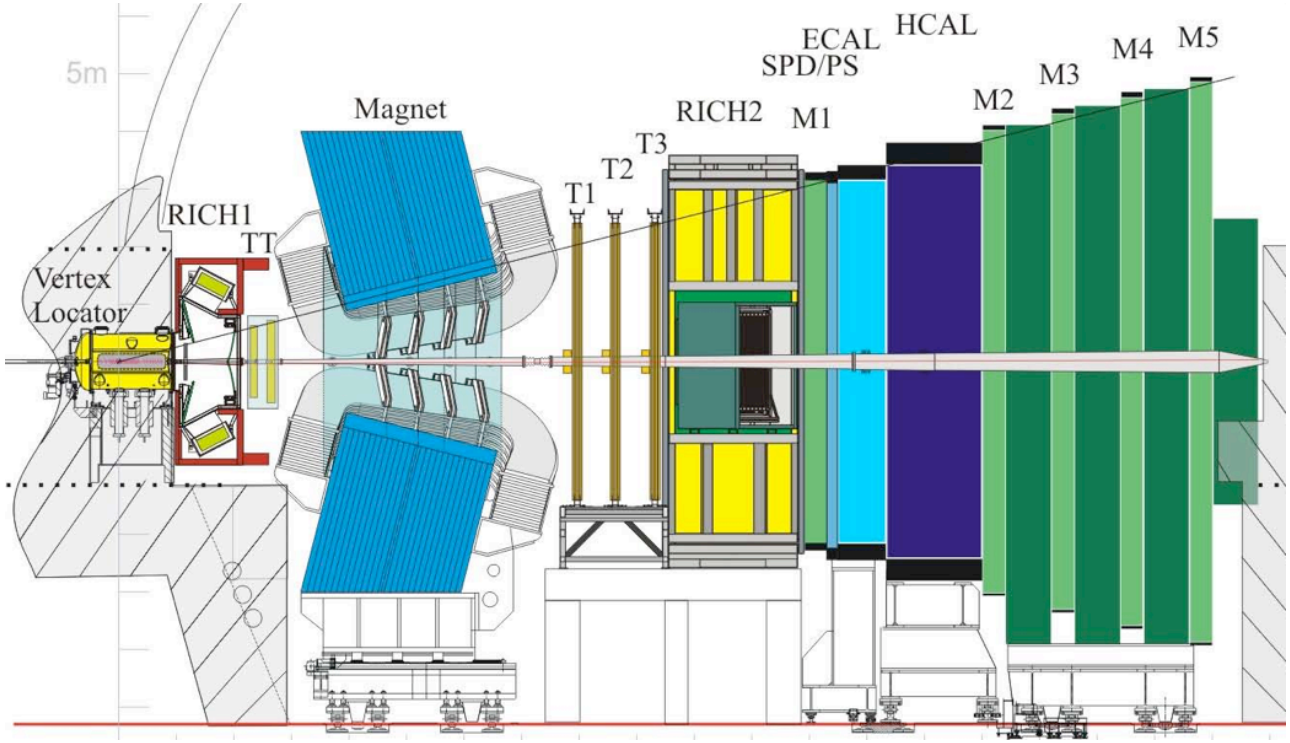
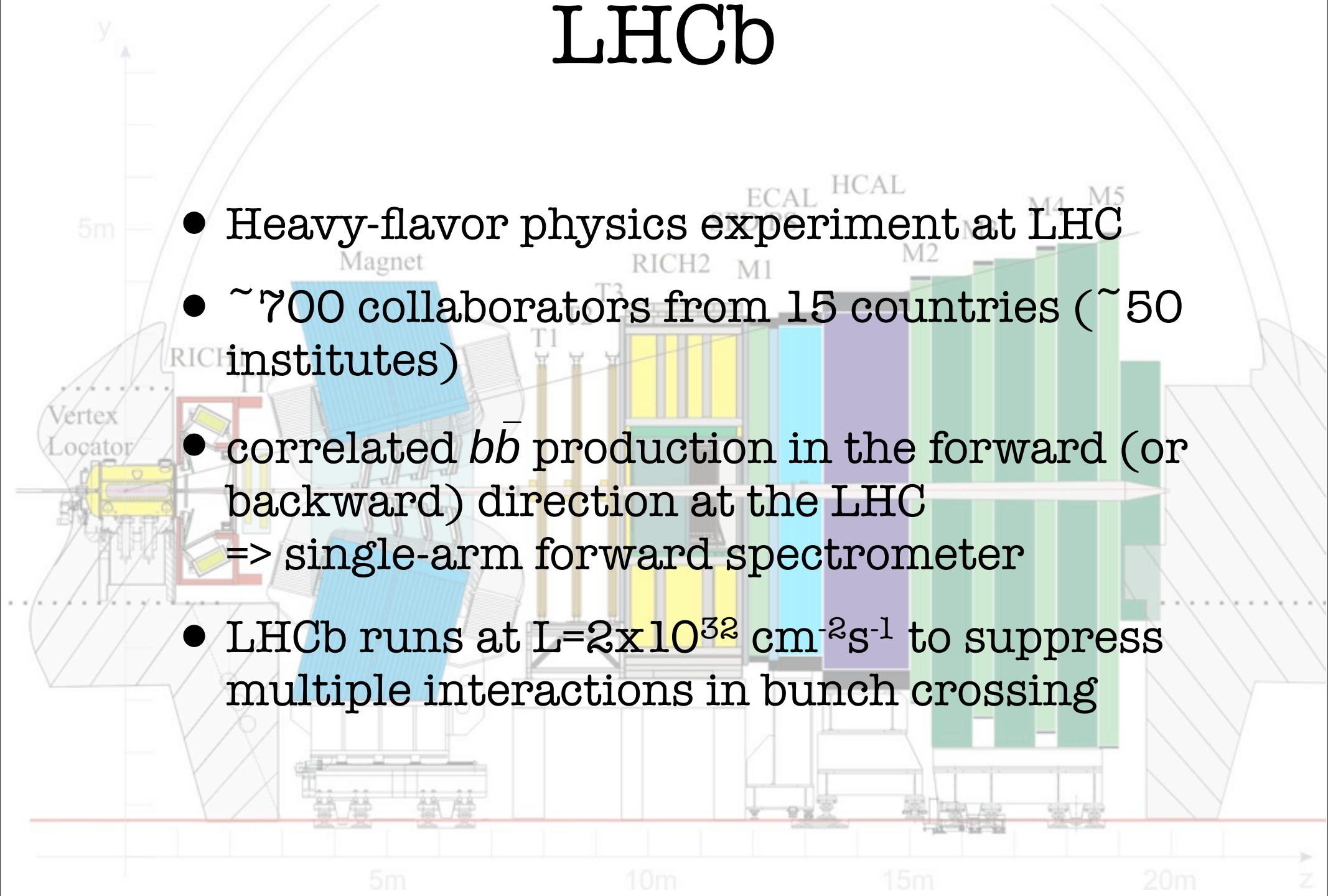
LHCb Status



Fred Blanc
EPFL

CHIPP Meeting
EPFL, Sep. 8th, 2008

LHCb



- Heavy-flavor physics experiment at LHC
- ~700 collaborators from 15 countries (~50 institutes)
- correlated $b\bar{b}$ production in the forward (or backward) direction at the LHC
  => single-arm forward spectrometer
- LHCb runs at $L=2 \times 10^{32}$ $cm^{-2}s^{-1}$ to suppress multiple interactions in bunch crossing

LHCb Physics Program

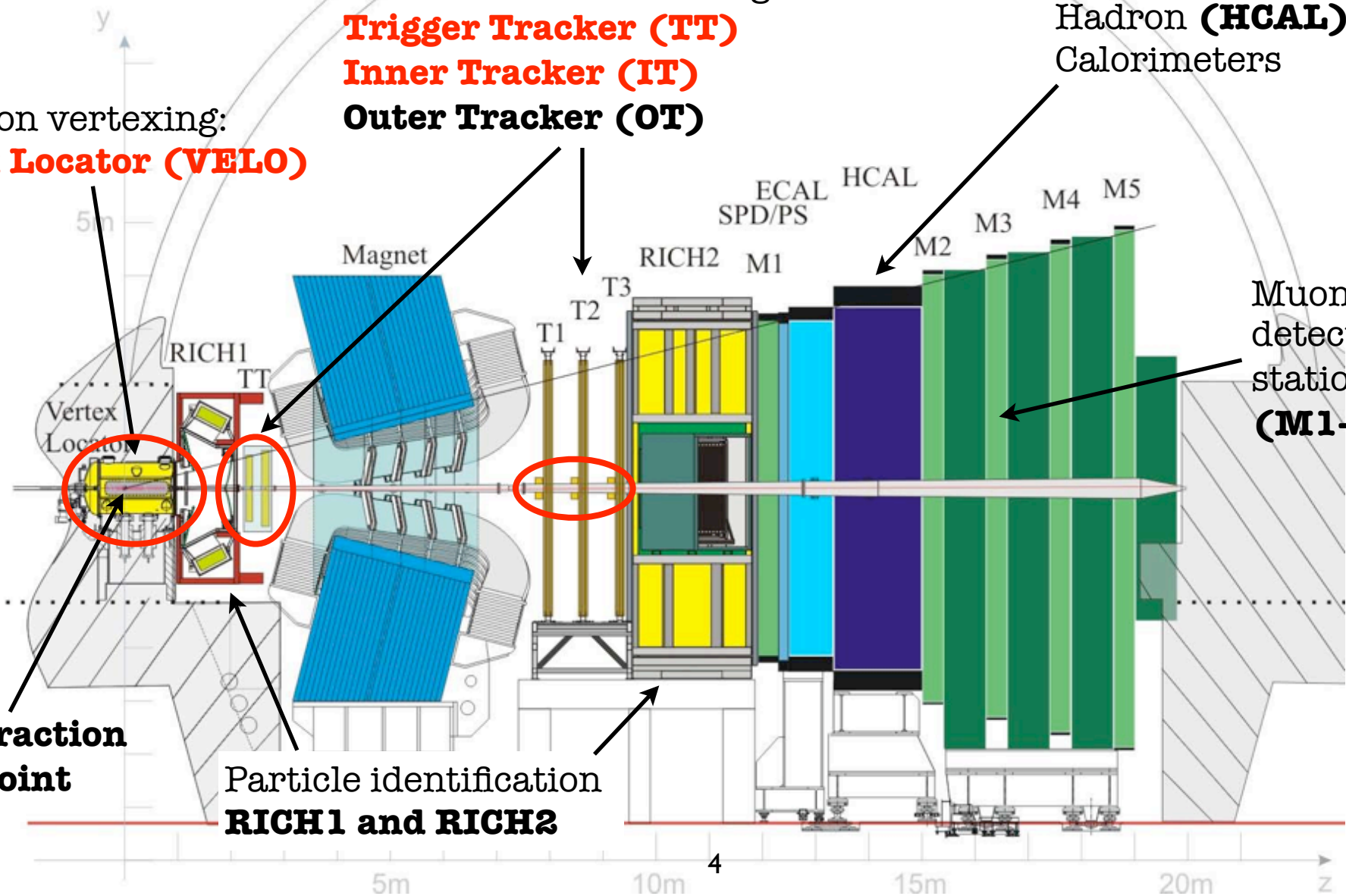
- Heavy-flavor physics
  - precision physics in the b-quark sector
    - access to B, B_s and B_c
    - measure all quark-mixing phases; improved tests of CKM matrix => sensitivity to physics beyond the standard model
    - rare decays
  - charm and tau physics
- Beyond SM physics
- Early physics results will include production rates at LHC energies

LHCb Detector

Excellent tracking performance with VELO + Tracking stations placed before and after the magnet:
Trigger Tracker (TT)
Inner Tracker (IT)
Outer Tracker (OT)

Electromagnetic **(ECAL)** and Hadron **(HCAL)** Calorimeters

Precision vertexing:
Vertex Locator (VELO)



Muon detector stations **(M1-M5)**

Interaction Point

Particle identification
RICH1 and RICH2

CP[LHCb Detector]

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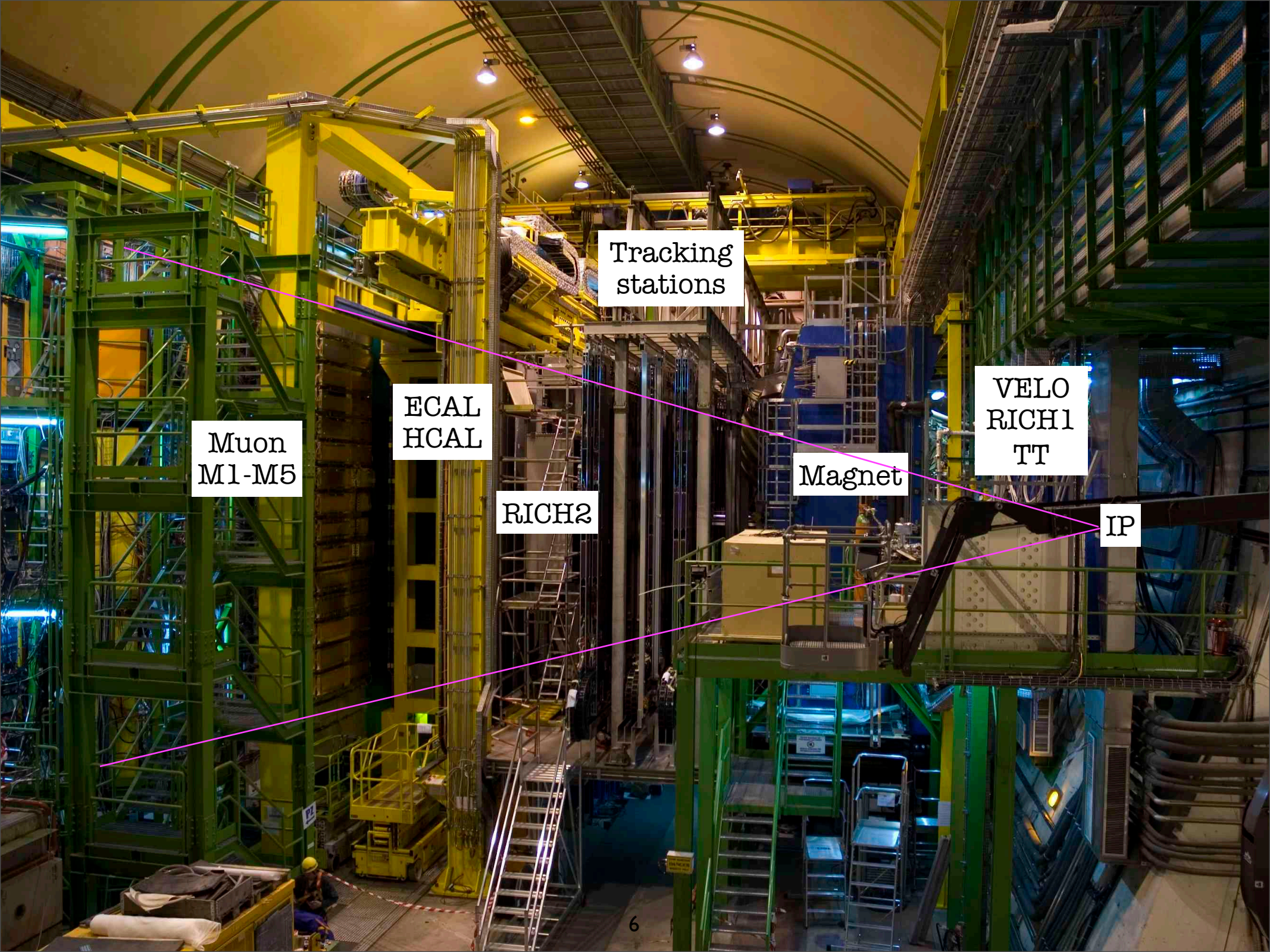

Tracking stations
ECAL
HCAL
Muon
M1-M5
RICH2
VELO
RICH1
TT
Magnet
IP

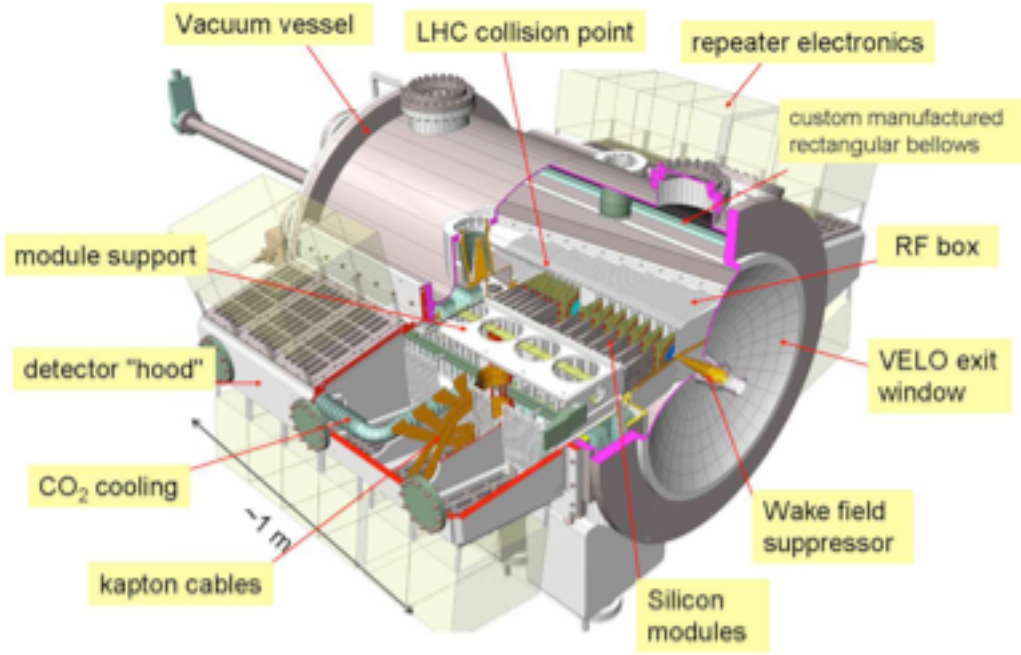
Swiss Contributions

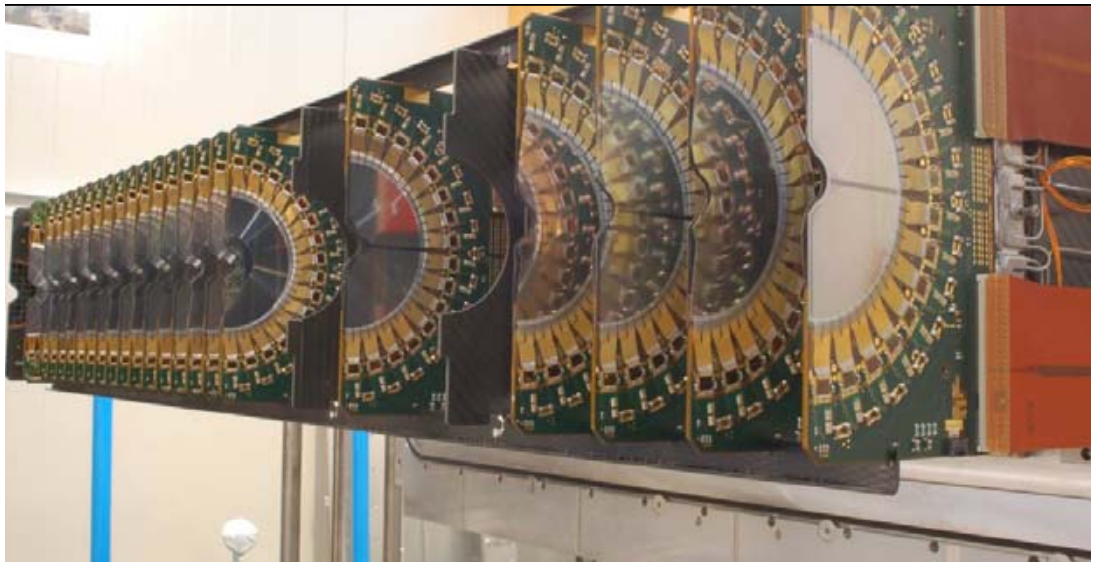
40 collaborators from University of Zürich and EPFL

1. Vertex Locator (VELO)
   - readout links and LV
   - TELL1 readout electronics board (common to most LHCb sub-detectors)
2. Silicon Tracker (Project leaders: O.Steinkamp, M.Needham)
   - Trigger Tracker
   - Inner Tracker
3. Physics studies (LHCb physics coordinator: T. Nakada; Heavy Flavor group convener: O.Schneider)
4. Newly elected Collaboration Board chair: U. Straumann

VELO

- 21-layer Silicon-based vertex detector
- 2D sensitive area only 8.2mm from LHC beam => installed in a secondary LHC vacuum
- ~180k channels
- Used for vertexing (resolution: 10μm in r, 50μm in z) and track seeds

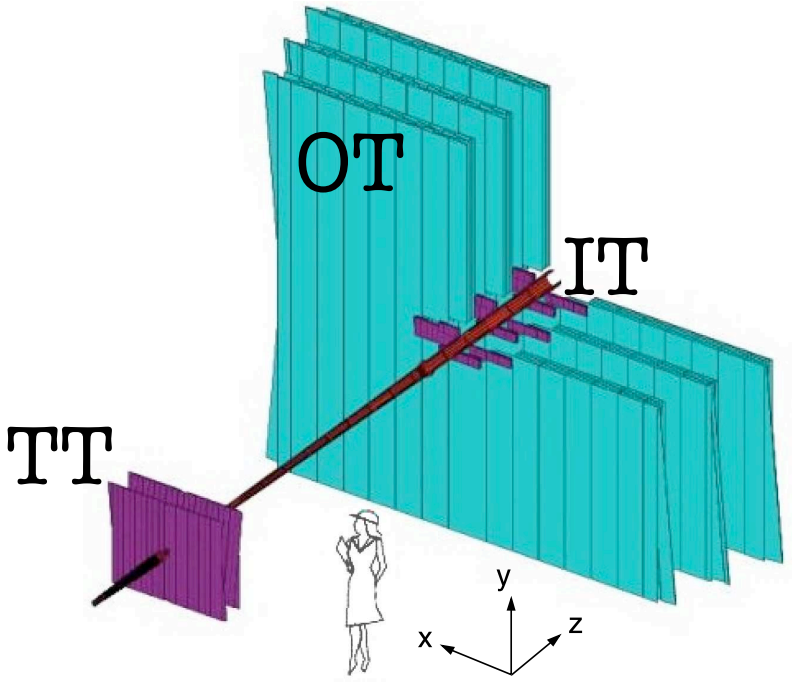




VELO Status

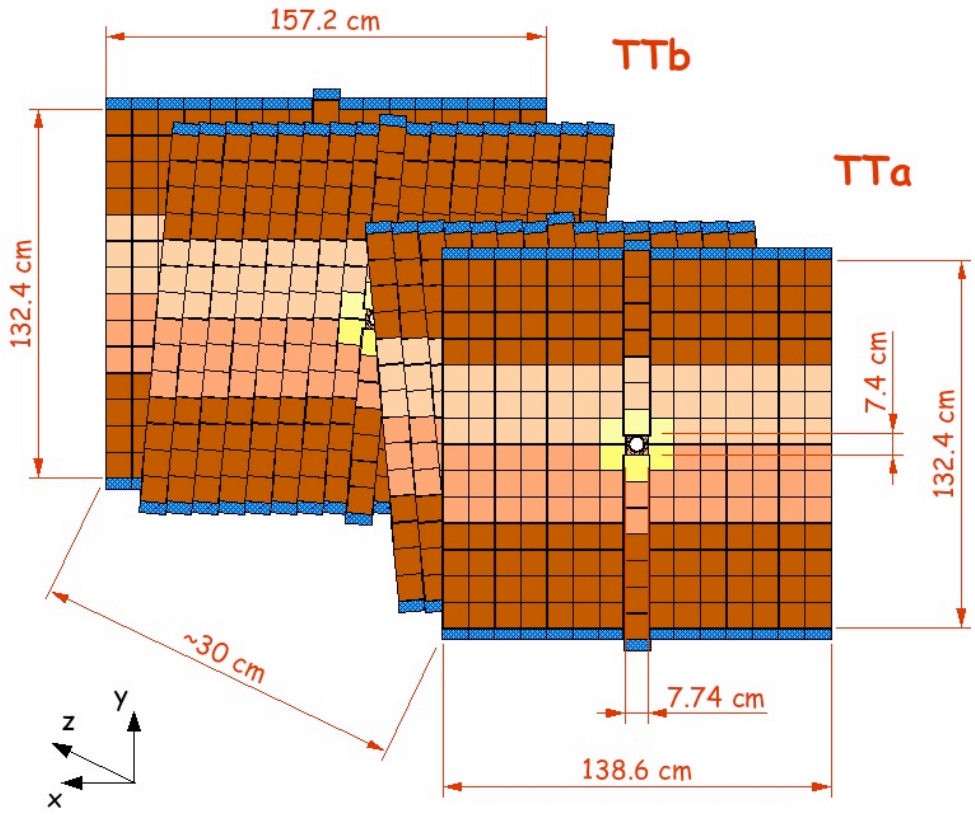
- Installation complete
- Detector is running
- Commissioning under way (seen first tracks from LHC injection tests)

Trigger Tracker



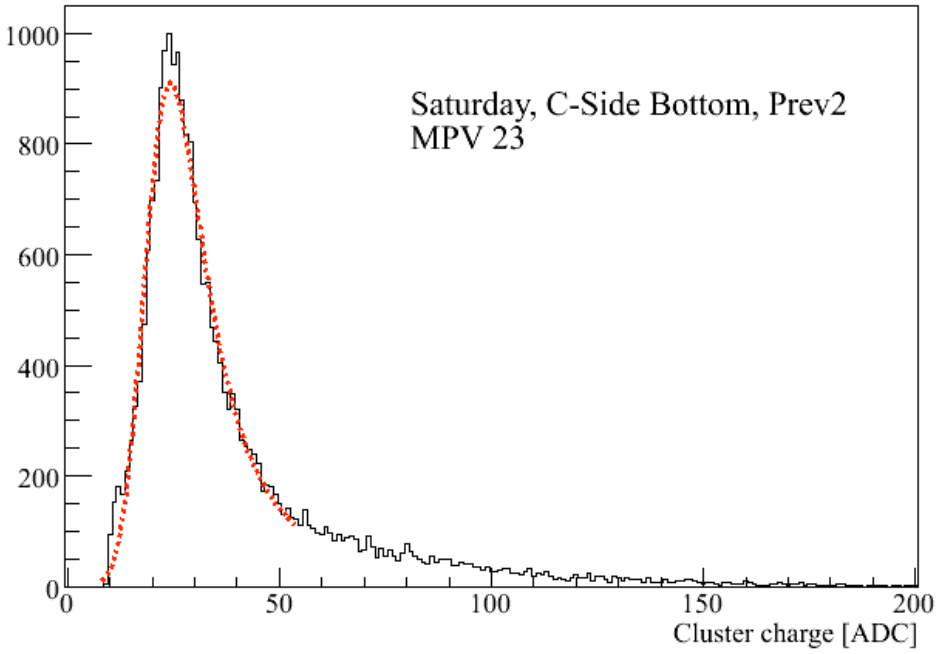
- 143k channels
- 183μm pitch, 50μm single-hit resolution

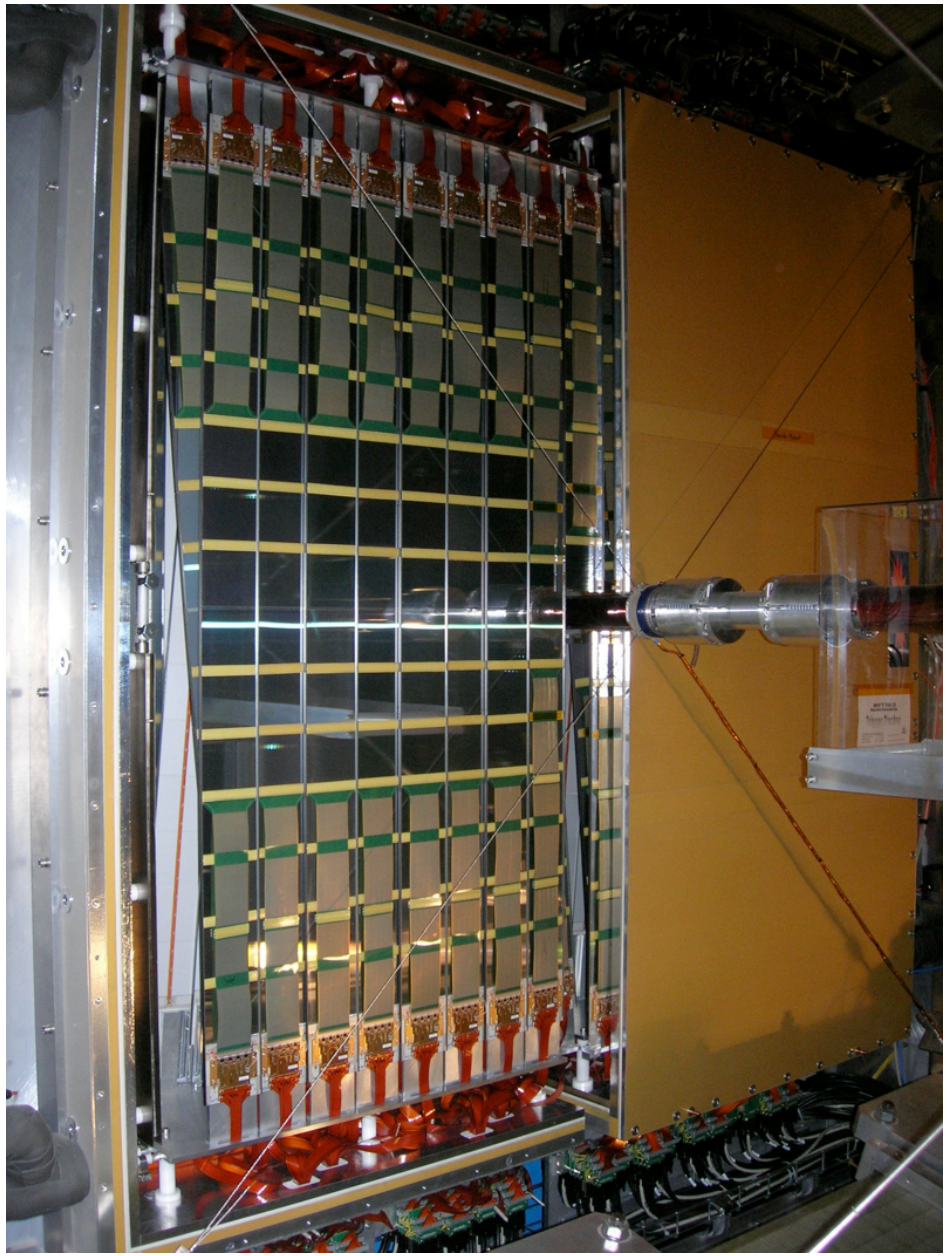
- 4-layer Silicon detector (0°, +5°, -5°, 0°), providing **tracking before the magnet**



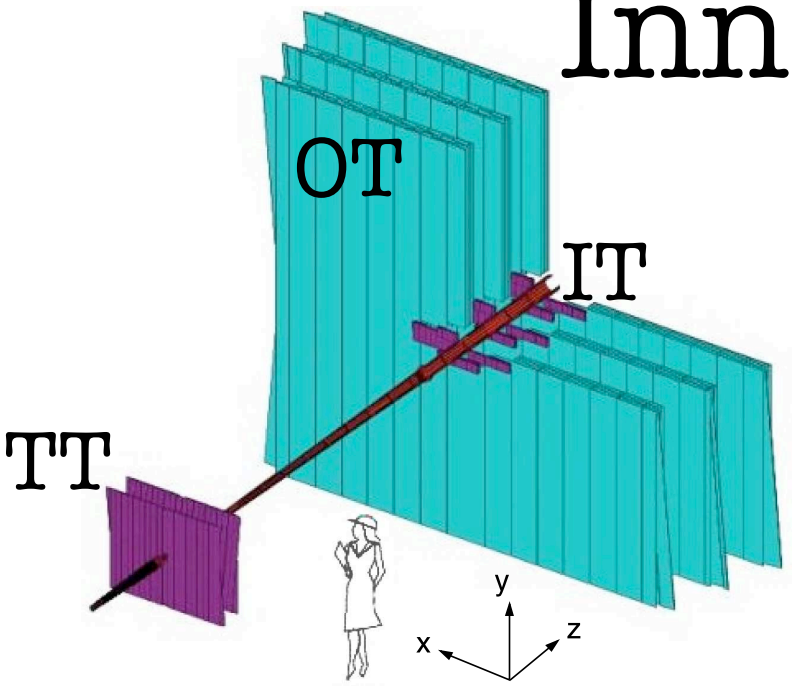
Trigger Tracker Status

- Installation is complete
- Detector is running
- Commissioning under way
- Ready for 2008 run



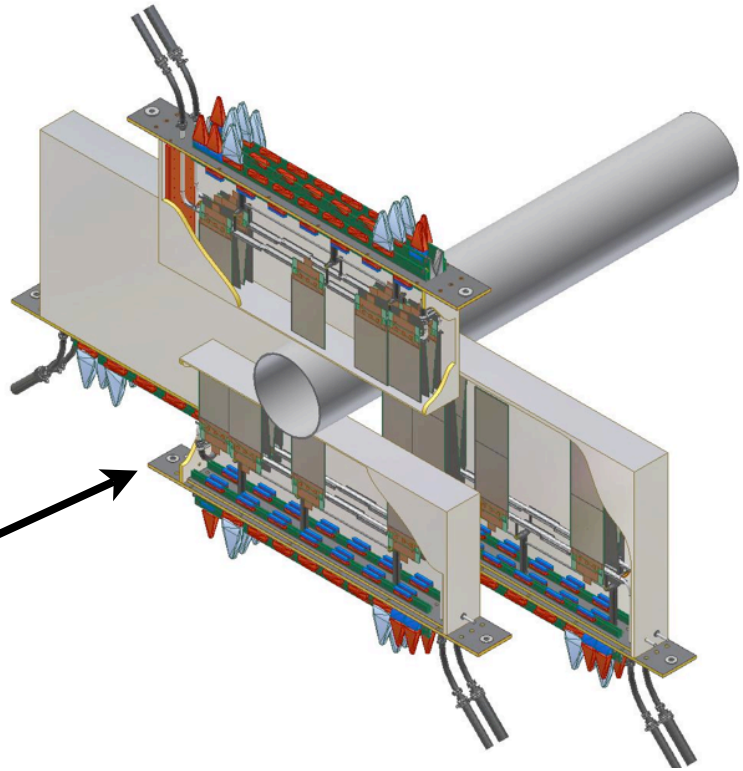


Inner Tracker

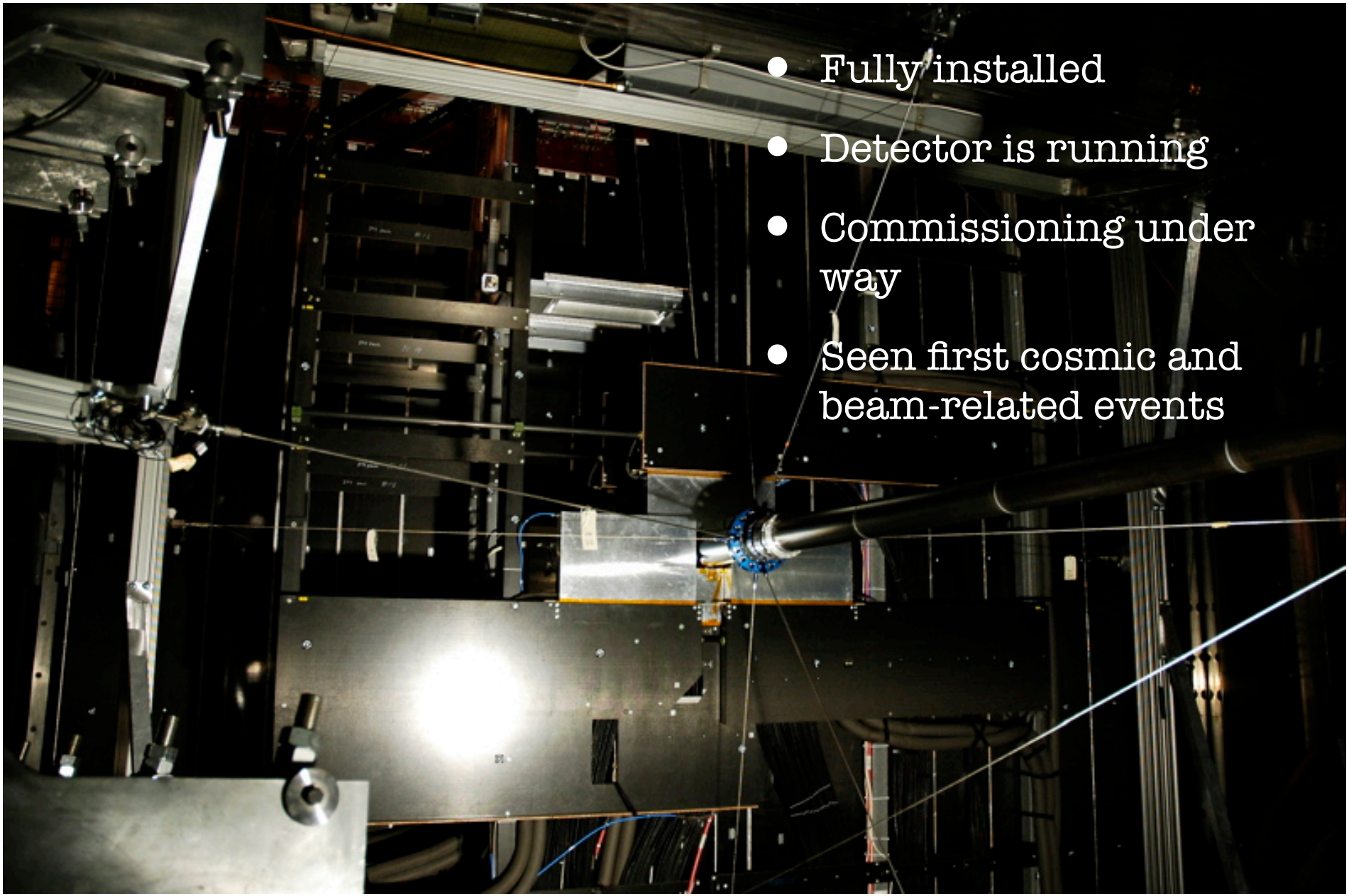


- 2% of area, but 20% of the tracks => Silicon technology for high occupancy
- 130k channels, 198μm pitch

- 3x 4-layer Silicon detector for innermost part of 3 tracking stations after the magnet (outer part: straw tubes)
- arranged in 3x 4 boxes around the beam pipe



Inner Tracker Status



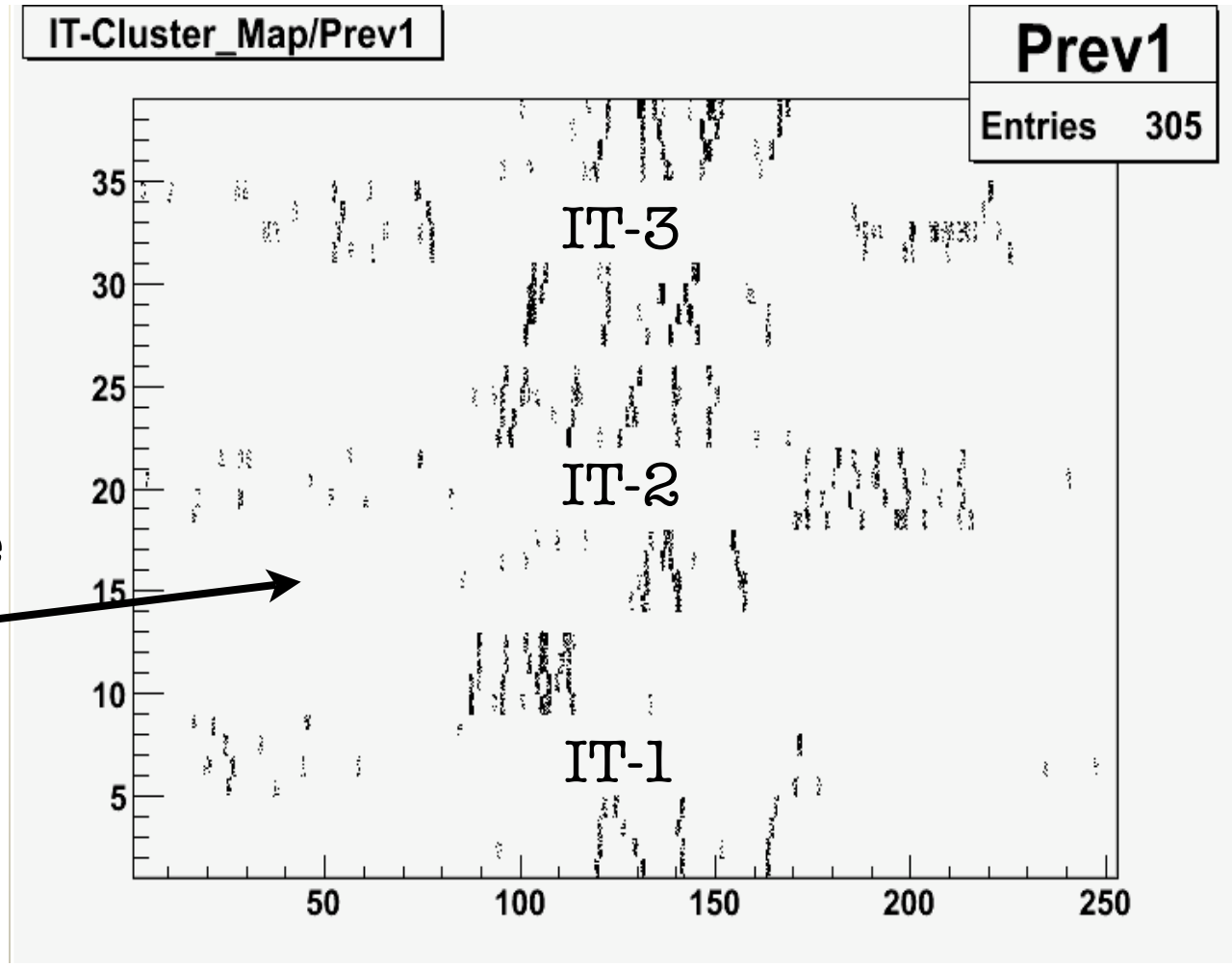
- Fully installed
- Detector is running
- Commissioning under way
- Seen first cosmic and beam-related events

LHCb Installation Status

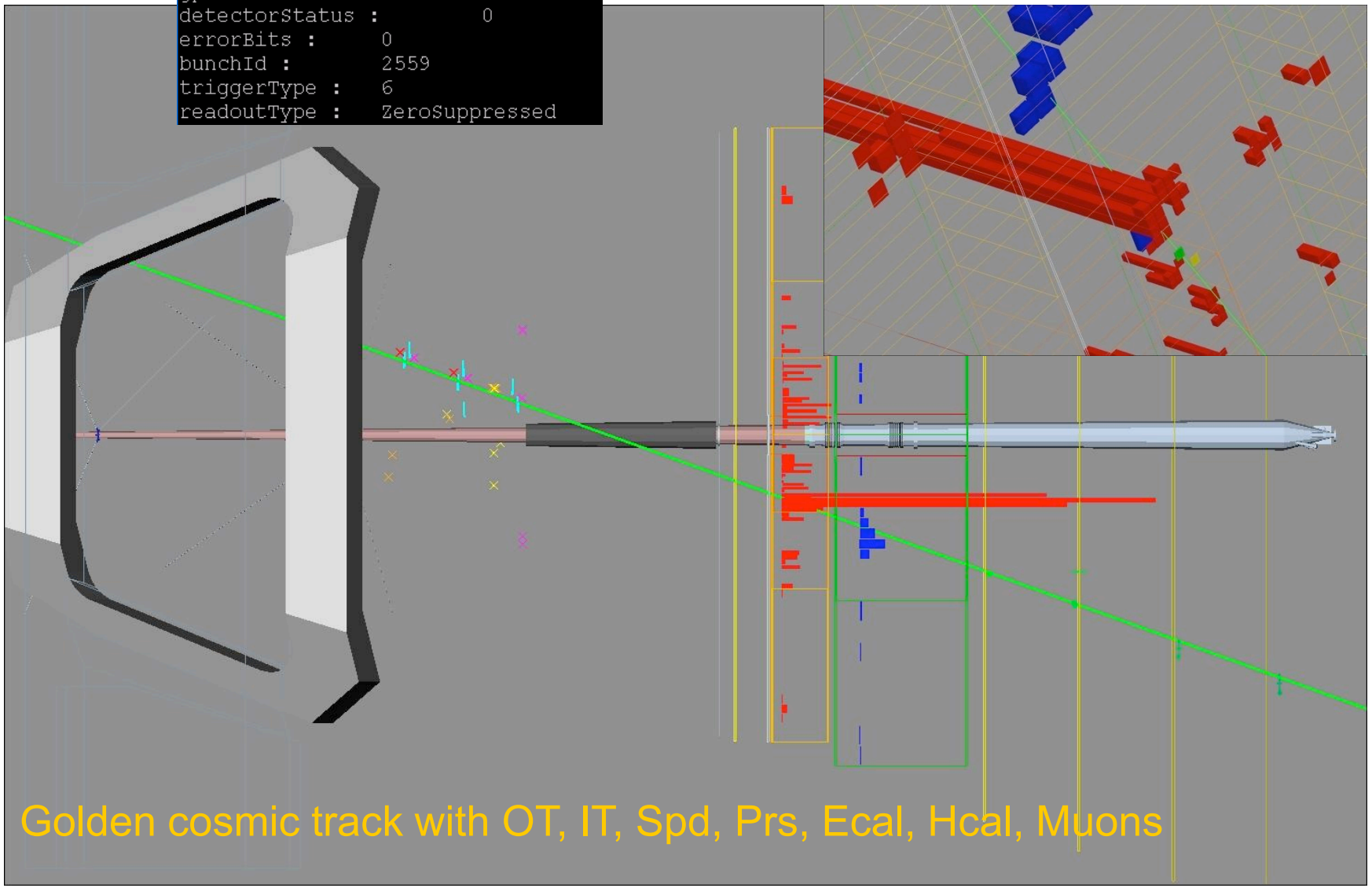
- Completed installation of all sub-detectors (except Muon station 1)
- Commissioning done at sub-detector level
- Currently exercising data acquisition in global readout mode
  - all sub-detectors with cosmics trigger
  - all sub-detectors with LHC injection test beams ("TED" data)

Cosmic data

- First tracks seen in cosmic events
- Trigger from calorimeters and/or muon detector
- Tracks seen in the Inner Tracker (hit map cumulated over one data-taking run)

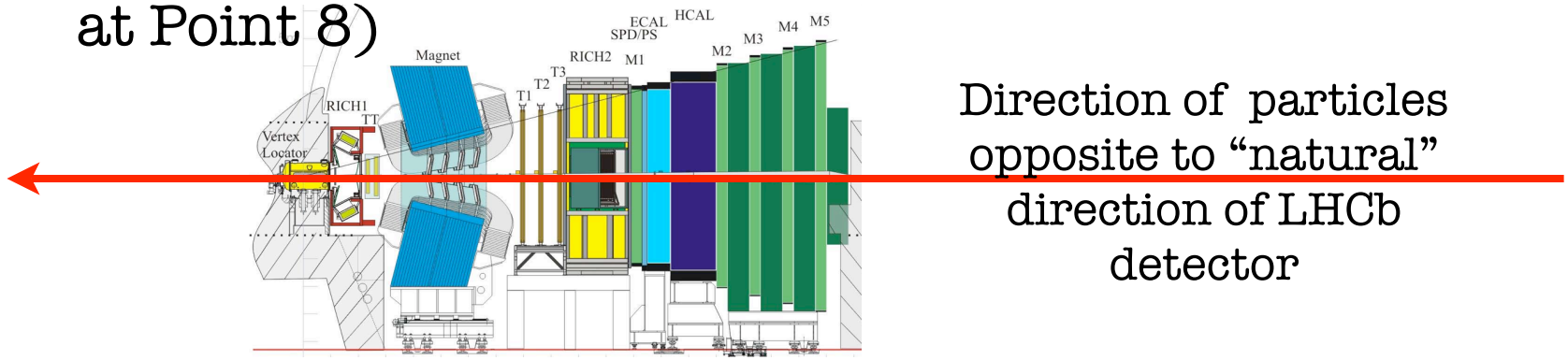


Tracking in cosmic event



LHC injection tests

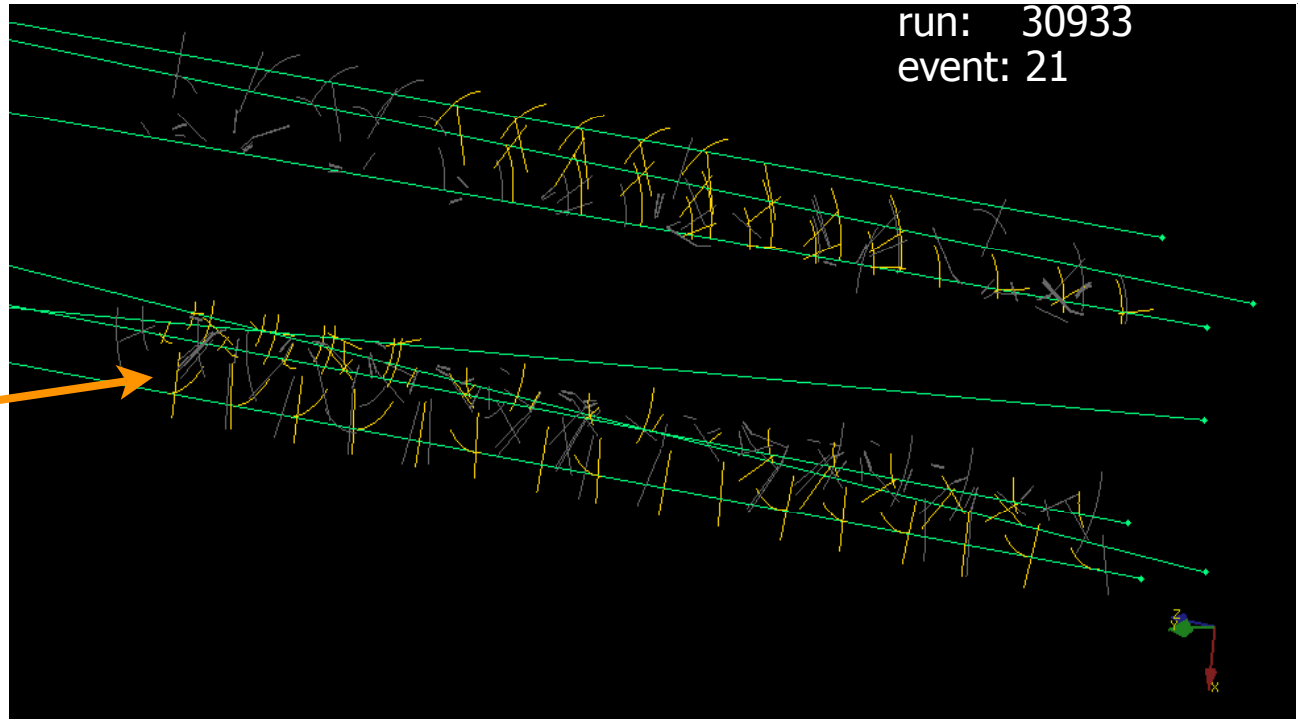
- Data taken during LHC injection tests, with beam dump on TED (situated before the LHCb detector at Point 8)



Direction of particles opposite to "natural" direction of LHCb detector

- Seen activity and tracks in most detectors

e.g. VELO tracks



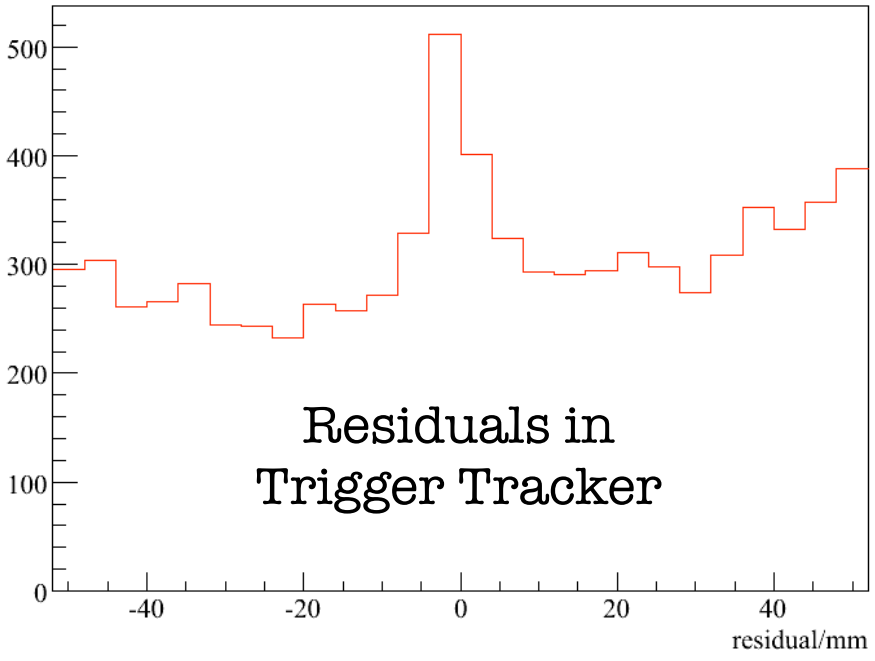
Alignment Test

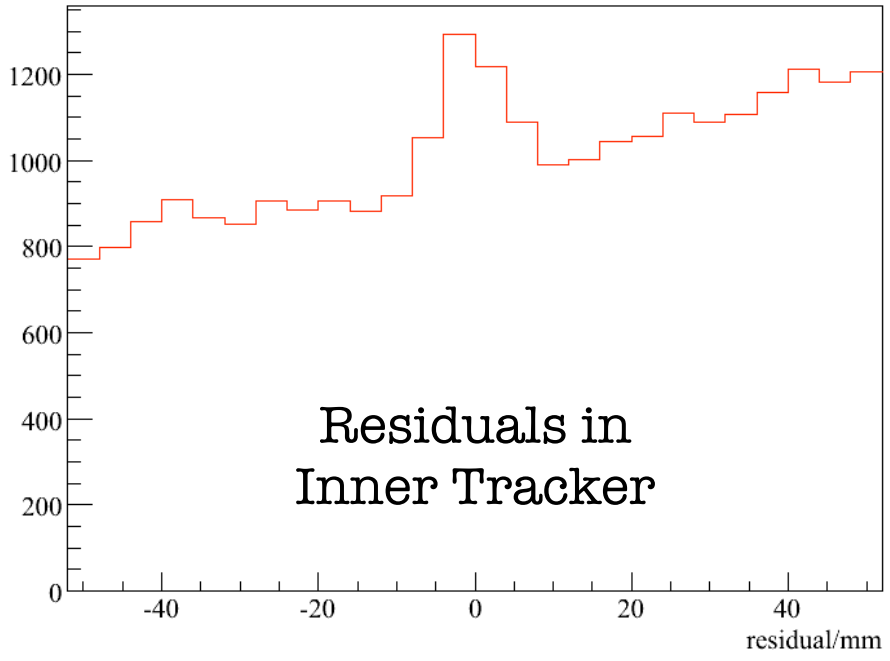
Hot off the press

1. Use track seeds in VELO
2. Extrapolate VELO tracks to TT and IT (magnet off)
3. Plot residual of closest hits in TT and IT

=> see correlation peaks!

- Successful test of **time** and **spatial** alignments between sub-detectors! (+ validation of offline reconstruction)



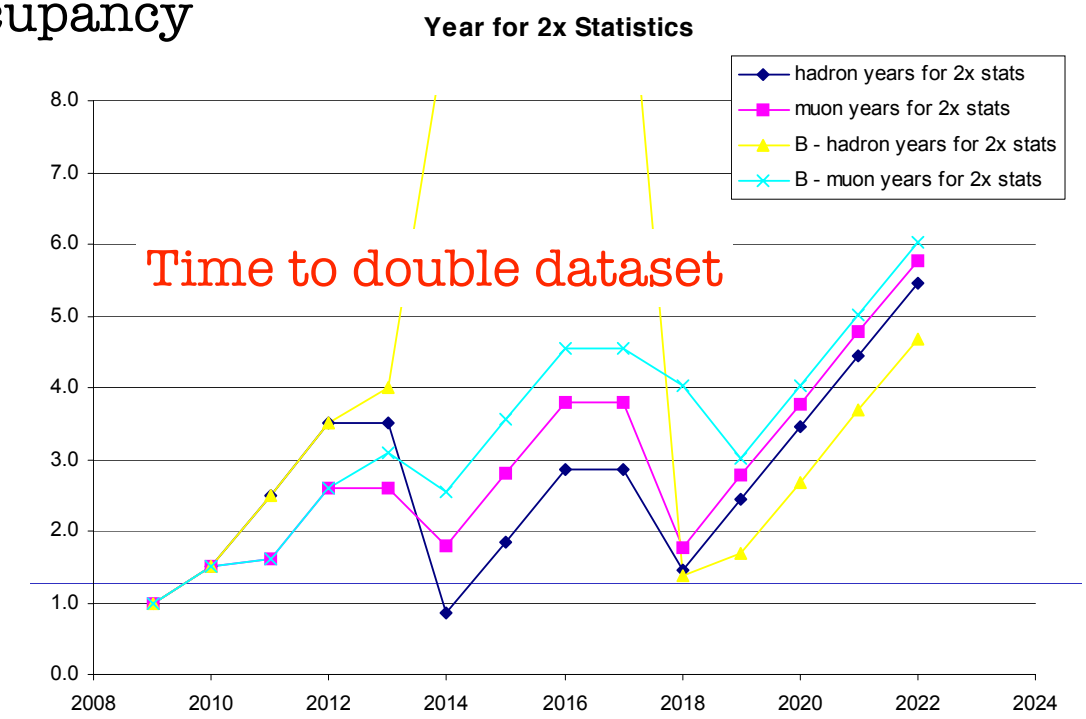


Commissioning Status

- Essentially ready for 2008 run
- Current effort on:
  - time alignment
  - fine tuning the operations procedure under beam conditions
- For 2009 physics run
  - complete installation of muon station 1
  - several hardware improvements planned for the Winter shutdown

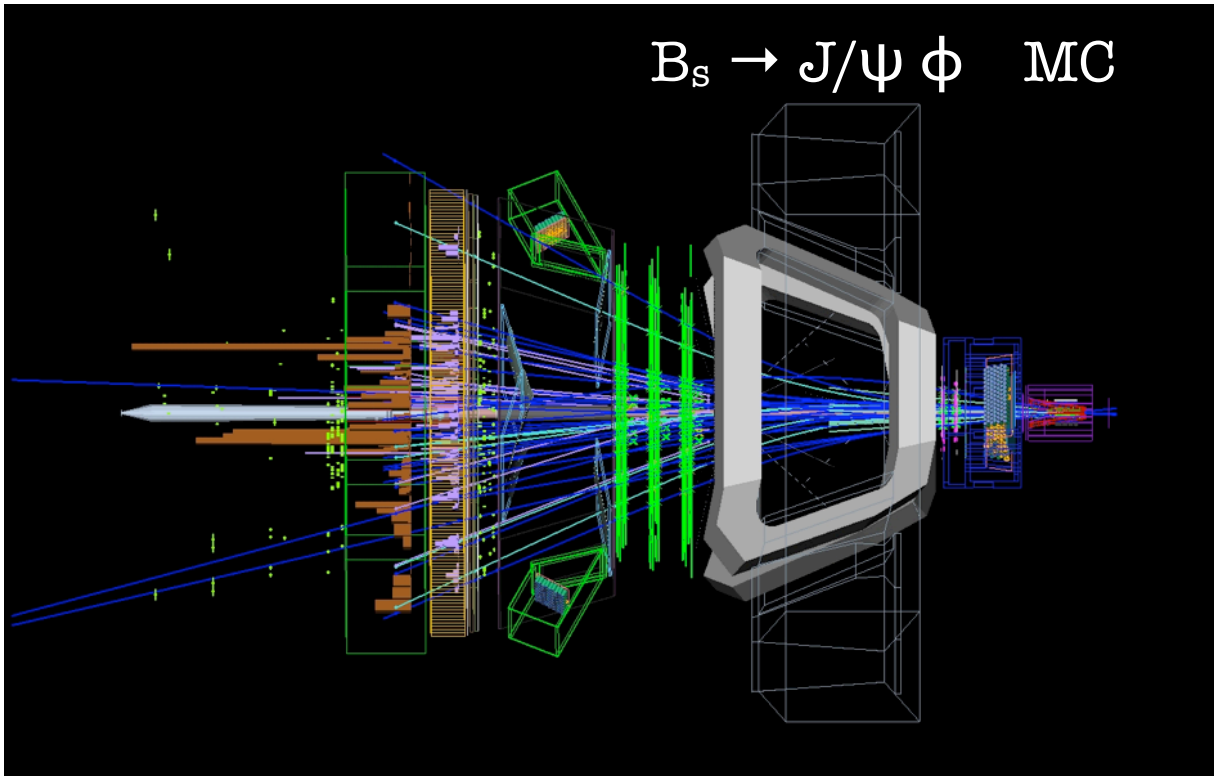
Upgrade options

- Issues after 5 years (L_{int}=10fb^{-1} at L=2x10^{32} cm^{-2}s^{-1}) :
  - significant time for doubling dataset
  - sub-detectors near end of lifetime (radiation)
- Upgrades considered for 2013 and 2017 shutdowns:
  - front-end electronics running at 40MHz => L=1x10^{33} cm^{-2}s^{-1}
  - replace all sub-detectors with improved radiation hardness and accepting higher occupancy
- Physics goal:
  high precision test of new physics discovered at the LHC



Conclusion

- Excellent progress towards LHCb readiness for 2008 data taking run
- Hope for first physics results soon
- Looking forward to real B physics events...



...but already considering detector upgrade