

Status of the TWOCRIST Project

P. Hermes

On behalf of the TWOCRIST Collaboration

3rd Workshop on EDM of unstable particles
IJCLab Orsay, France

11.12.2023

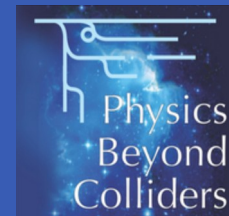


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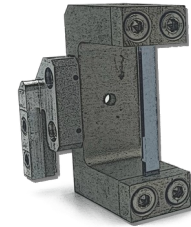
Introduction

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Layout & Integration

Key Device Status

Plans for 2024



Present TWOCRIST member list

C. Antuono, G. Arduini, L. Bandiera, M. Calviani, S. Carsi, S. Cesare, S. Coelli, M. D'Andrea, D. De Salvador, M. Deile, Q. Demassieux, K. Dewhurst, M. Di Castro, L. Esposito, M. Ferro-Luzzi, J. Fu, P. Gandini, H. Havlikova, S. Jakobsen, G. Lamanna, G. Lezzani, C. Maccani, L. Malagutti, D. Marangotto, F. Martinez Vidal, E. Matheson, J. Mazzora de Cos, A. Mazzolari, A. Merli, D. Mirarchi, R. Negrello, N. Neri, A. Perillo Marcone, J. Pinzino, M. Prest, S. Redaelli, P. Robbe, M. Romagnoni, B. Salvant, R. Seidenbinder, G. Simi, S. Solis Paiva, E. Soria, M. Sozzi, E. Spadaro Norella, M. Tamisari, G. Tonani, N. Turini, E. Vallazza, M. Zanetti, C. Zannini

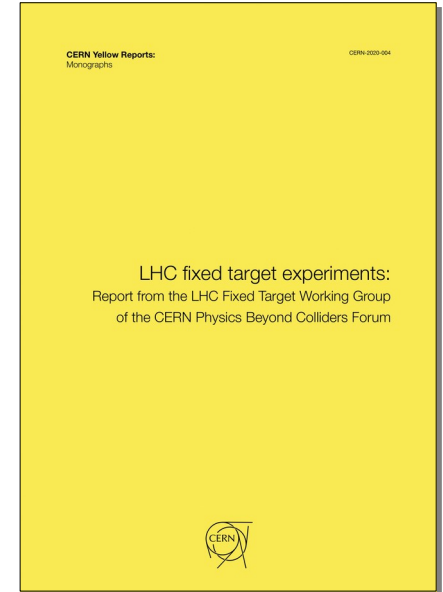
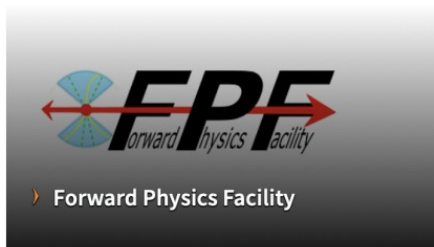
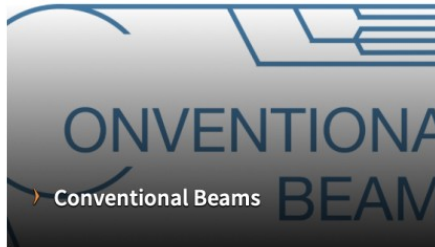
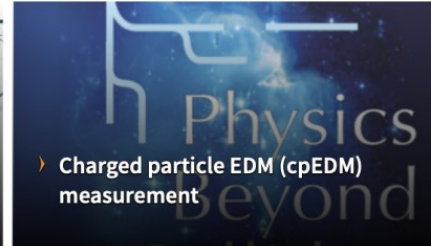
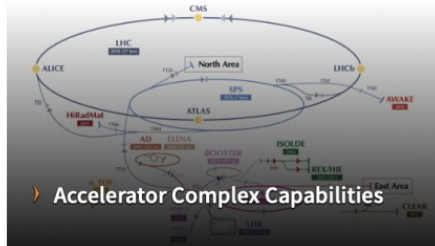


Introduction

Accelerators & Technology Domain

The Working Groups in the Accelerators & Technology Domain are coordinated through the PBC Accelerators & Technology Committee, a steering committee which meets around once per month. The steering committee includes the CERN conveners of the various Working Group in the Accelerators & Technology Domain. The Working Group's core members include accelerator experts and representatives of the projects. Requests from the Working Groups (tests, prototypes, manpower) are discussed by the steering committee.

ACCELERATORS & TECHNOLOGY WORKING GROUPS

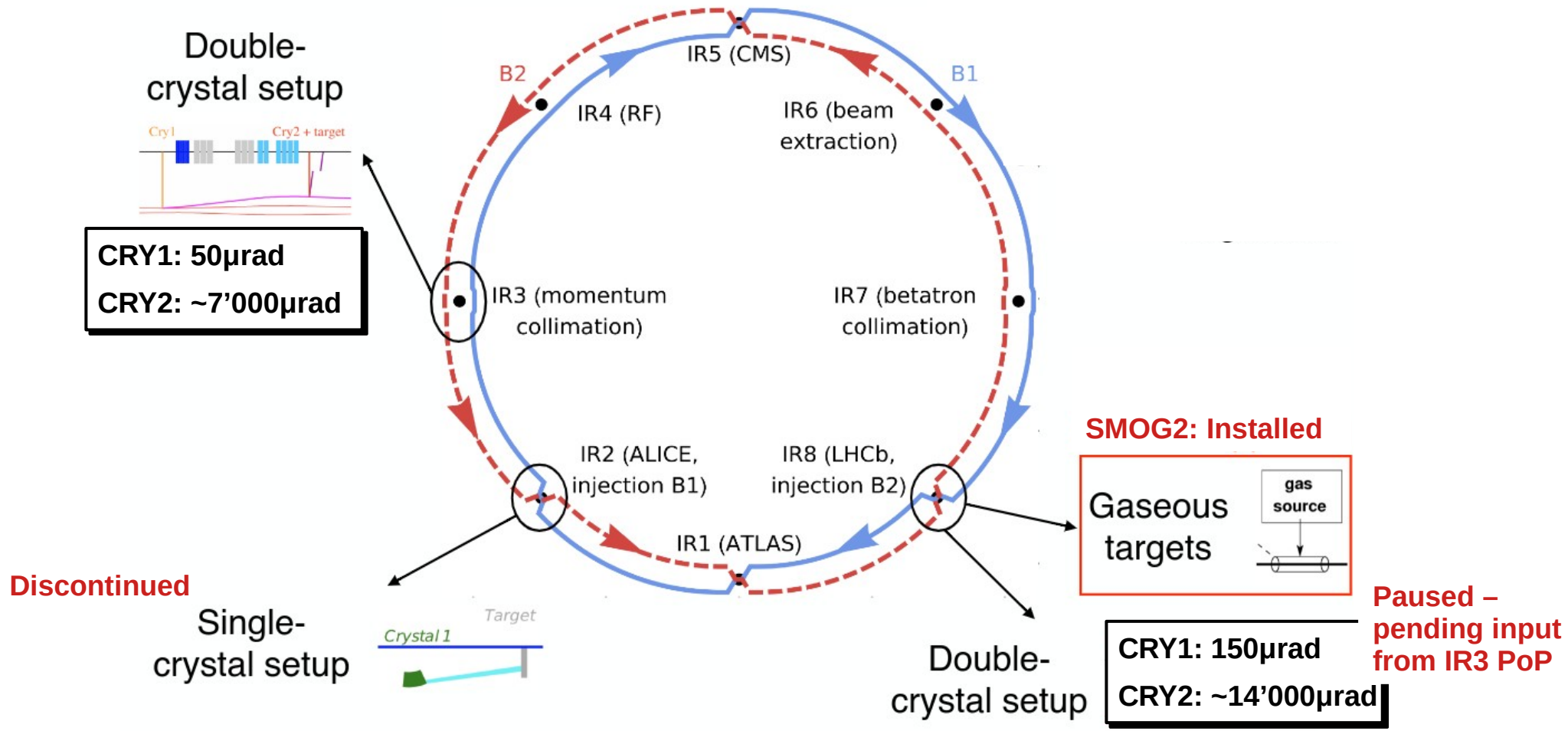


CERN Yellow Report
CERN-2020-004

**LHC FT WG
Updated
Mandate
(2021)**

“the [FT] WG will continue investigating FT proposals and conduct the relevant R&D to provide, as much as possible, the necessary support towards the evaluation of their technical feasibility.”

LHC FT Studies & Proposals



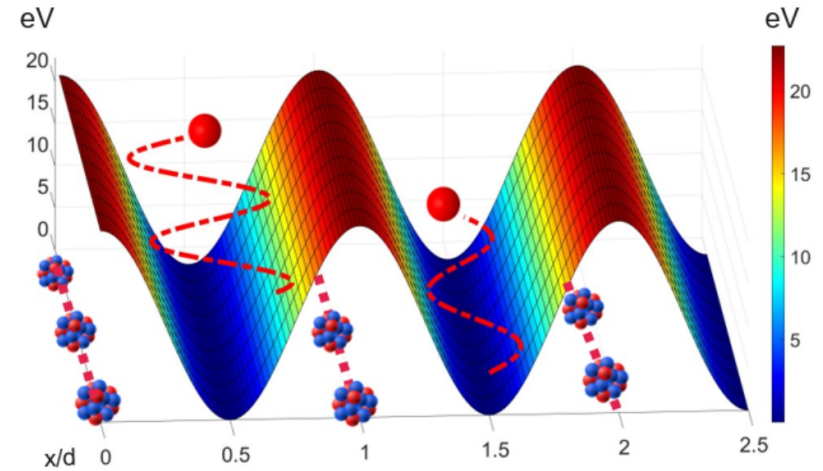
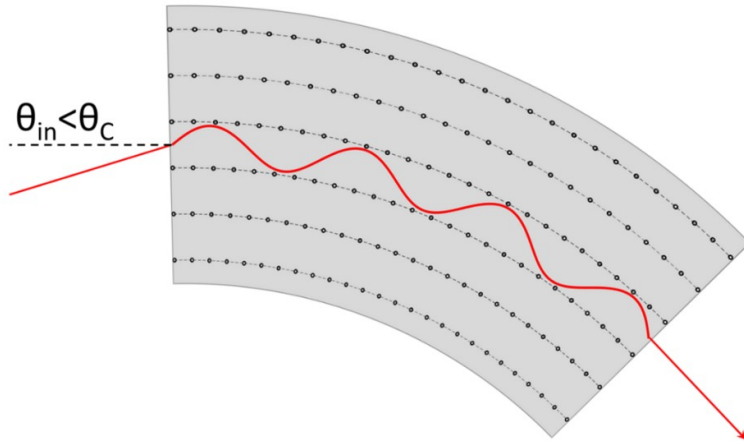
S. Redaelli, PBC General WG, 02/12/2021

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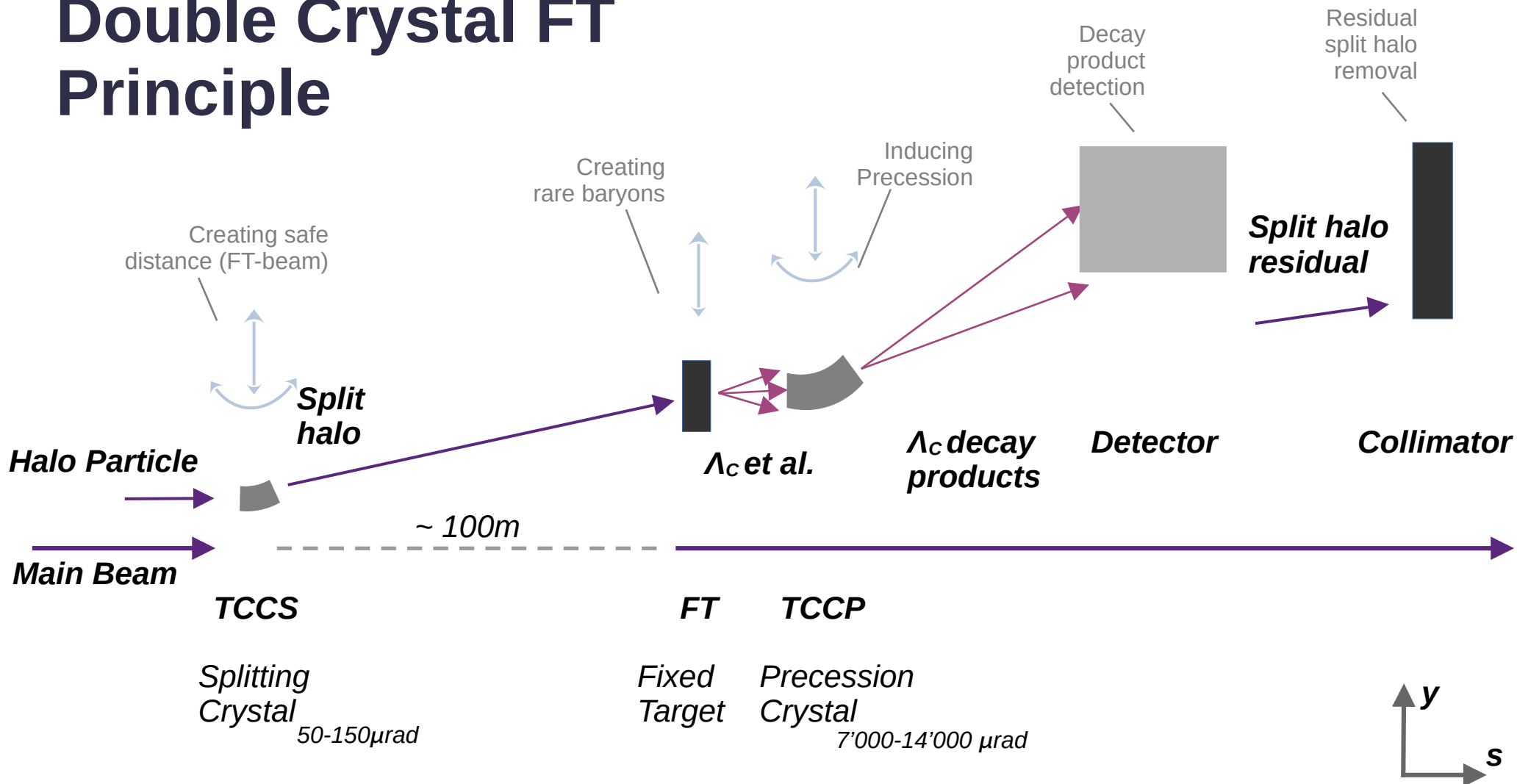
Channelling in bent crystals

Source of figures:

Crystals 2022, 12(9), 1263

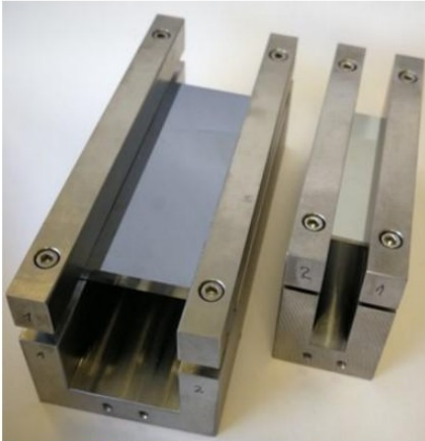


Double Crystal FT Principle



Bent crystals for spin precession

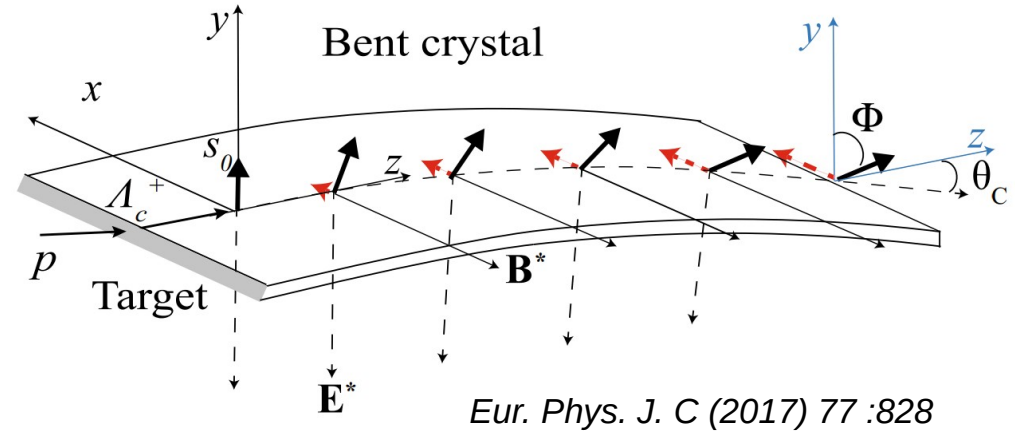
S. Aiola



Si

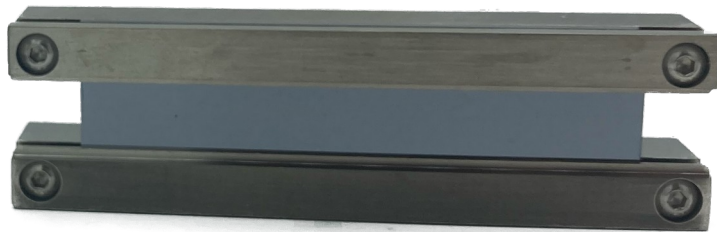
Ge

16.5mrad and 14mrad
crystals



Eur. Phys. J. C (2017) 77 :828

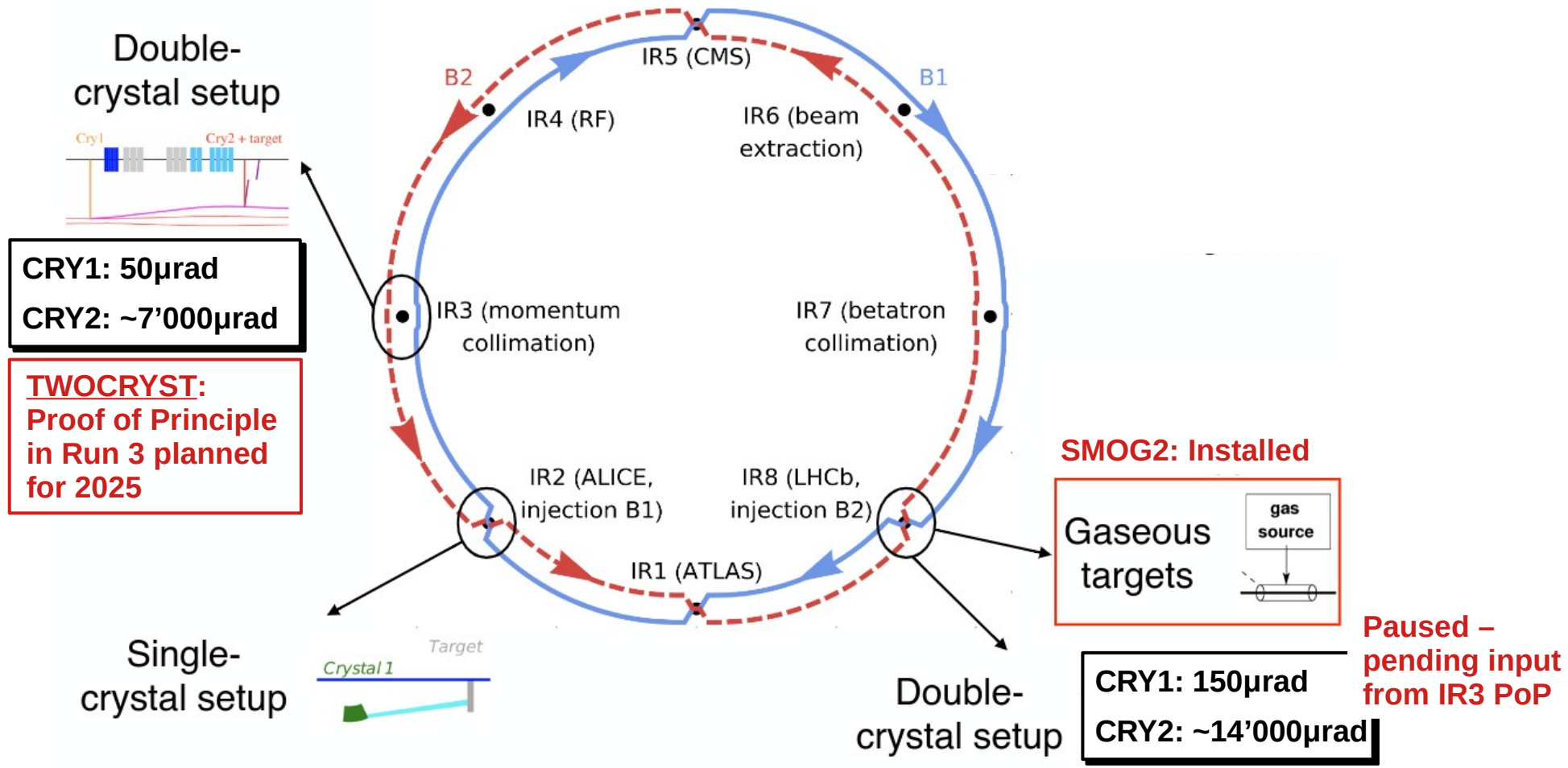
A. Mazzolari



7mrad crystal

- Collimation crystals in LHC shorter and smaller bending angle (50 μ rad)
- Long precession crystals tested with SPS beams, never in TeV range

LHC FT Studies



S. Redaelli, PBC General WG, 02/12/2021

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TWOCRIST Goals

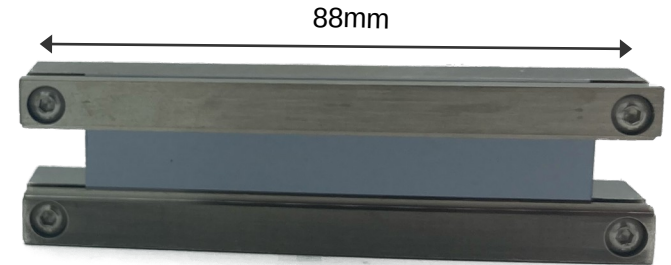


Validate crystal properties

Long TCCP crystal: challenging to manufacture with required accuracy

Hadron beam test (NA + SPS): promising results but need data in TeV range

Scaling to TeV to be addressed experimentally



TCCP Crystal, Courtesy of A. Mazzolari, INFN



Prepare Device Operation

Need to demonstrate operational feasibility + gain experience

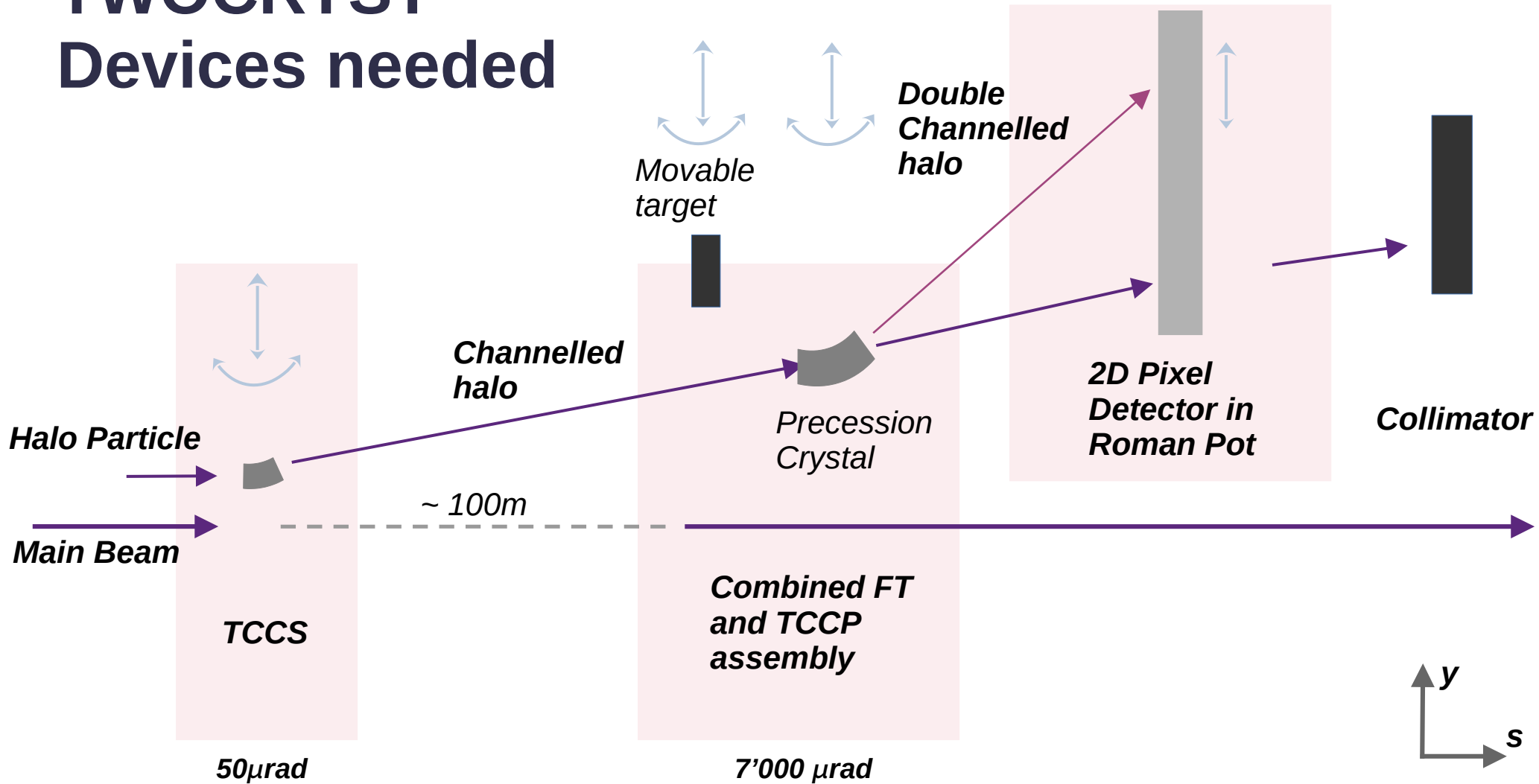


Prepare input for possible experiment design

Experimental validation of simulation based performance estimates

TWOCRIST

Devices needed



Project Schedule

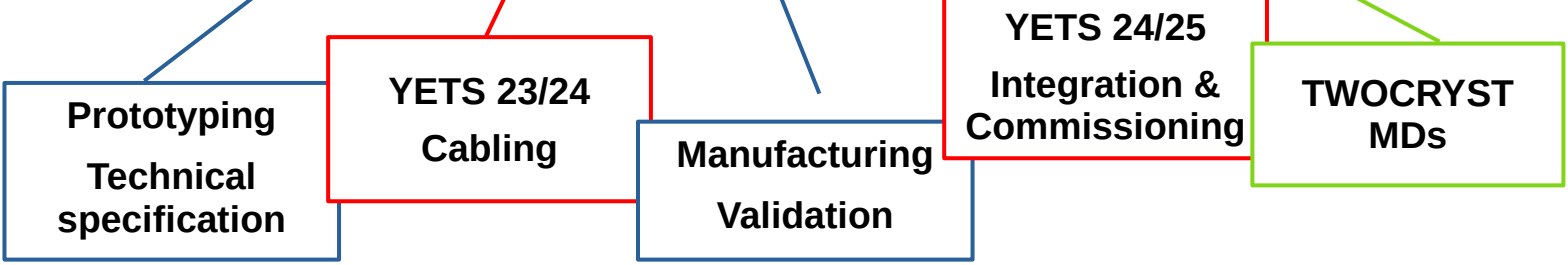
TWOCRIST inputs needed before LS3 to prepare possible experiment in LHC Run 4

Now
↓



- Shutdown/Technical stop
- Protons physics
- Ions
- Commissioning with beam
- Hardware commissioning/magnet training

Project endorsed by the LMC



Important Accomplishments 2023

- 05/23: Agreed work breakdown structure with CERN teams involved
- 07/23: TWOCRIST endorsed by the LMC

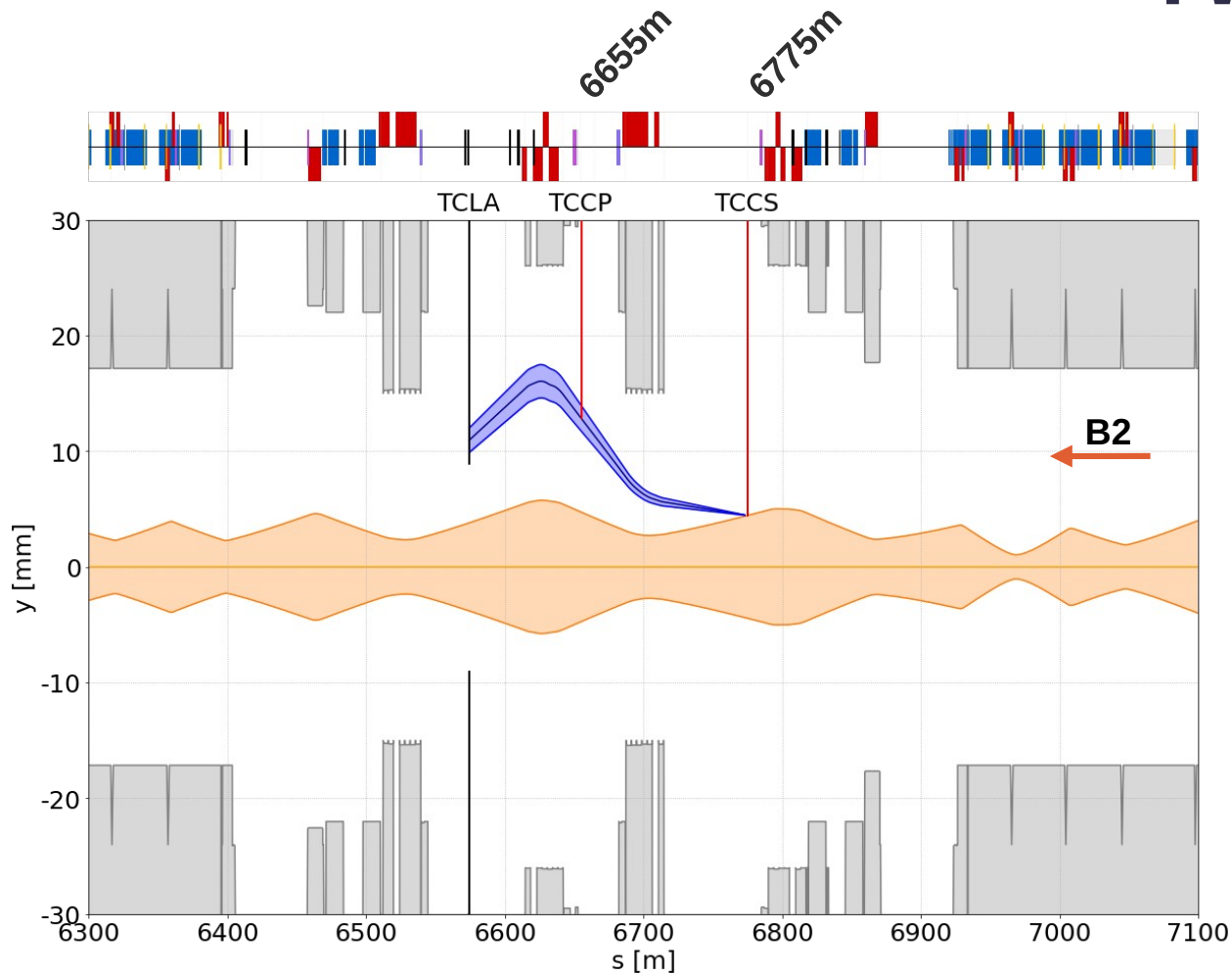
“DECISION: The LMC endorses the concept of the TWOCRIST experiment pending its formal approval via an ECR. The MD time allocation will follow the standard procedure via the LSWG, and will be prioritized according to needs.”

- 08/23: Delivery of TCCS and TCCP crystal from Ferrara
- 08/23: TCCS/TCCP test in H8 with 180 GeV hadron beams
- 10/23: Design of TCCP assembly completed
- 11/23: Removal of ALFA Roman Pots from the LHC tunnel
- 11/23: Procurement for TCCP manufacturing started

Layout and Integration



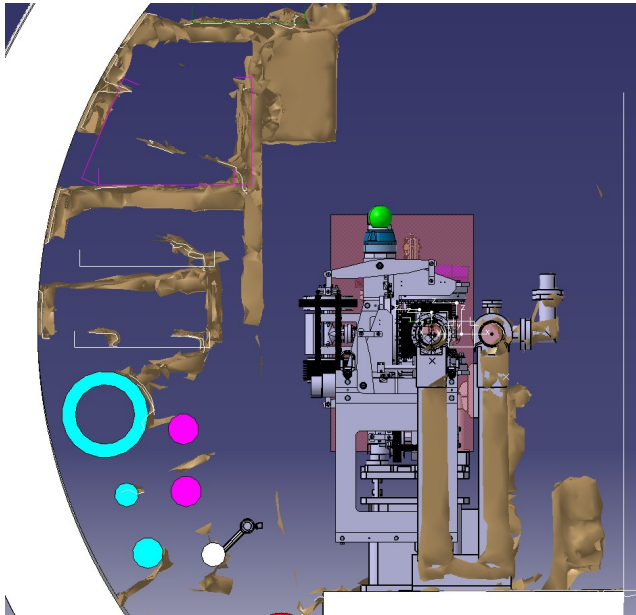
TWOCRIST Layout



- Initially foreseen to install on B1 (internal beam line)
- Revised baseline layout after feedback from transport team
- Roman Pot reaching into protected transport area if installed on B1
- No advantage for integration
- **Decision: B2 will be new baseline**

Integration

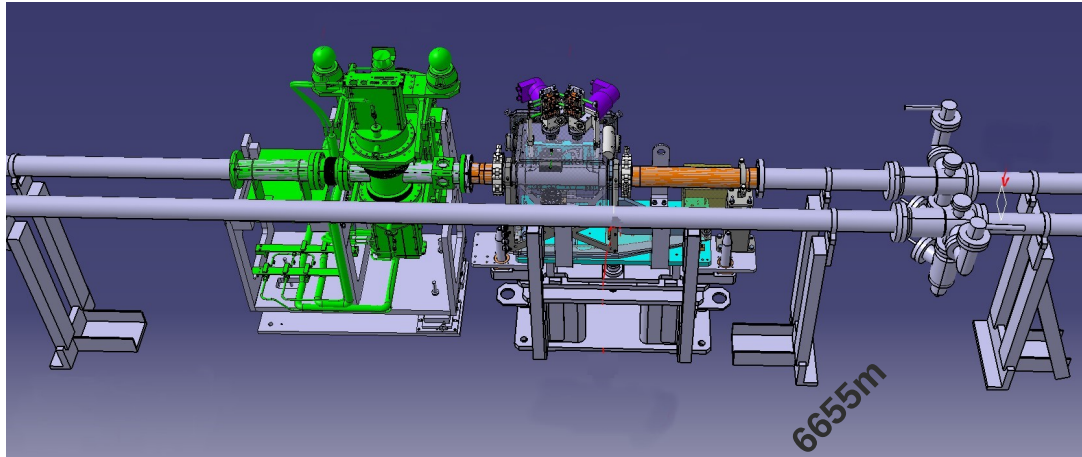
J. P. Corso



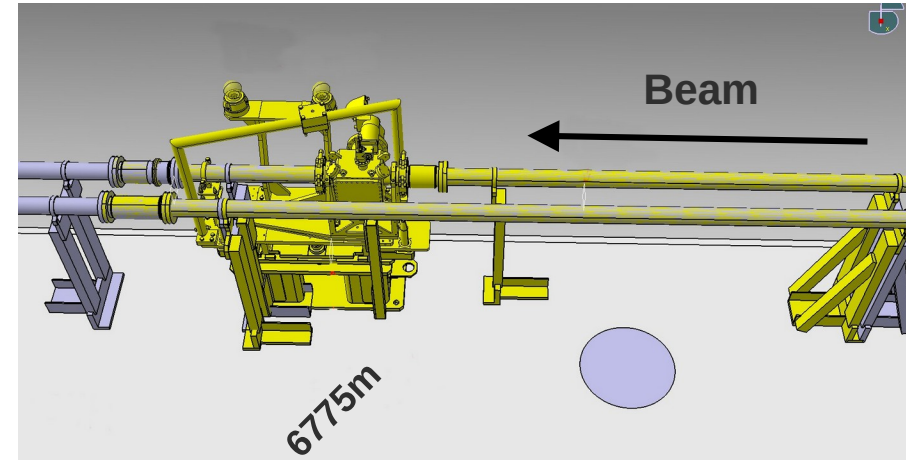
- Integration/space issue resolved by moving to B2
- Received (tentative) green light from integration
- Full study pending and must be performed

Integration

RP TCCP



TCCS



Key Device Status



Devices: TCCS goniometer

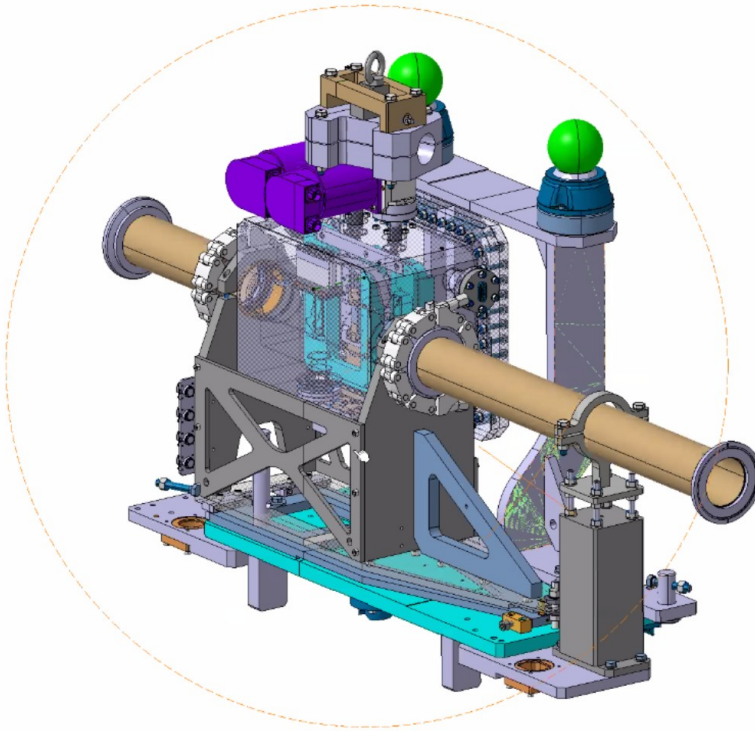


- TCCS goniometer recovered from LHC IR7
- Refurbishment currently ongoing (experts from STI & CEM)
- Cables for motion control – requested to be pulled in YETS23/24



*Dedicated talk by
Eloise Matheson*

Devices: TCCP goniometer



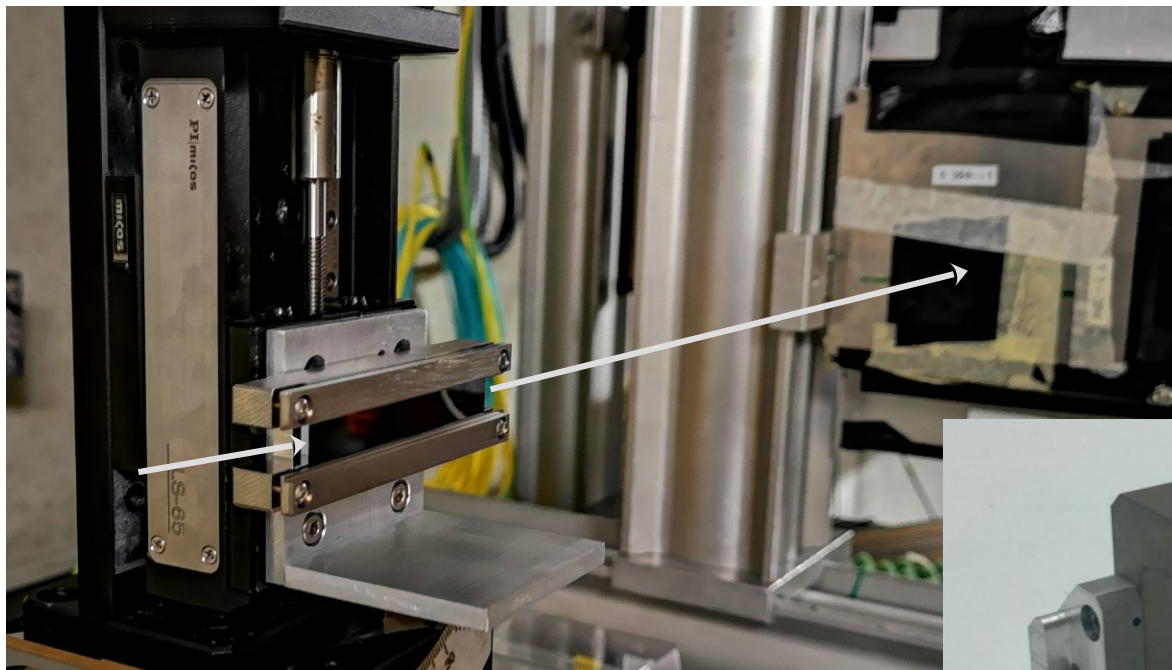
R. Seidenbinder

- TCCP goniometer design advanced
- Independent motion of target and TCCP crystal
- Procurement of raw material imminent
- Cables for motion control – requested to be pulled in YETS23/24



*Dedicated talk by
Hana Havlikova*

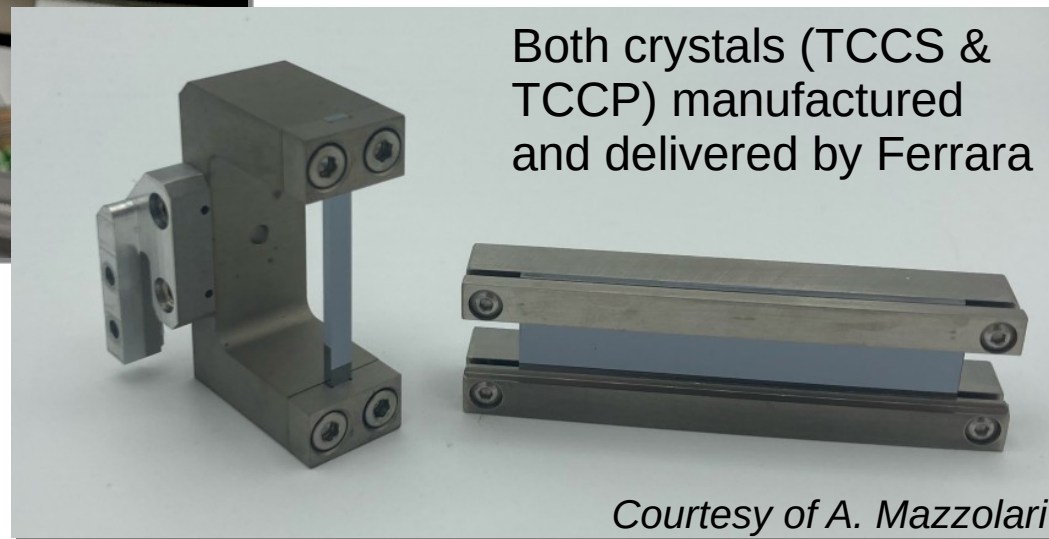
Devices: Crystals



Successfully tested in
CERN NA at H8 beam line

TCCP crystal mounted for H8 beam test

TCCP crystal also under
development by CERN STI team



Both crystals (TCCS &
TCCP) manufactured
and delivered by Ferrara

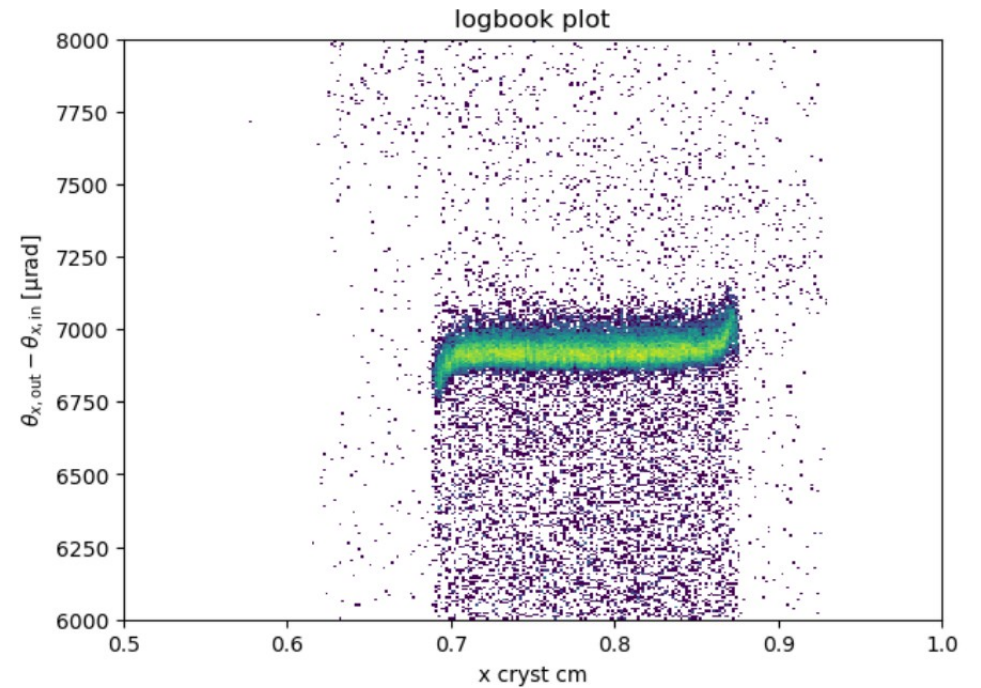
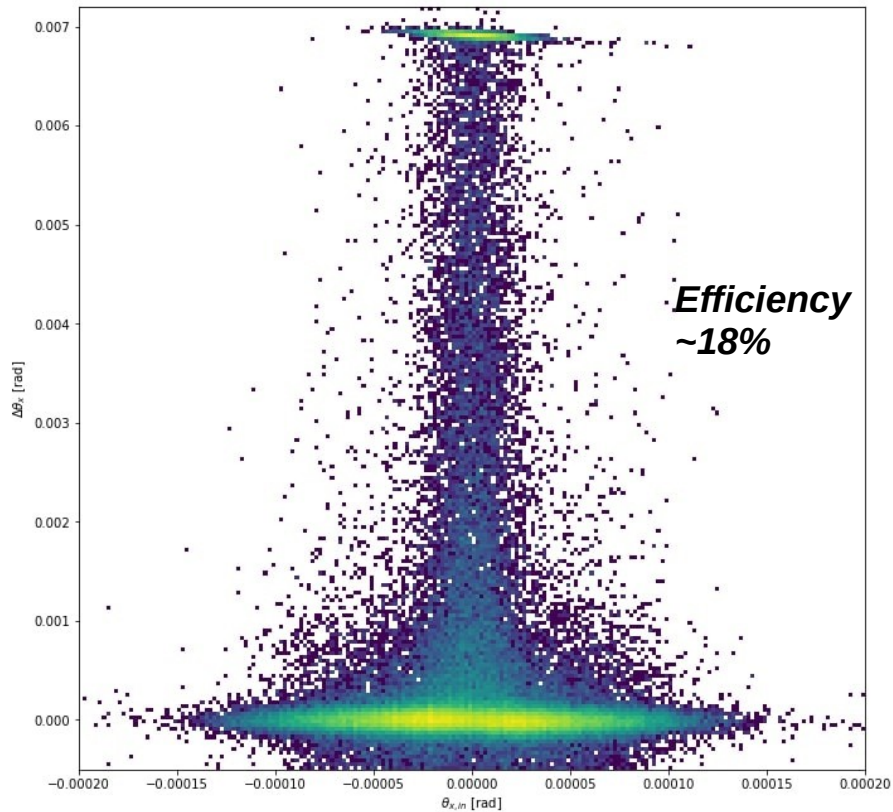
Courtesy of A. Mazzolari

H8 beam test



Dedicated talks by
K. Dewhurst / S. Cesare

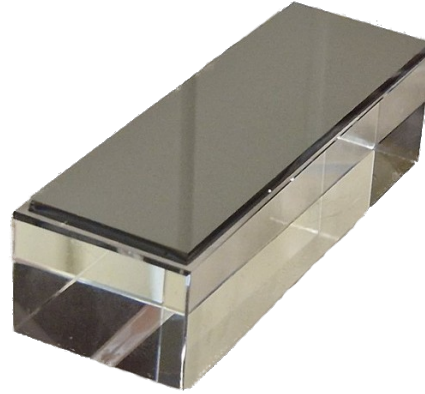
M. D'Andrea



Sara Cesare

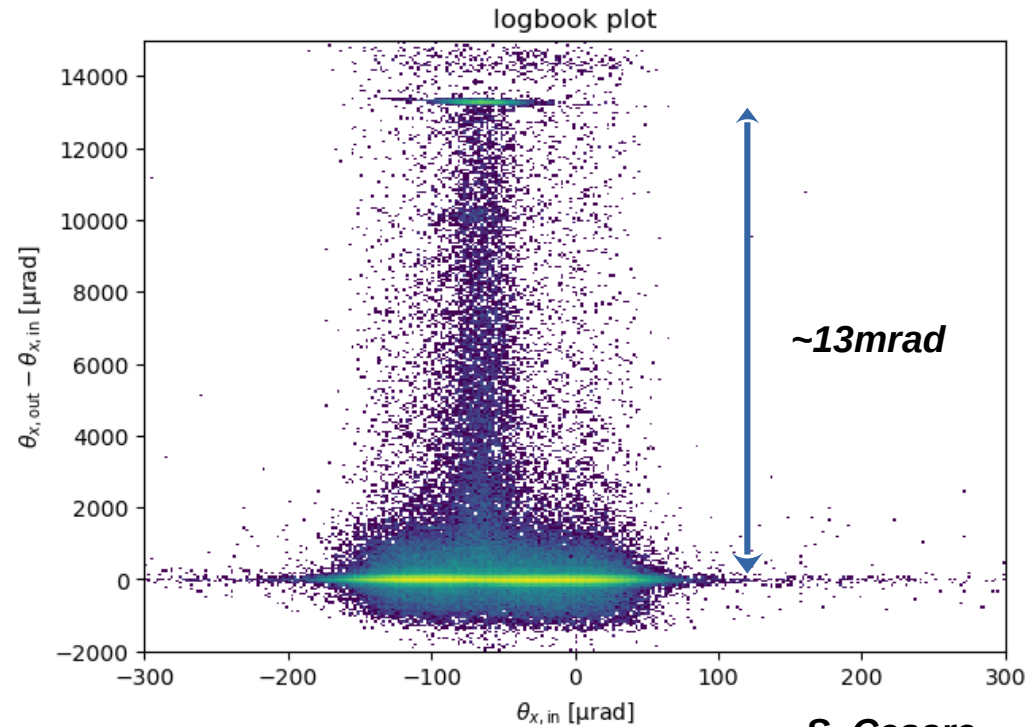
Anodic Bonding Crystal

Alternative technology to produce bent crystals



Under discussion: production of 7mrad crystal for TWOCRIST?

First hadron channelling through anodically bonded crystal measured in H8 beam test



S. Cesare

Devices: Roman Pot



Removal of two ATLAS-ALFA Roman Pot stations after high- β run 2023



ALFA detectors removed → refurbishment can be launched in 2024



S. Jakobsen



Dedicated talk by
Sune Jakobsen

Detector



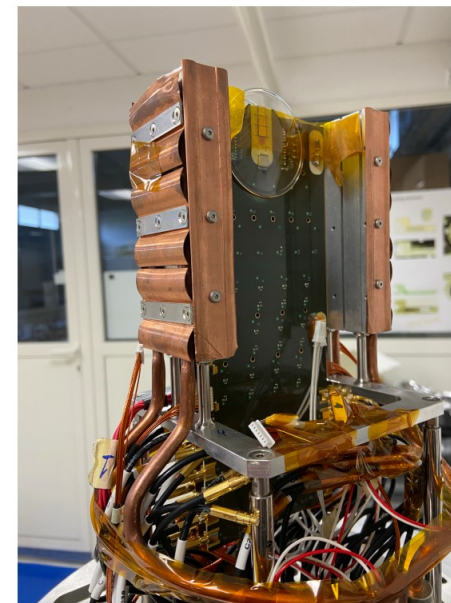
Detector Activities

N. Turini



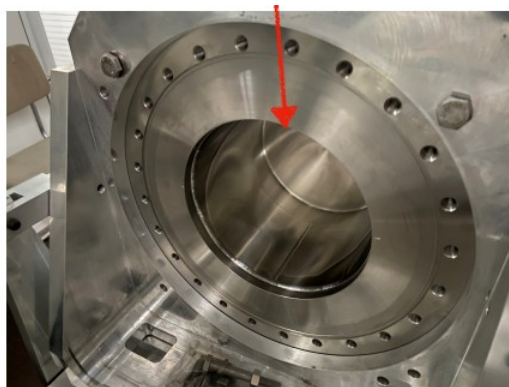
*Dedicated talk by
Sara Cesare*

**Possible cooling
techniques under
investigation**



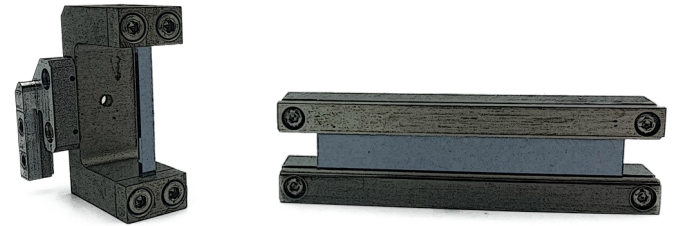
**RP for detector
housing could be
borrowed CMS PPS**

N. Turini



Detector design ongoing in dedicated
working group
(University Milan & Padova)

Infrastructure



Motion control cabling

- Carried out in EYETS 23/24
- Based on cabling extensions of empty collimator slots
- TCSM.A4L3.B2 (30m from TCCP)
- TCSM.C5R3.B2 (30m from TCCS)



Detector & Rack Space

- Rack space required (for detector)
 - RP team allows us to borrow their empty (1/2) rack space until LS3
 - Also MP team with positive feedback for neighbouring rack
 - Required rack space still evaluated (Valencia)
 - Separate power supply needed for TWOCRIST

Before

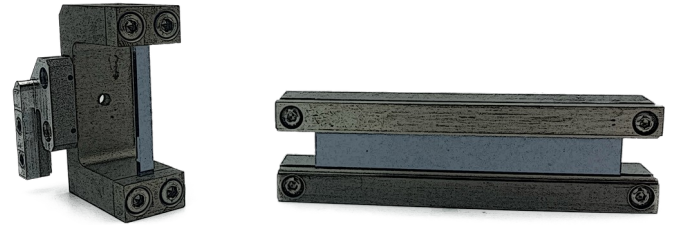


After



J. Rosset-Lanchet (RP)

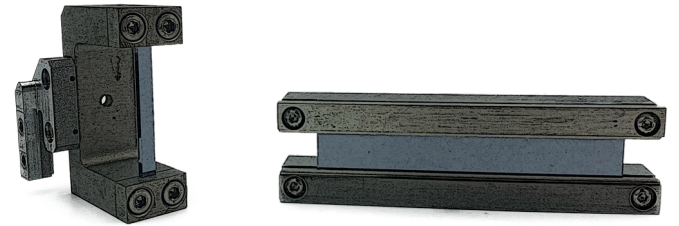
Milestones for 2024



Milestones 2024

- **2024 will be the last year of preparation**
- Crystal x-ray validation & thermal cycle checks at CERN
- Beam test with higher energy hadrons ($>180\text{GeV}$)
- Finalize validation and preparation of TCCS assembly
- Detector design and manufacturing
- Prepare ECR for installation
- Finish refurbishment of RP and TCCS assembly
- Construction, validation of TCCP assembly
- Installation of TWOCRIST devices into the LHC
- Validation and testing

Collaboration



Collaboration

- TWOCRIST: active and fruitful collaboration
 - **CERN** with 7 involved teams
 - **INFN**, Italy
 - **IJCLab**, France
 - **University of Valencia**, Spain
 - Contributions were defined at the TWICB (Addenda need to be finished)
- Two institutes expressed interest in joining TWOCRIST
 - **Warsaw University of Technology** (M. Patecki)
 - **University of Chinese Academy of Sciences** (J. Fu)
 - MoUs need to be signed
- Thanks a lot to all collaborators for their effort and energy!



Conclusions

Conclusions

- TWOCRIST project is well on track but still very challenging (important to continue at full pace in 2024!)
 - Crystals ready and tested with hadrons
 - TCCS goniometer available
 - TCCP assembly preparation on track
 - RP ready for refurbishment
- Thanks to all the motivated contributors!
- Finalization & installation of all key devices envisaged in 2024
- Looking forward to a productive workshop!