Magnetic Field Simulation in The ATF Extraction Line

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Introduction

- Our goal is to perform the tracking of the beam in the realistic magnetic field in the ATF extraction line.
- Current status of the project:

✓ 2-D field map of the ATF extraction line septum "A" and of the quadrupole very similar to Q7 has been modeled (Cherrill).

✓ First 3-D field map for septum "A" has been found (John).

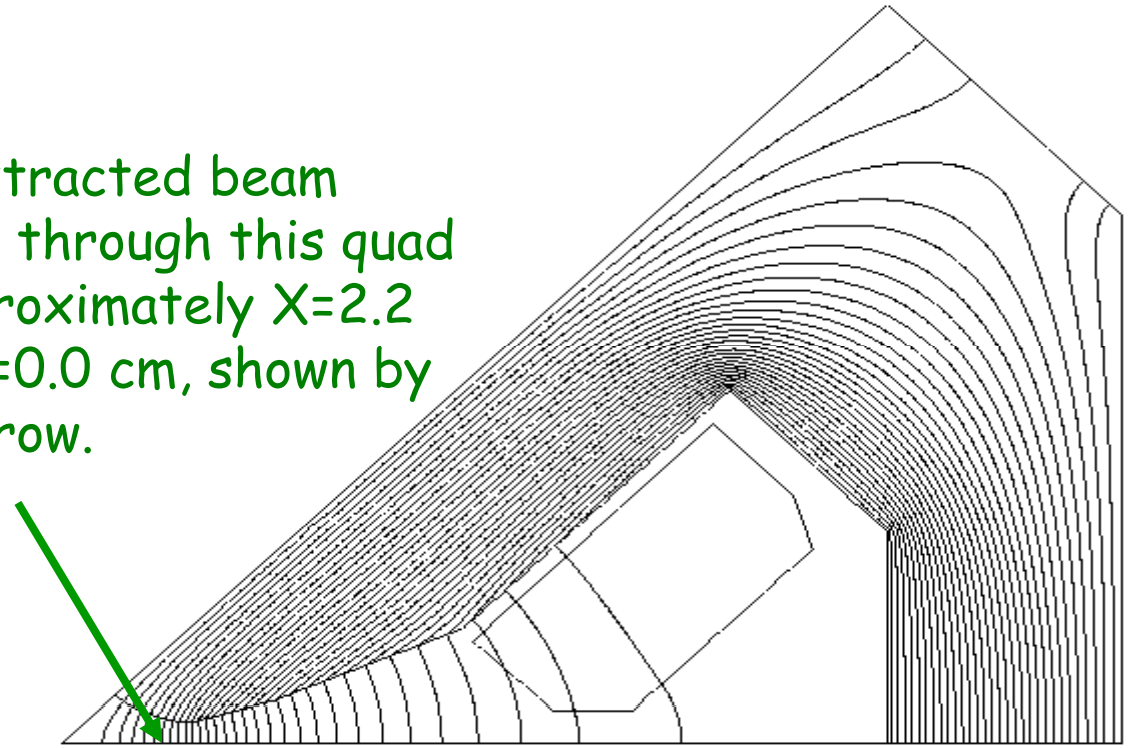
✓ The analyses of 2-D field in Q7 been carried out (Feng and Sergei).

✓ The first beam tracking in 2-D Q7 field been done (Feng).

QM7 2-D field

- Cherrill generated the map of magnetic field in POISSON for the quad similar to Q7 (at 131 Amps). The field is believed to be within 10% of Q7's field.
- Currently Cherrill provided us with the field generated with finer mesh; though it has not been analyzed yet.

The extracted beam passes through this quad at approximately X=2.2 cm, Y =0.0 cm, shown by the arrow.



Multipoles' fitting

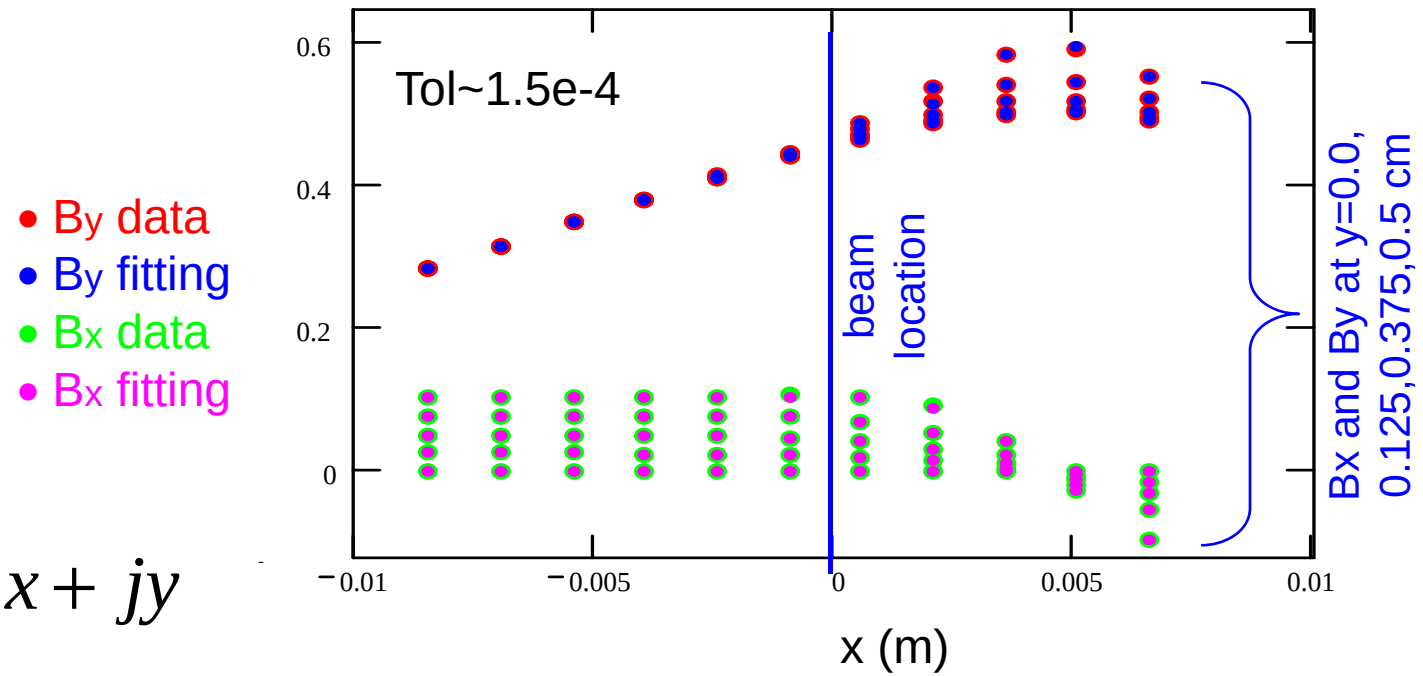
- There are two possible approaches to the beam tracking in the produced field. One can either develop the code allowing one to solve equations of motion for 1e5 particles in the given field (Sergei is working on it), or to fit the field with multipole expansion and use one of the existing beam tracking codes (Feng has results already!)
- We fitted the multipole coefficients of 2D magnetic field :

$$B_y + jB_x = \sum A_n (x + jy)^n$$

- Extracted beam has x=2.2 cm offset when passing through Q7; so we shifted the coordinate system's origin to (x, y)=(2.2, 0) cm.

Multipoles' fitting

- Fitting 2D field (By+jBx):



$$z = x + jy$$

$$B_y + jB_x = 0.461 + 17.557z - 959.345z^2 - 1.426\cdot 10^5 z^3 - 9.898\cdot 10^6 z^4$$
$$+ 4.93\cdot 10^8 z^5 + 1.551\cdot 10^{11} z^6 + 6.512\cdot 10^{12} z^7 - 9.81\cdot 10^{14} z^8$$
$$- 9.424\cdot 10^{16} z^9 + 2.051\cdot 10^{18} z^{10} + 4.082\cdot 10^{20} z^{11} - 6.191\cdot 10^{21} z^{12} - 1.281\cdot 10^{24} z^{13}$$