

LENA: LasEr-driven Neutron source for Applications

J. Hornung, V. Bagnoud, A. Maitrallain,
H.P. Schlenvoigt

A proposal tailored to fit very well the Horizon-2025-INFRA-01-SERV-03 call



- Development of a laser-driven neutron source at GSI for applications
- Extend capabilities at user facility PHELIX, enabling **interdisciplinary research**
- Offer **TNA and training** at PHELIX
- Enhance **F.A.I.R data standards** at the facility (improving VA capabilities)
- Extend infrastructure services for **wider community range**

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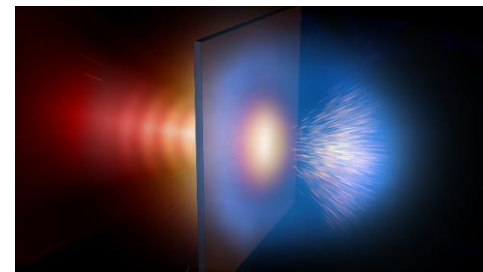
Our group



- HZDR - Hans-Peter Schlenvoigt
 - Laser-driven particle acceleration (Draco, PENELOPE)
 - High-Power Computing
 - Data management (HMC project HELPMI)
- Subatech - Antoine Maitrallain
 - Laser-driven particle acceleration
 - Generation of radioisotopes for medical research
- GSI - Vincent Bagnoud, Johannes Hornung
 - Laser-driven particle acceleration (PHELIX, planned FLARE)
 - Detector development
 - Data management (HMC project HELPMI)

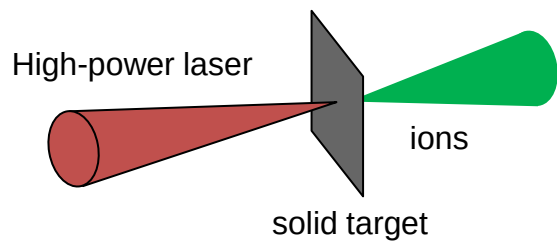


- Plasma accelerators have several desirable features:
 - Short bunches ($\sim$ ps)
 - Low emittance
 - Compactness
- Several test stands within Helmholtz - **ATHENA**
- Explored applications range...
 - ...medical science
 - ...radiation production incl. Neutrons
 - ...test of QED
 - ...accelerator technology (injector)



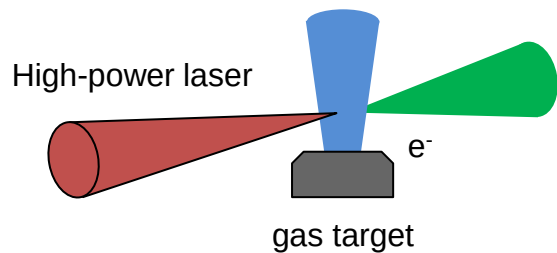
Laser-driven compact neutron sources

- Pitcher-catcher scheme



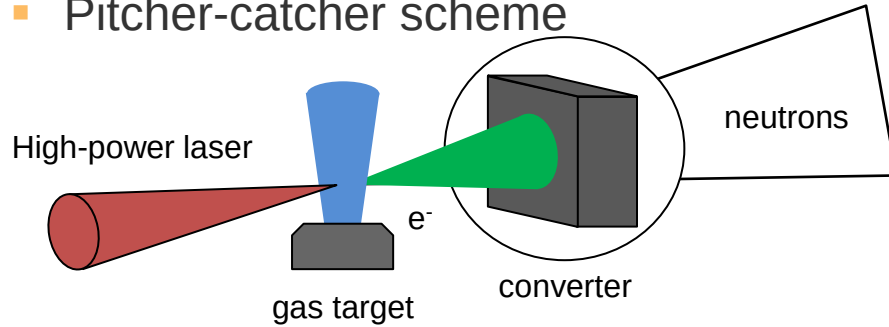
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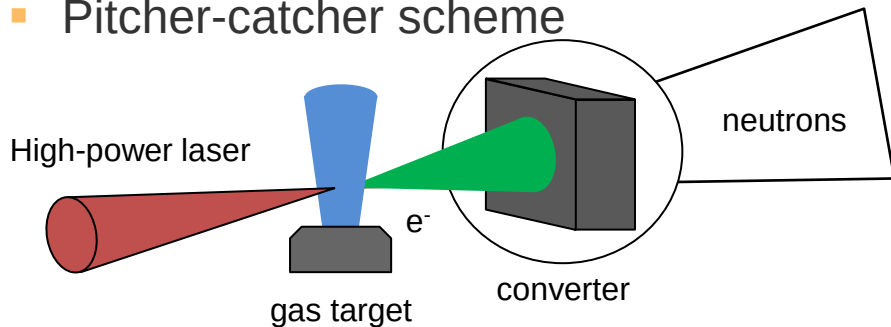


- Bunch duration: picoseconds (at source)
- Spectrum: broadband (10's of MeV)
- Peak angular flux: $\sim 10^{21}$ n/sr/sec [1]

[1] A. Yogo et al., Phys. Rev. X **13**, 011011 (2023)

Laser-driven compact neutron sources

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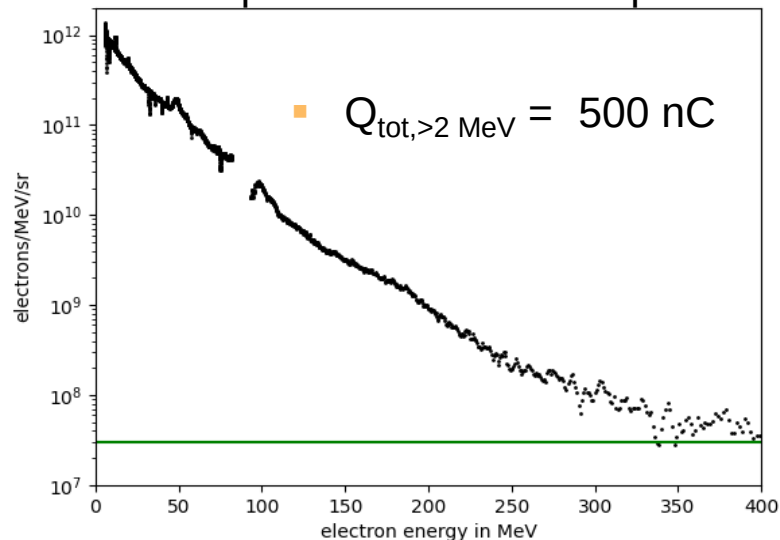


- Electron acceleration with PHELIX show outstanding properties for neutron productions

- $\sim 2 \times 10^{13}$ e^- /sr/shot (first experiment, half laser energy)
- Angular yield of $\sim 10^9$ n/sr/shot and 10^{21} n/sr/sec

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electron spectrum from first experiment

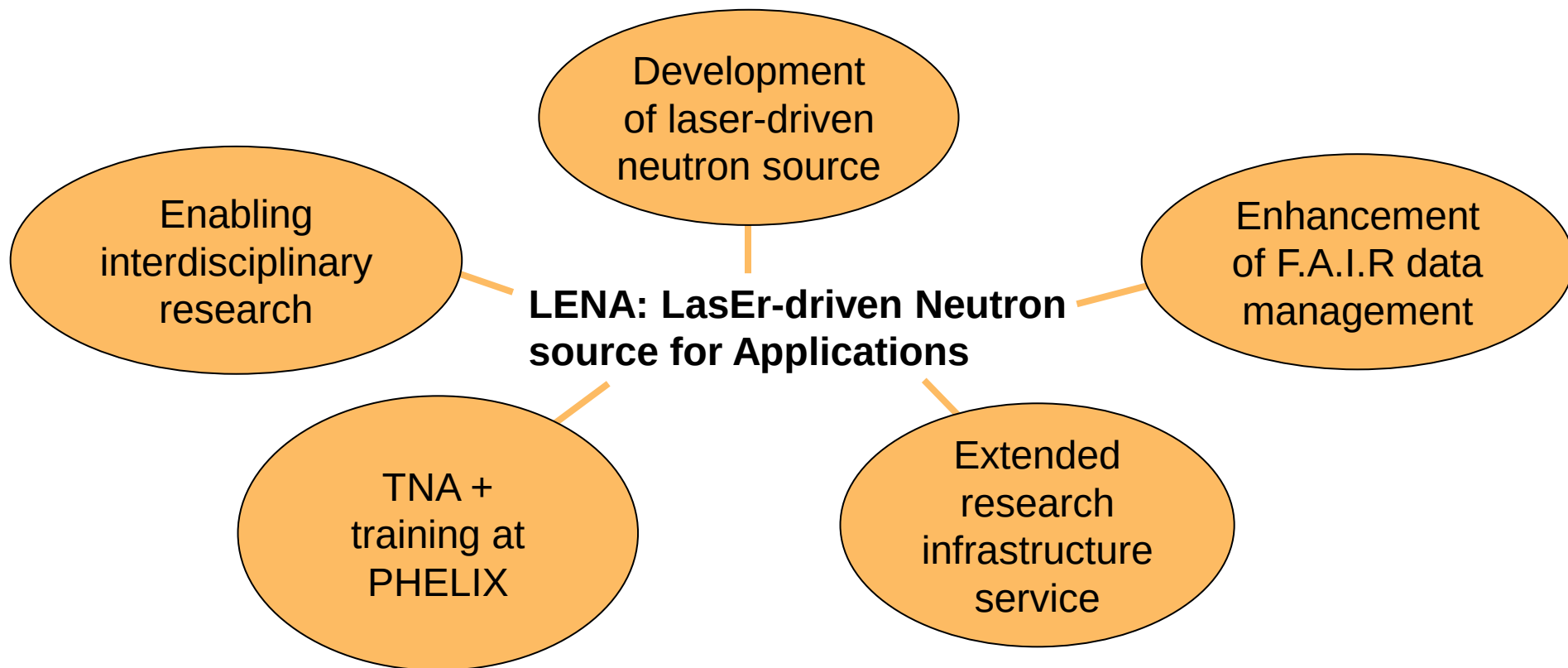


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Proposal objectives



- **Objective 1:** Create opportunities for interdisciplinary research
 - From Biology, over material science up to hadron physics
 - Development of the neutron source (upscaling by rep-rate)
 - 2 – 3 applications for beamtimes at PHELIX (TNA access)
- **Objective 2:** Work out technical bottlenecks by bringing the expertise of the communities together
 - Development of EMP resistant neutron detectors
 - Reaching required properties and extend secondary-source portfolio for external users
- **Objective 3:** Enable F.A.I.R data principles by standardized data acquisition and availability
 - Data storage according to recently developed metadata standard for LPA community based on NeXus
 - Integrate in infrastructure to extends reusability and accessibility of experimental data (also for partial VA users)



Budget of the proposal

position	beneficiary	cost	overhead	total	Objective
Post-doc 1 (2 years)	GSI	180.000 €	45.000 €	225.000 €	3
Detector development	GSI	100.000 €	25.000 €	125.000 €	2
PhD	Subatech	140.000 €	35.000 €	175.000 €	2
scientist (1 year)	HZDR	90.000 €	22.500 €	112.500 €	3
Travel to beamtime	Subatech	18.000 €	4.500 €	22.500 €	2
Travel to beamtime	HZDR	9.000 €	2.250 €	11.250 €	2
Total		537.000 €	134.250 €	671.250 €	

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