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The Nuclear Physics Program at the NESR Storage Ring at FAIR

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The upcoming FAIR facility in Darmstadt, Germany, will produce intense high energy beams of exotic nuclei, electrons and anti-protons, which will be used to explore the properties of new regions of the chart of nuclides of key importance for both nuclear structure and nuclear astrophysics. Since the nucleus under study is the one which is produced in the process of in-flight fragmentation, one has to deal with unusual kinematics in which the probe, generally a light nucleus, anti-protons and electrons, is the target being bombarded by the heavy nucleus. Anti-protons and electrons are accelerated as well and collide with the nucleus under study. At FAIR, there are plans to have several rings for all these activities. The radioactive ions are guided to the New Experimental Storage Ring (NESR) and bombard extremely thin stationary targets in the so-called inverse kinematics within the EXL program. The large revolution frequency of the beam in the ring compensates for the small target thickness and creates reasonable luminosities and unique possibilities for nuclear reaction studies. The same ring will be used for precision mass and decay measurements of radioactive ions by the ILIMA collaboration. Electrons will be accelerated in a different ring and collide with the radioactive nuclei in the ELISe experiment emphasizing the electromagnetic interaction with nuclei. Finally, the anti-protons will be brought to the same ring and collide with radioactive nuclei highlighting yet other aspects of nuclear structure.
The physics case and challenges for all these experiments will be discussed in this talk.

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