# Isobar separation at E < 1 MeV/amu

- ionization chamber:
  - only possible for very light ions (e.g. $^{10}$Be - $^{10}$B)
  - limitations due to statistics of charge carrier production and collection, energy-loss straggling in entrance window, electronical noise

- "inverse PIXE": particle induced x-ray emission
  - low efficiency (<1%)

- post-stripping:
  - low efficiency, because only one charge state can be used

- ΔTOF: new idea
  - high separation (e.g. $10^4$ with $^{36}$Cl - $^{36}$S at 0.5 MeV/amu)
  - efficiency ~ 50%
  - separation also possible for very heavy ions (e.g. ~$10^3$ for $^{182}$Hf - $^{182}$W at 1 MeV/amu)

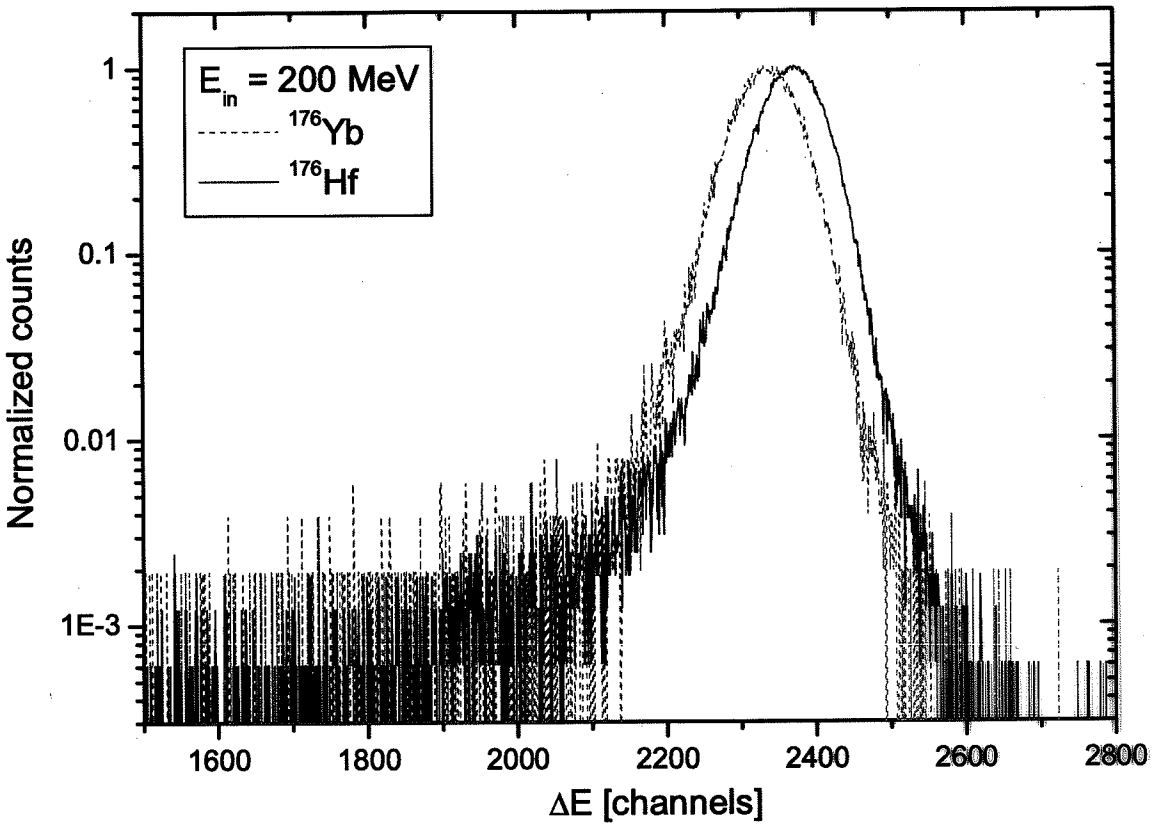



Figure 14.3: Measured separation of $^{176}$Yb–$^{176}$Hf at 175 MeV in the first $\Delta$E signal of the ionization chamber.

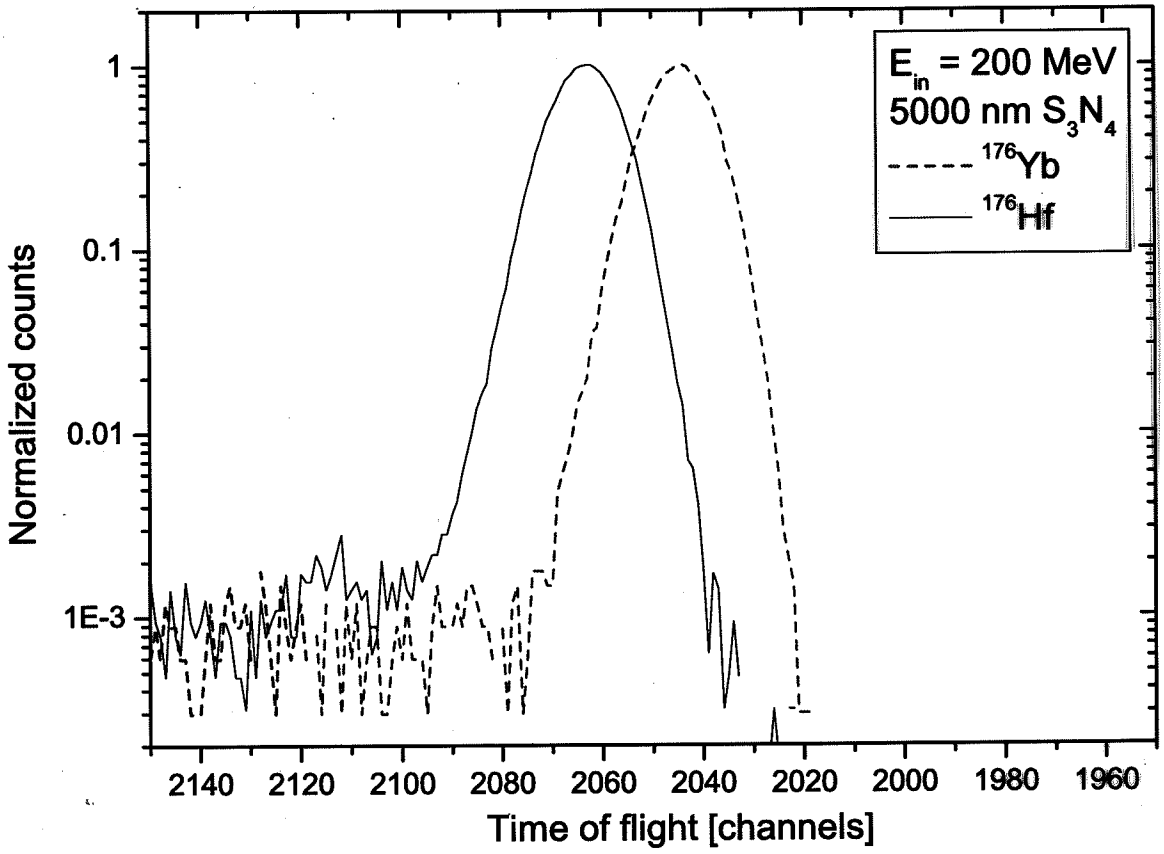
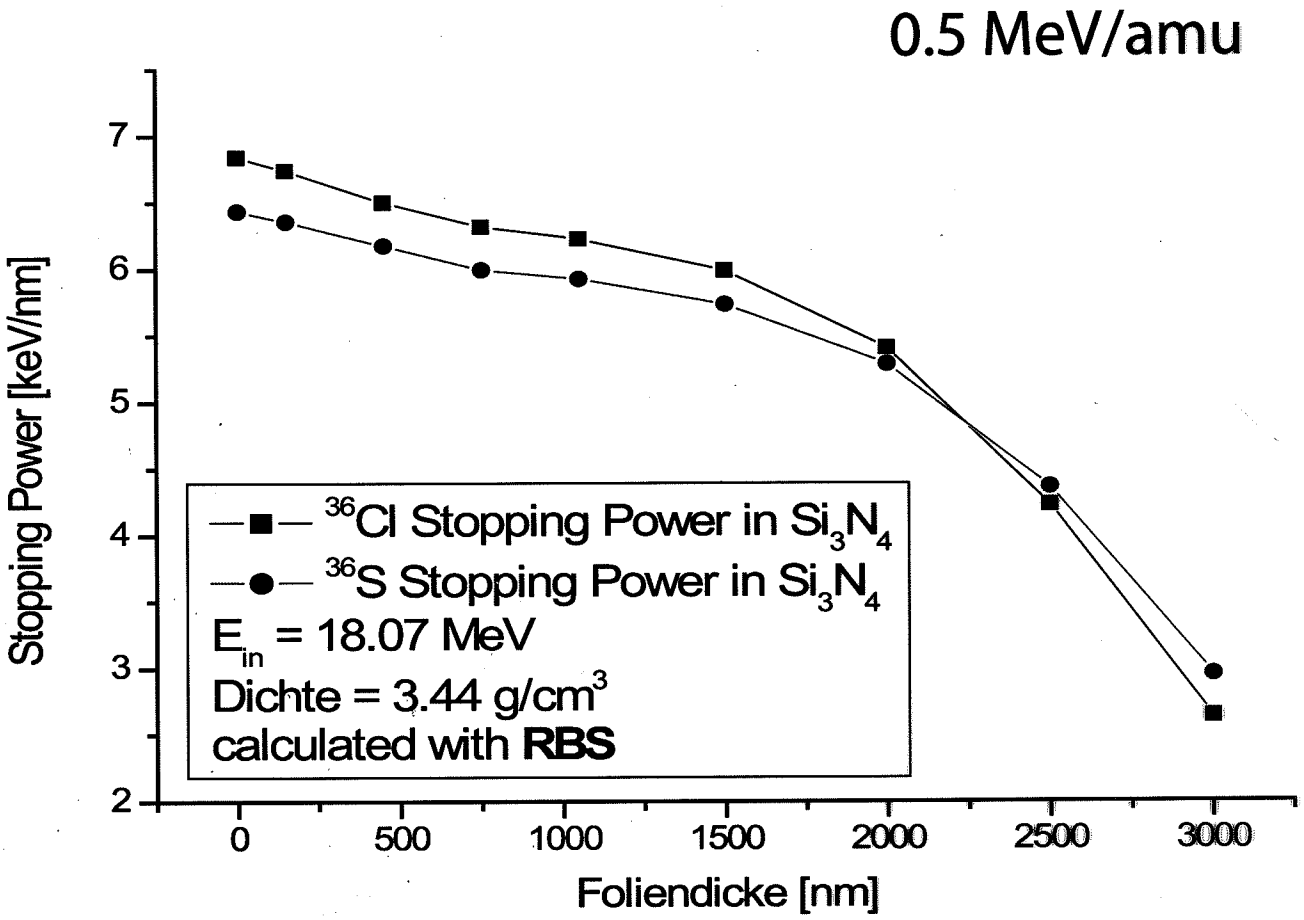



Figure 14.4: Measured separation of $^{176}$Yb–$^{176}$Hf at 200 MeV using $\Delta$TOF with 5000 nm $Si_3N_4$.


0.5 MeV/amu
Stopping Power [keV/nm]
Foliendicke [nm]
7
6
5
4
3
2
0
500
1000
1500
2000
2500
3000
36Cl Stopping Power in Si3N4
36S Stopping Power in Si3N4
Ein = 18.07 MeV
Dichte = 3.44 g/cm3
calculated with RBS

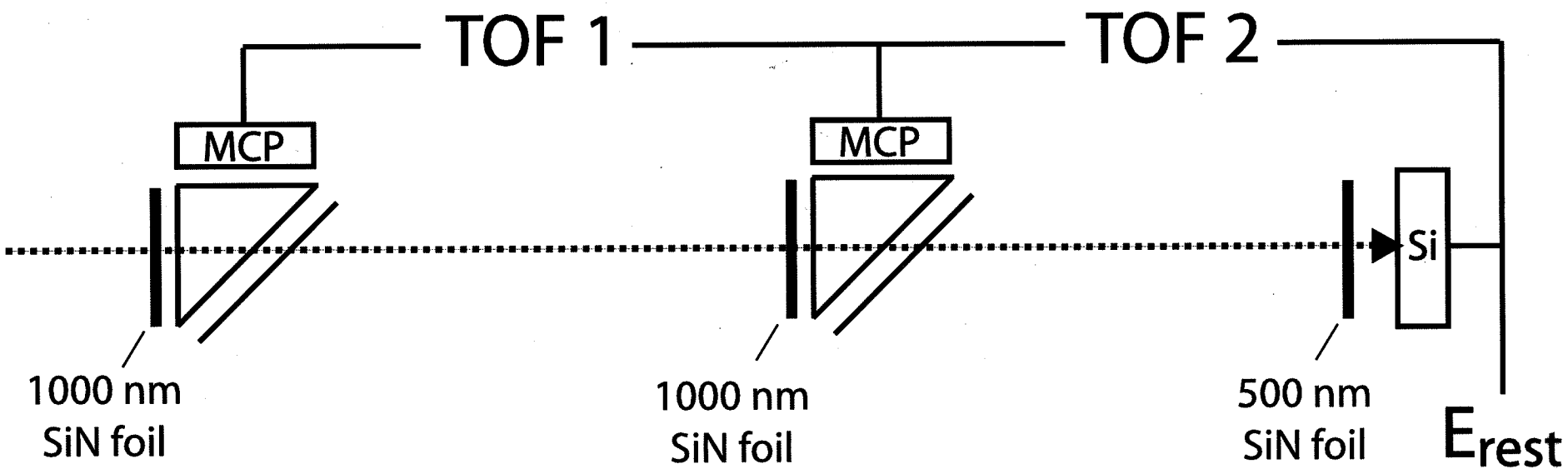



Fig. 1: Schematic setup of a ΔTOF detector.

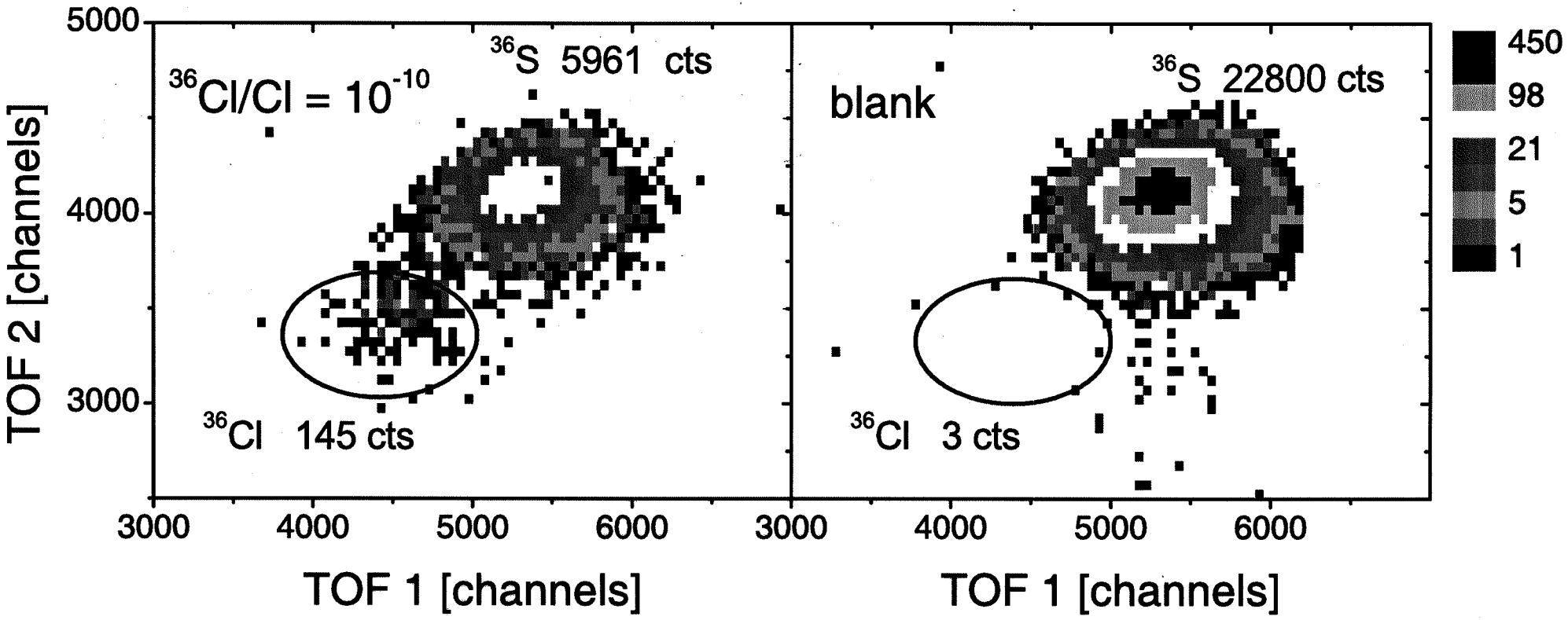



Fig. 4: TOF 1 versus TOF 2 spectra of a sample with $^{36}$Cl/Cl = 10-10 and a blank sample, measured at 0.5 MeV/amu. One 1000 nm SiN was used in front of each TOF. Low TOF channels corresponds to low energies.

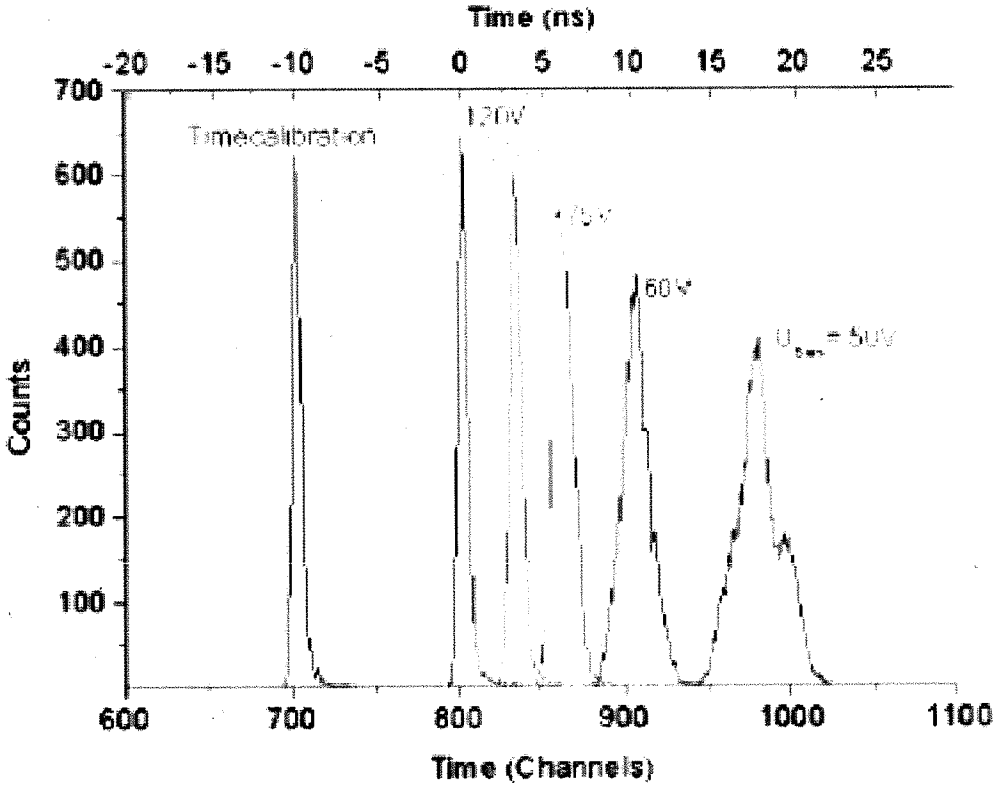



Abb. 30: Flugzeitspektren bei Variation der Bias–Spannung

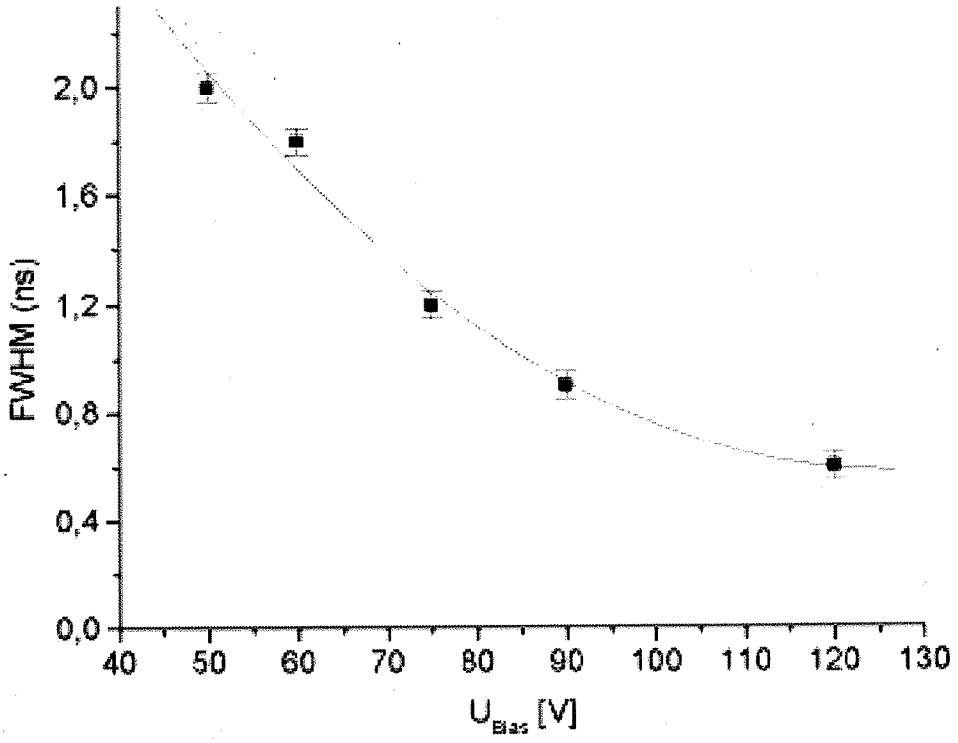



Abb. 31: Abhängigkeit der Zeitauflösung von der Biasspannung

It should be assumed that all the definitions in the section "IC mode" are prefaced by a test "MSIC closed", and in section "SSD mode" by a test "MSSSD closed".

A valve condition listing such as "RV62" means True if RV62 is open; "-RV62" means True if RV62 is closed. Logical AND is indicated by "*", logical OR by "+".

A definition such as RV61 = [logical condition] + RV61 means that in order to open RV61 the logical condition must be true, but once RV61 is open, it can remain open if the condition later becomes false.

## B.1 IC mode

There are 4 mutually-exclusive modes defined by user selection from the EPICS window for the IC: RoughMode, FillMode, RunMode and VentMode. The difference between FillMode and RunMode is that the experimenter is assumed to be closely monitoring the IC system in FillMode, while in RunMode there may be a long delay before the experimenter notices that an abnormal condition has occurred. If IV61 closes in RunMode, RV62 will automatically open to protect the thin window from overpressure or reverse pressure.

For clarity, define the following:

- NoIsobu = -IV61 * -VV61 * -SV72 * -SV73 * RV62 * (DPG61 < $P_{max}$)
- YesIsobu = -VV61 * -VV71 * -RV62 * SV73 * (DPG61 < $P_{max}$) * (CG61 < 0.2 T)
- CanRough = RP21 on * PV21 * (not pumping Separator) * (CG21A < CG61) * NoIsobu * -VV71
- CanFill = YesIsobu * -IV61

- CanRun = YesIsobu * -RV61 * (MFC > $MFC_{min}$)
- CanVent = NoIsobu * -RV61
- ForceRV62open = RunMode * -IV61 * (-(DPG61 < $P_{max}$) + -(CG61 < 0.2 T))
- ForceSV74open = -(DPG61 < $P_{max}$)

Conditions to enable devices to be "True" (open, on, enabled):

- HVenable = (MFC > $MFC_{min}$) * (DPG61 < $P_{max}$)
- IV61 = RunMode * CanRun * (CG52 < 0.2 T) * (CG61 < 0.2 T)
- RP71 start = MV21 open
- RP71_On = motor drawing current
- RV61 = (RoughMode * CanRough) + (FillMode * CanFill) + (-(Dif < $P_{max}$) * RV61)
- RV62 = ForceRV62open + (-IV61 * -SV72 * (RoughMode + VentMode)) + RV62
- RV63 = RV61 * (CG61 < 5 T)
- SV72 = YesIsobu * (FillMode + RunMode)
- SV73 = RP71_On * (-RV62 + -RV61)
- SV74 = RoughMode + FillMode + RunMode + ForceSV74open
- VV61 open = never
- VV71 = VentMode * NoIsobu * ((DPG61 < 1 Torr) + (VV71 * -(DPG61 < $P_{max}$)))

# DRAGON stable beam run October 1-4

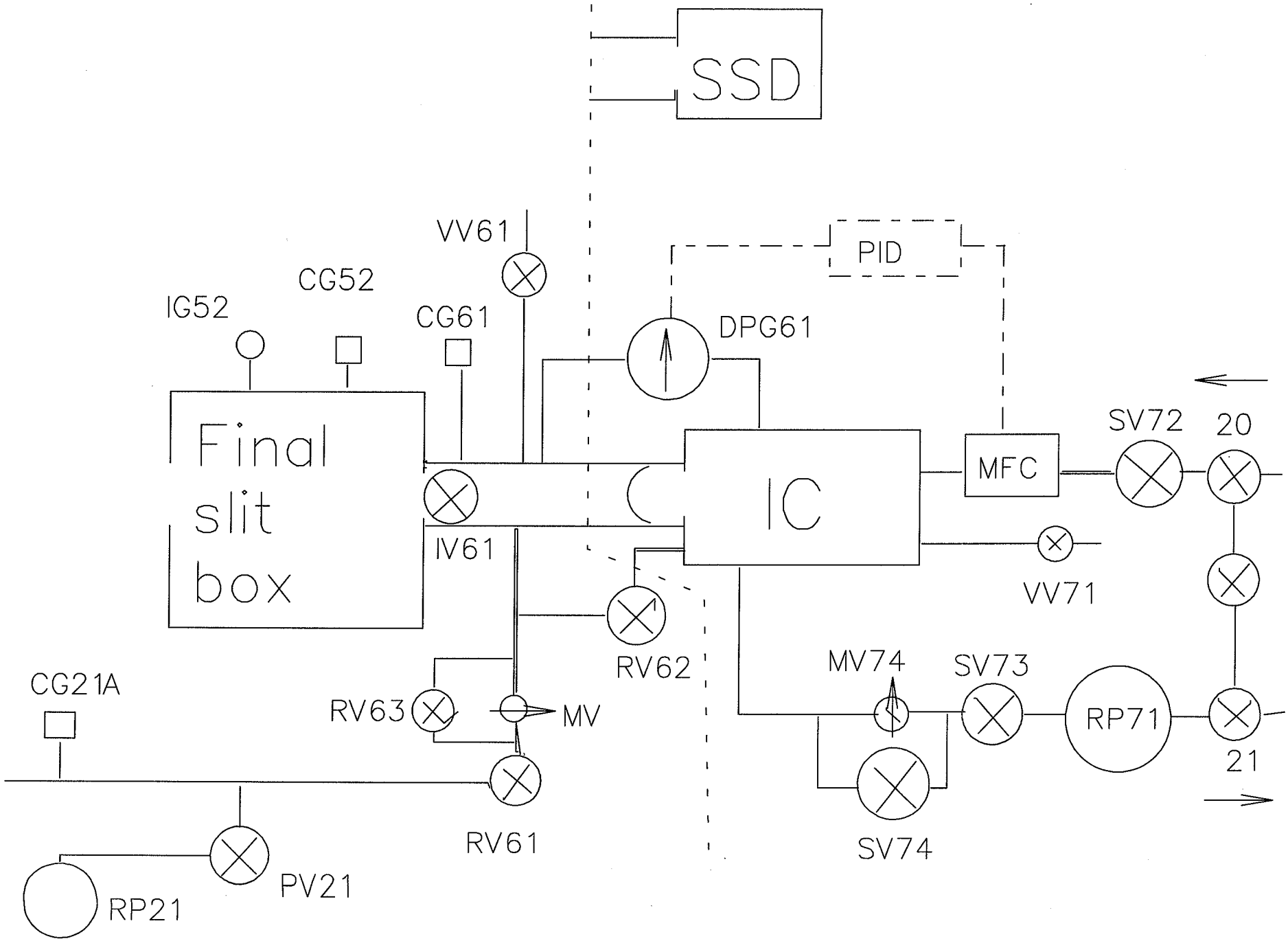
Objectives:

- check out DAQ upgrades
- check out SX3/4 and Q9/10 power supplies
- learn ROOT
- get to know the new beam physicist (Marco)
- new vs old tunes for 21Ne(p,g) 275 keV/u
- good measurement of 21Ne(p,g) "501" keV/u energy
- FC4 vs Elastic monitors: de-bounce FC4

~ TOF

Setup:

- hydrogen target
- DSSSD
- approx 16 hrs/day


SSD
VV61
PID
CG52
IG52
CG61
DPG61
Final
slit
box
IC
MFC
SV72
20
IV61
VV71
RV62
MV74
SV73
CG21A
RV63
MV
RP71
21
RV61
SV74
PV21
RP21