

Results

On the backdrop of the limitations caused by the pandemic the experimental group did very well in the implementation and the commissioning of the 100 TW and 1 PW beamlines with the latter to be used for the inaugural 93m-Mo creating shots at the E5 target station of ELI-NP at the end of 2022. As shown in the commissioning experiments, proton beam pulses with well over 45 MeV could be achieved with μm -wide laser beam shots facilitating the TNSA regime. This acceleration is well above the proton energy which is needed to optimize the production of the 93m-Mo isomer in the selected (p,n) reaction in niobium which lies around 10-14 MeV in which the amplitude of the cross-section reaches maximal value for the 93m-Mo production as well as for the 'spy' reaction on Sc on with which we will conclude on potential yield changes.

The PI (Spohr) also accrued valuable beam time for a full campaign as described in the ELI-RO proposal at the 300 TW installation at VEGA at the CLPU in Salamanca, Spain (see detail in the next Subchapter 2.). The beam time was awarded to the PI in a competitive selection process with a success rate of only about 16% but needed to be shifted from 2022 to early 2023 due to pandemic-induced delays at the Spanish facility. As such, our in-house 1 PW shots will be the first to (hopefully) prove the creation of 93m-Mo via a laser-induced proton pulse.

Moreover, the theme of laser-induced 93m-Mo production as a 'Nuclear Battery' was endorsed as a showcase experiment by the MP3 initiative inaugurated by the Laboratory of Laser Energetics at the University of Rochester (LLE) which aims to establish an 80 PW laser system in the USA. The PI submitted a shortened version of the project, to the editors of the related White Book and presented the case in related workshops and conferences.

The case was also presented at ELI Summer School (ELISS) organized by ELI-Beamline in Prague in in 2021 and the 3rd International Conference on Nuclear Photonics 2020 conference held via ZOOM in Kurashiki, Japan

Deliverables in the last year related to the project:

- List of papers (journal or conference proceeding);
- *) Design studies of a 200 MeV Thomson parabola spectrometer for the use at the 10 PW laser system at ELI-NP. L. Tudor et al., Romanian Reports in Physics, In Press (2022) , <http://www.rrp.infim.ro/IP/AP627N.pdf>
- *) The triggering of the isomeric state in 93mMo, a unique chance for laser-plasma studies at ELI-NP, K.M. Spohr et al. be submitted to Matter and Radiation at Extremes, 2022

- List of talks of group members (title, conference or meeting, date);
- *) Laser-plasma triggered production and release of the 2.4 MeV isomer in 93mMo, towards a Nuclear Battery, 11/06/2021, 5:45 am, 3rd International Conference on Nuclear Photonics, NP 2020, Kurashiki, Japan, 2021
- *) Nuclear Physics with High Power Lasers, K. M Spohr, 26/08/2021. ELI Summer School 2021, ELI-Beamlines, Prague