Probing the Neutron Skin Puzzle in ^{208}Pb: precision polarized electron scattering at Mainz

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The result from the PREX experiment on the neutron skin of ^{208}Pb [1] has sparked considerable debate in the nuclear physics community by revealing significant discrepancies with both other experimental approaches and theoretical models. This result was obtained via the parity-violating asymmetry $A_{PV} = (\sigma_R - \sigma_L)/(\sigma_R + \sigma_L)$ and provides a model-independent probe of the neutron distribution, allowing for the extraction of the neutron radius [2]. Additional measurements with improved precision are essential to clarify this tension. PREX also reported a value for the beam-normal single spin asymmetry $A_n = (\sigma_\uparrow - \sigma_\downarrow)/(\sigma_\uparrow + \sigma_\downarrow)$ of ^{208}Pb [3], a key background to A_{PV}, which significantly deviates from contemporary theoretical predictions [4] – a discrepancy now referred to as the PREX anomaly. This unresolved anomaly points to gaps in the theoretical treatment of electromagnetic backgrounds in parity-violating electron scattering off heavy nuclei.

In this talk, I will present recent results from measurements of A_n in electron–^{208}Pb scattering at MAMI and discuss their implications for understanding the PREX anomaly. I will also outline the strategy for the upcoming Mainz Radius EXperiment (MREX) at MESA, which aims to provide an independent determination of A_{PV} in ^{208}Pb with twice the precision of PREX.

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[3] D. Adhikari *et al.* Phys. Rev. Lett. **128** (2022) 142501
[4] O. Koshchii *et al.* Phys. Rev. C **103** (2021) 064316