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Technology and techniques for parity experiments at Mainz: Past, Present and Future[1]

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For almost 20 years the Mainz accelerator facility MAMI delivered polarized electron beam to the parity violation experiment A4 that measured the contributions of strange sea quarks to the proton electromagnetic factors. Parity violation asymmetries were of the order of A≈5 ppm. Currently the A1 collaboration carries out single spin asymmetry measurements at MAMI (A≈20 ppm) to prepare for a measurement of neutron skin depth on lead (A≈1 ppm). For such high precision experiments active stabilization and precise determination of beam parameters like current, energy, position, and angle are essential requirements in addition to precision electron beam polarimetry. For the future P2 experiment at the planned superconducting accelerator MESA in Mainz the requirements for beam quality will be even higher. P2 will measure the weak mixing angle with 0.15 percent total uncertainty and, in addition, the neutron skin depth of lead as well as parity violation in electron scattering off ^{12}C. A tiny asymmetry of only -0.03 ppm creates the needs to combine digital feedback with feedforward stabilizations along with new polarimetry developments like a hydro-Moller and a double-Mott polarimeter to meet the goals for systematic uncertainty. This talk gives an overview of our experience with polarimetry, analog feedbacks and compensation techniques for apparative asymmetries at the A4 experiment. It finally leads to the requirements and new techniques for the pioneering P2 experiment at MESA. First results from beam tests currently carried out at the existing MAMI accelerator, employing high speed analog/digital conversion and FPGAs for control of beam parameters, will be presented.

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