Memo on PDC (proton drift chamber)

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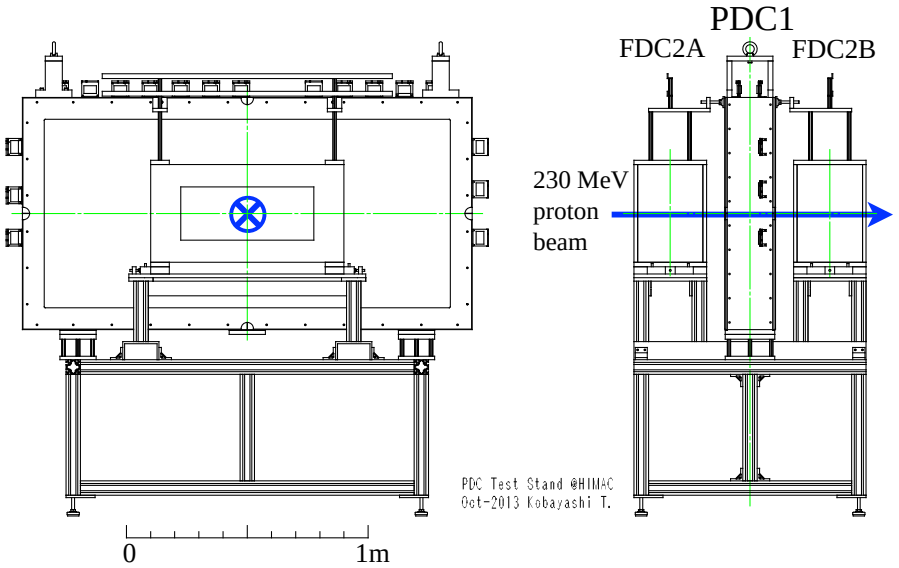
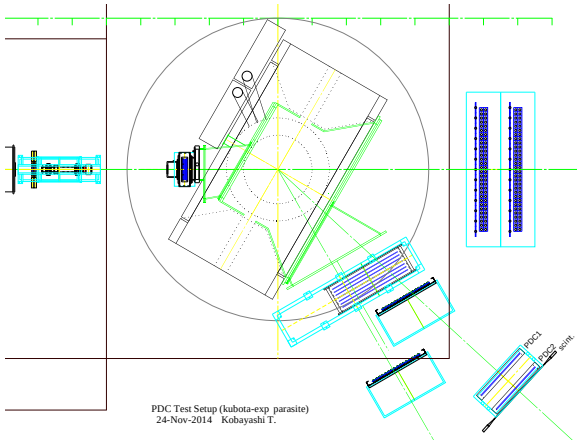
- PDC test using proton beam & He+60%CH_4
- PDC test using ^{11}Li beam & P10
- (γ,p) setup with detector stands

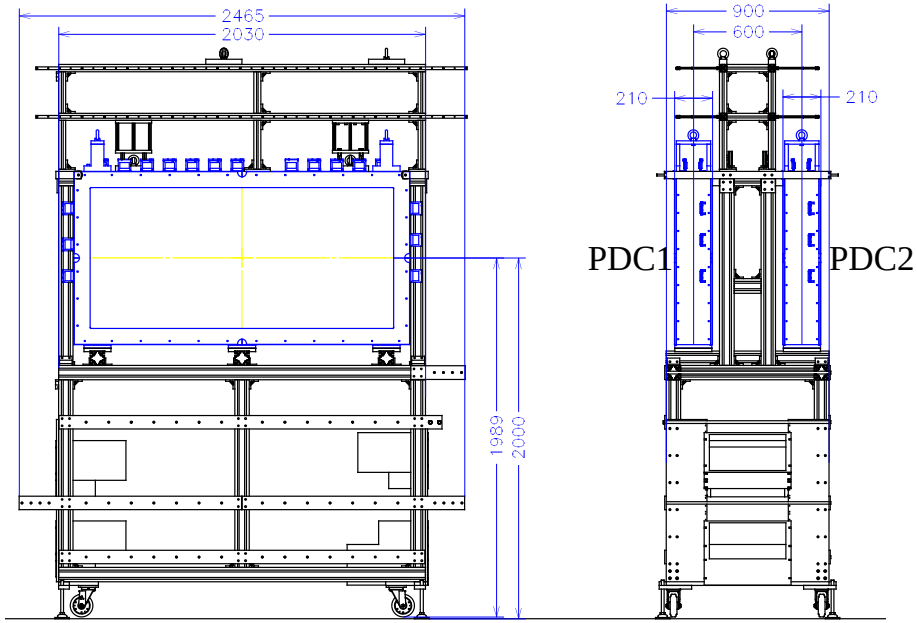
PDC (Proton Drift Chamber) Test Runs

- Nov-2013 @HIMAC SB2
  - beam: 250 MeV proton beam
  - PDC1 with 2 reference chambers
  - gas: He+60%CH_4
  - readout: 16x4 ch/plane (u,x,v)
    - total 192 ch (12 ASD, 3 TDC)



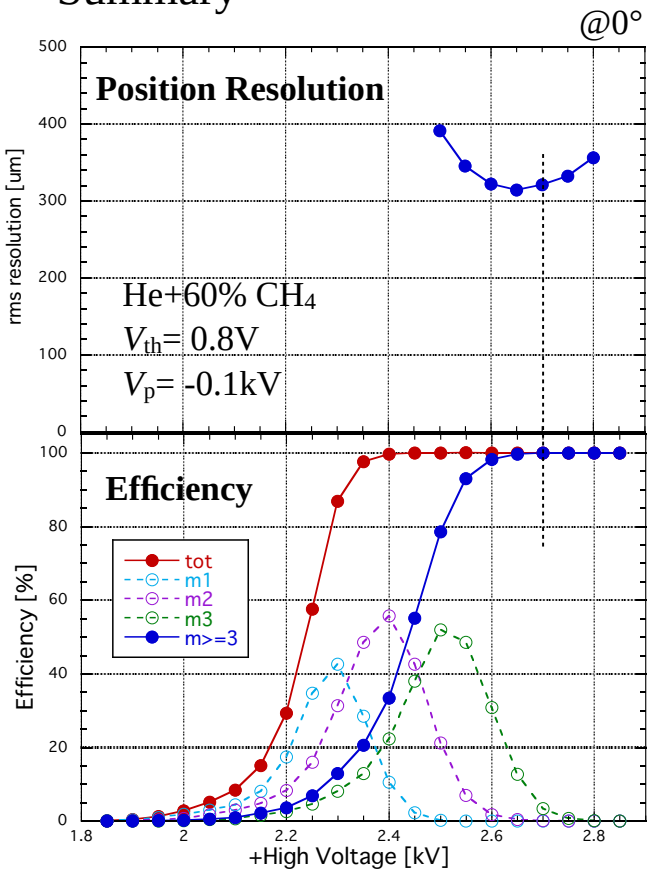
- Dec-2014 parasite to samurai-s18 (Kubota-exp)
  - beam: 250 MeV/A ^{11}Li beam
  - PDC1 & PDC2 without reference chambers
  - gas: P10
  - readout: all channels, 16x9 ch/plane
    - total 864 ch (54 ASD, 14 TDC, 6 ASDPS)
    - 2 ASD boards: oscillating @V_{th}=0.8V

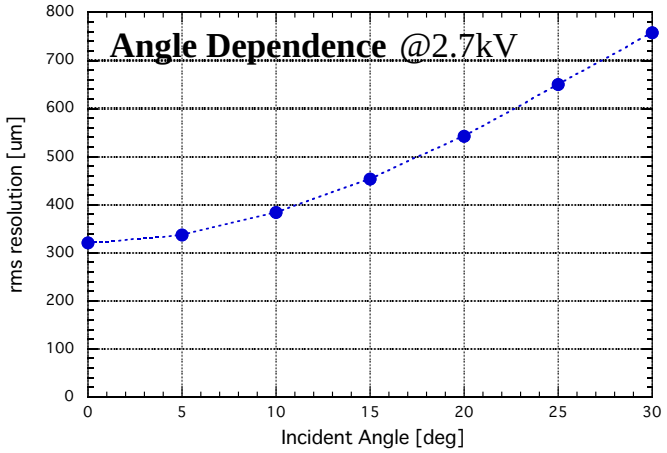




Proton run - 1

- Analysis
  - charge information : width (TOT time over threshold) $w \rightarrow$ "charge" q ; $q/C_f \propto V = V_{th} \exp(w/\tau)$
  - gain (width) calibration : necessary
  - CRM (charge ratio method) : q_{-1}, q_0, $q_{+1} \rightarrow$ position
    - optimum D_{eff} for best position resolution, using reference chambers
    - D_{eff} depends strongly on HV & incident angle
- Summary





- behavior
  - different from electrostatic calculation
  - effect of angle-dependent quenching effect ?
- **avoid large incident angle**

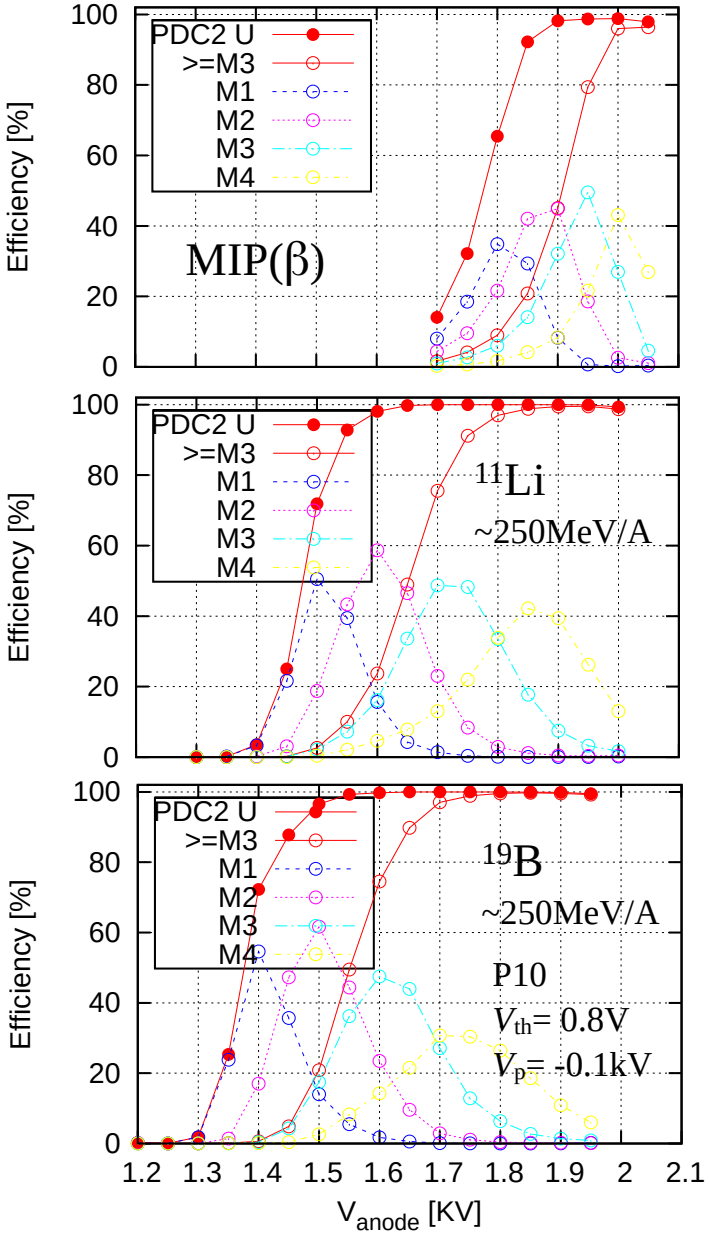
- D_{eff}
  - D_{eff} ~11.5mm @2.65kV $\neq D_{geo}$=16mm
  - position resolution : strongly dependent on D_{eff}
  - D_{eff} can be also determined from q_{-1}/q_0, q_{+1}/q_0 correlation
    - $\neq D_{eff}$ at best resolution ($\therefore$reference chamber needed)

Proton run - 2

- width (w) to charge (q) transformation:
  - rise time approximated by parabolic shape, followed by exponential decay with τ
    - $V(t) = -\frac{V_0}{t_0^2} t(t - 2t_0)$ or $V(t) = -at\left(t - 2\sqrt{\frac{V_0}{a}}\right)$
      - may not be a good approximation since the real shape is $\propto \ln(1+t/t_0)$
    - $w \rightarrow q \propto V$: $\exp\left(\frac{w}{\tau}\right) = \frac{V}{V_{th}} \exp\left\{\frac{1}{\tau}\sqrt{\frac{V_{th}}{a}\left(\frac{V}{V_{th}} - 1\right)}\right\}$
  - D_{eff} , then
    - D_{eff} ~ weakly dependent on HV & incident angle for constant a
    - ~the same position resolution compared with $q \propto \exp(w/\tau)$ method using optimized D_{eff}
    - $D_{\text{eff}} \sim D_{\text{geo}}$=16mm can be used without sacrificing resolution
    - D_{eff} (resolution optimum) ~ D_{eff} (q_{-1}/q_0, q_{+1}/q_0 correlation)
      - → no reference chambers necessary
    - why constant "a" ?, not constant t_0?
- What's left
  - improve or correct non-uniformity : periodic structure with 3mm pitch
  - (lower threshold if possible : currently V_{th}=+0.8V, sometimes unstable)
  - (correct x position from u & v information for large incident angle)
  - (slight angle dependent shift)

^{11}Li run -1

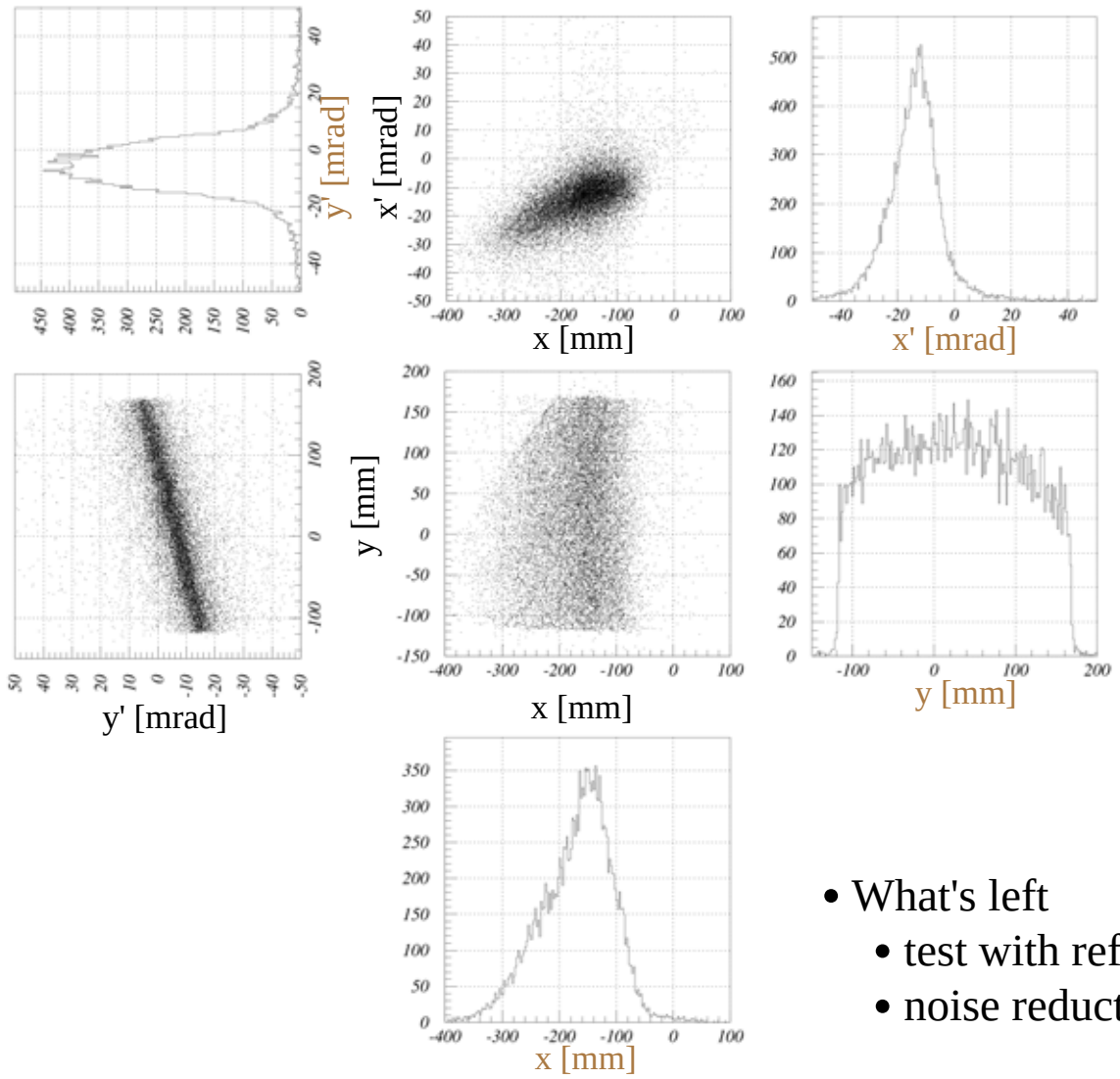
- Efficiency



- 2 ASD's: oscillating
  - cut on the width for analysis
  - sometimes unstable
- gain variation :
  - ΔV~70V for ΔG~2 for P10
  - $V_{50\%}$(PDC1) ~ $V_{50\%}$(PDC2) within ~20V

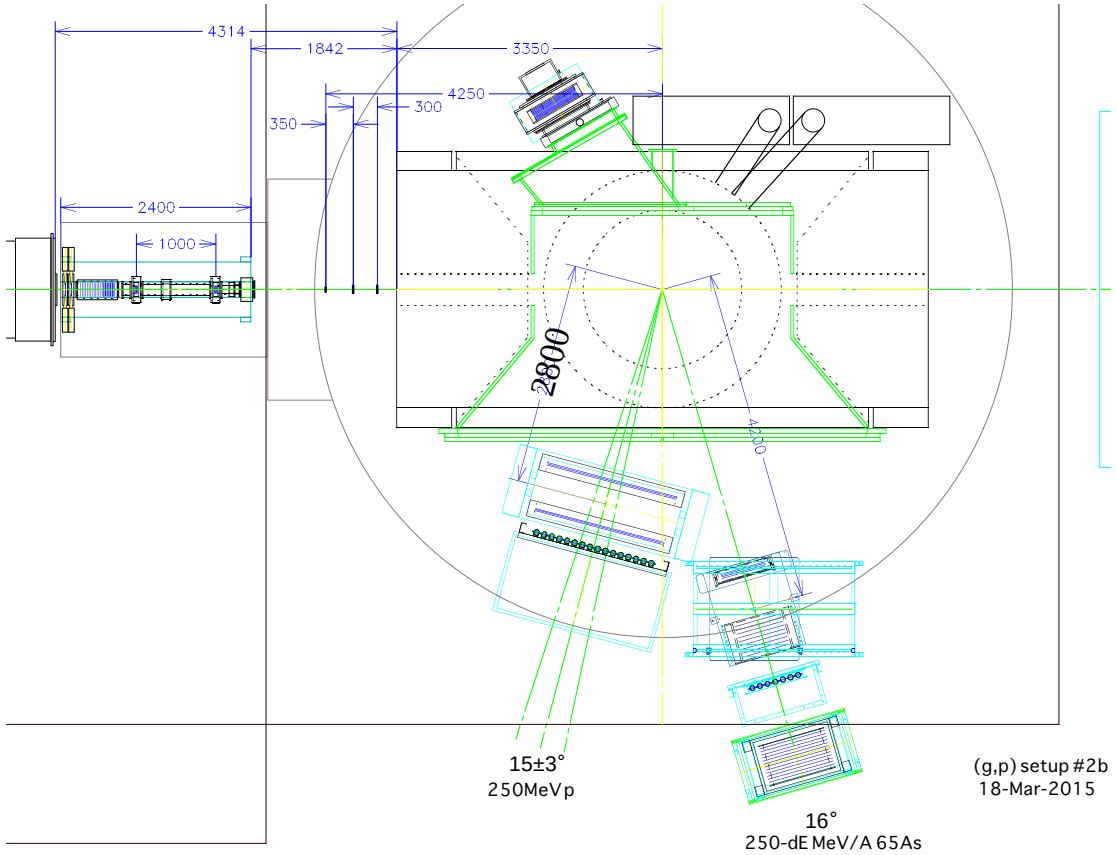
^{11}Li run -2

- *w* to *q* transformation : same parameter *a* used as proton run
  - need to be checked using reference chambers
- beam phase space for ^{11}Li @2.95kV



- What's left
  - test with reference chambers using P10
  - noise reduction ?

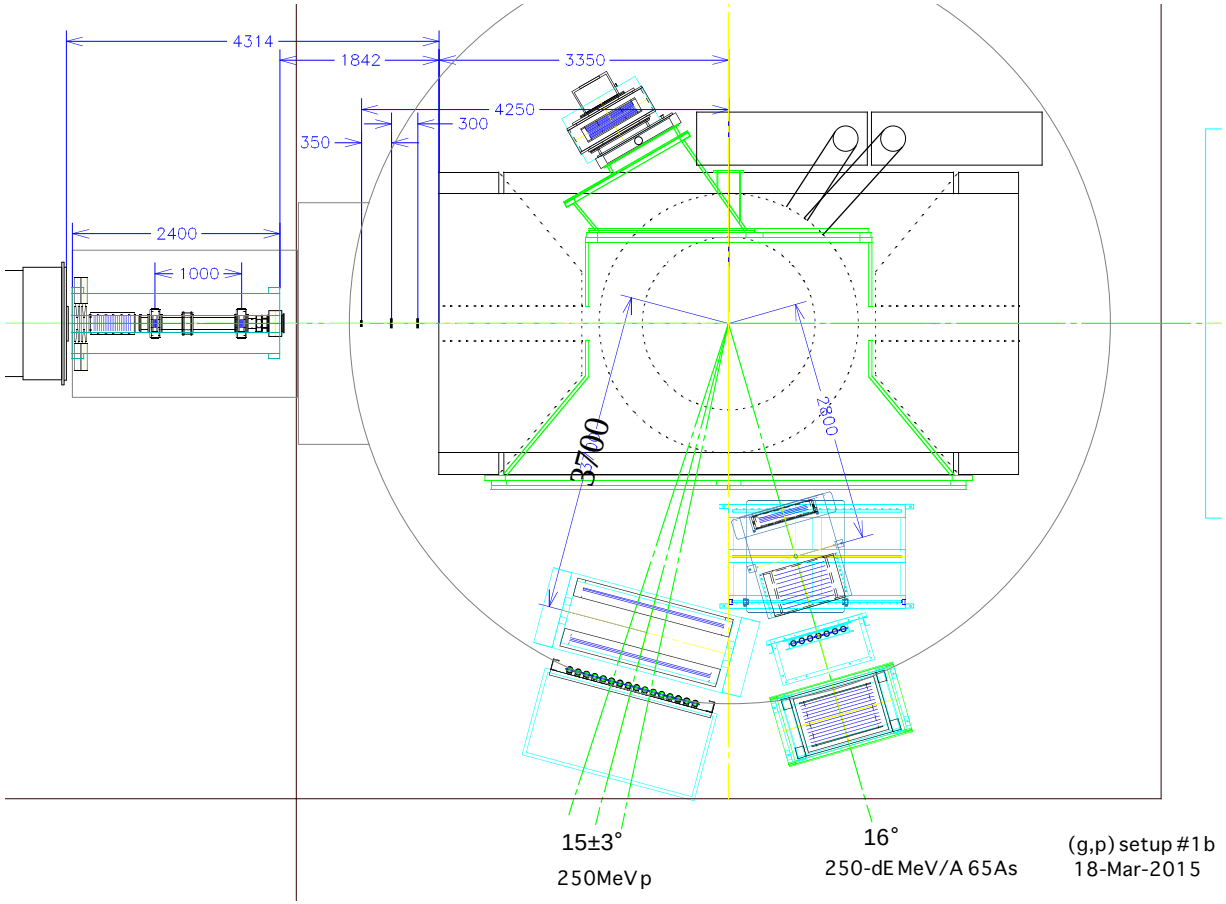
Setup with detector stands -2b

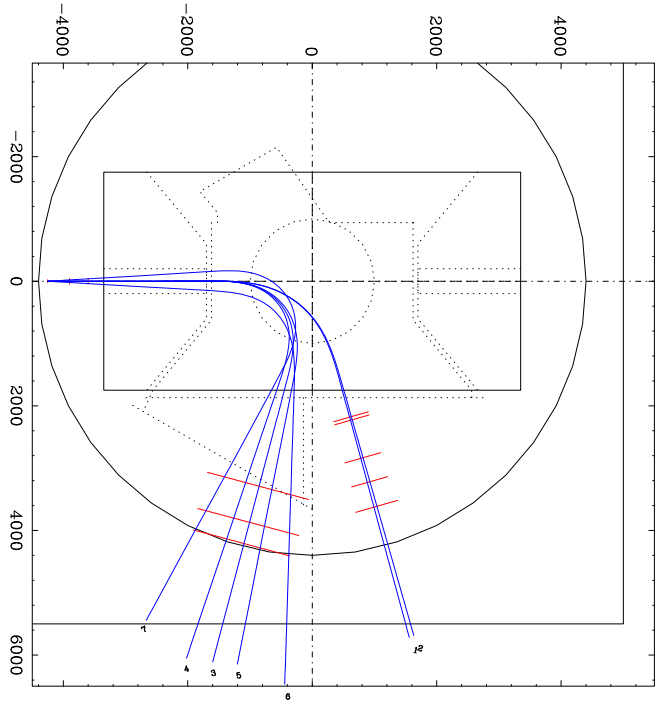


- ?
  - upstream stand & DALI2 stand ?
  - vertical acceptance of FDC2 & FDC3 ?
  - PDC cabling & heavy fragment ?

- What's necessary before physics run
  - sweep run for gain calibration
    - with ~same incident angle, if possible
  - resolution study using 2 movable reference chambers

Setup with detector stands - 1b





$T_p = 250 \pm 34$ MeV
$\theta_p = 0 \pm 3.4°$

- setup example w/o triangular vacuum extension
  - upstream stand (SBT, ICB, BDC1,BDC2) configuration ?
    - 2.4m-stand: conflict with DALI2 etc
      - need 1920mm from DALI2 to magnet from valerii ?
    - 1.6m-stand: difficult to put ICB
  - vertical acceptance of FDC2 & FDC3?