Fringe Field Effects in Quadrupole Cooling Channels

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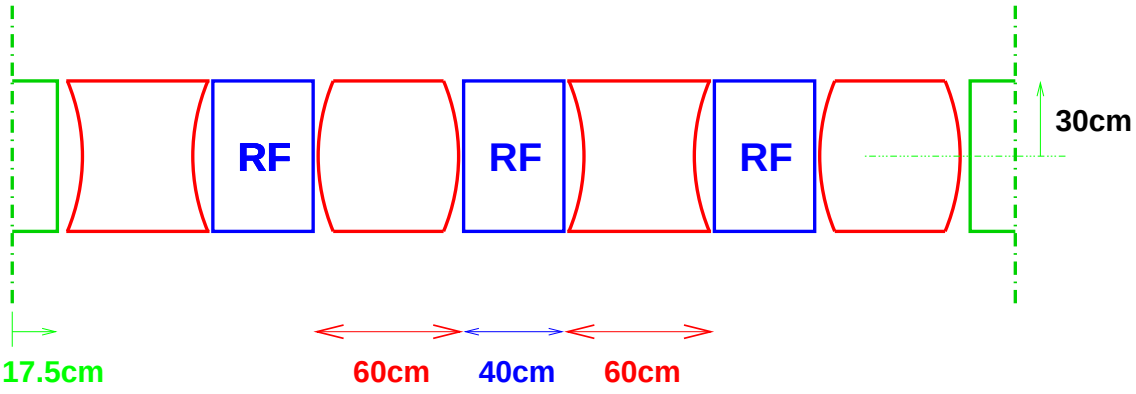


E-exchange meeting, Fermilab, 6/11/2002

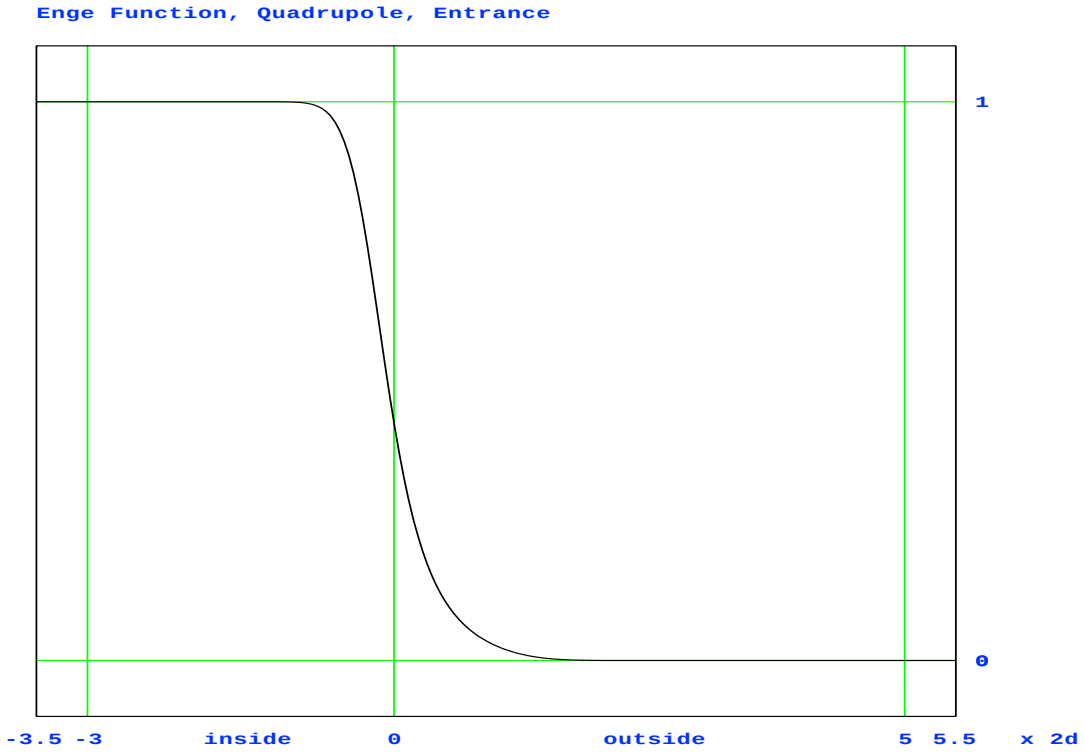
Enge Function for the Fringe Field Fall-off

$$F(s) = \frac{1}{1 + \exp(a_1 + a_2 \cdot (s/D) + ... + a_6 \cdot (s/D)^5)}$$

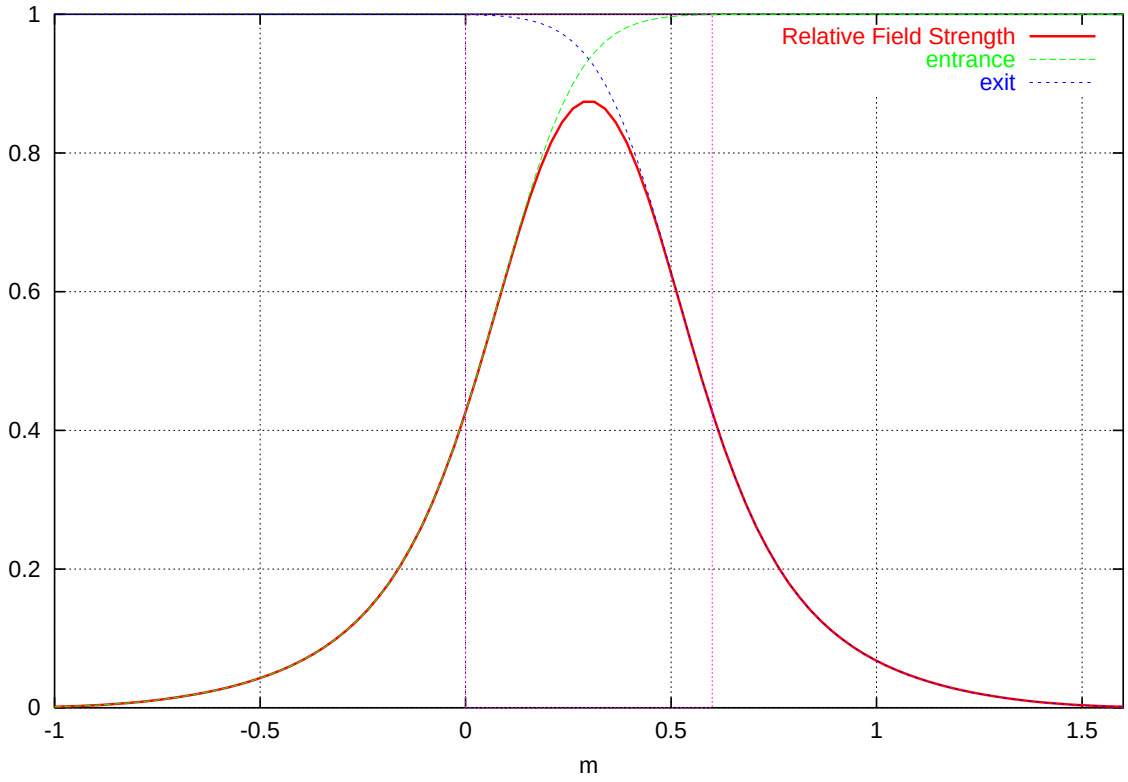
D : the full aperture

Enge Coefficients of Various Quadrupoles

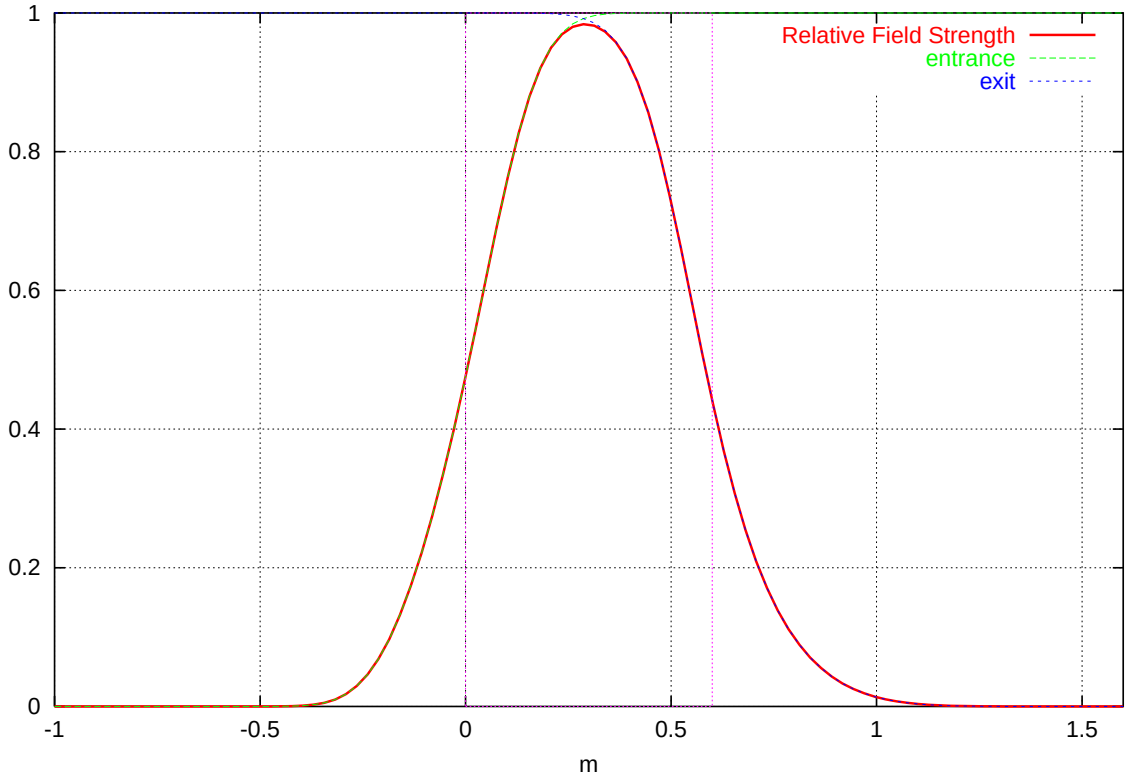
		a_1	a_2	a_3	a_4	a_5	a_6
SLAC-PEP		0.296471	4.533219	−2.270982	1.068627	−0.036391	0.022261
S800 Q II	Entr.	0.0965371	6.63297	−2.718	10.9447	1.64033	0.00
	Exit	0.235452	6.60424	−3.42864	4.38392	−0.573524	0.00
LHC-HGQ lead		−0.939436	3.824163	3.882214	1.776737	0.296383	0.013670



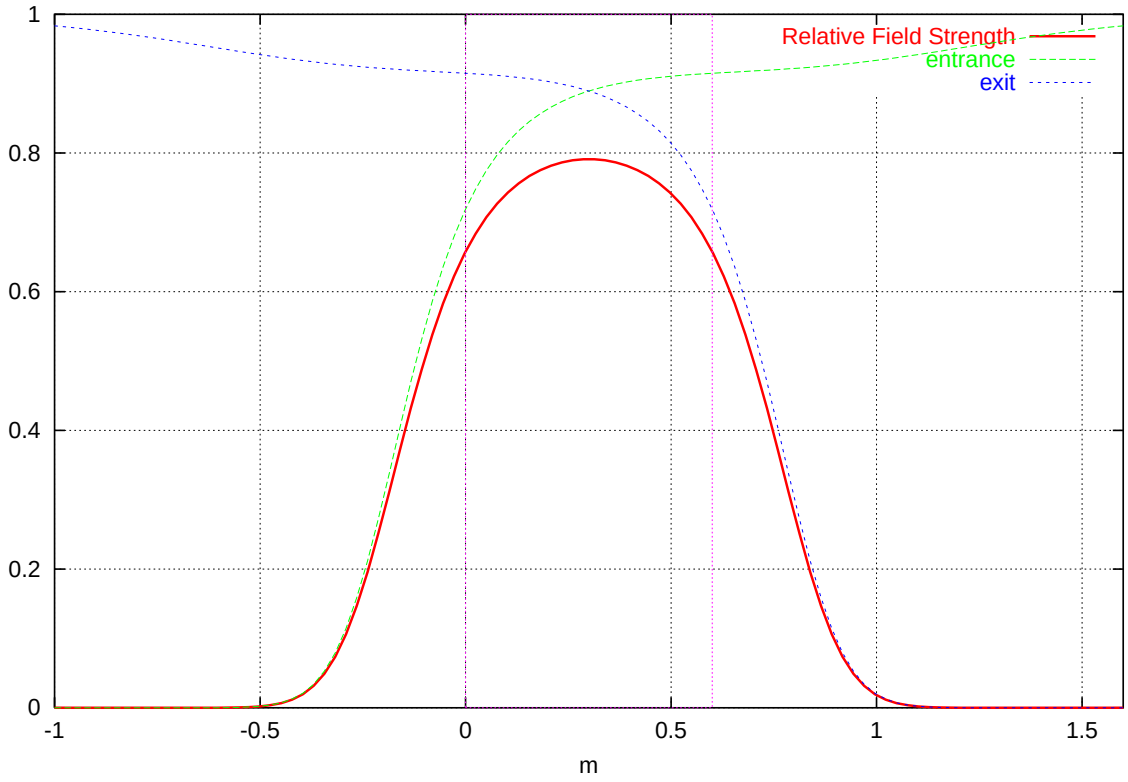
MQ Enge fall-off (measurement from PEP/SLAC) for 60cm full aperture, 60cm length



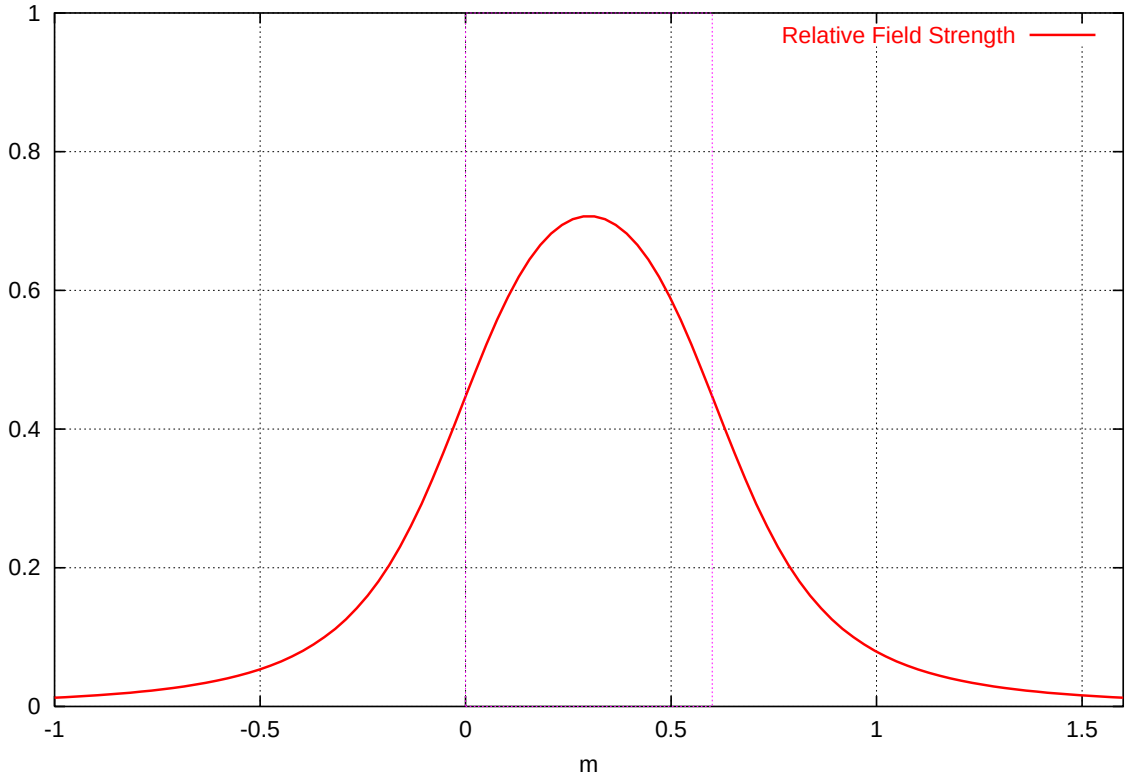
MQ Enge fall-off (measurement from MSU/S800 Quad II) for 60cm full aperture, 60cm length



MQ Enge fall-off (measurement from LHC/HGQ lead end) for 60cm full aperture, 60cm length



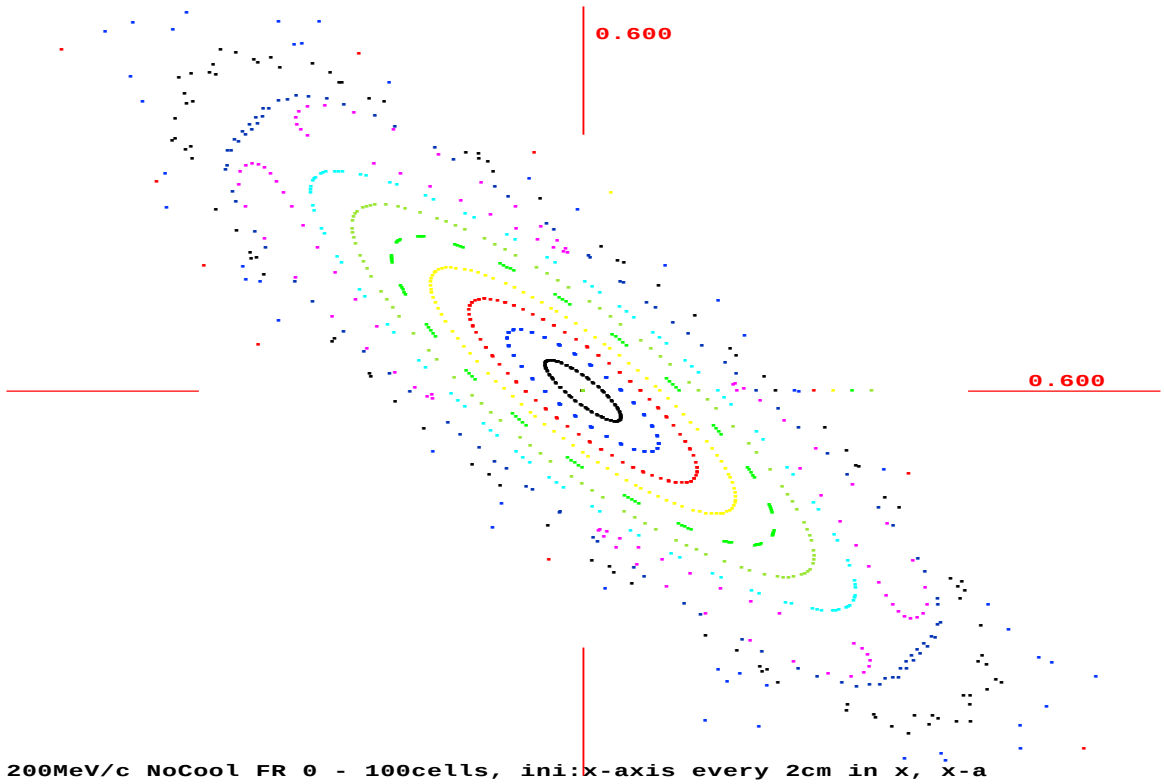
Ideal Solenoid for 60cm full aperture, 60cm length



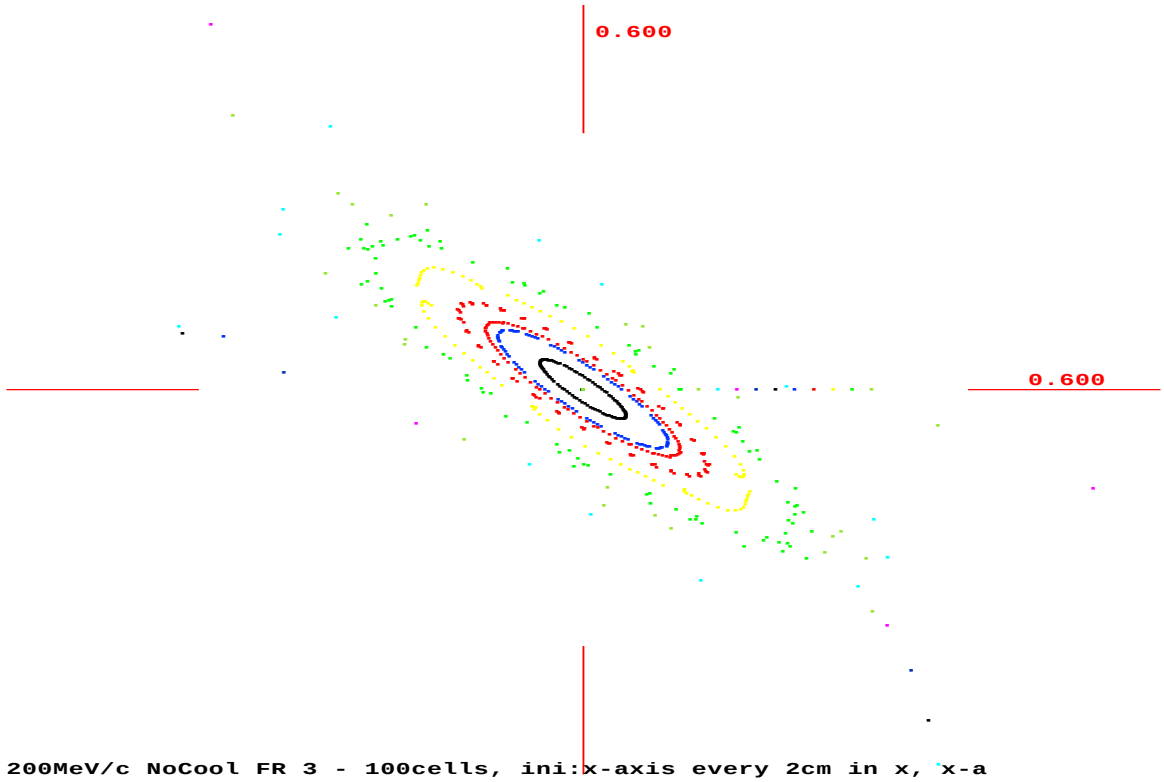
Fringe Field Effects on Quad Channel Tracking

200 MeV/c Particles along the x-axis at every 2cm are tracked through 100 Quad cells (without cooling, nor acceleration). The pictures are shown in the x - p_x/p_0 plane in the frame size 60cm $\times$ 0.6 rad.
(The title page shows the cell for this study.)

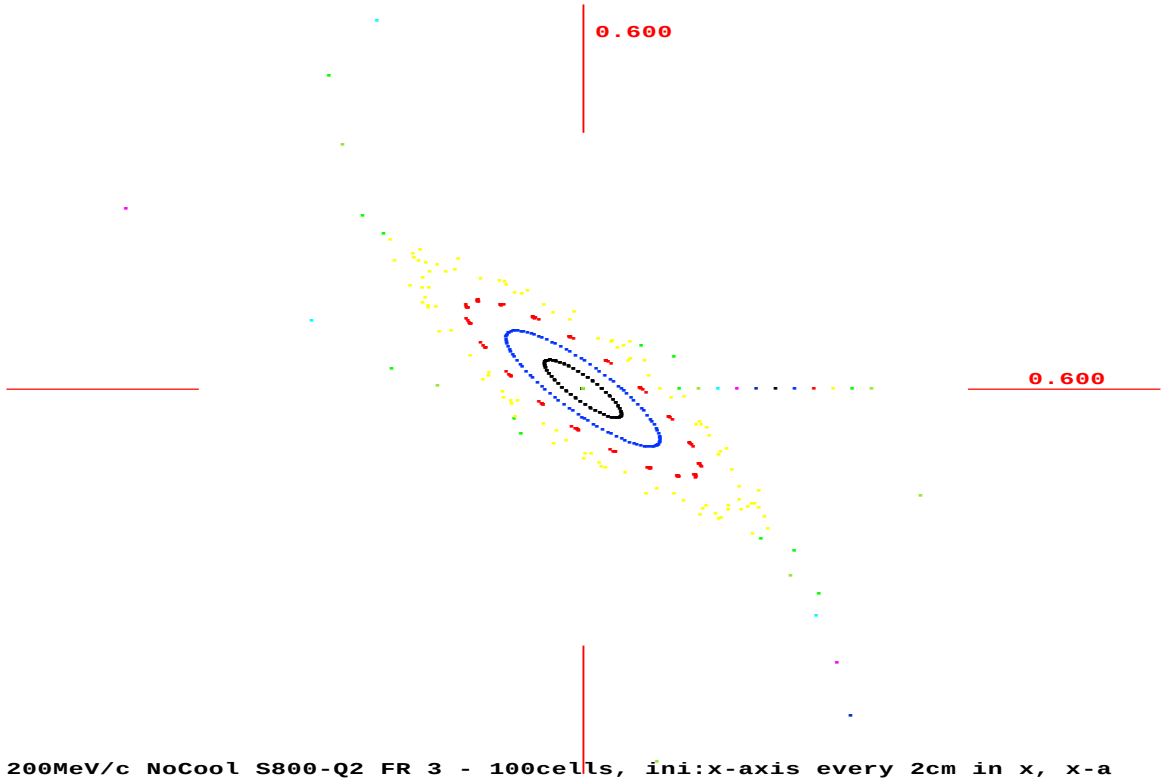
Sharp Cut-off Fringe Field Model
(No Fringe Field Effect Consideration)



PEP/SLAC Quad Fringe Field Fall-off Model



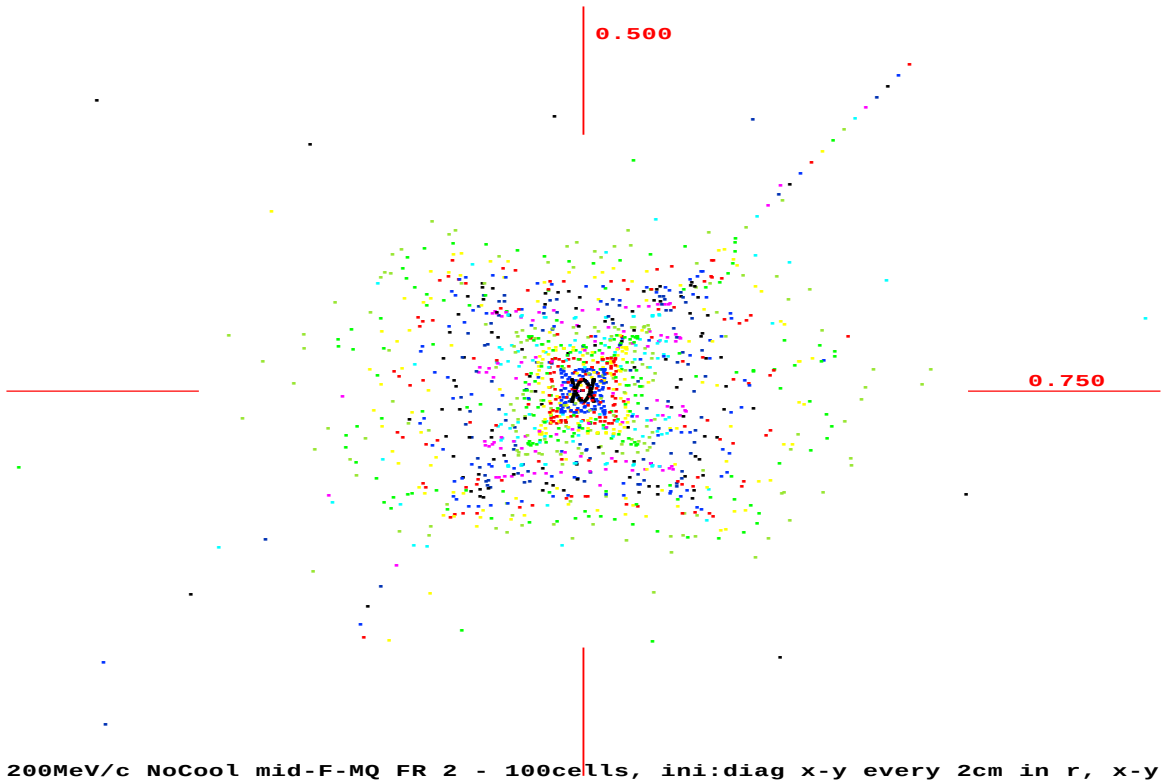
S800 Q II Quad Fringe Field Fall-off Model



Off Particles' Survival through the Channel

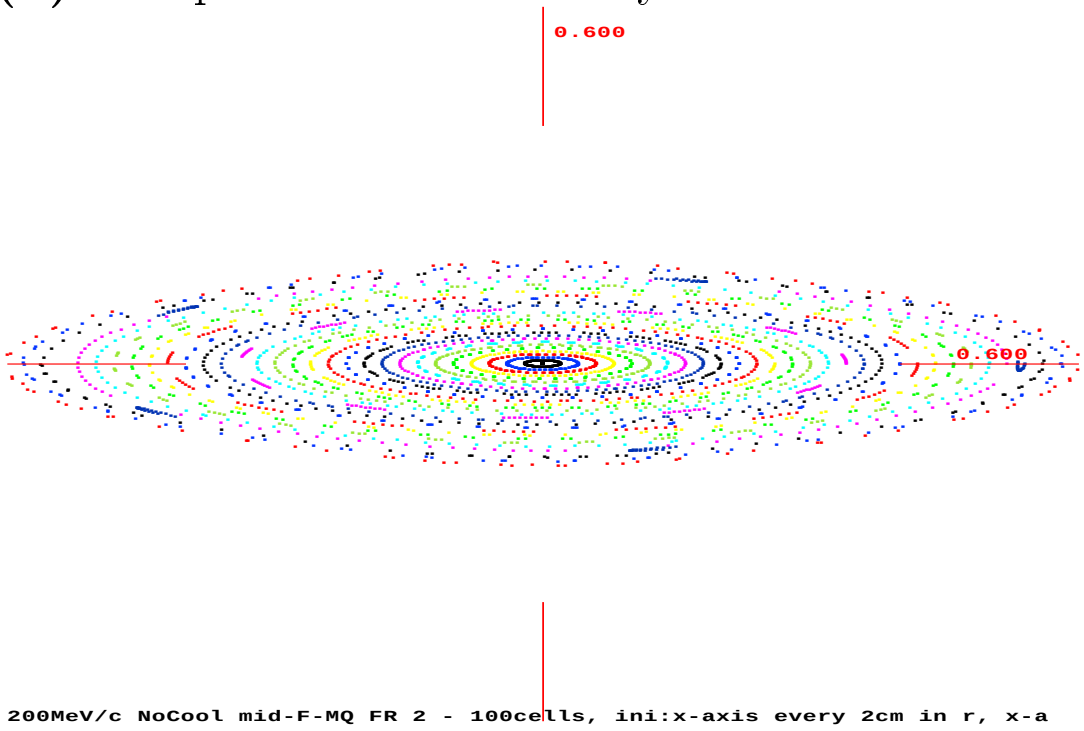
200 MeV/c Particles are tracked through 100 cells, where each cell starts in **the middle of focusing** quad (β_x is maximum). Particles start at every 2cm along
(1) the x axis,
(2) the y axis,
(3) the x-y diagonal.
COSY's fast fringe field computation mode (FR 2) is used with model for SLAC/PEP.

(3) in the x - y plane with frame size 75cm $\times$ 50cm.
The x direction survives more.

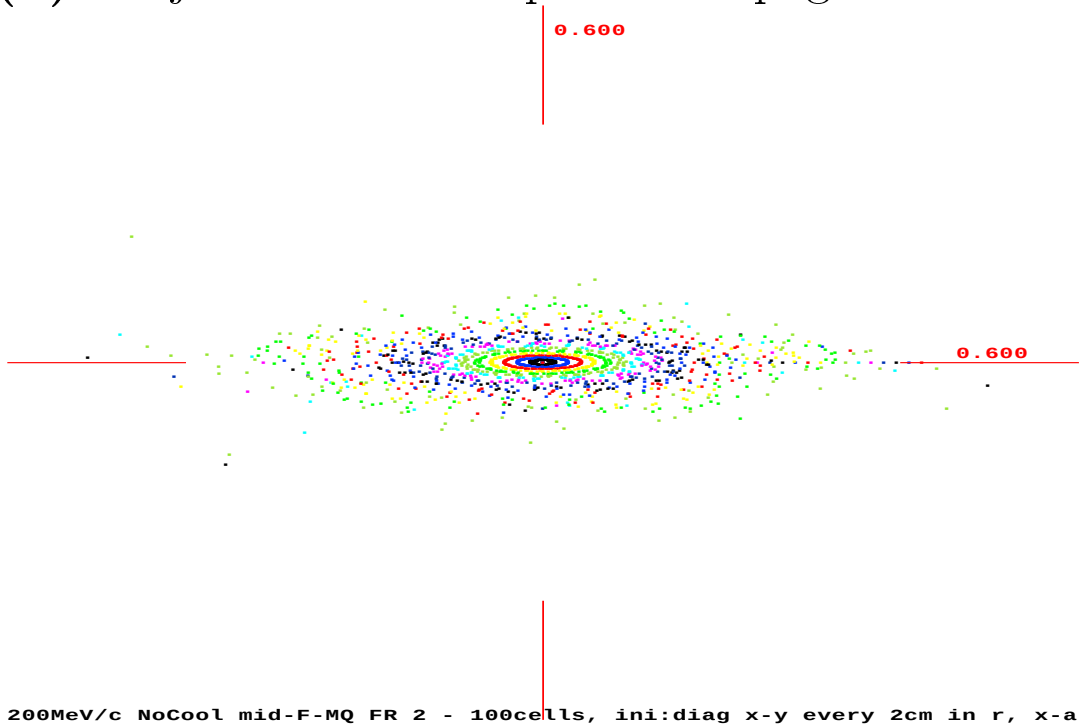


In the x - p_x/p_0 plane with frame size 60cm $\times$ 0.6 rad.

(1) The particles survive fully.

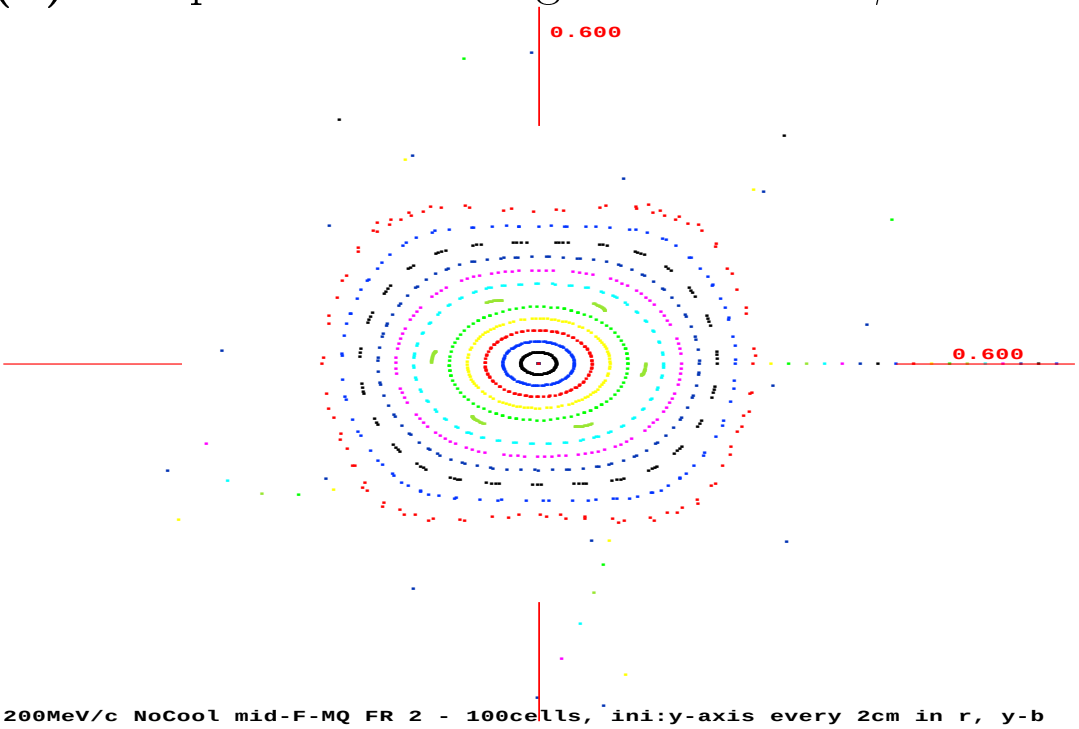


(3) Projected from the picture in page 7.



In the y - p_y/p_0 plane with frame size 60cm $\times$ 0.6 rad.

(2) The particles starting from the low β survive.



(3) Projected from the picture in page 7.