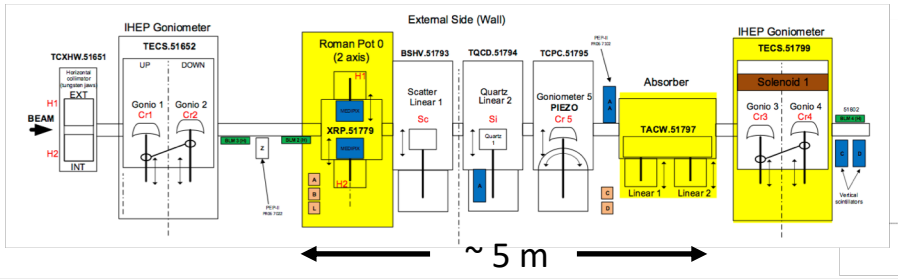
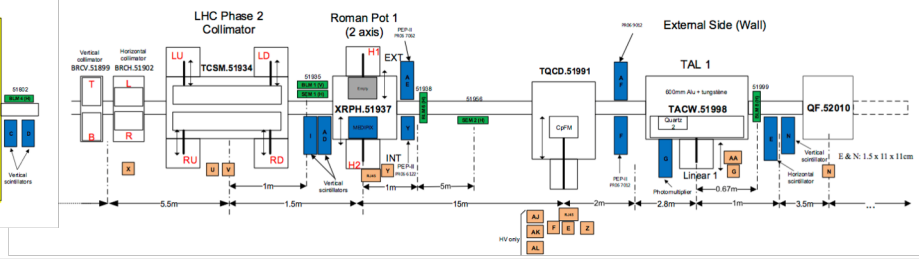
UA9 SPS layout after Long Shutdown 2 (LS2)

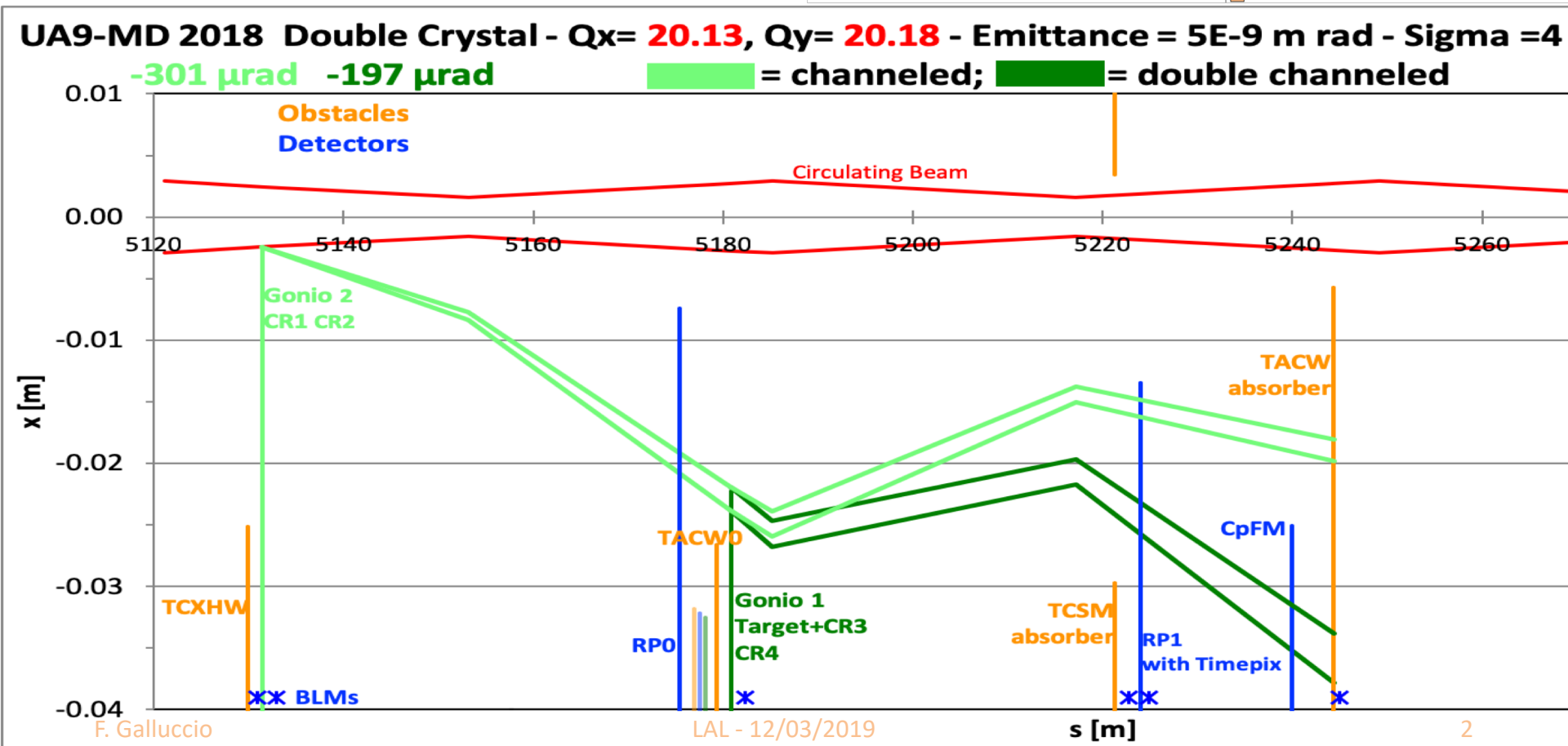
F. Galluccio

INFN-NA

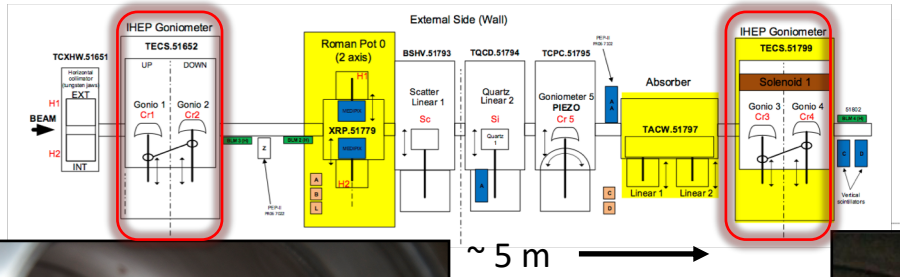
Latest 2018 layout in LSS5

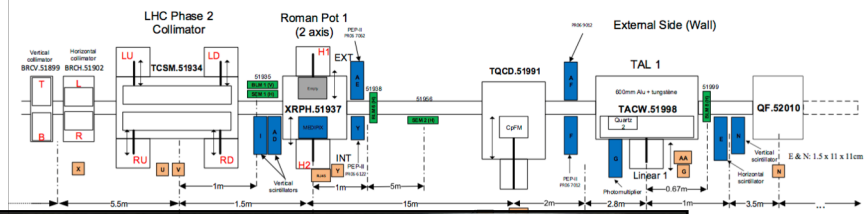


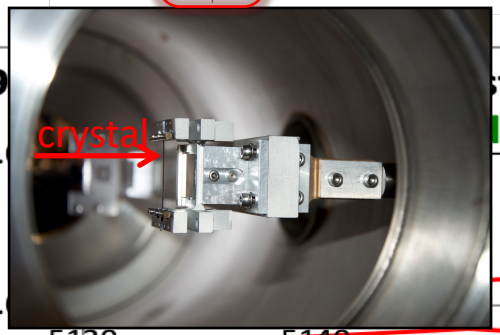


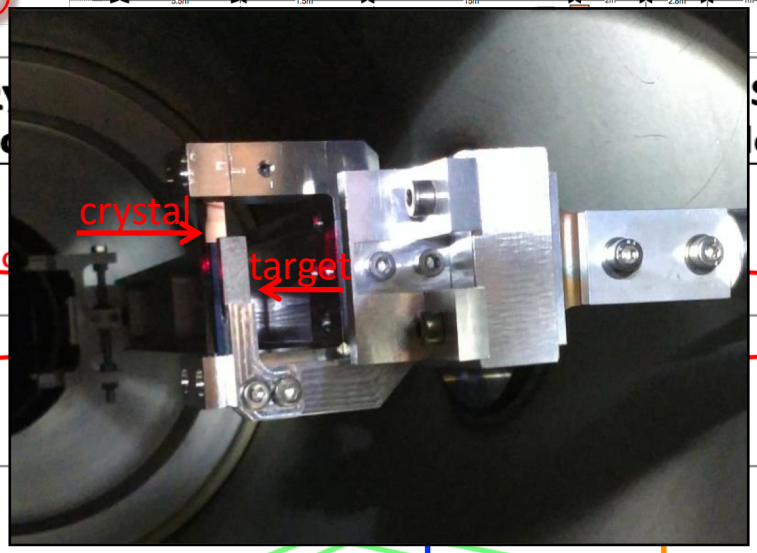


Latest 2018 layout: 4+1 crystals

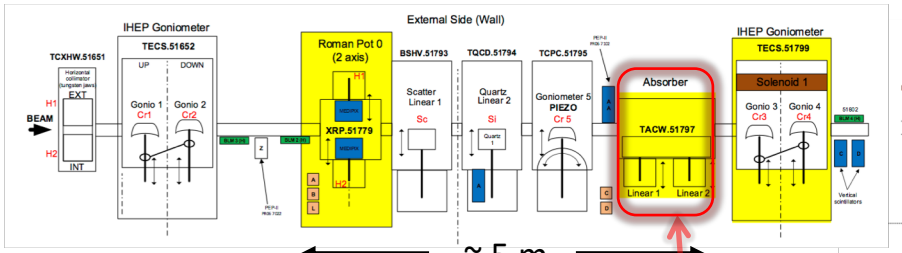


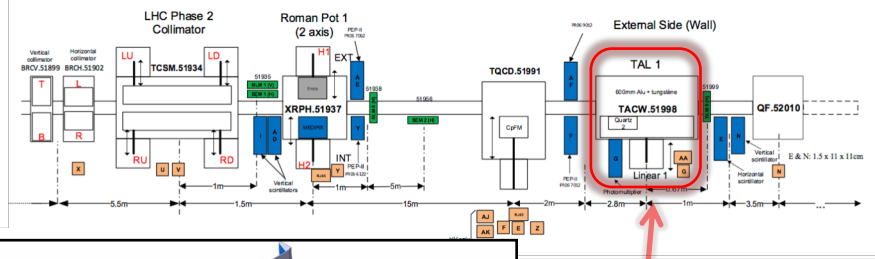


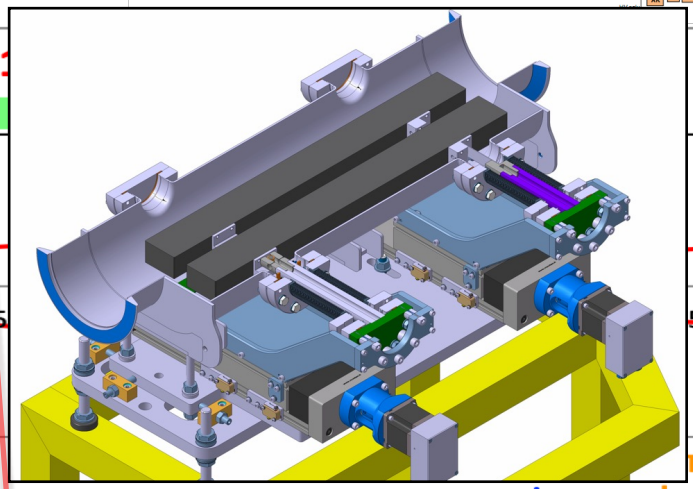




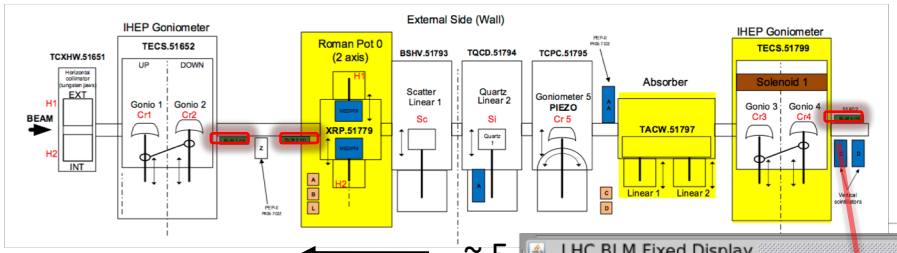
Latest 2018 layout: 2 W absorbers

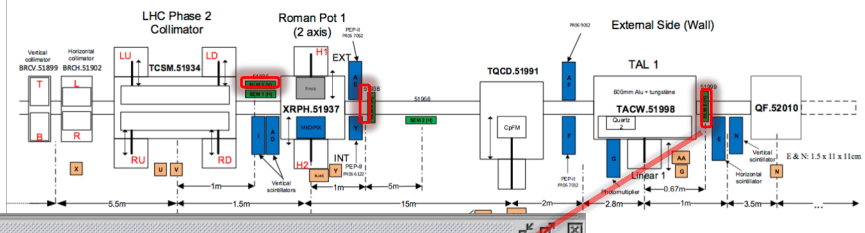




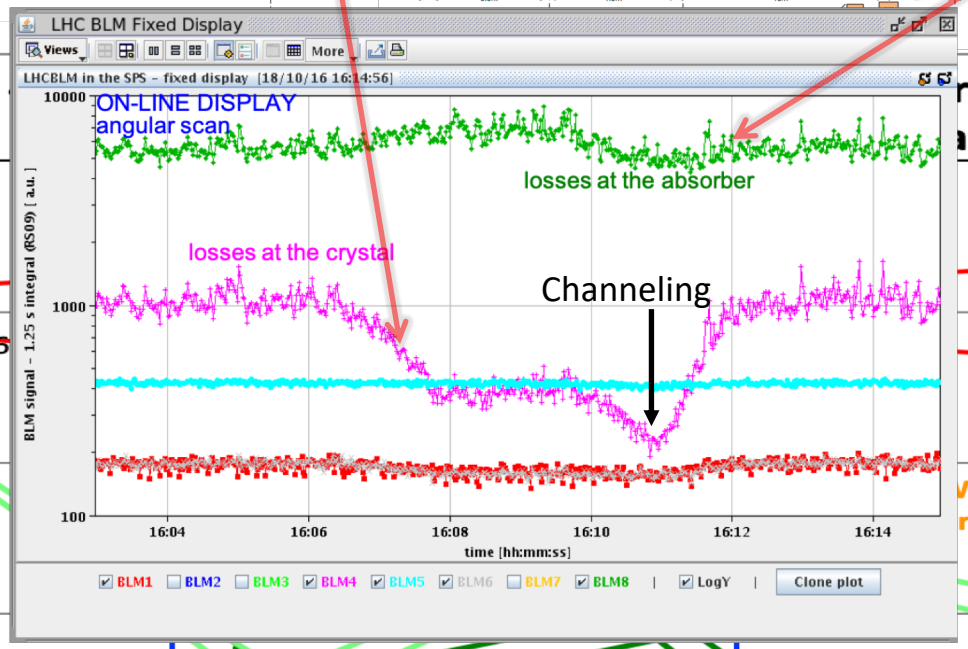


Latest 2018 layout: 8 BLM detectors



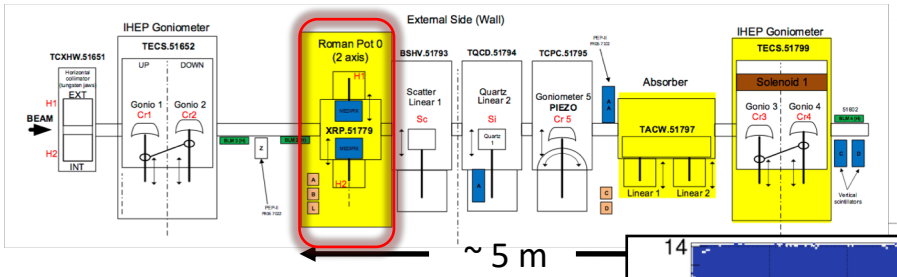


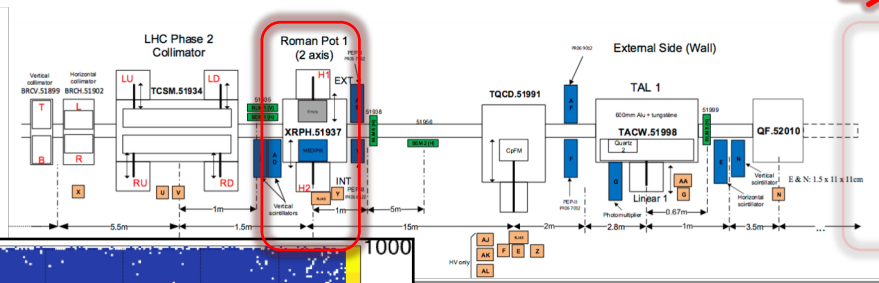
~ 5



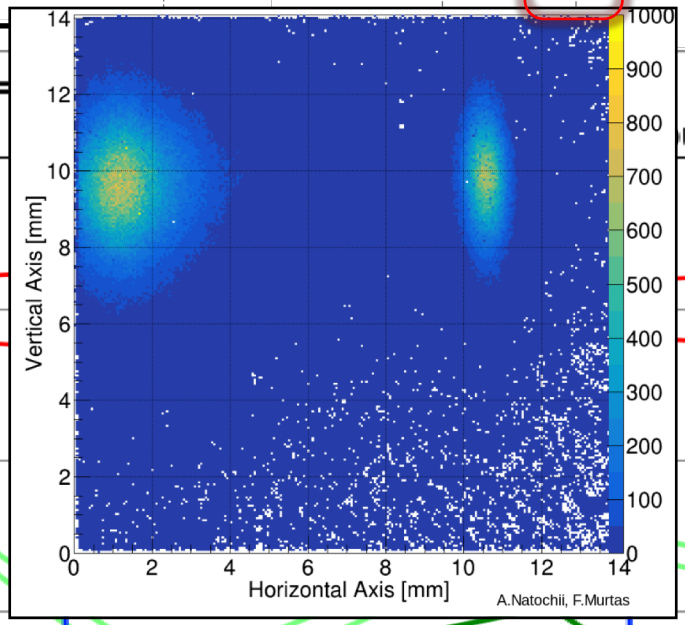
Latest 2018 layout: 3 Timepix stations

See Murtas talk



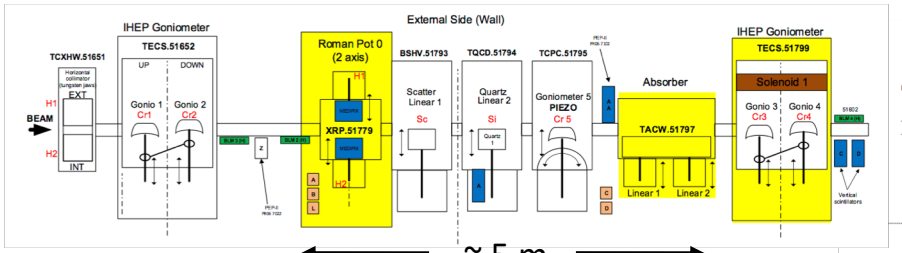


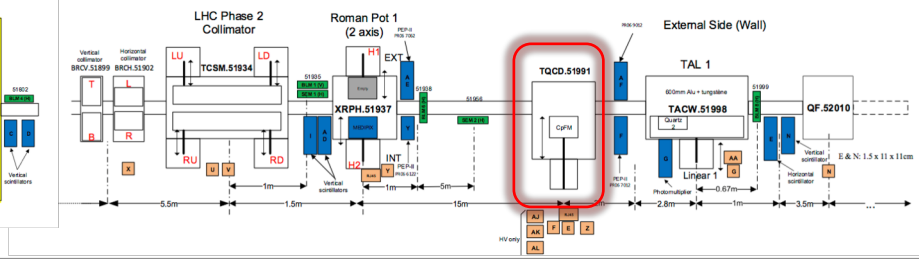
~ 5 m

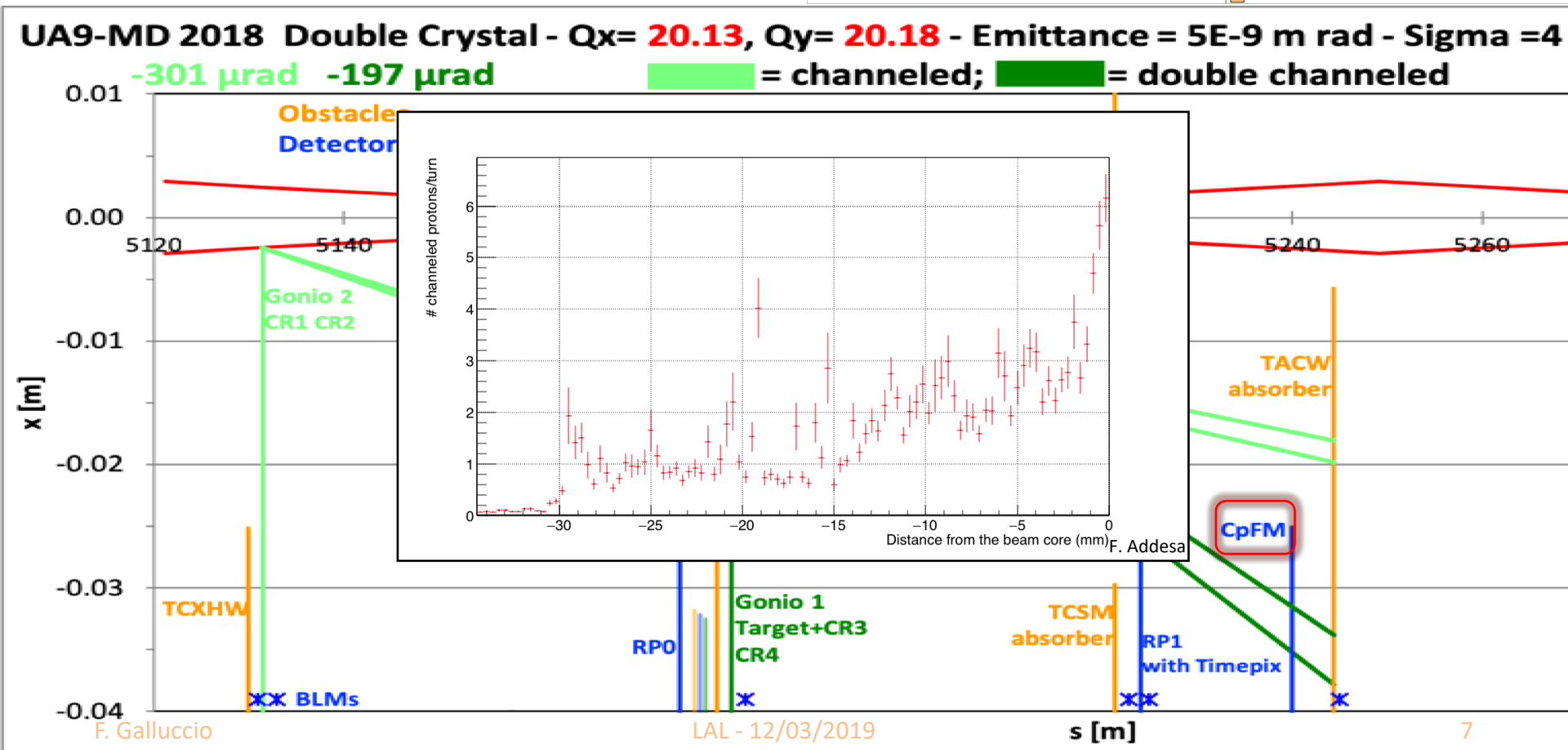


Latest 2018 layout: CpFM

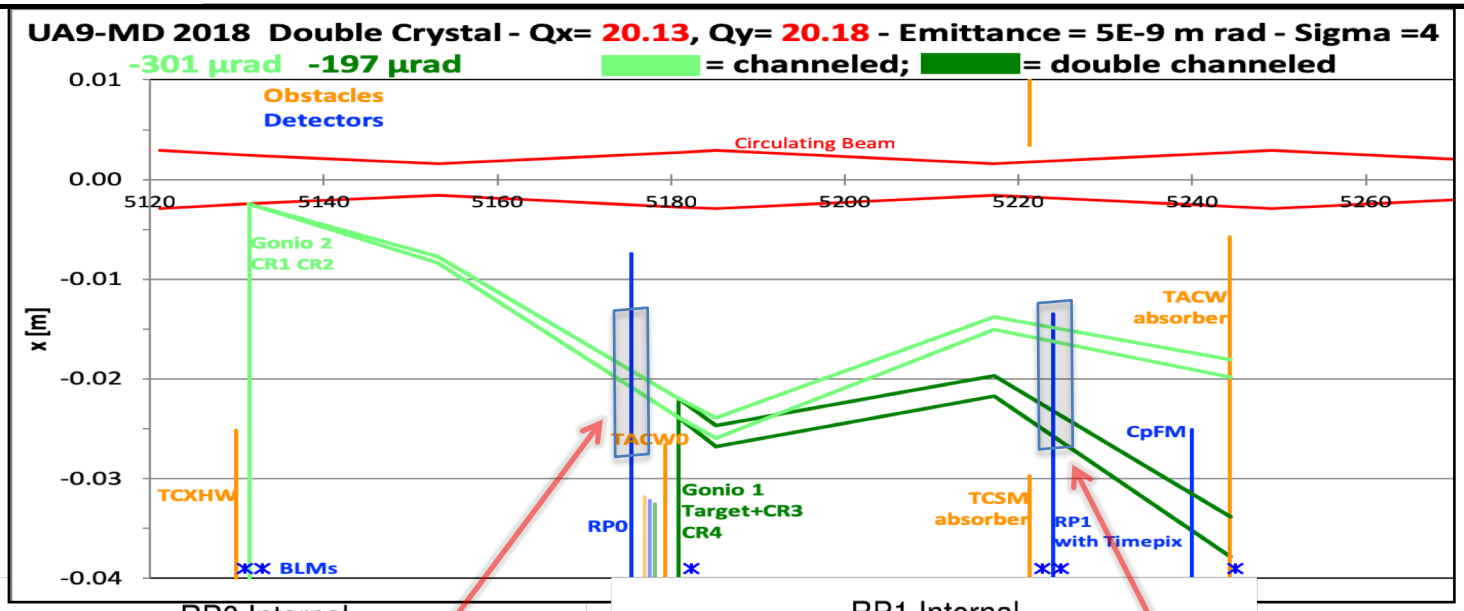
See Natochi talk



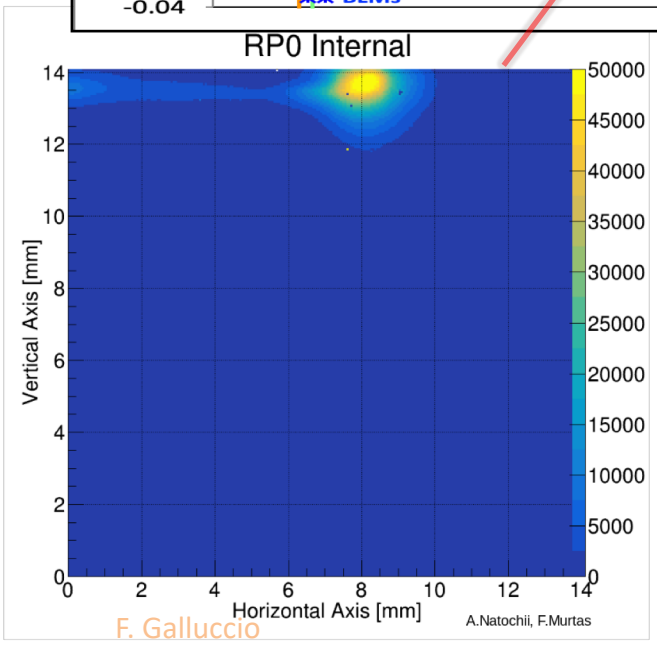


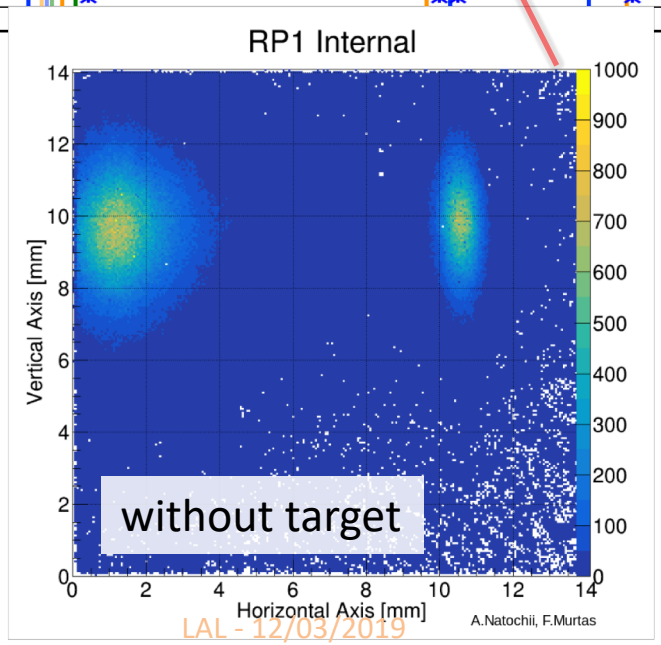


Double channeling observation

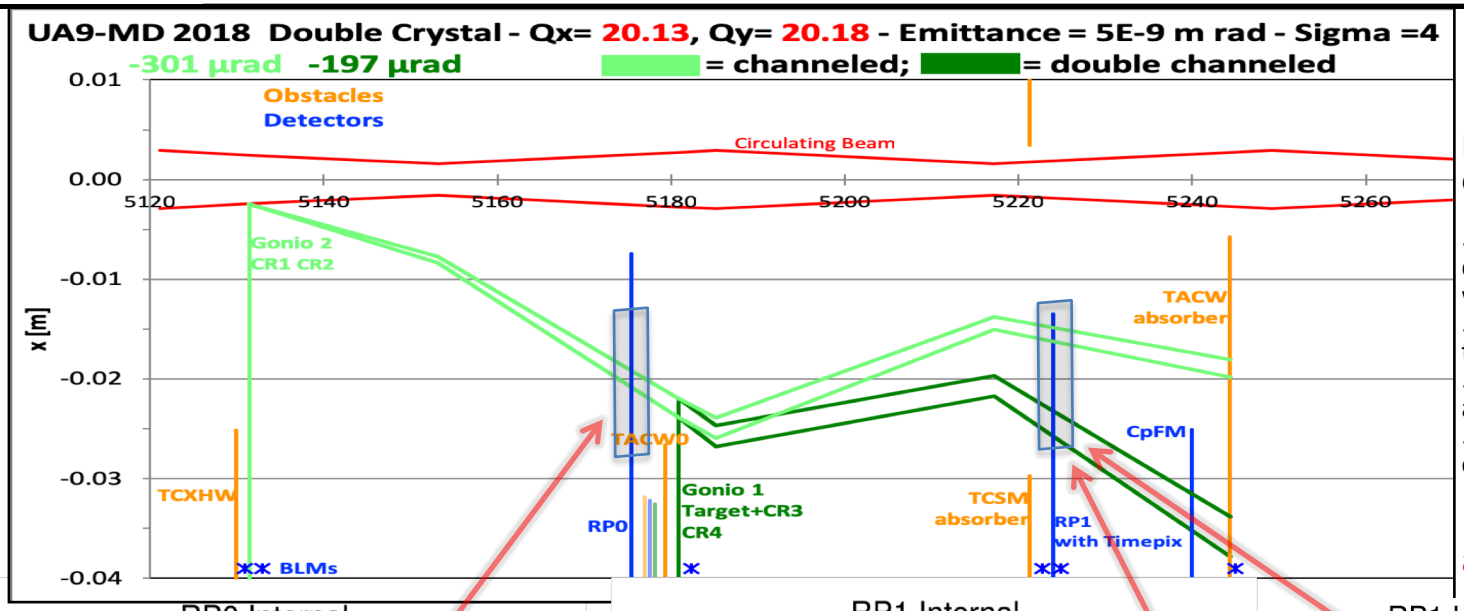


Preliminary





Double Channeling observation

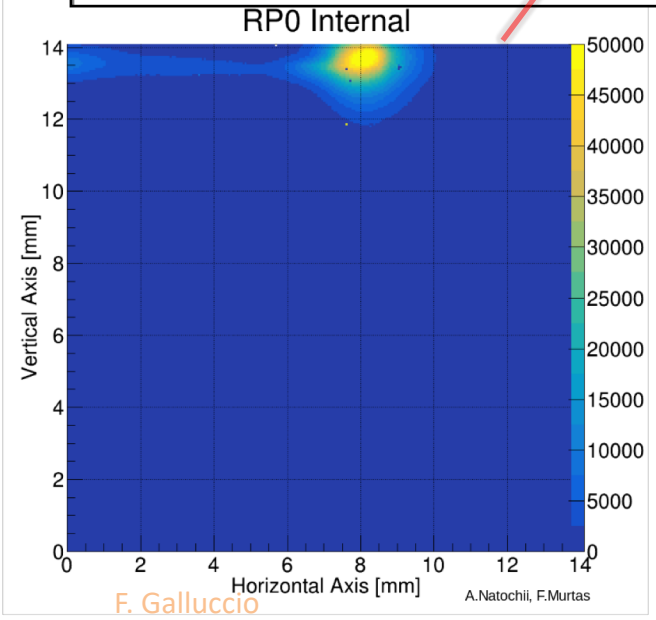


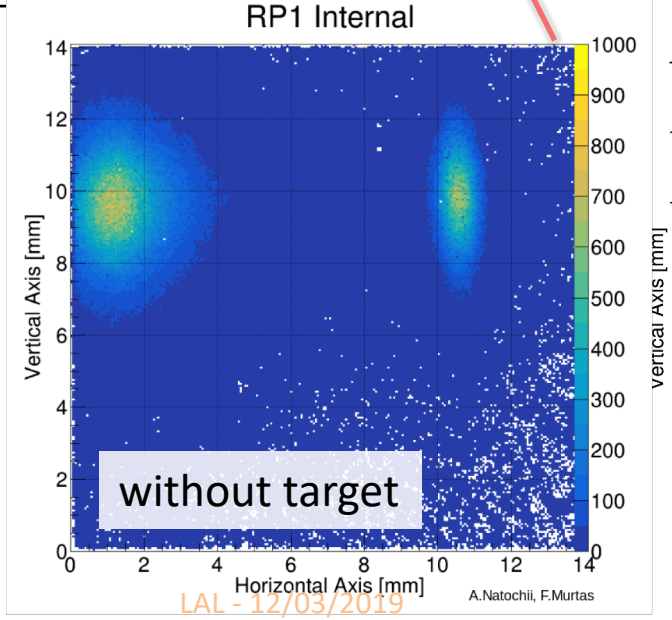
Preliminary

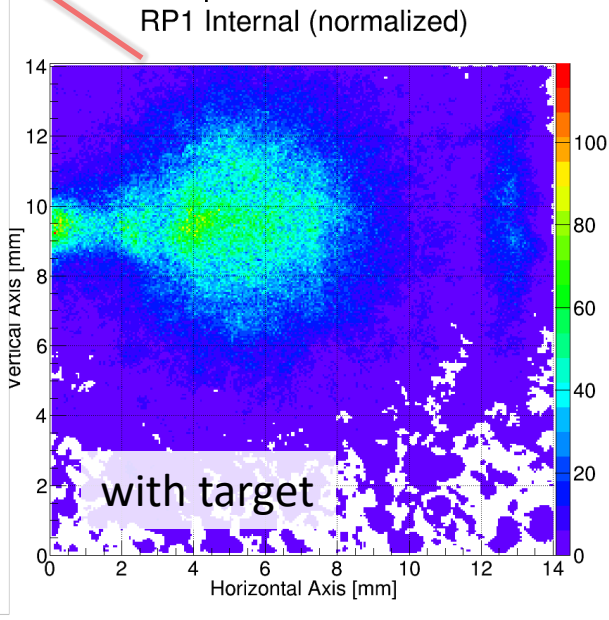
Promising, but not exhaustive results.

. different runs make difficult to compare without and with target.
. The offset RP0 does not allow to evaluate the DC efficiency
. Timepix in RP1 suffers by ageing.
. Crystal choice might be optimized.

→ Room for optimization and extension



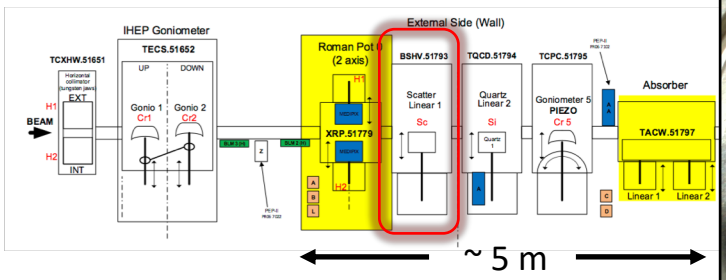


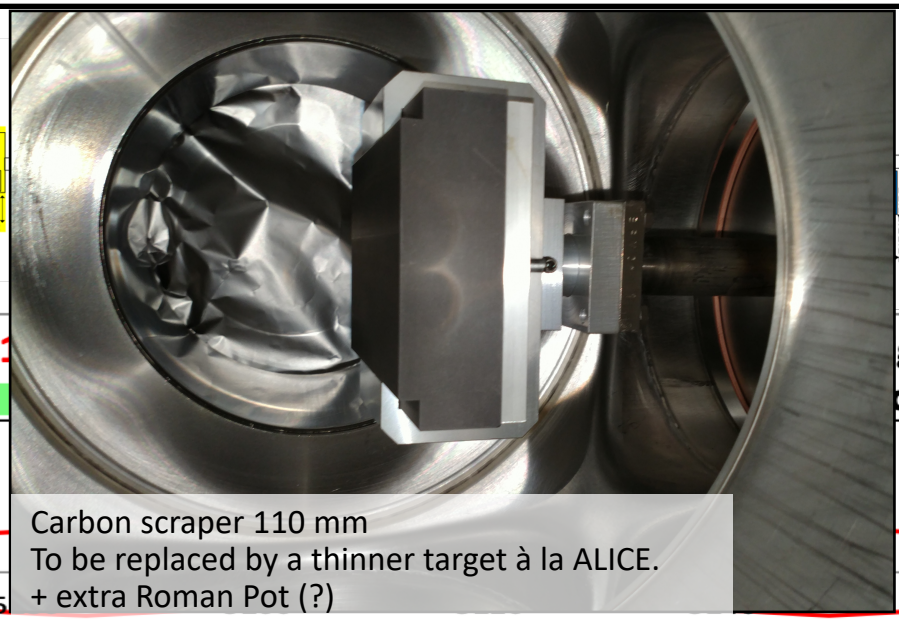


LS2 preparatory activities

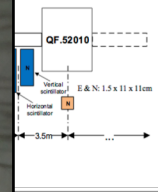
- Dump installation in LSS5: everything up to the second absorber has been removed from the tunnel and put in storage.
- We can profit of this year (reinstallation in spring 2020) to prepare refurbishment, upgrade, and also rearrangement of the devices.
  - Roman Pots will be renewed and equipped with Timepix3
  - Hopefully CpFM will find a home, will be maintained and possibly equipped with a rotating attenuator to accept heavier ion fragments.
  - Angle and shape of the 5 crystals can be optimized
  - More detectors can be added to check particle tagging
  - Some tanks can be repositioned to allow a vaster range of experiments

Proposed 2021 layout change 1

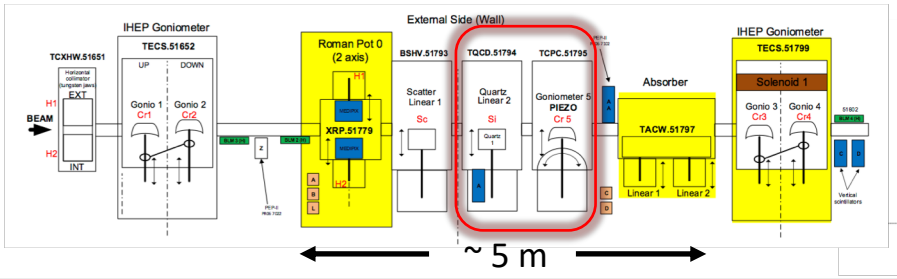


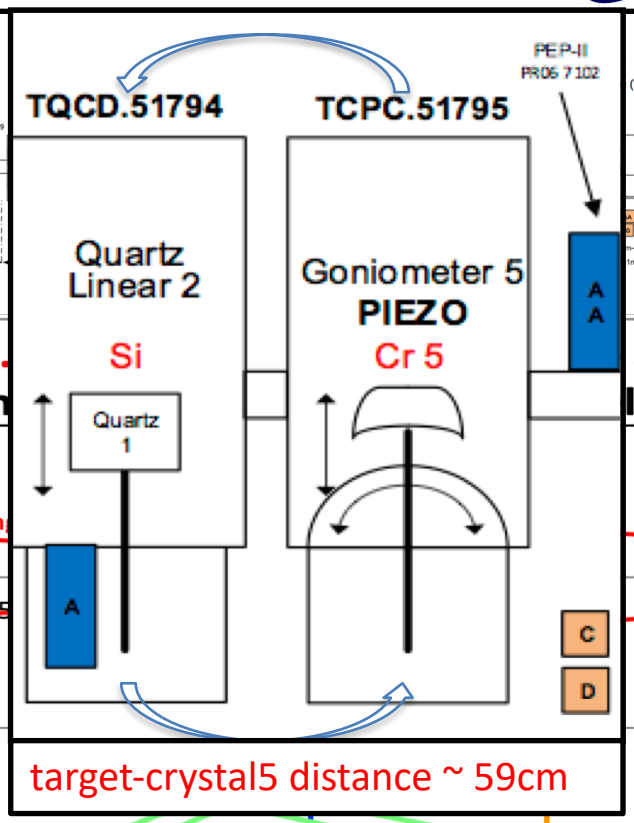


Carbon scraper 110 mm
To be replaced by a thinner target à la ALICE.
+ extra Roman Pot (?)



Proposed 2021 layout change 2





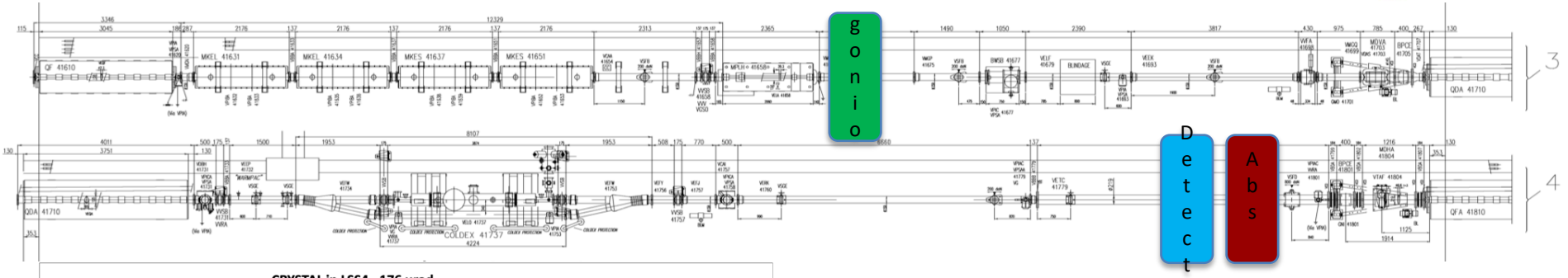
Summary LSS5

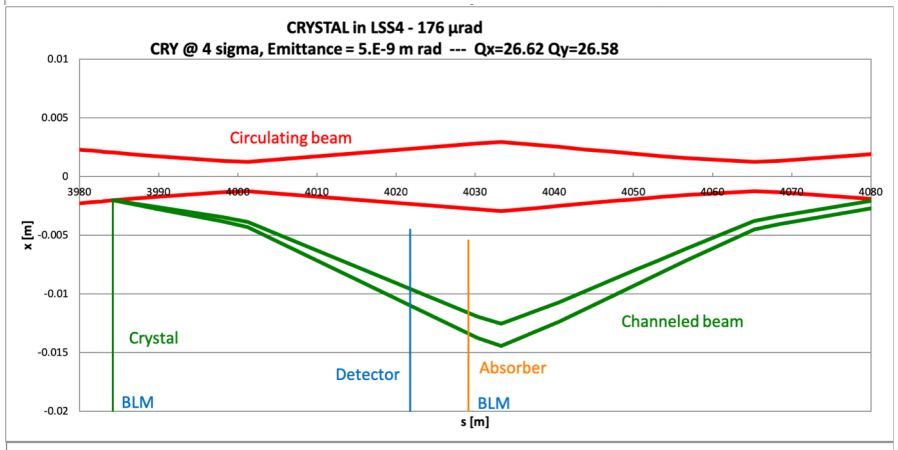
- Minimal changes in the layout allow setting a demonstrator for:
  - A configuration à la Fixed Target at ALICE
  - A double-crystal scenario with extractable target
- Detectors:
  - Complete upgrade of Medipix planned
  - It would be interesting to complete the set-up with some detector to tag high probability reactions at the SPS energy.

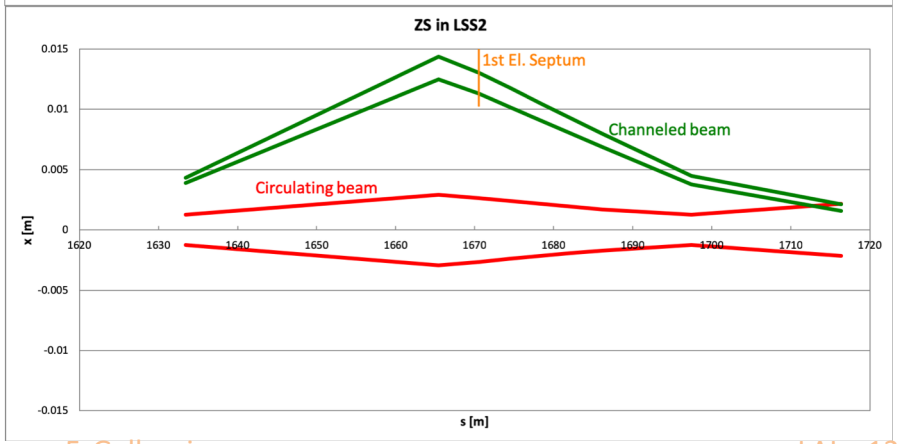
Non-resonant slow extraction

- Crystal-aided non-resonant extraction successfully demonstrated in SPS in 2016 with accumulated beam at 270 GeV.
- Demonstration in cycled (FT) mode cannot be done in LSS5 because of lack of strong enough bumpers.

Non-resonant non-local (LSS4) extract.





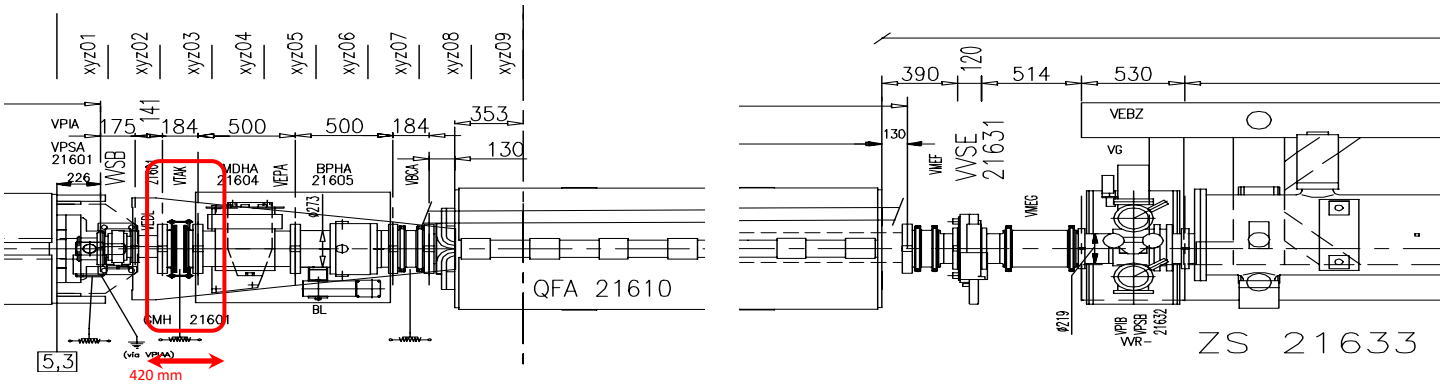


In LSS4 extraction to LHC-b2: strong bumpers
Minimum layout:

- A suitable location for the crystal at the right phase distance from the first electrostatic septum.
- An absorber can be placed 75 deg downstream the crystal preceded by a detector.
- LHC type BLMs at crystal and absorber.
- Timepix in the extraction line.

This section has to be equipped from scratch starting from cables (see Walter's list).

Crystal-aided resonant extraction LSS2



- Septum shadowing by a bent crystal was successfully tested in Autumn 2018.
- Still to be optimized:
  - Choice of bending angle to match the septum thickness
  - Working condition of the crystal (multicrystal in Volume Reflection)
  - Improvement of the diagnostics (Medipix in extraction line)

THANK YOU

Motivation for a double-crystal proof of principle in the SPS

"Parasitic fixed-target" experiments are proposed to be located in front of one of the LHC big detectors,

making use of

- 1 bent crystal to separate the periphery of the beam halo from the circulating beam
- 1 target + crystal assembly to generate short living polarized particles like Λ_c and to let their magnetic moment precess in the strong equivalent magnetic field of the bent crystal.

Superconducting environment in LHC is extremely challenging:

- careful beam manipulation
  - control of double channeling
  - Intercept not channeled particles impinging on crystal (scattered, dechanneled, ...)
- total control of the beam-induced background for machine protection

Magnetic moment of channeled particles should precess in a bent crystal

$$\vartheta_{spin} = \frac{g-2}{2}\gamma\vartheta_{crystal}$$

See V.G. Baryshevskii, Pis'ma Zh. Tekh. Fiz.5, 182 (1979) and 757 (2016) 426-9. PLB

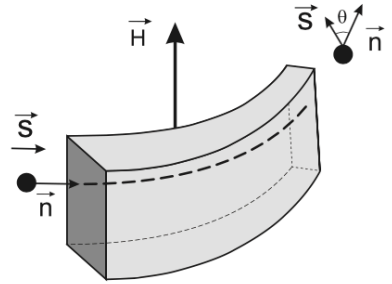


Figure 1. Spin rotation in a bent crystal

Minimal changes in the SPS UA9 layout provided a valuable test bench for the double-crystal scenario in LHC.

Key parameters:

Efficiency of double channeling, with and without target

Background estimate

Motivations for revamped SE studies

- Future Fixed Target experiments at SPS, and in particular the proposed Beam Dump Facility (BDF - SHiP), will require much higher intensity extracted beams (up to 4 x 10^{19} PoT/year, ~4 x as today)

- The present slow extraction (SE) system from the SPS to North Experimental Area (NA) is intrinsically affected by local beam losses of about 1% due to particles impinging on the Electrostatic Septum (ES) wires (BDF show stopper from machine side).

- The ABT group is exploring several strategies to reduce the losses at the electrostatic septum by a factor 4 at least, some of them making use of bent crystals.