

# WP8/NA3: Astronuclear library



Work package number	8	Lead beneficiary			CSIC/27	
Work package title	NA3 Astronuclear Library					
Participant number	1	5	9	11	16	20
Short name of participant	HZDR	CNRS	IPGP	GUF	ATOMKI	INFN
Person-months per participant	6	7	2	18	2	6
Participant number	21	22	27			
Short name of participant	UKE	UMIL	CSIC			
Person-months per participant	9	3	26			
Start month	1	End month				48

Task 8.1: Complementarities and Comparisons Towards Standards: The Big Three for Evolved Stars  
(PI A. Tumino / UKE, participants: INFN, UMIL, CNRS, HZDR, GUF, UHull)

Task 8.2: Complementarities and Comparisons Towards Standards: Solar Fusion Reactions and Solar Models  
(PI A. Serenelli / CSIC, participants: UMIL, HZDR, TUD)

Task 8.3: Astronuclear Reaction Rate Library  
(PI Rene Reifarh / GUF, participants: CSIC, HZDR, TUD)

Task 8.4: Web page, Data, and Metadata Format  
(PI Tanja Heftrich/ GUF, participants: HZDR, TUD)

# WP8/NA3: Astronuclear library



- Make nuclear and other data available to the community incl.  
evaluated cross sections  
(as) raw data (as possible) to serve as legacy for easier future analysis  
plans for maintenance and updates > 10 years after ChETEC
- ChETEC-INFRA webpage  
all data produced within ChETEC  
publications  
activities
- Network (European) research programs for key nuclear reactions requiring different techniques  
(exper. and theor.)  
Big three ( $^{12}\text{C}+^{12}\text{C}$ ),  $^{12}\text{C}+\alpha$ ,  $^{22}\text{Ne}+\alpha$   
H-burning reactions
- Solar structure as benchmark for solar, stellar and astroparticle applications (incl. neutrinos)

## Task 8.1

### Complementarities and Comparisons Towards Standards the Big Three for Evolved Stars

(PI A. Tumino / UKE, participants: INFN, UMIL, CNRS, HZDR, GUF, UHull):

This task will network the European research program around the 'Big Three':  $^{12}\text{C}(\alpha, \gamma)$ ,  $^{12}\text{C}+^{12}\text{C}$  and  $^{22}\text{Ne}(\alpha, n)$  fusion reactions, yet to be fully assessed, that play a fundamental role in advanced stellar evolution

- establish a framework for cooperation and joint activity between experimentalists in order to tackle the study of the same reaction with different and complementary techniques
- demonstrate with these example cases how validated data using different approaches can be gained
- activity framed as the nucleus of a larger intercomparison effort and as a recipe of best practices. It can benefit the community, and other partners that can connect at several points
- feed to data library (Task 8.3)

Some planned key activities:

**First workshop:** end of 2022, 3 days, each day dedicated to a "Big-Three" reaction

**Second workshop:** middle of 2024 again three days, each one for a "Big-Three" reaction

**Key publication:** by the end of 2023

## Task 8.2

### Complementarities and Comparisons Towards Standards Solar Fusion Reactions and Solar Models

(PI A. Serenelli / CSIC, participants: UMIL, HZDR, TUD):

- Evaluation of new cross sections of most pp-chains and CNO reactions – coordination of European and North American communities (through activities spinning off Solar Fusion III meeting – early 2022)
  - available data
  - new measurements during ChETEC-INFRA
- Roadmap for next decade
- (Standard) solar models as benchmark for solar, stellar and astroparticle physics
  - e.g. solar neutrino measurement
  - radiative opacities
- Feed to data library (Task 8.3)

# Task 8.3

## Astronuclear Reaction Rate Library

(PI R. Reifarth/ GUF, participants: CSIC, HZDR, TUD):

So far: e.g. kadonis.org


New: [exp-astro.de/astral](http://exp-astro.de/astral)  
Status (2018 – 65 isotopes)

Karlsruhe Astrophysical Database of Nucleosynthesis in Stars  
s-process [Standards] [Logbook] [FAQ] [Links] [Contact] p-process

ASTRAL - ASTrophysical Rate and rAw data Library

The new version KADoNiS v0.3 is finally online!


Version 0.3 provides data for 357 isotopes including 5 newly added isotopes, 42 updated MACS30, new stellar enhancement factors, and the MACS30 obtained from three different evaluated data libraries. More information below or in the logbook.



View Maxwellian-Averaged (n,g) Cross Section

Isotope  Show

(Examples: Ba138, Ta180m, Se.)



### KADoNiS v0.3

The KADoNiS project is an online database for cross sections relevant to the s process and p process. The respective s-process library provided on this webpage is an updated sequel of the well-established Bao et al. compilation [1].

If you want to cite the current version of KADoNiS, the reference is:

**KADoNiS v0.3 - The third update of the "Karlsruhe Astrophysical Database of Nucleosynthesis in Stars"**

I. Dillmann, R. Plag, F. Käppeler, T. Rauscher

Submitted as proceeding of the workshop "EFNUDAT Fast Neutrons - scientific workshop on neutron measurements, theory & applications" held on April 28-30 2009 at Leuven, Belgium.

[Home](#)

[View Maxwellian-Averaged Cross Section](#)

Isotope  Show

(Examples: Ba138, Ta180m, Se.)

65 isotopes found in database.

[Intern](#)

[Experimentelle Astrophysik](#) | [Goethe Universität Frankfurt](#) | [IAP](#) | [Datenschutz](#) | [Impressum](#) | [Kontakt](#)

Foundation of new, flexible, low-maintenance library is already laid out.

Reifarth et al Eur. Phys. J. Plus (2018) 133: 424

DOI 10.1140/epjp/i2018-12295-3

Largely outdated, since difficult to maintain

# Task 8.3

## Astronuclear Reaction Rate Library



(PI R. Reifarth/ GUF, participants: CSIC, HZDR, TUD):

New: [exp-astro.de/astral](http://exp-astro.de/astral)  
Present day status (2021)

### ASTRAL

ASTrophysical Rate and rAw data Library

[Home](#)

[Internal](#)

View Maxwellian-Averaged Cross Section

Isotope

(Examples: Ba138, Ta180m, Se.)

Download table of ASTRAL MACS (1 line per isotope)

Kind of reaction:

kT >=  keV (leave open for full range)

kT <=  keV (leave open for full range)

99 isotopes found in database.

[Experimentelle Astrophysik](#) | [Goethe Universität Frankfurt](#) | [IAP](#) | [Datenschutz](#) | [Impressum](#) | [Kontakt](#)

Improvements have already started: **99 isotopes** now in data base.

Will fill it with (much) more content during **ChETEC-INFRA**  
Envisaged Extensions:

- Raw data
  - more n-induced reactions (300-400)
  - charged-particle-induced reactions (100-200)
  - abundances?? Maybe different name/lib
- User data
  - Cross sections (MACS)
  - Rates (parametrized or table)
  - Standard nucleosynthesis results (e.g. sensitivities...)

## Task 8.3

### Astronuclear Reaction Rate Library



(PI R. Reifarh/ GUF, participants: CSIC, HZDR, TUD):

- New data library for astrophysical important nuclear reactions
  - evaluated cross sections
  - raw data for future reevaluation of cross sections
  - automatic reevaluation of cross sections as new data becomes available
- Within ChETEC-INFRA: reactions from Tasks 8.1, 8.2 and neutron induced reactions (s-process)
  - study of feasibility for large networks: r- and p-processes
- User-friendly database for sensitivity studies  $\leftrightarrow$  WP4
- Extended maintenance and support for at least 10 years after ChETEC-INFRA

## Task 8.4

### Web Page, Data, and Metadata Format



(PI R. Reifarh/ GUF, participants: HZDR, TUD):

- Setup and maintenance of the ChETEC-INFRA webpage, the most important outreach tool

<https://exp-astro.de/chetec-infra/>

Host data, project-related publications, platforms developed within ChETEC-INFRA (WP4 activities)

Proposals on TA activities by users

- Development Data Management Plan
- Actions towards establishing a common framework for (nuclear) data sharing, generalization of access to data, metadata, etc. Exploration of new policies for the future based on ChETEC-INFRA experience



## Milestones:

- M1 Project web page is fully operative (Task 8.4, Month 6)



## Deliverables:

- **D8.1 Launch of project web page (Task 8.4, Month 3)**
- **D8.2 Data Management Plan (Task 8.4, Month 6)**
- **D8.3 Report to GA on plans for two workshops to discuss complementary reaction studies (Task 8.1, Month 12)**
- **D8.4 First release of new s-process library (Task 8.3, Month 12)**
- **D8.5 Report on expert meeting on shared data formats (Task 8.4, Month 18)**
- **D8.6 Key publication with description of methods and results for analysis of H-burning reactions and release of fusion library on web page (Task 8.2, Month 24)**
- **D8.7 Key publication with description of methods and results for analysis of Big Three reactions and release of fusion library on web page (Task 8.1, Month 30)**
- **D8.8 Release of the new generation of solar models on project web page and associated publication (Task 8.2, Month 30)**
- **D8.9 First release on sensitivity library (Task 8.3, Month 36)**
- **D8.10 Report on possible strategy for community wide sharing of raw data (Task 8.4, Month 48)**