Protection issues for TOTEM

- Why TOTEM needs Roman Pots (RP)
- RP design (first prototype ready end 2003)
- TOTEM dedicated runs and RP mode of operation
- LHC/RP protection issues

Why Roman Pots

PHYSICS PROGRAM

- Measurement of total cross section (1% acc.) with the luminosity independent method

$$\sigma_{tot} = \frac{16\pi}{1+\rho^2} \times \frac{(dN_{el}/dt)\big|_{t=0}}{N_{el} + N_{inel}}$$

=> measurement of the absolute luminosity (~1% accuracy)

- Measurement of the elastic scattering
- Measurement of diffractive processes and forward physics

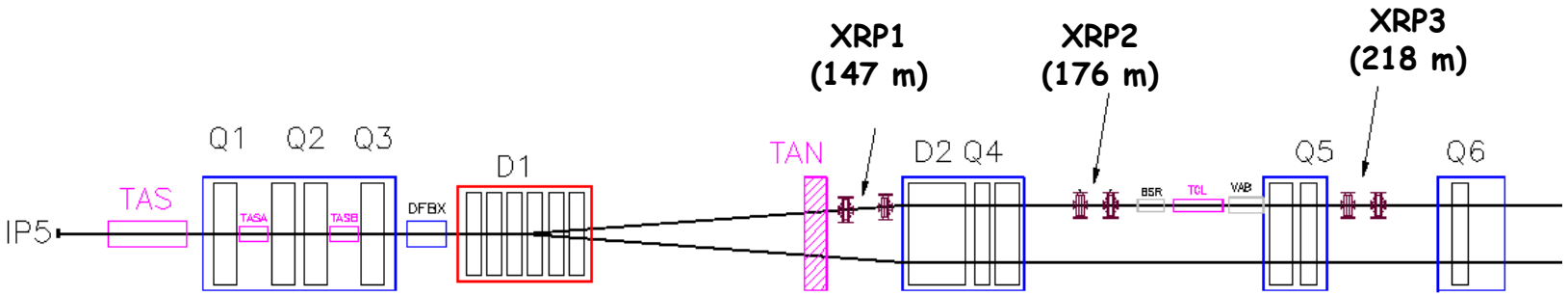
METHOD

Detection of protons produced at very small angle (~10 μrad)
=> go very close to the beam (~ 1mm)

- High β* optics (β* = 1540 m)
  - Small beam divergence at IP
  - Big $L_{effective}$ (> 200 m)
  - Parallel to point focusing (in both planes)

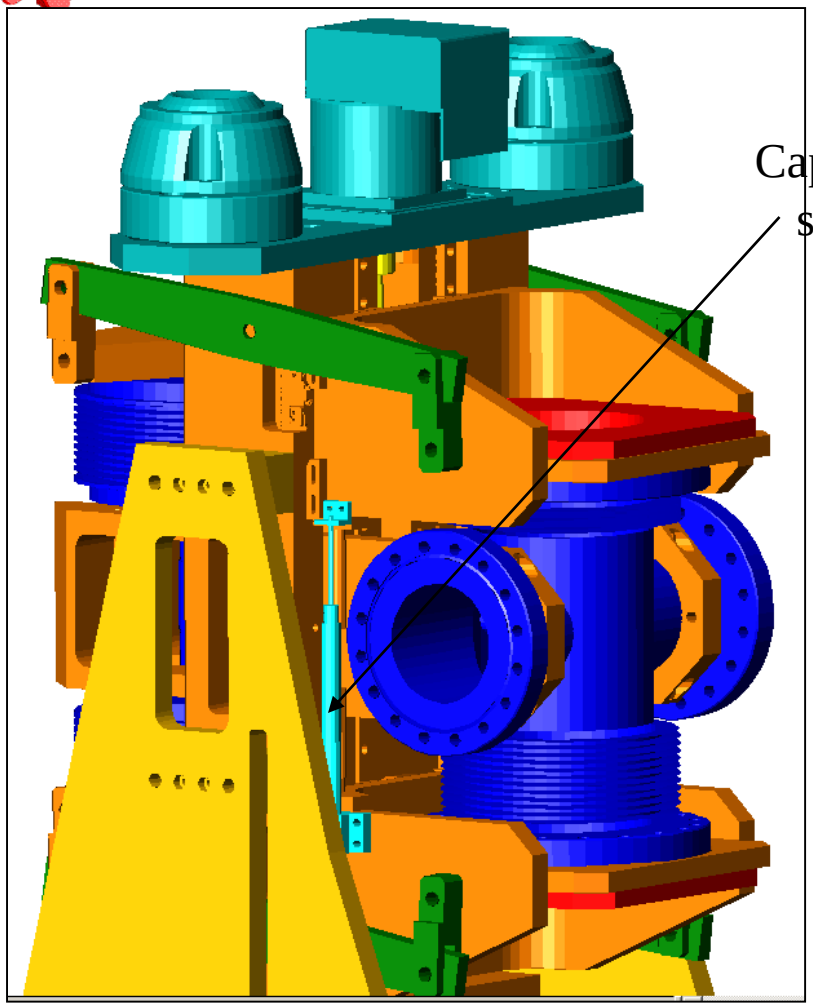
- Small beam emittance (ε_n ~ 1 μm rad if possible)
- Medium β* optics (β* = 18 m) for large t elastic scattering

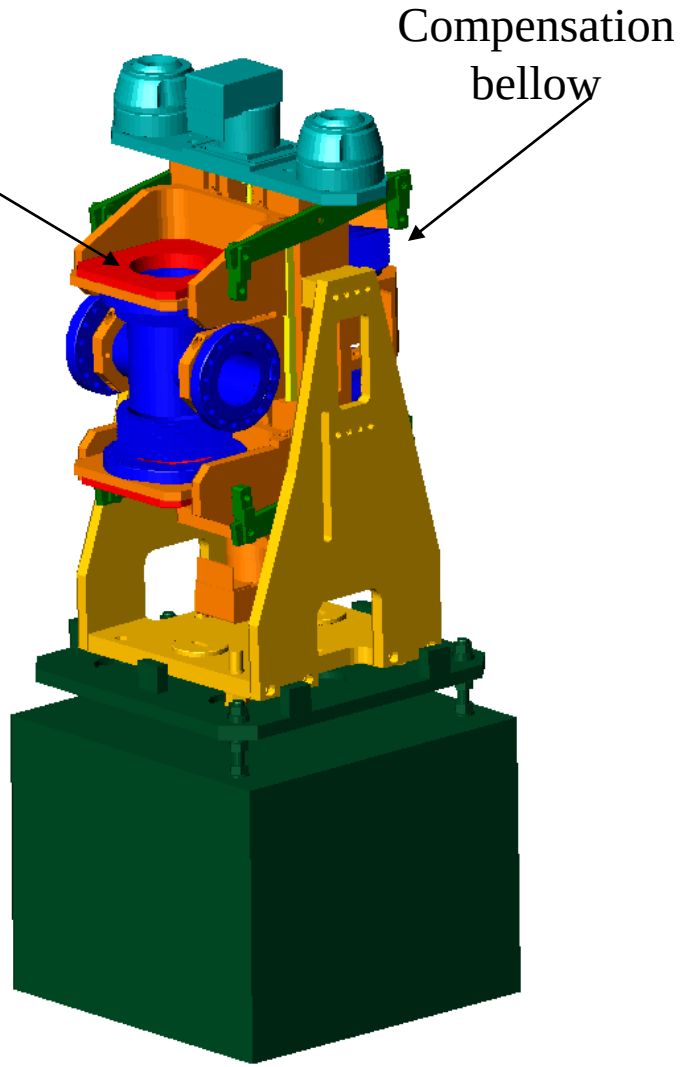
LOCATION



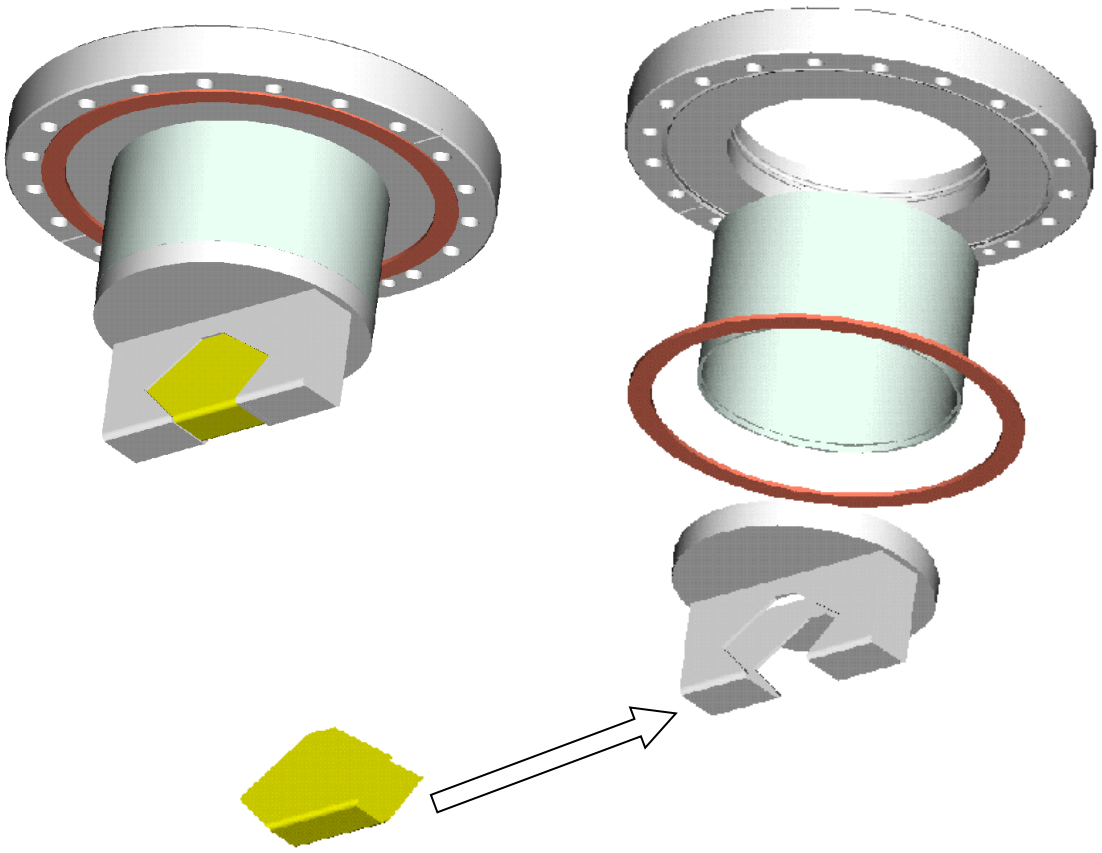
Symmetric with respect to the IP

DESIGN





WINDOW



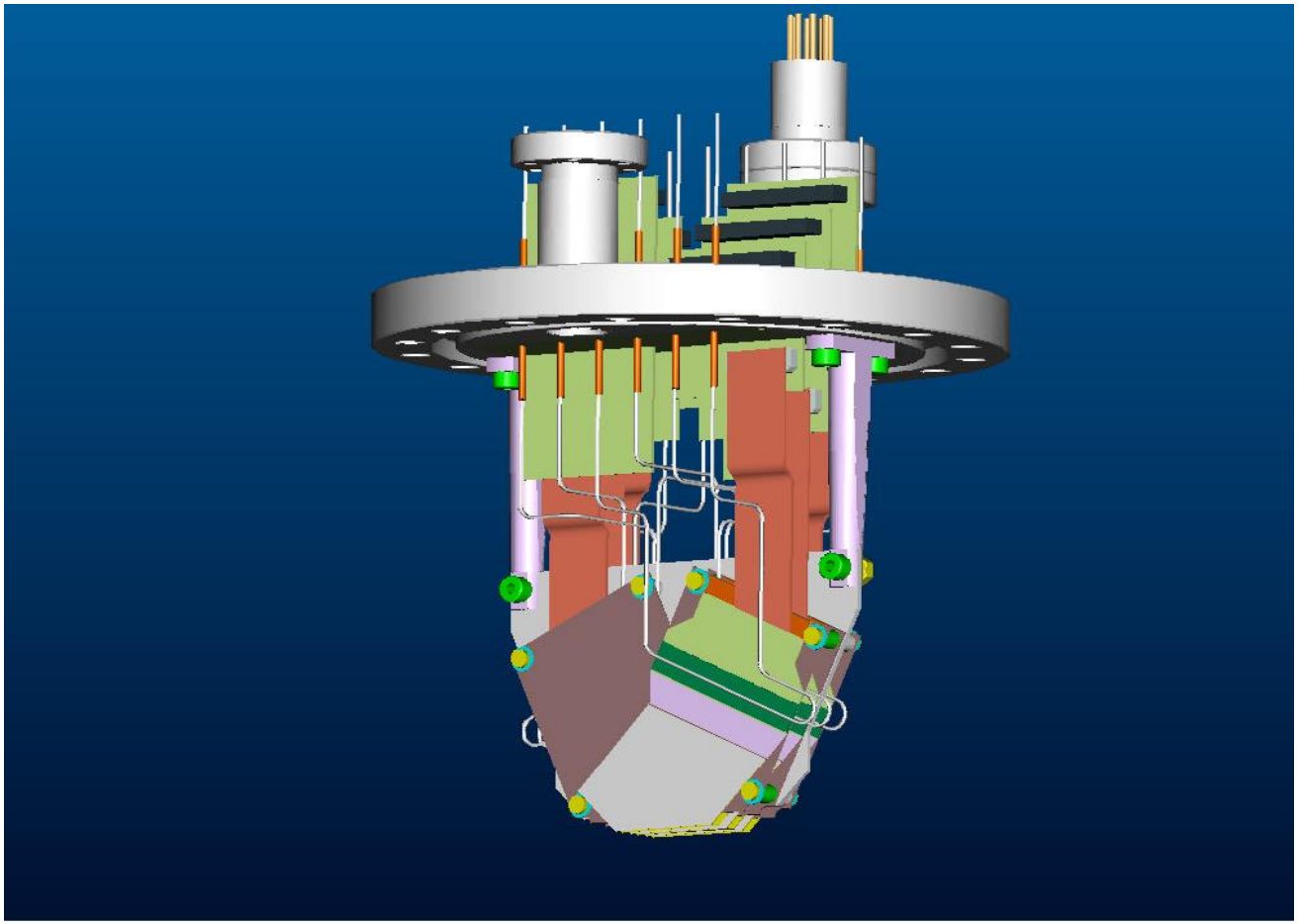
Inconel 718

Box dimensions (mm)
106(H)x58(V)x30(S)

Thickness
Window 0.2 mm
Bottom 1,2 mm
Lateral 2.0 mm

Safety
- Pot designed to stand 1 bar (successful test at 2 bar)
- Pot should stand the impact of a full bunch (simulation to be done)

Detectors inside the Roman Pot



TOTEM dedicated runs

- Low t elastic scattering and luminosity measurement:
  - 43 bunches scheme (2.025 μm bunch spacing)
  - $N_{bunch} \approx 4.5\ (2.3) \times 10^{10}$ p, $\varepsilon = 3.75\ (1)$ μm, $\beta^* = 1540$ m

    => $L = 10^{28}\ cm^{-2}s^{-1}$

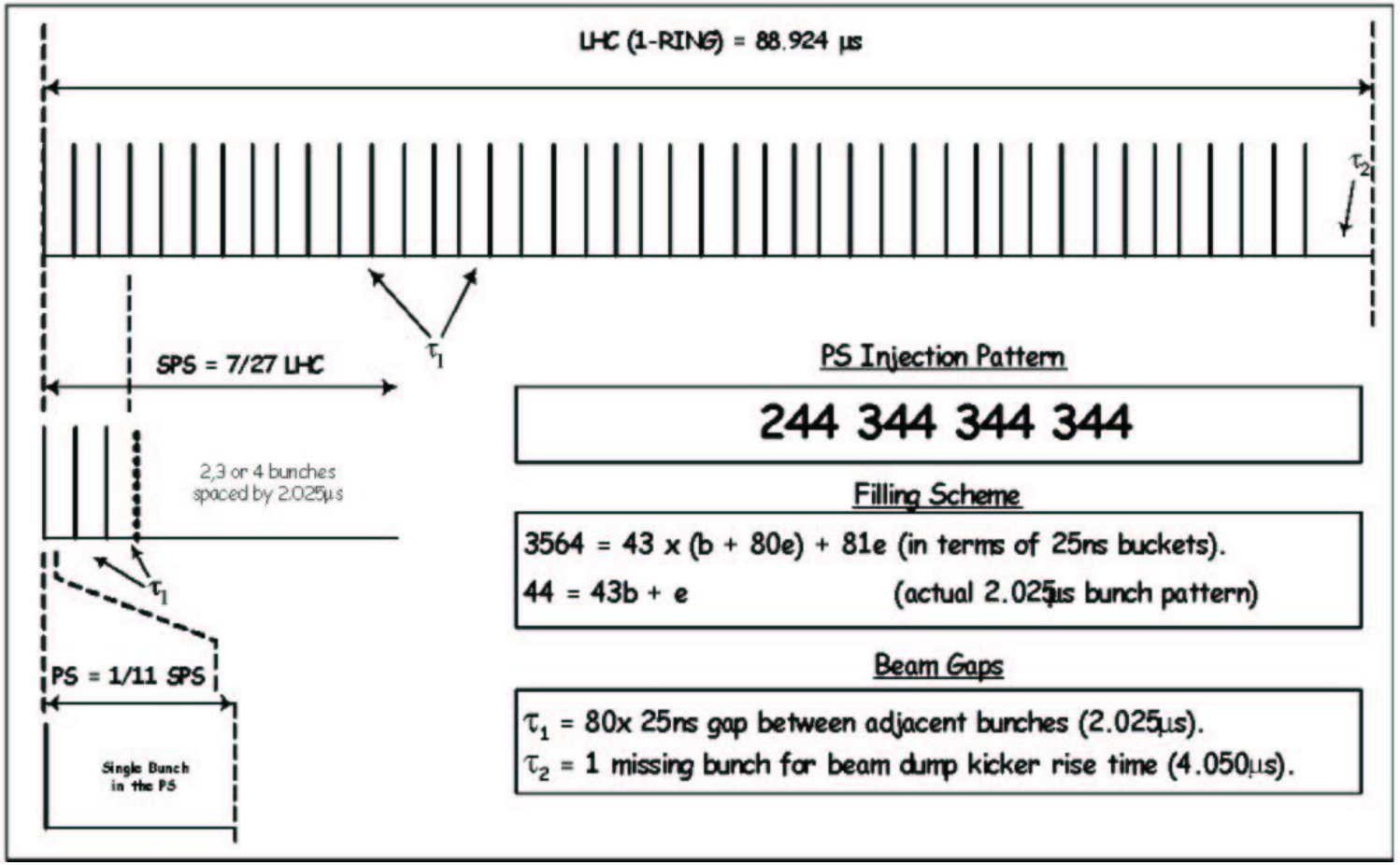
- High t elastic scattering, very forward physics:
  - 156 bunches scheme (0.525 μm bunch spacing)
  - $N_{bunch} \approx 11 \times 10^{10}$ p, $\varepsilon = 3.75$ μm, $\beta^* = 1540$ m

    => $L = 2.2 \times 10^{29}\ cm^{-2}s^{-1}$
  - $N_{bunch} \approx 4 \times 10^{10}$ p, $\varepsilon = 1.0$ μm, $\beta^* = 1540$ m

    => $L = 10^{29}\ cm^{-2}s^{-1}$

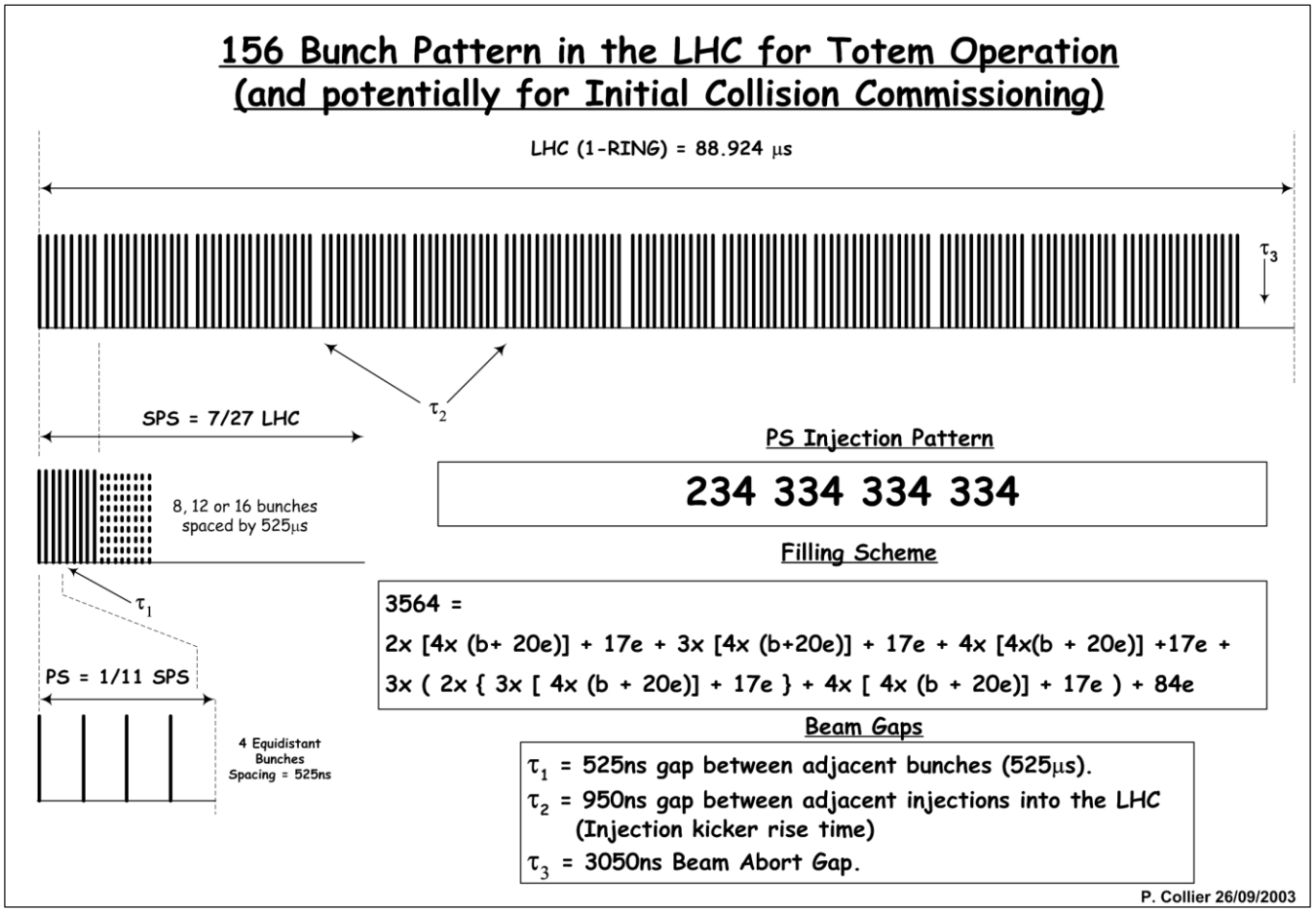
Nominal bunch scheme for TOTEM

43 bunches per ring



New Bunch Scheme for the TOTEM run

156 bunches per ring



Mode of operation

- Roman Pot is in the open position during injection
- Moved into the data taking position when beams are stable and in collisions
- The bottom of the pot is as close as possible to the beam
- Proposed position 10 σ to be in the shadow of the secondary collimators (=> edge of the silicon detectors at 16 σ)
- The real position will be imposed by the machine conditions (beam halo rate, position of the collimators, beam absorbers etc..)
- The Roman Pot is not sensitive to the absolute beam position . However beam stability during the run is very important
- Test of a Roman Pot equipped with silicon detectors proposed in the SPS ring next summer (first prototype ready by the end of 2003)

LHC/RP protection issues

- The Roman Pot is designed to stand 1 bar =>
  - If secondary vacuum is broken => no problem
  - Silicon detector cooling with cold finger (no two phase cooling anymore)
- UPS?
- BLM? (TOTEM would like to have such a signal)
- BMP? (the local stability of the beam)
- Hardware/software interlocks:
  - At injection
  - Roman Pot will not be equipped with signals to dump the beam
- Are there accidents scenario which could drive 1 or more bunches into the pot? (We believe the pot can stand one bunch but simulation to be done)