Short-lived radionuclei as clocks for the prehistory of the Solar System

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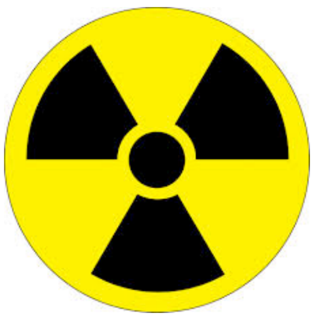
Monash Centre for Astrophysics, Australia



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Konkoly Observatory, Budapest, Hungarian Academy of Sciences

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Benjamin Wehmeyer

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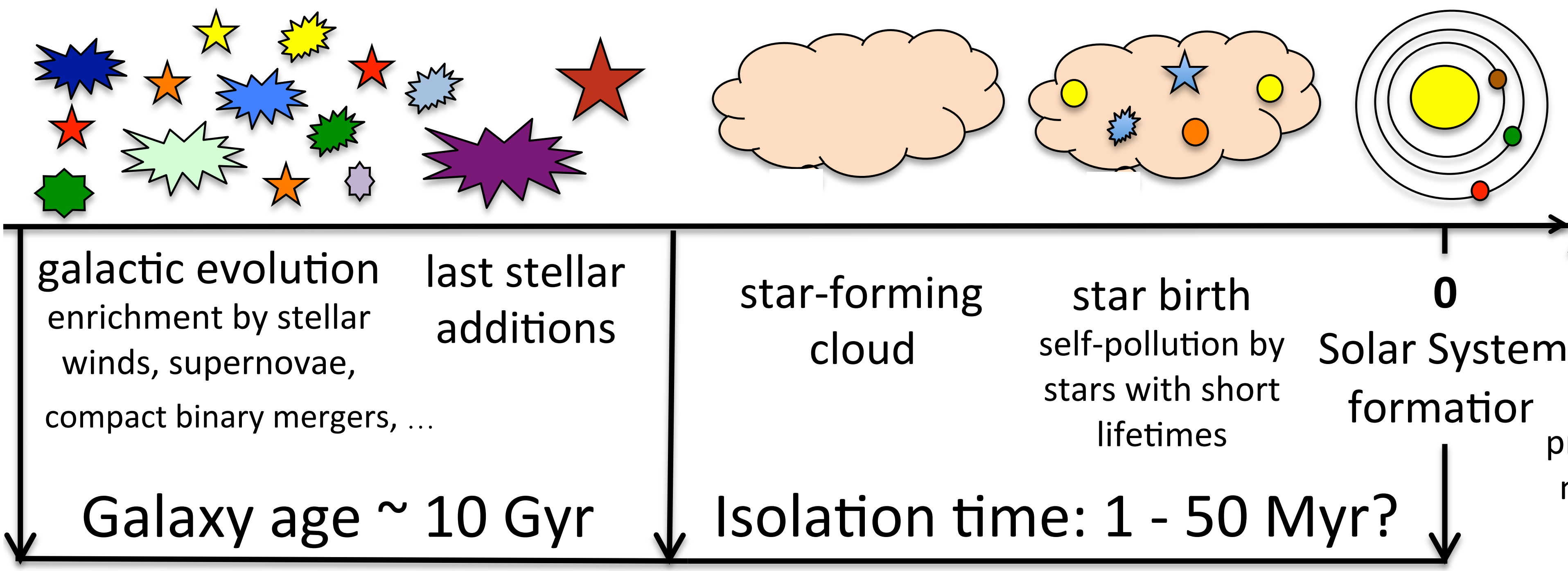
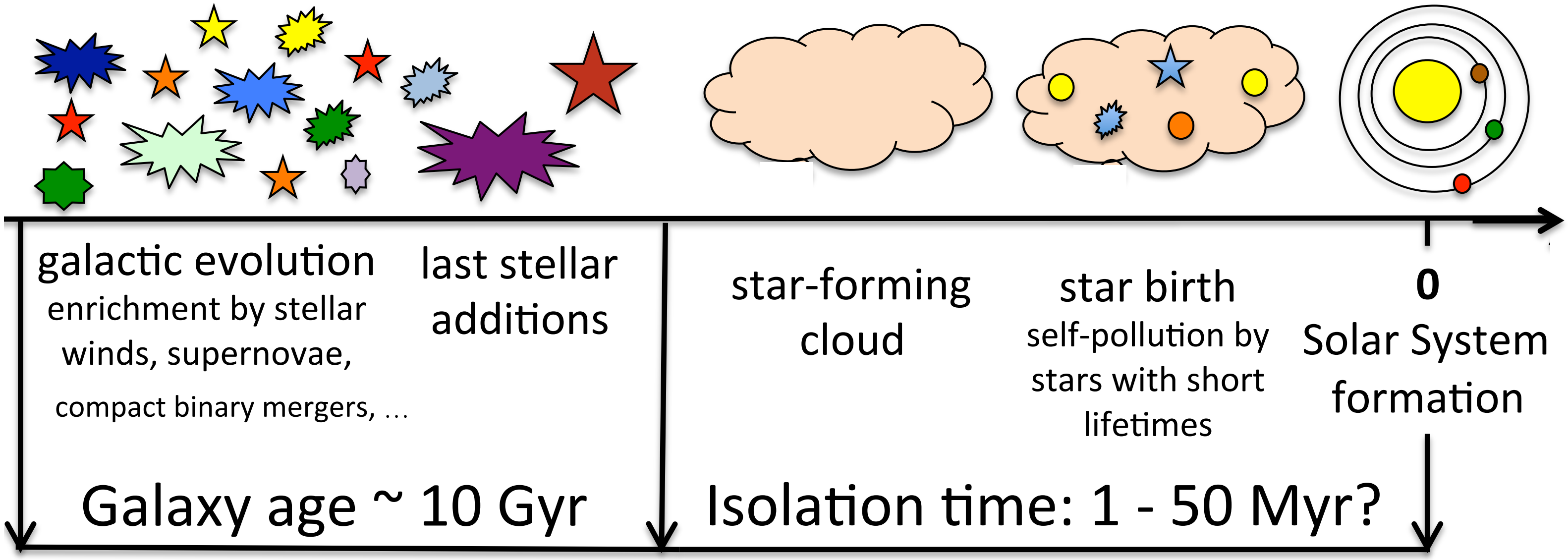
What is the "prehistory" of the material that makes up the Solar System?



How can we use radioactive nuclei understand this prehistory?



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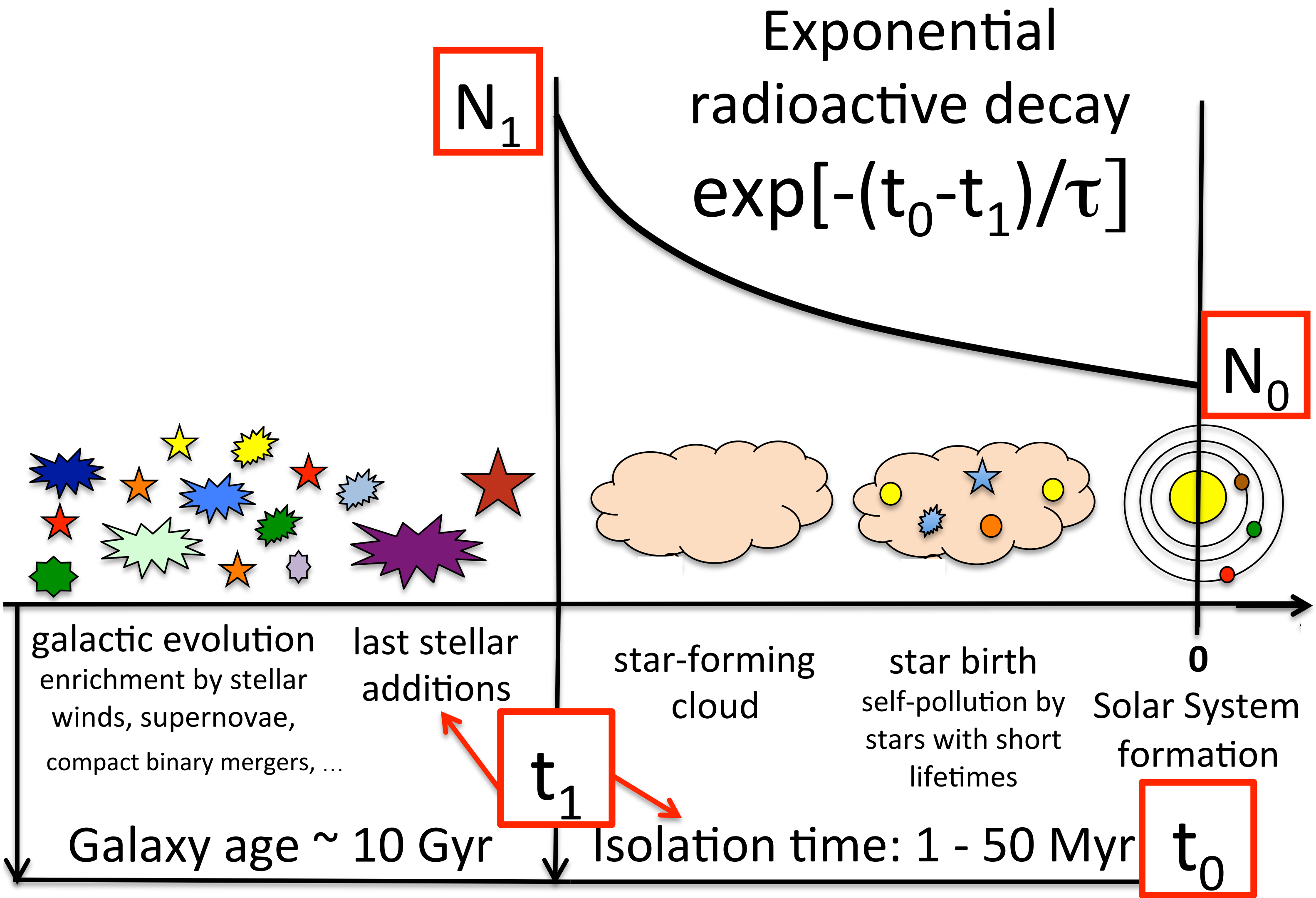

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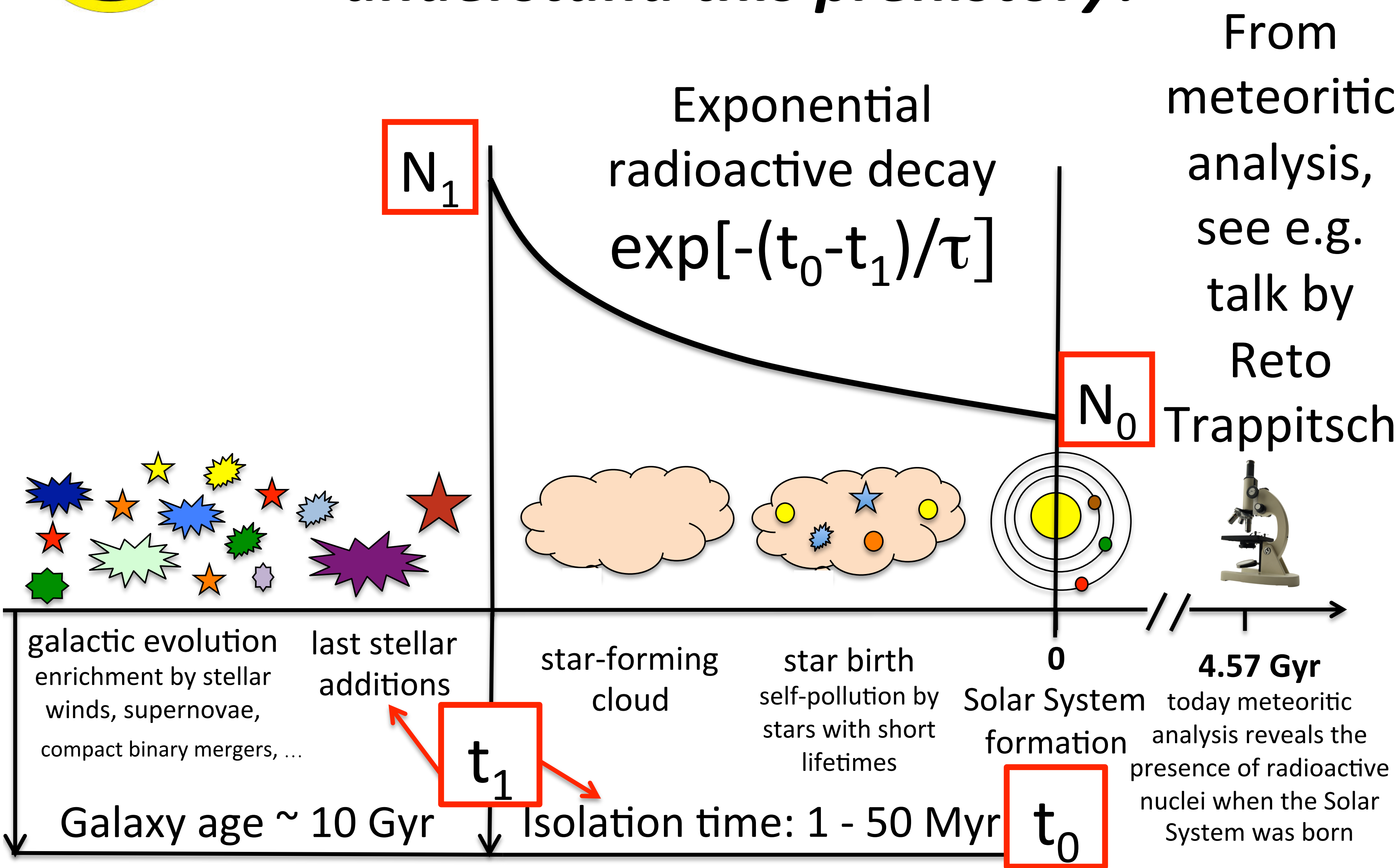

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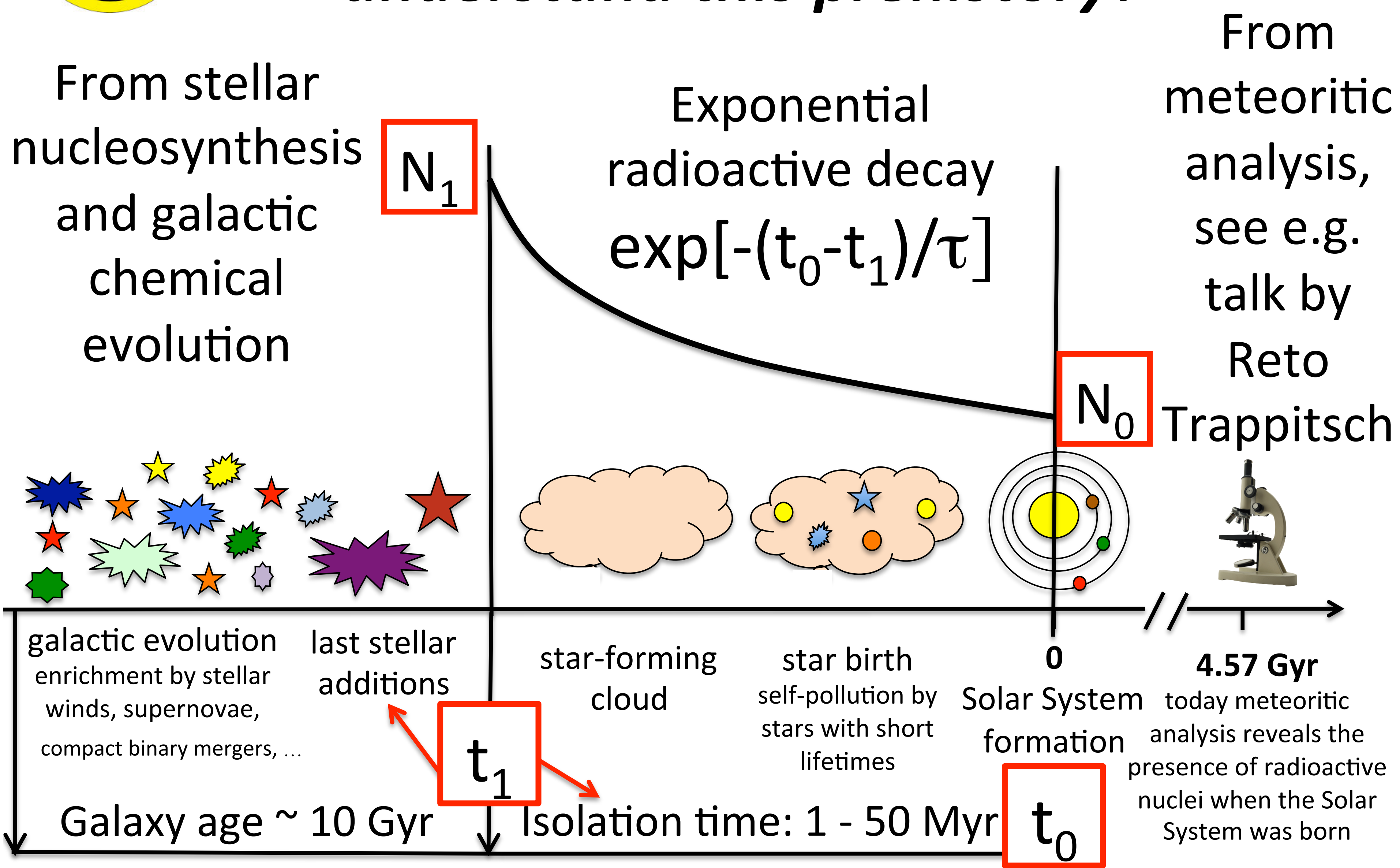

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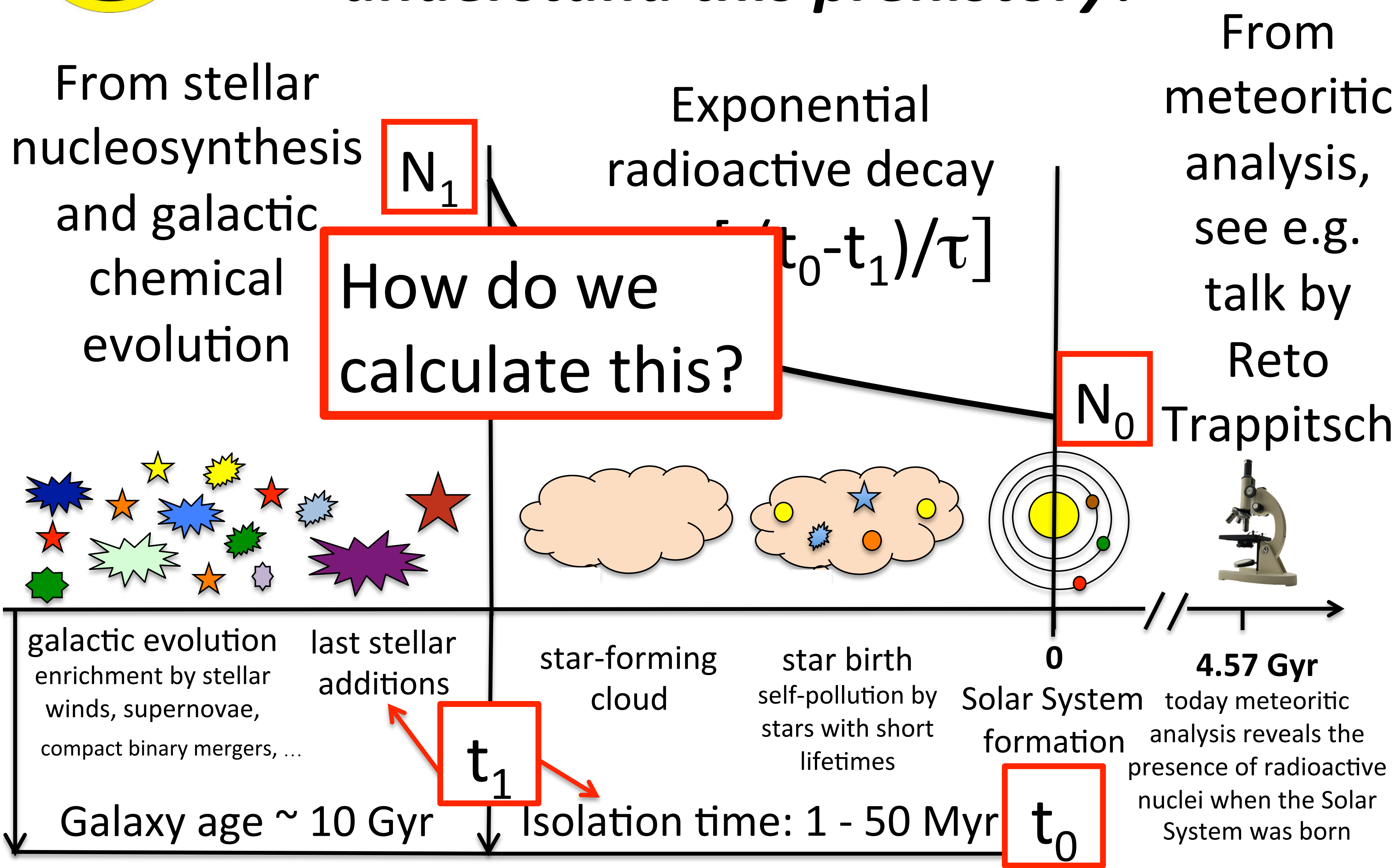

Abundance ratio of a radioactive to a stable nucleus (produced by the same process) in a parcel of galactic matter just after the last contributing nucleosynthetic event

$$\frac{N_{\mathrm{rad}}}{N_{\mathrm{stable}}} = K \times \frac{p_{\mathrm{rad}}}{p_{\mathrm{stable}}} \times \frac{\delta}{T_{\mathrm{Gal}}} \times \left(1 + \frac{1}{e^{\delta/\tau} - 1}\right)$$

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the "memory" term

δ = time interval between the production events

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$K > 1$: effect of galactic infall on the star formation rate

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Radioactive isotopes with 3 Myr < $T_{1/2}$ < 100 Myr present in the early solar system (i.e., N_0 is available)

Radio isotope	half life (Myr)	Stable isotope
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^{107}Pd	6.5	^{108}Pd	s+r
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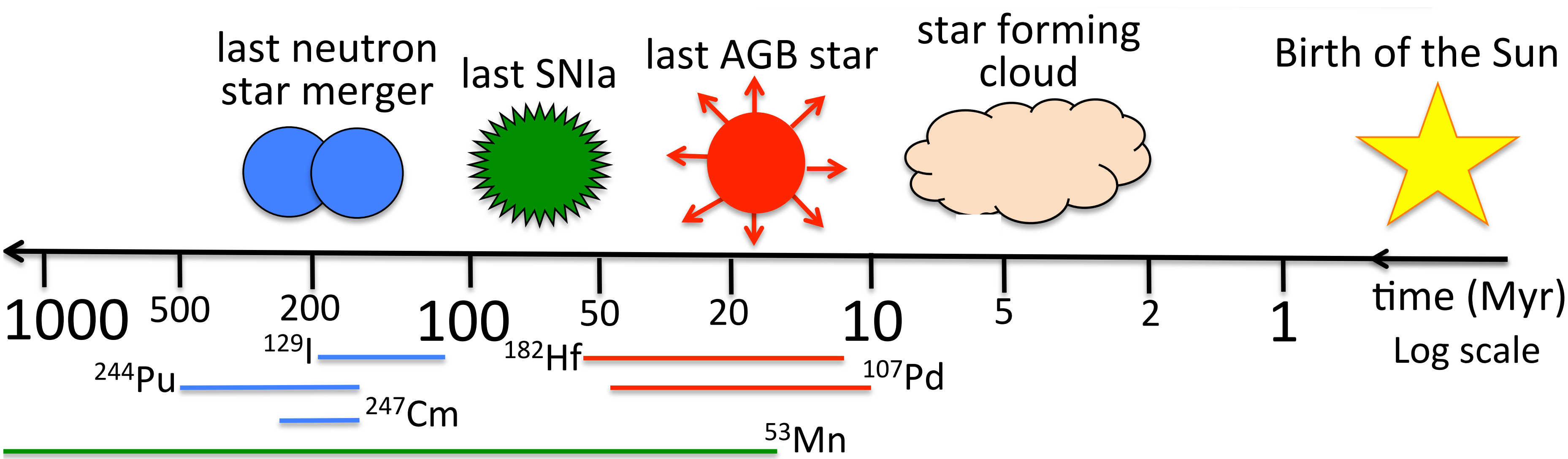
The times of last events

Ranges obtained by varying the parameters **K** and **δ**, we are working on them (*Côté et al.* in prep, *Wehmeyer et al.* in prep)



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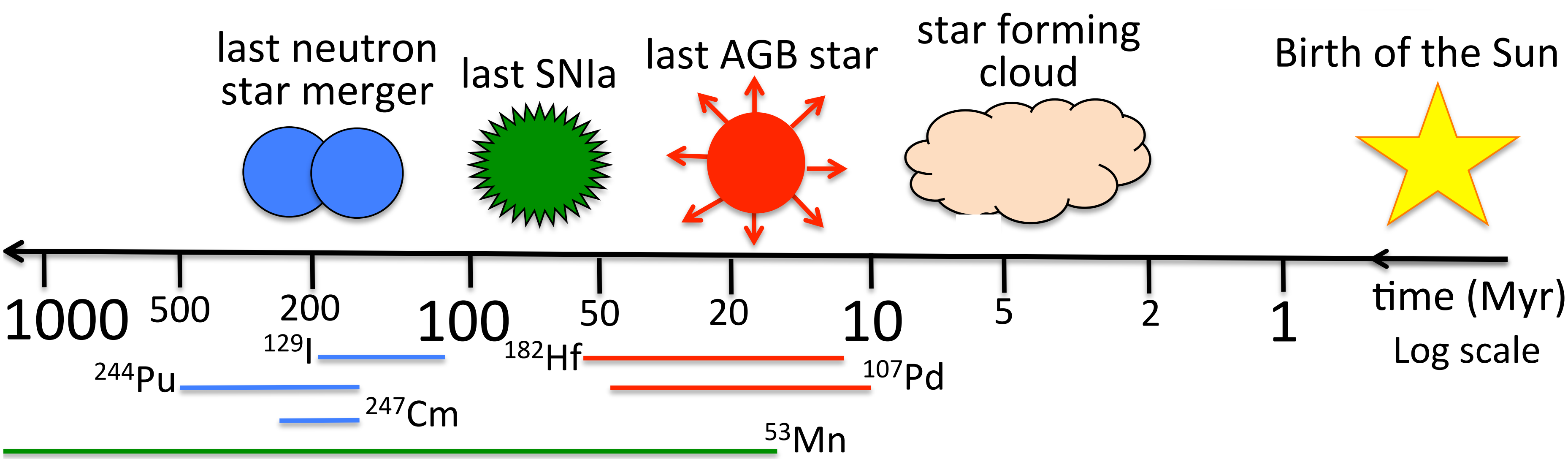

But we are still using one given choice of the stellar production ratios!

$$\frac{p_{\mathrm{rad}}}{p_{\mathrm{stable}}}$$

We need to also start analysing these ratios and their uncertainties

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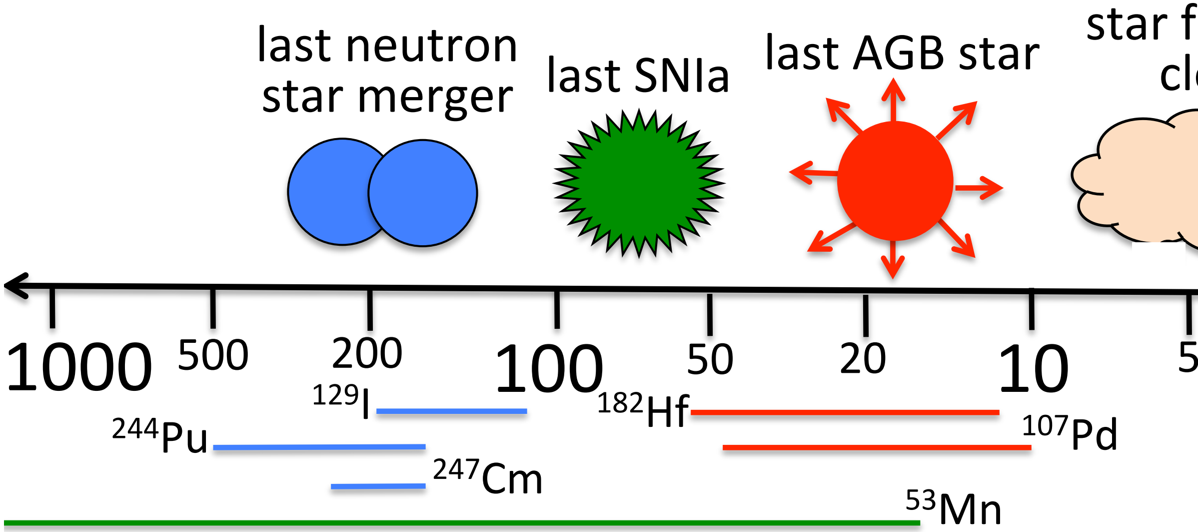

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$^{53}Mn/^{55}Mn$ production ratios in different types of SNIa

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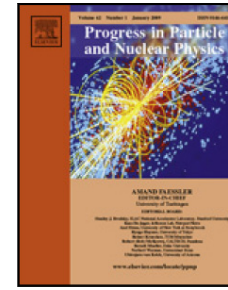

Review

Radioactive nuclei from cosmochronology to habitability

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M. Lugaro [a,b,*], U. Ott [c,d], Á. Kereszturi [a]

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[b] Monash Centre for Astrophysics, Monash University, VIC3800, Australia
[c] Atomki Institute for Nuclear Research, Hungarian Academy of Sciences, H-4026, Debrecen, Hungary
[d] Max-Planck Institute for Chemistry, D-55128 Mainz, Germany

A R T I C L E   I N F O

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This paper is dedicated to the memory of Gerald J. Wasserburg, who pioneered, built up, and inspired the science presented here.

A B S T R A C T

In addition to long-lived radioactive nuclei like U and Th isotopes, which have been used to measure the age of the Galaxy, also radioactive nuclei with half-lives between 0.1 and 100 million years (short-lived radionuclides, SLRs) were present in the early Solar System (ESS), as indicated by high-precision meteoritic analysis. We review the most recent meteoritic data and describe the nuclear interaction processes responsible for the creation of SLRs in different types of stars and supernovae. We show how the evolution of radionuclide

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Spare slides

Times before Sun formation from the last *s* and *r* process events that contributed to the galactic parcel of gas from which the Sun formed