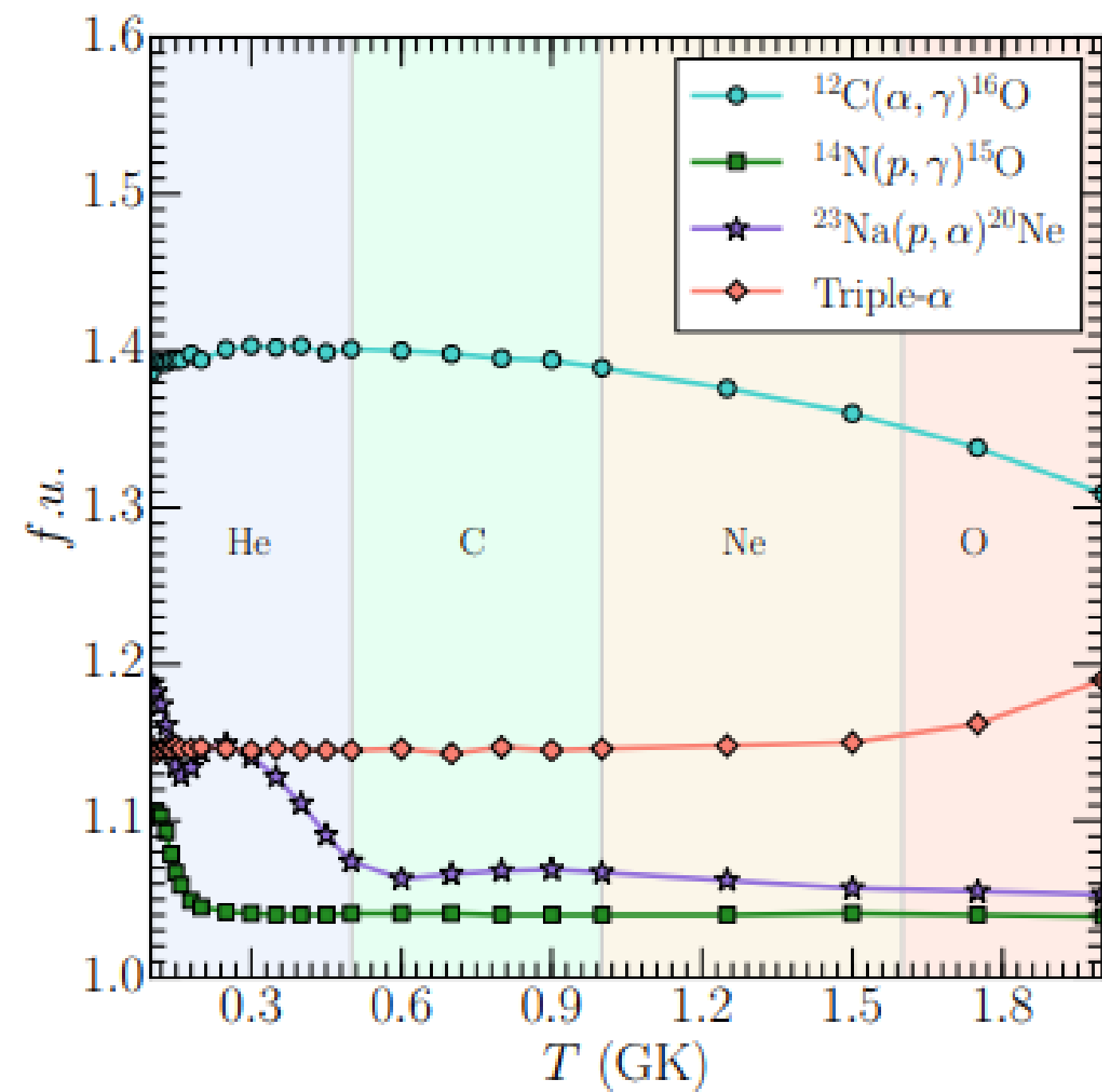
- Explore properties of core-collapse supernova progenitors with respect to uncertainties in thermonuclear reaction rates
- Most impactful uncertainties are in the  $^{14}\text{N}(\text{p}, \gamma)^{15}\text{O}$ , triple- $\alpha$ ,  $^{12}\text{C}(\alpha, \gamma)^{16}\text{O}$ ,  $^{12}\text{C}(^{12}\text{C}, \text{p})^{23}\text{Na}$ ,  $^{12}\text{C}(^{16}\text{O}, \text{p})^{27}\text{Al}$ ,  $^{16}\text{O}(^{16}\text{O}, \text{n})^{31}\text{S}$ ,  $^{16}\text{O}(^{16}\text{O}, \text{p})^{31}\text{P}$ ,  $^{16}\text{O}(^{16}\text{O}, \alpha)^{28}\text{Si}$

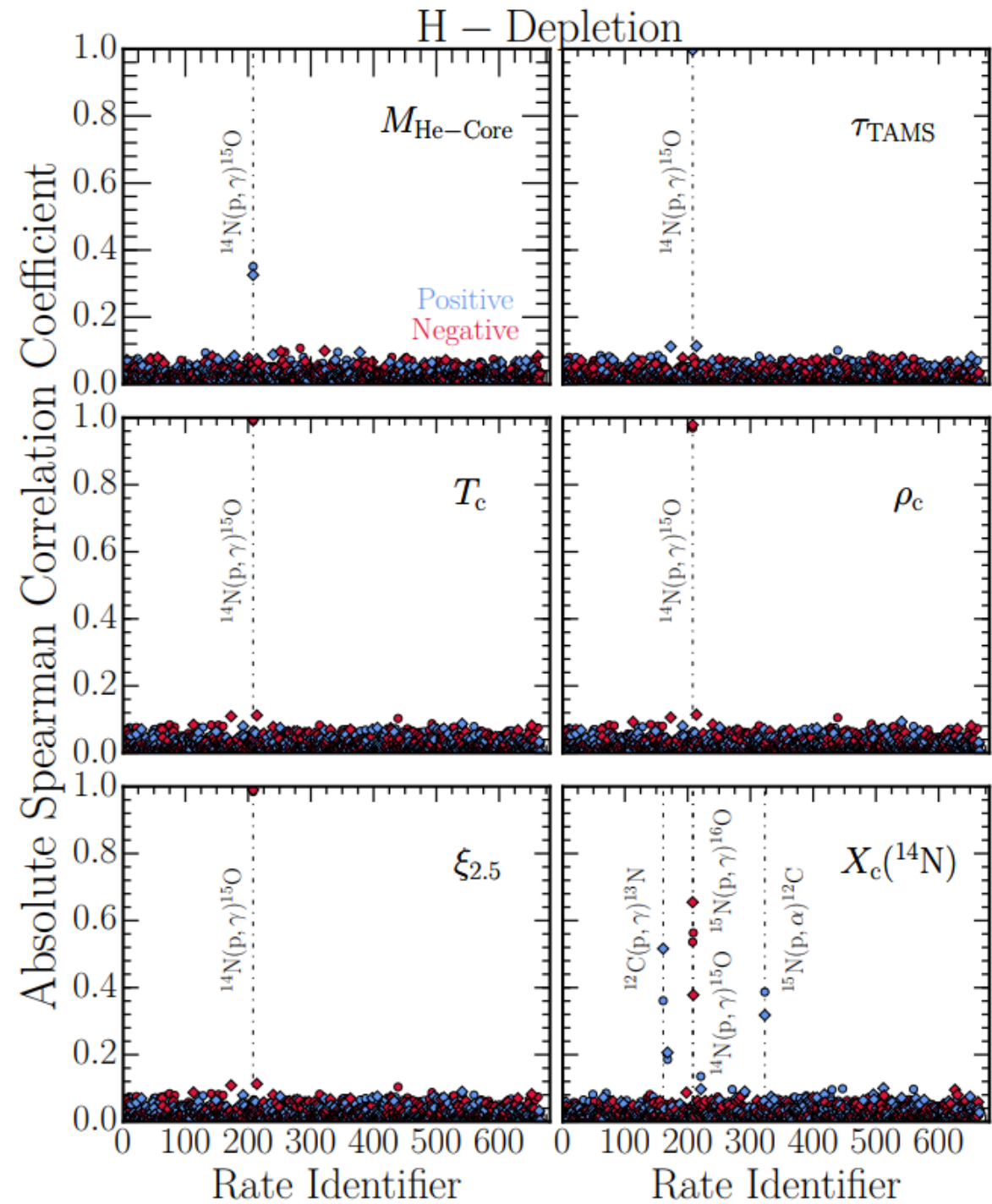
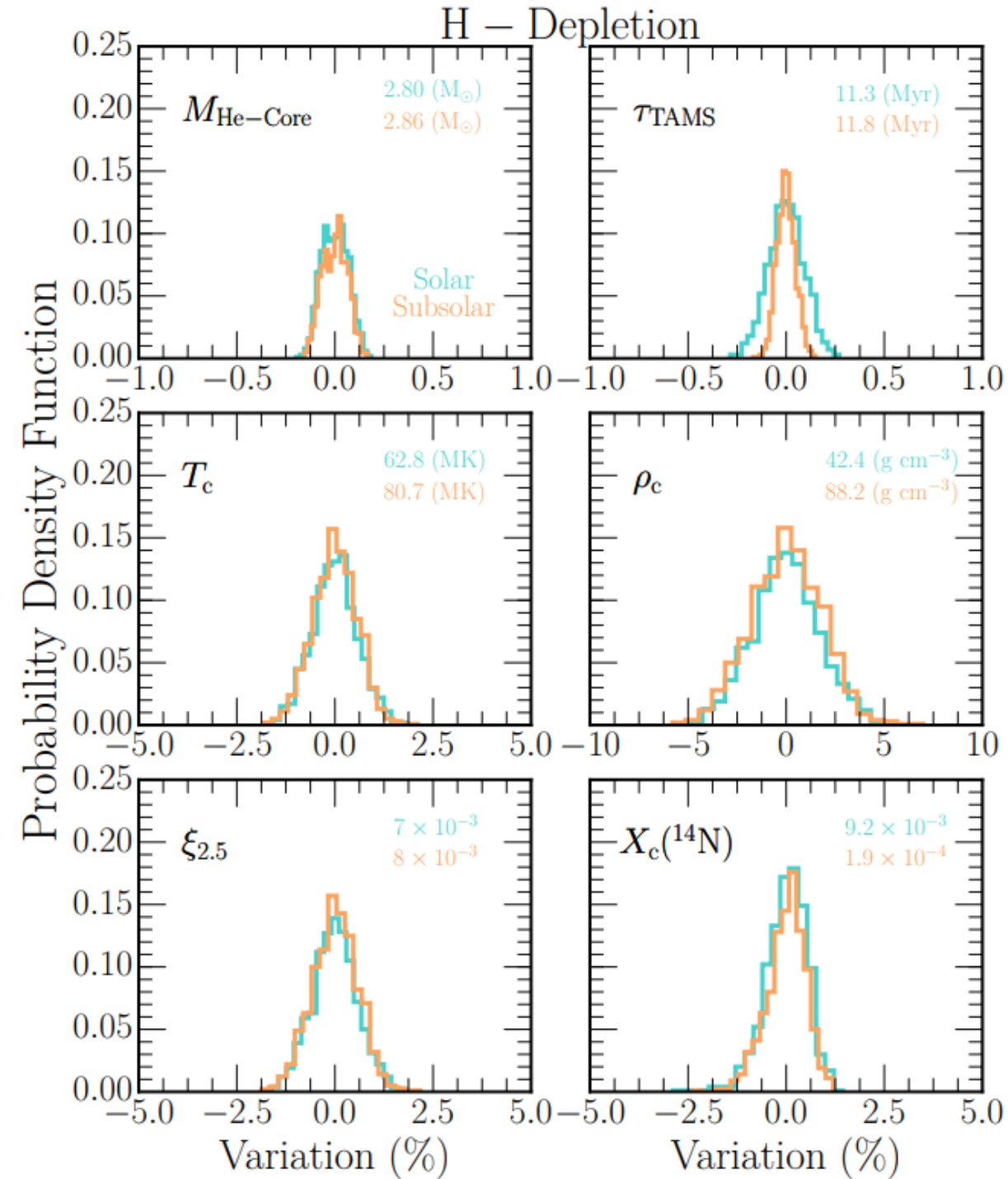
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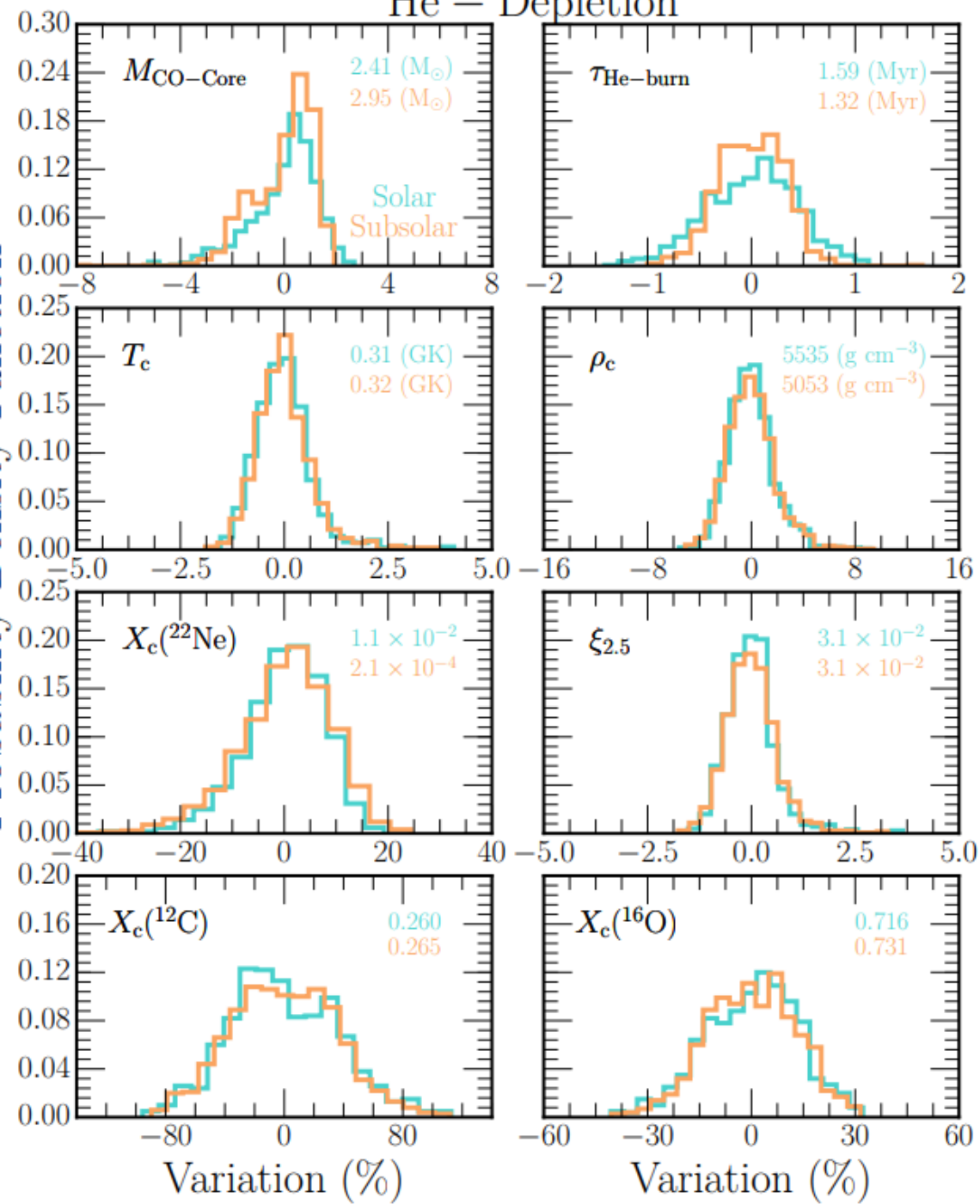
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- Variations increase with each phase of evolution
- By C-, Ne-, and O-depletion, the reaction rate uncertainties can dominate the variation in some various properties of the model near iron core-collapse

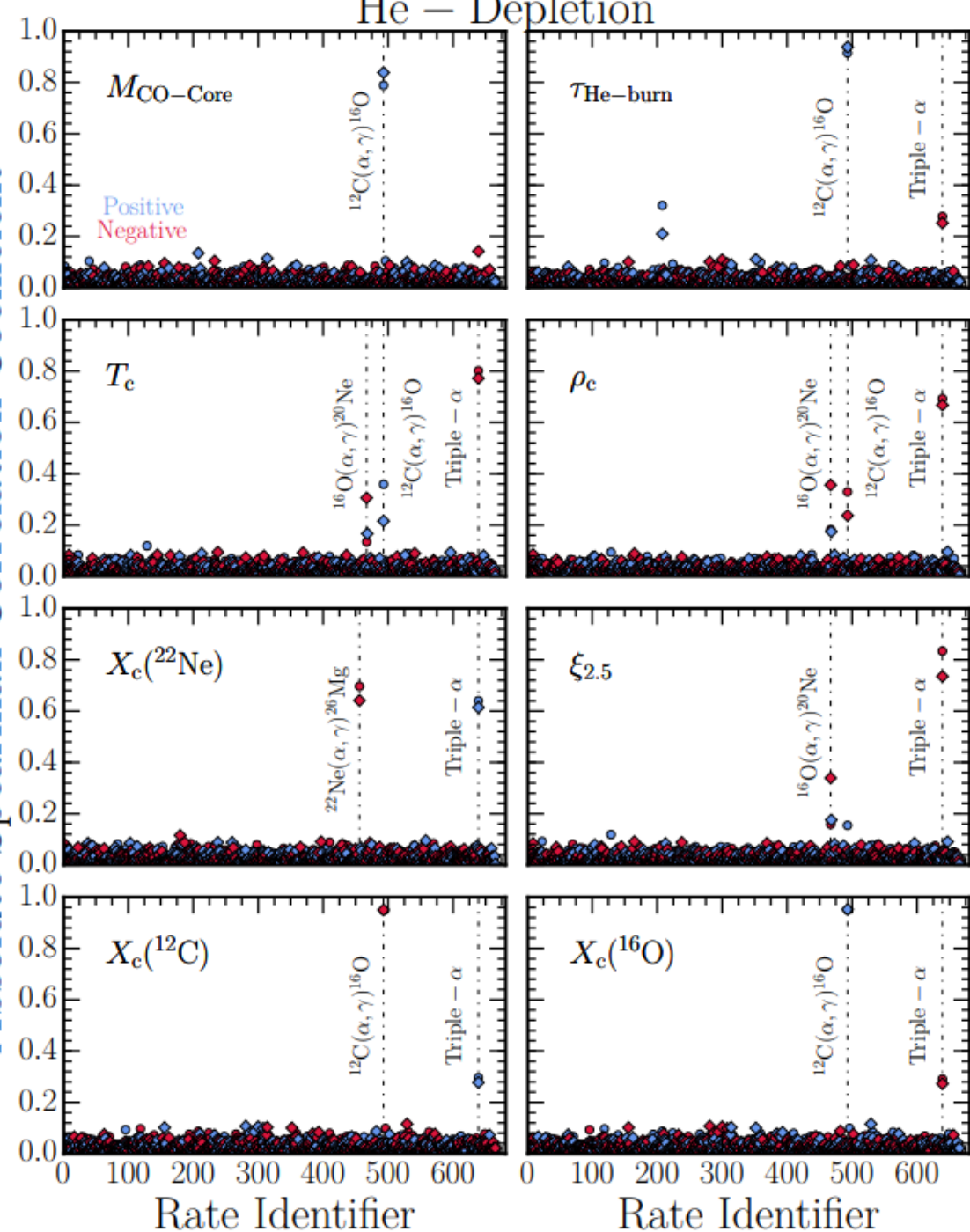




## He – Depletion

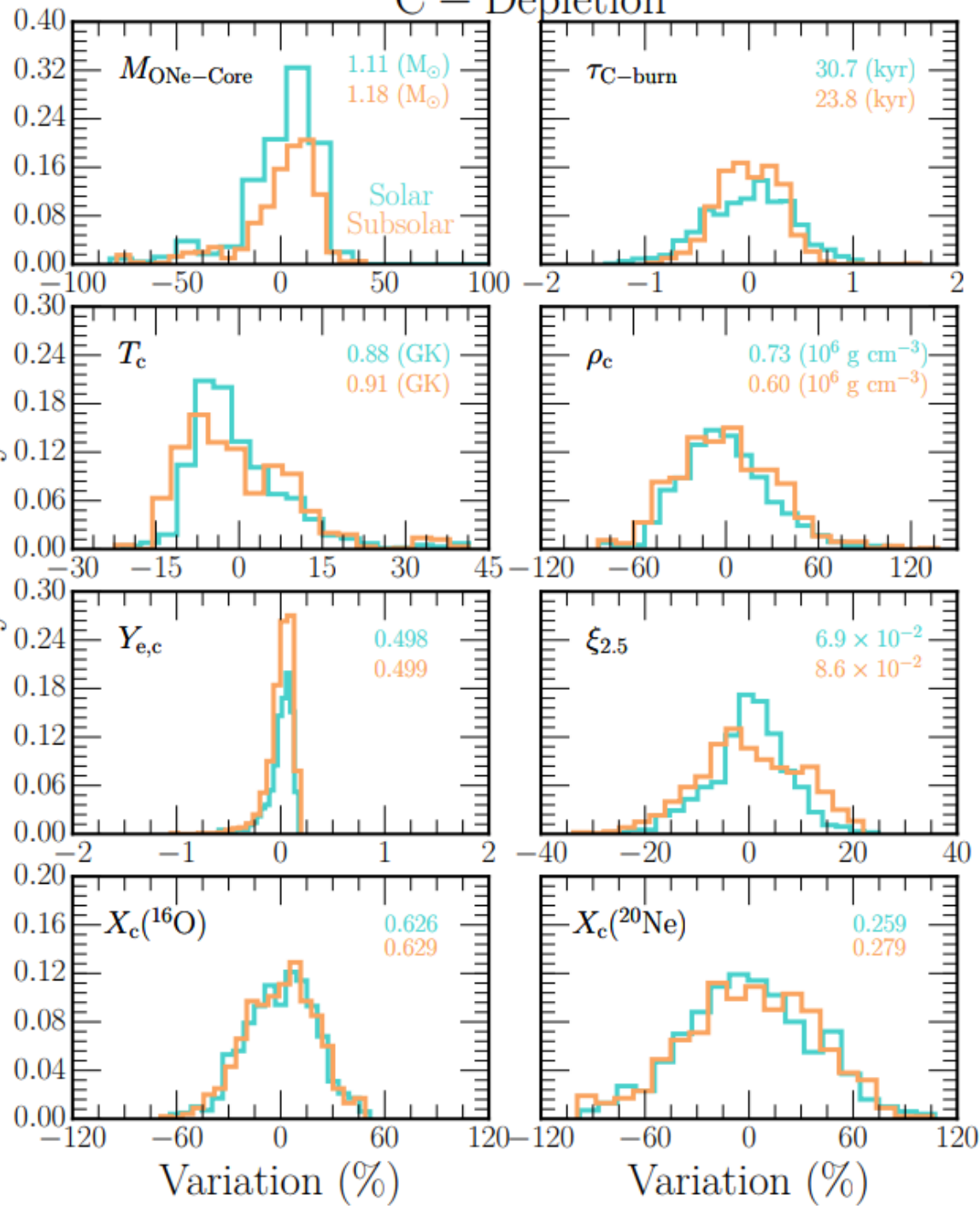


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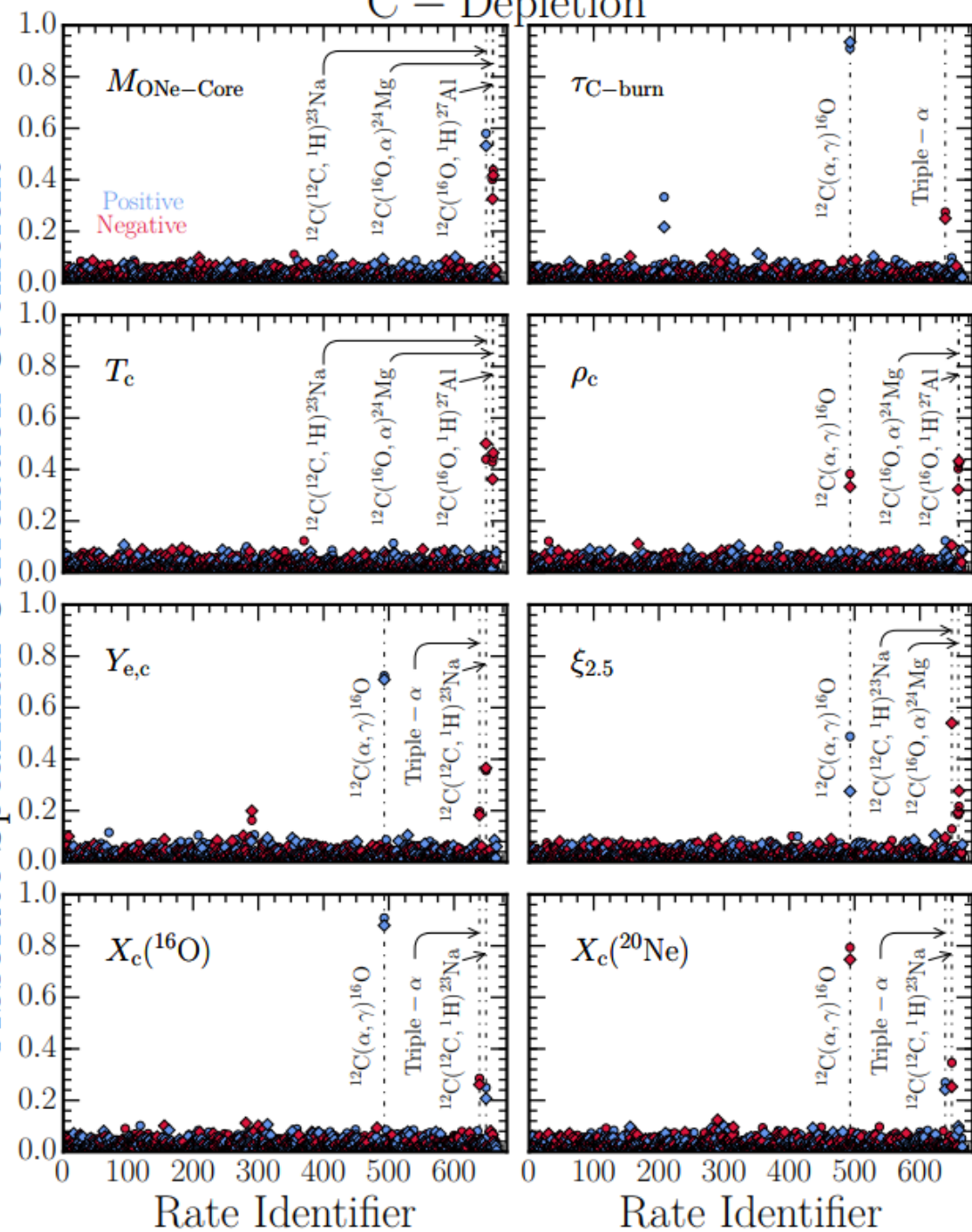


## C – Depletion



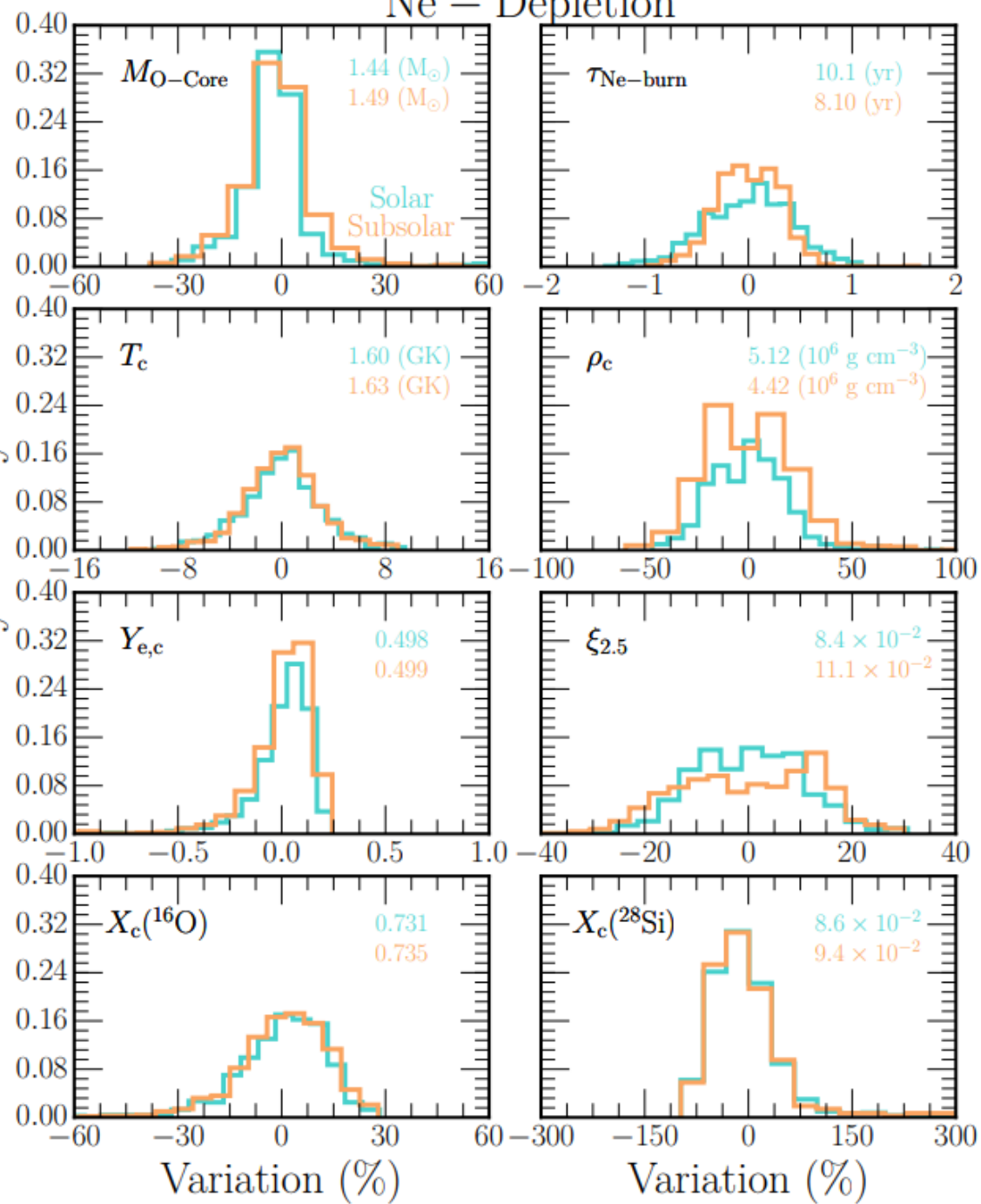
## C – Depletion

## Absolute Spearman Correlation Coefficient



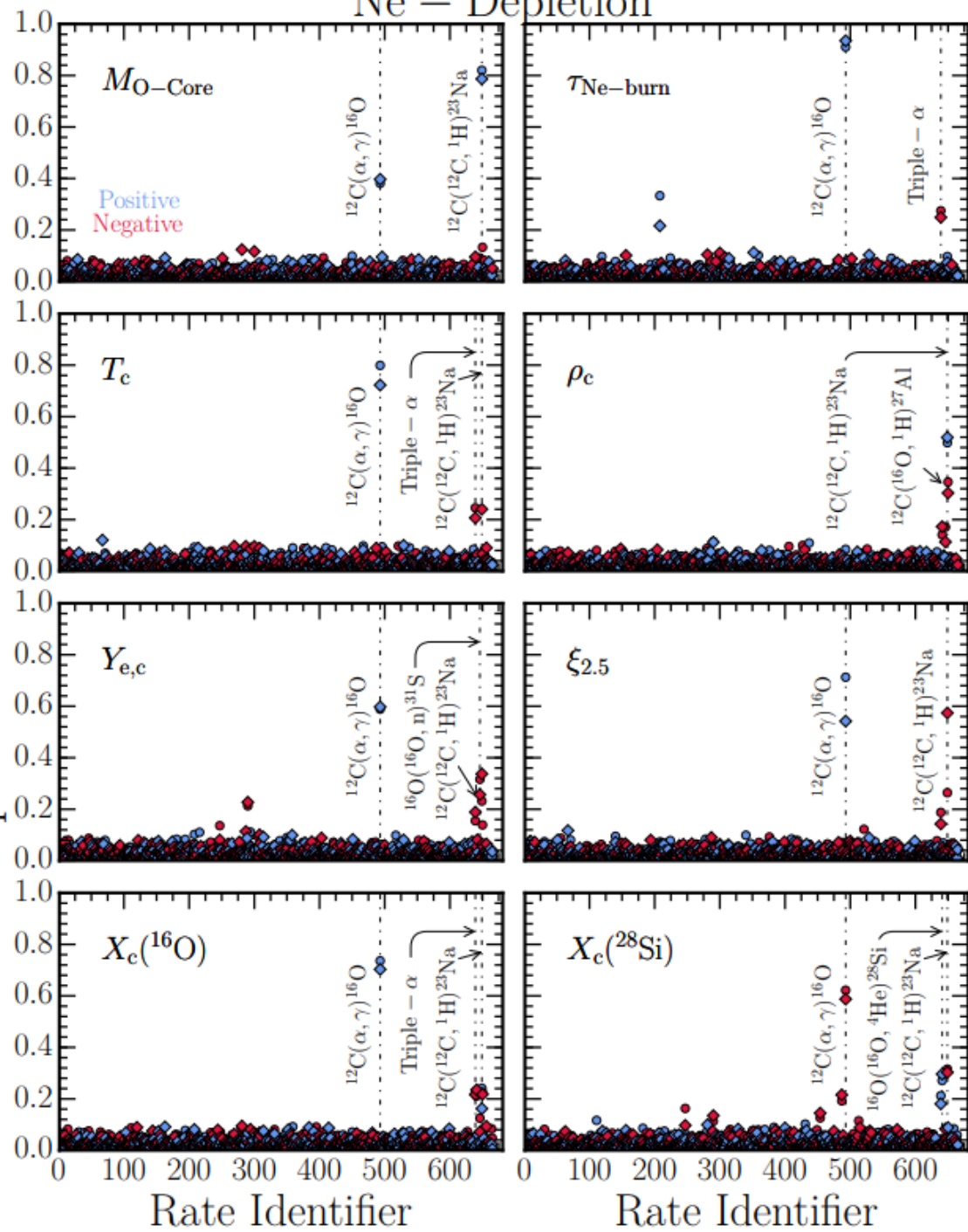
Probability Density Function

## Ne – Depletion

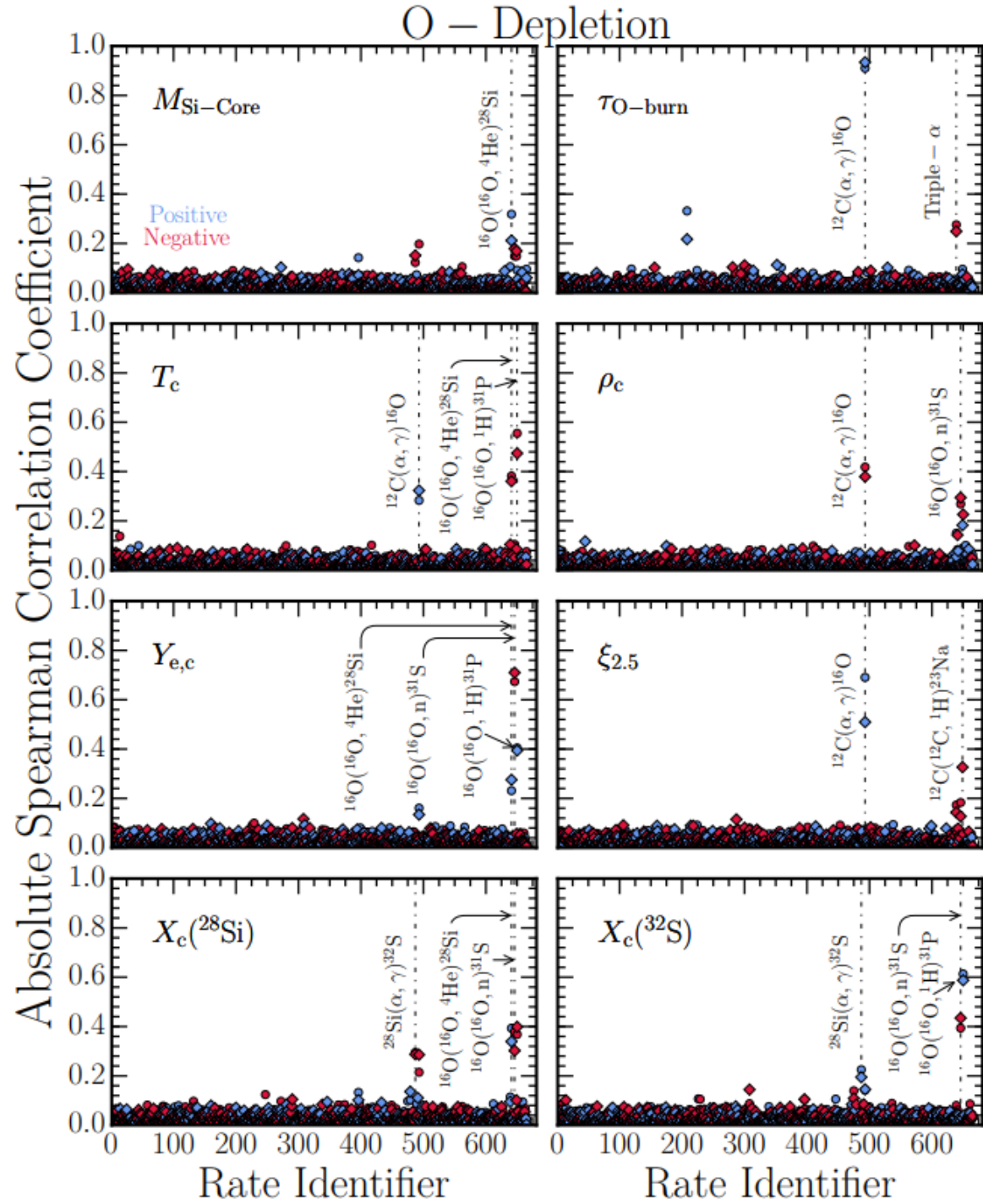
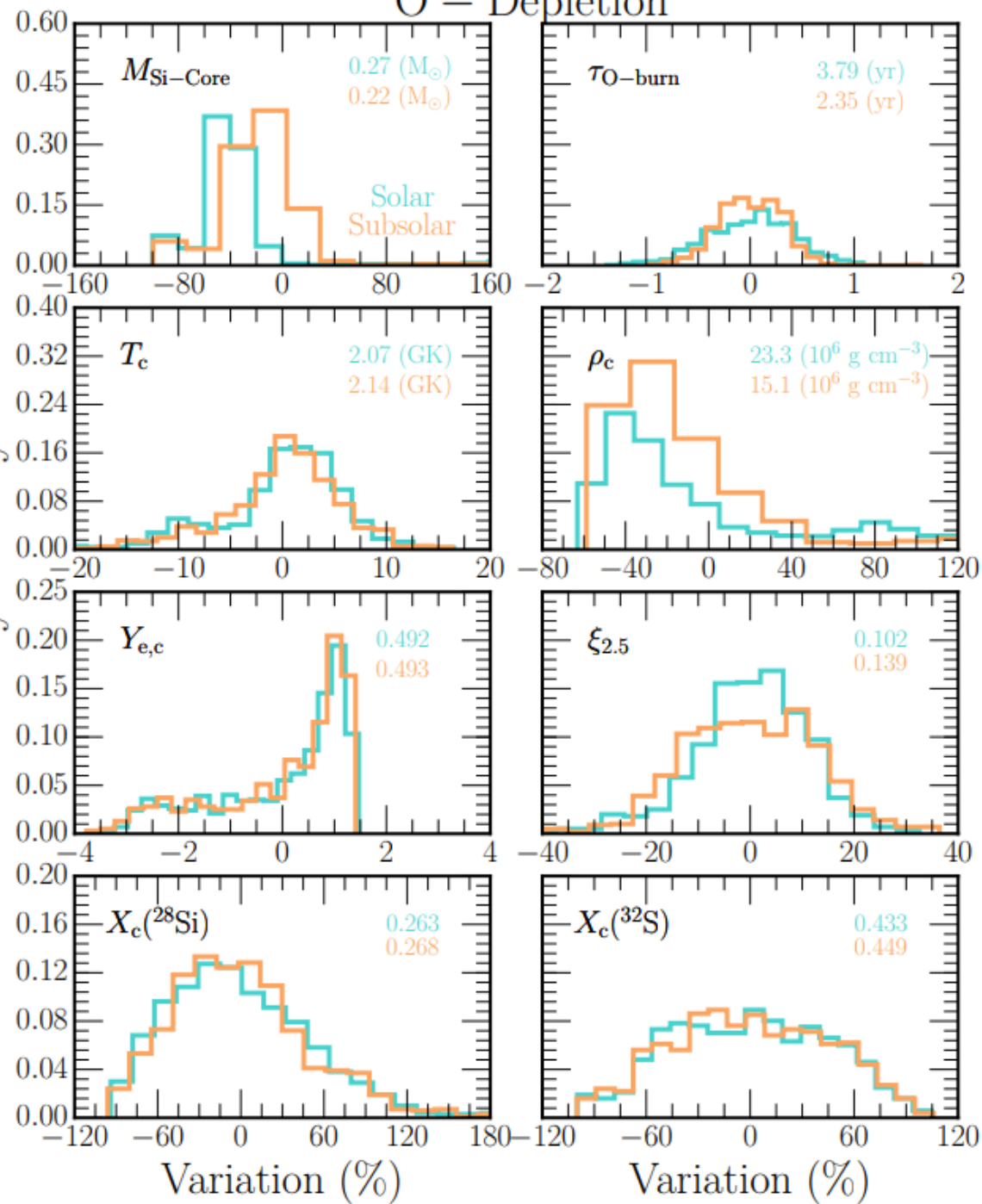


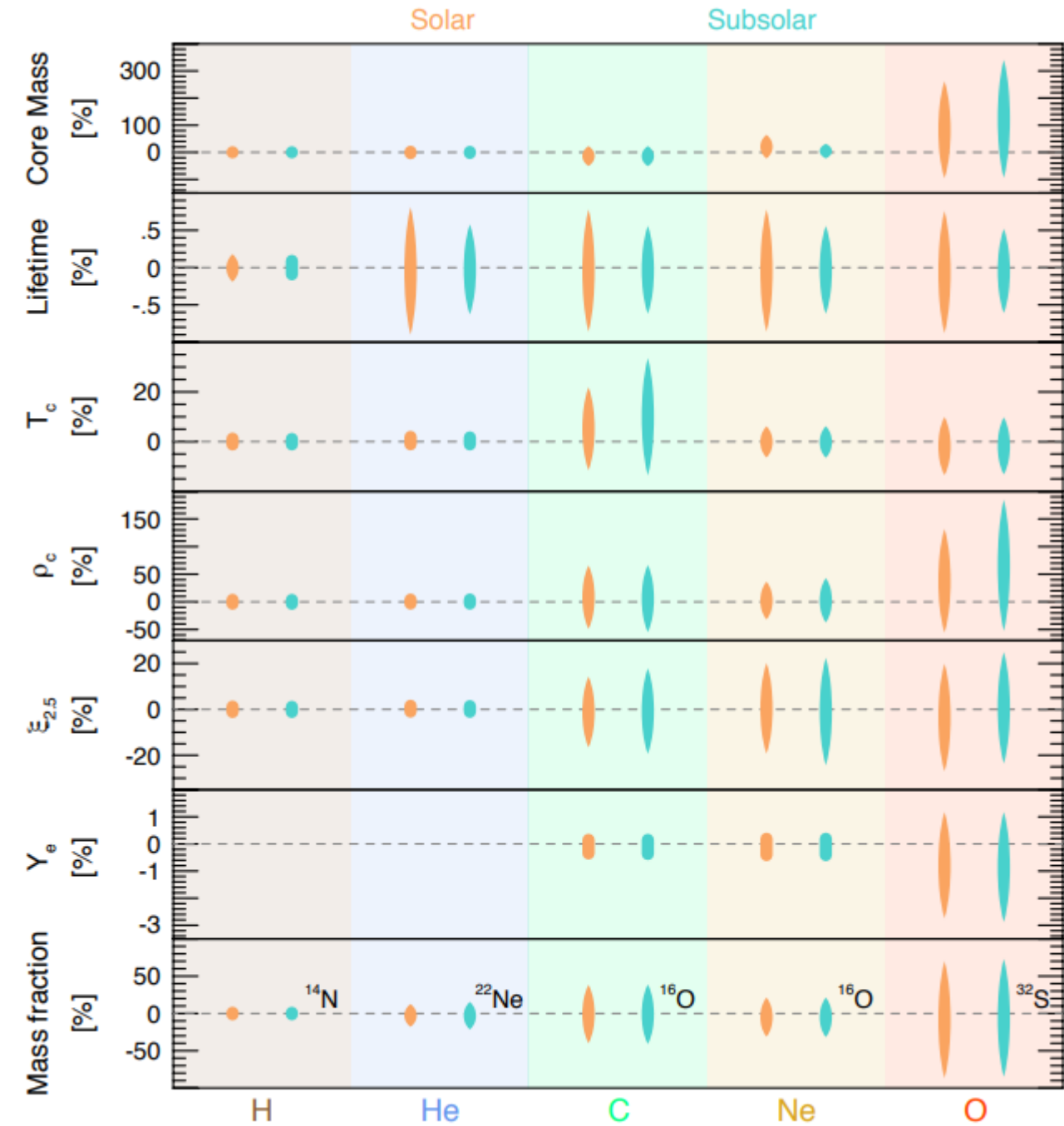
## Ne – Depletion

Absolute Spearman Correlation Coefficient



## O – Depletion





Vertical length of each tapered uncertainty band is the 95% CI for variations around the mean, the horizontal width represents the underlying PDF.

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- Surveyed core mass, burning lifetime, central temperature, central density, compactness parameter, and key abundances at five epochs
- In general, variations induced by nuclear reaction rates grow with each passing phase of evolution
- Variations from nuclear reaction rates are comparable in magnitude to variations from mass and network resolution choices