Beam extraction at LHC [CRYSBEAM]

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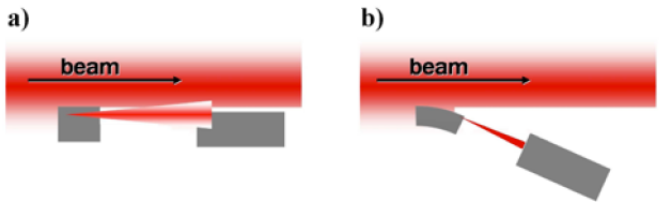
ECT* Trento

UA9 success

- UA9 experience in
  - Construction and test of crystals
  - Motion in vacuum (goniometers)
- Crystal collimation is now a well established technique on SPS
- Now working on a LHC setup

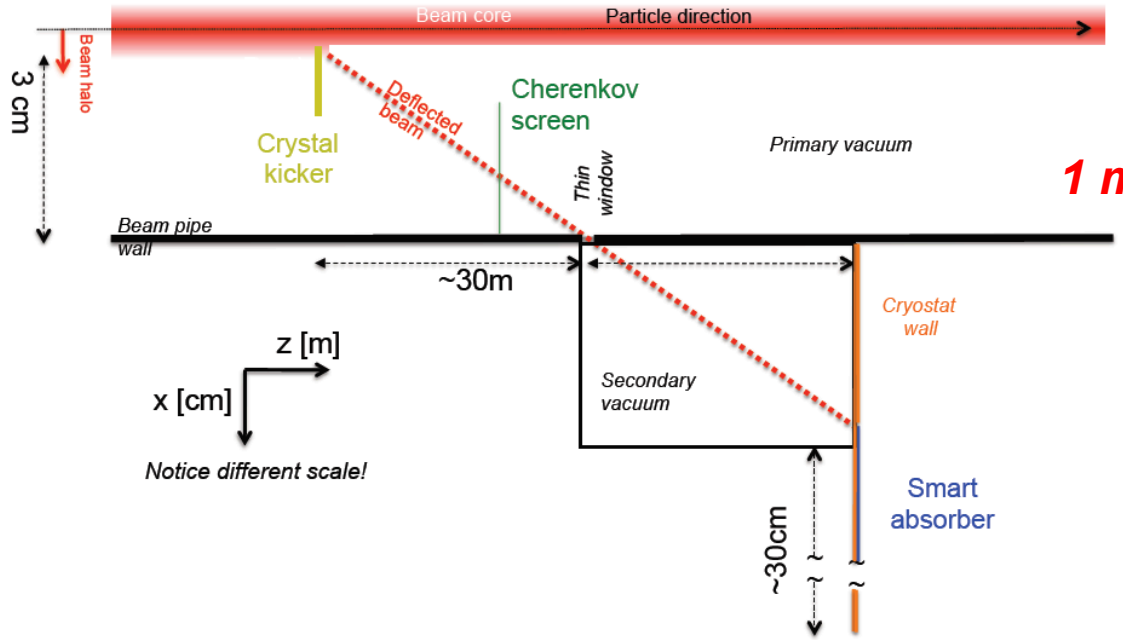


Beam extraction is the core ingredient of crystal collimation

100 protons extracted per bunch (~10^{11} protons)

UA9 2.0: CRYSBEAM

- A possible setup to extract a hadron beam (not for for collimation but sharing the same difficulties)
- Meant to work at high luminosity (high current)



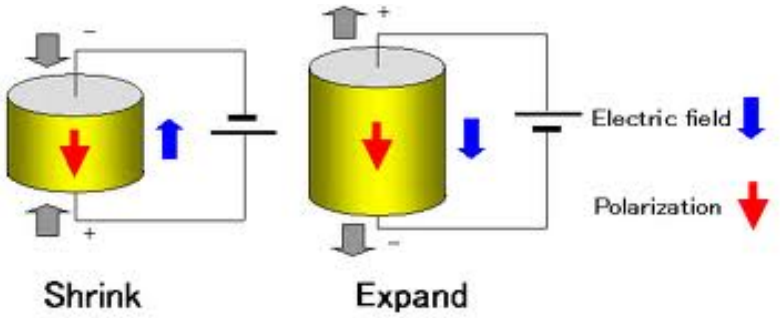
1 mrad deflection

CRYStal channeling to extract a high energy hadron **BE**am from an **A**ccelerator **M**achine

Presented for FP7 ERC CoG call

Crystal kicker

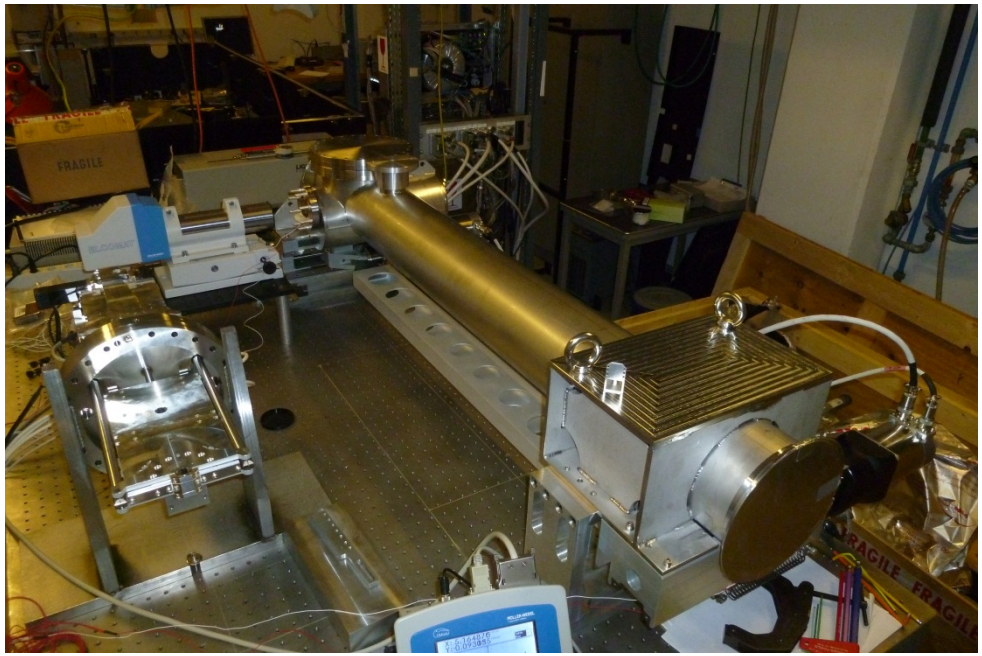
- 7 TeV critical angle is ~ 2 μrad
- Need a very accurate positioning system
  - Current best realized by CINEL (Italy) for INFN (2μrad static repeatibility)

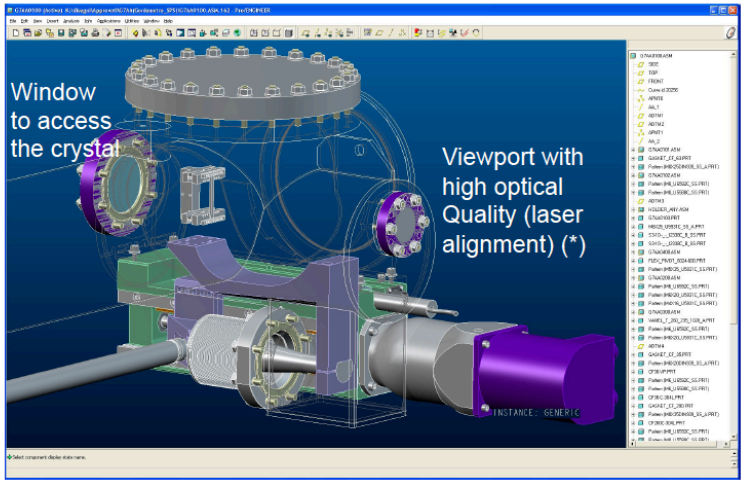


Piezolectric actuator

  - Sub-nm precision on short scales!
  - Closed loop control with interferometer technique to correct for backslash, hysteresis, etc.
    Rad hard optical fibers needed!

CINEL goniometer





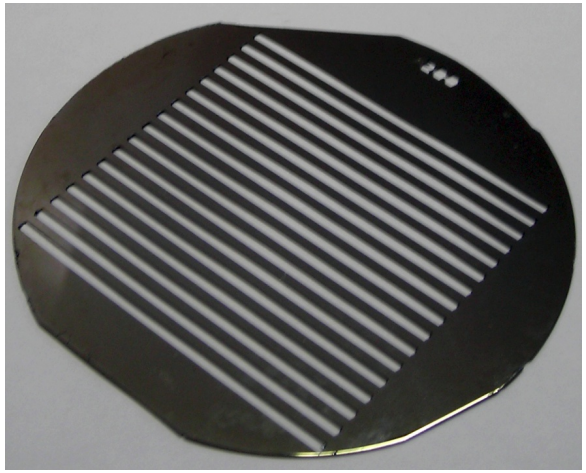
To be installed on SPS

- Fully characterized at CERN with interferometric techniques
  - Static behaviour good!

New design to cope with
E.m impedance
Dynamical behaviour
Electron cloud effect

Crystal for collimation

Silicon wafer with crystal strips



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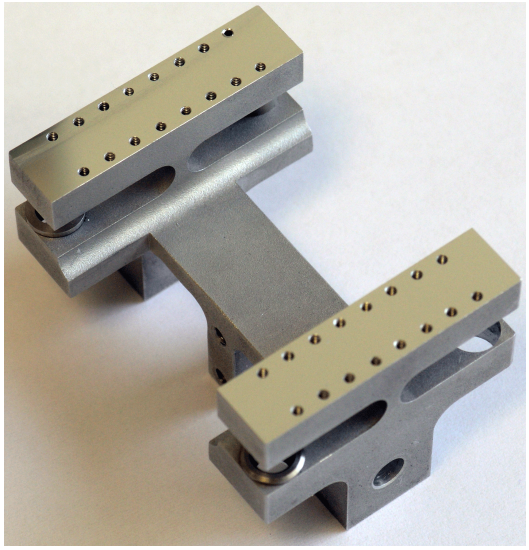
Photolitography and chemical etching

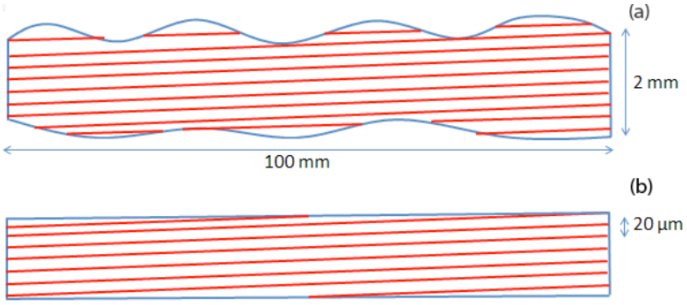


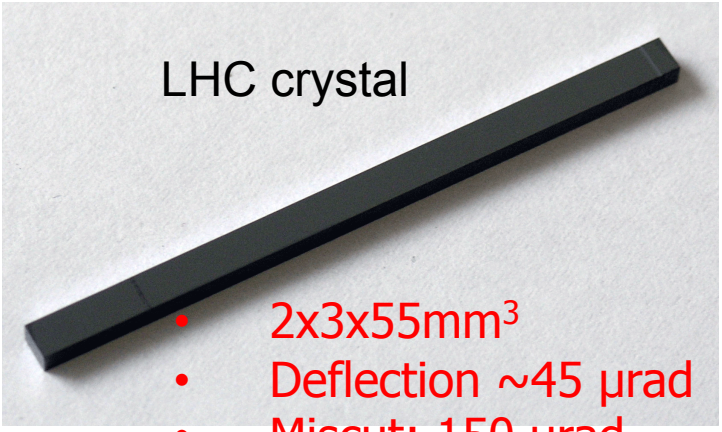
INFN Ferrara

Crystal holder

R&D on material (resistance to heating)

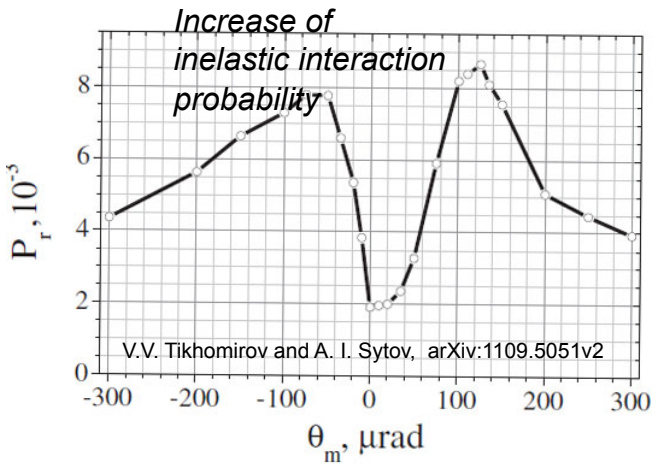
Planarity ?

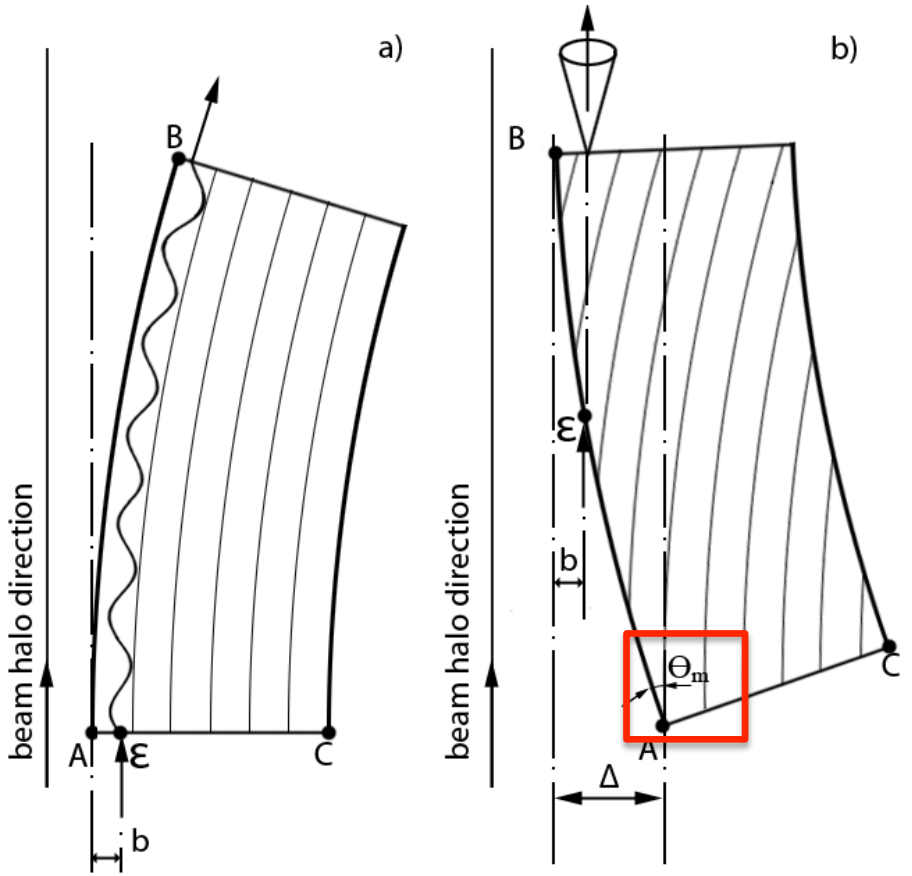




Miscut angle

- Miscut angle: angle between atomic layer and external crystal surface.
- Most of (halo) particles impinge on the crystal edge
  (b ~ 200nm ~ 400 lattice planes)
- Current best miscut achieved: 150 microrad (crystal length: 2mm)



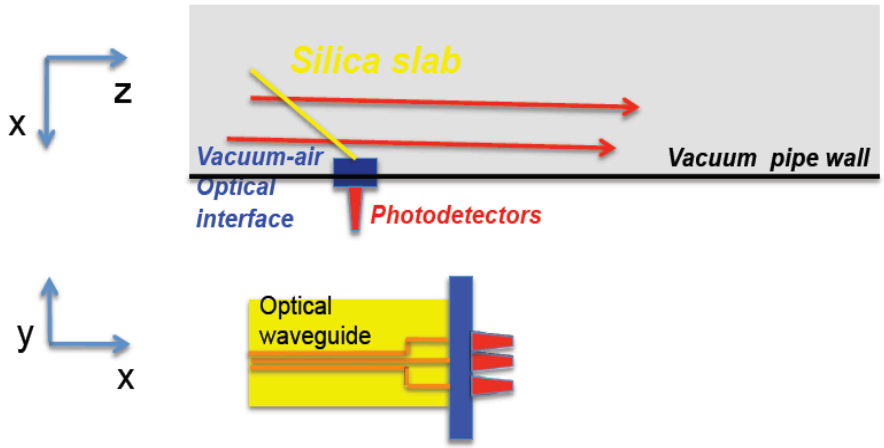


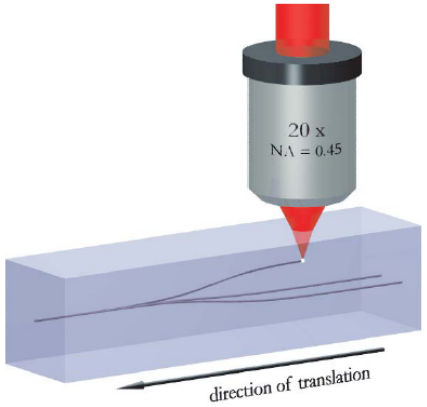
Magneto-rheologic finishing
Measure the miscut angle
(HRXRD with autocollimator)

Cherenkov screen

– Tag deflected particles:

- Count them, measure the beam spot, measure the time of proton IN THE LHC BEAM PIPE



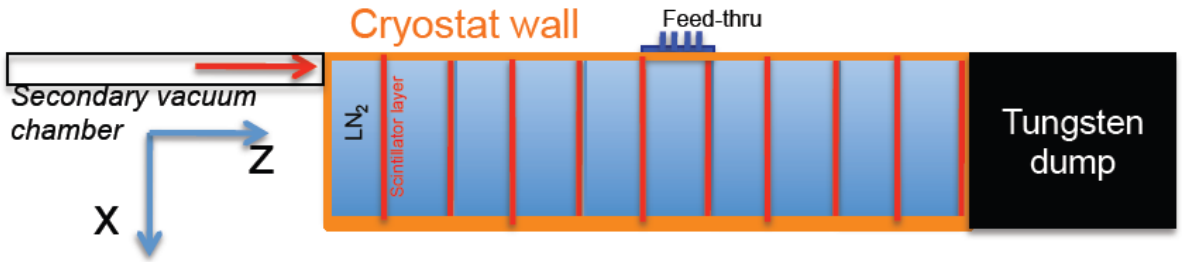


Write optical waveguide in a silica slab with a **ultra fast laser**

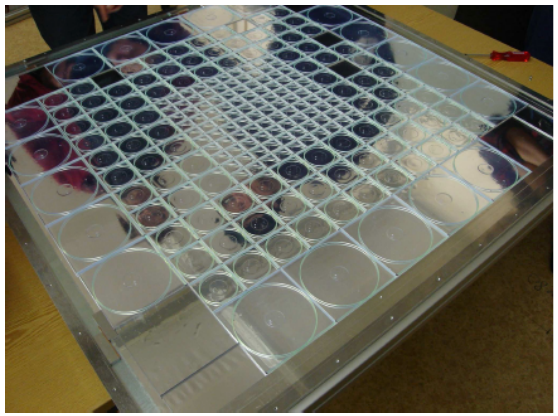
Facing enormous dose (can be 100 kGy/year!!!)
Light readout with MultiChannel Plate PMT under study
Otherwise bring light far from beam pipe.

Smart absorber

– Secondary collimator are massive absorber, replace them with mix of detectors and absorber (sampling analog calorimeter)



Liquid nitrogen "target"



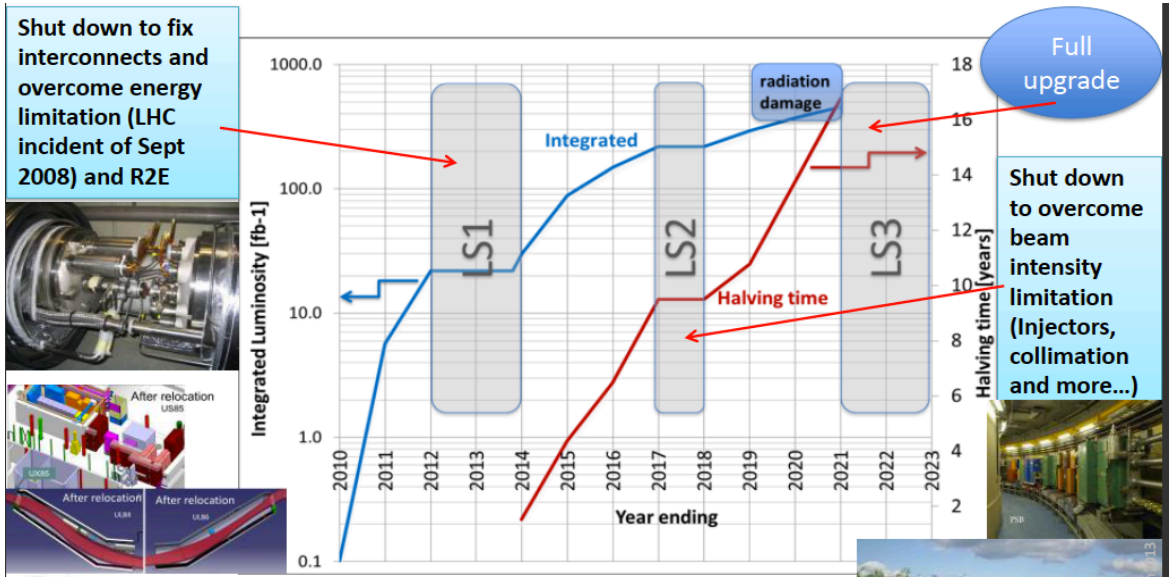
CALICE AHCAL

Interaction of hadron in atmosphere

It can be interesting for UHECR MonteCarlo simulation (SYBILL)

Schedule

L.Rossi at last CLIC workshop



- UA9 instrumentation for LHC collimation should be ready for LS1

In general instrumentation that is very close to the beam should pass stringent test (e.m. impedence, outgassing, very solid motion system, etc.)
Need time to design, build and test it.

For LS2 CRYSBEAM could be ready