Programme / Sub-progr. / module	5/5.1/ELI-RO
Project type	RDI
ELI-NP thematic	RA4/II.3 Application of NRF techniques to material science or cultural heritage research RA4/II.4 Industrial tomography and radiography 5.6.1. Industrial Applications for the management of nuclear materials
Project title / Acronym	**Security applications development at ELI-NP: detecting concealed threatening materials by using Nuclear Resonance Fluorescence and 2D/3D tomography with gamma beams / ELI_THREAT_DETECT**
Project duration	26.5 months

PROJECT SUMMARY

Motivation. Since the attacks of September 11th 2001 and many others that followed, high emphasis and increasing efforts have been put towards protecting people from terrorist attacks. However, unlike several years ago, this protection is no longer directed against conventional weapons only; nowadays a radiological "dirty bomb" attack or even a nuclear attack poses serious threats, according to experts, and these threats only continue to grow. The materials used in nuclear weapons are Uranium (U-235) and Plutonium (Pu-239) both named as "special nuclear material" (SNM). When Uranium is enriched then we are speaking about highly enriched uranium, or HEU. Same for weapons-grade plutonium, or WGPu. Since those nuclear materials could be transported only in highly shielded enclosures, the security authorities are focussing in detecting SNM smuggled in cargo containers. The project propose to improve the detection techniques of the SNMs and other threatening materials hidden in cargo containers by using the Nuclear Resonance Techniques (NRF) combined with 2D/3D Transmission tomography, hence exploiting the unique advantages offered by highly-specialized ELI-NP Gamma Beam equipment in accurately measuring the nuclear resonances. The recent developments in the production of high-energy gamma beams by Laser Compton Scattering (LCS) technique have ignited interest in exploring the potentials of the LCS gamma beam in active interrogations for security applications [1-5]. Gamma beams obtained through inverse Compton scattering of laser light on relativistic electrons have attractive features from the perspective of the potential applications, such as high spectral density, small bandwidth and tunable energy. The Nuclear Resonance Fluorescence (NRF)-based applications planned to be developed at ELI-NP target the use of NRF and Computed Tomography (CT) obtained with high-energy **ELI-NP gamma beams** for providing unique opportunities for industry and society [6]. The potential of NRF for security applications has been demonstrated by using bremsstrahlung radiation and the currently available LCS gamma beams for several applications like detection of shielded special nuclear materials [1], assay of spent nuclear fuel [2] and material identification based on the ratio between elements [3], with some limitations encountered due to the available technologies. The **ELI_THREAT_DETECT** project aim is to combine 2D&3D imaging techniques based on gamma-ray transmission and nuclear resonance fluorescence (NRF) for developing screening/scanning algorithms for large-size objects, like cargo containers, trucks, vans, parcels, etc., in order to accurately detect the most forbidden threatening materials hidden inside, such as: special nuclear materials, shielded gamma sources, various type of explosives or precursors of explosives, contraband materials, flammable liquids, drugs, toxic substances, etc. The **ELI_THREAT_DETECT** proposal combines the expertise of AP2K in Security (single, dual and multi energy, diffraction X-ray applied in Digital Radiography and Tomography for baggage scanners) with the equipment and the know-how available at ELI-NP for creating skilled scientists and a dedicated experimental set-up for having the background in high-energy gamma beam security applications development at ELI-NP.