Swiss contributions to LHCb

Structure of this talk:

- *b* physics will still be interesting in 2007
- the LHCb experiment and its present status

- inner tracking
- Swiss manpower and resources

RECFA, University of Zurich Irchel, March 1st, 2002, U. Straumann

b experiments at hadron colliders

LHCb at CERN
BTeV at Fermilab

both are multipurpose *B* physics facilities designed to study all interesting final states

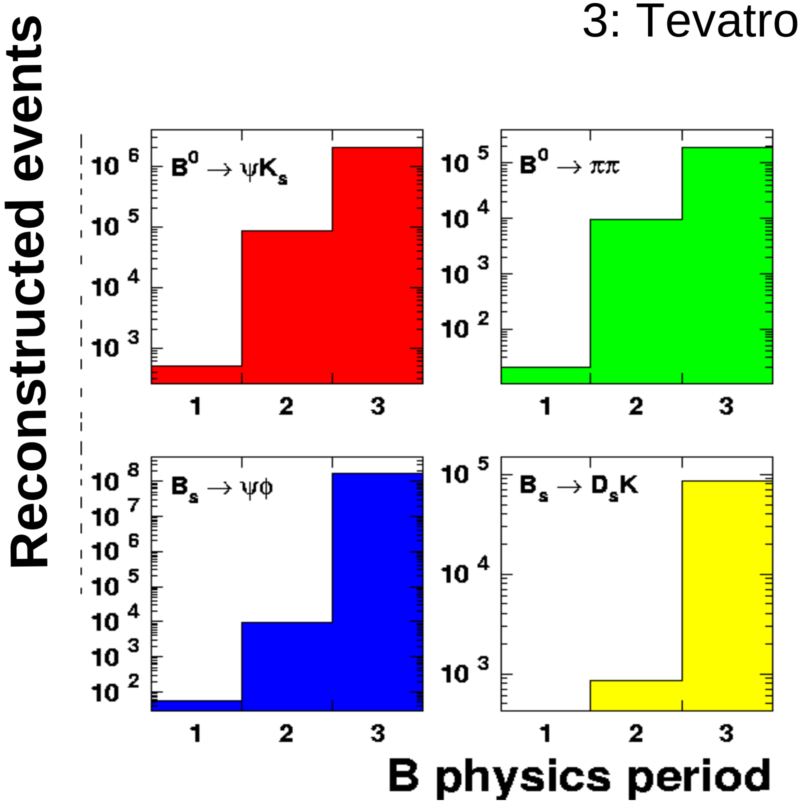
Essential requirements for *B* experiments:

- π / K seperation to identify several important rare *B* decays
- hadron trigger
- excellent vertex resolution

Goal: LEP like precision measurements in the flavor sector

Evolution of *B* physics in time

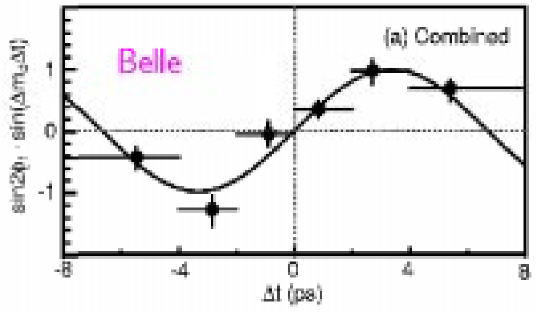
B physics periods:
1: now
2: after Tevatron 2a and B−factories (500 fb^{-1})
3: Tevatron 2b, LHCb, BTeV (5 years each)



period 3 will
- be a precision boost in CKM values
- for example measure the UT angle γ

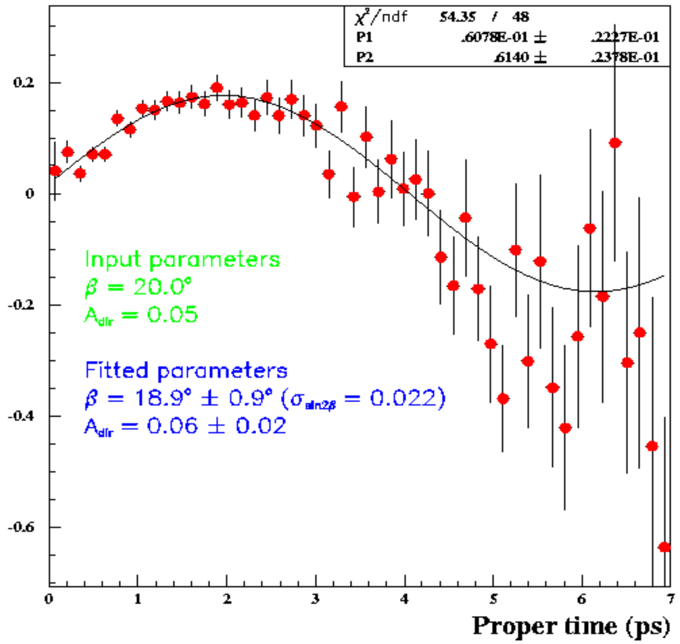
(from Guy Wilkinson, Feb. 2002)

Example: prospects for B_d mixing

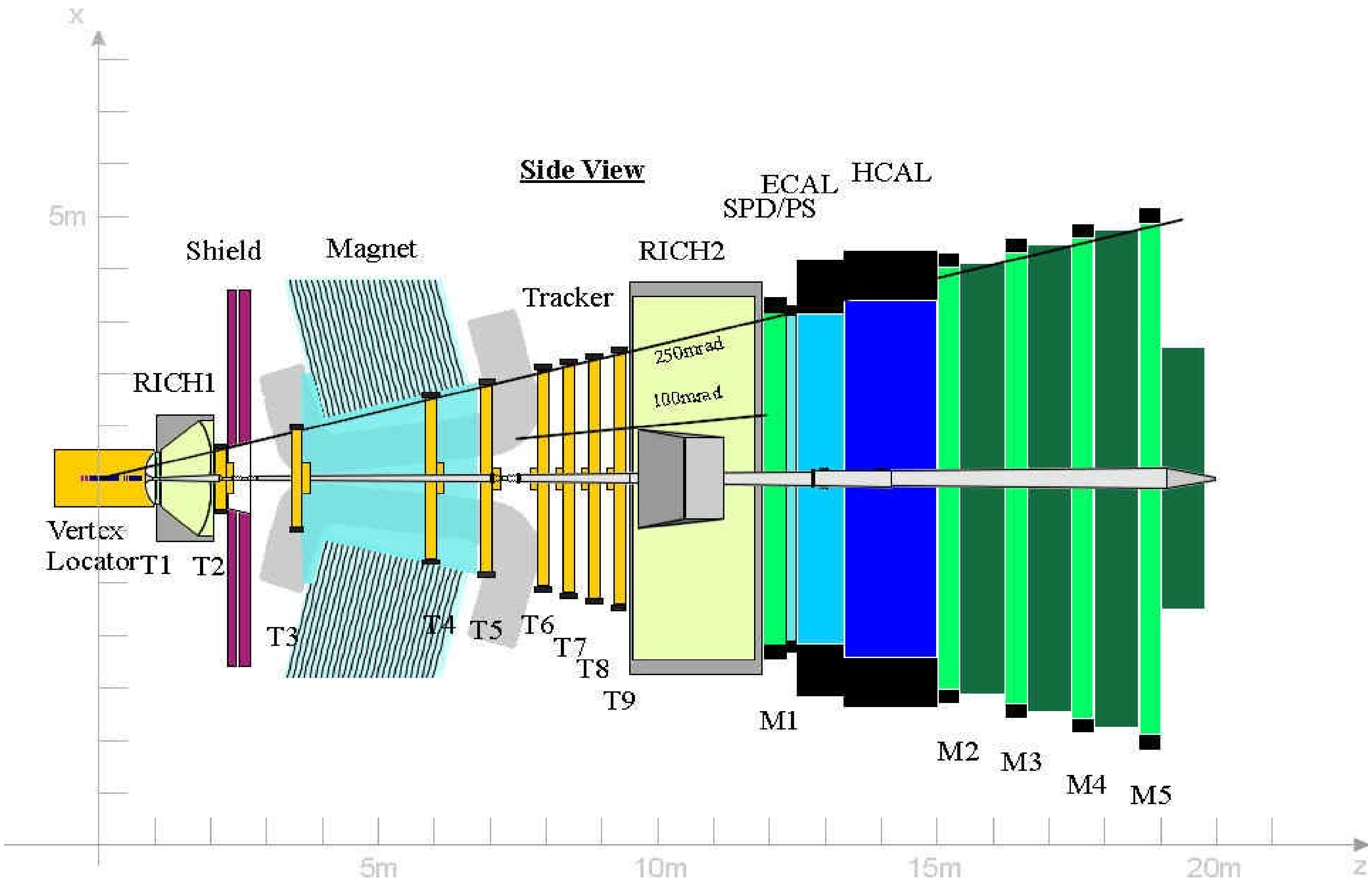


now: $\sin(2\beta) = 0.80 \pm 0.10$

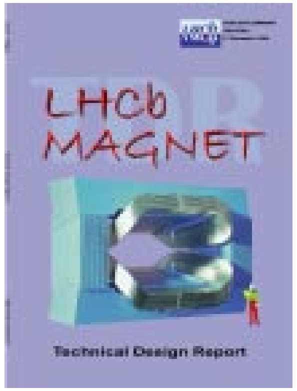
LHCb

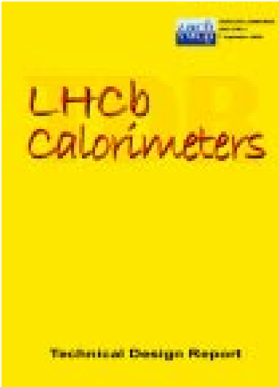


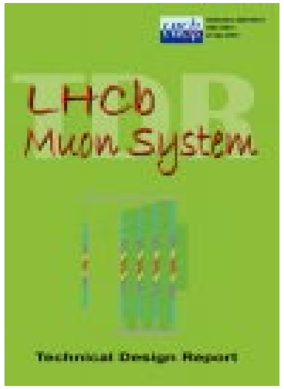
LHCb – detector



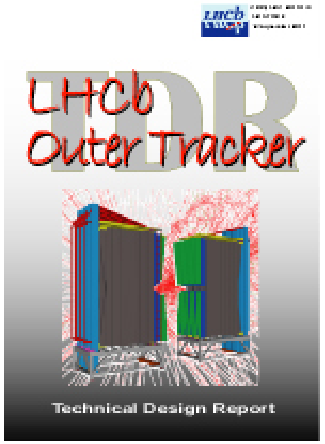
Subsystem Technical Design Reports







all approved



submitted Sept. 01

submitted Dec. 01

Present activities:

- Optimisation of spectrometer
- Inner tracking design
- Calo production started

Inner Tracking − Requirements

Particle Rates: up to $10^6/\mathrm{cm}^2/\mathrm{s}$

− primary hadrons
− secondary electrons
(from γ conversions)

Spatial resolution: $\leq 100\mu\mathrm{m}$ (matching the overall spectrometer resolution)

Stereo Angle: 0°, +5°, −5°

Obvious first choice: Micropattern Gas Detector.

Zürich developed 3−GEM detector (thesis Marcus Ziegler)
however: too much occupancy due to low angle background.

Silicon Strip Detectors

- very large pitch: 0.2 mm (to keep electronic costs down)
- thickness: 0.32 mm (to keep *X0* low)

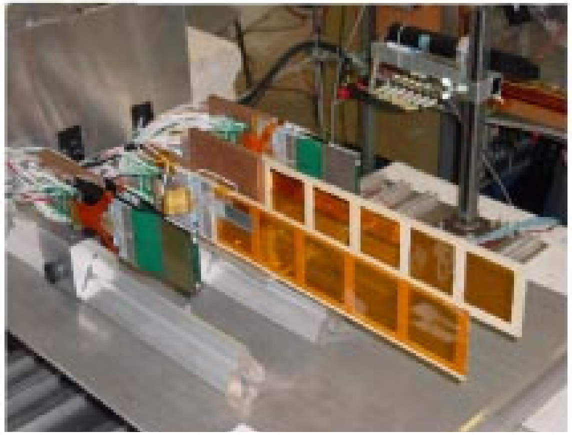
What is the maximum possible strip length?

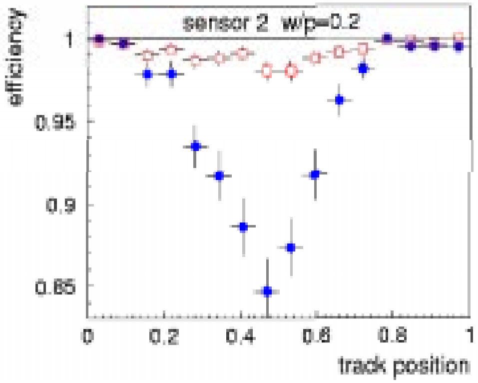
mainly determined by thermal amplifier noise,
which reduces S/N and thus efficiency

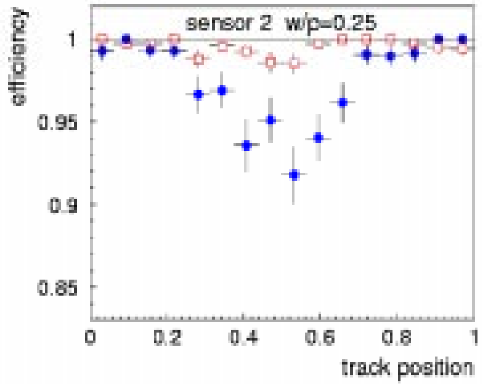
Various beam tests with
- different prototype sensors
- different ladder length
- hopefully final readout electronics

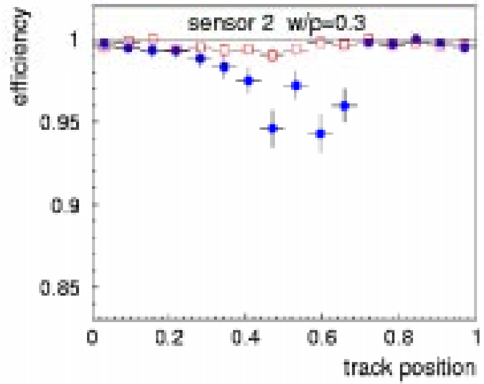
Beam Tests

measure efficiency as a function
of position between readout strips









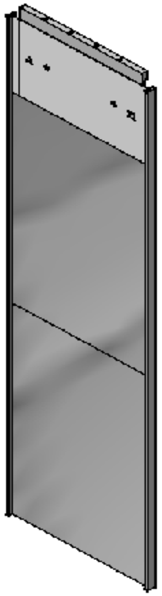
Beam Tests – (preliminary) conclusions

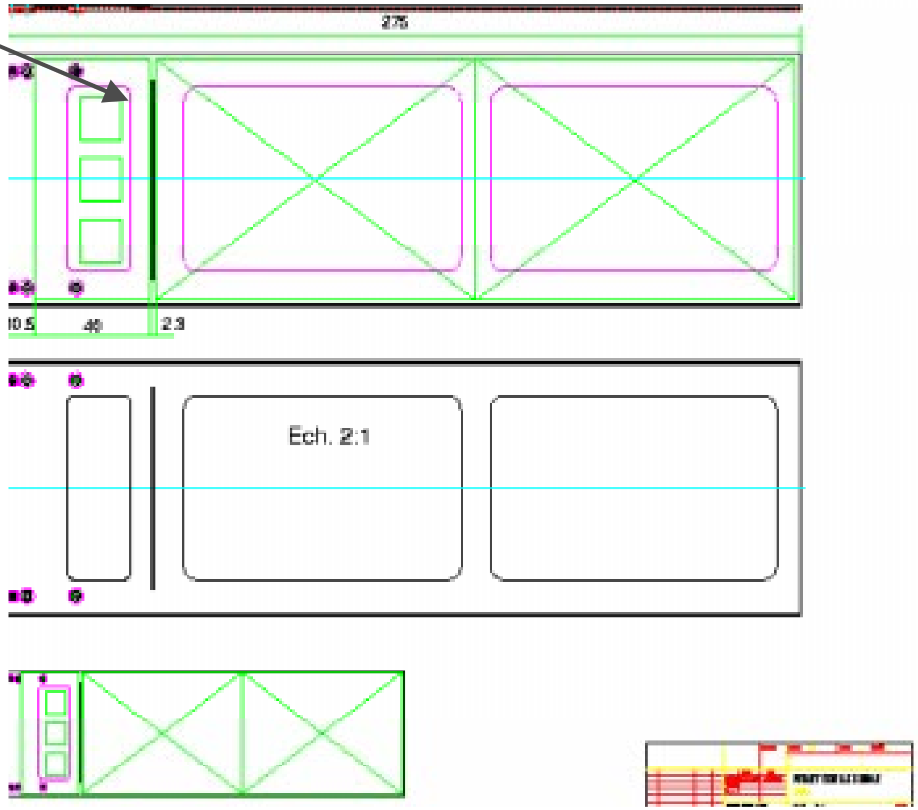
- maximum ladder length is 22 cm
- large width/pitch is preferable (w/p = 0.3)
- need increased electrical field to avoid charge loss between strips

200 µm pitch
300 µm thickness

Ladder Layout

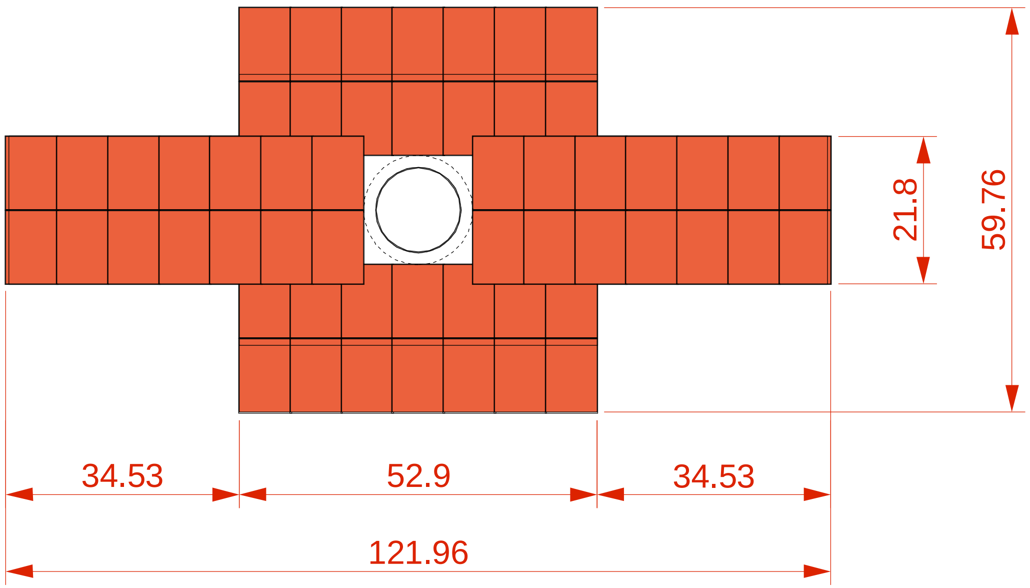
Readout chips: Beetle (MPI HD)





Inner Tracking Station: Geometrical Layout

- optimal boundary to outer tracking determined by particle flux
- conical beam pipe requires different inner hole for every station



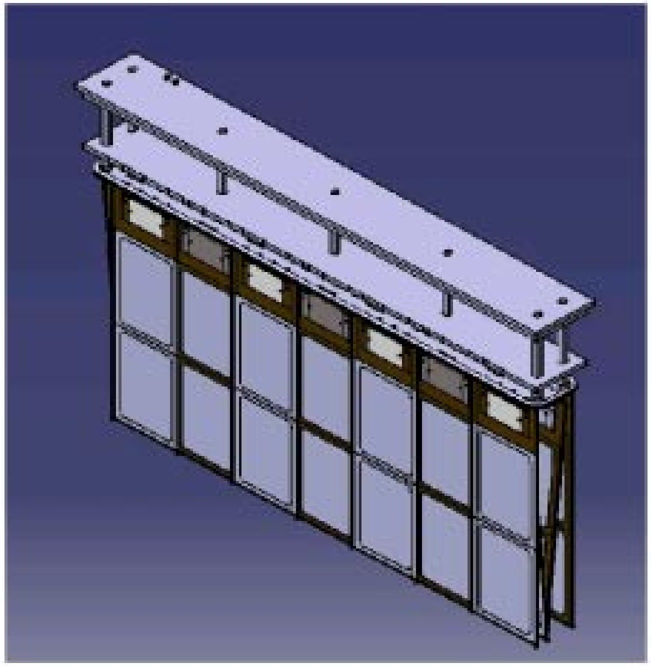
total surface:
about 12 m²

900 ladders
1500 sensors
350k channels

Inner Tracking Box Design

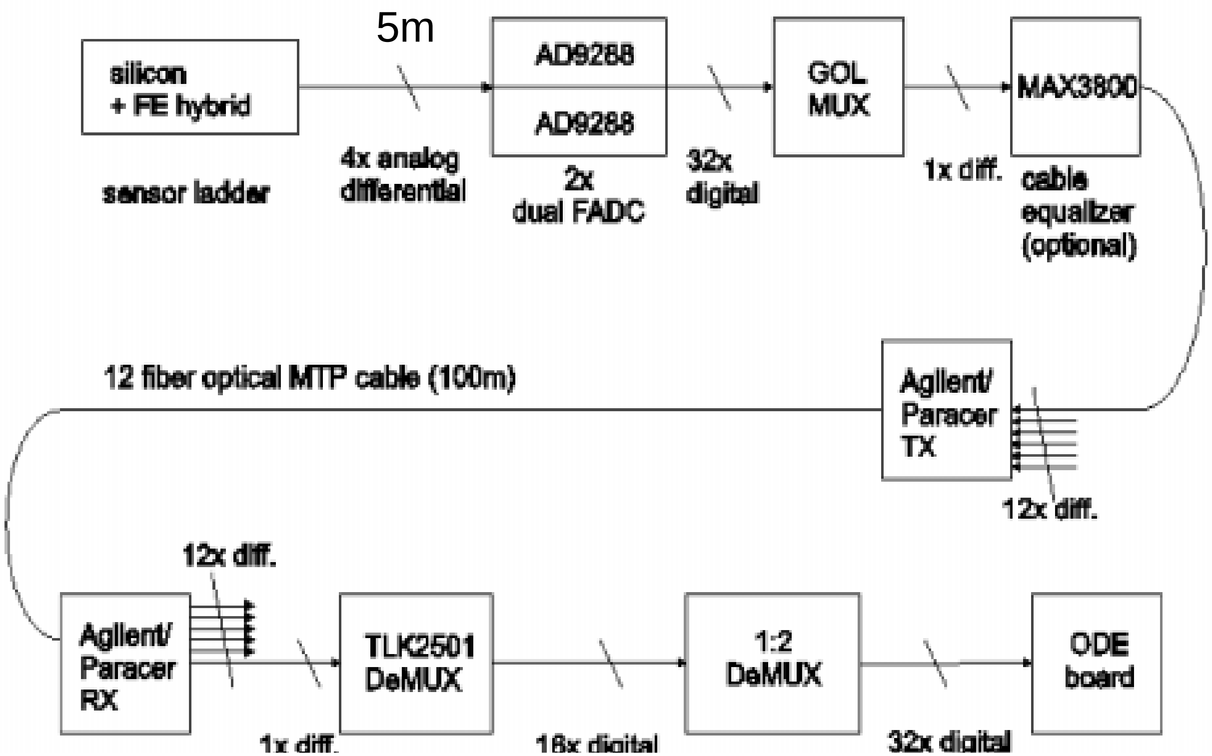
One box consists of:

- 4 planes
- 28 ladders
- super light insulation box



Optical Digital Readout Link

Testsystem presently being assembled in Zürich



Inner Tracking Management

Coordinators: U. Straumann, O. Steinkamp, Univ. Zürich

Groups involved:

- MPI Heidelberg: frontend elektronik
- Univ. Santiago (Spain): infrastructure
- Nowosibirsk: rate simulations
- Univ. Lausanne: off − detector − electronics,
  ladder support structure
- Univ. Zürich: mechanical system design,
  cooling (−5°),
  sensor studies, frontend studies,
  electronic system design
  optical readout link

Swiss Contributions to LHCb: Summary

Spokesperson: Tatsuya Nakada (Lausanne, CERN)
Physics coordinator: Olivier Schneider (Lausanne)
Inner tracking coordination: U. Straumann / O. Steinkamp (ZH)

Inner tracking design
Off detector electronics for inner tracking and vertex locator (VELO)

University of Lausanne: 4 seniors, 3 postdocs, 10 PhD students
University of Zürich: 1 senior, 3 postdocs, 3 PhD students
≈ 5% of collaboration members

MoU: 7.9 MCHF for construction
≈ 10% of total investment

No cost overrun foreseen!