Application of intense ion beams to planetary physics research at the FAIR facility

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Discovery of thousands of extrasolar planets of different type including gas giants, water rich as well as rocky planets has led to a much greater interest in planetary physics research. Existing planetary models predict that extreme physical conditions including ultra-high pressures (5-30 Mbar), super-solid density, but relatively low temperatures (5000-20000 K) exist in the planetary interiors. To have a better understanding of the processes of planetary formation and evolution, it is necessary to study the thermophysical and transport properties of matter under such extreme conditions in the laboratory. Theoretical work has shown that intense heavy ion beams are a very efficient tool to implode material samples to induce planetary core conditions.

The heavy ion synchrotron, SIS100, which is under construction at the Facility for Antiprotons and Ion Research [FAIR] at Darmstadt, will deliver strongly bunched, well focused energetic intense ion beams with unprecedented intensities. Numerical simulations have shown that using the FAIR beam parameters, it is possible to generate core conditions of hydrogen rich planets like Jupiter and Saturn [1], water-rich planets like Uranus and Neptune [2] as well as rocky planets like Earth and more massive Earth-like extrasolar planets, the Super-Earths [3]. Based on these simulation results, a dedicated experiment named LAPLAS [Laboratory Planetary Sciences] has been proposed as part of the FAIR High Energy Density program. An overview of this work is presented in this presentation.

REFERENCES

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