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Simulations on Particle and Radiation Sources at ELI NP

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The Extreme Light Infrastructure Nuclear Physics (ELI NP) facility in Măgurele, Romania, runs the currently most powerful laser in the world, capable of delivering two 10 PW pulses each minute. It stands at the forefront of cutting-edge research in laser-driven particle acceleration and high-energy nuclear physics. We present a selected part of our simulation effort where the SMILEI capabilities and the PIC approach in general are tested at the edge regime, in particular:

1. **Interaction of a 10 PW pulse with a nickel target:** simulations for an ongoing experimental campaign aimed at the measurement of the plasma state evolution within a picosecond after the target irradiation. Roles of field ionisation, collisions and QED effects are discussed.
2. **Monochromatic ions from the nanostructured peeler:** high-energy, quasi-monochromatic ion beam can be generated by shooting a PW-class laser pulse at the narrow side of a tape target. We further develop the scheme by placing a carbon nanostructure at the non-irradiated edge of the tape to tune it to deliver monochromatic proton and carbon bunches with a narrow energy spread suitable for hotly anticipated medical applications.
3. **Ultrabright Gamma Sources:** The generation of ultrabright gamma sources is a key research area at ELI NP, with implications for fundamental nuclear physics and medical imaging. The newly implemented *NewParticles* diagnostic provides a new insight into the process of photon emission. We will provide feedback to developers and potentially suggest additional ideas for further development.

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