

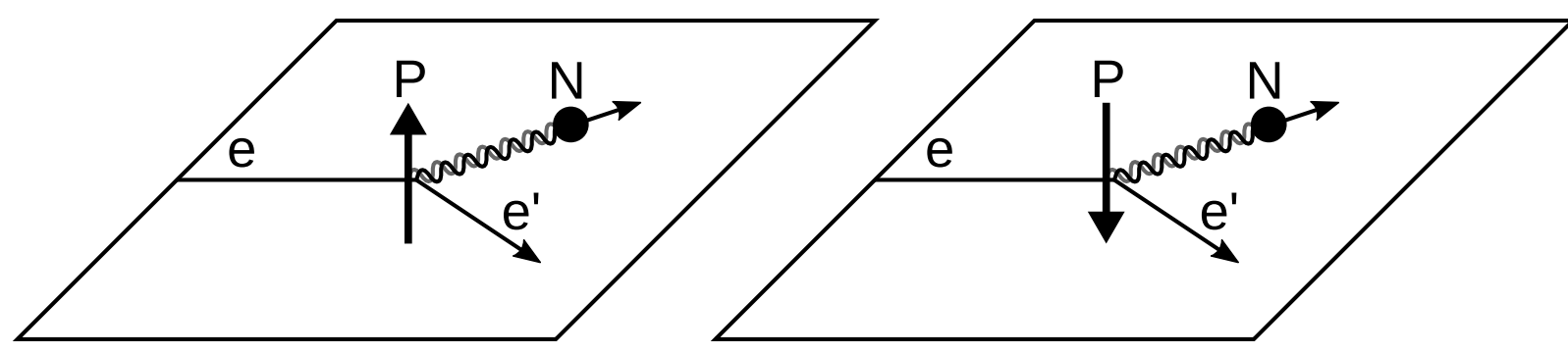
Measurement of the Beam-Normal Single-Spin Asymmetry on ^{208}Pb

Dr. Anselm Esser
for the A1 Collaboration

DFG Deutsche Forschungsgemeinschaft

GUTENBERG UNIVERSITÄT JG|U

Beam-Normal Single-Spin Asymmetry



Theoretical description:

- Interference term amongst one- and multi-photon exchange
- Important input for effective field theories

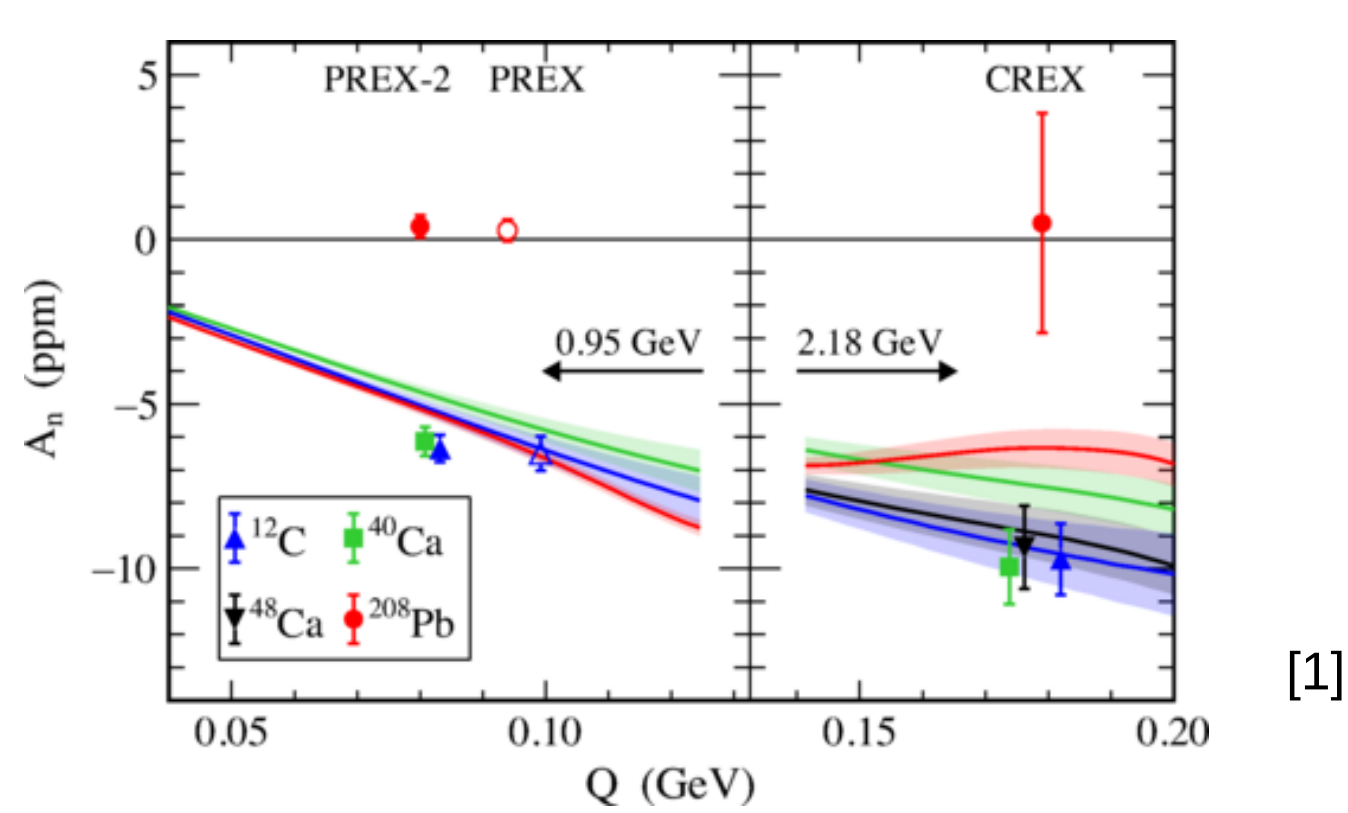
Experimental importance:

- Background in parity violation experiments

Measurement:

- Elastic scattering of polarised electrons on unpolarised targets
- Polarisation vector perpendicular to scattering plane

State of Knowledge

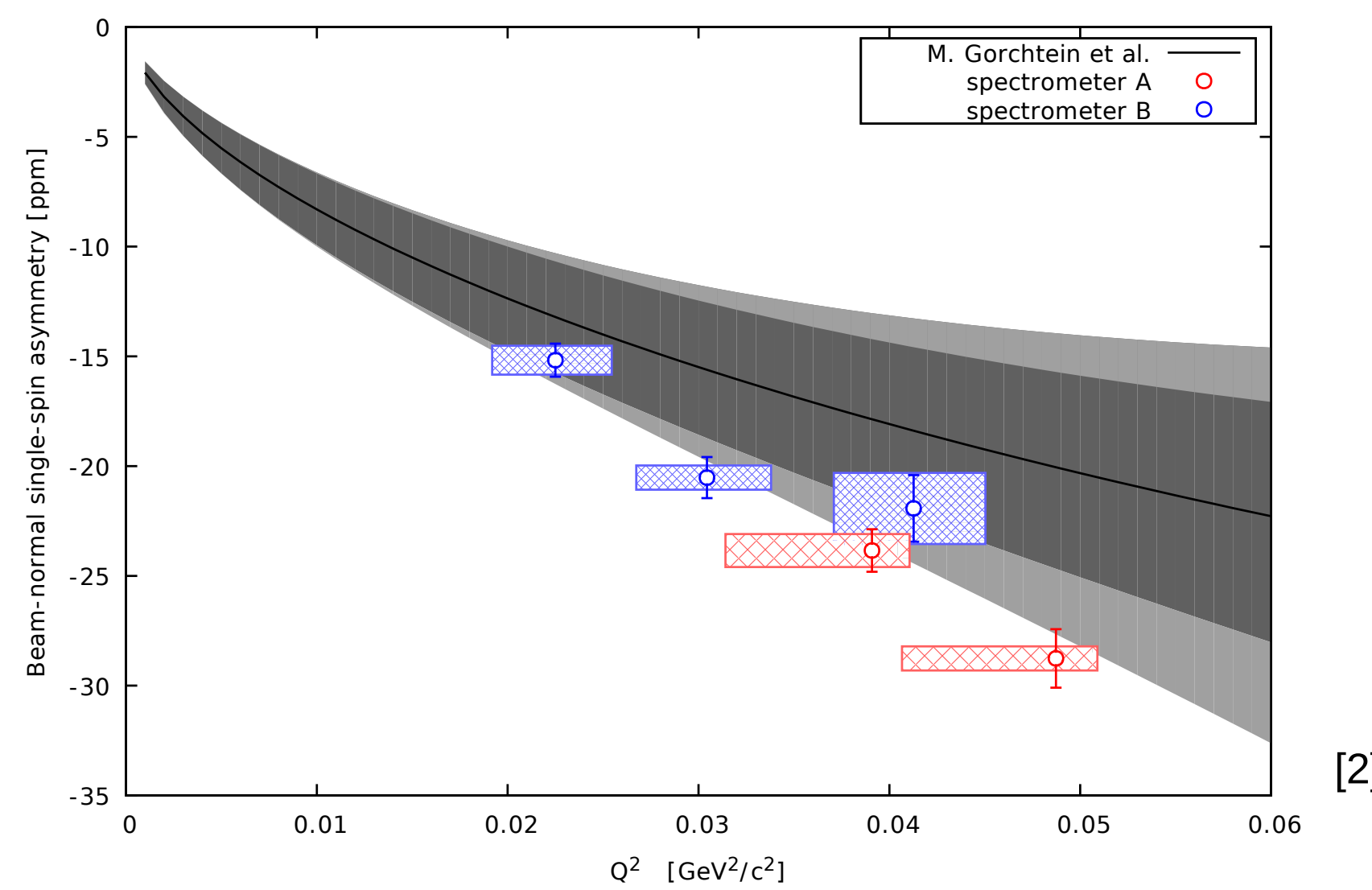


- Acceptable agreement between existing theories and experiments for light nuclei
- Significant discrepancy for ^{208}Pb

Previous Measurements in Mainz

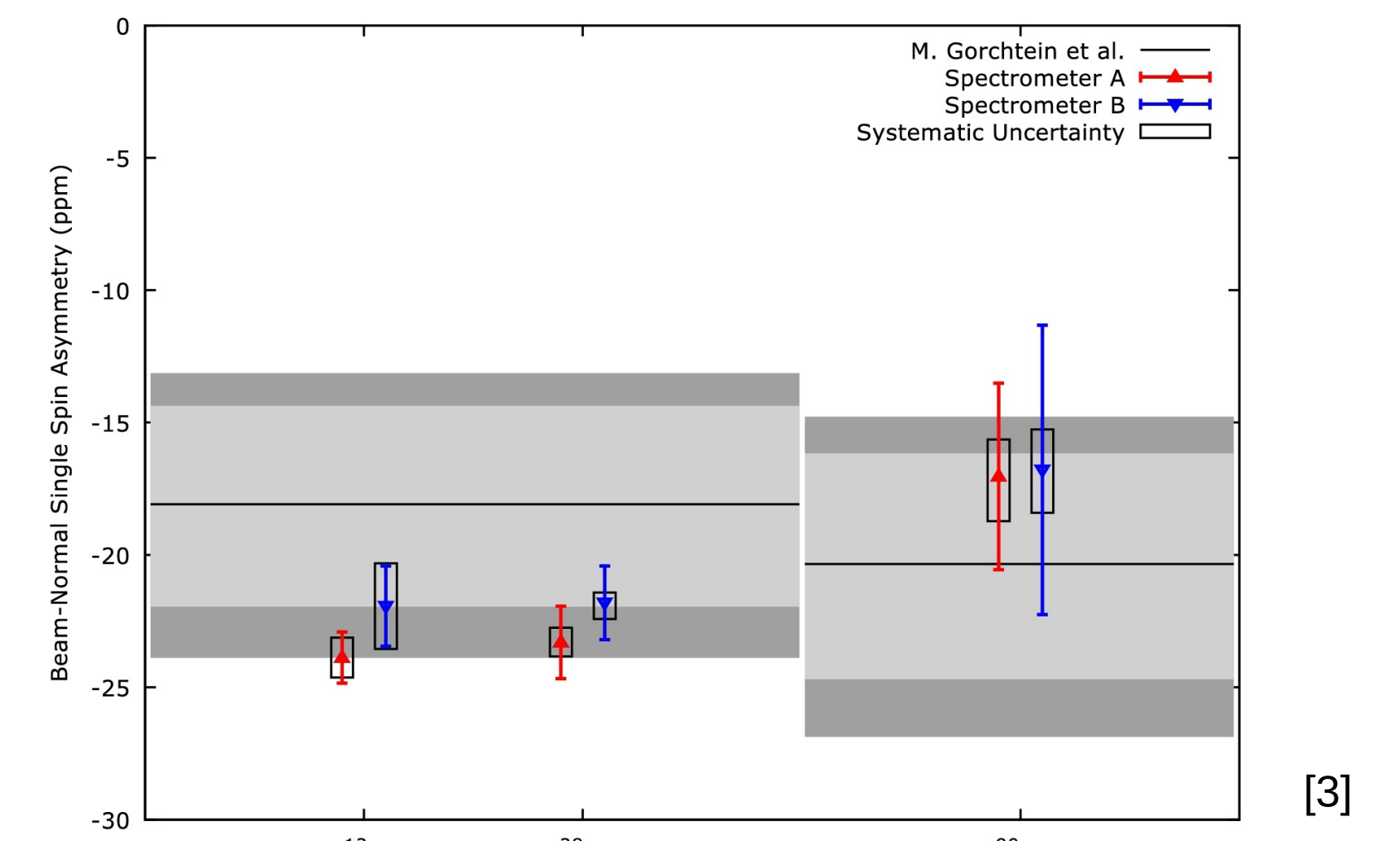
Q^2 -Dependence

- Target: ^{12}C
- Beam energy: 570 MeV
- Beam current: 20 μA



Z-Dependence

- Q^2 : 0.04 GeV^2/c^2
- Beam energy: 570 MeV
- Beam current: 20 μA



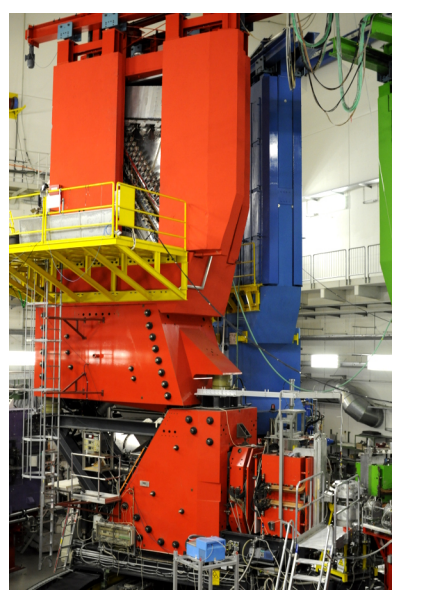
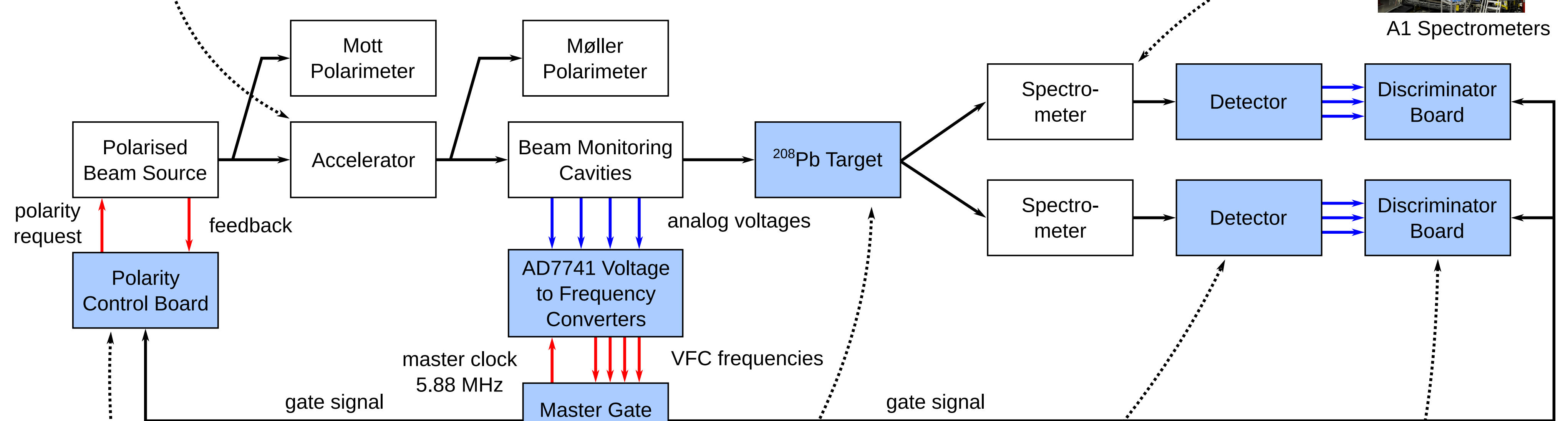
New Experimental Set-up



Mainz Microtron

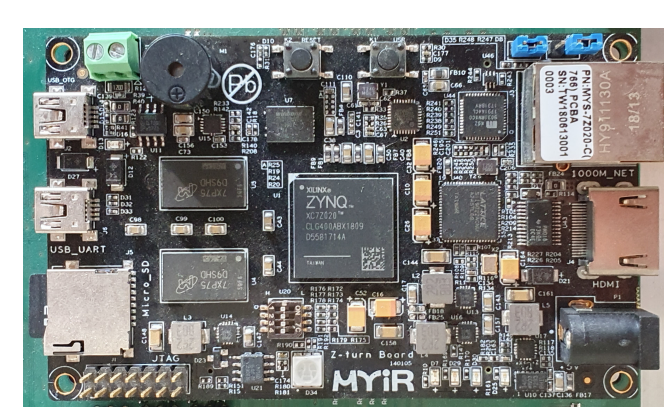
Design principles

- Early digitisation of analog signals \Rightarrow Reduction of analog noise
- Power grid synchronous gate \Rightarrow Suppression of mains hum
- No information about beam polarity in detector readout section



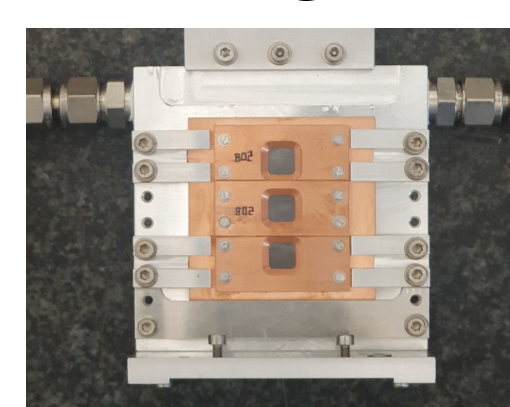
A1 Spectrometers

FPGA/SoC Board



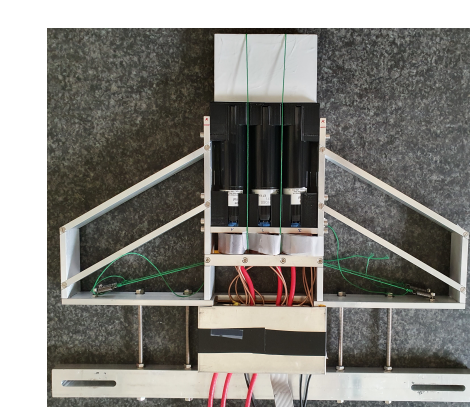
- Central component for readout and control
- XILINX Zynq SoC

Target



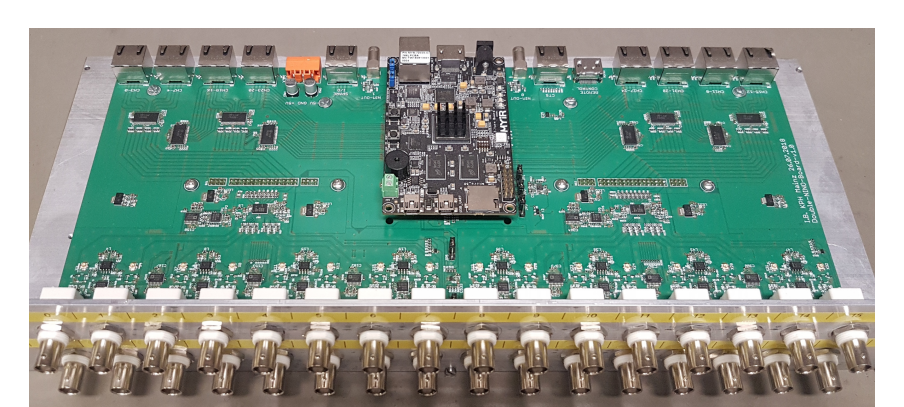
- 20 x 20 x 0.5 mm^3
- ^{208}Pb , 99.36 % purity
- Active cooling at 5°C with water/glycol mix

Detector



- Custom build
- Fused silica radiator
- UV sensitive quartz window PMTs

Readout Board



- In-house build
- NINO Discriminators
- 32 Channels
- FPGA readout

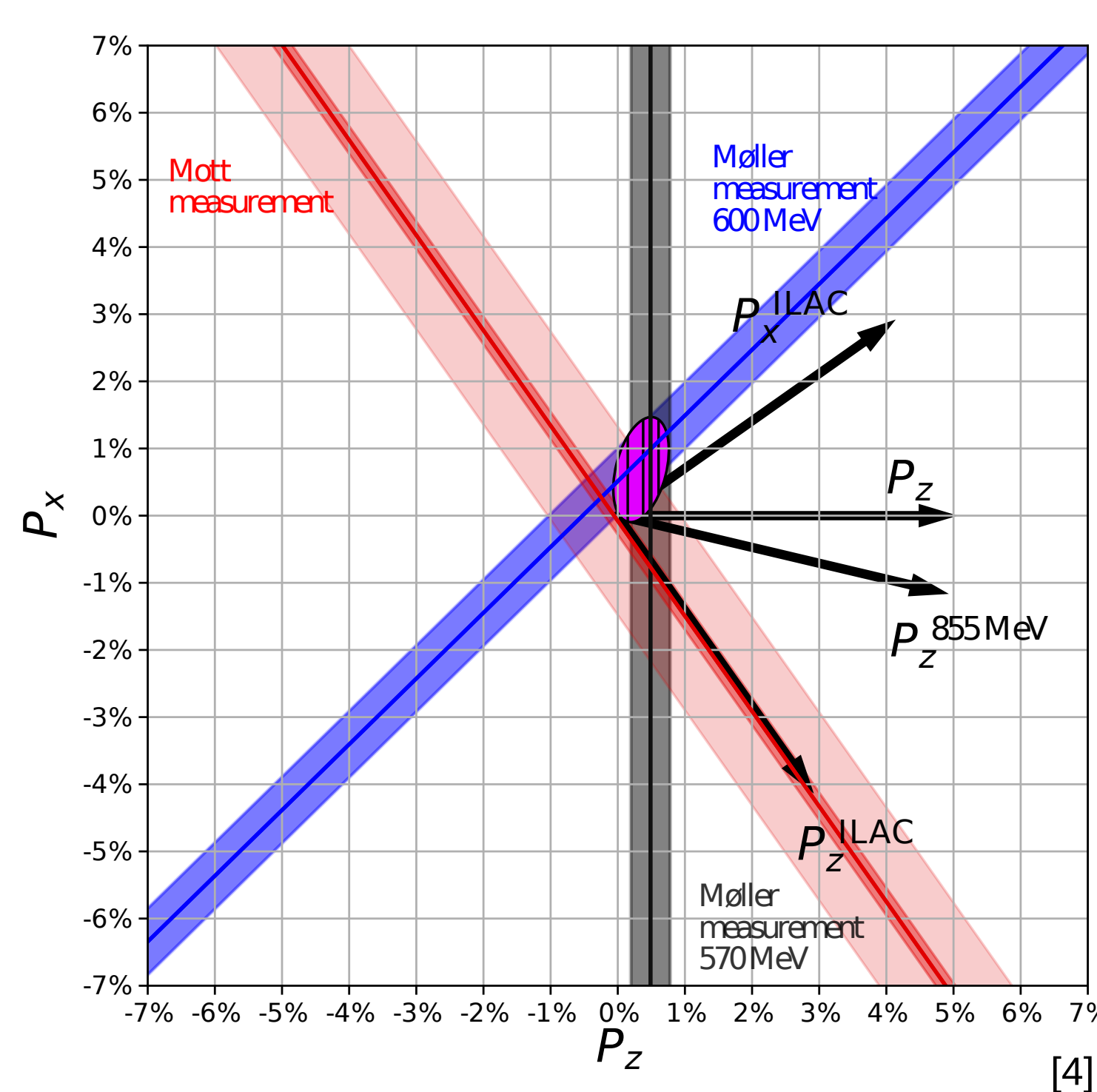
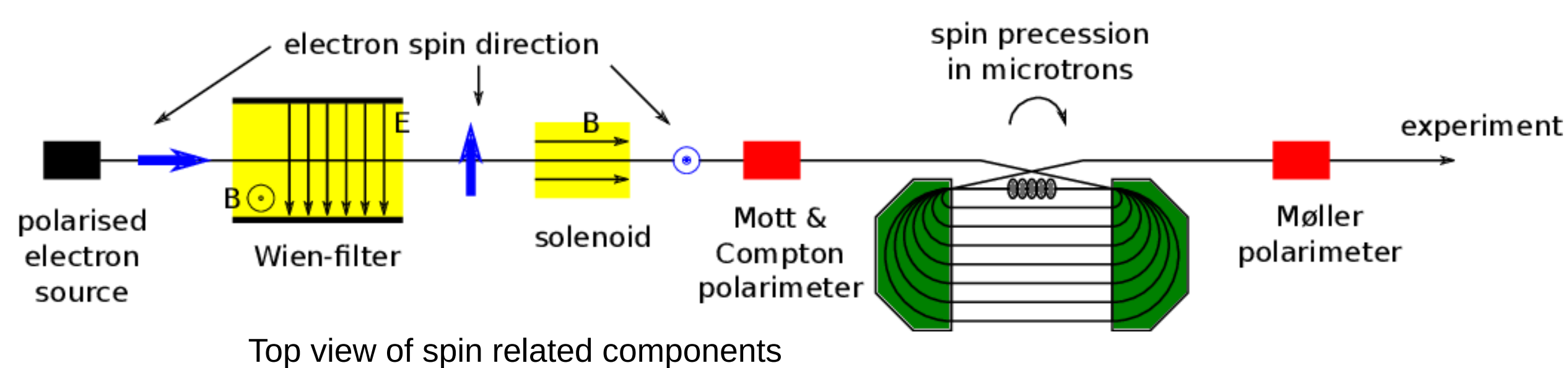
Polarimetry

Problem:

No dedicated polarimeter to measure vertical polarisation

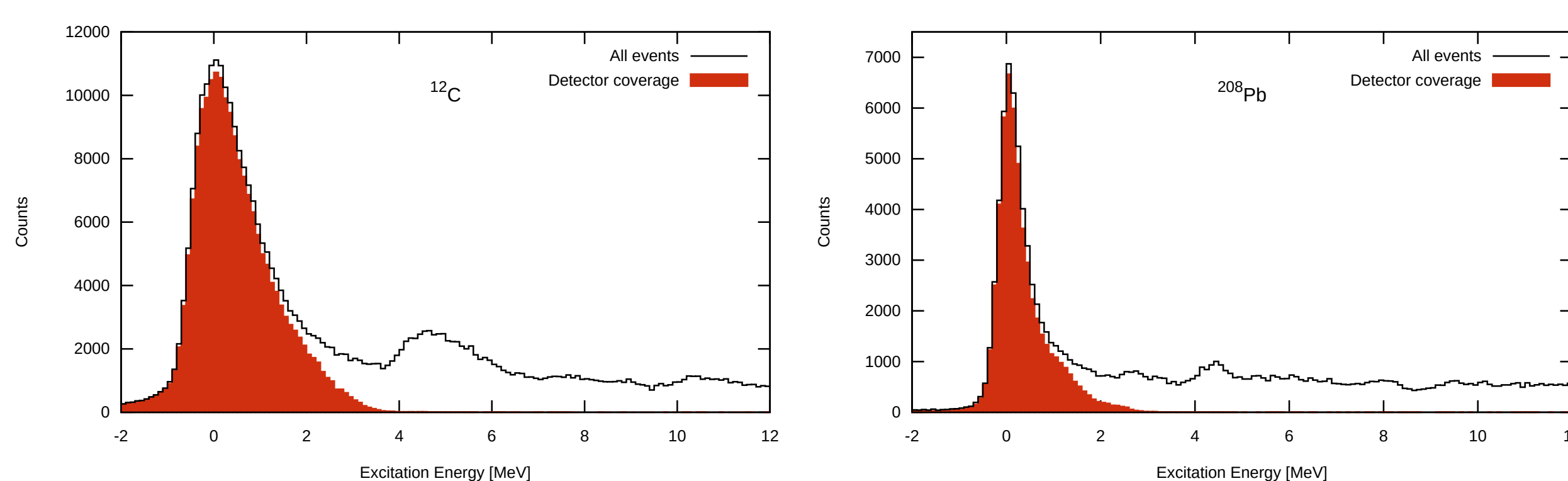
Multi-Stage Approach:

- 1) Maximisation and measurement of longitudinal polarisation
- 2) Spin rotation with solenoid to vertical direction
- 3) Minimisation of remaining horizontal spin components



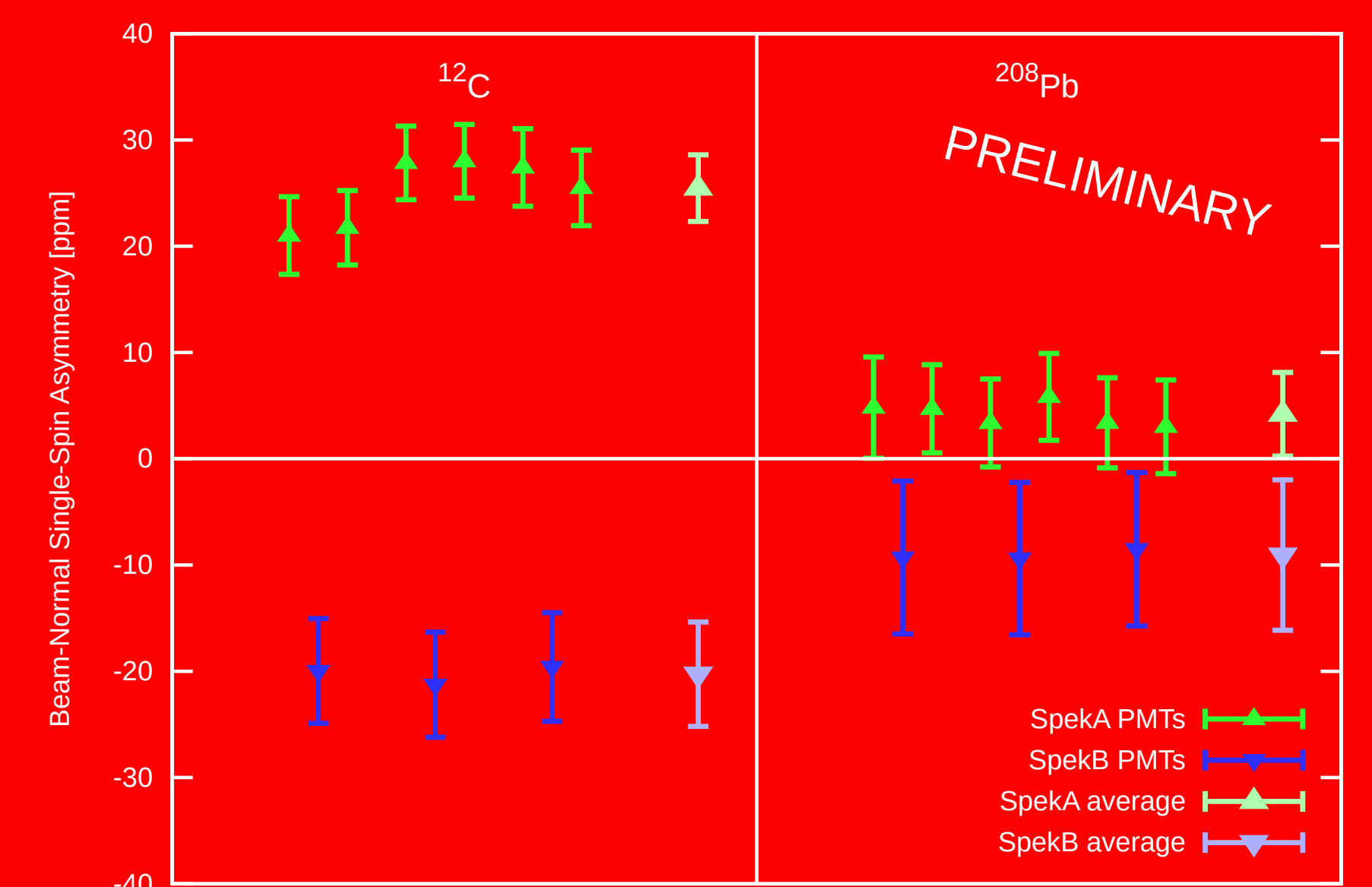
Detector Alignment

- Alignment of detector and elastic line at low beam currents
- Usage of existing tracking detectors
- Simultaneous measurement of Q^2 -distribution
- Tracking detectors switched off at high beam currents



Preliminary Results

$E_{\text{beam}} = 570 \text{ MeV}$
 $I_{\text{beam}} = 20 \mu\text{A}$
 $Q^2 = 0.04 \text{ GeV}^2/c^2$



~ 15 h on ^{12}C Individual PMTs ~ 80 h on ^{208}Pb

Further Strategy

Short Term:

- Increase statistics for ^{208}Pb

Intermediate Term:

- Study energy dependence at lower beam energies (420 MeV, 315 MeV, 210 MeV)
- Extend measurements to intermediate mass range (^{124}Sn , ^{184}W)

Long Term:

- Measurement on ^{208}Pb at MESA at even lower energies (150 MeV, 55 MeV) with significantly increased statistics

References

