Tracking studies with high intensity beam (160MeV case)

Magdalena Kowalska
supervised by Elena Benedetto

LIU-PSB Injection Studies Meeting

13 October 2014

Goals of the studies

Fact: With the H- injection we will have the possibility to paint transverse profile of the beam.

The main goal is to determine the best beam profile in terms of emittance and intensity preservance, to reduce the halo and to minimize the losses.

Current studies and results

Studies made using PTC-ORBIT

- *Intensity = 1100 e10*
- *Number of macro particles = 500 000*
- *Transverse bin = 256x256*
- *Longitudinal bin = 128*
- 10000 first turns at 160 MeV
- Assuming no acceleration and no ramp of the magnets

Super Gaussian transverse distribution

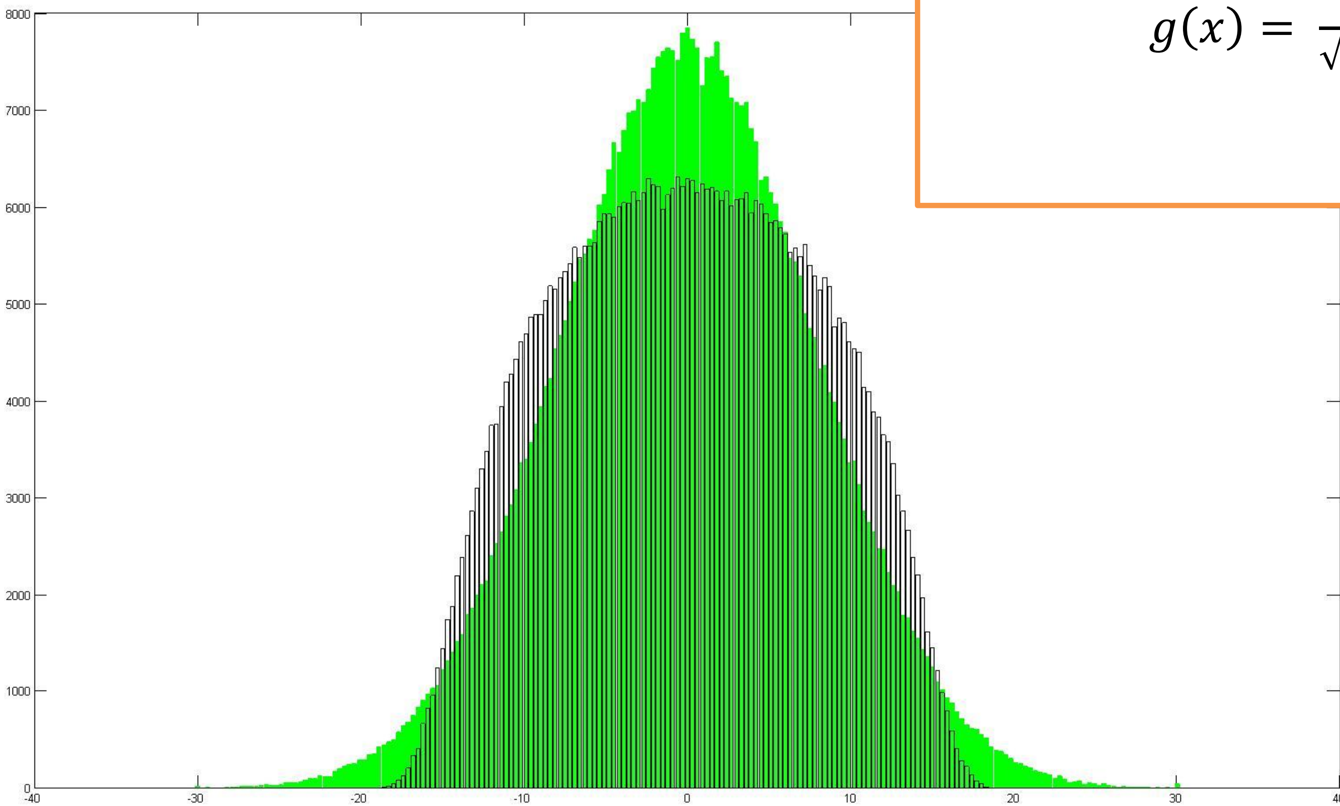
- Normalized horizontal emittance = *15 mm mrad*
- Normalized vertical emittances *10 mm mrad*

Studies of the best beam profile (vertical plane), 160 MeV case

Formula for Super Gaussian distribution:

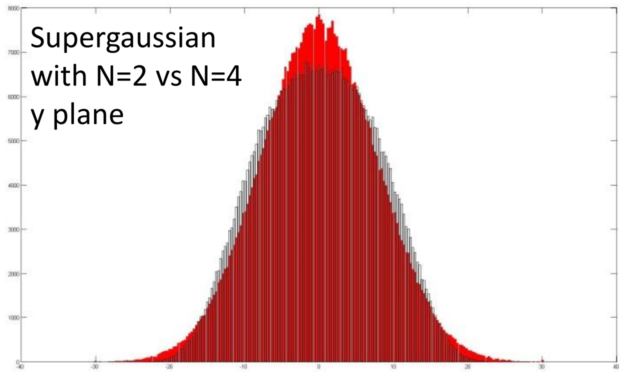
$$g(x) = \frac{1}{\sqrt{2\pi}\,\sigma_0}\, exp\left(\frac{-(abs(x))^N}{2\sigma_0^N}\right)$$

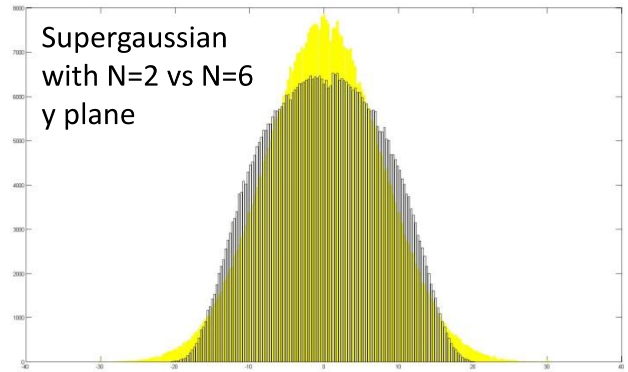
$$\text{with } \sigma = \sigma_0 \left(\frac{\pi}{2}\right)^{\frac{2}{N}-1}$$



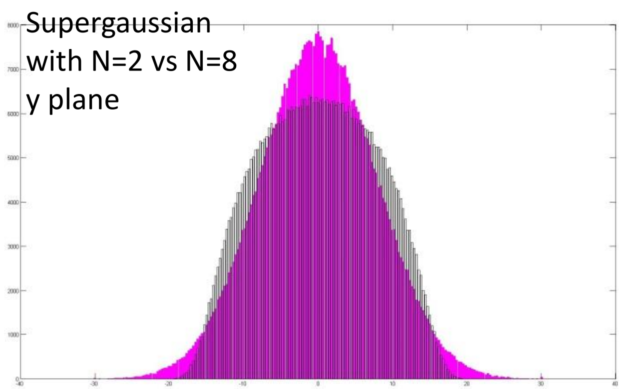
Comparison between Supergaussian distribution for N=10 (in bars) and N=2 (in green)

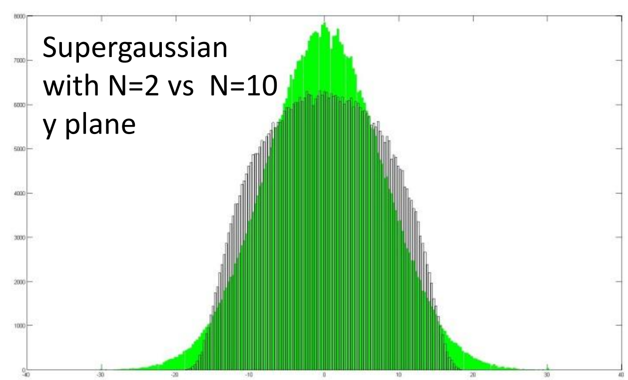
Studies of the best beam profile (vertical plane), 160 MeV case





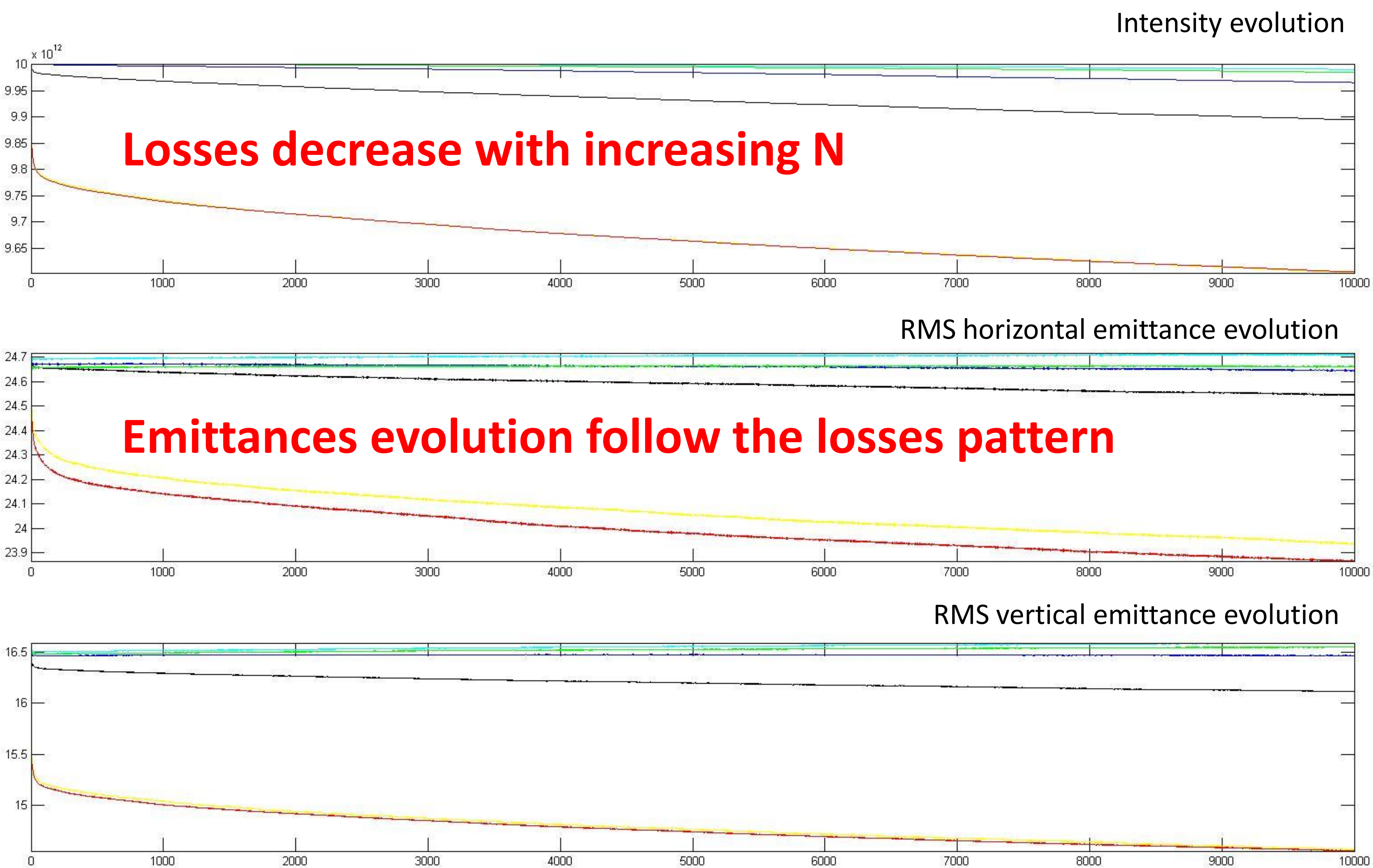
Choice of the N parameter influence the beam profile shape.





Distributions generated for different N with the same horizontal and vertical emittances.

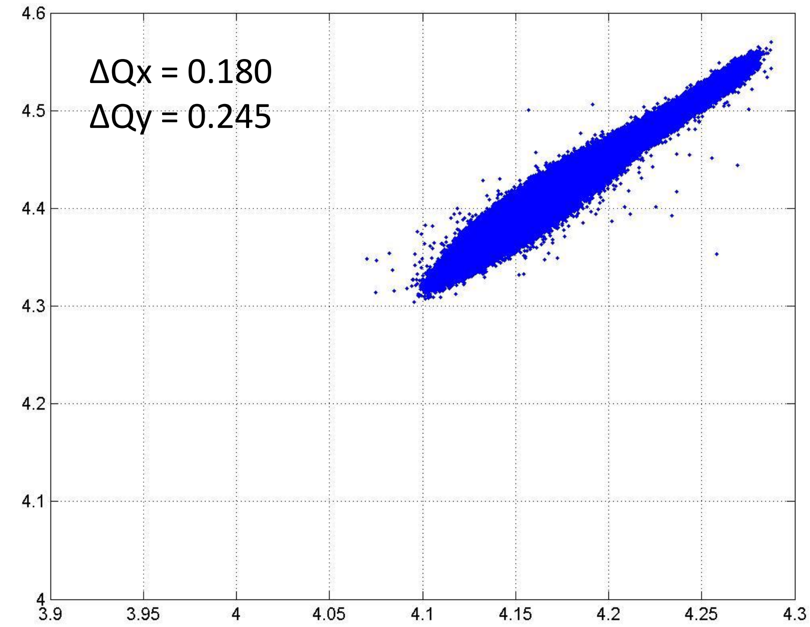
Studies for different beam profiles



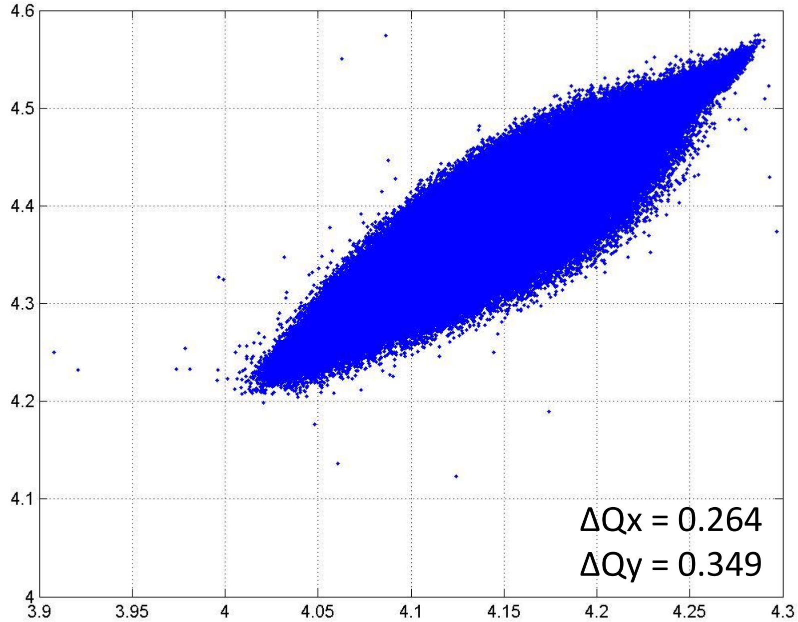
Legend:

standard Gauss
N=2
N=4
N=6
N=8
N=10

Tune spread as a function of beam profile (peak height), 160 MeV case



Tune footprint for Supergaussian N=10 at 160 MeV



Tune footprint for Supergaussian N=2 at 160 MeV

Work plans

Determine the beam parametres at injection for H- 160 MeV case (intensity, emittances)

Run the simulation for assumed scenarios

and

Run the simulations for the painting scheme (i.e. the KSW functions and offsets) produced by Jose and Chiara

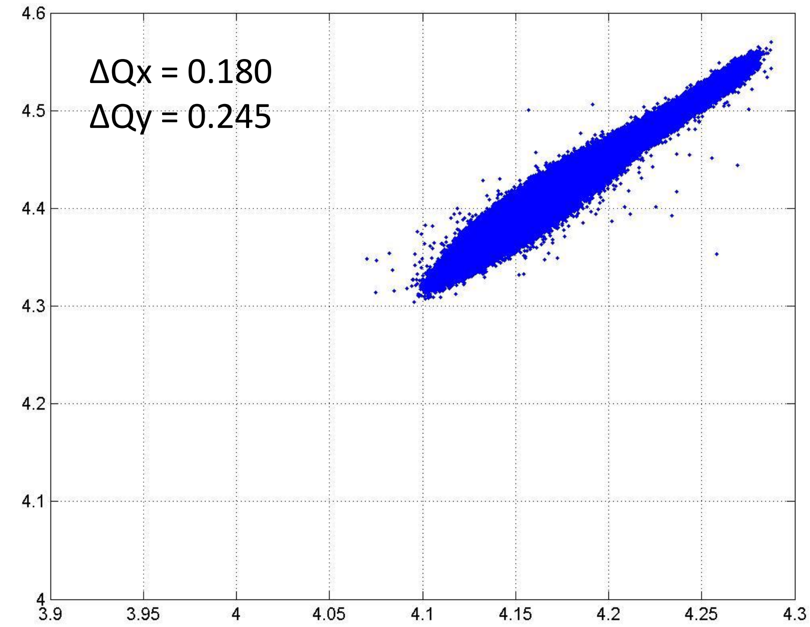
Summary and outlook

It would be nice to determine the initial beam parameters and how flexible we are in terms of the transverse painting (open question to the others)?

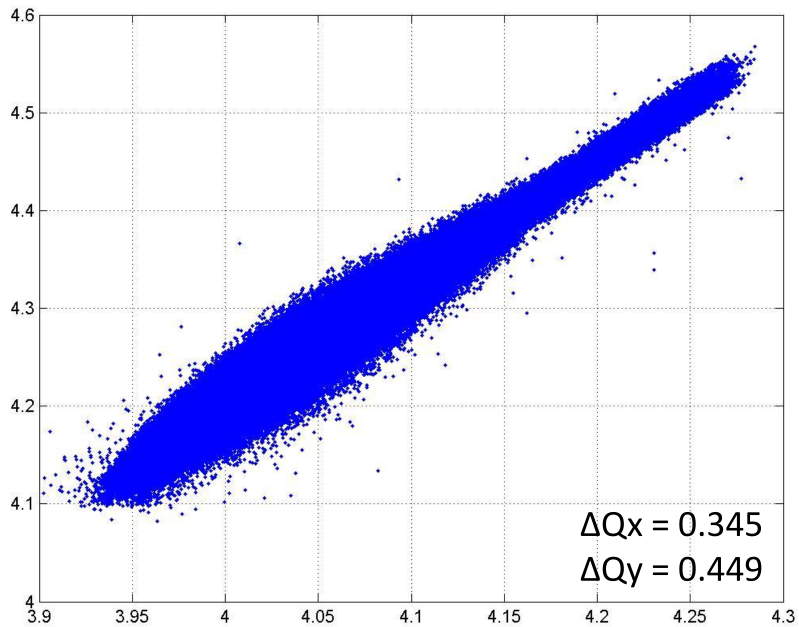
Super Gaussians, with exponent > 6, seem to represent quite well HI beam transverse profile.

Measurements at 160 MeV are foreseen for incomming days in order to observe real beam and to perform the best fit for the transverse profile.

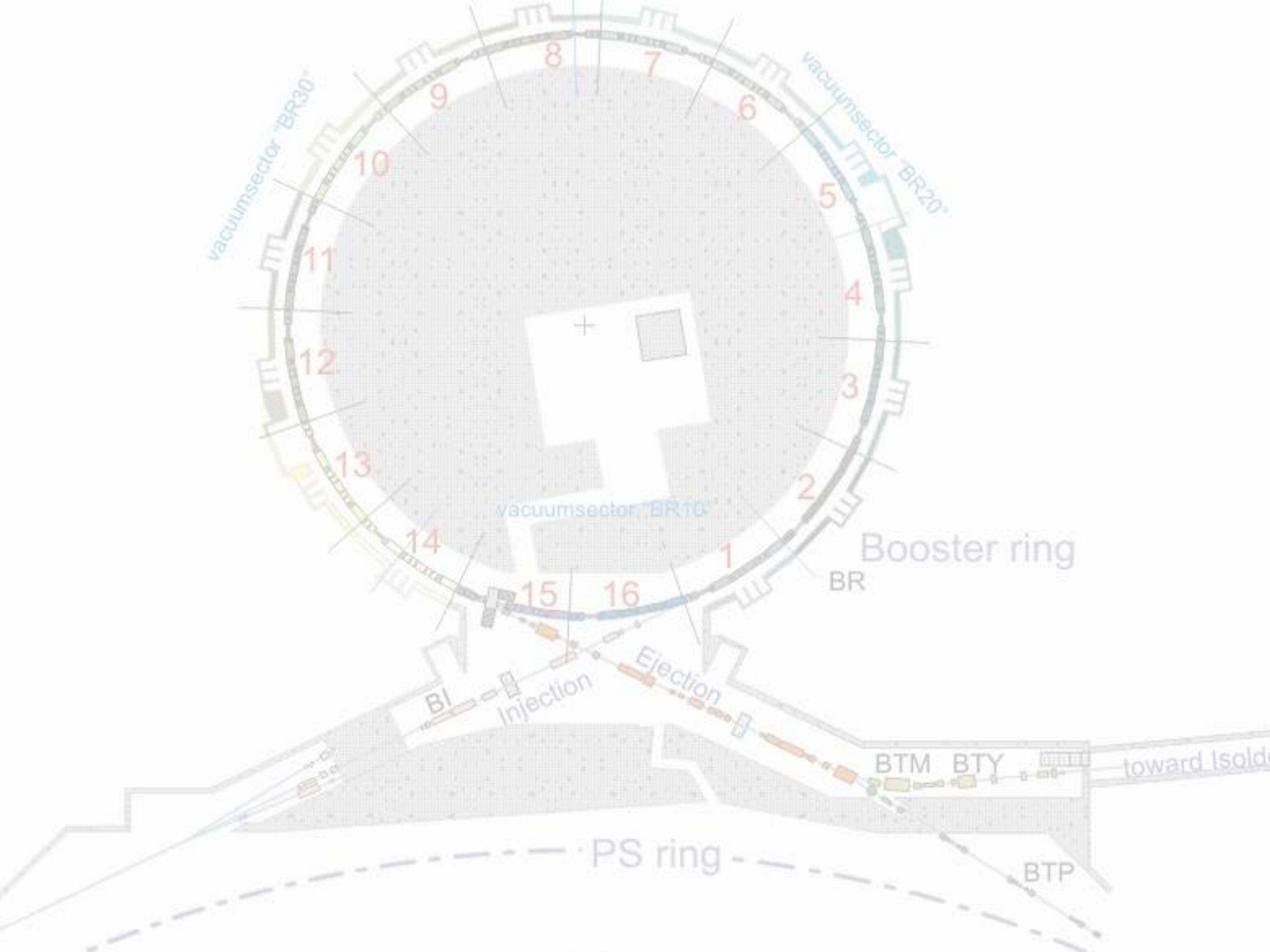
Tune spread as a function of beam intensity (peak height), 160 MeV case



Tune footprint for Supergaussian N=10 at 160 MeV



Tune footprint for Gaussian N=10 at 160 MeV with double intensity



8
7
9
6
vacuumsector "BR30"
vacuumsector "BR20"
10
5
11
4
12
3
13
2
vacuumsector "BR10"
14
1
Booster ring
BR
15
16
Ejection
Injection
BI
BTM
BTY
toward Isolde
PS ring
BTP