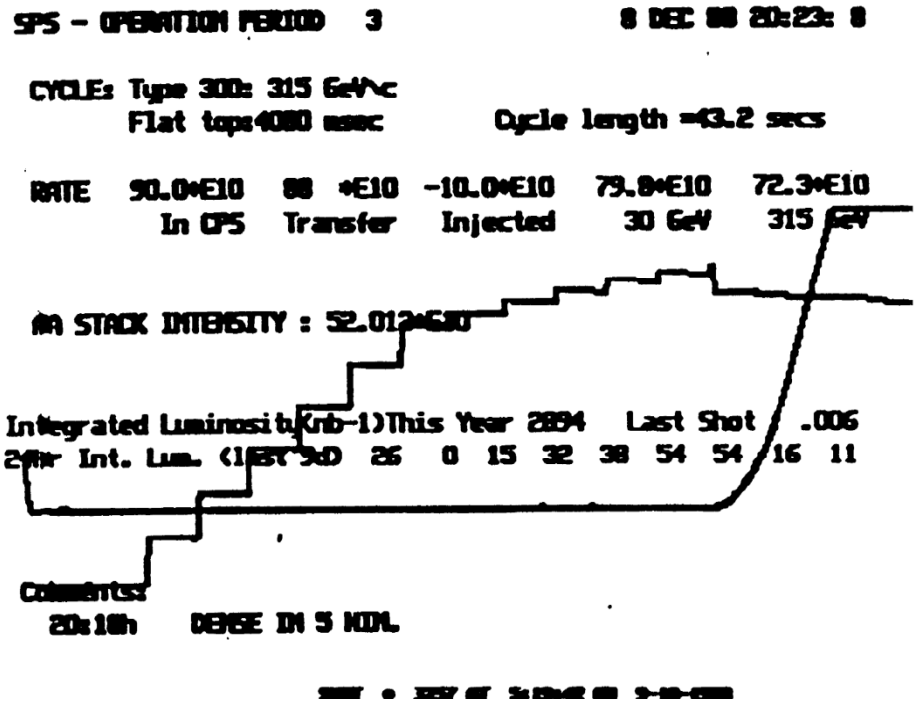
SPS experience with reduced distance encounters

K. Cornelis

CERN

Some parameters



Injection energy : 26 GeV

Coast energy : 315 GeV

Protons :1.7 10^{11}/bunch 6 bunches

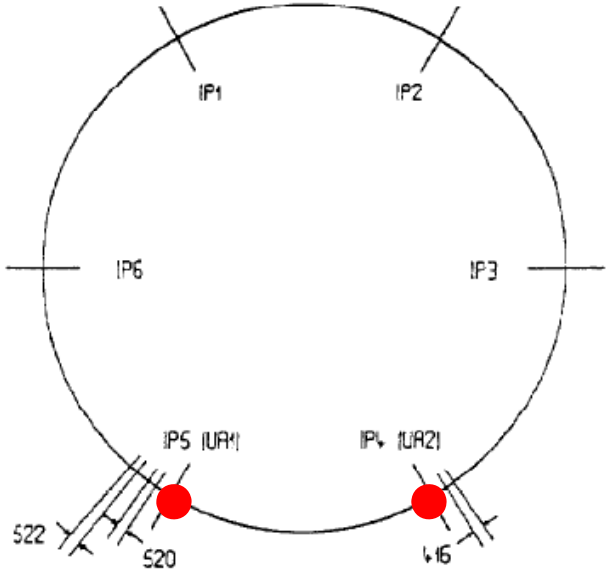
Pbar :0.8 10^{11}/bunch 6 bunches

ε_x,ε_y **:**15 to 20 mm mrad (ε being defined as $4\gamma\sigma^2/\beta$)

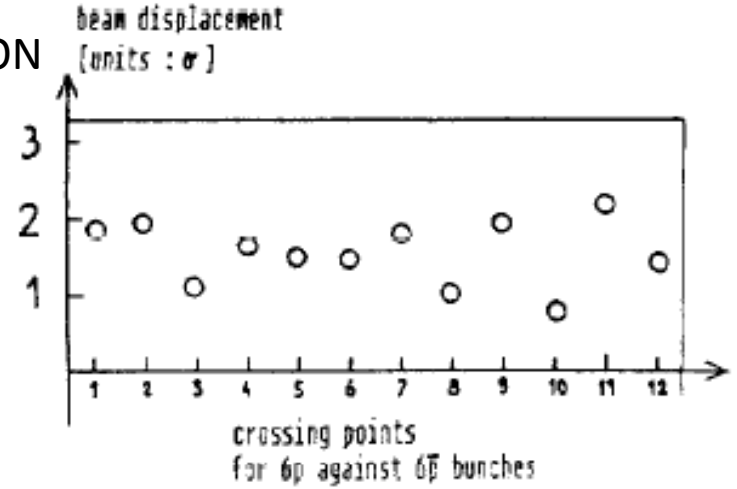
b-b tunshift $\xi_{x,y}$ **:** 0.015 to 0.02 (total)

Cromaticity : .005 (dQ/Q/dp/P)

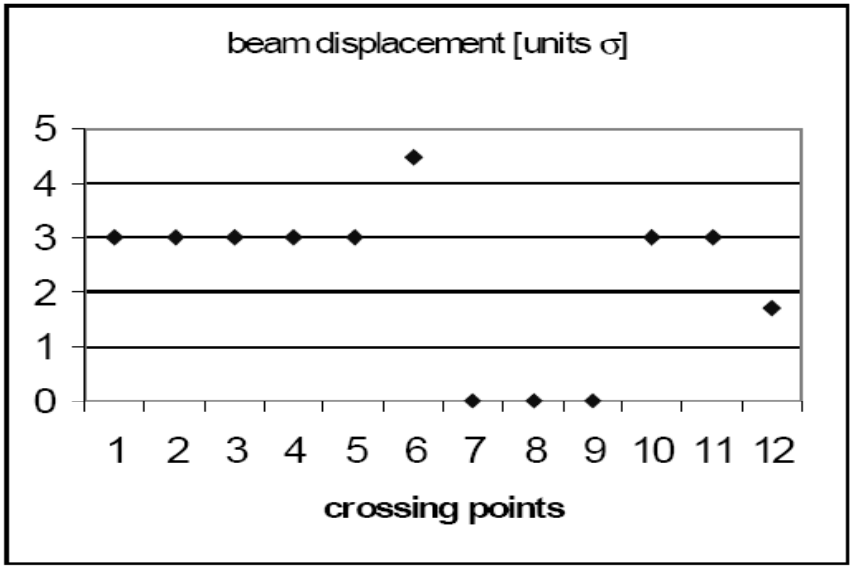
SPS separation scheme

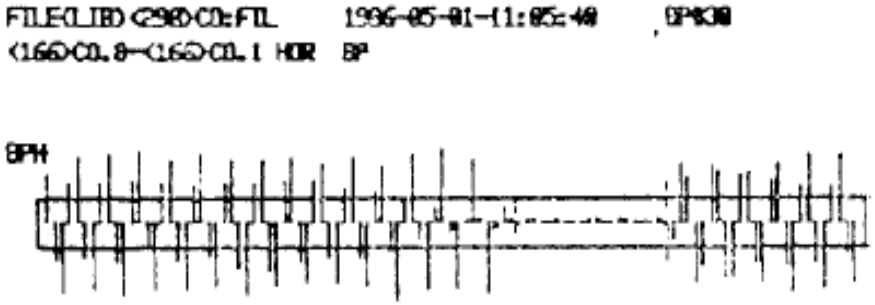


INJECTION

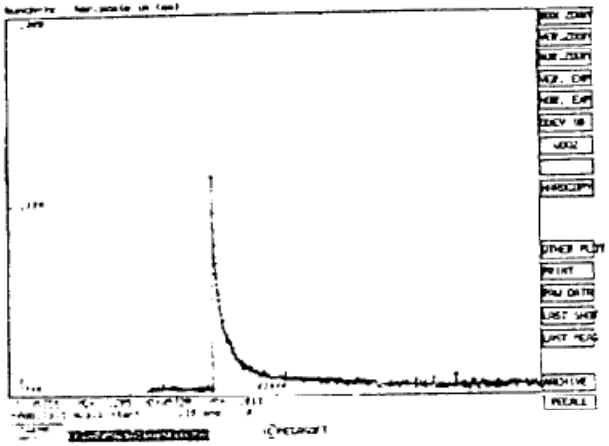


COAST

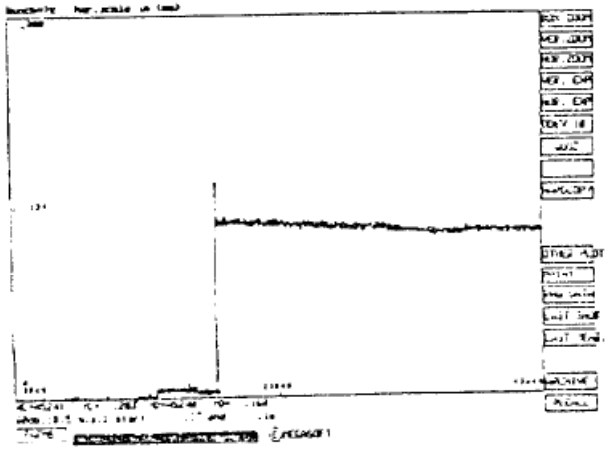




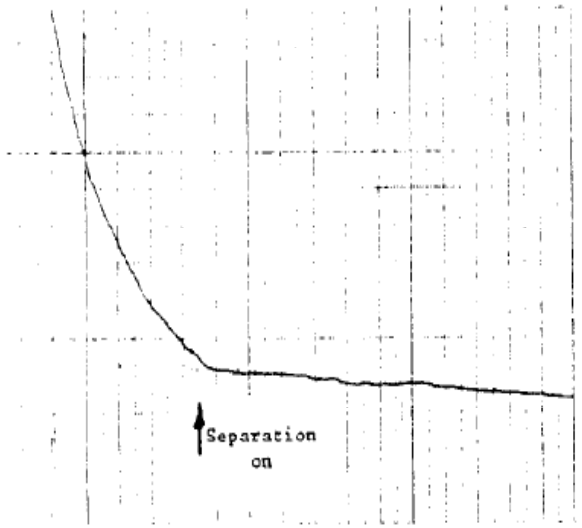
Separation is beneficial



Injection
Without separation

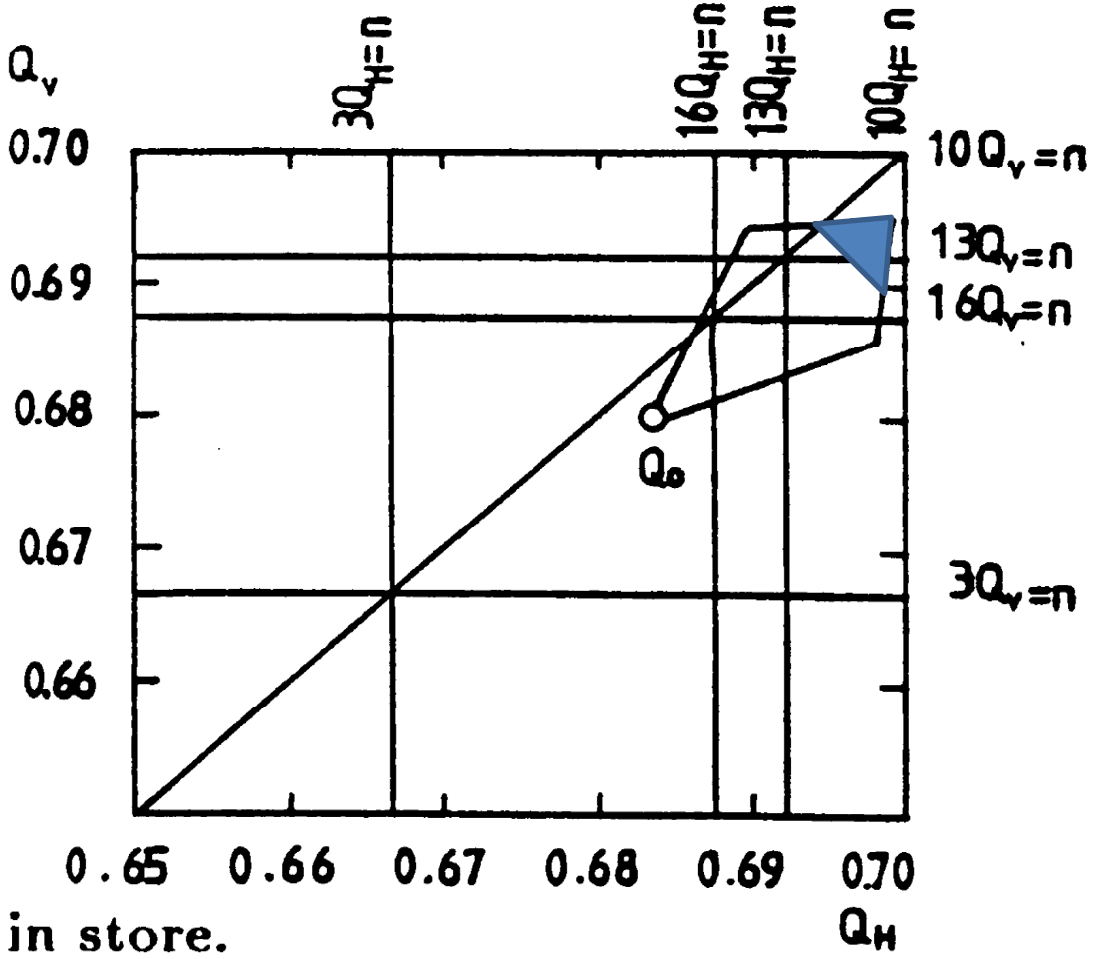


Injection with
separation



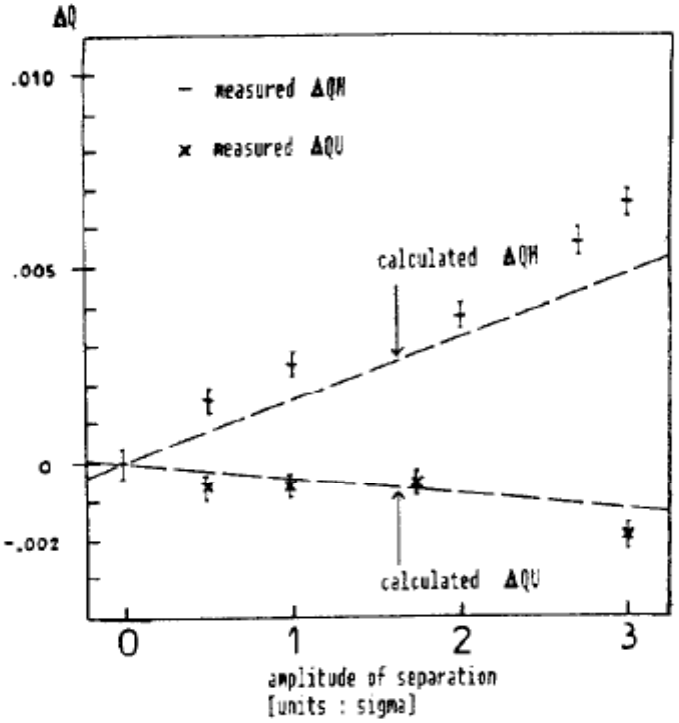
COAST

Working point in coast



.m in store.

(some) Independent tune control for **p** and **pbar**

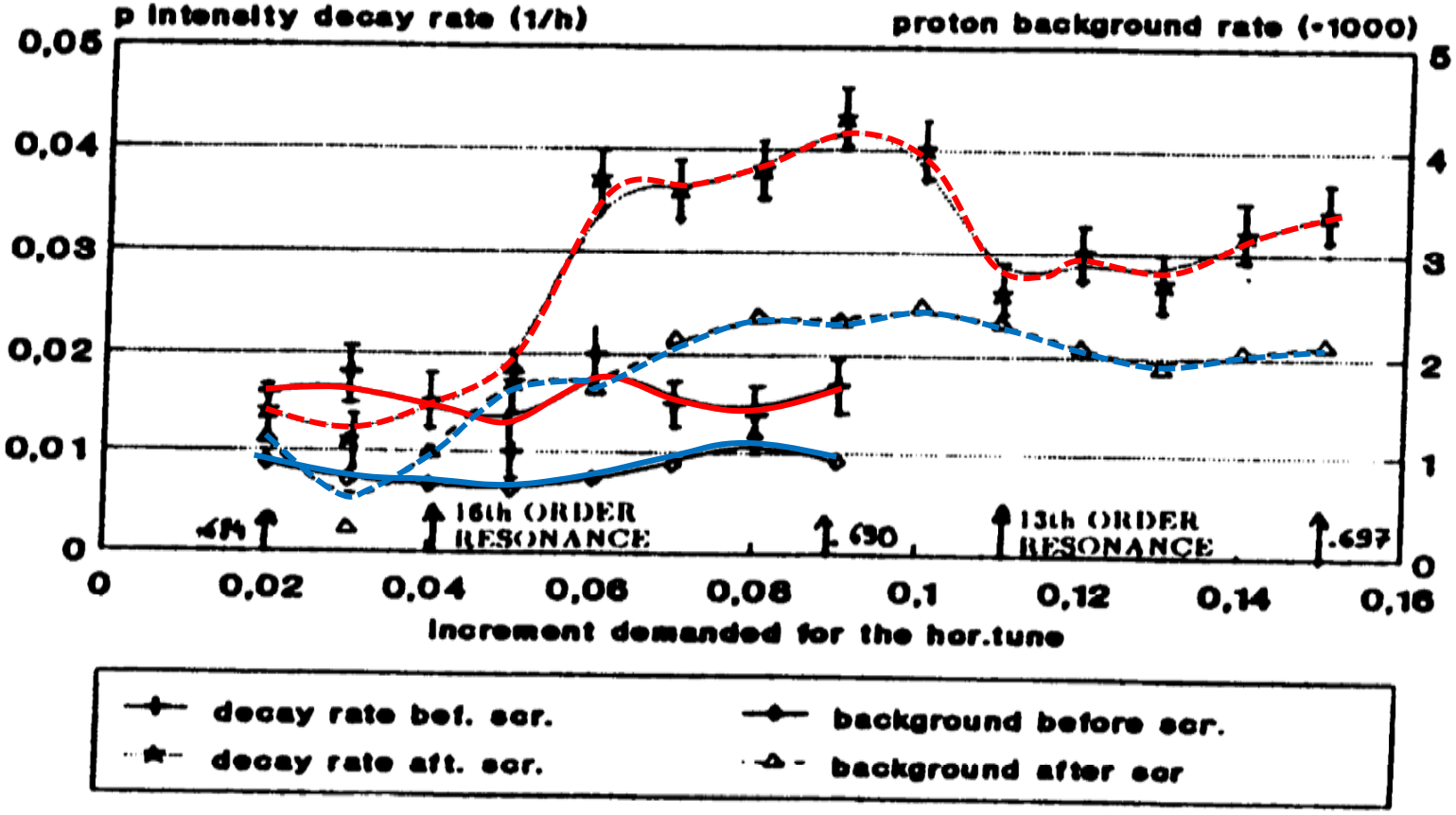


Tune shift due to separation orbit in chromaticity sextupoles

Additional sextupoles were installed on the separated orbits in order to tweak the tunes of p and pbar differently.

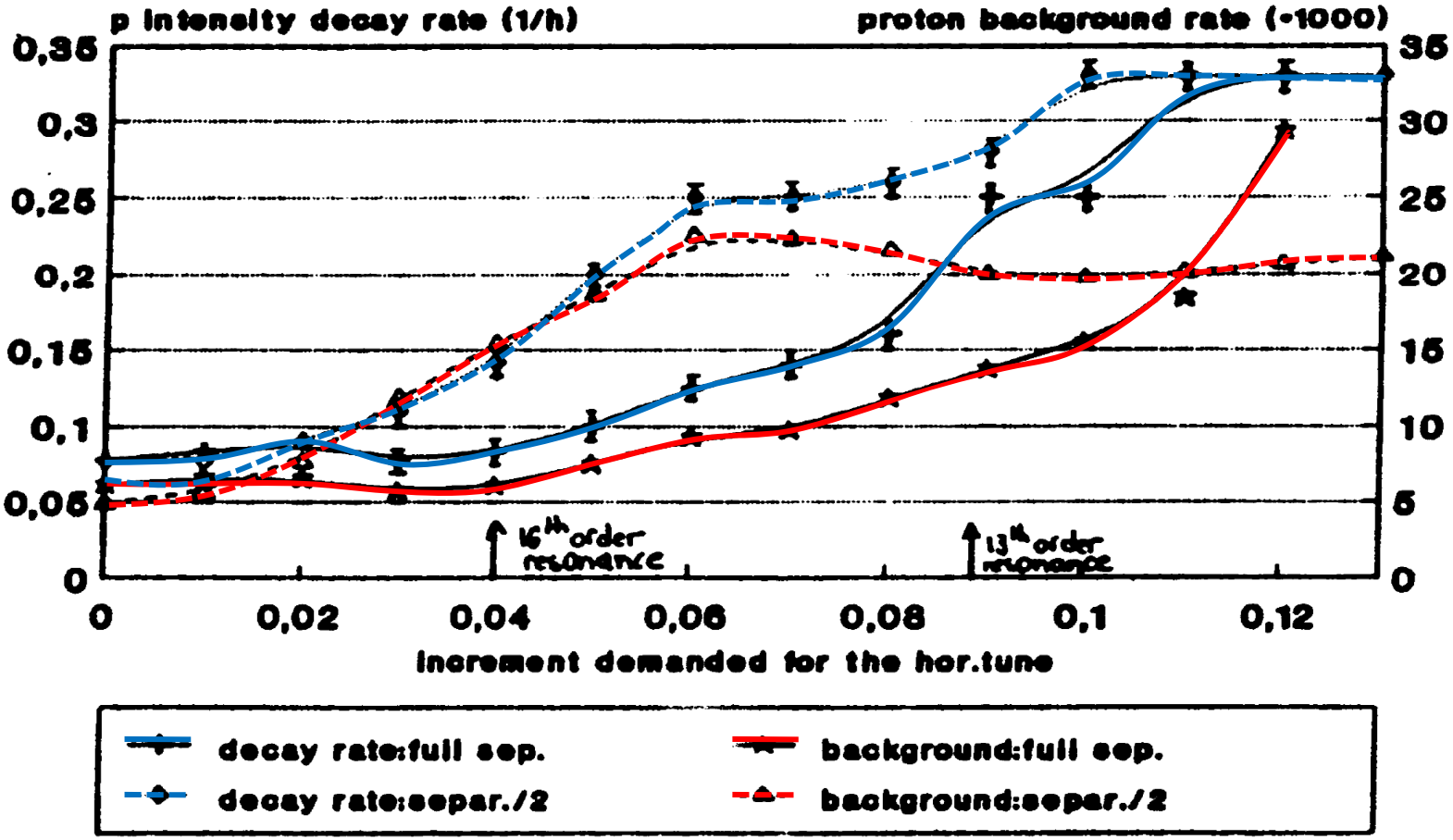
Tune scans : Effect of beam size

1p colliding with **1 pbar** 2 collision points

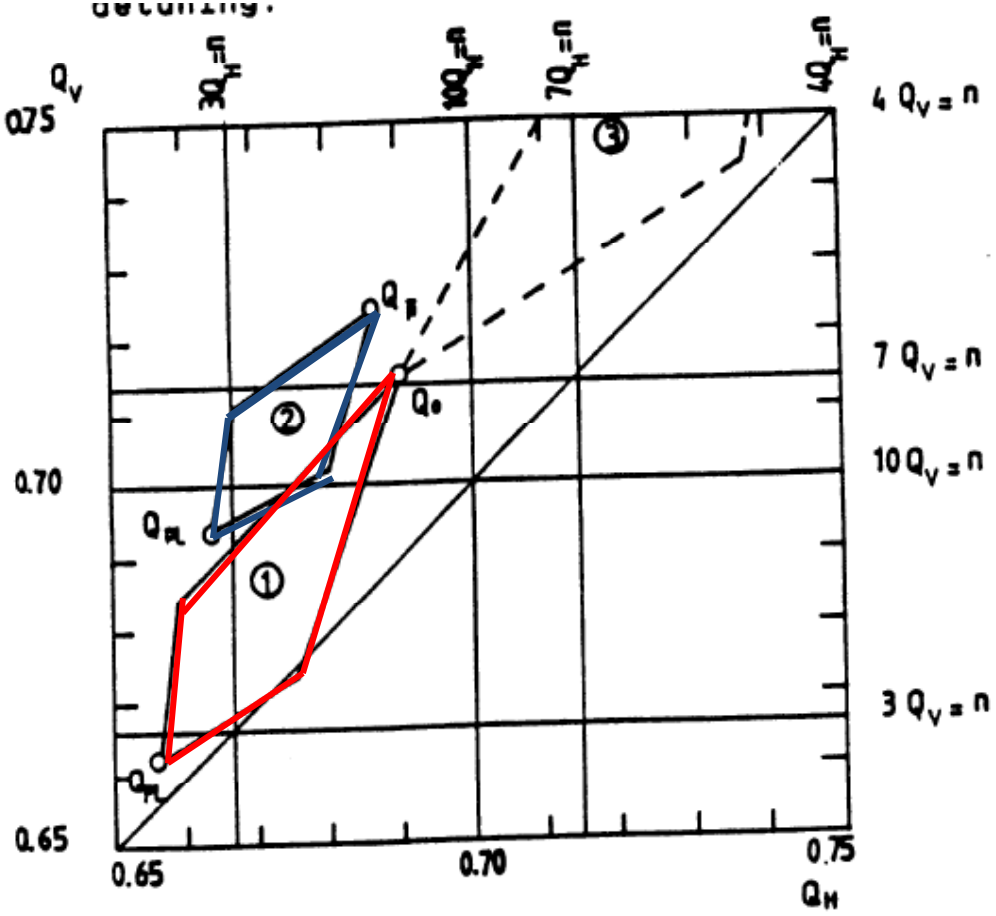


Tune scans : Effect of separation

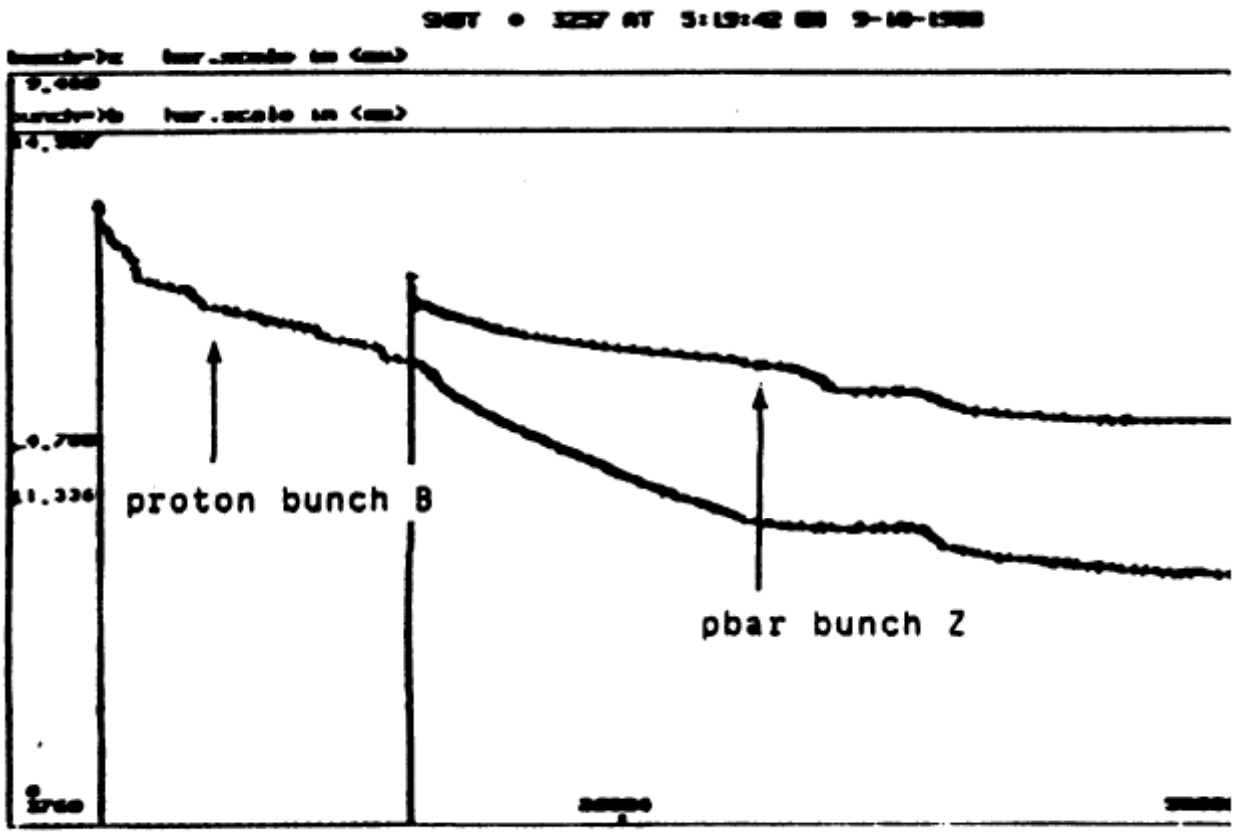
1p against **2pbar** colliding in 2 points and separated in 2 other points



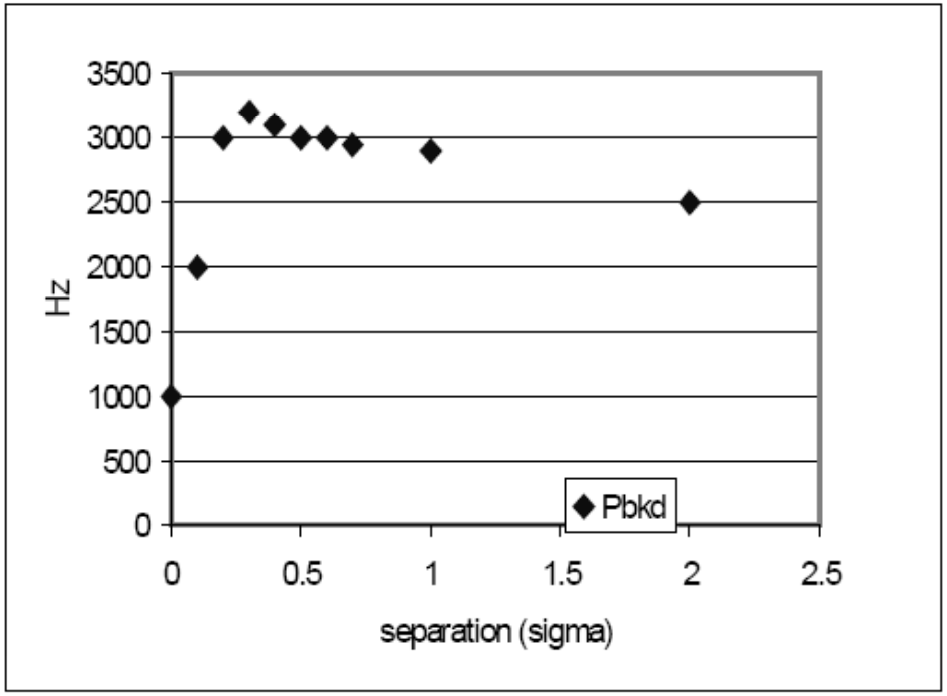
Tune diagram during injection



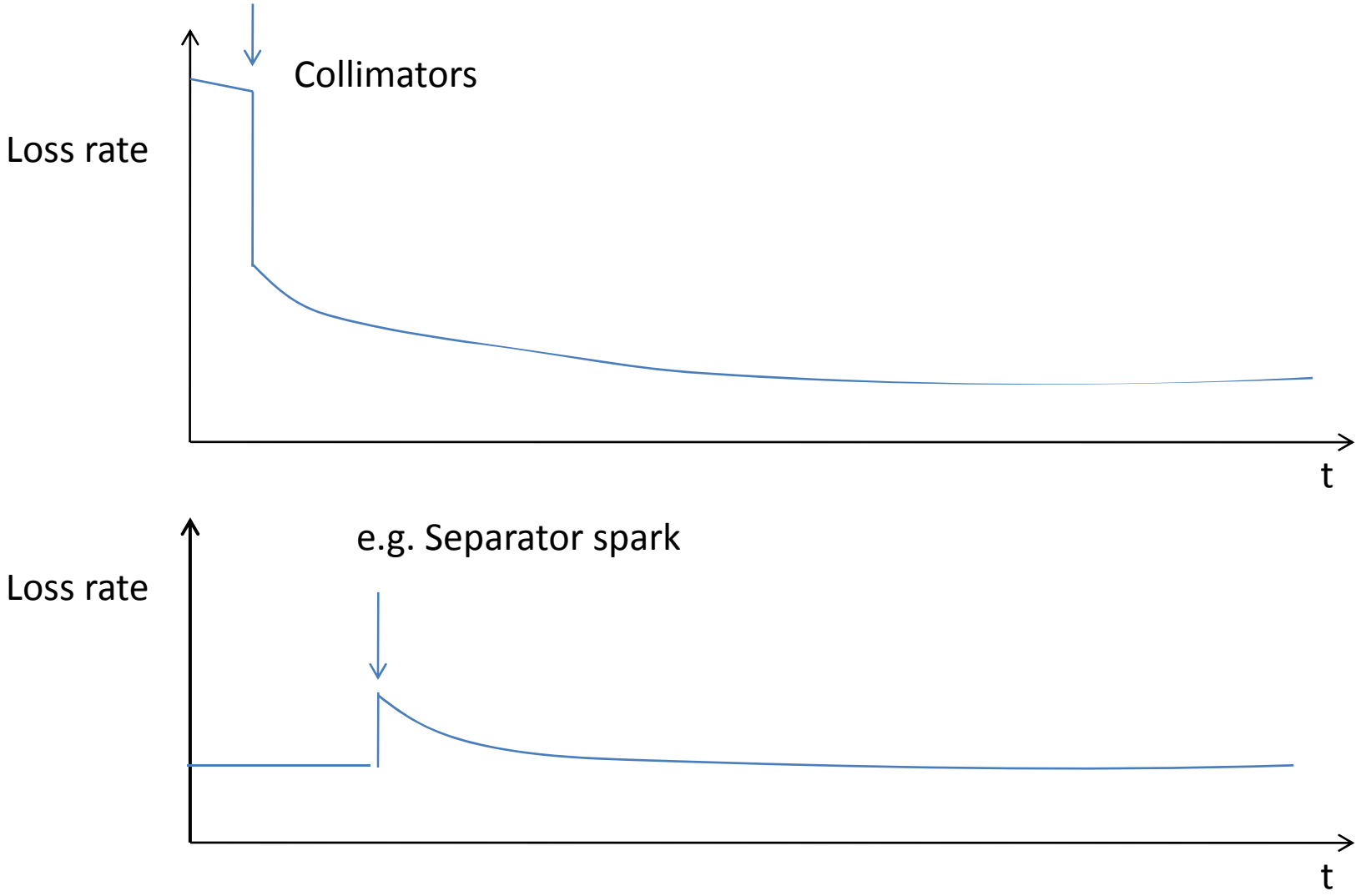
The tune footprint at 26GeV is given by a combination of beam-beam and space charge tune shifts.
Moreover, the space charge is modulated with the longitudinal motion,


proton bunch B
pbar bunch Z

Small separation no good



Beam loss behaviour in Beam-beam regime



Conclusions

- Beam separation reduces the tune spread but it also creates new resonances.
- Separation should be big enough (6 sigma proved sufficient in the SPS)
- Avoid noise and shocks.