Contribution ID: **131** Type: **Invited talk**

Nuclear physics and astrophysics ELI-NP: The emerging future

Wednesday, 21 June 2017 08:30 (30 minutes)

The mission of the Extreme Light Infrastructure Nuclear Physics (ELI-NP) research infrastruc- ture are nuclear physics studies with high-power lasers and high-brilliance quasi-monochromatic gamma beams [1,2]. The laboratory will become operational as an user facility in 2019. Two high-power lasers will provide laser pulses on target, each of them having three outputs, e.g. of100TWat10Hz,1PWat1Hzand10PWonceperminute. Thetwolaserarmswillbe synchronized and it will be possible to deliver any combination of these pulses on target, since each output will be provided with its own amplifier [3]. In addition, a high-brilliance narrow-bandwidth gamma beam will be produced at ELI-NP via Compton backscattering of laser light off electrons accelerated to relativistic energies [4]. The 100 Hz electron bunches will be delivered by an electron linac, where they will be accelerated up to energies of 750 MeV. There will be two interaction points where the electrons will collide with laser pulses provided by 0.2 J 100 Hz Yb:YAG lasers. At one of them, a low-energy gamma beam will be produced, with energies up tp 3.5 MeV, and at the other one the maximal energy of the gamma beam will reach 19.5 MeV. Each electron bunch will consist of a train of 32 microbunches and laser re-circulators will be used at the interaction points to ensure the interaction of the laser pulse with each of the bunches in the train. Thus, gamma beams of spectral density of 104 photons/s/eV will be produced, which after collimation results in highly polarized (¿ 95%)quasi-monochromatic gamma beams (bandwidth le0.5%) with beam intensities of 1010 photons/s, or ~ 109 per microbunch.
Several types of experiments will be possible at ELI-NP, e.g. laser-driven experiments in single or double pulse-shot mode on target, gamma-beam experiments in narrow- or wide- bandwidth mode, and combined laser- and gamma-beam experiments. Thus, the ELI-NP labo- ratory opens a new dimension for nuclear physics studies with intense electromagnetic probes. The experimental program, which is under preparation at ELI-NP targets all these experimental modes and at present a large variety of instruments are under construction [2,5,6]. The present status of the implementation facility, as well as the emerging experimental program in the field of nuclear physics and astrophysics will be described, with an emphasis of the considered day-one experiments.

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[5] ELI-NP TDR teams, Rom. Rep. Phys. 68S (2016) (www.rrp.infim.ro);
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Session Classification: Nuclear astrophysics with lasers