Strategic scientific objectives and research directions of the National Institute for Research and Development in Laser, Plasma & Radiation Physics

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Ob #1 Study of matter in extreme regimes by using ultra high electromagnetic fields (TW-PW laser beams & electron beams)

- **D1.1** Development of high power femtosecond lasers.
- **D1.2** Targets development for interactions with TW and PW lasers.
- **D1.3** Plasma accelerators and secondary radiation sources from matter in hyperintense fields.
- **D1.4** Development of a facility for laser beam diagnosis and for testing of optical components and materials subjected to high power laser beams.
- **D1.5** Technological and environmental applications of electron accelerators, including LINAC.

Ob #2 Leadership position in photonics science and technology at national and regional level (including biophotonics and nanophotonics)

- **D2.1** Nanomaterials, nanostructures and thin films – synthesis and functionalization by laser techniques.
- **D2.2** Laser biomedical and environmental advanced applications.
- **D2.3** Development of new coherent and noncoherent photon sources.
- **D2.4** Transparent ceramics for large scale high power lasers.
- **D2.5** Nonlinear and quantum optics, micro- and nano-photonics.
- **D2.6** Development of new micro- and nano-scale laser processing technologies.

Ob #3 Development of the scientific & technological pool of knowledge related to fusion technology within EURATOM framework

- **D3.1** Physics of magnetically confined plasmas for fusion reactors.
- **D3.2** Methods and devices for plasma wall interaction studies for fusion reactors.
- **D3.3** Development of coating technologies for nuclear fusion applications.
- **D3.4** Diagnostic techniques for fusion material characterization and plasma studies.
- **D3.5** Extension of the knowledge to a wider range of plasma parameters (plasmas in hyperintense fields and quantum plasma).

Ob #4 National and regional leadership position in plasma sources physics and applications

- **D4.1** New concepts of non-thermal atmospheric pressure plasma sources.
- **D4.2** Development of multifunctional films and surface modification based on novel plasma technologies.
- **D4.3** Plasma based technologies for synthesis of nanomaterials and particle trapping.
- **D4.4** Plasma chemistry and plasma catalysis for environmental applications.
- **D4.5** Plasma applications in biology, medicine and elemental analysis.

Ob #5 Space exploration and applications

D5.1 Investigation of solar system plasmas by satellite observations, ground experiments, and numerical modelling – with emphasis on ESA missions Cluster, Venus Express, Swarm, Solar Orbiter, as well as NASA missions THEMIS and MMS.

D5.2 Participation to ESA scientific missions PLANCK, EUCLID and CoRE (search for dark matter, dark energy, and modified gravity).

D5.3 Neutrino astrophysics. Multi-messenger astrophysics with neutrino, gamma, and ultrahigh energy cosmic rays (participation at ANTARES, KM3NeT, DWARF, Pierre Auger Observatory). Innovative particle detection techniques with applications at large scale ground-based experiments.

D5.4 Search of exotic particles and phenomena in cosmic rays and colliders/accelerators beams (participation at LHC-ALICE-CERN, FAIR-GSI, ILC, NICA-IUCN DUBNA, NUCLOTRON-IUCN DUBNA).

D5.5 Complex processes and structures in theoretical astrophysics, gravitation, and cosmology. Physics of the Violent Universe.

D5.6 Large scale computing clusters and High Performance Computing for high energy physics, space sciences, astrophysics, and applications (GRID sites for the ALICE-CERN Collaboration, GPU computing, ESA-PLANCK, FAIR-NUFAR-GSI).

D5.7 Microsatellites development and integration, satellites formation flying, satellites ground test facility development, satellites communication ground station.

D5.8 Space applications: Remote sensing, disaster management. Telemedicine. Countermeasures to the human space flight adverse conditions.