NF-FE: 44-88 MHz scenario
44-88 MHz Front-end (1/2)

Pion production: 2 GeV proton beam on a 26 cm long Hg target in 20 T field (SPL+accumulator & compressor ring).

Decay: 30 m long in 1.8 T.

Rotation: particles with 100-300 MeV in kinetic energy rotated using 44 MHz (2 MV/m) RF cavities (energy spread divided by 2) in 1.8 T solenoid.

Cooling I: 44 MHz RF + H$_2$ absorbers ($\varepsilon_{\perp}$ reduced by 40%).

Acceleration I: particles accelerated to an average energy of 300 MeV with 44 MHz cavities.

Cooling II: 88 MHz RF + H$_2$ absorbers ($\varepsilon_{\perp}$ reduced by 30%).

Acceleration II: 88 MHz cavities.
44-88 MHz Front-end (2/2)

Cavities phasing from 121 to -4 degrees.

Lattice translated in ICOOL:
- using 0.5 m solenoids coils and 1 m long cavities.
- cell length of 3 m - 1 m and 7 m.
Lattice transverse optics (1/3)

Scott's method: initial beam of 8 particles with \((x,px,y,py)\) coordinates \((\pm \delta x,0,0,0) - (0,\pm \delta px,0,0) - (0,0,\pm \delta y,0,0)\) and \((0,0,0,\pm \delta py)\).

\pm \delta x,y = 1 \text{ mm} - \pm \delta px,y = 1 \text{ MeV/c}.

Transfer map:

\[
M_{ij} = \left. \frac{\partial f_i}{\partial x_j} \right|_{x_0} = \frac{f_i(x_0 + e_j \cdot \mathbf{u}_j) - f_i(x_0 - e_j \cdot \mathbf{u}_j)}{2 \cdot e_j}
\]

Where \(f_i\) is the \(i\)th coordinate of the transform of a particle with small deviation \(e_j\) in direction \(\mathbf{u}_j\).
Lattice transverse optics (2/3)

Case of a drift of length $L$ (no RF no magnetic field):

$$M = \begin{pmatrix} 1 & L/pz & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & L/pz \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

and $\text{Tr}(M) = 4$.

Particles momenta constant.

Defocusing in the transverse plane.

ALGORITHM OK.
Lattice transverse optics (3/3)

Case of a solenoid only (no RF): M can be decomposed into a product of a rotation matrix and a focusing matrix function:

- still struggling to get the equations right (field strength and period angle calculations).

- there is some periodicity in the lattice still not understood.
Lattice transverse optics (4/5)
Lattice Transverse optics (/6)
Lattice transverse optics ()

Trace of transfer matrix

-140
-120
-100
-80
-60
-40
-20
0
20

0 5 10 15 20 25 30 35

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Optimization of B field

Magnetic field on axis

![Graph showing the variation of magnetic field with distance](image-url)
To do

Need to verify if periodicity of transfer map values corresponds to the solenoid periodic functions.

Need to understand the jump at 24 m.

Finishing to optimize the field to a constant field on axis of 1.8 T.