Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

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Astronomical Observatory of Trieste

GAT

Galactic Archaeology in Trieste (and beyond)

Gabriele Cescutti
on the behalf of team

Virtual meeting INAF

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Galactic Archaeology

Telescopes + Spectrographs

Stellar spectra

Stellar chemical abundances

(Super) Computer

Stellar evolution model

Stellar evolution & Nucleosynthesis

Model of chemo-dynamical evolution of the Galaxy

Dynamic of the stellar component

Astrometry (GAIA) + radial velocity

Understanding Our Galaxy & galaxy formation

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Galactic Archaeology in Trieste

Stellar chemical abundances

Mariagrazia Franchini

Paolo Molaro

Gabriele Cescutti

Stellar evolution & Nucleosynthesis

Paolo Di Marcantonio

Model of chemo-dynamical evolution of the Galaxy

Dynamic of the stellar component

Daniela Carollo

Virtual meeting INAF

Francesca Matteucci

Understanding Our Galaxy & galaxy formation

Galactic Archaeology in Trieste & beyond

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Stellar chemical abundances

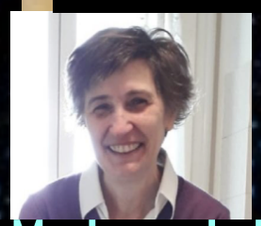
Sara Lucatello

Laura Magrini

Paolo Ventura

Sergio Cristallo

Leo Girardi
PARSEC TEAM



Mariagrazia Franchini

Alessandro Chieffi

Marco Limongi

Paolo di Marcantonio

Paolo Molaro

Stellar evolution & Nucleosynthesis

Model of chemo-dynamical evolution of the Galaxy

Dynamic of the stellar component

Daniela Carollo

Francesca Matteucci

Gabriele Cescutti

2.5 FTE/year
12 INAF
1 INAF associate

Virtual meeting INAF

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Astronomical Observatory of Trieste

GAT

ESPRESSO
Echelle SPectrograph for Rocky Exoplanets and Stable Spectroscopic Observations

CUBES
Cassegrain U-Band Efficient Spectrograph

HIRES
HIgh REsolution Spectrograph

PARSEC
PAdova and TRieste Stellar Evolution Code

HRMOS
A high-resolution multi-object spectrograph for the VLT

FIFA
The Final Fate of Super-AGB and Massive Stars:

BIDSTAR
Birth, evolution and final destiny of the stars,

WEAVE

HEN
Heavy elements Nucleosynthesis

GAIA ESO

STARDUST
Evolved STARs and DUST formation

RED
Reading the Evolution of Dirty stellar systems

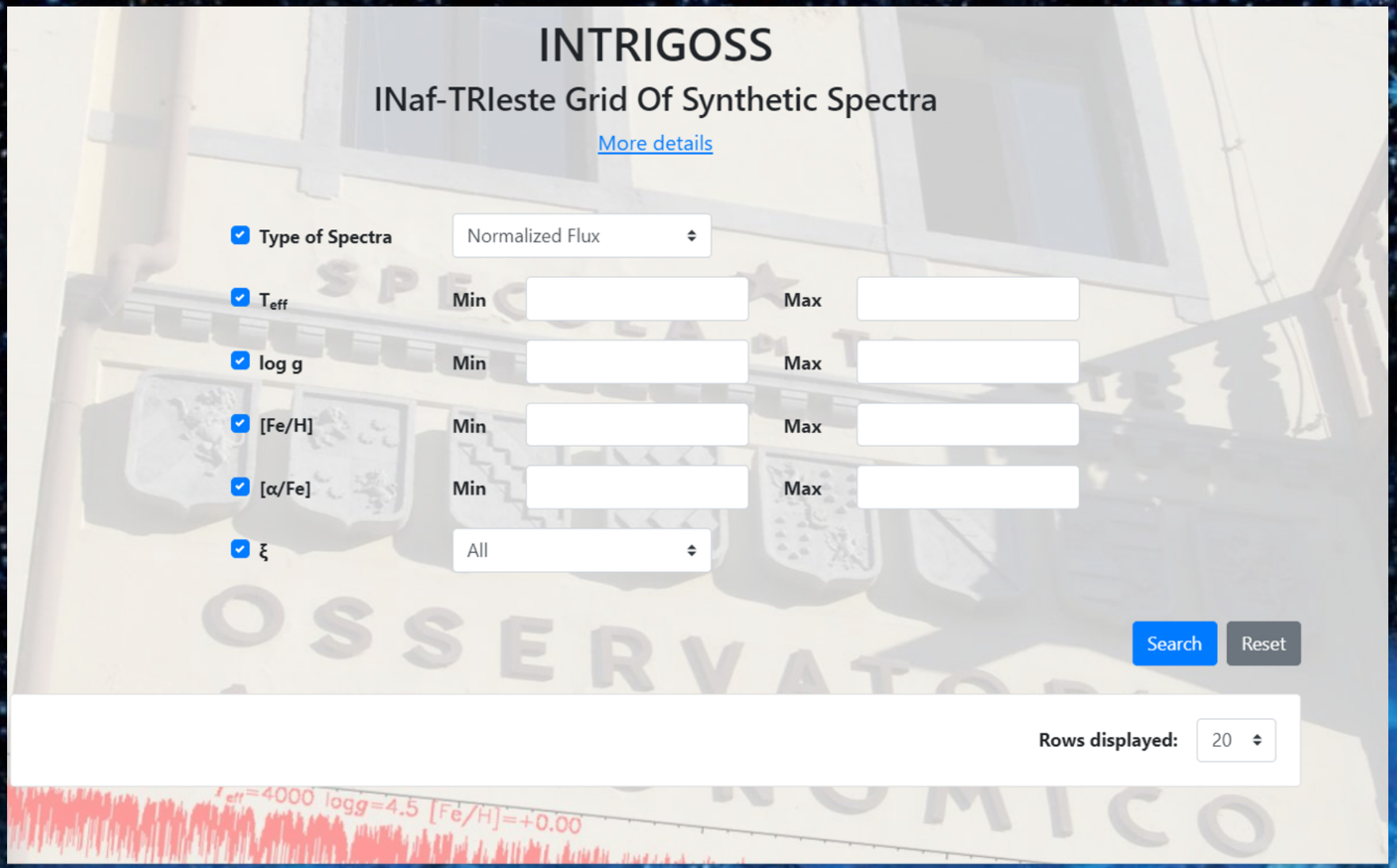
OC-GAST
Galactic Archeology, STar formation and evolution with open clusters

GRAWITA
GRAvitational Wave Inaf TeAm

INTRIGOSS

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

High resolution spectra for F,G,K stars computed with SPECTRUM from the atmosphere models ATLAS12: Fully consistent.
New atomic and molecular line list built by tuning loggf to reproduce reference spectra (Sun + 5 GES cool giant stars) and including predicted lines.



public database archives.ia2.inaf.it/intrigoss

Virtual meeting INAF

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

C & O in the disk

The Gaia-ESO Survey: Oxygen Abundance in the Galactic Thin and Thick Disks*

Mariagrazia Franchini[1], Carlo Morossi[1], Paolo Di Marcantonio[1], Miguel Chavez[2], Vardan Adibekyan[3,4], Thomas Bensby[5], Angela Bragaglia[6], Anais Gonneau[7], Ulrike Heiter[8], Georges Kordopatis[9], Laura Magrini[10], Donatella Romano[6], Luca Sbordone[11], Rodolfo Smiljanic[12], Gražina Tautvaišienė[13], Gerry Gilmore[7], Sofia Randich[14], Amelia Bayo[15,16], Giovanni Carraro[17], Lorenzo Morbidelli[10], and Simone Zaggia[18]
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[4] Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal
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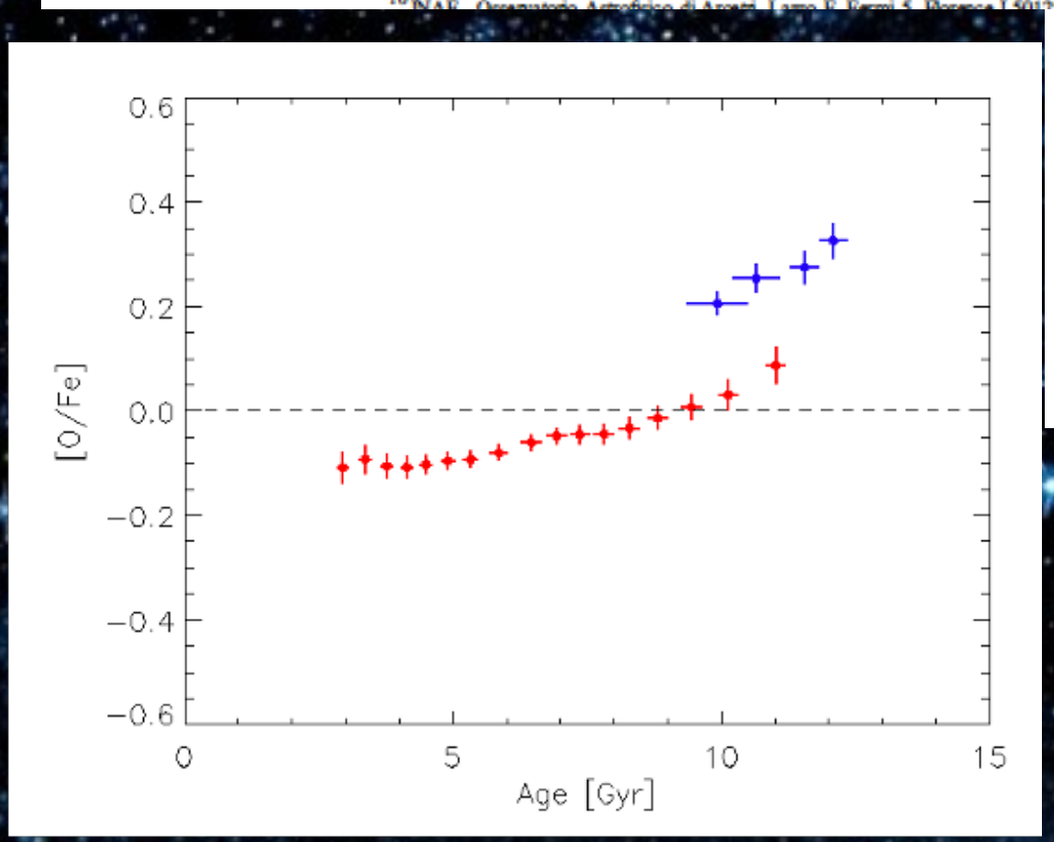

p), 2020 January 10
https://doi.org/10.3847/1538-4357/ab5dc4

The *Gaia*–ESO Survey: Carbon Abundance in the Galactic Thin and Thick Disks*

Mariagrazia Franchini[1], Carlo Morossi[1], Paolo Di Marcantonio[1], Miguel Chavez[2], Vardan Zh. Adibekyan[3], Amelia Bayo[4,5], Thomas Bensby[6], Angela Bragaglia[7], Francesco Calura[7], Sonia Duffau[8], Anais Gonneau[9], Ulrike Heiter[10], Georges Kordopatis[11], Donatella Romano[7], Luca Sbordone[12], Rodolfo Smiljanic[13], Gražina Tautvaišienė[14], Mathieu Van der Swaelmen[15], Elisa Delgado Mena[3], Gerry Gilmore[16], Sofia Randich[17], Giovanni Carraro[18], Anna Hourihane[16], Laura Magrini[15], Lorenzo Morbidelli[15], Sérgio Sousa[19], and C. Clare Worley[16]
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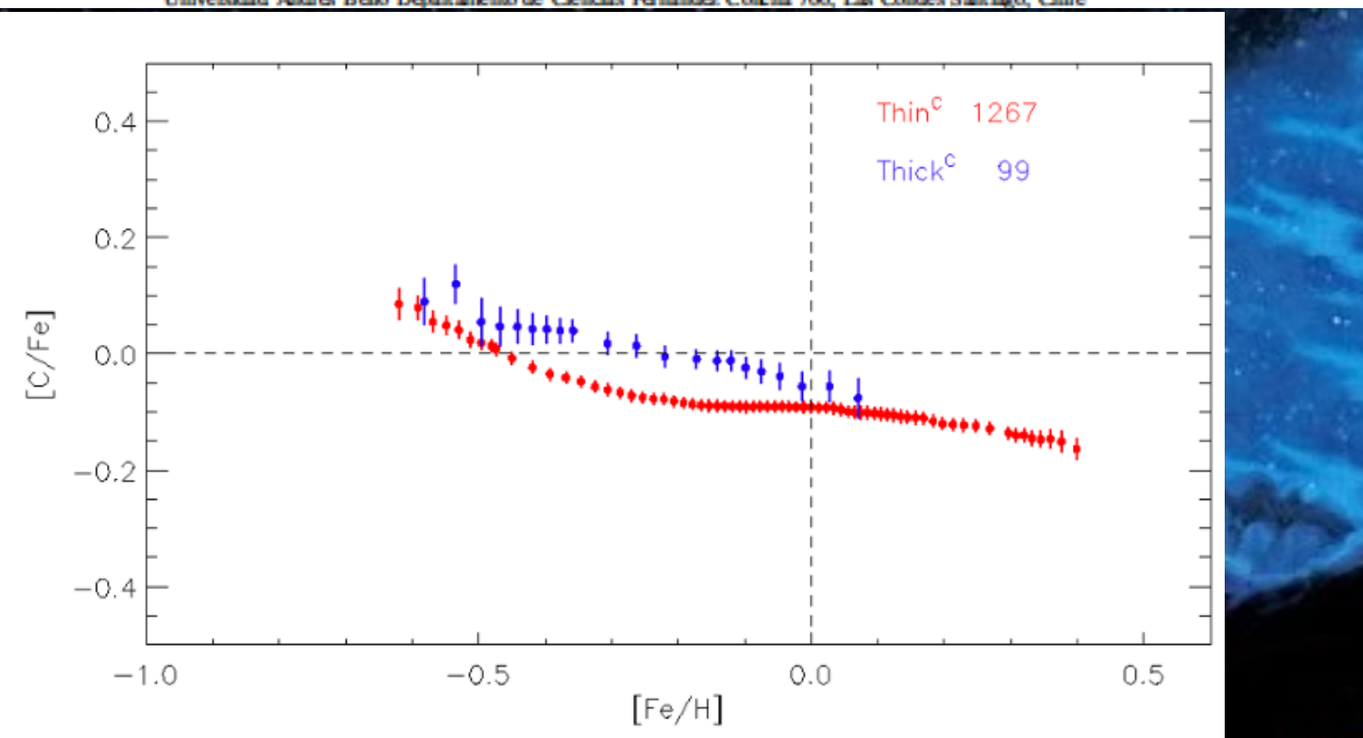
[8] Universidad Andrés Bello Departamento de Ciencias Fernandez Concha 700, Las Condes Santiago, Chile



Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

First stars & CEMP-no

European Organisation for Astronomical Research in the Southern Hemisphere

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49 89 320 06473

APPLICATION FOR OBSERVING TIME PERIOD: **104A**

Important Notice: **ESPRESSO-consortium GTO**

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

1. Title — Category: **D–8**

ESPRESSO observations of the Most Metal Poor stars ([Fe/H] <-4.5)

2. Abstract / Total Time Requested

Total Amount of Time:

There are only a dozen of stars known with [Fe/H] < -4.5, i.e. Extremely Metal [illegible] of less processed material in the Universe reaching down to [Fe/H] ≈ -7, i.e. 10 two show high C overabundance (CEMP stars). We propose ESPRESSO observ binary nature by means of accurate RV measurements. The proposed observat if C comes from a companion AGB or is related to Weak SNe or Spinstars thus on the nature of the first stars in the Universe and on the first elemental enrich measure oxygen abundance in the dwarfs of the sample through the OI 777 nm O abundant . As a byproduct we will derive the Fe, n-capture elements (Sr,Ba) existing upper limits.

Astronomy & Astrophysics manuscript no. stellina_ref2 ©ESO 2016
August 11, 2016

Does the chemical signature of TYC 8442−1036−1 originate from a rotating massive star that died in a faint explosion?⋆

G. Cescutti[1,2] **, M. Valentini[3], P. François[4,5], C. Chiappini[3], E. Depagne[6], N. Christlieb[7], and C. Cortés[8,9]

[1] Centre for Astrophysics Research, School of Physics, Astronomy and Mathematics, University of Hertfordshire, College Lane, Hatfield AL10 9AB, UK
[2] BRIDGCE UK Network (www.bridgce.net), UK
[3] Leibniz-Institut für Astrophysik Potsdam (AIP), An der Sternwarte 16, 14482, Potsdam, Germany
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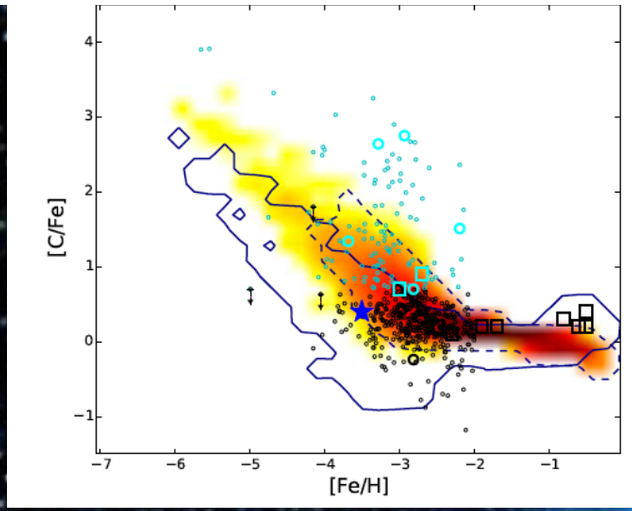
[9] Millennium Institute of Astrophysics (MAS), Santiago, Chile

1 Aug 2016



A&A 633, A129 (2020)
https://doi.org/10.1051/0004-6361/201935833

Astronomy & Astrophysics

ESPRESSO highlights the binary nature of the ultra-metal-poor giant HE 0107−5240⋆

P. Bonifacio[1], P. Molaro[2,3], V. Adibekyan[4], D. Aguado[5], Y. Alibert[6], C. Allende Prieto[7,8], E. Caffau[1], S. Cristiani[2], G. Cupani[2], P. Di Marcantonio[2], V. D'Odorico[2,3,9], D. Ehrenreich[10], P. Figueira[11], R. Genova[7,8], J. I. González Hernández[7,8], G. Lo Curto[11], C. Lovis[10], C. J. A. P. Martins[4,12], A. Mehner[11], G. Micela[13], L. Monaco[14], N. J. Nunes[15], F. A. Pepe[10], E. Poretti[16,17], R. Rebolo[7,8], N. C. Santos[4,18], I. Saviane[11], S. Sousa[4,18], A. Sozzetti[19], A. Suarez-Mascareño[7,8], S. Udry[10], and M. R. Zapatero-Osorio[20]

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versidade do Porto, CAUP, Rua das Estrelas, 4150-762 Porto, Portugal

GTO PI Molaro

Dynamic of halo stars

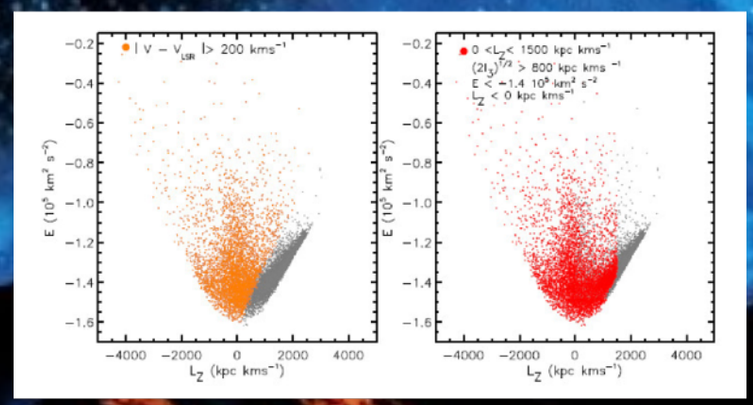
The Nature of the Milky Way's Stellar Halo Revealed by the Three Integrals of Motion

Daniela Carollo[1] and Masashi Chiba[2]

Published 2021 February 24 •

The Astrophysical Journal, Volume 908, Number 2

Citation Daniela Carollo and Masashi Chiba 2021 *ApJ* **908** 191



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Astronomical Observatory of Trieste

^{7}Be in novae ->lithium

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **463,** L117–L121 (2016) doi:10.1093/mnrasl/slw169
Advance Access publication 2016 September 1

Highly enriched ^{7}Be in the ejecta of Nova Sagittarii 2015 No. 2 (V5668 Sgr) and the Galactic ^{7}Li origin

P. Molaro,[1⋆] L. Izzo,[2] E. Mason,[1] P. Bonifacio[3] and M. Della Valle[4,5]

[1]*INAF–Osservatorio Astronomico di Trieste, Via G.B. Tiepolo 11, I-34143 Trieste, Italy*
[2]*Instituto de Astrofísica de Andalucía (IAA-CSIC), Glorieta de la Astronomía s/n, E-18008 Granada, Spain*
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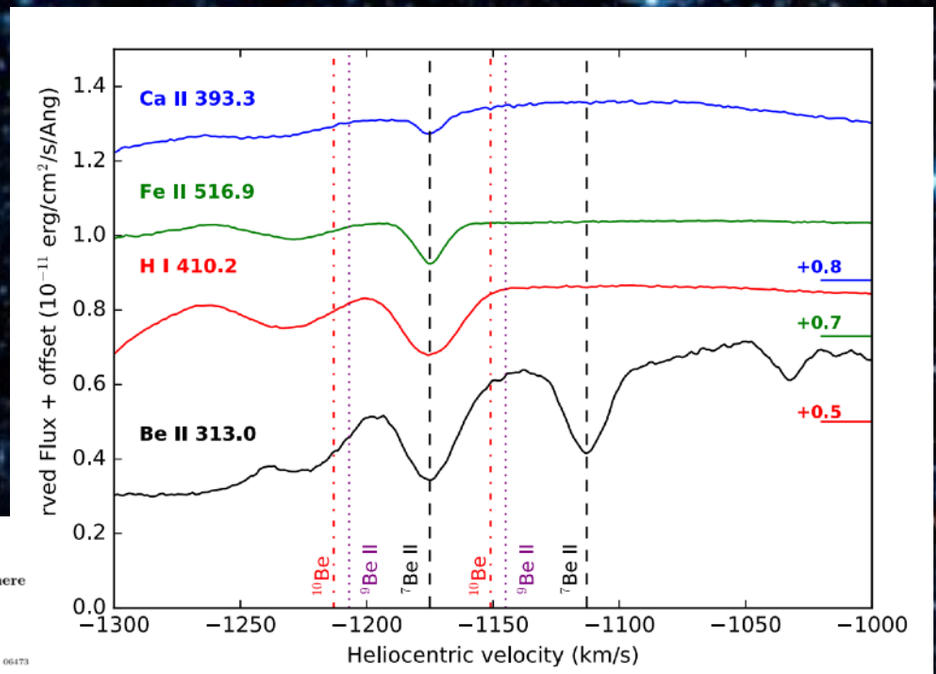
Accepted 2016 August 24. Received 2016 August 24; in original form 2016 August 5



European Organisation for Astronomical Research in the Southern Hemisphere

OBSERVING PROGRAMMES OFFICE • Karl-Schwarzschild-Straße 2 • D-85748 Garching bei München • e-mail: opo@eso.org • Tel.: +49 89 320 06473

APPLICATION FOR OBSERVING TIME PERIOD: **102A**

Important Notice: **ToO**

By submitting this proposal, the PI takes full responsibility for the content of the proposal, in particular with regard to the names of CoIs and the agreement to act according to the ESO policy and regulations, should observing time be granted.

1. Title Category: **D–8**
Search for ^{7}BeII in bright ($m_V^{max} \leq 9.0$ mag) Novae

2. At
Tot
The indeed
proc gesting

ToO (3y) PI Molaro

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **492,** 4975–4985 (2020) doi

Search for ^{7}Be in the outbursts of four recent novae

P. Molaro,[1,2⋆] L. Izzo,[3,4] P. Bonifacio,[5] M. Hernanz,[6] P. Selvelli[1] and M. della Valle[7]

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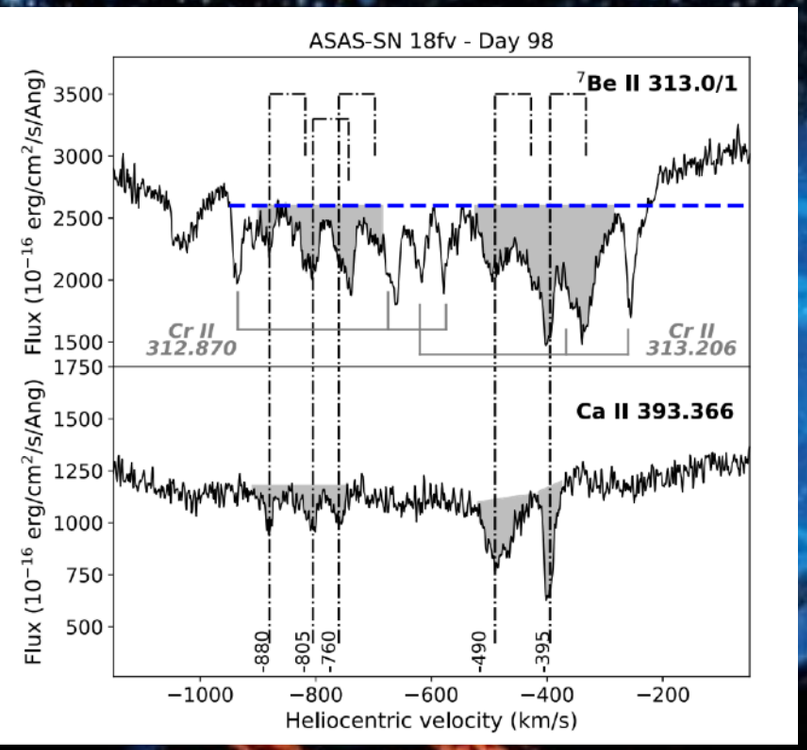
[4]*DARK Cosmology Centre, Niels Bohr Institutet, Københavns Universitet, Lyngbyvej 2, 2100 København, De*
[5]*GEPI, Observatoire de Paris, Université PSL, CNRS, Place Jules Janssen, 92195 Meudon, France*
[6]*Institute of Space Sciences (ICE, CSIC) and IEEC, Campus UAB, Camí de Can Magrans s/n, 08193 Cerdan*
[7]*Capodimonte Astronomical Observatory, INAF-Napoli, Salita Moiariello 16, 80131-Napoli, Italy*

Accepted 2019 December 18. Received 2019 December 18; in original form 2019 August 14



Main Stream Project

THE ORIGIN OF LITHIUM: A KEY ELEMENT IN ASTRONOMY

Virtual meeting INAF

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

^{7}Li and ^{9}Be

Lithium and beryllium in the Gaia-Enceladus galaxy

P. Molaro [1,2★] G. Cescutti [1★] and X. Fu [3]

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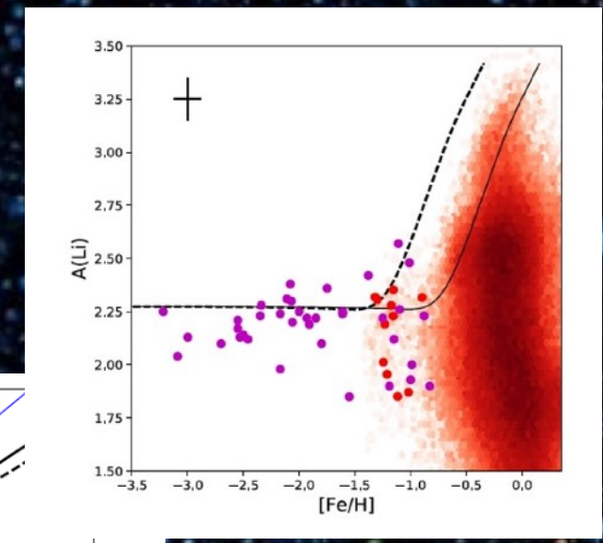
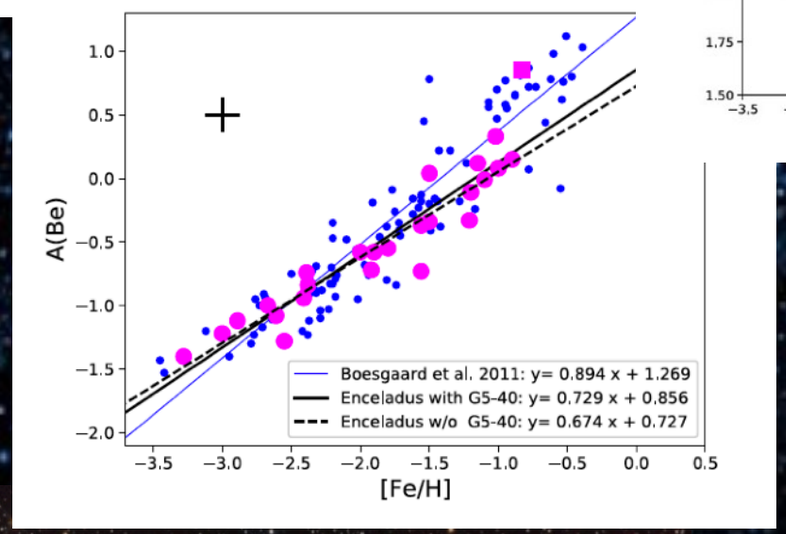
[3] *The Kavli Institute for Astronomy and Astrophysics at Peking University, Beijing 100871, China*

Accepted 2020 May 29. Received 2020 May 27; in original form 2020 January 21





MEMORIE DELLA SOCIETÀ ASTRONOMICA ITALIANA
Vol.91 n.-1-2 2020

Lithium in the Universe: to Be or not to Be?

Monte Porzio Catone, November 18-22, 2019

editors: G. Cescutti, A. Korn and P. Ventura

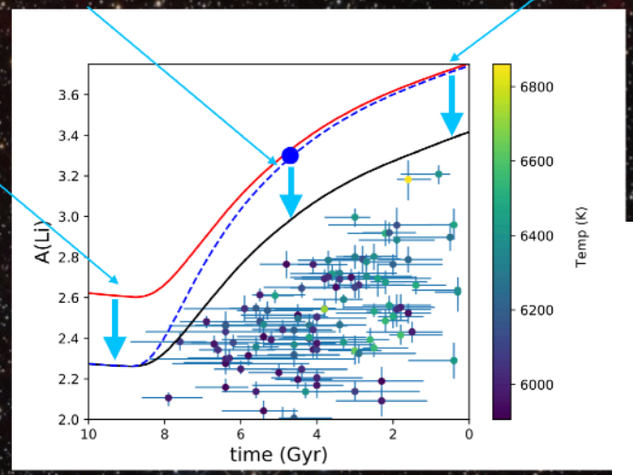
TABLE OF CONTENTS

Possible explanation?
need to adopt a fix depletion ~0.3dex

Meteoritic value

T Tauri

synthesis



Monthly Notices
of the
ROYAL ASTRONOMICAL SOCIETY
MNRAS **482,** 4372–4382 (2019)

^{7}Li evolution in the thin and thick discs of the Milky Way

G. Cescutti ★ and P. Molaro
INAF–Osservatorio Astronomico di Trieste, Via G.B. Tiepolo 11, I-34143 Trieste, Italy

Accepted 2018 October 26. Received 2018 October 05; in original form 2018 July 19

ABSTRACT
Recent detection of the isotope ^{7}Be (which decays into ^{7}Li) in the outh

ChETEC Action

Virtual meeting INAF

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Neutron capture elements
s-process from rotating massive stars

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY
MNRAS **489,** 5244–5255 (2019) doi:10.1093/mnras/stz2505
Advance Access publication 2019 September 5

The contribution from rotating massive stars to the enrichment in Sr and Ba of the Milky Way

F. Rizzuti,[1★] G. Cescutti,[2] F. Matteucci,[1,2,3] A. Chieffi,[4,5] R. Hirschi[6,7] and M. Limongi[7,8]

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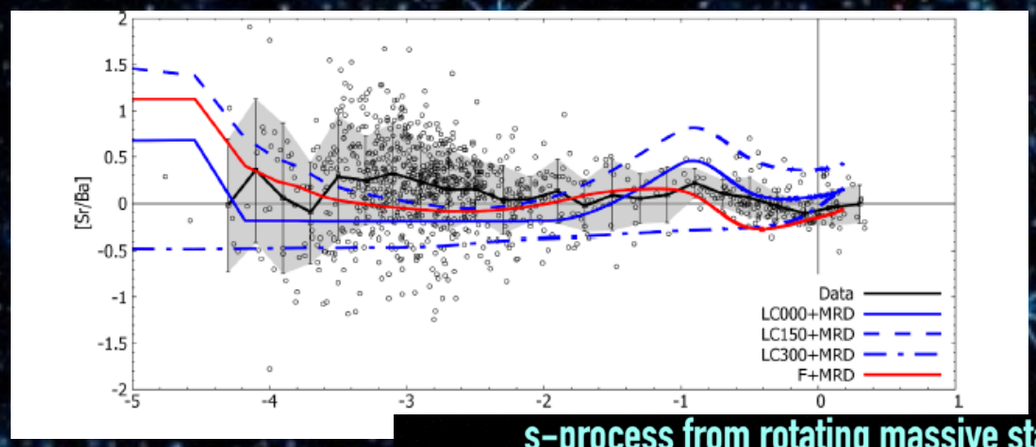
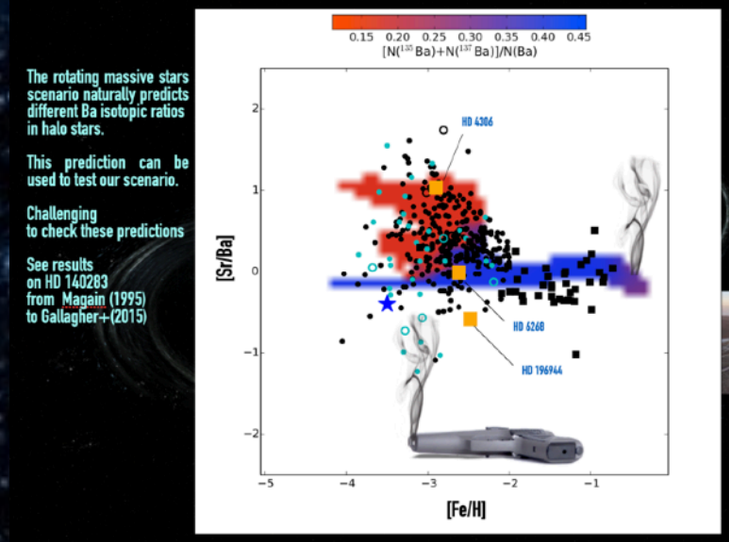


Isotopic ratio for Ba



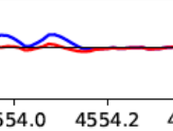
The rotating massive stars scenario naturally predicts different Ba isotopic ratios in halo stars.

This prediction can be used to test our scenario.

Challenging to check these predictions

See results on HD 140283 from Magain (1995) to Gallagher+(2015)

PI Cescutti proposal at ESO to measure the Ba isotopic ratio in three stars with a R~100'000 & S/N~900 with UVES at VLT



"normal" value high R ~ 30'000 high S/N ~ 80-100

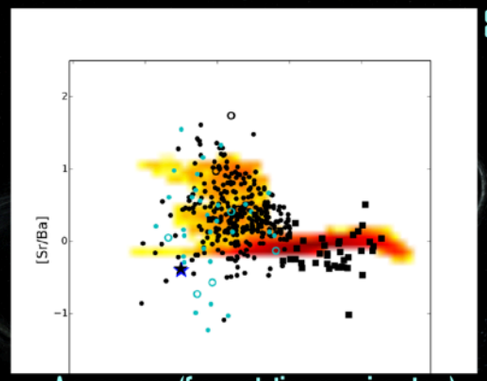
Astronomy & Astrophysics manuscript no. output ©ESO 2021
May 17, 2021

Barium lines in high quality spectra of two metal-poor giants in the Galactic halo★

G. Cescutti[1,2,3],★★ C. Morossi[1], M. Franchini[1], P. Di Marcantonio[1], C. Chiappini[4], M. Steffen[4], M. Valentini[4], P. François[5,6], N. Christlieb[7], C. Cortés[8,9], C. Kobayashi[10] & E. Depagne[11]

s-process from rotating massive stars

+ an r-process site (the 2 productions are not coupled!)



Cescutti et al. (2013)
Cescutti & Chiappini (2014)

A s-process (from rotating massive stars) and an r-process (from rare events) can reproduce the neutron capture elements in the Early Universe

Virtual meeting INAF

Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Neutron capture elements
role of Neutron Star mergers

Constraints on stellar rotation from the evolution of Sr and Ba in the Galactic halo

F. Rizzuti,[1★] G. Cescutti,[2,3] F. Matteucci,[2,4,5] A. Chieffi,[6,7,8] R. Hirschi,[1,9] M. Limongi[7,9,10] and A. Saro[2,3,4,5]

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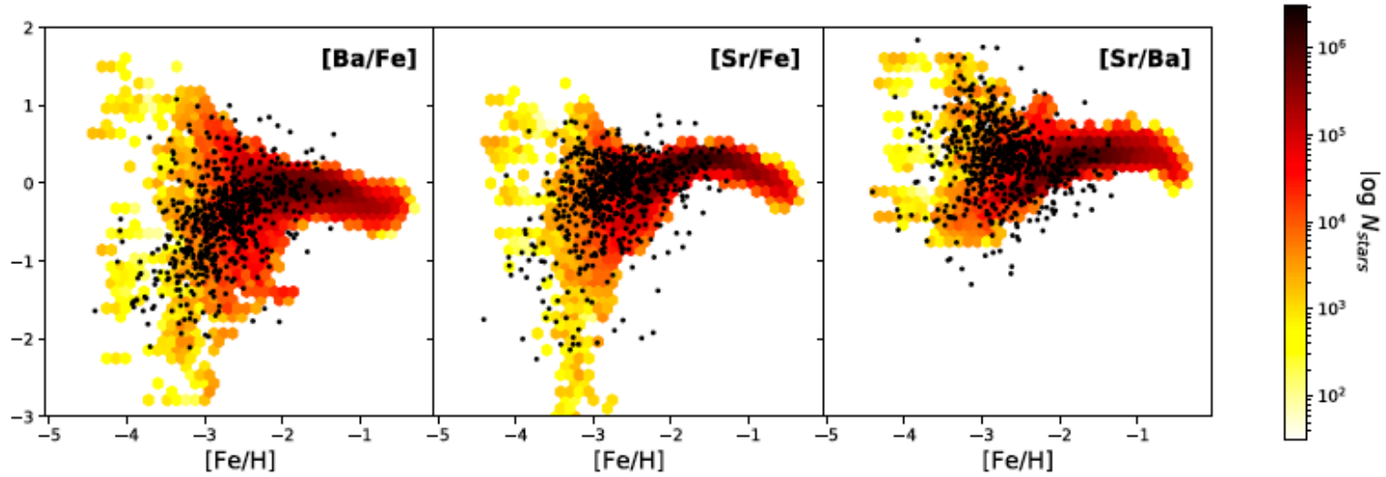

Neutron stars mergers in a stochastic chemical evolution model: impact of time delay distributions

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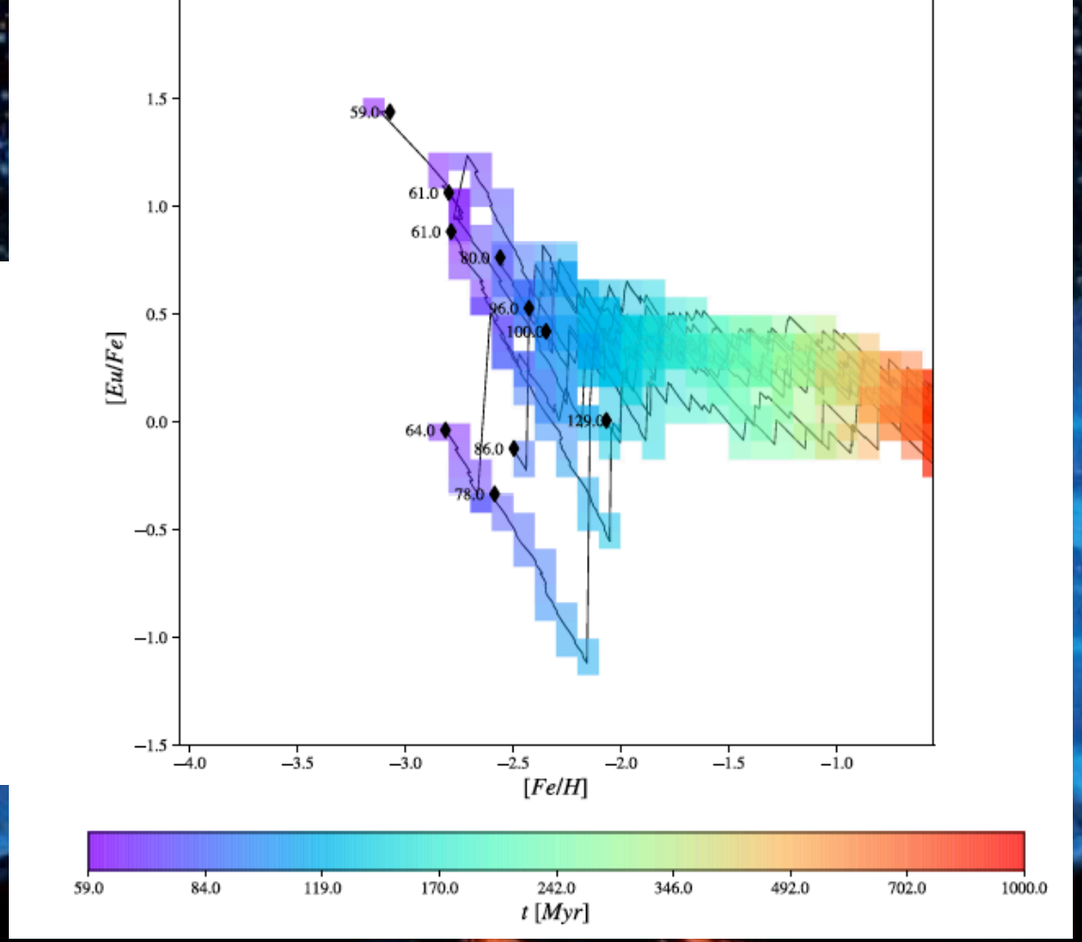

Stochastic model for Ba in the Galactic halo

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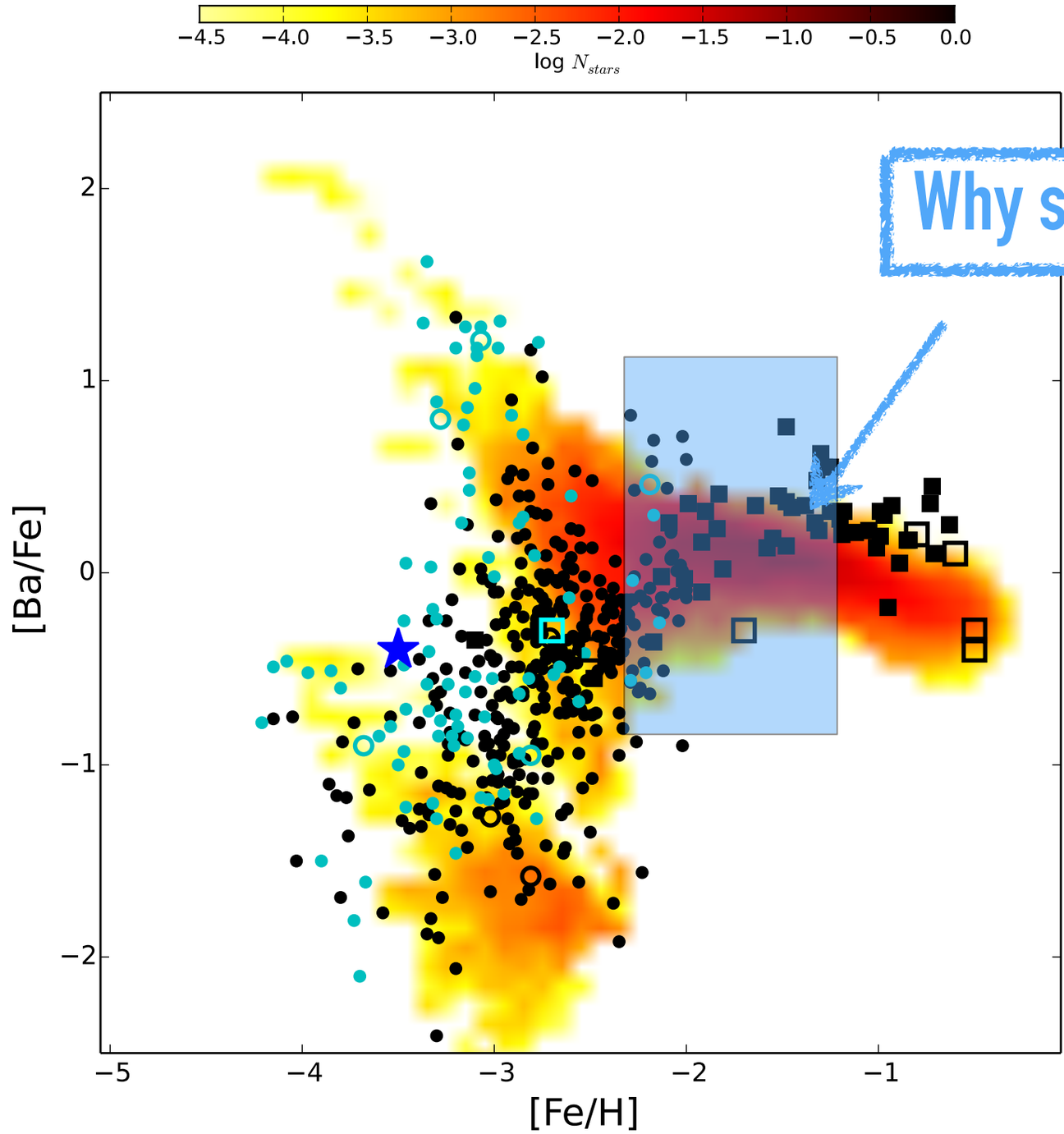

Why so few stars here?

data from in
Placco+14
Hansen+12
Hansen+16
Cescutti+16

Metallicity distribution function of the Galactic halo

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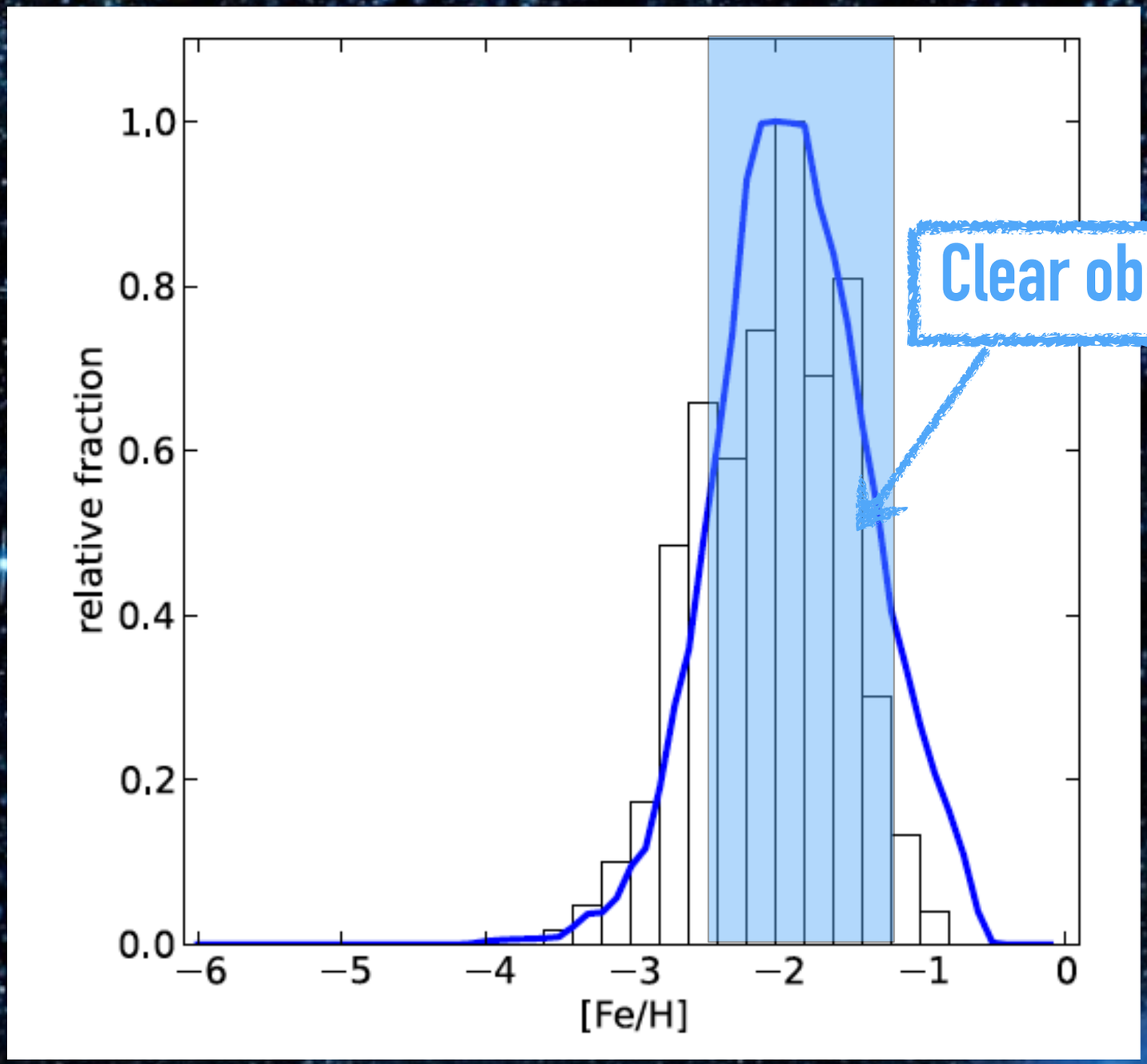

Clear observational bias

Li et al. (2010): main-sequence turnoff stars in the HESS (Hamburg ESO)

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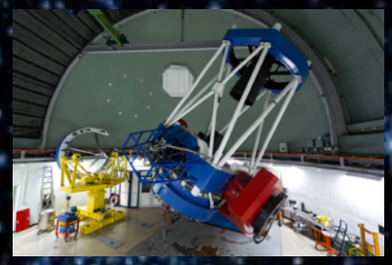
MINCE Survey

Measuring at Intermediate Metallicity Neutron Capture Elements

9 facilities used



High resolution >50'000
high S/N >70
on going

PI Cescutti

P. Bonifacio, C. Hansen, M. Franchini, L. Monaco, E. Spitoni, A. Kučinskas,E. Kolomiecas, L.Lombardo, A. Mucciarelli, P. Di Marcantonio, V. S. Cristallo, P. Molaro, F. Matteucci, D. Carollo, M. Valentini, J. Klevas, M. F. Andersen, M. Hanke, A.M. Matas Pinto, E. Caffau, Dobrovolskas, P. François, M. Spite, F. Spite, L. Sbrodone,
...

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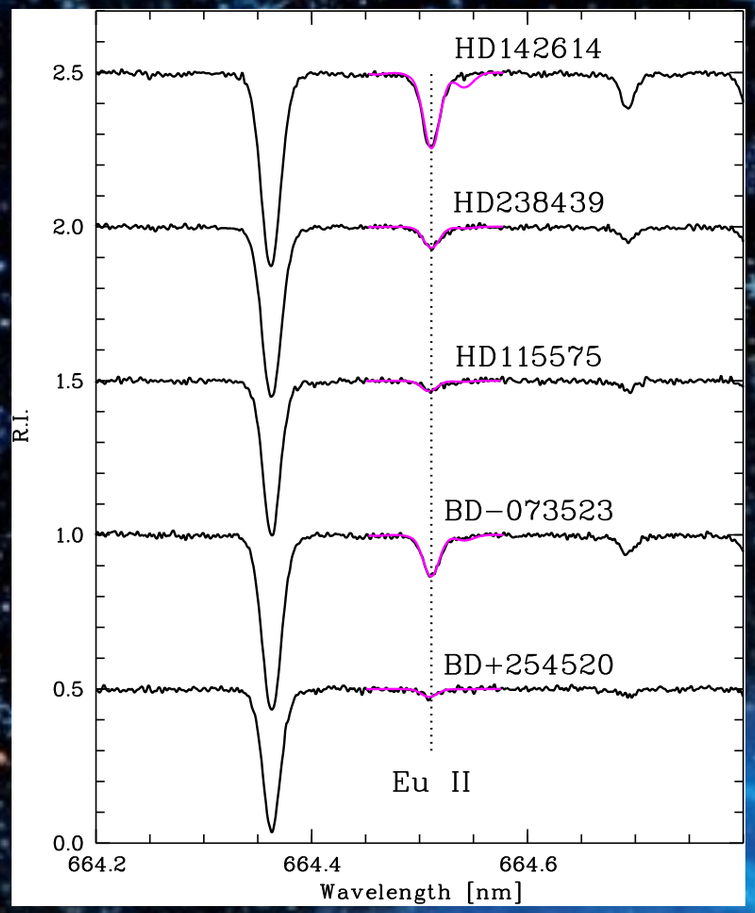
MINCE Survey

up to now~400 stellar spectra

20 proposal accepted ~ 50n (excluding Moletai)

Table 1 Awarded time by MINCE project:

telescope	instrument	time	targets	status
A40 TNG	HARPS-N	7.5 h	15	observed
A41 TNG	HARPS-N	13.5 h	16	observed
A42 TNG	HARPS-N	9 h	9	due in January
CFHT 2019B	ESPaDOnS	10h	6	observed
CFHT 2020A	ESPaDOnS	24.5h	6	observed
CFHT 2020B	ESPaDOnS	24.5h	30	accepted
OHP 2019B	Sophie	3n	23	observed
OHP 2020A	Sophie	3n	19	observed
TBL 2020A	NeoNArval	13h	12	observed (reduction problematic)
2019B 2.2m	FEROS	2n	65	observed
2020A 2.2m	FEROS	2n	72	cancelled due to corona virus shutdown
2020B 2.2m	FEROS	2n	65	accepted, due in January
Magellan	MIKE	1n	20	cancelled due to corona virus shutdown
Magellan	MIKE	1n	14	observed in October
VLT ESO period 105	UVES	50h	50	6/50 stars taken (but extended next semester)
VLT ESO period 106	UVES	50h	50	16/50 stars taken up to now (filler)
period 61, NOT	FIES	3n	16	only 7 taken due to corona virus shutdown
period 62, NOT	FIES	8h	8	accepted due in January
2019 winter Moletai 1.65m	VUES	12n	10	total loss due to weather
2020 spring Moletai 1.65m	VUES	26n	15	15 stars observed



MINCE results public database

IA2 *Italian Center for Astronomical Archives*
Centro Italiano Archivi Astronomici

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Critical issues for GAT & beyond

Stellar chemical abundances

Stellar evolution & Nucleosynthesis

Model of chemo-dynamical evolution of the Galaxy

Dynamic of the stellar component

Understanding Our Galaxy & galaxy formation

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Critical issues in the determinations of stellar abundances

Pipeline for homogenous measurements of chemical abundances

INAF is leader in this area, see the role in the GAIA ESO survey

Corrections for the 3D non-LTE effects will also be taken into account

But, we are missing expertises such as:

- NLTE for the creation of the lines
- 3D modelling of stellar atmosphere

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ChETEC – INFRA

Chemical Elements as Tracers of the Evolution of the Cosmos - Infrastructures for nuclear astrophysics

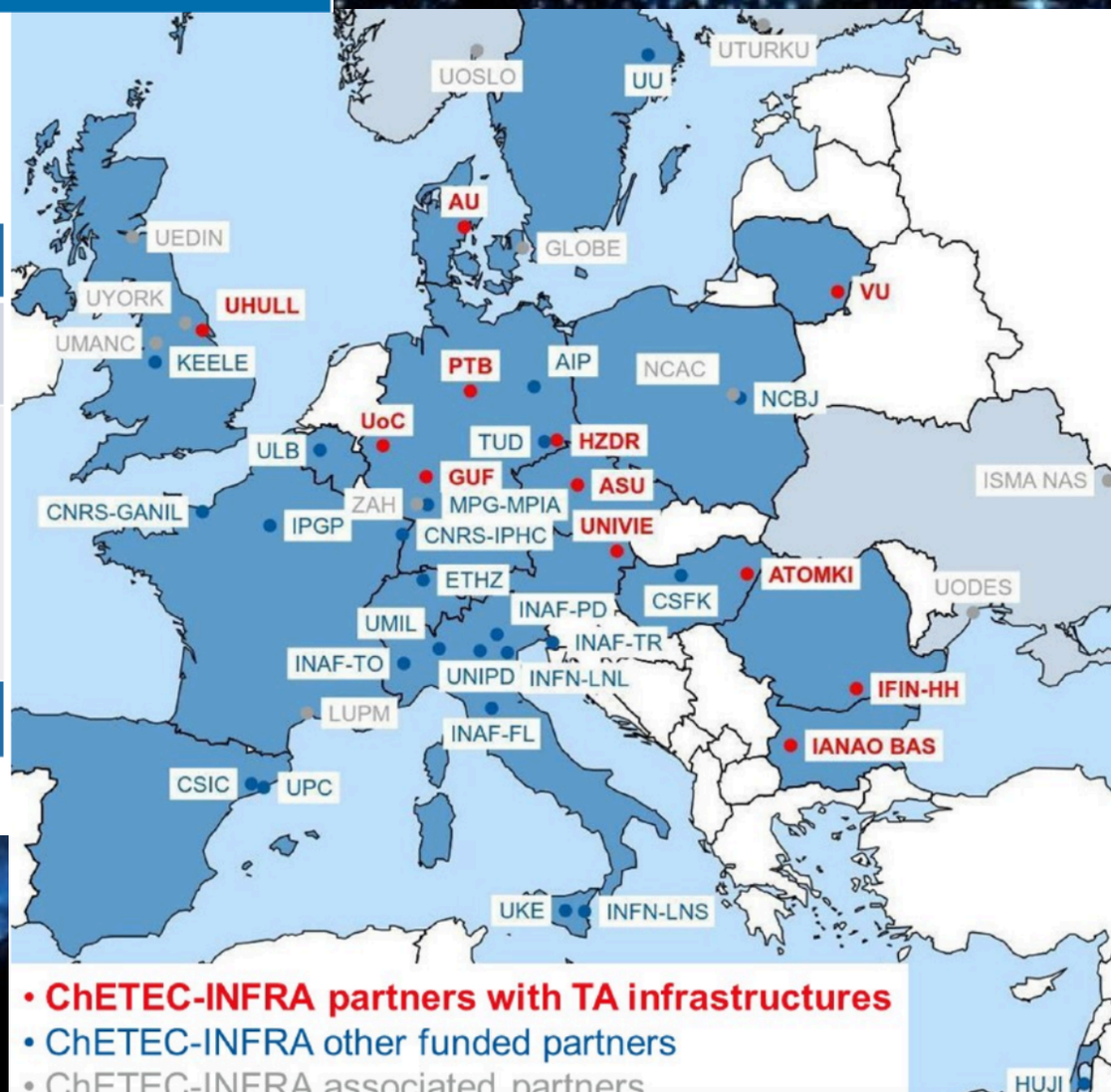
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008324 (ChETEC-INFRA).

ChETEC-INFRA, an EU-supported Starting Community of Research Infrastructures for Nuclear Astrophysics

5.0 M€ EU HORIZON2020 support (2021-2025)

TNA Transnational Access	JRA Joint Research Activities	NA Networking Activities
Infrastructure **access** • 8 nuclear labs • 4 telescopes • 1 computer	Infrastructure **usability** • Targets • Abundance corrections • Analysis pipelines	Infrastructure **networking** • Complementary Expermiments. • Solar fusion+model • Geochemistry/Astrophysics • Outreach

32 partners, 17 countries, largest EU project for nuclear astrophysics yet



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WP: Astronuclear Abundances

Task 5.1 Database of 3D & NLTE Abundance Corrections

Vilnius + AIP, LSW Heidelberg

Task 5.2 Homogeneous Open-Source Stellar Pipeline

INAF + Uppsala University (A. Korn)

Homogenous pipeline corrected for effects of stellar evolution like atomic diffusion and dredge-up episodes that systematically modify surface abundances.

Corrections for the 3D/NLTE effects will also be taken into account

2 years PostDoc —> good start but this expertise shall be preserved and improved

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Critical issues for GAT & beyond

Galactic Archaeology for neutron capture elements

Stellar chemical abundances

Stellar evolution & Nucleosynthesis

Model of chemo-dynamical evolution of the Galaxy

Dynamic of the stellar component

Understanding Our Galaxy & galaxy formation

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Critical issues in the nucleosynthesis for neutron capture elements

Again impressive expertise in stellar evolution and nucleosynthesis.
The INAF experts are renown worldwide.

Concerning Neutron capture elements nucleosynthesis,
we have excellent studies for the s-process.

However, we are missing expertise on the:

r-process nucleosynthesis

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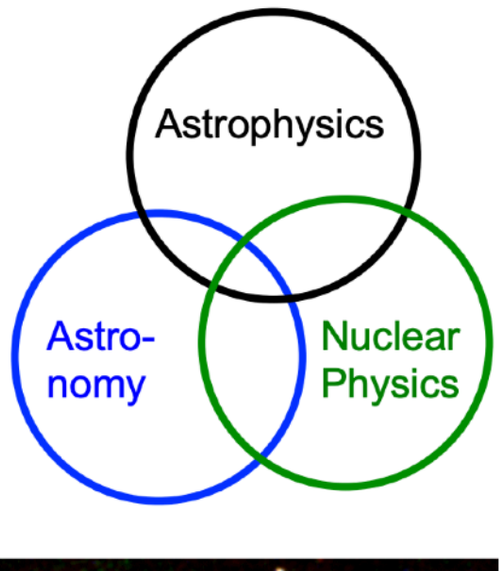
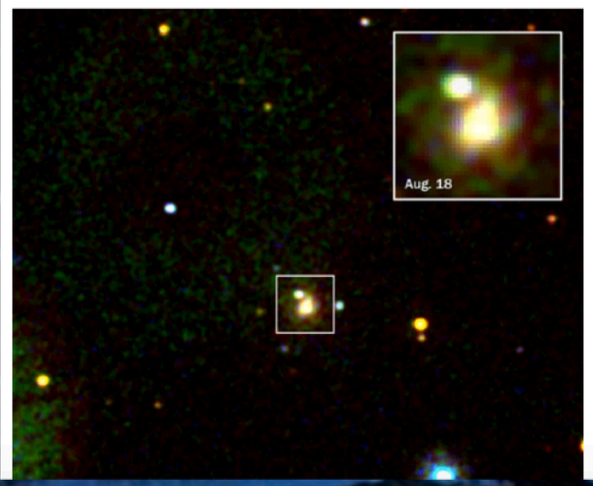
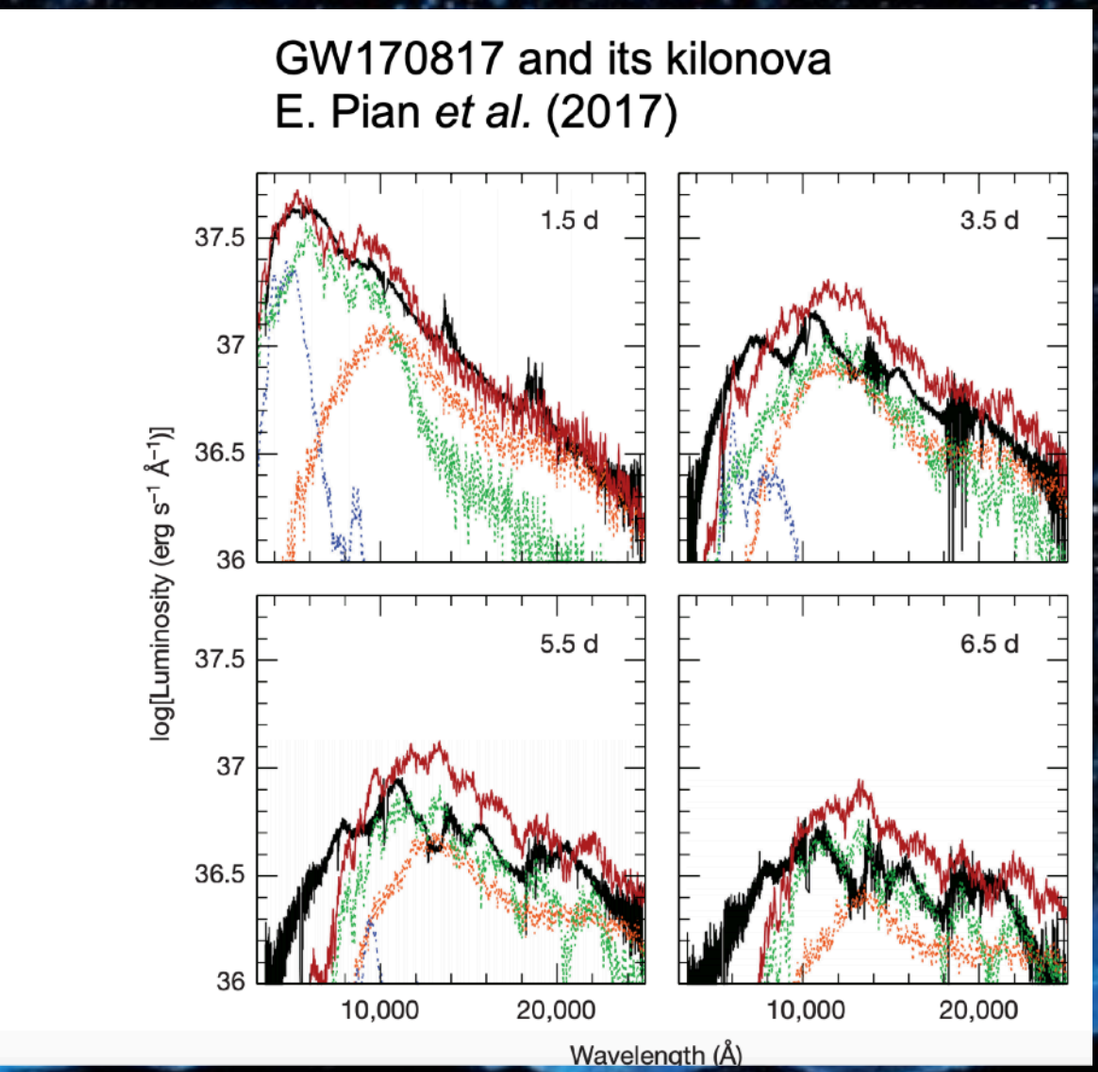
submitted PRIN URKA
Understanding R-process & Kilonovae Aspects
PI S. Cristallo (GAT involved!)

r-process nucleosynthesis calculations and open access r-process yields repository (WP2)







Strong synergy with INFN:
- nuclear reaction
- atomic opacities

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Virtual meeting INAF