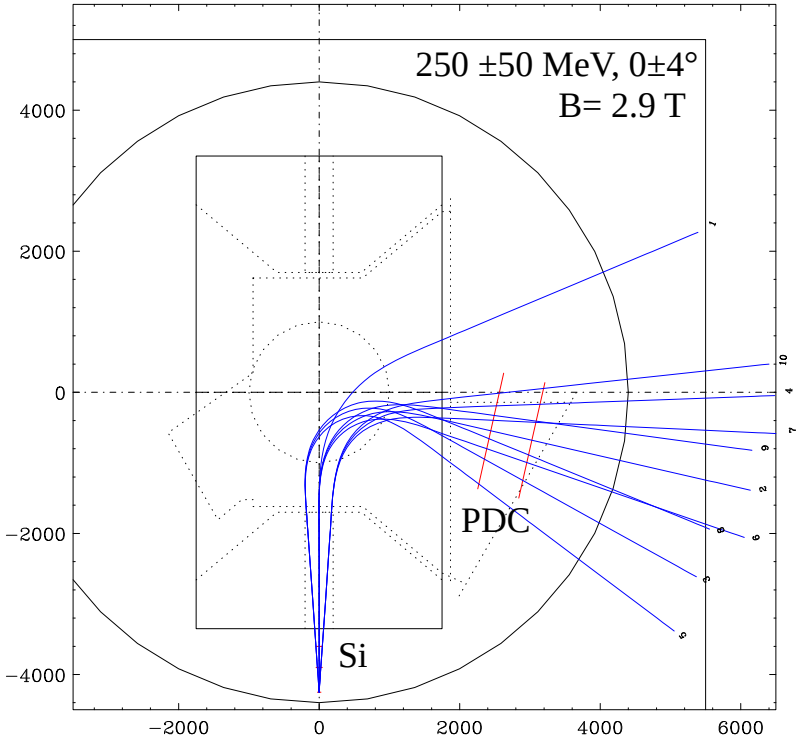
Memo on
possible improvement for (γ, p)-type exp.
and
possibility of (γ, pn)-type exp.

- (γ, p)-type exp. : example from Panin's proposal (p2)
  - E_{rel} acceptance is very small (but OK for low-lying states of interest)
  - neutron detection impossible
- Possible setup for (γ, pn)-type exp. (p3)
  - E_{rel} acceptance can be comparable to neutron detection by NEBULA
  - 2 new detectors
    - proton detectors in the magnetic field (p4)
    - proton/heavy fragment trackers between target & FDC1 (p5)
- Possible improvements for (γ, p)-type exp. using existing detectors (p6)
  - Si & PDC → Si & KDC

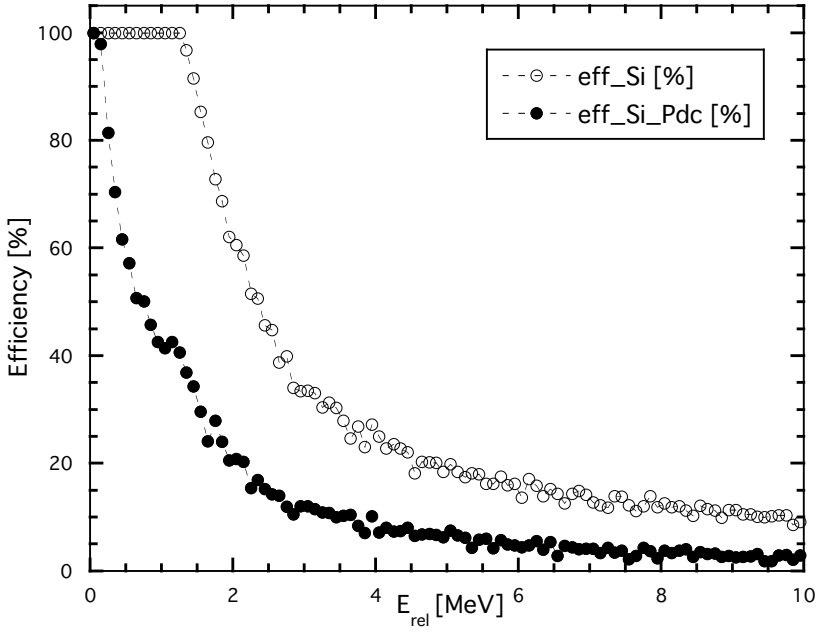
(γ, p)-type exp. : present plan(?)

- Setup$_{example}$: Panin's proposal $^{66}Se \rightarrow ^{65}As+p$



- Beam : ~250 MeV/u, A/Z~ 2
- B= 2.9 T
- Z_T= -4250 mm
- Si (88 mm□) : 4 Si's @350, 650mm from T
- PDC : perpendicular to central rays

- Geometrical acceptance

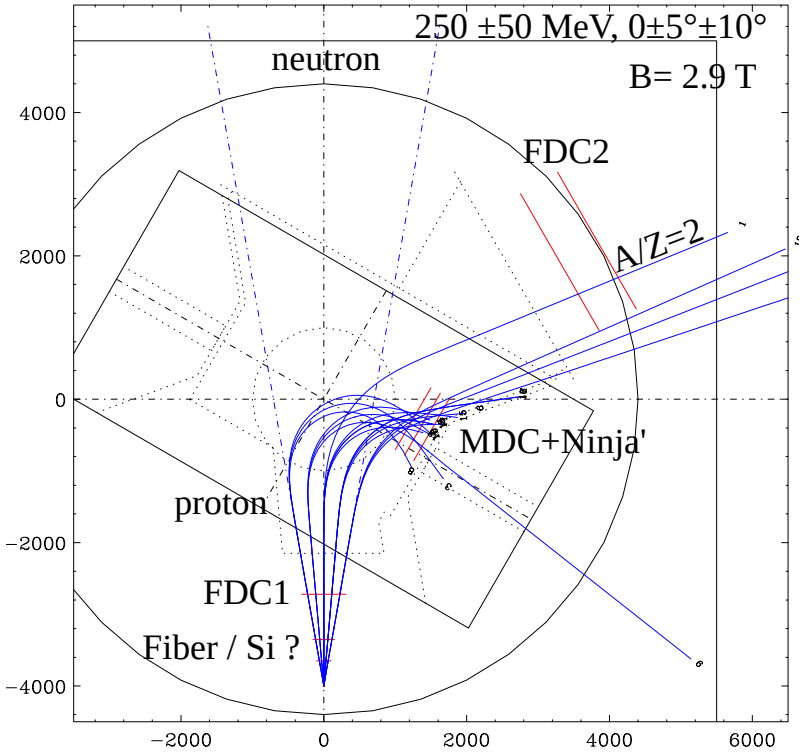


- Efficiency : (very) small
  - (OK for low-lying states)
  - Si : 88 mm□
  - Hole in Return yoke : 400 mm□
  - Magnet gap : 800 mm
  - PDC vertical size : 700 mm

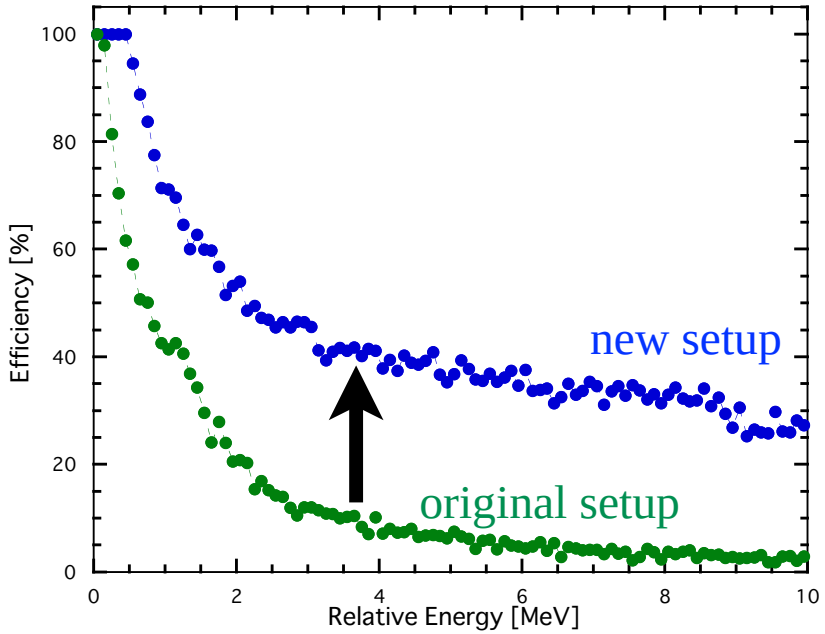
- Additional problems (?)
  - Magnet rotation, triangle-vac. ch removal, He filled (exit window), ladders, etc
  - Interference with FDC2
  - no neutron detection

Ideas for (γ, xnyp)-type exp. : ideal case

- Setup : standard setup+α



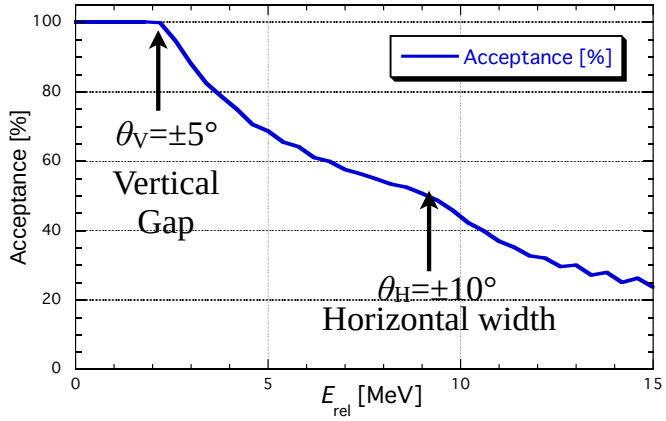
- Geometrical acceptance (proton)



- $\varepsilon_{p(det)}$~ 100%, $\varepsilon_{n(det)}$~ 40%
  - total efficiency for proton is higher

- Detectors
  - FDC1+FDC2 : for heavy fragment
  - MDC : 1000x650 mm^2 for proton detection
  - Fiber : heavy fragment + proton
    - Si (80x80) is too small even at D=350 mm
    - 140(H) x 80(V) mm^2 @ D= 350 mm
    - 250(H) x 160(V) mm^2 @ D=650 mm

- cf: Geometrical acceptance (neutron by NEBULA)



Detector-1 : Proton tracker in the magnetic field

- Position detector for protons in the magnetic field
  - vertical acceptance is more important than horizontal in terms of acceptance
  - environment ?
    - vacuum (not easy, but preferred) or He (easy)
  - information ?
    - x,y (probably OK w upstream detectors) or x,y,y'y' (better, bent track, thicker)
    - D~ 10 mm / %
- Design v01
  - drift distance & half gap : 8 mm
  - active area : ~1000 (H) x 600 (V) mm^2
    - (need to increase vertical acceptance)
  - configuration : xx'xx'yy'yy'
  - #readout : 64 ch / x-plane, 40ch / y-plane
  - total# readout : ~420 ch, ASD's in vacuum
  - gas : 100~150 torr i-C_4H_{10} operation in vacuum
  - window : 125 um Kapton + support bars
  - (can be used as small FDC2, but with thinner anode)
  - possible problems: multi-track(w trigger scint.), ...
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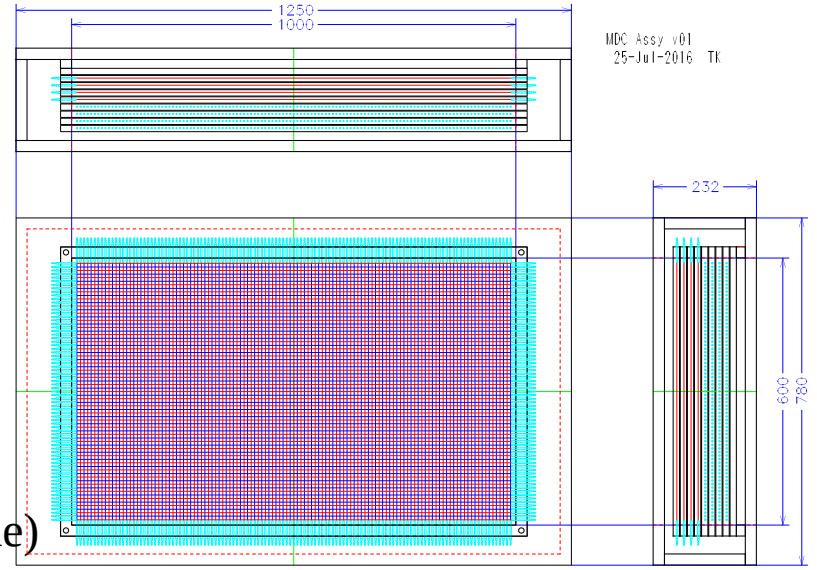
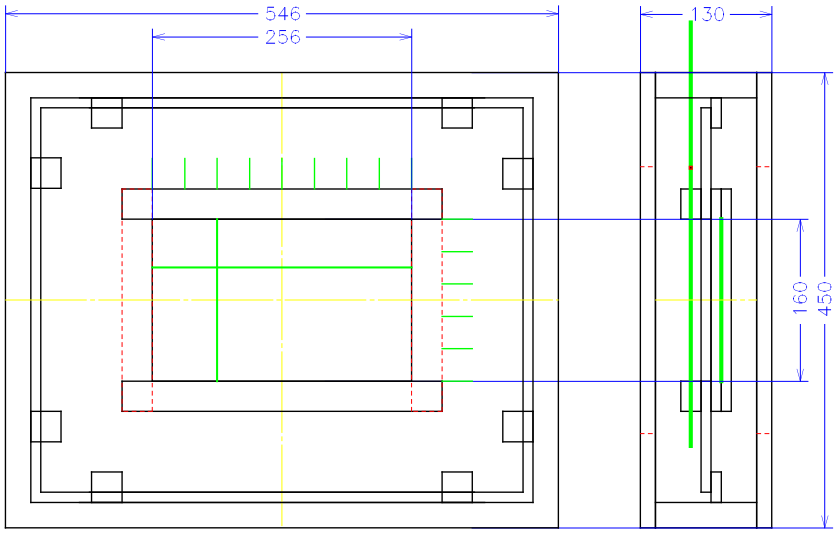


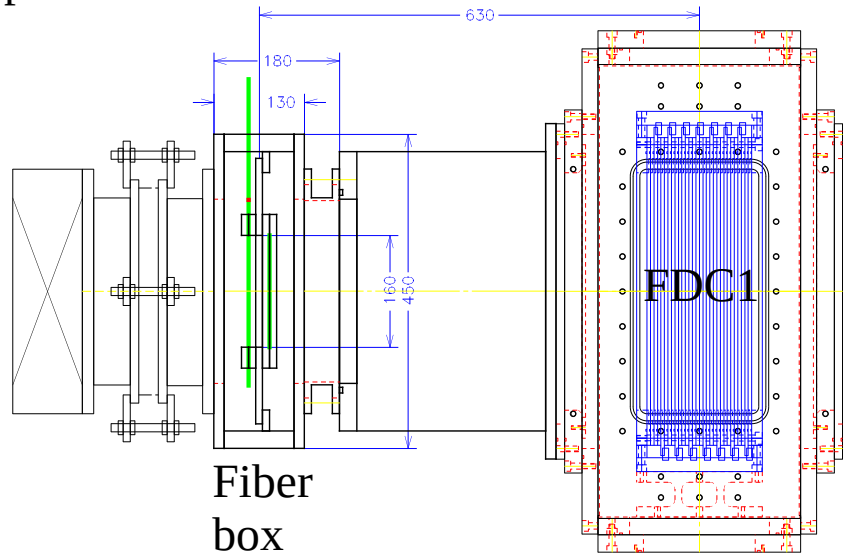
Detector-2 : fiber scintillator tracker between target & FDC1

- Requirements & methods
  - detection of proton & heavy fragment
    - limit the dynamic range in the photo censor, i.e. MPPC (partly tested @HIMAC)
    - use MPPC with small# pixels for easier saturation
    - (~several usec of deadtime → fine segmentation)
  - position resolution
    - σ~0.33 mm @650mm may be enough : 1mm□ fiber scintillator with MPPC readout
  - effective area
    - 256 (H) x 160 (V) mm^2 @650mm from target → #MPPC readout~ 416ch
- very preliminary design v01



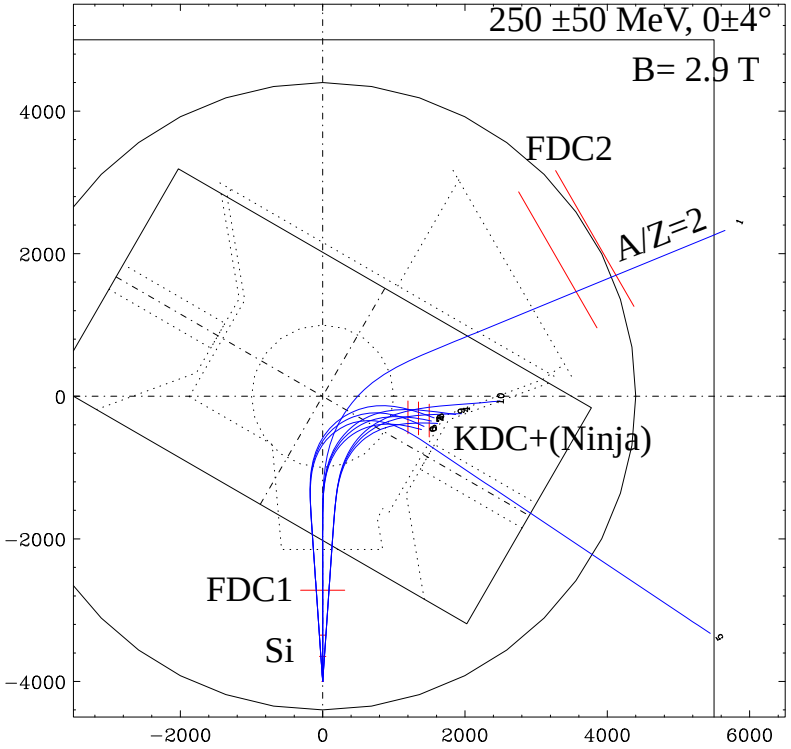
- contact to MPPC : outside the vacuum box

- setup with FDC1



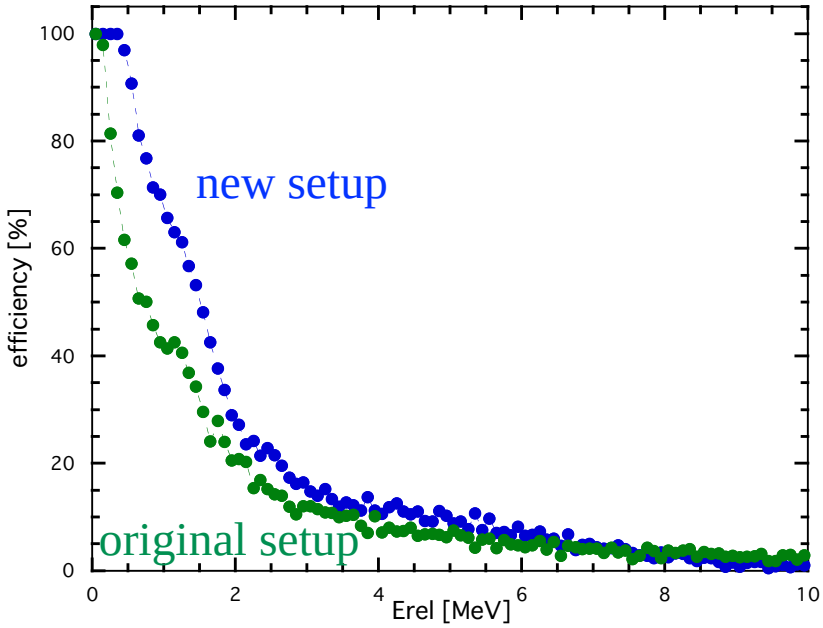
Possible improvement for (γ, p)-type exp utilizing existing detectors

- Setup : $^{66}Se \rightarrow ^{65}As+p$ alternative setup



- Detectors
  - Si : xyxy : being prepared
    - D= 350, 650 mm from target
  - FDC1+FDC2 : heavy fragment
  - KDC : use 2 or 3 existing KDC's for protons
    - 460(H) x 600(V) mm^2 ; PDC prototype
    - Kx, (Ku), Ky: x3 sets
    - in He : easy
    - in vacuum : slightly difficult (window)
  - Plastic trigger counter (Ninja?)

- Geometrical acceptance



- Merits
  - efficiency for E_{rel}<1.5 MeV higher
    - due to vertical acceptance
  - no need to rotate magnet
- Demerits
  - large change from the original proposal
  - operation of KDC in the strong magnetic field
  - 2 proton detection ?