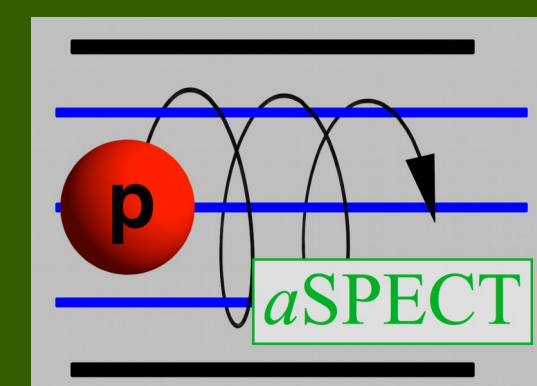# The *aSPECT* experiment – current status of the analysis

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G. Konrad[c,d], J. Kahlenberg[a], R. Horn[a], W. Heil[a], F. Glück[e], E. Bickmann[a], M. Beck[a], S. Baeßler[f]
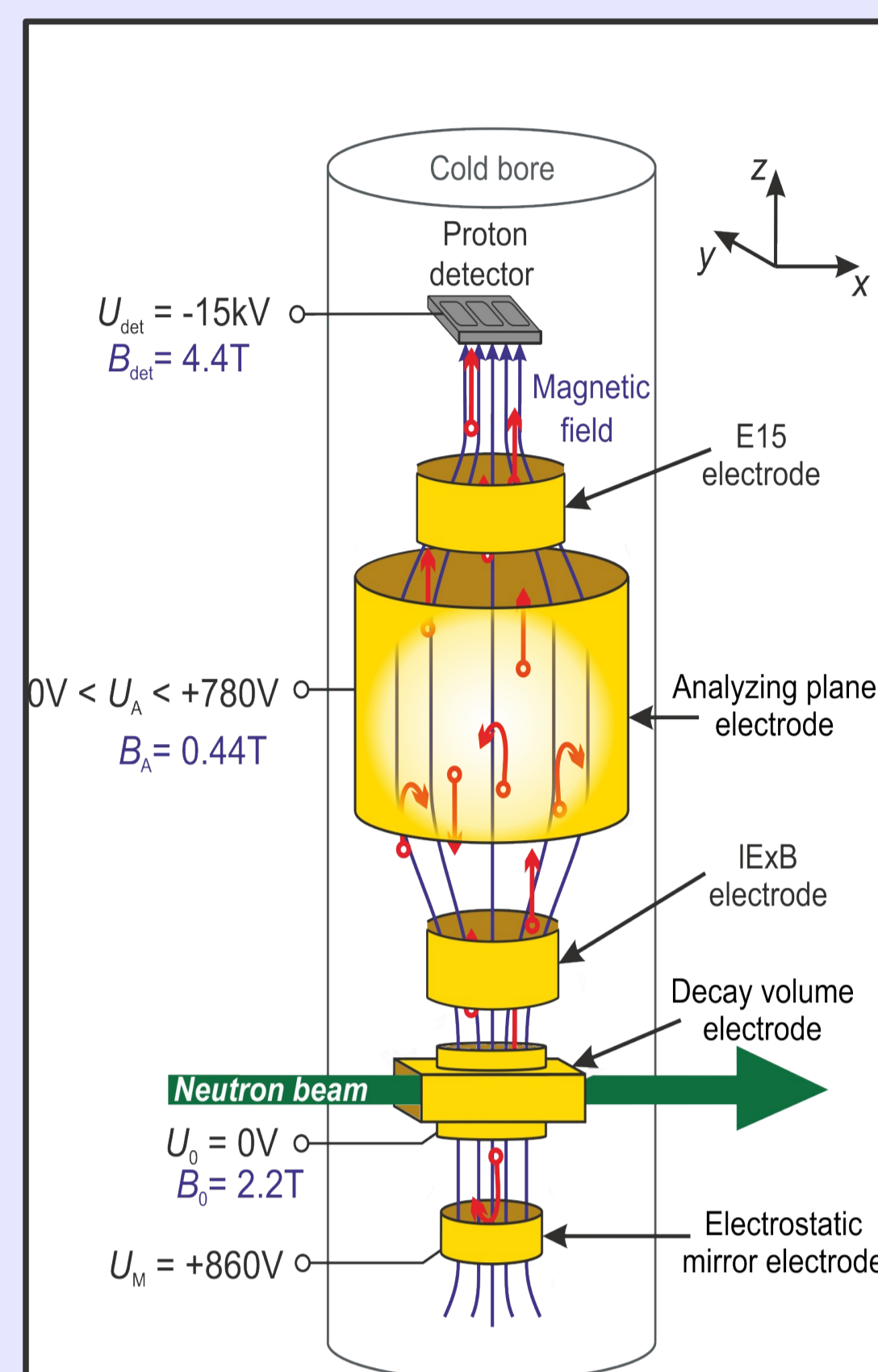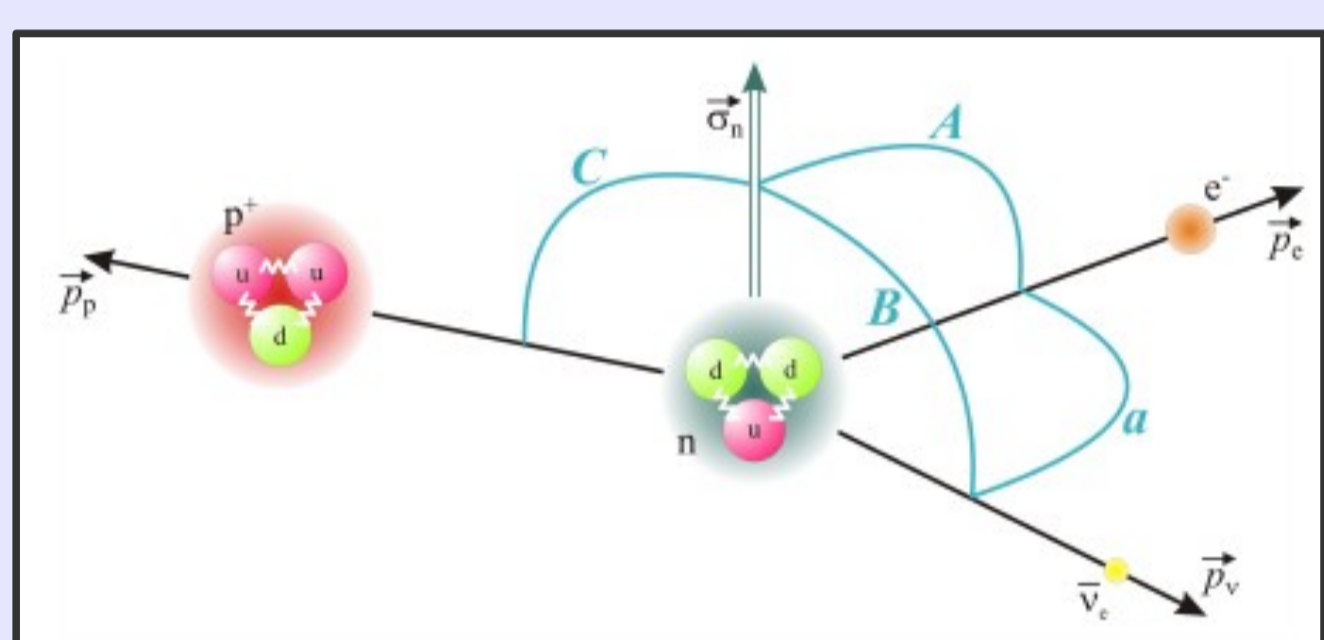
The *aSPECT* experiment:

Goal: Determine the β-v angular correlation coefficient *a* in free neutron decay with unprecedented precision

How to reach it: Measure proton spectrum with high precision using a MAC-E type spectrometer

Where we are:
- ✔ Successful beam time in 2013
- ✔ Check integrity and consistency of data
- ✔ Investigate systematic effects
- ✔ Determine *a* and its uncertainty

U_{det} = -15kV
B_{det} = 4.4T

E15 electrode

0V < U_A < +780V
B_A = 0.44T

Analyzing plane electrode

IExB electrode

Decay volume electrode

Neutron beam

U_0 = 0V
B_0 = 2.2T

U_M = +860V

Electrostatic mirror electrode

Top: Sketch of the measuring principle of *aSPECT*
Left: Sketch of various correlation coefficients in free neutron decay

Systematic effects:

- ✔ Uncertainty of Transmission Function:
  - ✔ Uncertainty of retardation voltage
    - ✔ Fluctuations and offset due to surface potential differences and field leakage into decay volume
    - ✔ Error of multimeter
    - ✔ RF noise
  - ✔ Uncertainty of magnetic field ratio
- ✔ Retardation voltage dependent background
- ✔ Detector efficiency and DAQ
  - ✔ Dead time
  - ✔ Pile Up
  - ✔ Backscattering of protons
- ✔ Edge effect
- ✔ Fields in the decay volume
- ✔ Small angle scattering
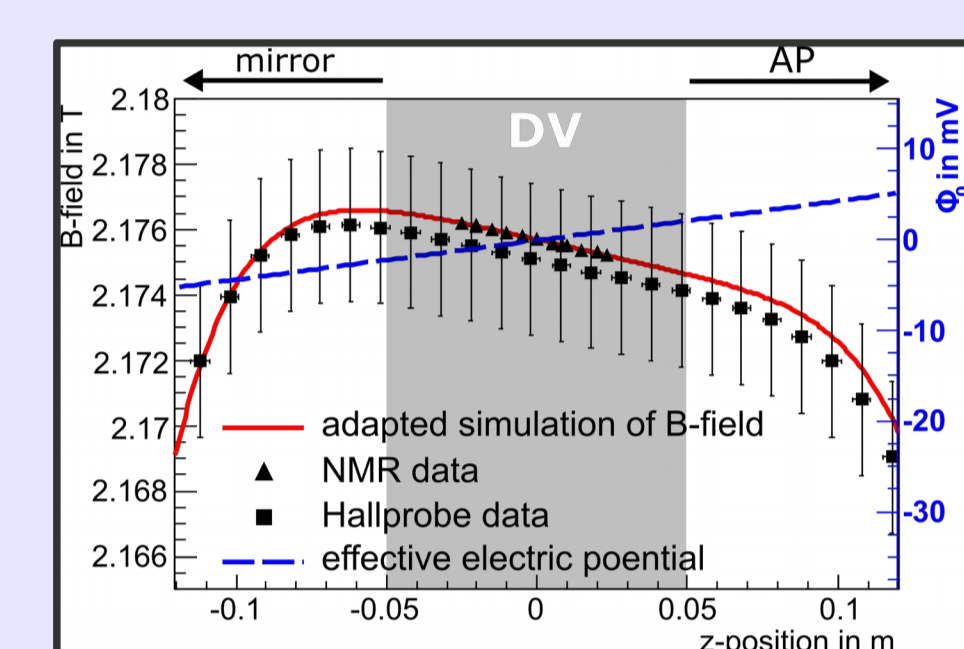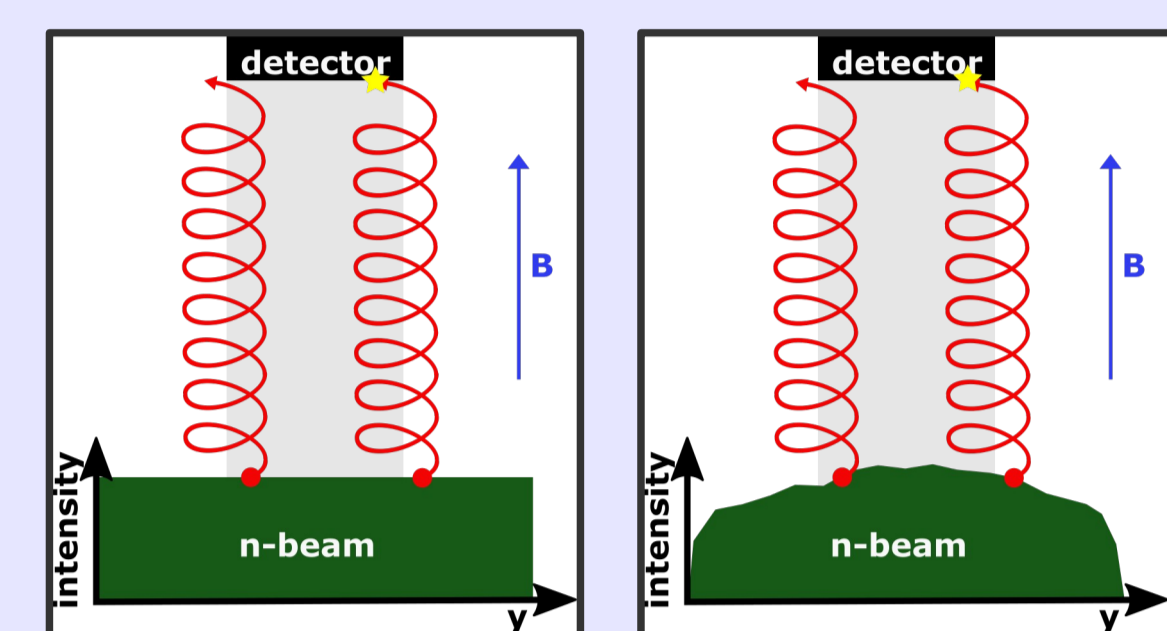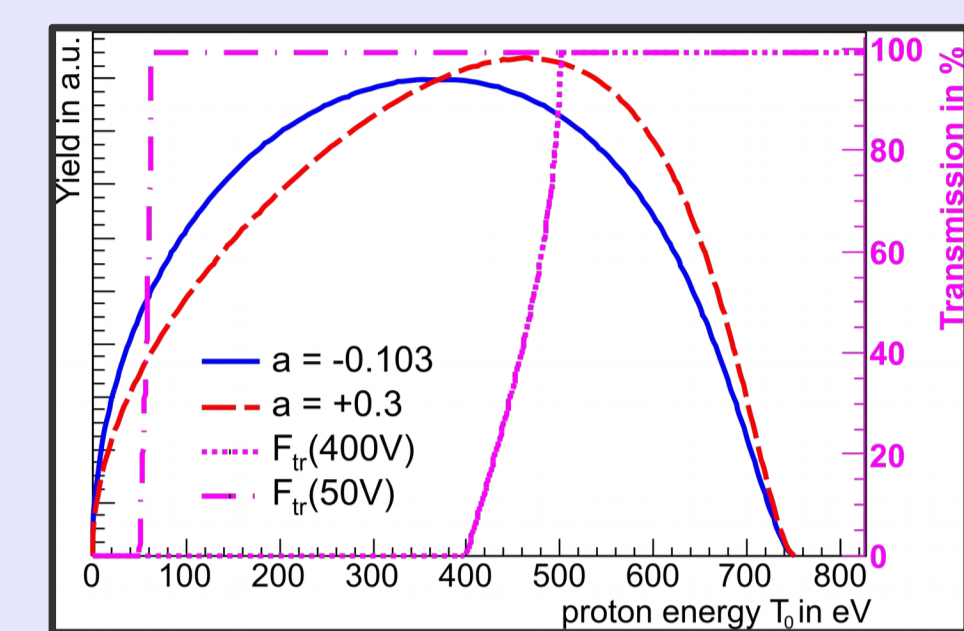
Top: Transmission Function
Middle: Edge effect
Bottom: Fields in decay volume

From raw-pulse to proton spectrum

1. Determine first pulse using a spline
2. Generate pulse-height spectrum
3. Pulse-height spectrum for each retardation voltage
4. Integration over proton region
5. Each retardation voltage is a point in the integral proton spectrum
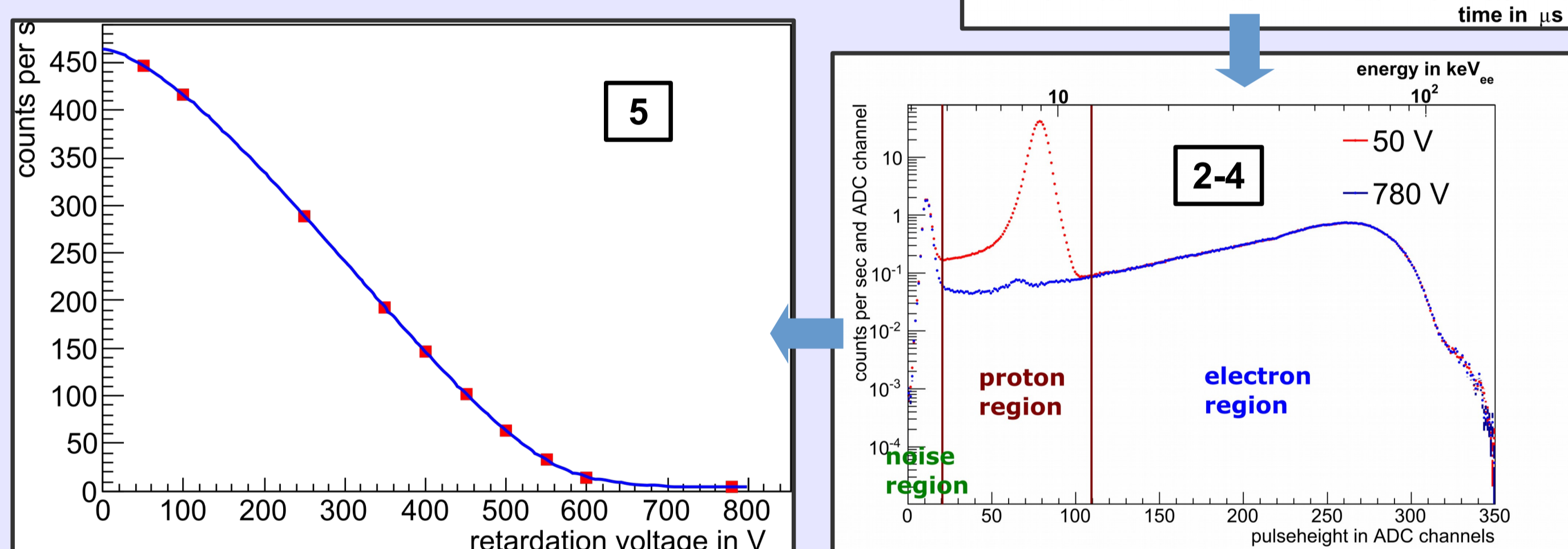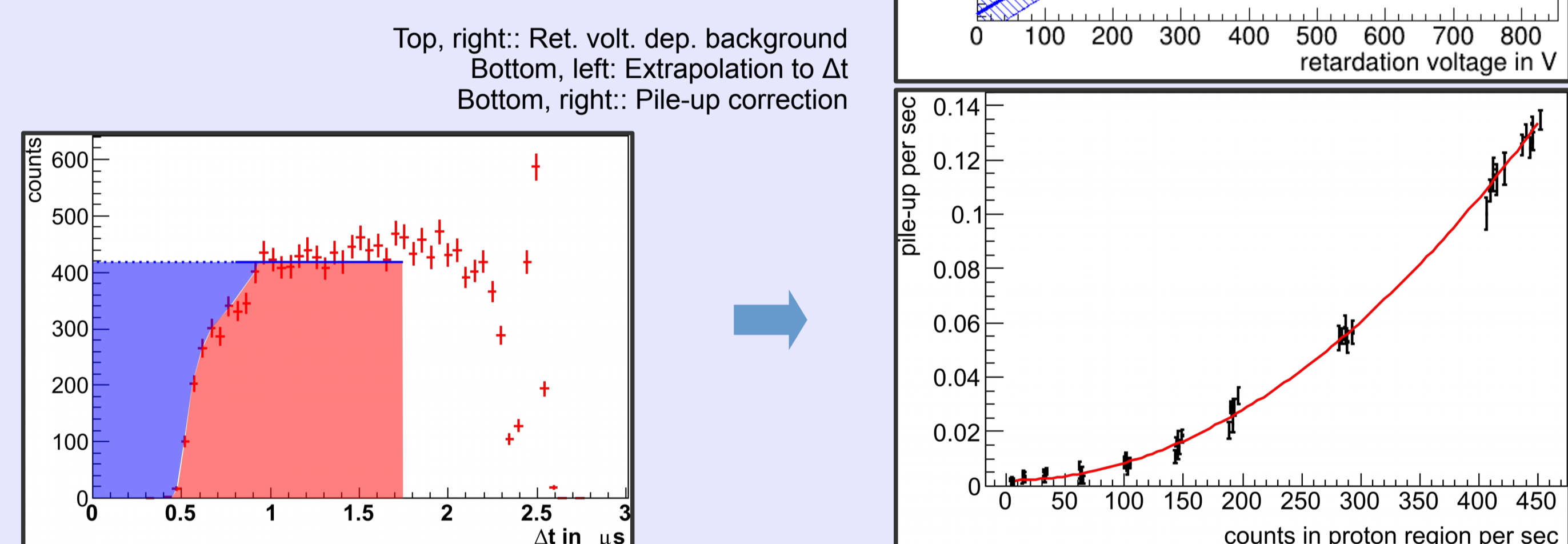
Investigation of systematics

Determine the retardation voltage or count rate dependence of each systematic separately for each

- channel
- configuration

Implement each systematic as additional fit dimension to the global fit.

Top, right:: Ret. volt. dep. background
Bottom, left: Extrapolation to Δt
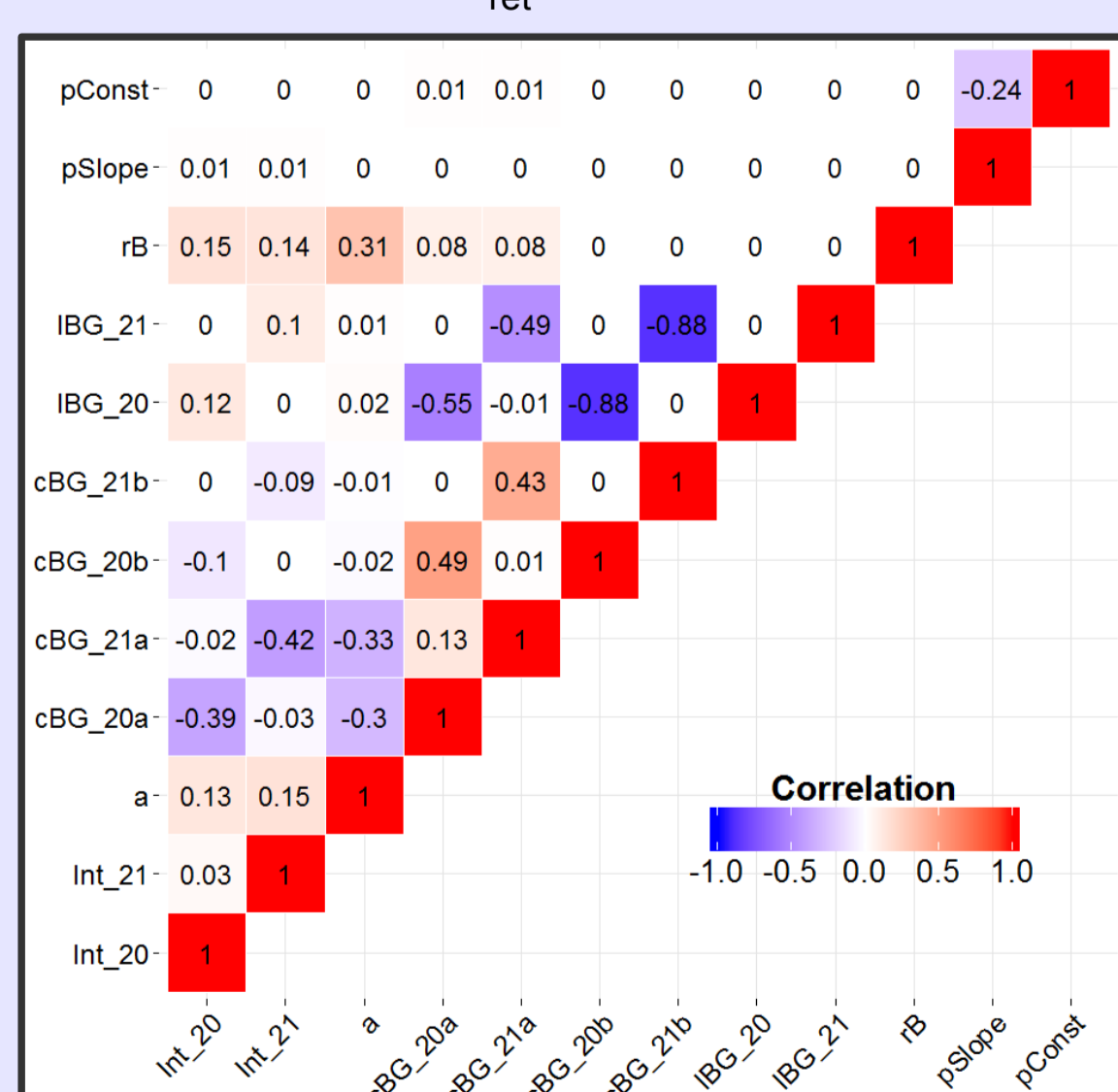Bottom, right:: Pile-up correction

Include all to ONE multi-dimensional fit

Extra dimensions for each
- channel of each configuration
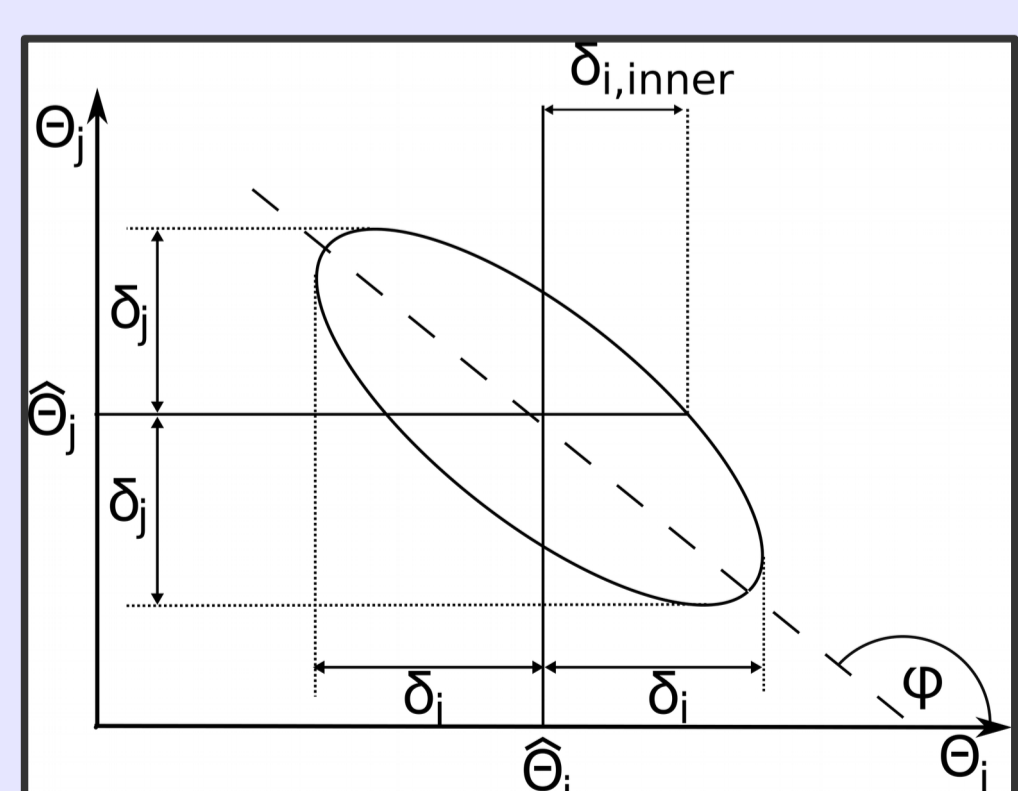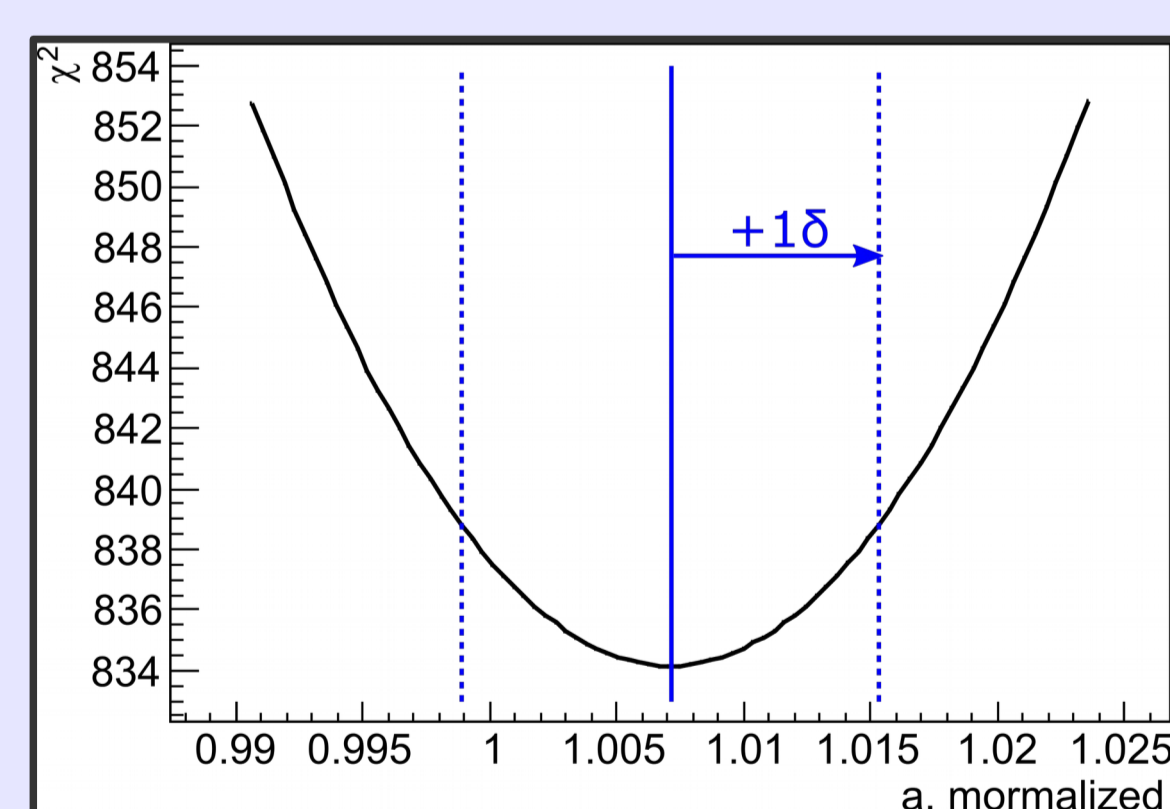- systematic

r_B included as fit parameter
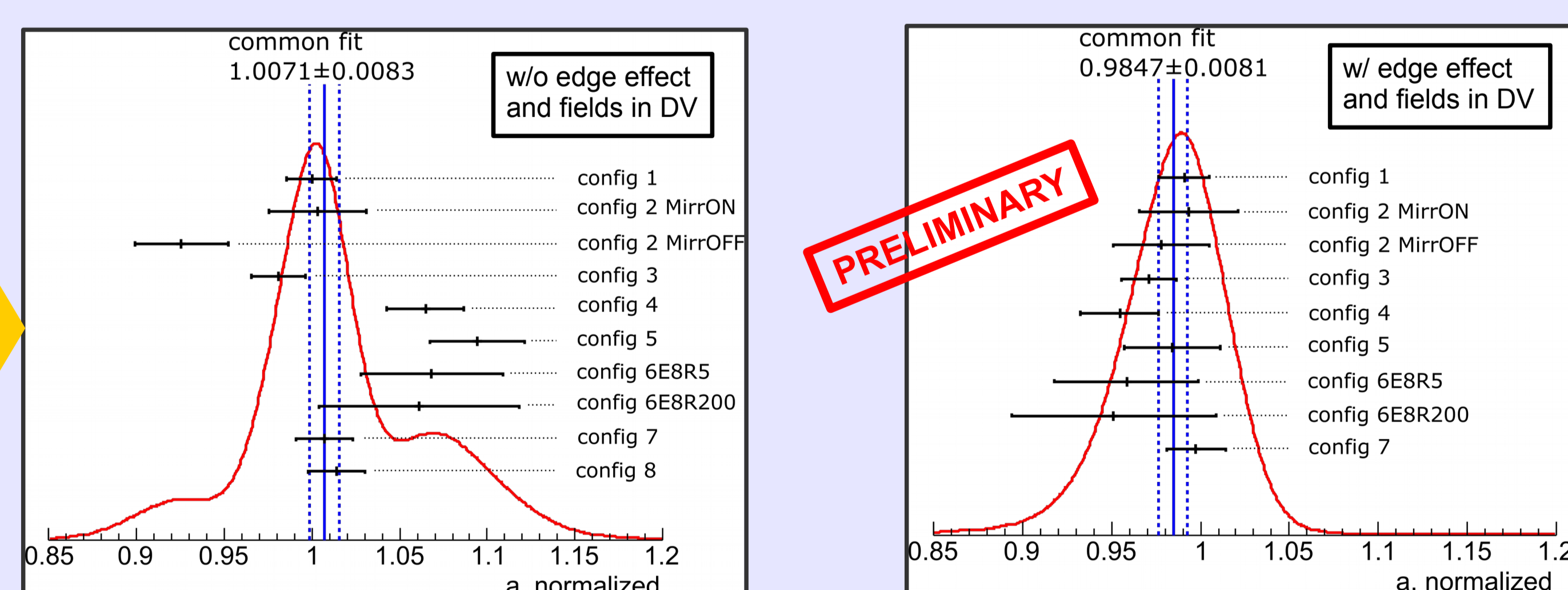Uncertainty of U_{ret} included as x-errors

Top, right:: Cut through χ^2 surface

Bottom, right:: Exemplary χ^2 ellipse

Left: Correlation matrix of config 1

Resulting ideograms

common fit
1.0071±0.0083

w/o edge effect and fields in DV

config 1
config 2 MirrON
config 2 MirrOFF
config 3
config 4
config 5
config 6E8R5
config 6E8R200
config 7
config 8

common fit
0.9847±0.0081

w/ edge effect and fields in DV

PRELIMINARY

config 1
config 2 MirrON
config 2 MirrOFF
config 3
config 4
config 5
config 6E8R5
config 6E8R200
config 7

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