

Preparation for the Time Reversal Invariance experiment at COSY (TRIC)

Yury Valdau^{1,2} for the PAX collaboration

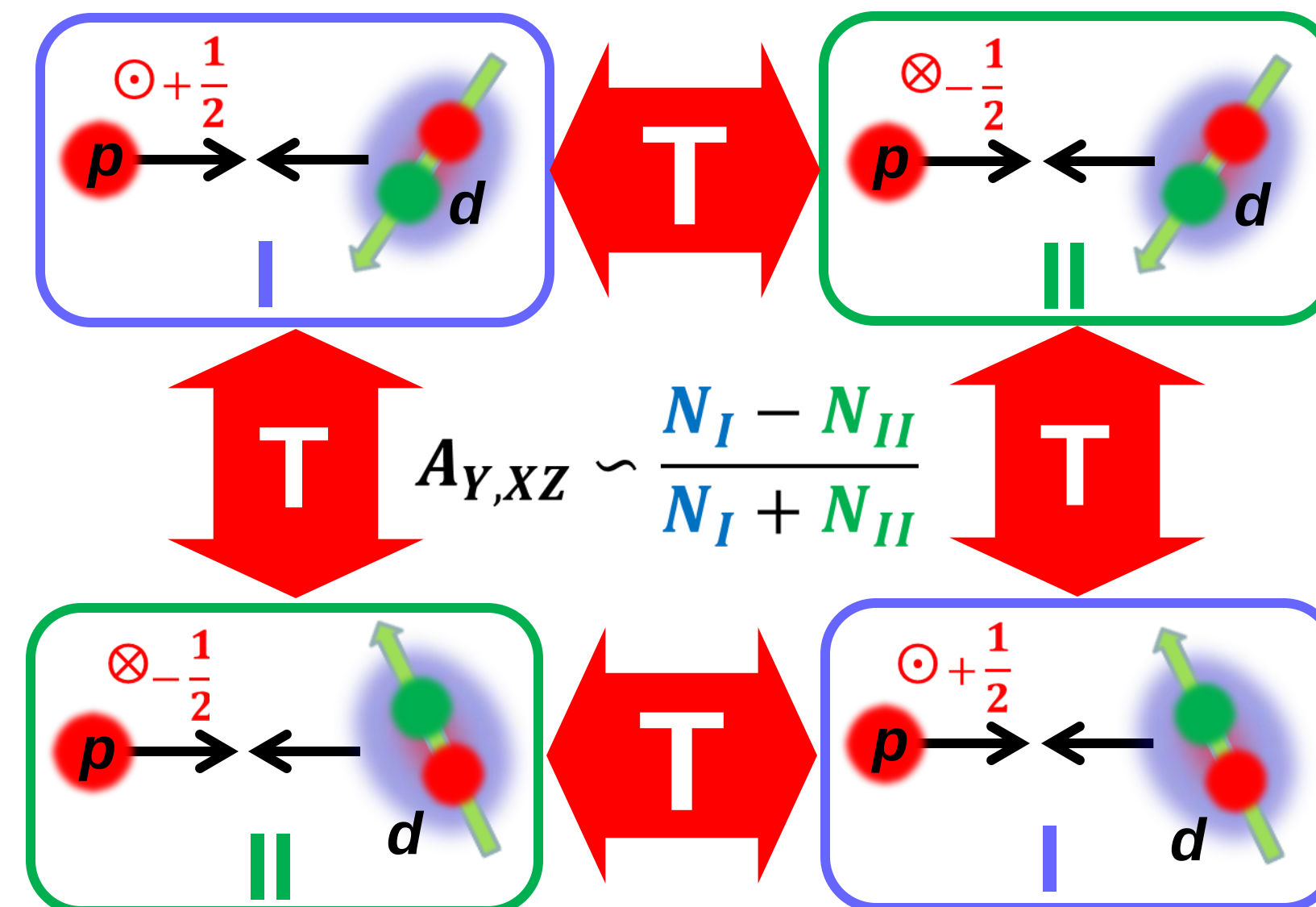
¹Forschungszentrum Jülich, Institut für Kernphysik, IKP2, Jülich, Germany

²Rheinische Friedrich-Wilhelms-Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

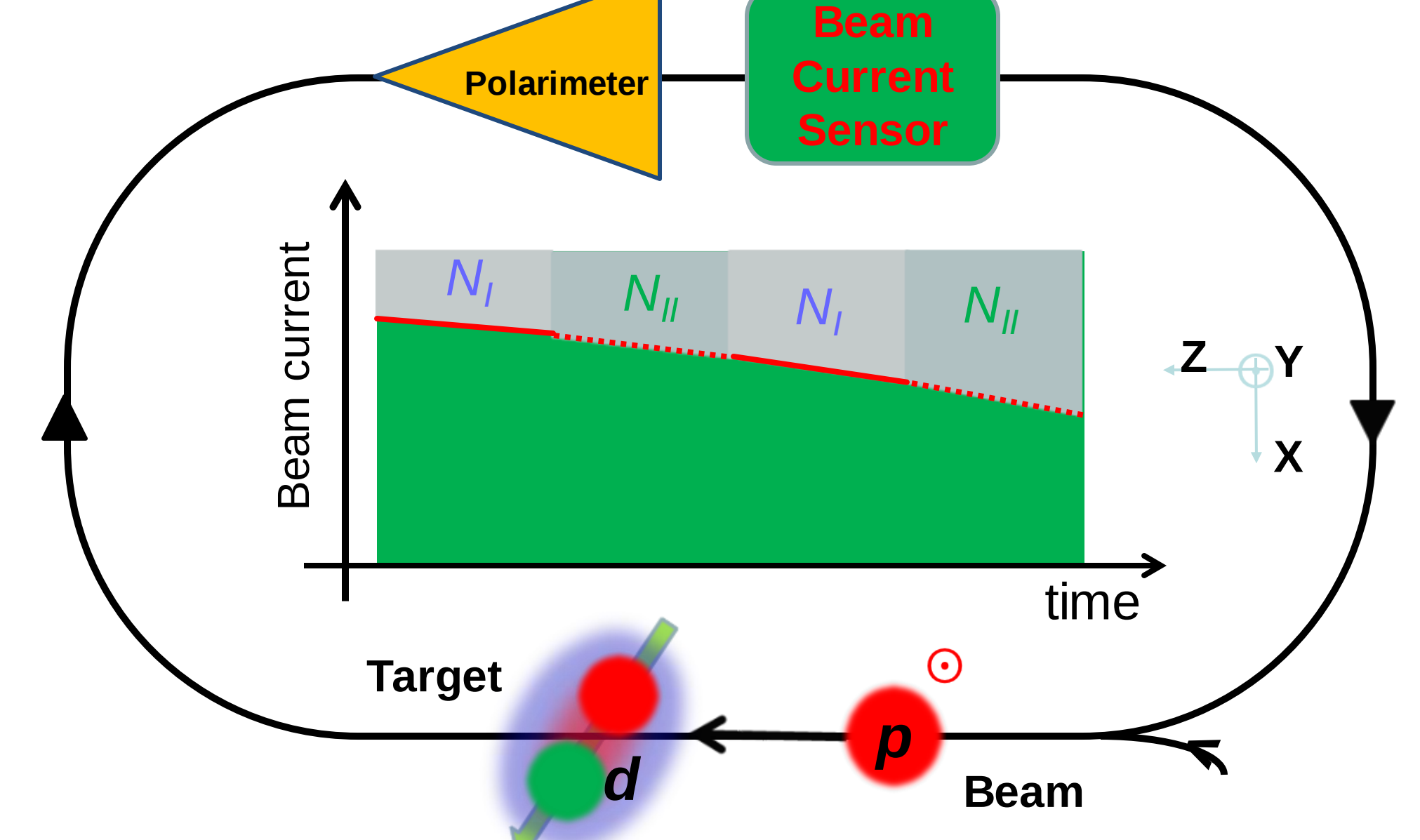
TRIC – direct T symmetry test

- Science Case:** search for physics beyond SM
- Place:** complementary to other CP tests
- Measurement:** null observable in $\vec{p}\vec{d}$ scattering
- Method:** transmission experiment at Storage Ring
- Advantages:**
 - model independent due to the use of simple $\vec{d}$ target
 - free from corrections for ISI and FSI
 - control systematics using spin flip for $\vec{p}$ and $\vec{d}$
- Result:** improved upper limit by at least one order of magnitude

Trick behind TRIC: T reversal via spin-flip!



Comparison of slopes for states I and II



TRIC requirements:

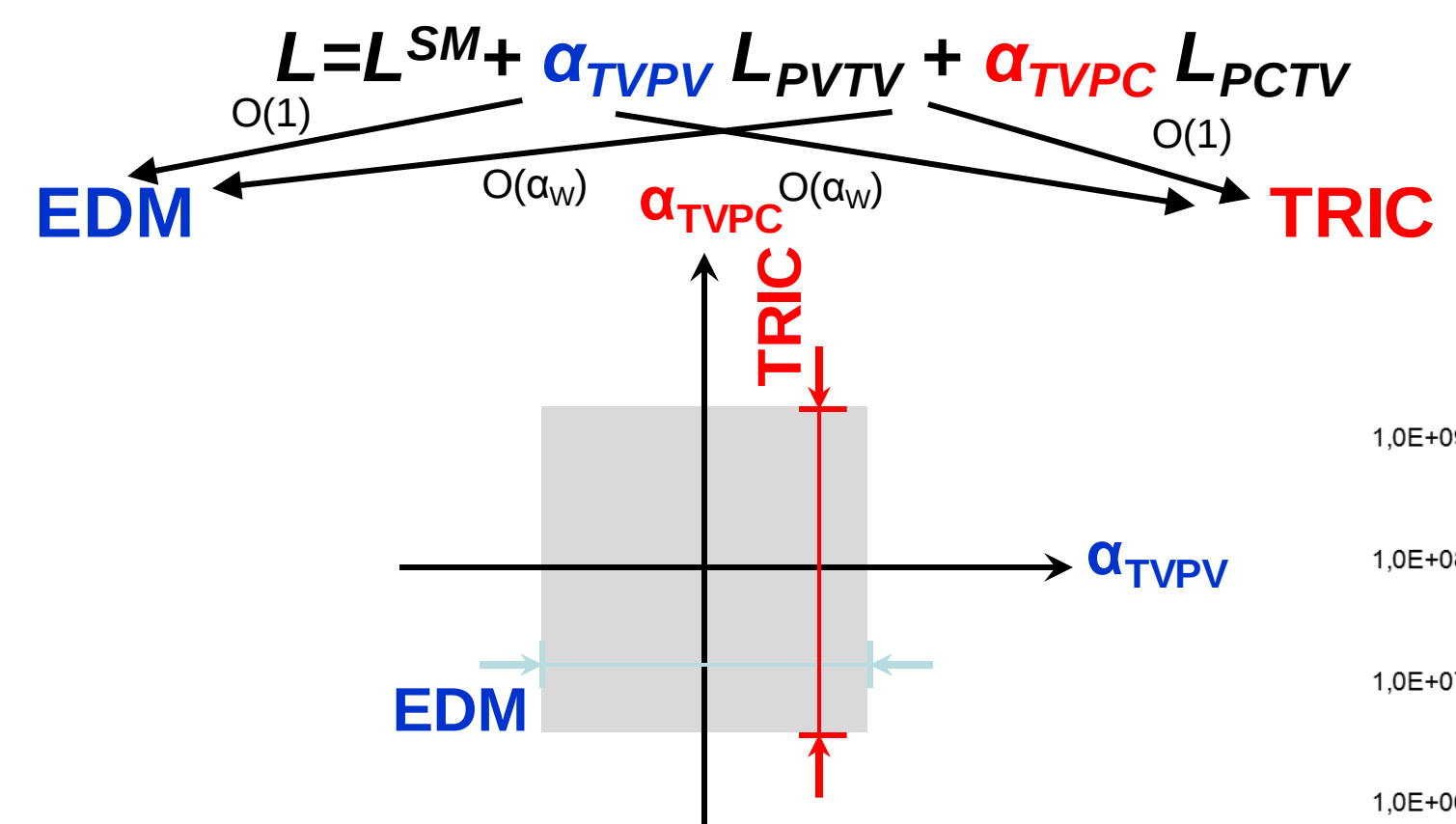
- Polarised proton beam ($N_p > 10^9$, $\tau \sim 10000$ s, $P_Y > 0.6$)
- Tensor polarised deuterium target ($P_{ZZ} > 0.6$, $\alpha_{XZ} = 45^\circ$)
- Beam and target polarimeter ($\sigma_D \sim 10\%$)
- High resolution beam current measurement ($\sigma_{I/I_0} < 10^{-4}$)

Goal:

After 4 weeks of beam time improve upper limit by one order of magnitude

Parametrizing BSM physics

Considering only flavour-conserving CP/T tests (u,d,s quarks)



EDM and TRIC experiments are complementary

Possible Systematic Uncertainties

TRIC Result: $A_{Y,XZ} \pm \sigma^{stat} \pm \delta^{syst}$

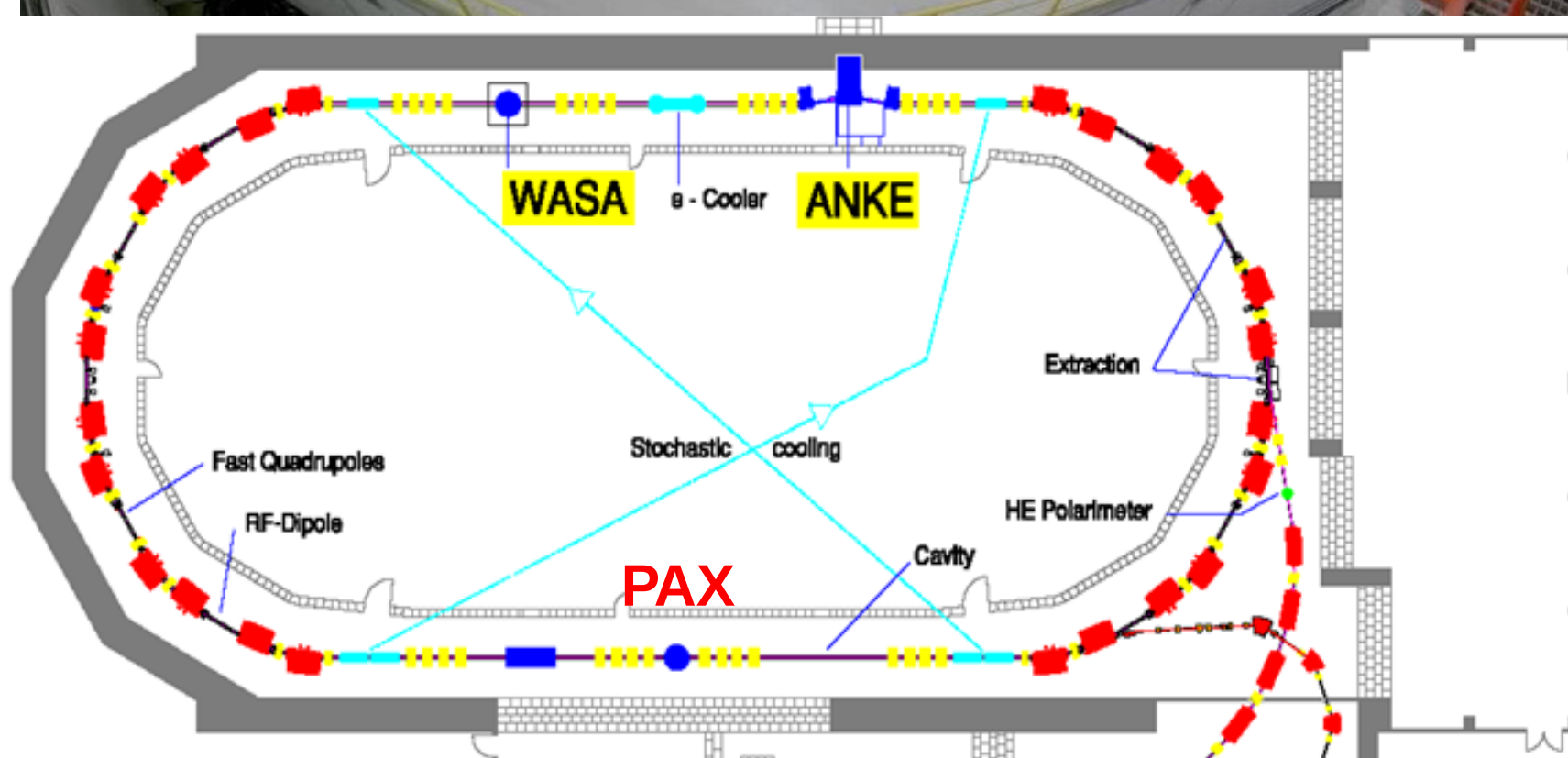
$$\delta^{syst} = A_{Y,XZ} \times (\Delta_{time} + \Delta_{target} + \Delta_{COSY}) + A_{Y,Y} \times (S_{ABS} \times S_{angle} \times S_{homo})$$

be tested

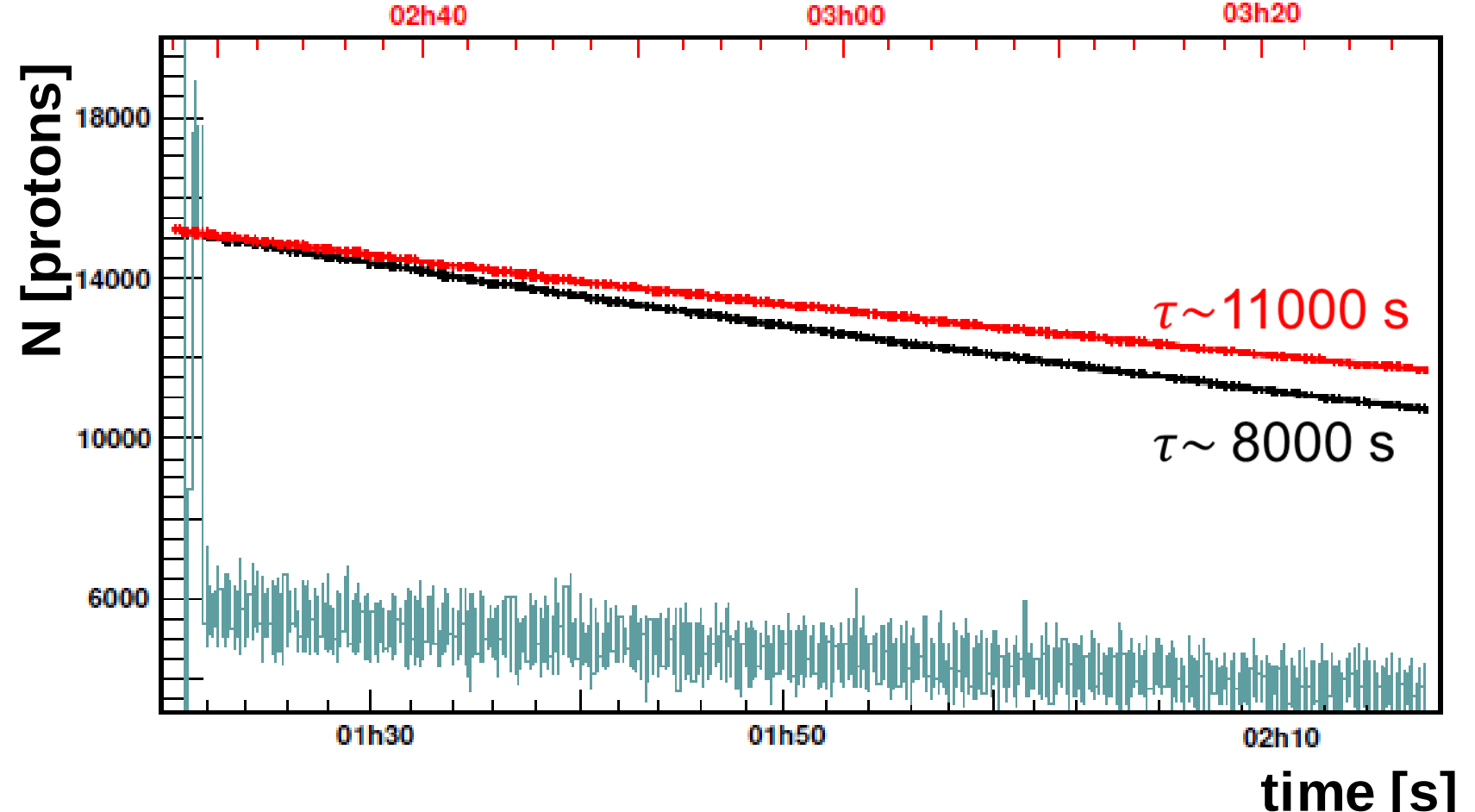
able to keep $\delta^{syst} < 10^{-7}$

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Polarised Proton Beam



Lifetime measurement at 135 MeV

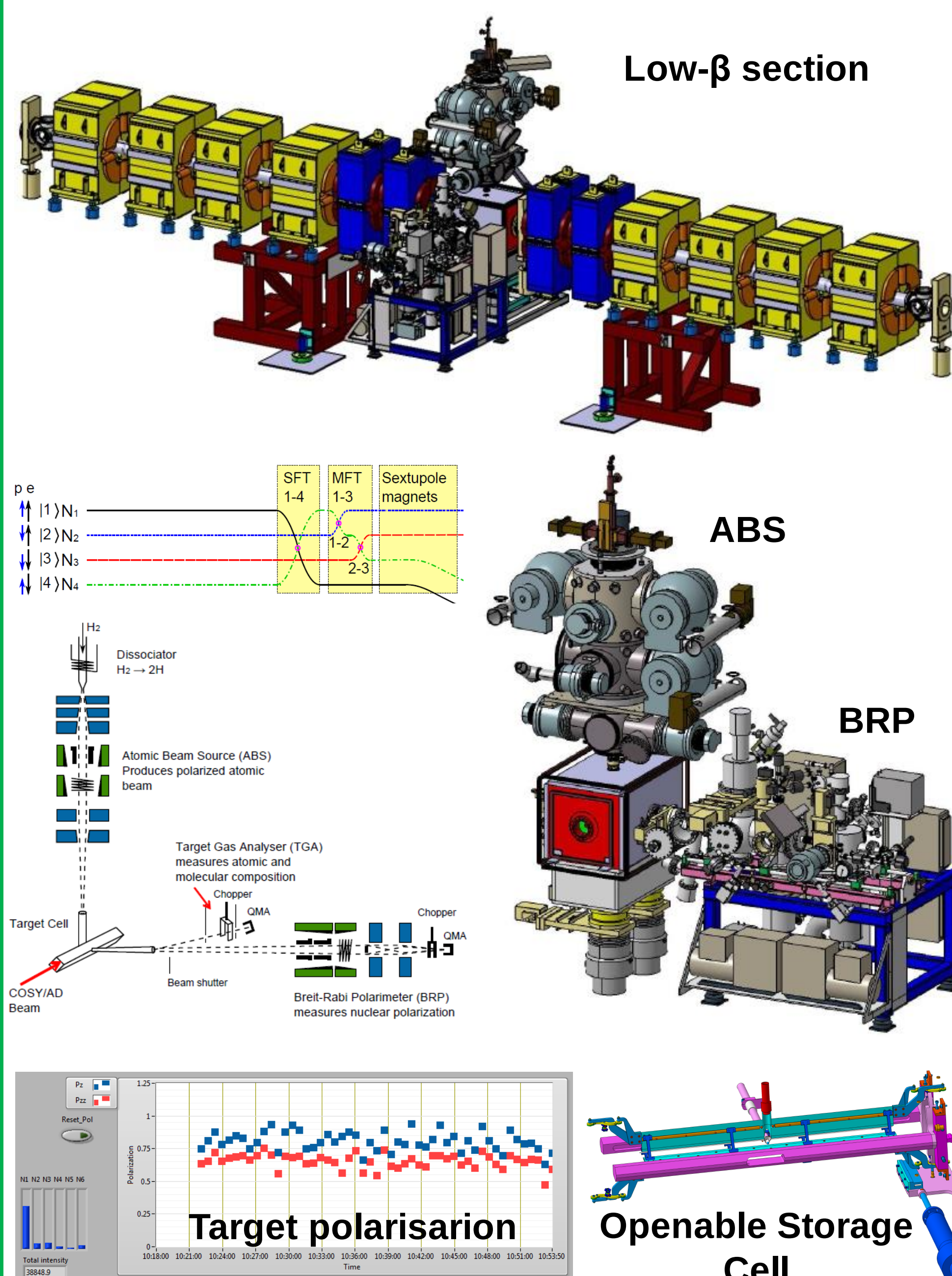


Beam Parameters:

Energy	135 MeV
Intensity after stacking	1.7×10^9 (120 s)
Proton polarisation	64%
Polarisation life time	>10000s
Beam life time	10000s

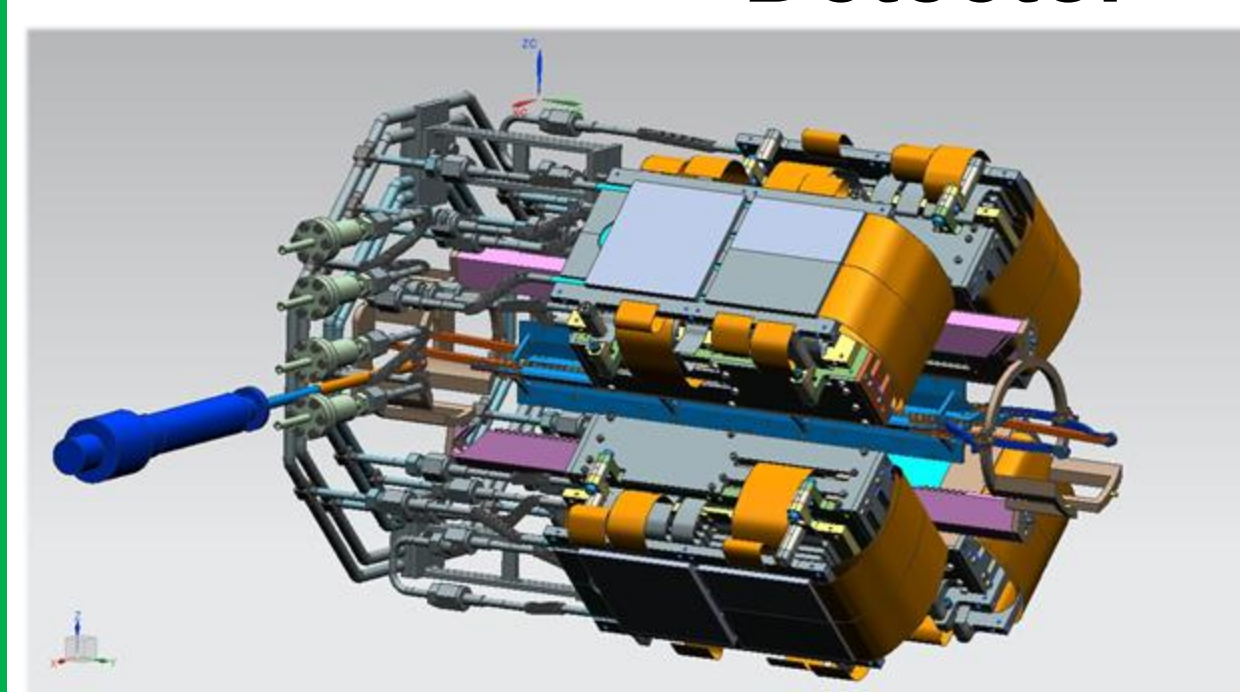
Beam is ready for TRIC

Polarised D Target & Polarimeter



Target is ready for TRIC

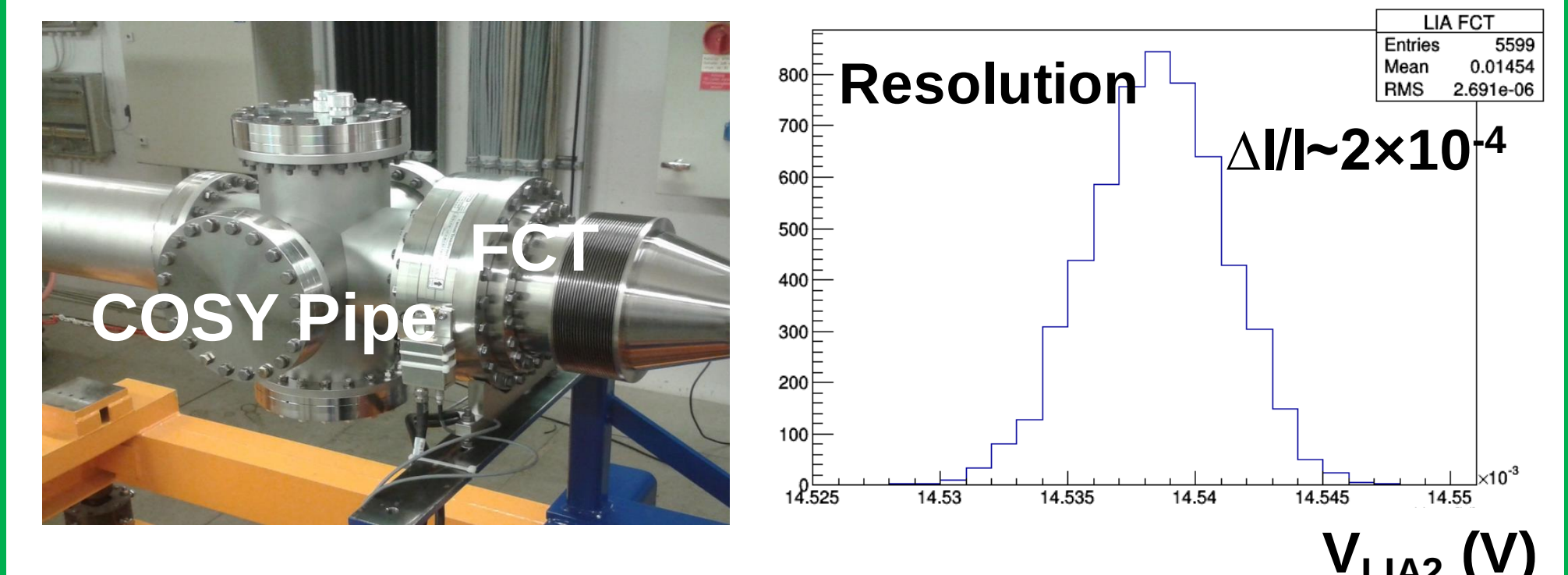
Detector



Commissioning by PAX collaboration in 2017

- ϕ -symmetric detection system
- Modular construction
- 24 double-sided silicon strip detectors (2x300 μ m and 1 mm)
- Strip pitch of 0.7 mm

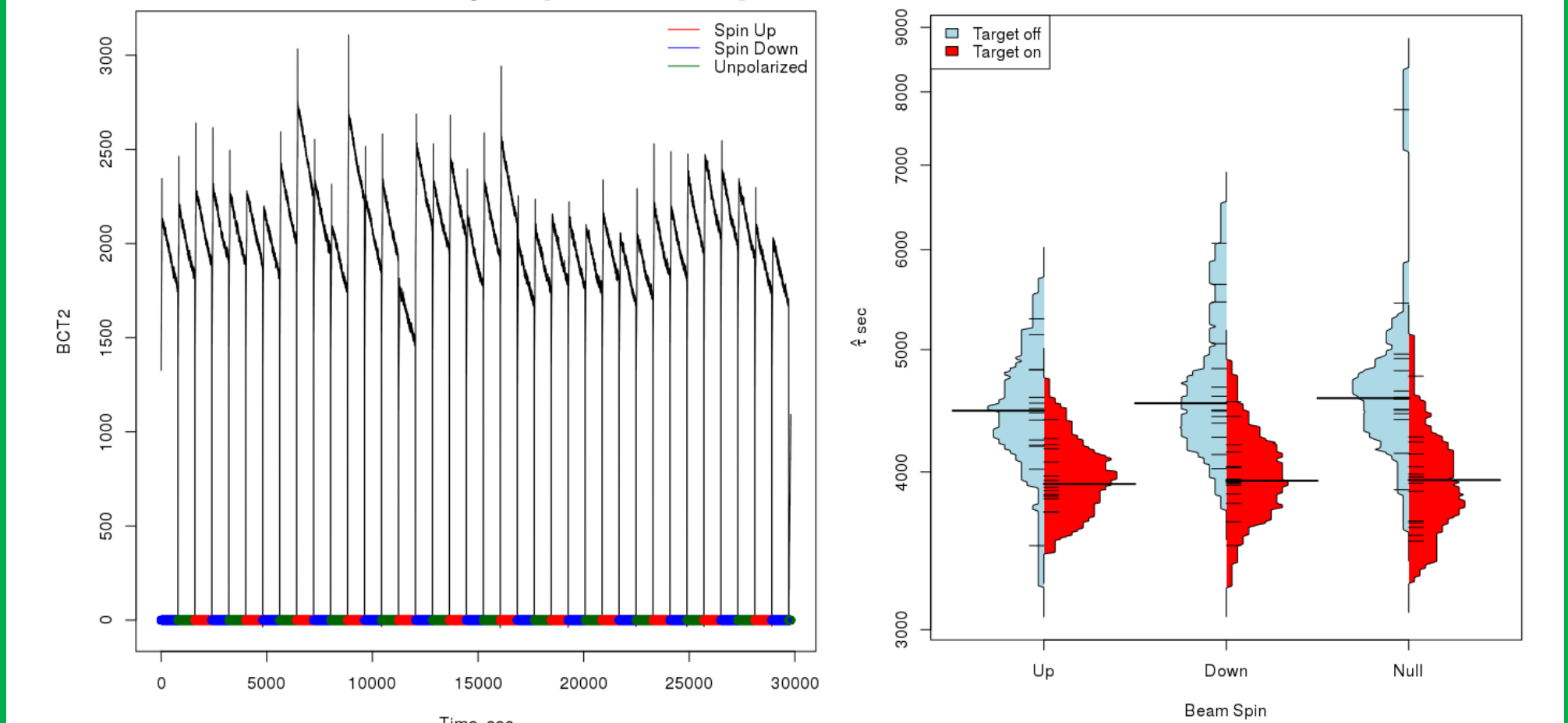
Beam Current Measurement



Yu. Valdau et al., IBIC2016 Conference Proceedings, TUPG41

$A_{Y,Y}$ Measurements @ COSY

Data from one night (1/08/2016)



- Preliminary result: $A_{Y,Y} \approx 0.04 \pm 0.03$
- Theoretical prediction $A_{Y,Y} = 0.05$

Yu. Uzikov PRC 92 (2015) 014002

Conclusions:

- TRIC is a genuine T-symmetry test in $\vec{p}\vec{d}$ scattering
- COSY can provide a polarised beam for TRIC
- Tensor polarised D target and polarimeter are available for TRIC
- Beam current measurement system with resolution sufficient for TRIC has been constructed
- First measurements of $A_{Y,Y}$ are in agreement with expected value

Contact: y.valdau@fz-juelich.de