CHALLENGES FOR NUCLEAR PHYSICS RESEARCH AT THE ADVANCED GAMMA BEAM SYSTEM OF ELI–NP

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Extreme Light Infrastructure – Nuclear Physics (ELI–NP) [1], currently under implementation on the Magurele Physics Platform (near Bucharest), is designed to accomplish a science program dedicated to nuclear physics research with the use of extreme electromagnetic fields. One of the main equipment of ELI–NP is the Gamma Beam System that will provide gamma beams with properties far beyond the present day state–of–the–art part facilities. High brilliance narrow gamma beams at ELI–NP will be produced via the incoherent inverse Compton scattering of high repetition short laser pulses on a high–intensity, low–emittance relativistic electron beam provided by a warm linac [2]. The main features of the gamma beams at ELI–NP will be: continuous range of energies between 200 keV and 19.5 MeV, high degree of monochromaticity (bandwidth of less than 0.5%), high spectral density of about 10^4 photons/s/eV, degree of linear polarization higher than 95%.
The unprecedented features of the gamma beams at ELI–NP will open new perspectives in nuclear photonics studies with significant outcomes in both basic and applied nuclear physics research. The scientific team of ELI–NP with the support and contribution of a broad international collaboration has identified the main directions of research and the 'Day–1' experiments to be performed with the Gamma Beam System. Research activities were grouped in several main topics as follows:

- Nuclear Resonance Fluorescence (NRF) studies of nuclear structure;
- Photo–fission studies and production of exotic neutron–rich nuclei;
- Dipole response of nuclei above the neutron threshold;
- Astrophysics interest studies via (gamma, charged particles) reactions.
- Industrial applications based on NRF and tomography with high–energy gamma rays.

The Technical Design Reports for the main experimental setups required to accomplish the physics cases proposed at ELI–NP were completed and are presently under scientific evaluation. The proposed experimental setups will have to face the challenges of measuring gamma rays, charged particles, neutrons or fission fragments in the presence of a high intensity gamma beam and they were designed such to take full advantage of the features of the beam. State–of–the–art solutions are proposed for the construction of the setups, such as: segmented Ge detectors, fast scintillator detectors or time projection chamber with electronic readout.

The main physics cases proposed for investigation at ELI–NP and the associated experimental setups will be discussed in the presentation.

REFERENCES

[1] http://www.eli-np.ro
[2] O.Adriani *et al*., arXiv:1407.3669 [physics.acc-ph]