

A success story for nuclear astrophysics

Chemical Elements as Tracers for the Evolution of the Cosmos – Infrastructures for Nuclear Astrophysics

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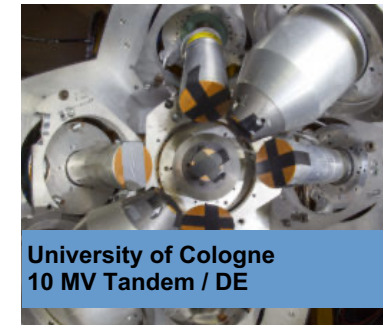
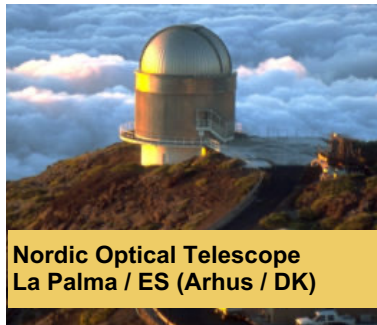
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- ♦ EU Horizon 2020 **Starting Community of Research Infrastructures** to serve nuclear astrophysics
- ♦ H2020-INFRAIA-2020-1
- ♦ **31 partners** in 17 EU+ countries
- ♦ 1 May 2021 – 31 October 2025
- ♦ 5.0 M€ support by European Union
- ♦ **14 research infrastructures** offer EU-supported transnational access, selection based on scientific merit

<https://www.chetec-infra.eu>



14 research infrastructures made accessible by ChETEC-INFRA



laboratories

supercomputers

telescopes



Transnational access to research infrastructures

Funding tool by the European Union, as part of time-limited "Communities of Research Infrastructures"

- ◆ Member infrastructures must be of **regional or global interest**
- ◆ Member infrastructures must be based in the EU or EU-associated countries, but exceptions apply for unique infrastructures in third countries of strong EU interest

Transnational access, the idea

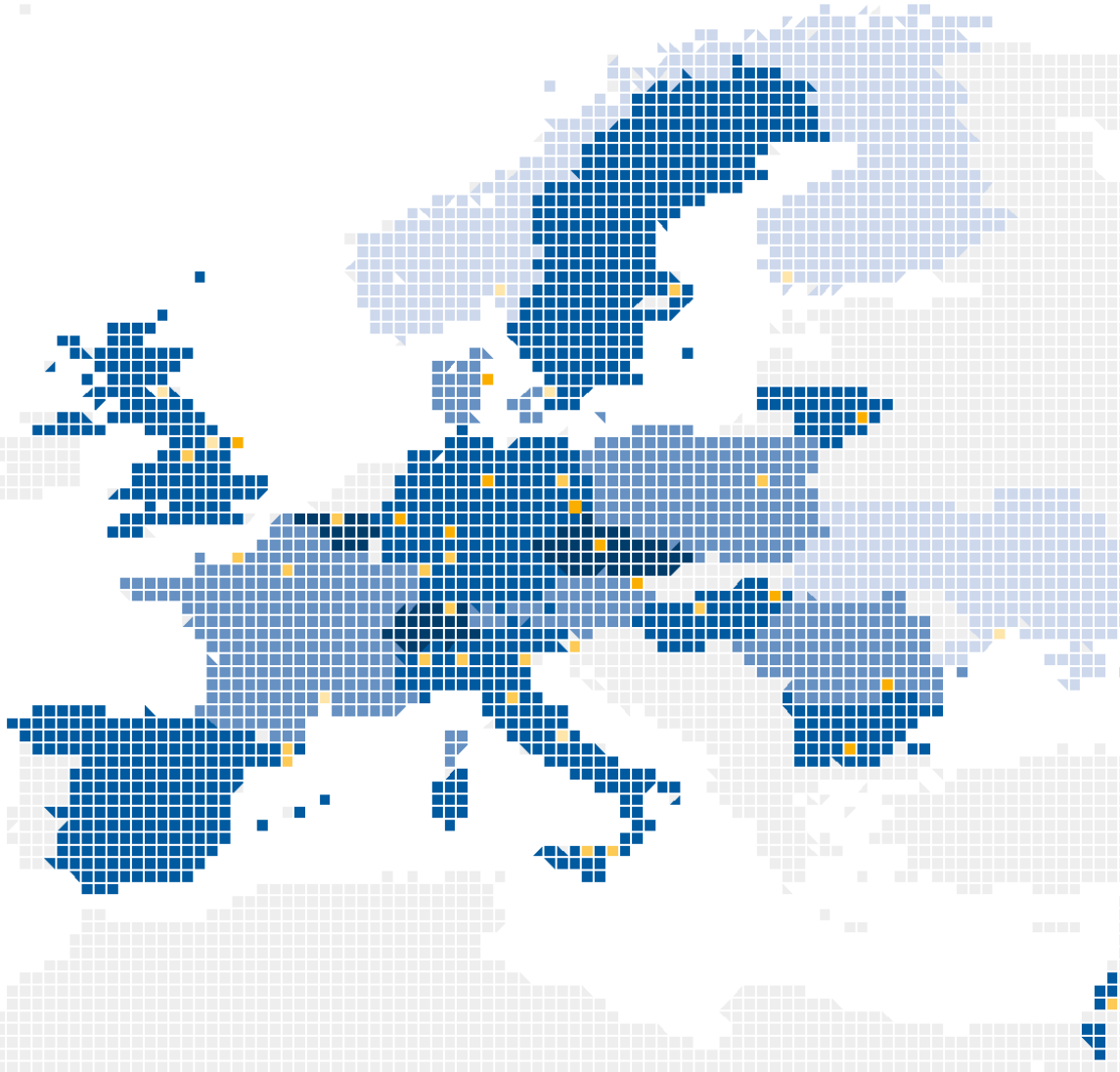
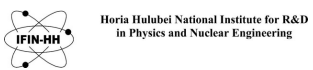
- ◆ Researchers based in countries lacking an infrastructure they need can access it in a different country
- ◆ Selection of proposals based on **scientific excellence** (sole criterion)
- ◆ For the access, researchers must **cross a national border**
- ◆ EU support, part 1 = **Support to the infrastructures** to help defray access costs (e.g. hourly rate)
- ◆ EU support, part 2 = **Travel support** to the infrastructure users
- ◆ Users may also come from any country in the world (20% limit applies)

EURO-LABS Advanced Community of Research Infrastructures (GSI, GANIL, ELI-NP – 2022 - 2026)

ChETEC-INFRA Starting Community of Research Infrastructures, 2021 – 2025

- ◆ **5039 beam hours** of accelerator time, **39 nights** of telescope time, **3.9 M cpu-hours**

31 funded partners in EU, UK, Israel



Achievements, in line with EU commission expectations

Opening up of national and regional research infrastructures

- Central European telescopes (Moletai/LT, Ondrejov/CZ, Rozhen/BG)
- Nordic Optical Telescope (Canary Islands – operated through Arhus University / Denmark)
- Nine accelerator laboratories of different capabilities
- One supercomputer (viper Hull/UK)

Nourish the landscape of nuclear astrophysics schools

- New tool for the field: remote controlled telescope observations
- Strong support for traditional nuclear astrophysics schools (Rußbach, Santa Tecla, Sinaia, ...)
- New schools established: Nuclear Physics in Astrophysics School, ChETEC-INFRA Observational School

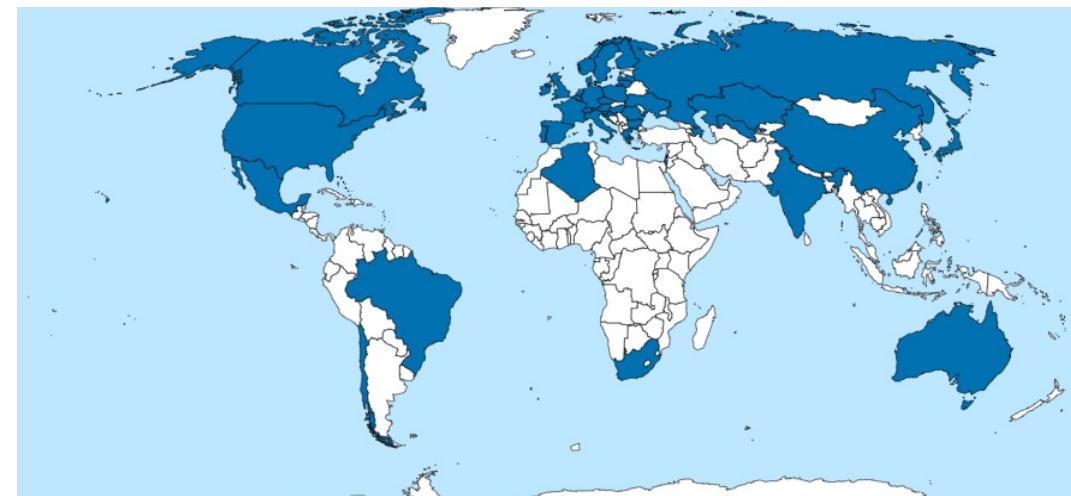
Collaboration with large European nuclear physics laboratories

- Strong ChETEC-INFRA presence in NuPECC 2024 Long Range Plan for Nuclear Physics in Europe
- Joint experiments on Big Bang nucleosynthesis (FAIR phase-0), more are planned

Completed ChETEC-INFRA Scientific Schools (12 x online)

Schools on Nuclear Astrophysics Questions (SNAQs)

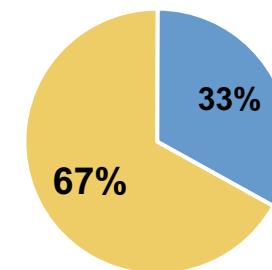
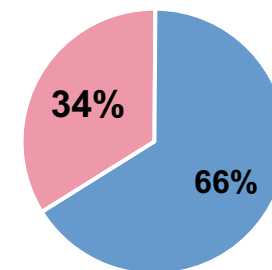
- **Online** format as response to COVID-19 pandemic
- from Feb 2021 to May 2022, **12 editions**
- **1243 participants**, 34% female, 67% young scientists



Countries of online participants in SNAQs

Concept:

- 2nd Wednesday each month
- Lectures by senior scientists
- Scientific talks by young researchers, acknowledged with SNAQs Scientific Talk Award
- Networking sessions in breakout rooms



■ Female ■ Male

■ Young Scientists ■ Senior scientists

Achievements (continued)

Outreach to high school students

- Two nuclear astrophysics Masterclasses
- Masterclass = Full-day teaching unit deployed in high schools, by PhD students as teachers
- Available in 12 consortium languages, more on the way: Bulgarian, Czech, **English**, French, German, Italian, Lithuanian, Polish, Romanian, Upper Sorbian, Spanish, and Swedish

Outreach to policymakers

- NuPECC Long Range Plan 2024 for Nuclear Physics in Europe
- NuPECC Report “Nuclear Physics in Everyday Life” translation

Outreach to industry

- Model industry day at INFN
- Industry sessions at ChETEC-INFRA supported conferences and meetings



Many online databases and tools

Databases available on web page chetec-infra.eu

- Barium Star Repository
- Reaction Network Generator – NetGen
- New Generation of Solar Models
- Nuclear Reaction Rates – ChANUREPS
- Stellar Trajectories – ORChESTRA
- s-process Library – ASTRAL
- 3D NLTE Abundance Correction Grid
- Database of stable isotope anomalies in bulk meteoritic materials
- Implantation Of Noble Gases In Grains – IONGIG

Courses and Tutorials

- Course on Galactical Chemical Evolution Modelling
- Course on Stellar Nucleosynthesis Tools for HPC Clusters
- Multidisciplinary Guide to Astronuclear Science Cases

Tools

- Stellar Interpretation for Meteoritic data and PLOtting – SIMPLE
- Translation of Stellar Yield Predictions for Comparison with the Laboratory Analysis of Meteorites
- Nucleosynthesis Sensitivity Library

Scientific achievements, so far

Already >220 peer-reviewed publications, cited 1800 times, with explicit ChETEC-INFRA acknowledgment

- ◆ Many science papers benefiting from project-funded work
- ◆ Transnational access based papers are starting to arrive

Scientific legacy

- ◆ Previously non-existing interdisciplinary network between astronomers, astrophysicists, nuclear physicists
- ◆ Previously national-only facilities successfully opened up for TNA
- ◆ Community-based decadal evaluation of Solar Fusion Cross Sections III
- ◆ Strong bridge to meteoritic and planetary science communities

General aspects of ChETEC-INFRA

- ◆ Strong educational aspect for PhD students and also secondary school students
- ◆ Inclusiveness across many dimensions (countries, gender, ages, ...), extraordinary for a MINT-based network
- ◆ Active and thriving industry contacts

ChETEC-INFRA – thanks for your attention!

HZDR

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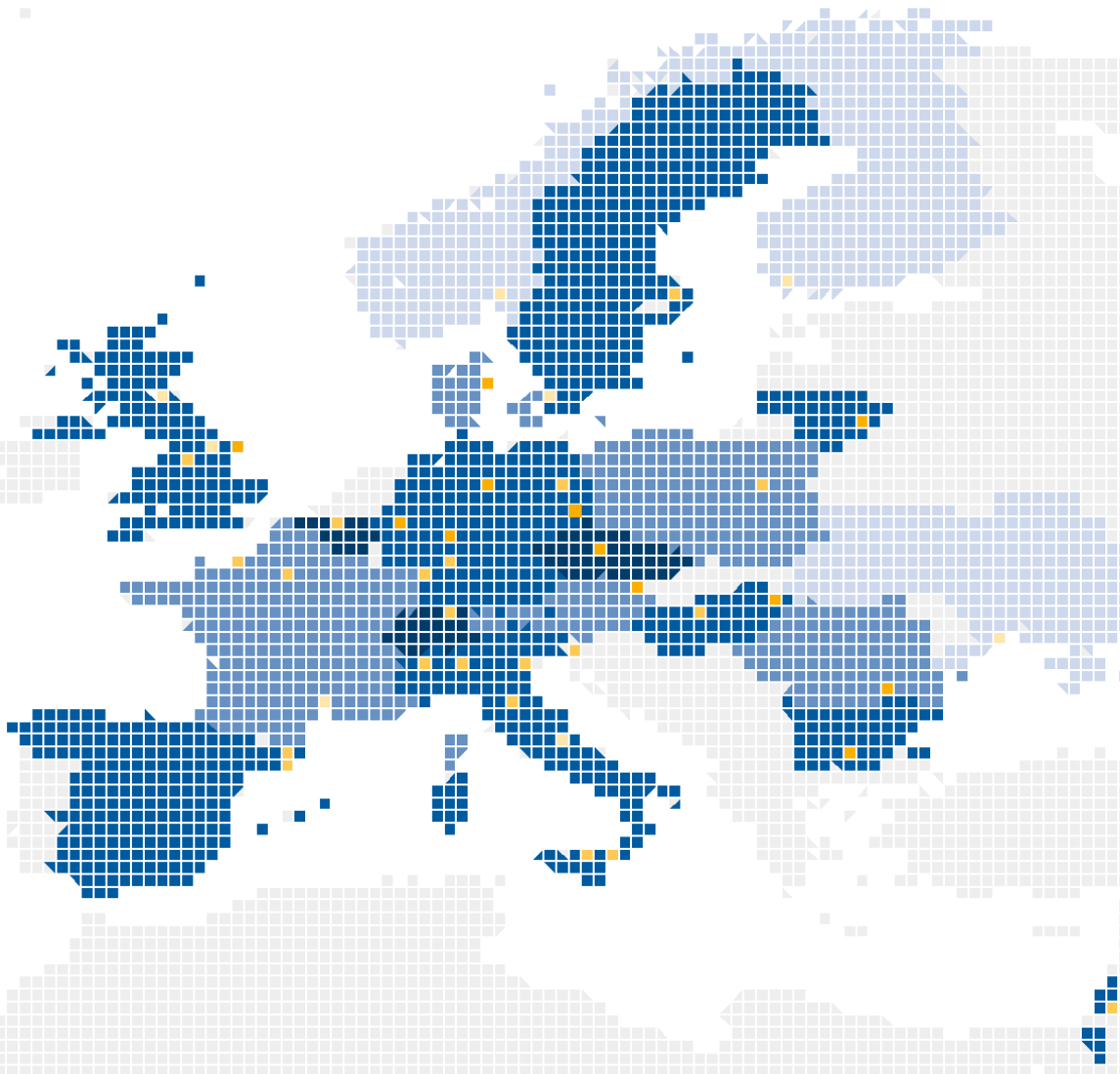


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