QD Design
: fringe function

20130516 lab meeting
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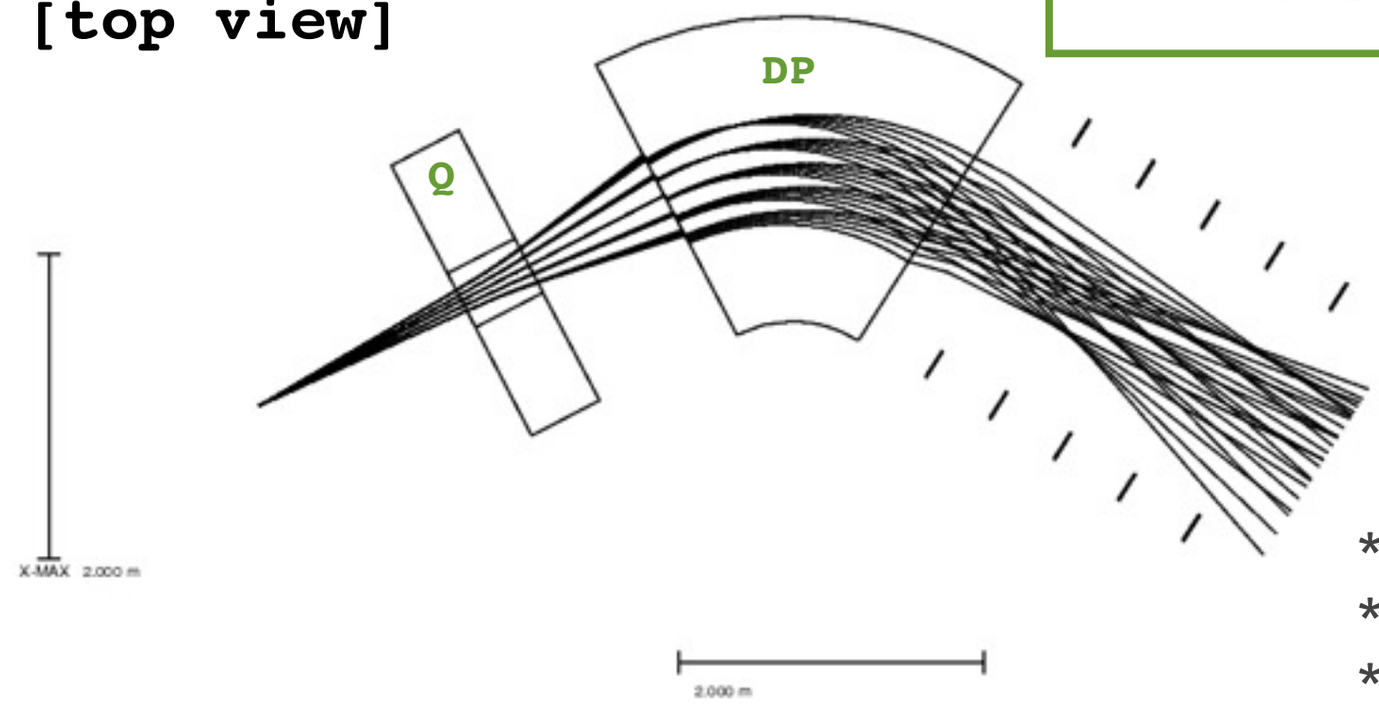
QD system (GICOSY)

1.5m ->Q-> 1.0m ->DP-> 0.5m*6 -> C

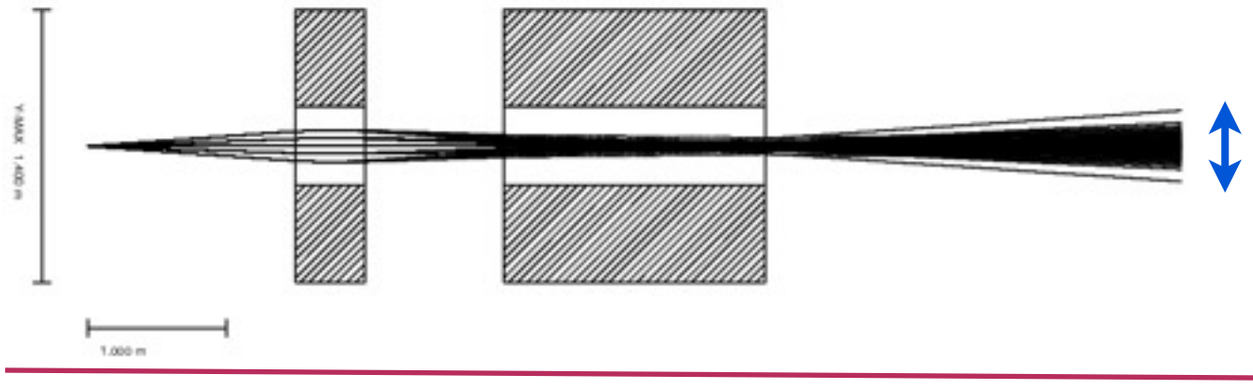
***Q** : L=50cm, full_a=40m, B=-1.42T/m (y-focusing)

***DP** : θ=60°, half_gap=20cm, w1=2m?, w2=2m?,
R=1.8m, B =-0.36T, β_1=-25°, β_2=-25°

[top view]



[side view]



*** 2nd order calculation**
*** angular acceptance = 50mr, 50mr**
*** momentum Range = ±15%**
(corresponding KE Range ~ ±30%)

KE=14.5MeV (165.5MeV/c)

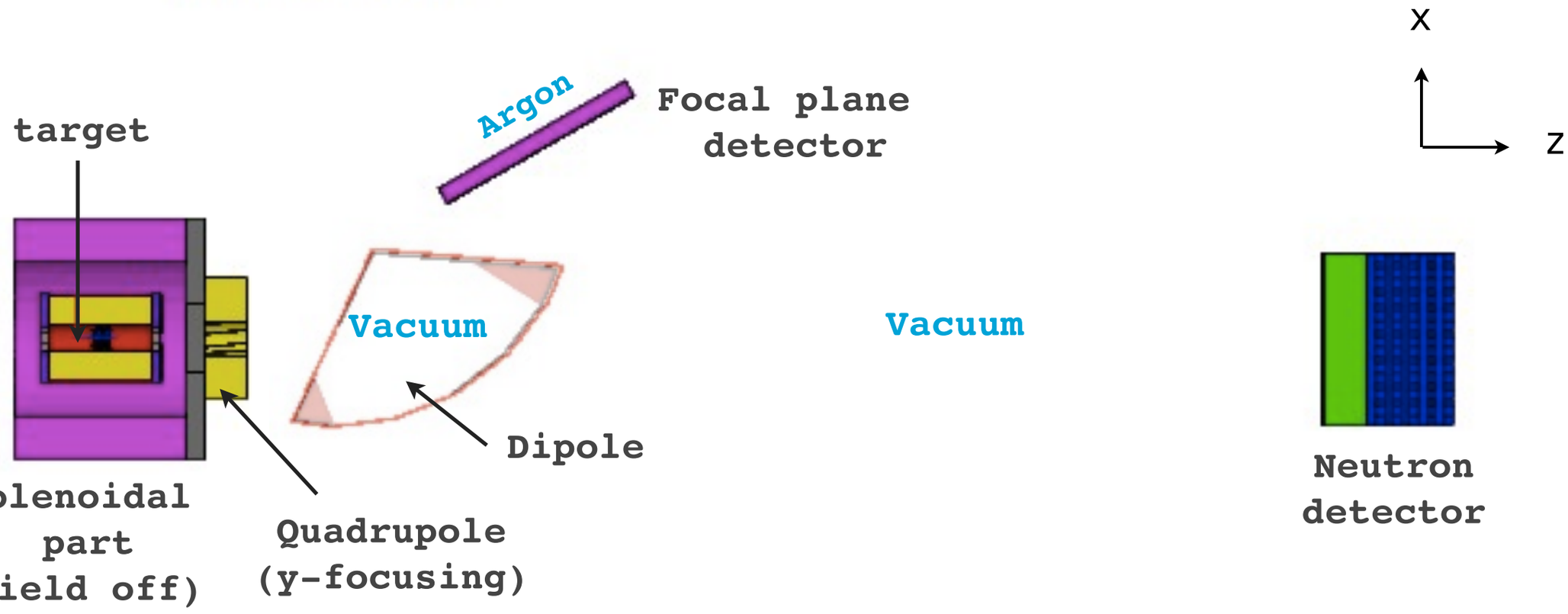
KE=20MeV (194.7MeV/c)

KE=26.3MeV (224MeV/c)

[04_QD_130401/GICOSYIN_2_drift.DAT]

QD system (Geant4)

[Whole Configuration for LAMPS$_H$]

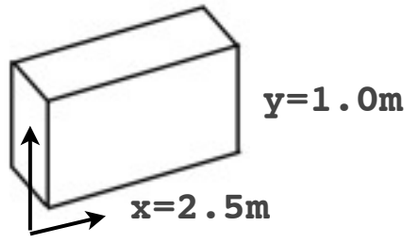


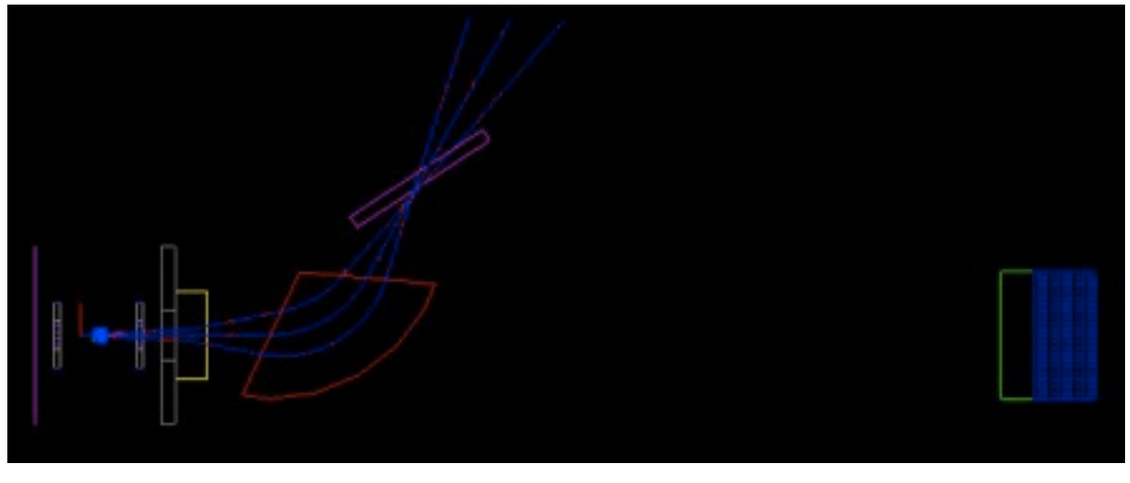
[Focal Plane Detector]

: 2.5m × 1.0m × 0.2m

: ψ (angle tilted from the exit pole face of DPO=) = 33°

$$\tan(\psi) = -\frac{T_{126}}{R_{22}R_{16}}$$

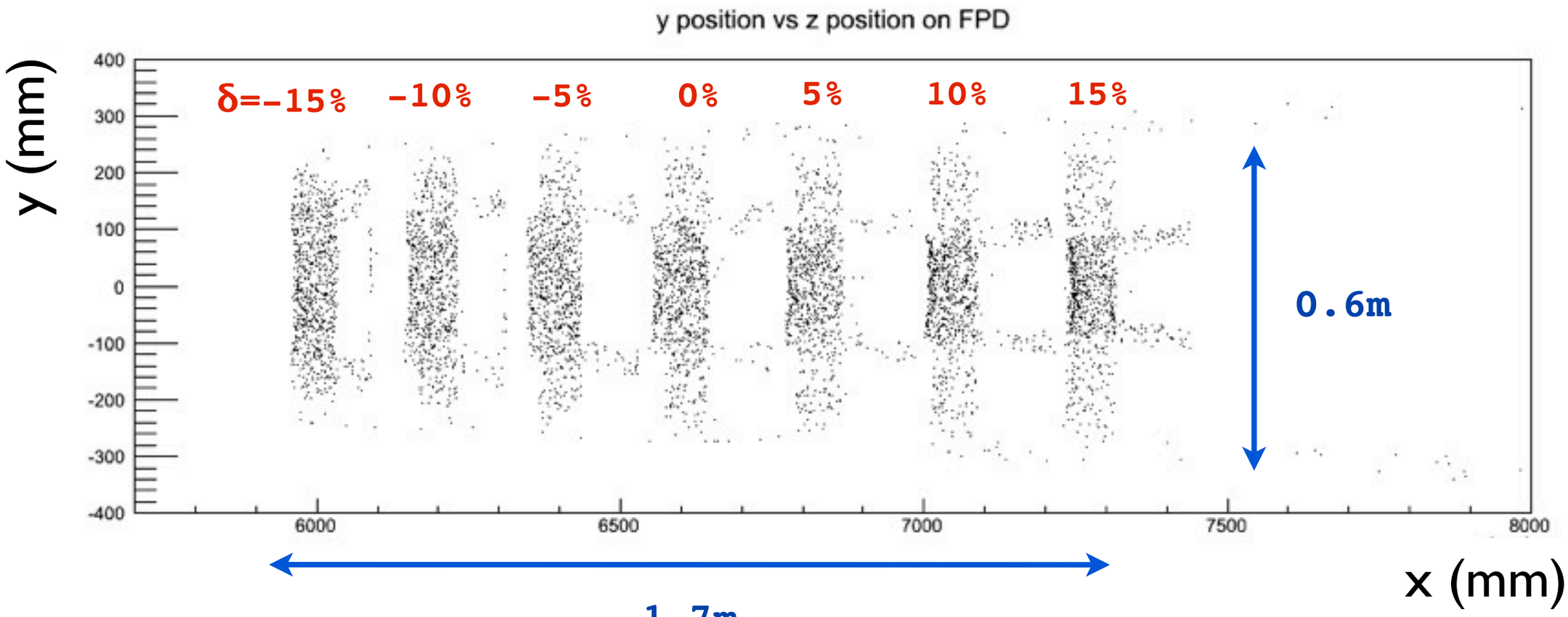




FPD Simulation

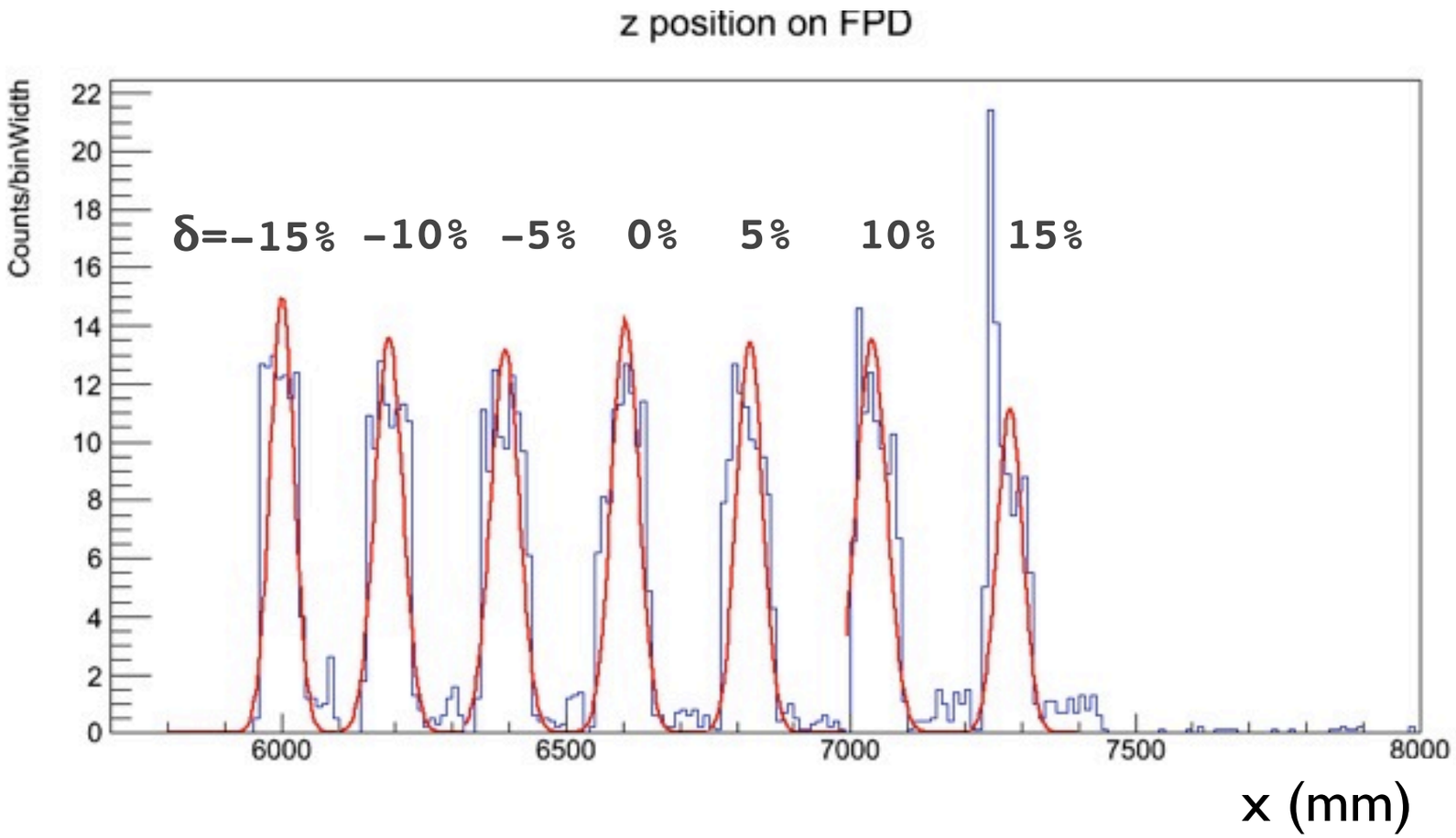
*** for constant B field**

- central trajectory : proton with KE = 20MeV (p=194.7MeV/c)
- 7000 protons (1000 protons for each δ)
- fastest hit on FPD only



FPD Simulation

*** for constant B field**



- **Gaussian fitting**
  σ ≃ 2.4 cm ⇐ too large!

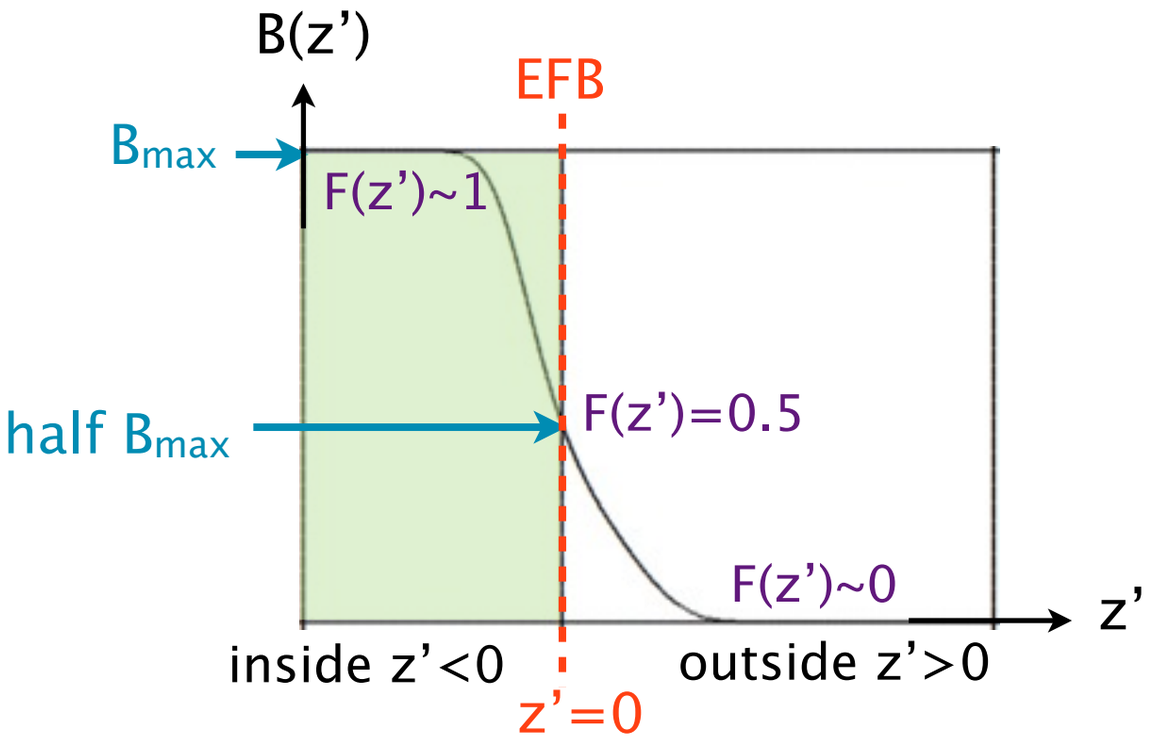
- **Dispersion D = 4.26[cm/%]**
- **Resolving power R ~ 180** ⇐ too bad!

Fringe function

- **Enge Function :** $$F(z) = \frac{1}{1 + \exp(a_1 + a_2 \cdot (z/D) + ... + a_6 \cdot (z/D)^5)},$$

where D = gap parameter (=half-aperture)
z' = distance from the effective field boundary
a_n = parameter for the n_{th} order polynomial

- B-field is defined by $B(z')=B_{max}\times F(z')$



1. D = 200mm for Q and DP both
2. a_n = extracted from the GICOSY
   (This is default value)

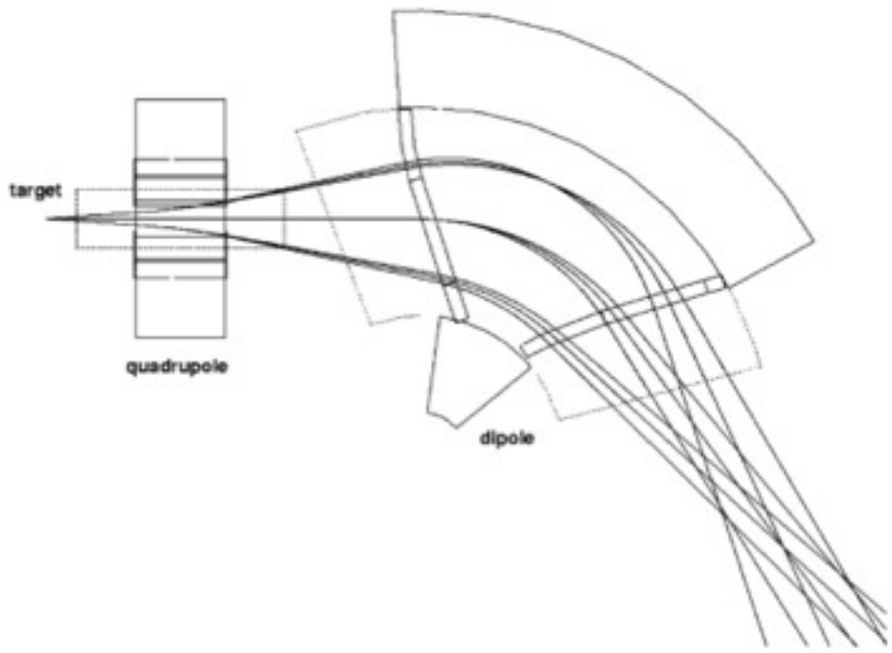
For dipole magnet
a1=0.205133
a2=0.840972
a3=-0.141308
a4=0.050050
a5=0.000076
a6=0.005197

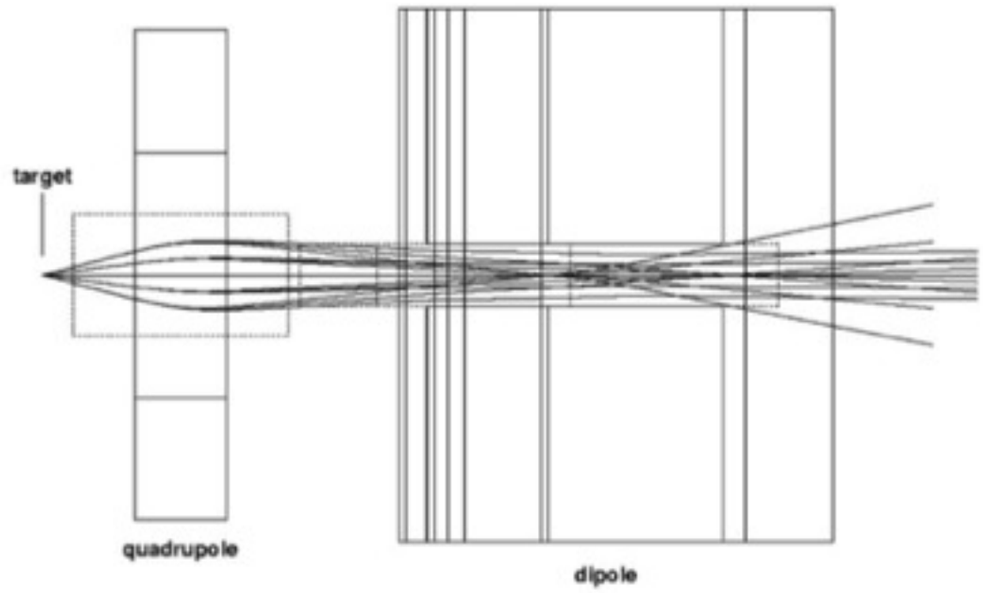
For Q-magnet
a2=3.59463

3. z' = give a cut (see next slides)

MAGNEX spectrometer

i.e) Enge Function for the MAGNEX Geant4 simulation





Parameters of the fringe field Enge functions for the dipole and the quadrupole

	C_0	C_1	C_2	C_3	C_4	C_5
Dipole	0.503	4.43	−1.39	0.84	−0.1590	0.0575
Quadrupole	0.3795	4.0034	−2.1	1.1973	−0.3683	0.0478

- Since the Enge function covers z'=±∞, we should give a cut for the field range!

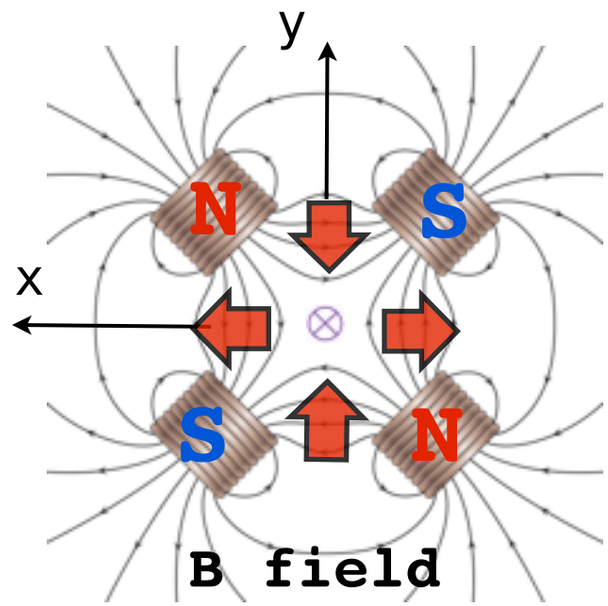
Quadrupole

- **B-field w/o fringe**

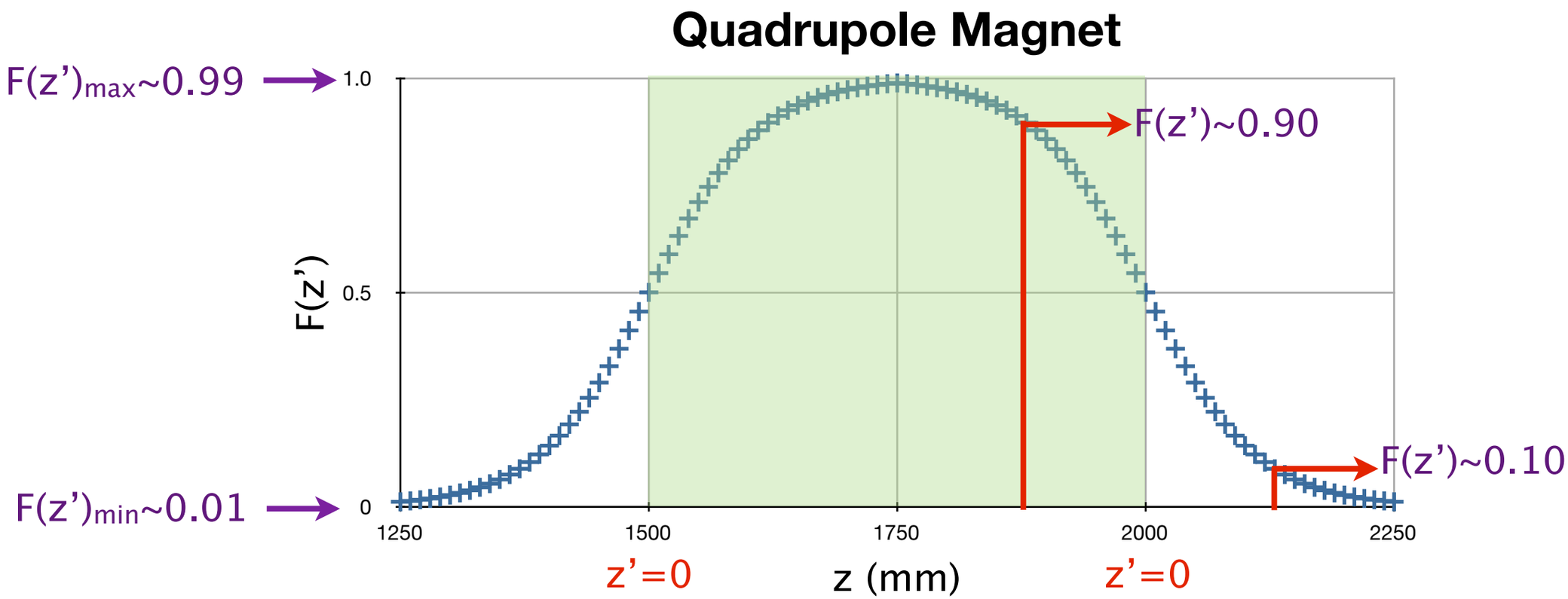
$$B_x = \frac{\partial B}{\partial y} \cdot y \qquad B_y = \frac{\partial B}{\partial x} \cdot x$$

Field gradient

$$K = \frac{\partial B}{\partial y} = \frac{\partial B}{\partial x}$$



- **B-field w fringe** $B_f = B \cdot F = \sqrt{(FB_x)^2 + (FB_y)^2}$



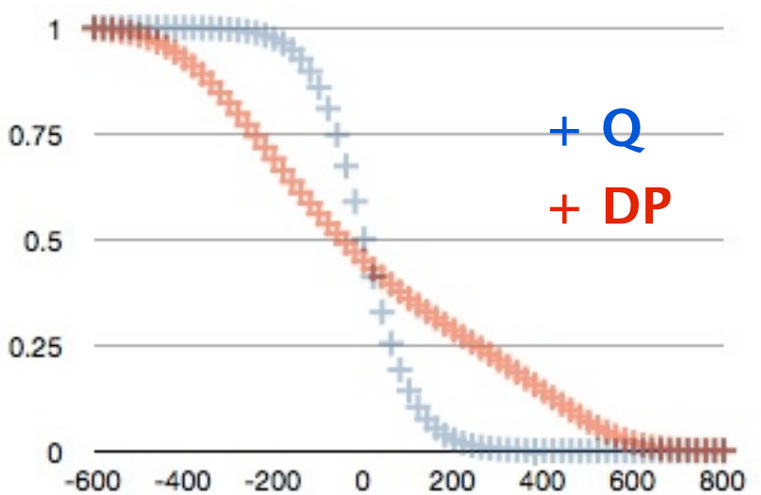
Dipole

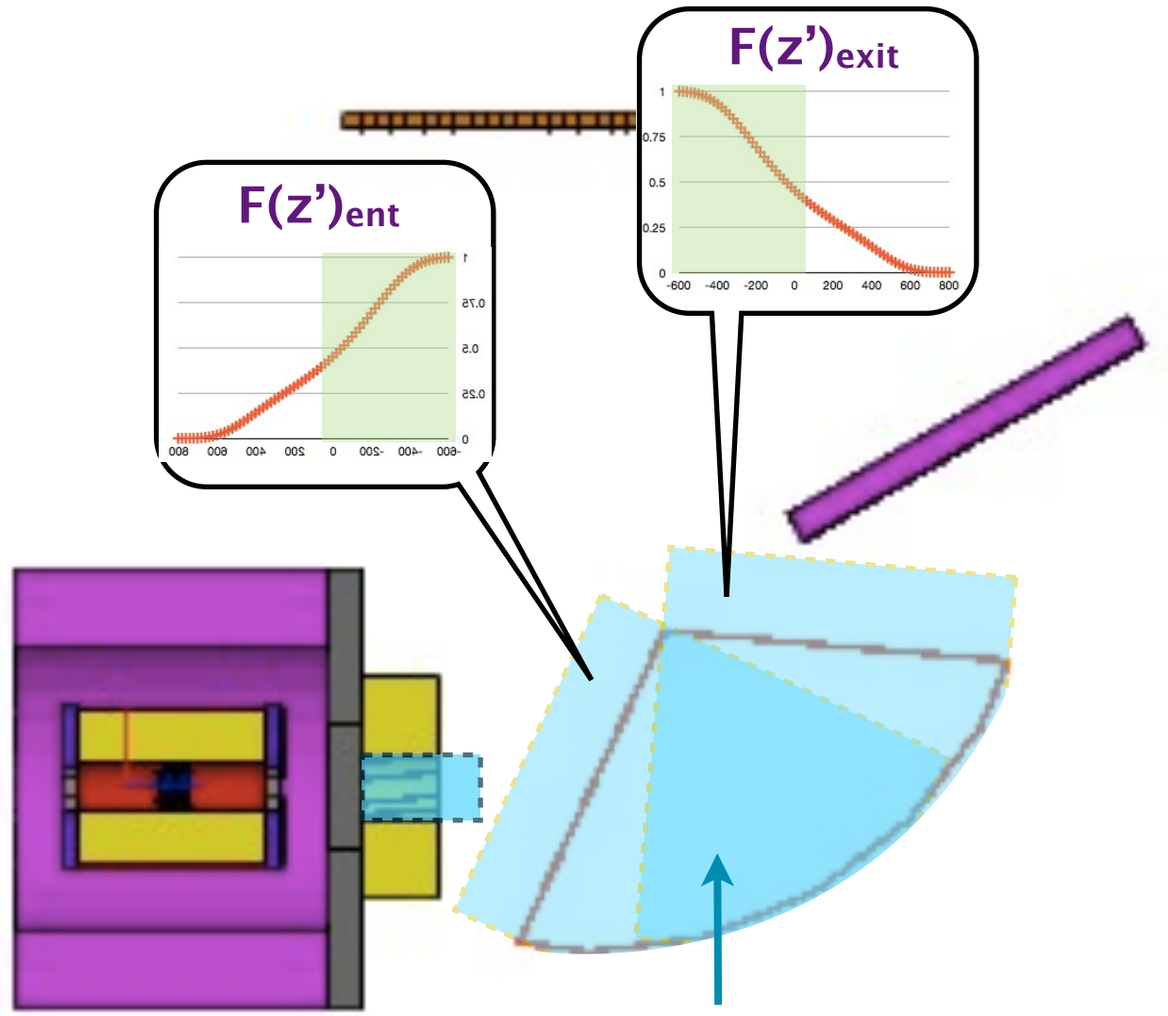
- **B-field w/o fringe**

  B_y = -0.36 T (constant)

- **B-field w fringe**

  : different Enge function for Q and DP





SUMMARY & FUTURE PLANS

- **Determine the proper field range (z′ cut)**
  Then, FPD simulation

- **MOCADI & QQD simulation**
  : focal plane width 1m & momentum acceptance ±30%
  : waiting for Doctor Yoon

- **Enge function parameter**

단, 이 값들은 GICOSY에서 사용하는 Default값입니다.
실지로는 자석 설계를 하면서,
Fringing field값으로 부터 a1~a6을 구하게 됩니다.
(예를 들어 opera3D와 같은 magnet 설계 code를 이용하여....)
실제 자석이 있으면 자기장 분포를 측정하여 측정값으로 부터
계수를 구하는 일을 해야 합니다.

이 값들을 사용하여 다시 GICOSY 계산을 수행합니다.....
이 과정을 반복하면 real에 가까운 계산 결과를 얻을 수 있게 됩니다.