n_TOF
Sezione di Perugia

RISULTATI 2019

1. Calcoli sulla nuova ^{89}Y(n,γ)

2. Calcoli su rivisitazione della ^{92}Zr(n,γ)

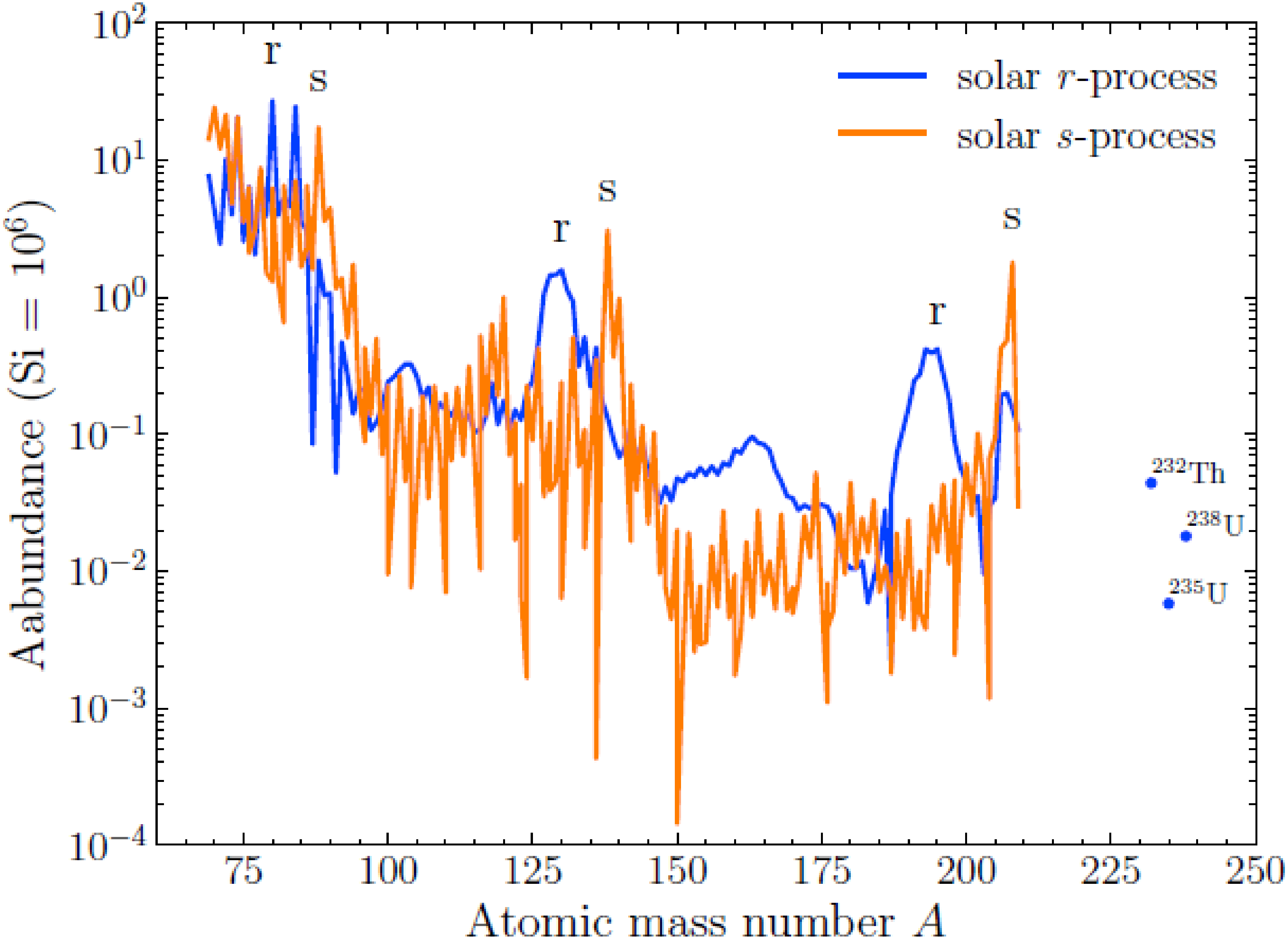
3. Risultati teorici (tesi PhD Diego Vescovi)

GRAN SASSO SCIENCE INSTITUTE
SCHOOL OF ADVANCED STUDIES
Scuola Universitaria Superiore

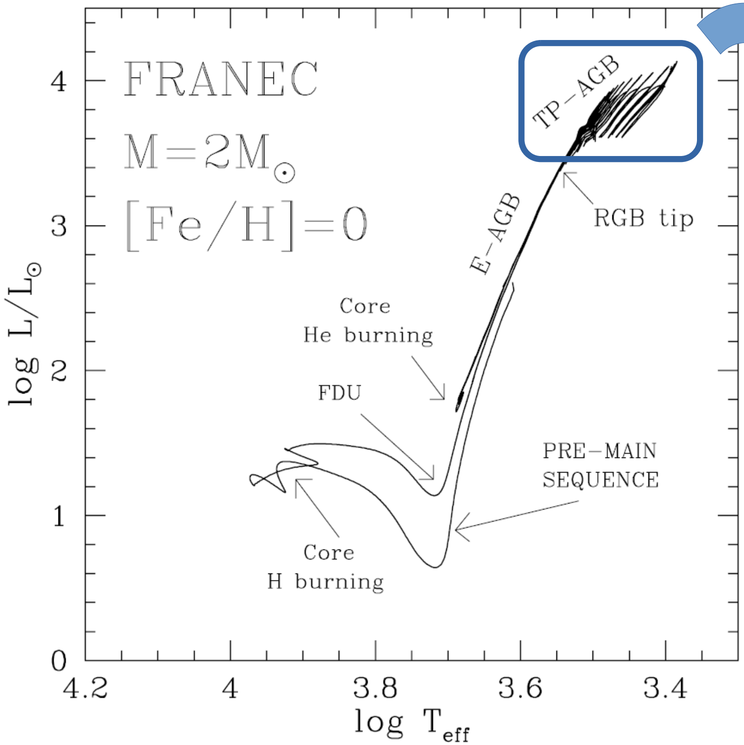
Gran Sasso Science Institute

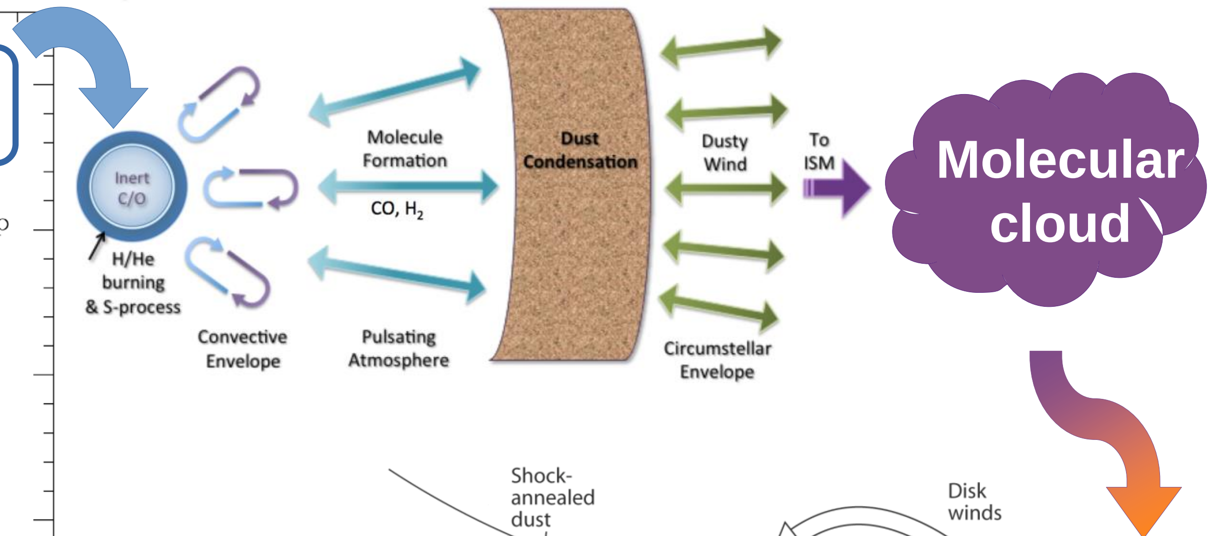
Nucleosynthesis of light and heavy elements across the Galaxy

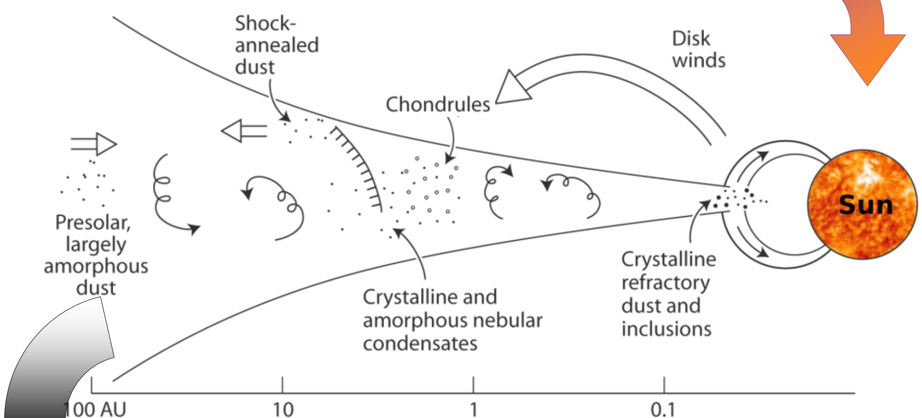
Results from Prantzos+2018,2020

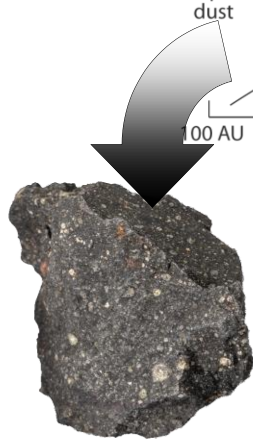


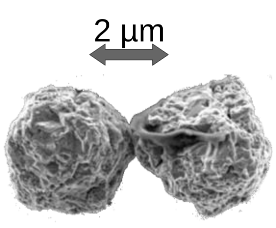
AGB stars and presolar SiC grains









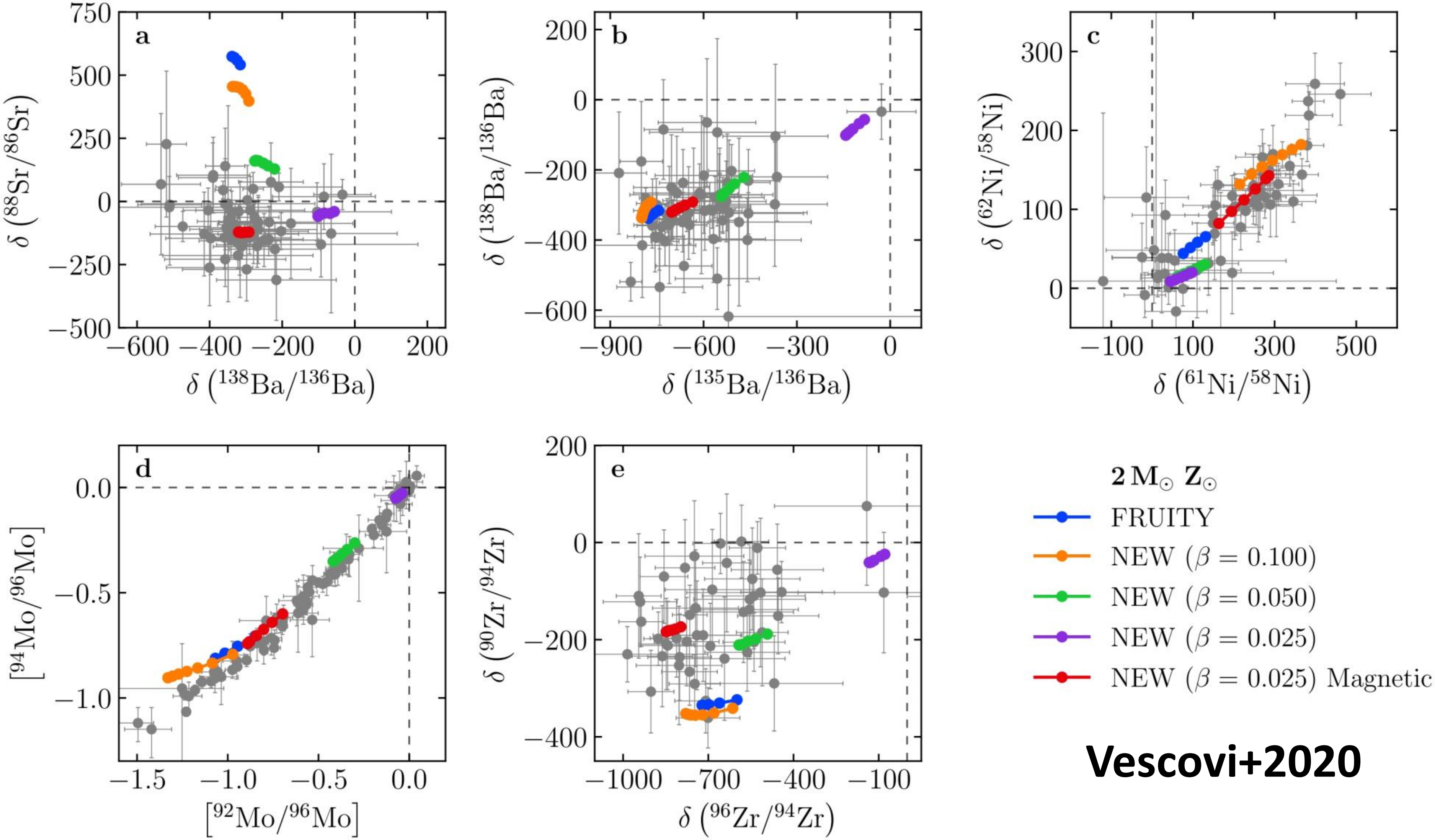


Meteorites and asteroids

Presolar grains

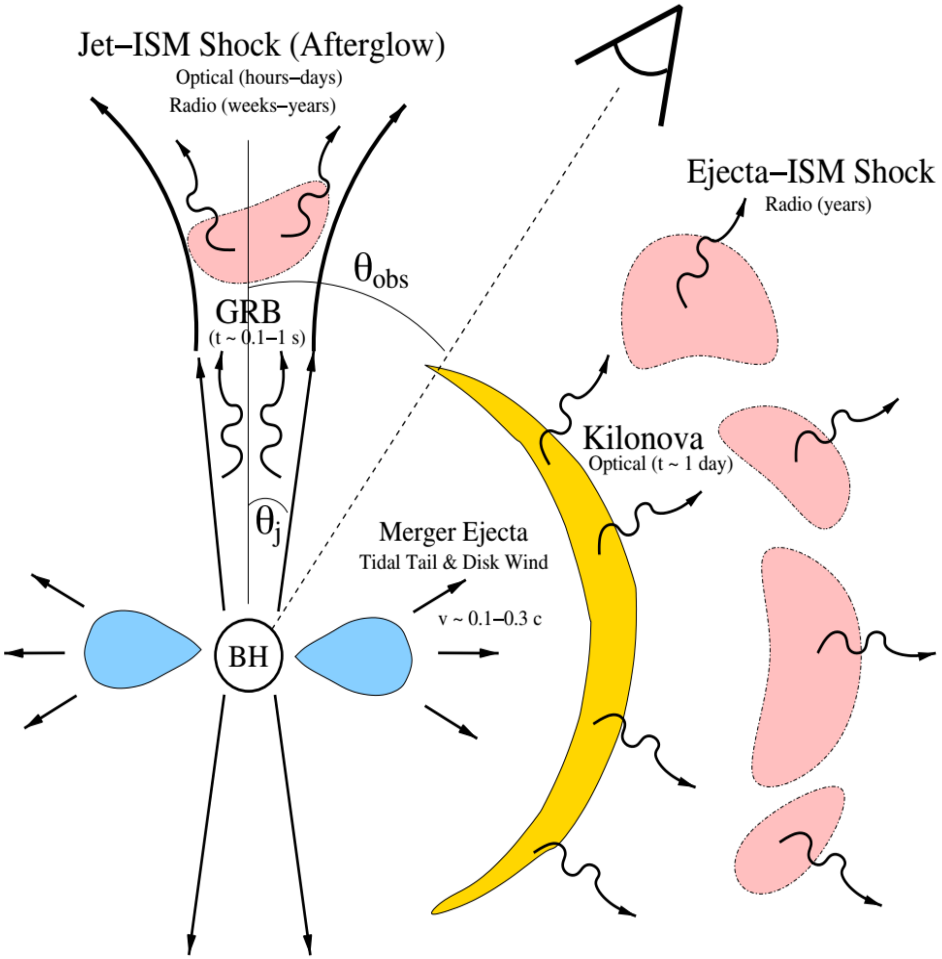
SiC Grains II

- **Magnetic** contribution account for SiC data!!
- Best fit for $u_p = 5 \times 10^{-5}$ cm/s and $B_\varphi = 5 \times 10^4$ G



Vescovi+2020

BNS merger + kilonova



Metzger & Berger 12

Basic ideas:

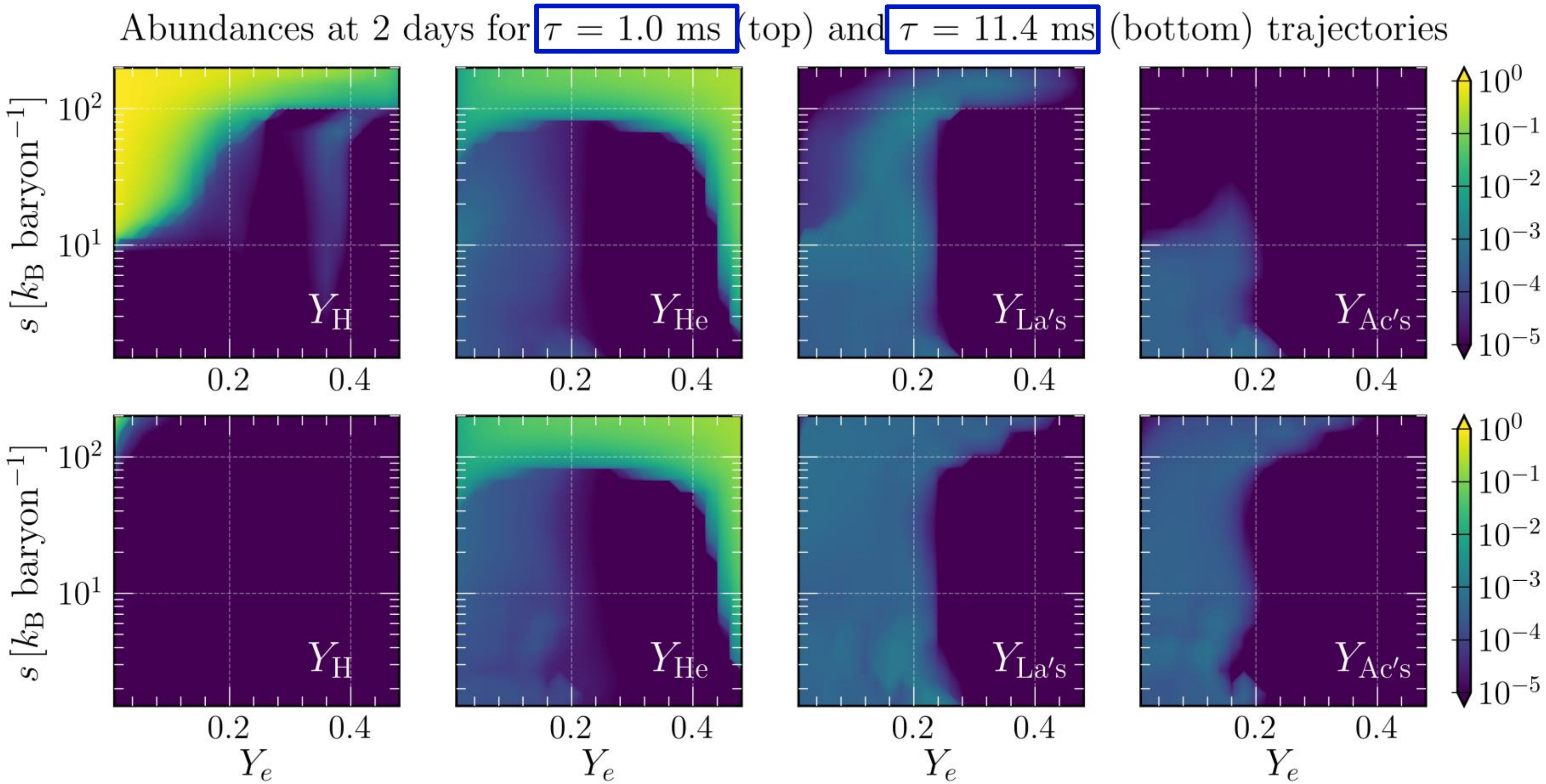
- <u>radioactive decay</u> of freshly synthesized *r*-process elements in ejecta: release of **nuclear energy;**
- thermalization of high energy decay products with ejecta;
- **diffusion** of thermal photons during ejecta expansion;
- thermal emission of photons at photosphere.

<u>A few days after merger</u> the spectrum reveals absorption features, qualitatively compatible with the forest of lines expected for **lanthanides and actinides**. The analysis at <u>1.5 days</u> suggested the presence of **strontium (Watson+2019)**.

Origin of H and He

Perego+(PRL,submitted)

RELEVANT TIMESCALES FOR DYNAMICAL AND SPIRAL-WAVE WIND EJECTA

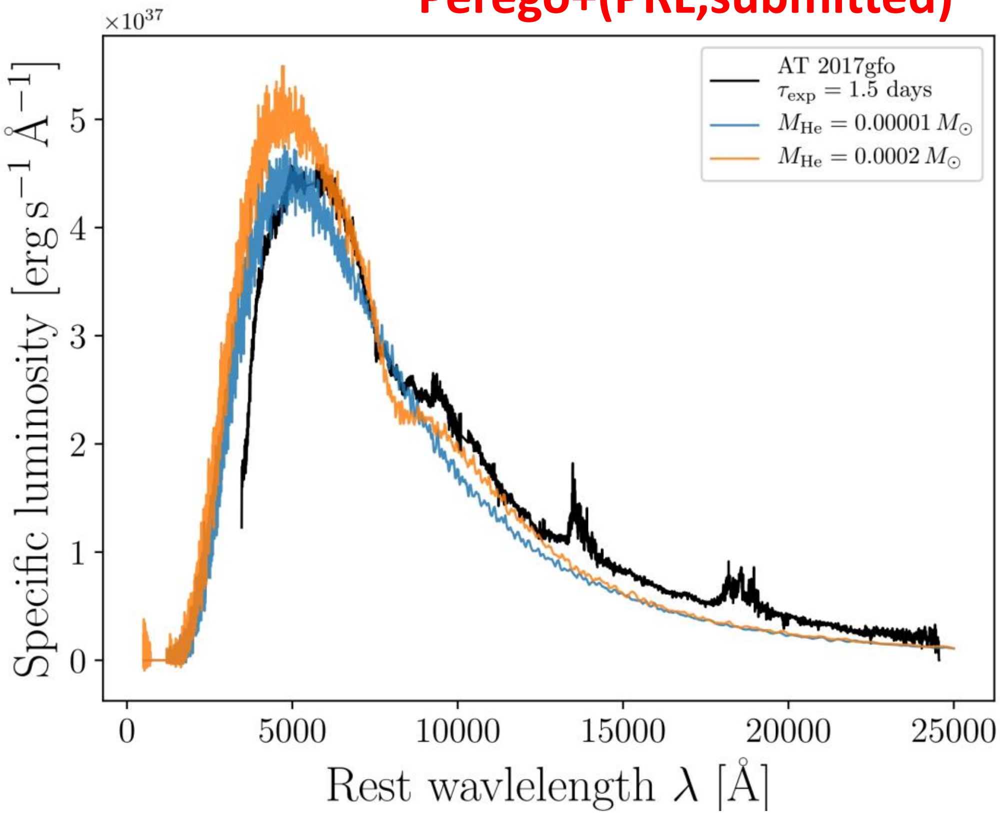


- abundances obtained for individual trajectories characterized by different (s, Y_e, τ) sets
- the presence of **H** in the ejecta is related with **high-*s*** and **low-Y_e**
- <u>He</u> production can happen both <u>in association or in the absence of heavy elements</u>

Detecting H and He features in kilonova spectra

- H and He are synthesized in hot conditions as <u>bare nuclei</u>; electrons recombine as matter expands and cools (at 0.5 days T≈10^4 K). First He and then H could **recombine in** atomic form after a **few hours**
- the spectrum of AT2017gfo at 1.5d shows a broad absorption at 810 nm that was explained by a transition of SrII (**Watson+2019**)
- based on the velocity profile only, the feature <u>could be consistent</u> with a He 10831 line in the ejecta expanding at 0.25c? We use **TARDIS** to test whether this feature can be produced by a high velocity He layer in favorable conditions.
- Yes, but only with high M_{He} and in non-LTE conditions

Perego+(PRL,submitted)



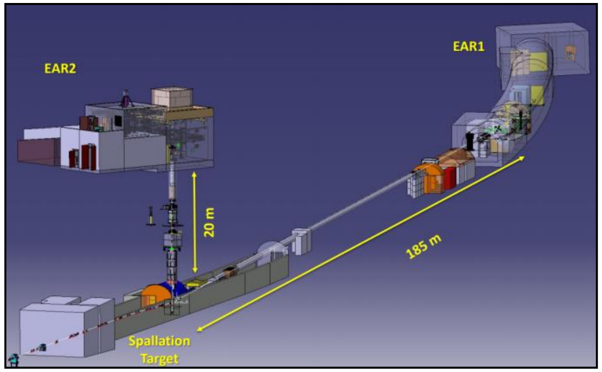
→ He **is likely not responsible** for the observed 810 nm feature, unless non-LTE effects or the He mass are severely underestimated

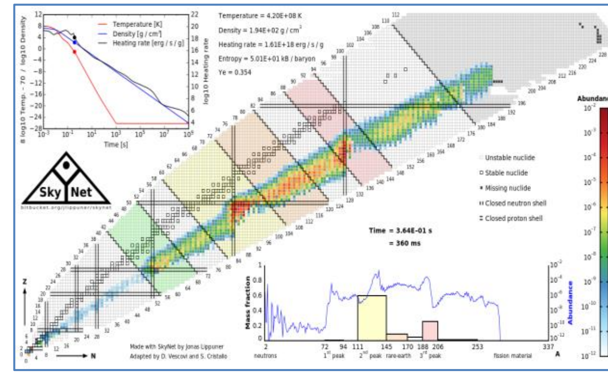
→ Similar results for a H-rich ejecta composition

PROSPETTIVE SUL PROCESSO s (2020)

1. Calcoli stellari sulla $^{140}Ce(n,\gamma)$

PROSPETTIVE SUL PROCESSO r (2020)

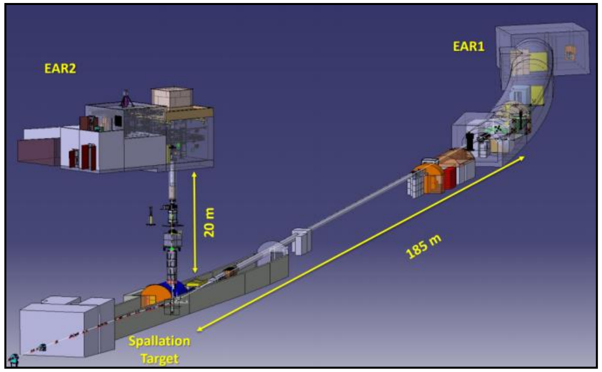


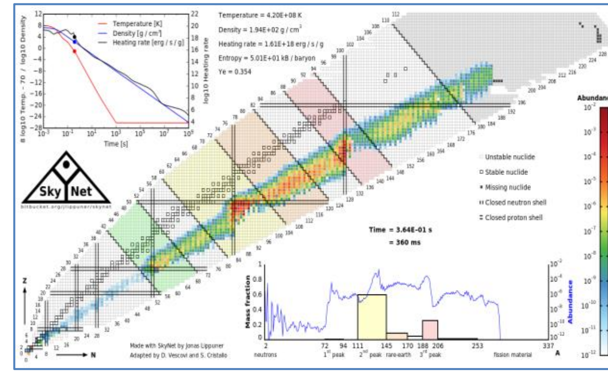


MISURE DI FISSIONE

NUCLEOSINTESI

PROSPETTIVE SUL PROCESSO r (2020)

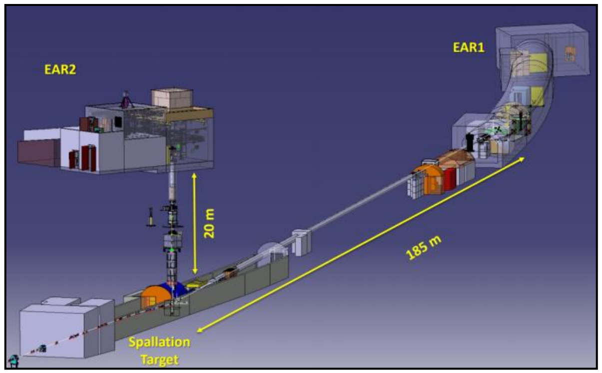


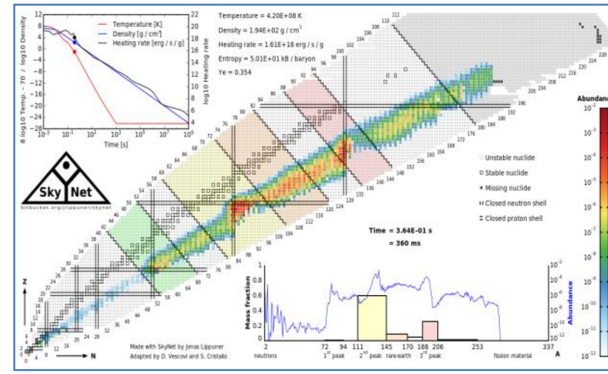


MISURE DI FISSIONE

NUCLEOSINTESI

PROSPETTIVE SUL PROCESSO r (2020)





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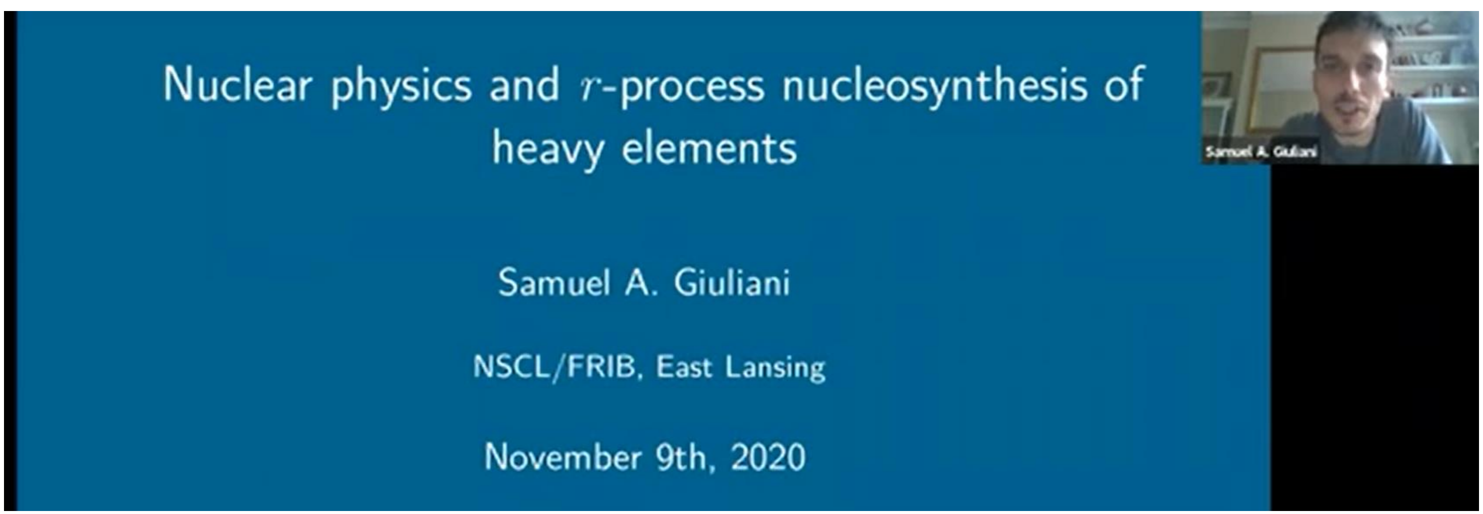
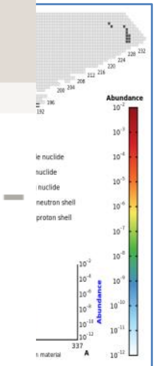


Fission and the r-process nucleosynthesis of translead nuclei in neutron star mergers

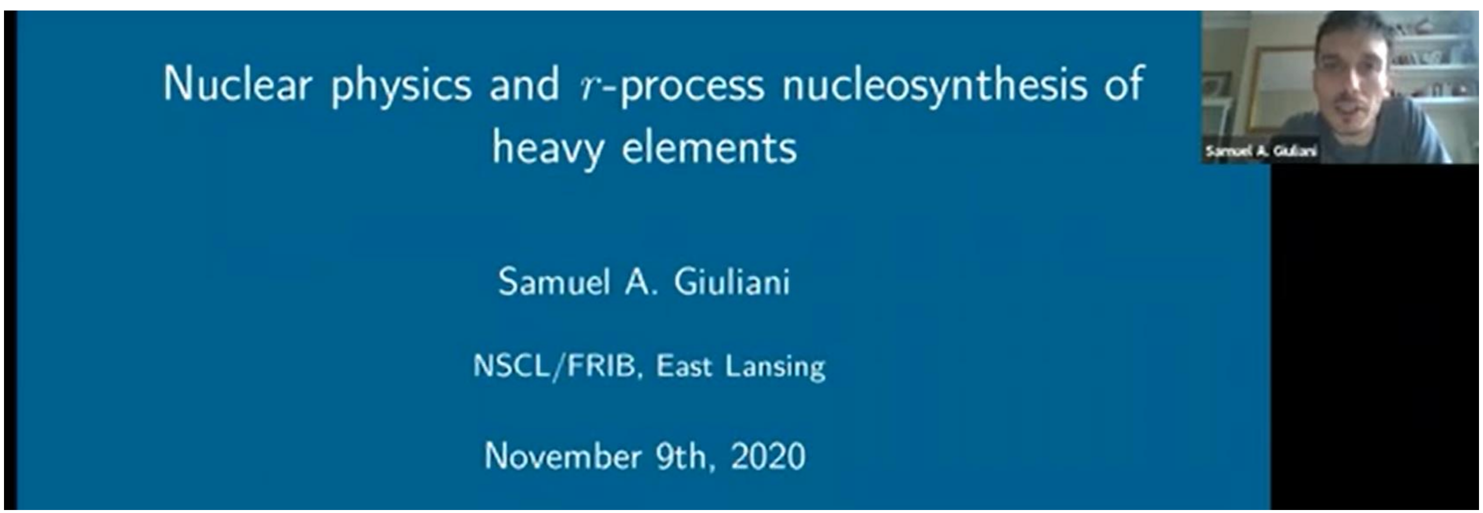
Samuel A. Giuliani, Gabriel Martínez-Pinedo, Meng-Ru Wu, and Luis M. Robledo
Phys. Rev. C **102**, 045804 – Published 9 October 2020



ABSTRACT

We study the impact of fission on the production and destruction of translead nuclei during the r-process nucleosynthesis occurring in neutron-star mergers. Abundance patterns and rates of nuclear energy production are obtained for different ejecta conditions using three sets of stellar reaction rates, one of which is based on microscopic and consistent calculations of nuclear masses, fission barriers, and collective inertias. We show that the accumulation of fissioning material during the r process can strongly affect the free neutron abundance after the r-process freeze-out. This leads to a significant impact on the abundances of heavy nuclei that undergo α decay or spontaneous fission, affecting the radioactive energy production by the ejecta at timescales relevant for kilonova emission.

SI



PhD
Riccardo Mucciola