

Crystal Collimation at LARP CM15

LARP Collaboration Meeting-15 at SLAC, November 1-3, 2010

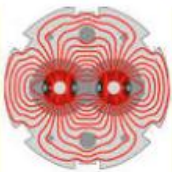
Two talks:

- U. Wienands, UA9 Status & Plans
- N. Mokhov, T980 Status & Plans

LARP Support

UA9 Goals

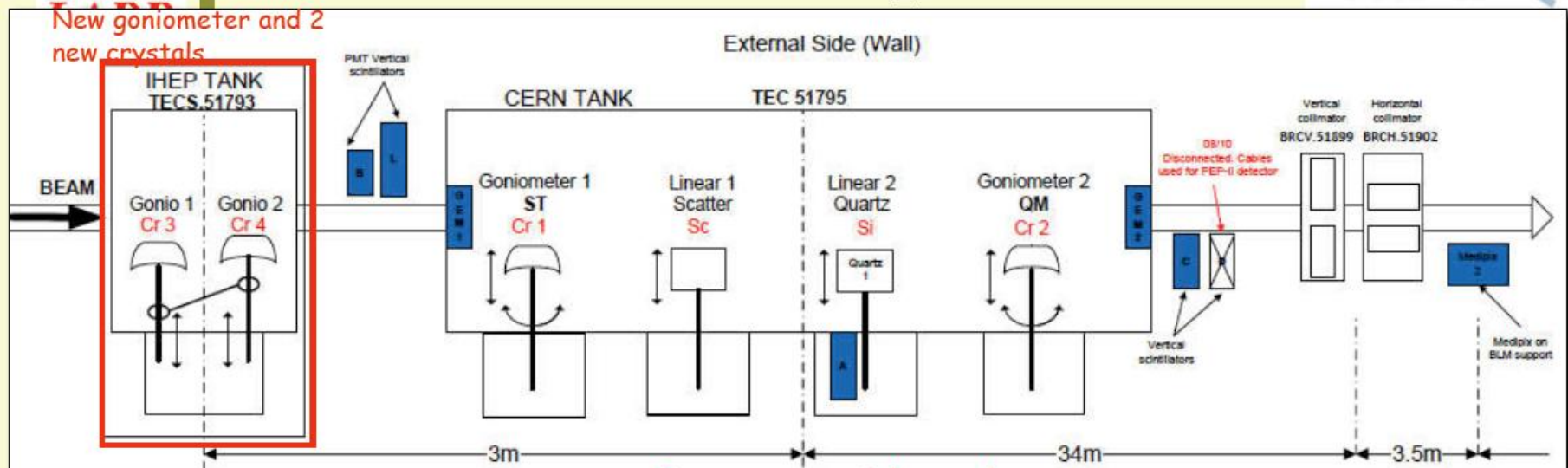
- Characterize crystals suitable for beam collimation in the SPS and, ultimately, the LHC
- Proof of principle and demonstration of collimation efficiency in the SPS
- Pending results, extension to mount a beam-collimation experiment with crystals in the LHC



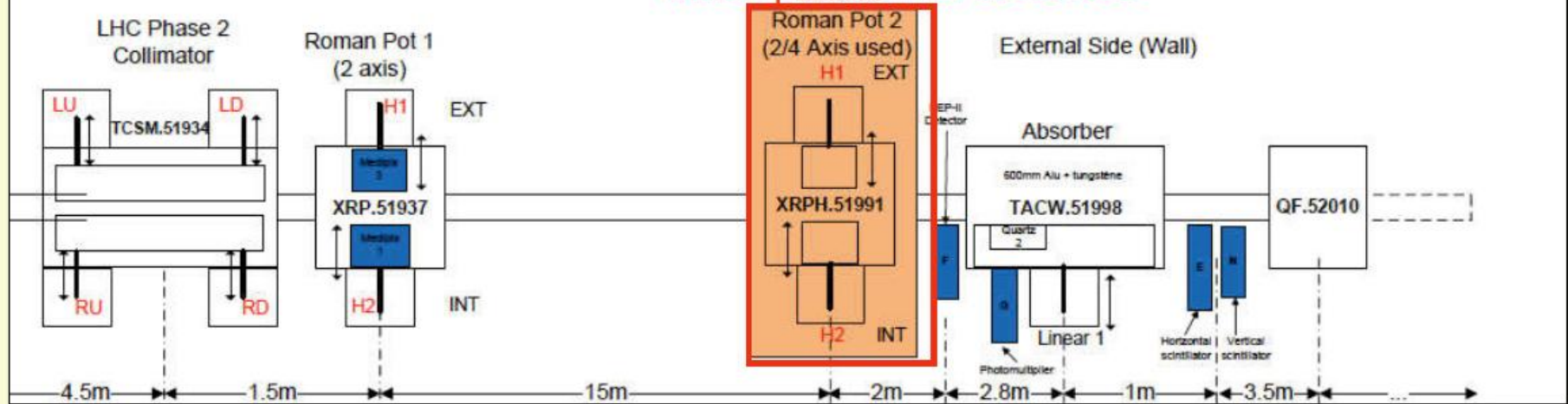
UA9 (SPS) Setup in 2010



New goniometer and 2 new crystals



Roman pot without detectors



U. Wienands, SLAC
LARP CM15, 02-Nov-10



UA9 Main Results



- Crystal collimation works very well based on channeling process
 - Optimal crystal alignment easily detected and achieved
 - Collimation leakage in amorphous orientation larger than in channeling
- Collimation leakage rate reduced by more than a factor of 5 at the TAL2 in the dispersive location (sextant 5, position 22)
 - Nuclear loss rate (including diffractive) strongly depressed
 - In channeling versus amorphous mode : $\times 16$ in multi-turn (SPS)



UA9 Plans



- **Complete the runs in 2010**
 - (pending request of one additional shift of 8 h to partly compensate the two UA9 shifts used to fill LHC)
 - **Main goals**
 - Improve the estimate of the collimation efficiency
 - Improve loss map detection in the dispersive area
 - Test the remaining crystals
 - Add one or two Medipix in the Roman pot 2 (→ 2011)
 - Test with IONS Pb82
- **Extension of the UA9 apparatus in the 2011 winter shutdown**
 - Replace gonios 1 and 2 with more accurate short goniometers (suited for LHC)
 - Complete the beam loss detectors (a coincidence telescope everywhere)
 - Fill the RP2 with 4 medipix and 2 fiber hodoscopes
 - Add SPS collimators and loss detectors in 2 more areas to introduce betatronic aperture restrictions.
- **Request submitted for similar run time in SPS and H8 next year.**
 - endorsed by the CERN SPSC



SPS Results vs LHC Requirements



Parameters	Obtained in 2009	Obtained in 2010	Required for LHC
Channeling efficiency, %	75	80	90-95
Nuclear loss reduction	5	16 - 20	20 - 30
Goniometer angular accuracy, μrad	30 - 40	10	1 - 2
Crystal bend angle, μrad	140 - 150	150 - 170	50 - 100
Crystal torsion, μrad	20 - 30	5 - 10	0.5 - 1
Amorphous layer on crystal	About zero	About zero	About zero
Collimation leakage reduction	-	5	Should be analysed



Road Map towards an LHC Expt.



- Crystals in preparation at PNPI and INFN-Ferrara to be tested in H8
- Goniometer in preparation with and industrial partnership with CINEL, to be tested in H8
 - IHEP also proposed to build new goniometers for SPS, should fit LHC also
- Special instrumentation [loss detectors and mini-Roman pots] in preparation at CERN with the help of INFN and Imperial College to be tested at the SPS
- Simulation!
 - Simulation working group to be formed (CERN, INFN, IHEP, ...)
 - important for both the SPS expts as well as any planning for LHC
- Layout of a possible installation at the LHC
 - There are flanges in the LHC available, details to be worked out, close coordination with LHC ops and LHC collimation group needed.

T980 Status & Plans

- Status and New Results
- New Crystals and Beam Diagnostics
- Beam Study Plans

MVR Parameters for MS-08-09 Crystal

Specified VR angle = 64 urad (8 strips X 8urad/strip) Note: This is not a strictly defined angle

	MVR angle (by collimator scan) (μ rad)	MVR width (μ rad)	MVR displaced at E03V collimator (mm)	MVR efficiency (%)	Bend angle (by angle scan) (μ rad)	MVR peak (μ rad)
Measured	74.6 (+/- 7.5 stat) (+/- 1.6 instr)	36 (+/- 10 stat) (+/- 2.5 instr)	1.7 (+/- .6 (stat)) (+/- 1.6 instr)	83.5% (+/- 4 instr)	255 (+/- 28.3 stat) (+/- 6 inst)	767 (+/- 12.72 stat) (+/- 3 inst)
Simulated	64	43.3 (+/- 1.9)	1.61	-	-	758 (+/- 2.9)
SPS H8 Run Result	60* <small>* scaled by 1/sqrt(E)</small>	28.6* <small>* scaled by sqrt(E)</small>	-	-	300 (+/- 50)	-
Measured /Expected	SPS 1.24 Simulated 1.17	SPS 1.25 Simulated 0.83	Simulated 1.05	-	SPS 0.85	Simulated 1.01

Channeling Parameters for O-05-09 Crystal

This crystal will be used in the horizontal plane for 2 plane Crystal collimation.

	CH angle (by collimator scan) (μ rad)	CH width (μ rad)	CH displaced at E03H (mm)	CH Efficiency (%)	Bend angle (by angle scan) (μ rad)	CH peak (μ rad)
Measured	158.8 (+/- 22.8 stat) (+/- 1.2 instr)	16.2 (+/- 5.3stat) (+/- 1.5 instr)	3.8 (+/- .5 stat) (+/- 3 (instr)	79.57 (+/- 9.38)	280.4 (+/- 53.5 (stat) (+/- 100 inst)	-960.8 (+/- 9.1 stat) (+/- 1.5 inst)
Simulated	360	10.5 (+/- 1.1 stat) (+/- 1.0 inst)	8.5	-	192.8 (+/- 20)	-962.8 (+/- 1.6 stat) (+/- 1.0 inst)
Measured /Expected	.44	1.5	.45	-	1.45	.99

The CH angle being smaller is a consistent result with the other O-shaped crystal O-BNL-02 (300 μ rad/410 μ rad = .72 Meas/Exp). Thought that this was miscut related but O-05-09 miscut = 120 μ rad not 1600 μ rad like O-BNL-02.

Think this is related to the O-shaped crystal beam-side profile.