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WP4 "Astronuclear HPC"

- Marco Pignatari Konkoly Observatory/CSFK, Hungary
- WP4 main team: U. Battino (UHULL), J. Keegans (UKEELE), S. Martinet (ULB), A. Sanz (UPC), R. Hirschi (UKEELE), J. Jose (UPC), S. Goriely (ULB)



F K ChETEC-INFRA General Assembly, June 6th, 2023



JRA2/WP4 Members and Status

- A) WP members, communication / coordination:
 - WP4 mailing-list = 37 members
- B) Status of staff hiring for the person-months inside this WP.
 - PDRA UHULL (2.0 years; until May 2024 @ U.Battino)
 - PDRA UKEELE (2.0 years; until March 2024 @ J. Keegans)
 - PDRA ULB (10 months; until February 2024 @ S. Martinet)
 - PhD UPC (4 years; started: October 2027 @ A. Sanz)
- C) Associated partners
 - University of York, University of Edinburgh





- Task 4.1 Stellar Nucleosynthesis Software Tools for Access to HPC (PI: R. Hirschi, UKEELE, participants: CSFK, UHULL)
- Task 4.2 Nuclear Astrophysics Software Pipeline (PI: M. Pignatari, Konkoly/CSFK, participants: UKEELE, UPC, GUF, ULB, UPC, HZDR, York, Edinburgh)
- **Task 4.3** EXNUC Explosive Nucleosynthesis Codes (PI: J. José, UPC, participants: ULB, UKEELE)





User Training and Online Training Course: HPC Nucleosynthesis Calculations

<u>GOAL</u>: provide the stellar nucleosynthesis tools and user-friendly support to access these capabilities within an HPC framework

Activity:

- ongoing training for 3 PhDs and 2 Postdoc
- training material on the ChETEC-INFRA YouTube channel
- broad spectrum of help and support activities for new and ongoing



M=300Msun star, Z=0.014 Stellar model vs nucleosynthesis model Step: Validation of the nucleosynthesis simulations – OK

@ PhD P. Fong - HPC simulations



HPC UHull VIPER racks of nodes for computation





Marco Pignatari, Konkoly Observatory/CSFK, marco.pignatari@csfk.org, chetec-infra.eu









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Tutorials!

https://www.youtube.com/channel/UCB2SFPWEpNFeWZURED8PXZw/videos





Platform for the Exchange of Nuclear Astrophysics Data - ChANUREPS

<u>GOAL</u>: share and distribute new published nuclear reaction rates as open source and with the same simple format.

Tool: Wordpress software; hosted by Frankfurt Uni.

Activity:

- New nuclear rates available: 24+
- Link to major nuclear reaction libraries
- Portal: http://chanureps.chetec-infra.eu/

ChANUREPS

ChETEC AstroNUclear REPositorieS

How to use ChANUREPS?

Upload your reaction rate

Create your reaction rate file

the nuclear reactions listed <u>here</u>, consider uploading your rate also in the MESA

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The Brussels BRUSLIB nuclear library and the nuclear network generator NETGEN (ULB)

<u>GOAL</u>: Provide to the community an extended library of computed data of astrophysics relevance and a user-friendly nuclear network generator including experimental and theoretical rates

<u>Activity</u>:

- Update the sets of experimental nuclear reaction rates
- Update the theoretical library on the basis of state-of-the-art microscopic models
- Improve the website design
- Portal: http://www.astro.ulb.ac.be/pmwiki/IAA/NuclearData

UNIVERSITÉ LIBRE DE BRUXELLES INSTITUT D'ASTRONOMIE ET D'ASTROPHYSIQUE











Stellar Trajectories - ORChESTRA

<u>GOAL</u>: publish fully documented library of verified trajectories for nuclear astrophysics simulations, covering a wide range of stellar conditions.

Activity:

- Portal: https://zenodo.org/communities/chetec-infra-wp4
- Preliminary version with 4 published trajectories
- The nucleosynthesis for the s-process and Novae is covered
- More trajectories on preparation coming soon









Online Training Course: star and stellar explosion codes

<u>GOAL</u>: provide series of courses/video tutorials for stellar evolution simulations and hydrodynamics simulations for stellar explosions

Activity:

- 2 tutorials published for the stellar code **MESA**:
 - Massive stars
 - How to write output suitable for post-processing
- 3 tutorials in preparation:
 - low mass AGB and data handling (MESA)
 - setting up the FLASH code.
- coming soon: more tutorials using $\ensuremath{\textbf{SPHINX}}$ and $\ensuremath{\textbf{FLASH}}$
- training on the ChETEC-INFRA YouTube channel



https://www.youtube.com/channel/UCB2SFPWEpNFeWZURED8PXZw/videos





Deliverable status

- D4.1: First online training course on the use of stellar evolution and explosion codes and software tools for data anaAlysis active on ChETEC-INFRA web page (12 months, UKEELE). [Deliverable ready & submitted on time]
- D4.2: Platform where nuclear astrophysics data can be exchanged online on the ChETEC-INFRA web page (12 months, UHULL). [Deliverable ready & submitted on time]
- D4.3: Publication online of the first version of the library of stellar trajectories as github repository, and make available the list of nuclear reactions identified with high priority for the community (12 months, UHULL/UPC). [Deliverable ready & submitted on time]
- D4.4: Review simulations done in the first two years, and report on project web page the list of simulations made and resulting publications (24 months, UKEELE) [Deliverable ready & submitted a week late]
- D4.5: User forum active for support and Q&A (24 months, UHULL) [Deliverable ready & submitted on time].
- D4.6: Review stellar simulations, and report on project web page the list of simulations made and resulting publications (36 months, UKEELE).
- D4.7: Report on sustainability of web platforms beyond the end of the project (42 months, UKEELE)
- D4.8: Review simulations done in years 3-4, and report on project web page the list of simulations made and resulting publications (48 months, UKEELE).







- About 30 refereed publications related to WP4 activities carry the ChETEC-INFRA acknowldegements;
- Person-power covered by ChETEC-INFRA until the end of year 3, a PhD running for the all duration of the project;
- D4.6 (and possibly D4.8) should not be a problem;
- Potential issue with D4.7: no source of funding identified so far in the long-term to support the open-source tools developed/supported within WP4. Not included in SpaceSciRI.



