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WP6 /NA1
Comprehensive Nuclear Astrophysics

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Table 3.1b6: Work package description (NA1 - WP6)

Work package number	**6**	**Lead beneficiary**			**UPC/28**	
Work package title	**NA1 Comprehensive Nuclear Astrophysics**					
Participant number	1	3	12	18	19	24
Short name of participant	HZDR	ULB	MPG	HUJI	INAF	VU
Person-months per participant	3	2	21	12.5	2	2
Participant number	27	28	29	32		
Short name of participant	CSIC	UPC	UU	UHULL		
Person-months per participant	2	30	1	15		
Start month	1				**End month**	48

Task 6.1 Binary Star Database to support observations (PIs: C. J. Hansen, MPA, & R. Stancliffe, UHull, participants: VU)

-Training a student in **all** astro-nuclear-disciplines: Observations, theory, experiments – the plan is to hire a student at MPIA, starting out with observations, and following train the student in theory (Hull), and experiments (Oslo / TNA)
-Observe AGB & CEMP-s stars, derive RV + 1D, LTE abundances → apply corrections (WP5 collaboration)
-Run stellar evolution models & post processing (AGB + s-process)
-Experiments relevant for the s-process (rates for Kr & Rb, cross sections for Bi & Pb)

Start: Apply for observing time this spring to have a long baseline for RVs

Deliverable (6 months): Set up a web page with binary star information – RV monitoring (observations), links to AGB models & yields (theory), and possibly the new rates and cross sections – since it is an early deliverable, we will start out with links and a skeleton for the RV data base.

Task 6.2 Cross-Collaboration Textbook Examples

(PI: J. José, UPC Barcelona, Participants: HUJI Jerusalem, ULB Brussels, HZDR Dresden, U Hull, MPIA Heidelberg, VU Vilnius)

Provide the ChETEC-INFRA community with textbook examples of cross-collaboration between astronomers, astrophysicists, nuclear physicists, and cosmochemists.

(i) Identification of suitable science cases (i.e., nuclear reactions of astrophysical interest affected by large nuclear uncertainties) through sensitivity studies

(ii) Feasibility studies of the nuclear physics experiments planned to reduce their associated uncertainties

(iii) Preparation of a proposal for the experiment

(iv) Measurement and data analysis

(v) Evaluation of the astrophysical/cosmochemical impact for a specific stellar site

Bearing in mind the limited duration of the project, we plan to start with a number of experiments on key reactions previously identified in existing sensitivity studies

(1) ^{30}P(p,γ), relevant for classical novae
(2) ^{15}O(α,γ), relevant for type I X-ray bursts
(3) ^{26}Al(n,p) and ^{26}Al(n,α), relevant for core-collapse supernovae.

The impact of the new reaction rates will be evaluated with state-of-the-art stellar codes developed and maintained in JRA2 (e.g. SHIVA and SPHYNX).

PhD Students and young Postdocs will participate in all the different stages mentioned above, hence getting training in computational astrophysics, observational astronomy, experimental nuclear physics, and cosmochemistry.

Definition of standard nuclear reaction networks for different explosive stellar sites (e.g., classical novae, type I X-ray bursts, thermonuclear and core-collapse supernovae, stellar mergers etc.) and for different methodologies (post-processing techniques, 1D and multidimensional grid-based hydrodynamics, SPH codes etc.).

Task 6.3 Galactic Chemical Evolution

(PI: Brad K. Gibson, UHull; CoIs: B. Cote, CSFK, G. Cescutti, INAF)

-PDRA will be appointed to oversee development of the next generation of the OMEGA/OMEGA+ software pipeline, linking GCE expertise at Hull, with those at CSFK and INAF. These sub-tasks include, but are not limited to:

Multi-zone extension to the existing single-zone versions of both codes
Phenomenological molecular chemistry and dust cycle implementation
Stellar population synthesis post-processing tool
Radial gas flows, churning, and 2D resonances

-All partners responsible for maintaining (i) stellar yields databases, and (ii) stellar observational abundances databases; their seamless integration with OMEGA/OMEGA+ remains integral to maintaining the unique value-added by our open source pipeline

Immediate Need: Clarity on funding arrangements and the appointment of the GCE PDRA

-**Year 1 Deliverables:** (i) Training school (online, pending clarity on Covid19 protocols); (ii) downloadable training materials to be made available for asynchronous consumption

Milestone:

- **M11** First documented example of cross-collaboration led by an early-stage researcher from outside the consortium involving identification of a key nuclear rate, supported by elemental or isotopic abundance determinations, in the framework of astrophysical simulations (Month 36).

Deliverables:

- D6.1 Provide AGB/binary database interface on project web site with open access to all new observations to outside users (Task 6.1, Month 6)
- D6.2 Publication on project web page of the first version of the multidisciplinary guide to astronuclear science cases (Task 6.2, Month 12)
- D6.3 First online training course active; expected 40 users-institutes per year (Task 6.3, Month 12)
- D6.4 Cross disciplinary training of a student/postdoc in all three disciplines – experiments (GUF, HZDR, and associate partner Oslo), theory (UHULL), Observations (MPG/VU) (Task 6.2; Month 24)
- D6.5 Report on uptake of web-based training courses (Task 6.3; Month 24)
- D6.6 Scientific publication (review) on NA1 results (Task 6.3, Month 36)
- D6.7 Report on uptake of web-based training courses (Task 6.3, Month 48)

WP6 Meeting on May 5

- Invite participants to join efforts
- Arrange short (10-15 min) talks on a monthly basis to provide multidisciplinary background for WP6 participants (Moshe Friedman)
- **Regular meetings** per TASK
- **Annual meeting** of the whole WP6