



# Estimating the effects from non-linearities in the ATF extraction line

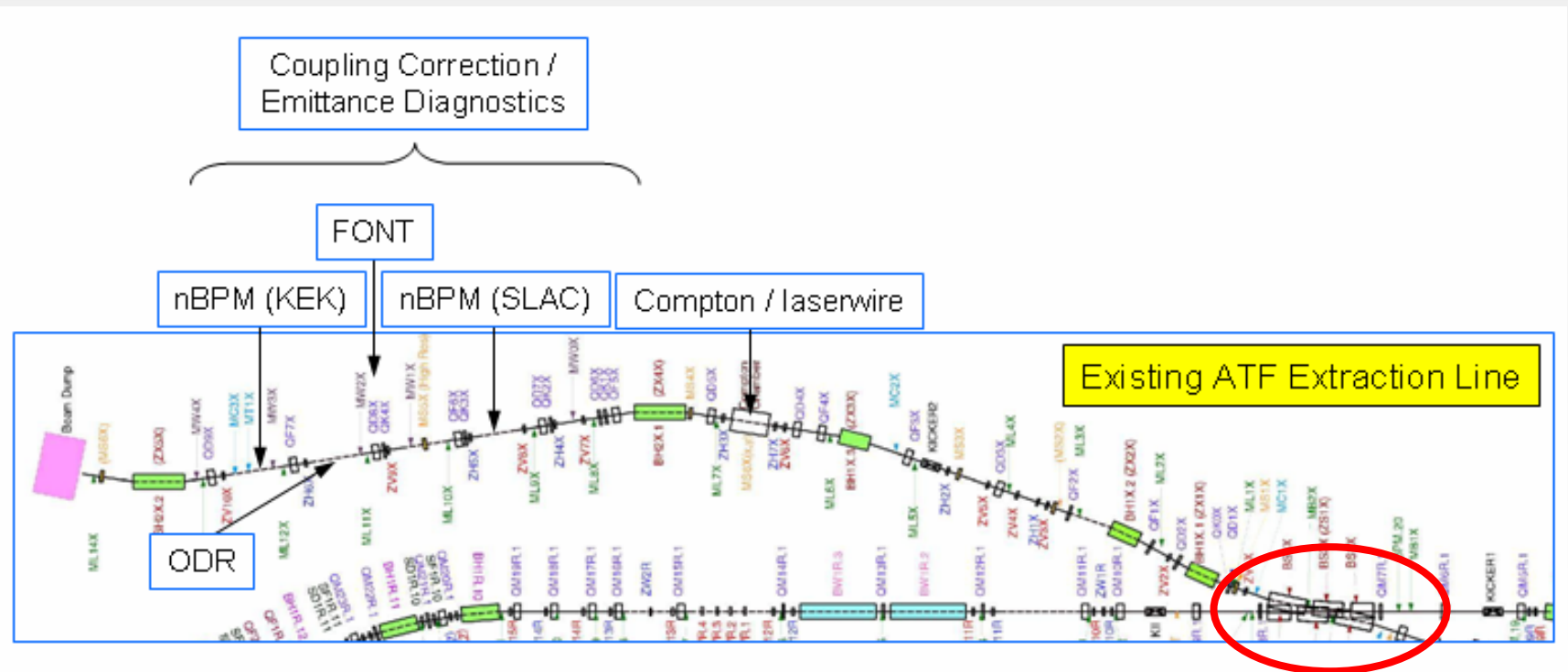
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IFIC - LAL - CERN

15<sup>th</sup> October 2007

# ATF Extraction Line (EXT)

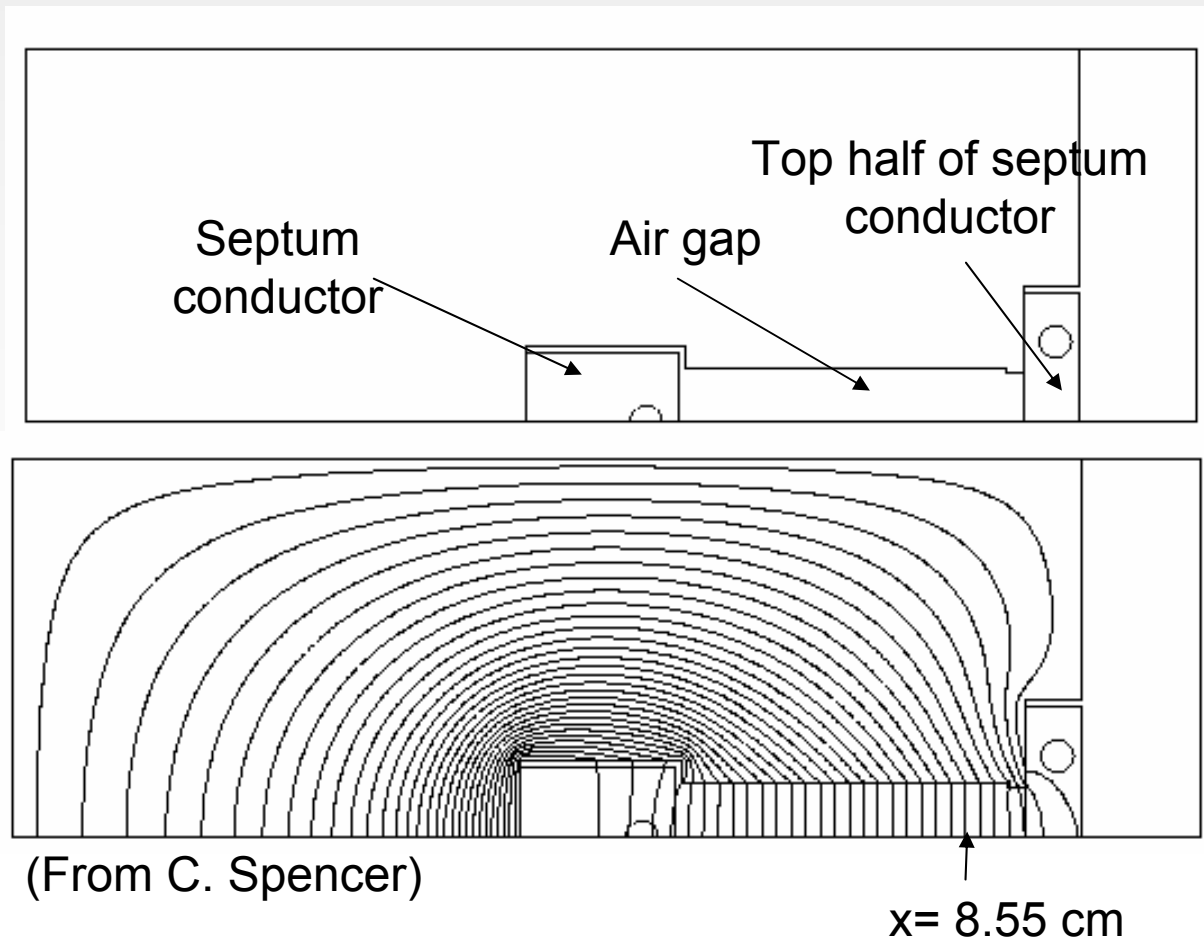
Study the effect of the non-linearities of the magnets shared with the DR on the vertical emittance



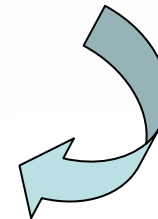
Septum magnets + Q7 and Q6 quadrupoles

# Shared magnets

The beam passes off-axis through the QM6X and QM7X quadrupoles and the BS1X, BS2X and BS3X septum magnets.



The beam passes off-axis through the septum (BS1X)



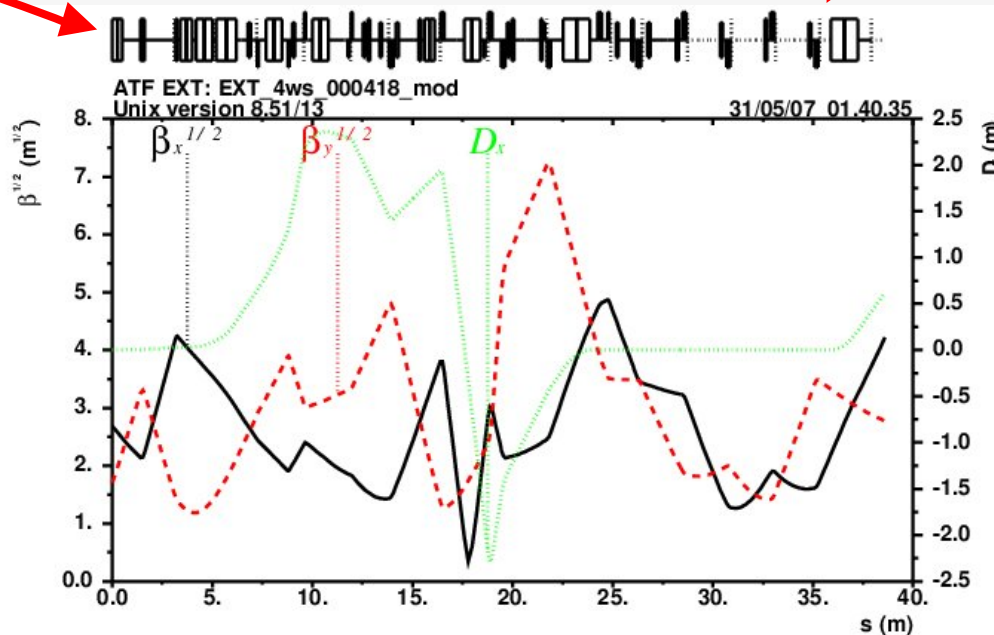
# On-going work

## Tracking studies in the ATF Extraction Line:

- Introducing multipole components for the septum magnets and the QM7 and QM6 quadrupoles (from C. Spencer)
  - For different beam offsets
- to estimate the impact on the emittance of the beam.

# On-going work

- Create distribution of particles with PLACET (50000 particles) at the entrance of EXT (KE1X) with different x/y beam offsets (transverse Gaussian distribution, uniform flat momentum distribution)
- Tracking with MAD8 (SR)
- Reading emittance in the last wire scanner (MW4X):



# On-going work

Properties of the beam at the EXT entrance (KE1X):

normalized  
emittances

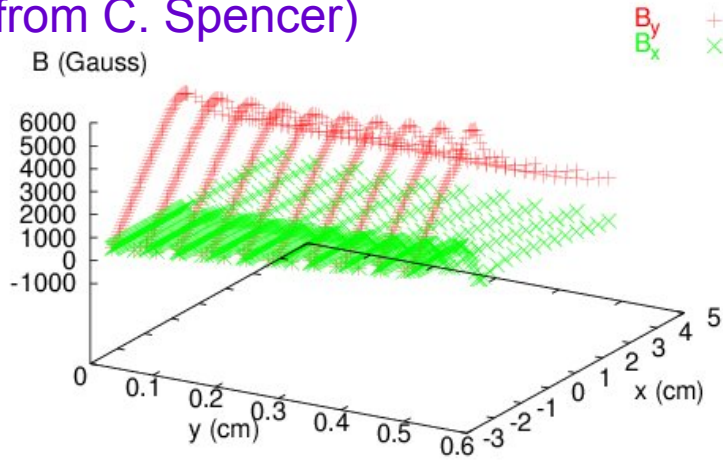
$E_0$ (GeV)	1.3
$\gamma\varepsilon_x$ (m rad)	$3.0 \times 10^{-6}$
$\gamma\varepsilon_y$ (m rad)	$3.0 \times 10^{-8}$
$\sigma_\varepsilon$ (%)	0.1
$\sigma_z$ (mm)	8.0
$\beta_x$ (m)	7.212
$\beta_y$ (m)	2.903
$\alpha_x$ (m)	1.151
$\alpha_y$ (m)	-1.721

	Beam offsets
y (mm)	0 – 1.4
x (mm)	0 – 5.0

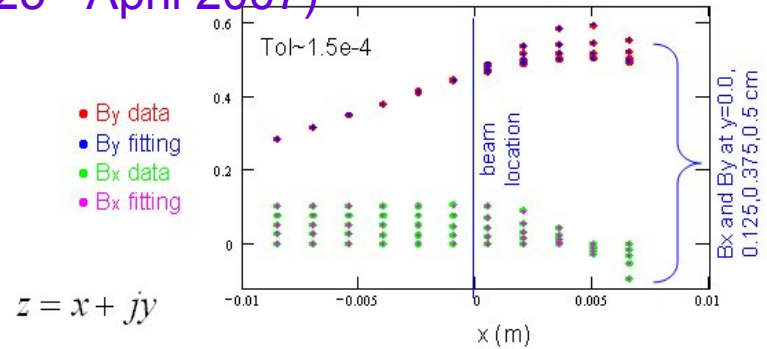
Tracking studies with MAD8 introducing only QM7 multipoles

# Quadrupole QM7 (multipole decomposition)

Field map of a Q7-like quadrupole (from C. Spencer)



Fit presented by F. Zhou and S. Seletskiy (25<sup>th</sup> April 2007)



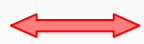
$$z = x + jy$$

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

QM7 Multipoles used:

N	KN	MAD notation
1	0.008393025	K0L
2	0.319194707	K1L
3	-26.54876593	K2L
4	-11839.7016	K3L
5	-3287021.959	K4L
6	818592369.1	K5L
7	1.5452E+12	K6L
8	4.54134E+14	K7L
9	-5.47305E+17	K8L

N	KN	MAD notation
1	-0.00894	K0L
2	0.39808	K1L



20% difference

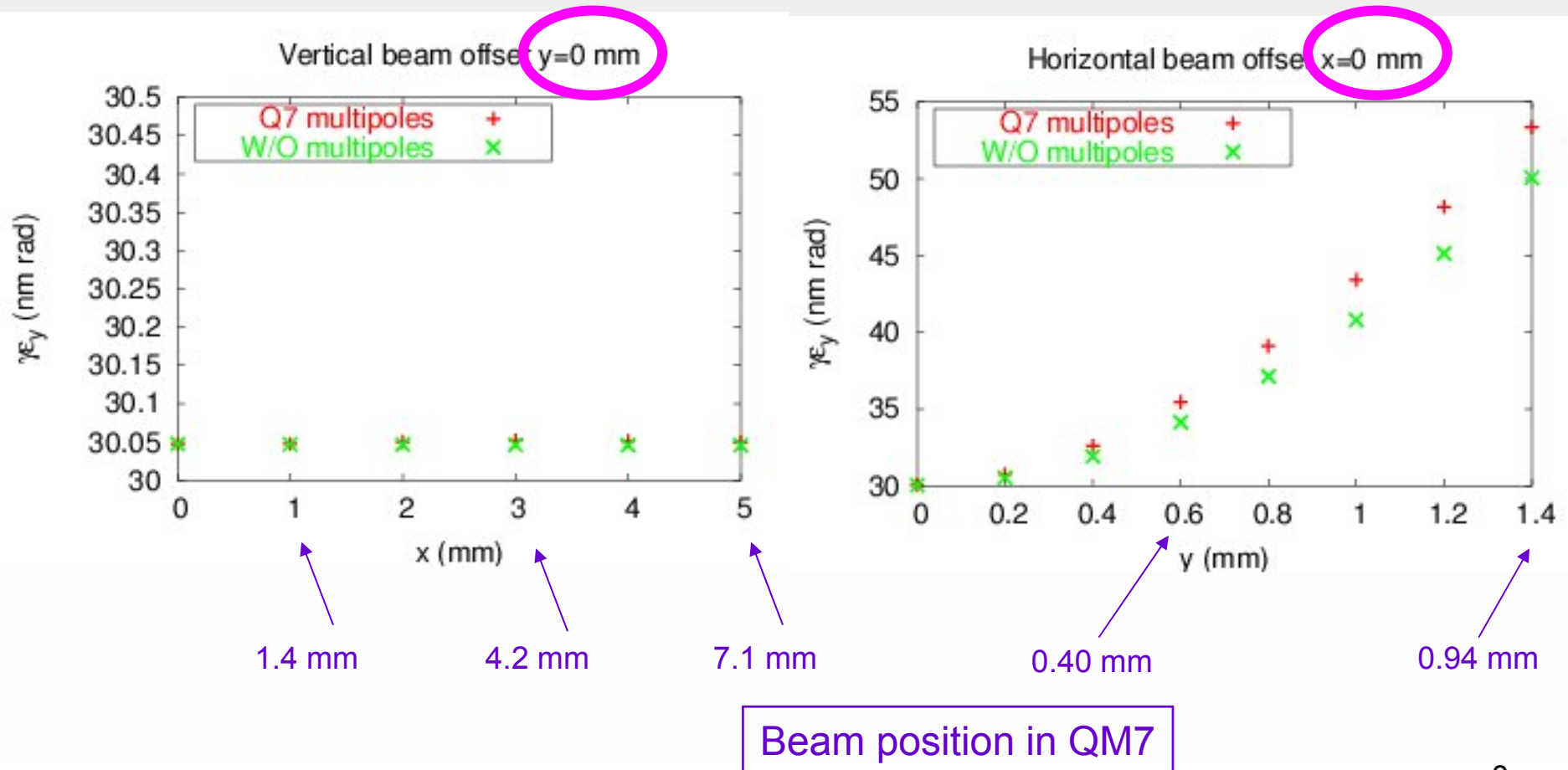


(from EXT.mad file)

# Tracking studies with multipole field for QM7

Vertical emittance vs horizontal beam offsets

Vertical emittance vs vertical beam offsets





# Tracking studies with multipole field for QM7

## Vertical emittance with x and y beam offsets

