

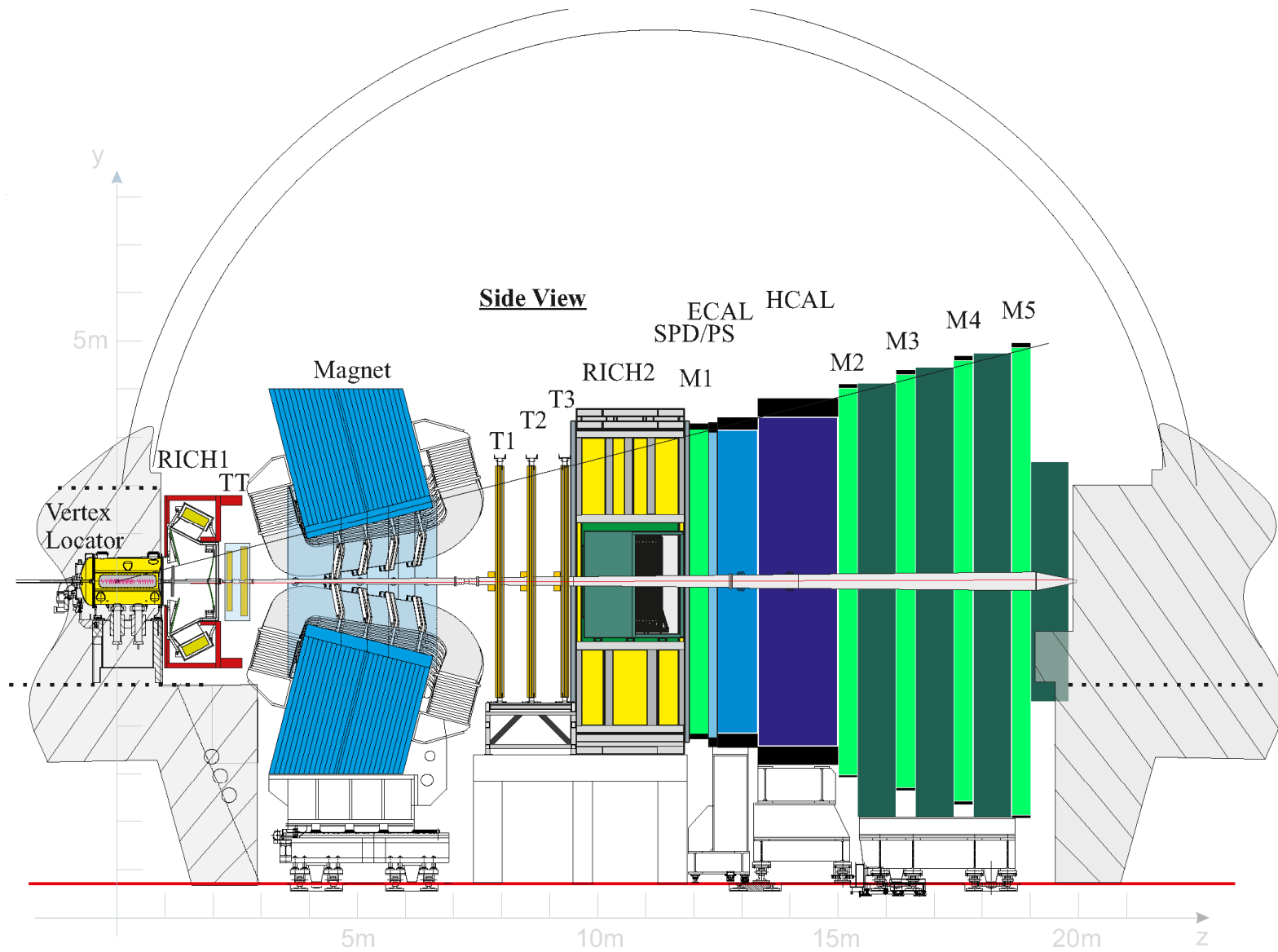
Update on LHCb Outer Tracker Modules

Tassos Belias, GSI

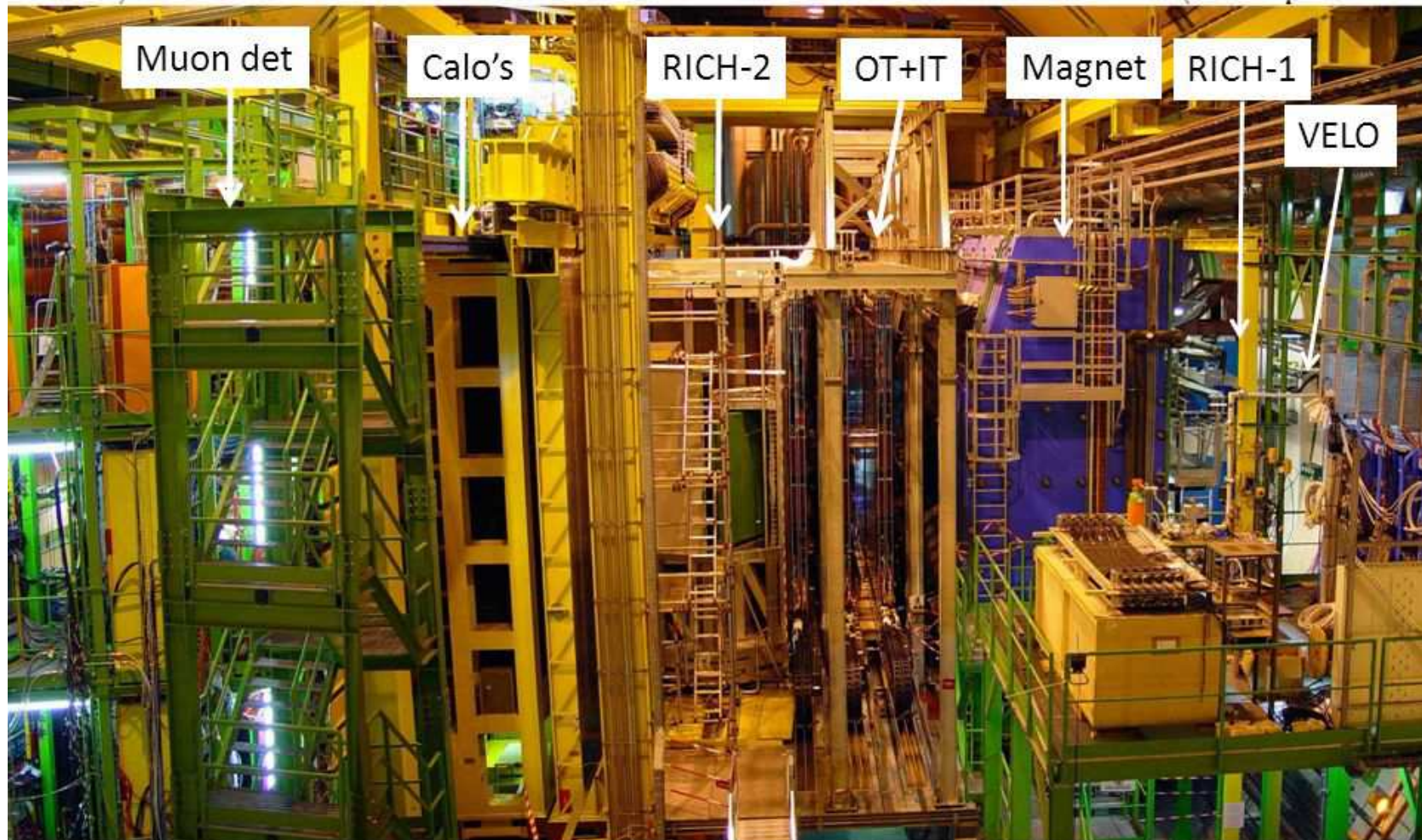
Feasibility checks for PANDA
Mechanics
Readout Electronics

Opportunity for PANDA

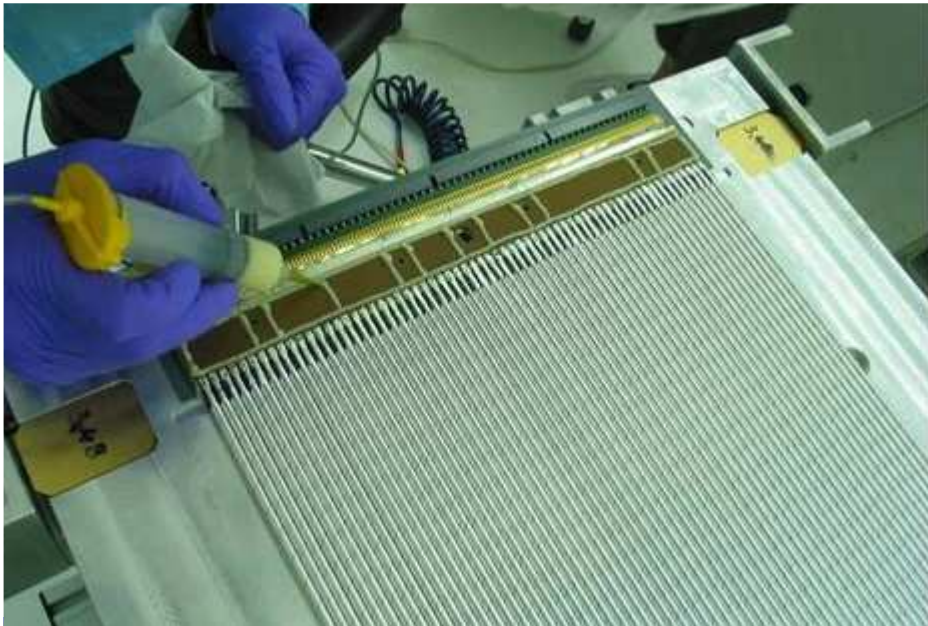
- LHC upgrade requires detectors due to much higher rates
- At LHCb the Outer Tracker will be replaced with Scintillating Fiber detectors
- The Outer Tracker (OT), a straw tube detector, is available for use in other experiments
 - Thanks to Karin Schoening for the info and contacts
- Could this be of interest to us in PANDA ?
- Check the possible use of Outer Tracker modules in the PANDA Forward Spectrometer as substitutes for FT5 and FT6 in Day-1



The LHCb Detector



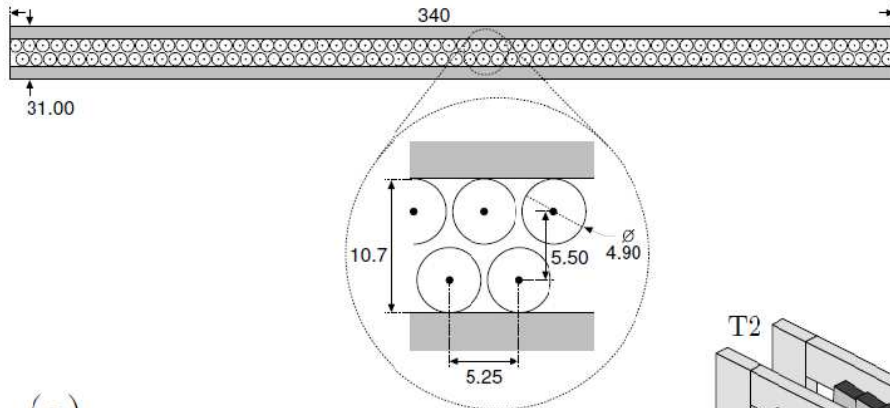
Installation is complete



07/11/2018

LHCb – Outer Tracker

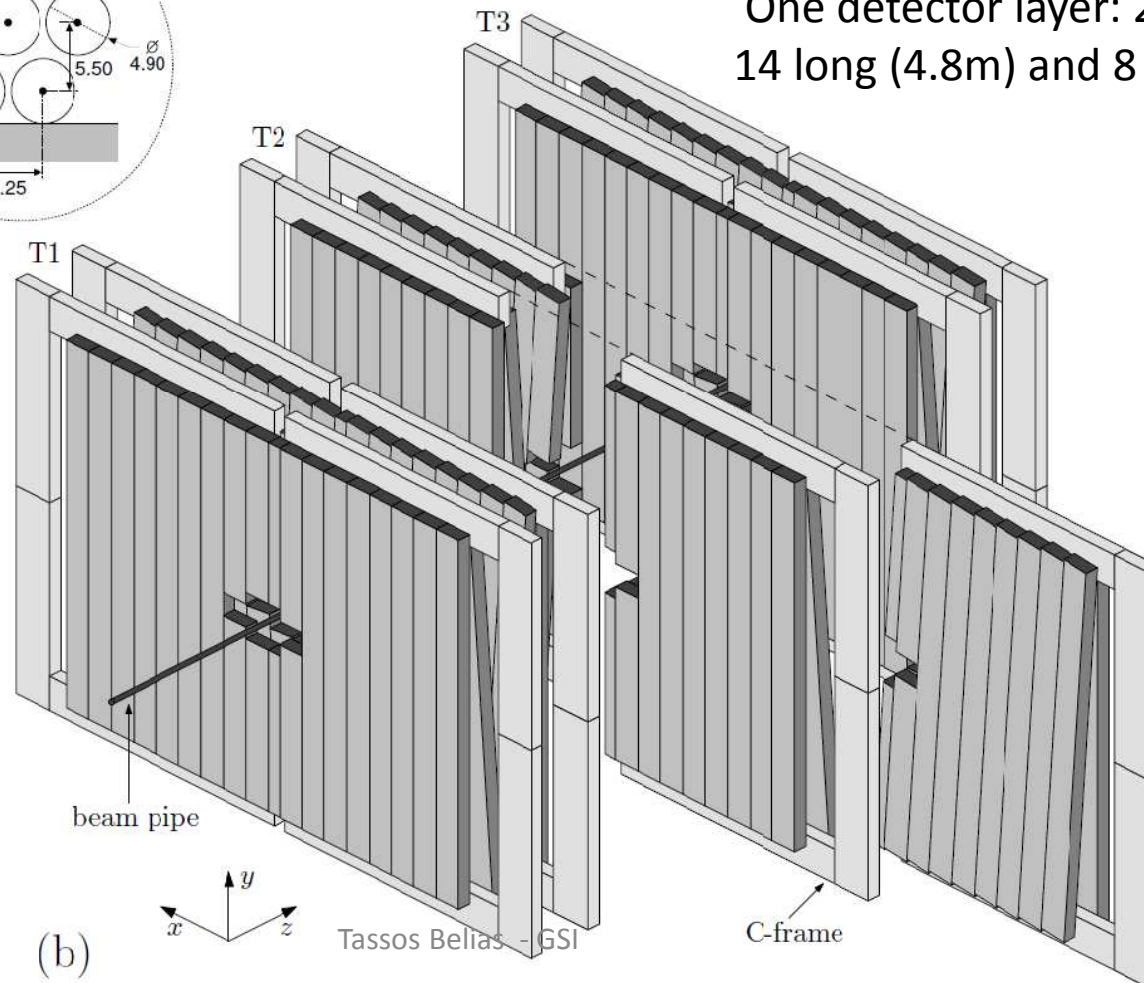
Module: Two staggered layers of 64 straw tubes



(a)

Three Tracking Stations, each with 4 detector layers (x-u-v-x)
Total: 12 tracking layers

One detector layer: 22 modules;
14 long (4.8m) and 8 short (2.4m)

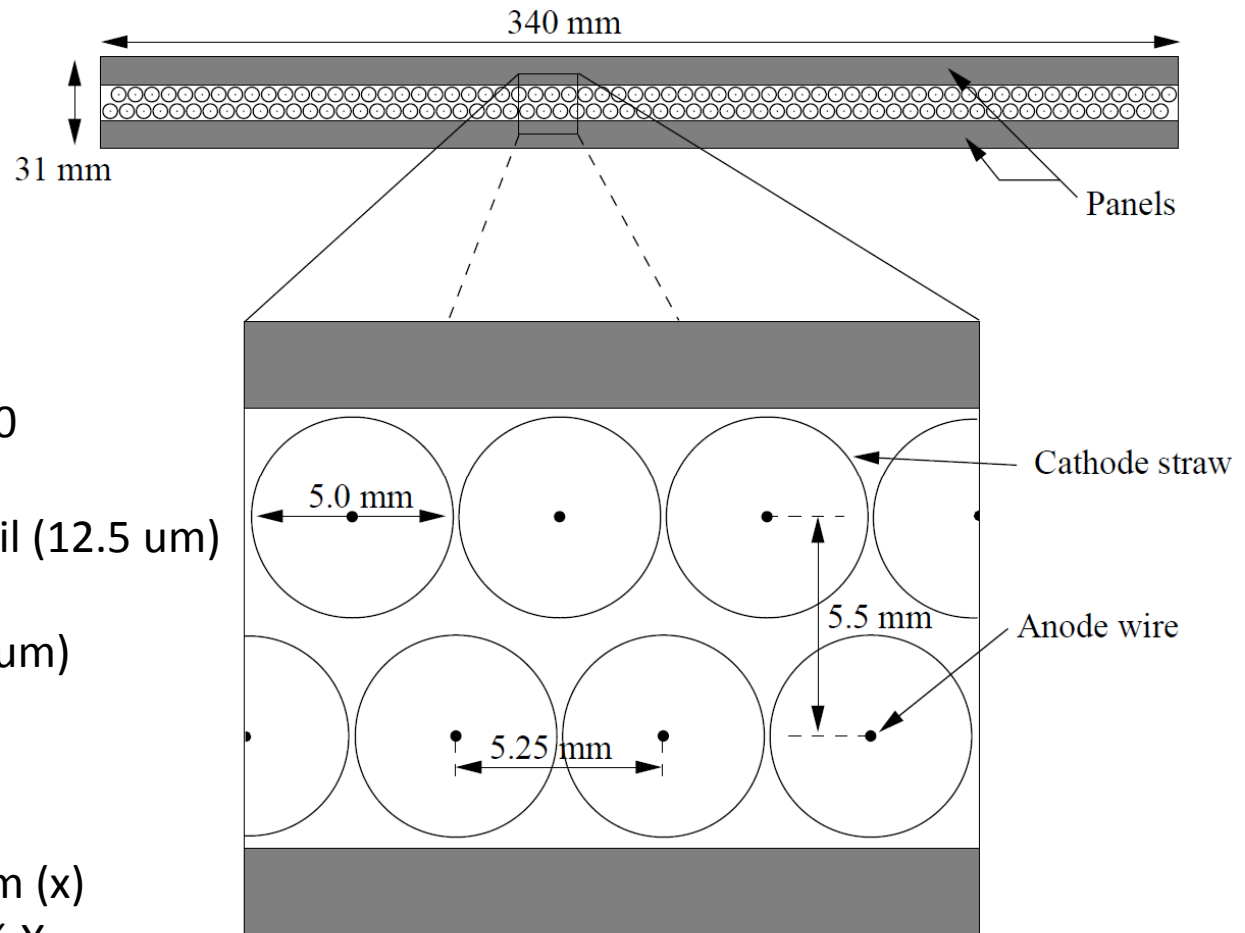


(b)

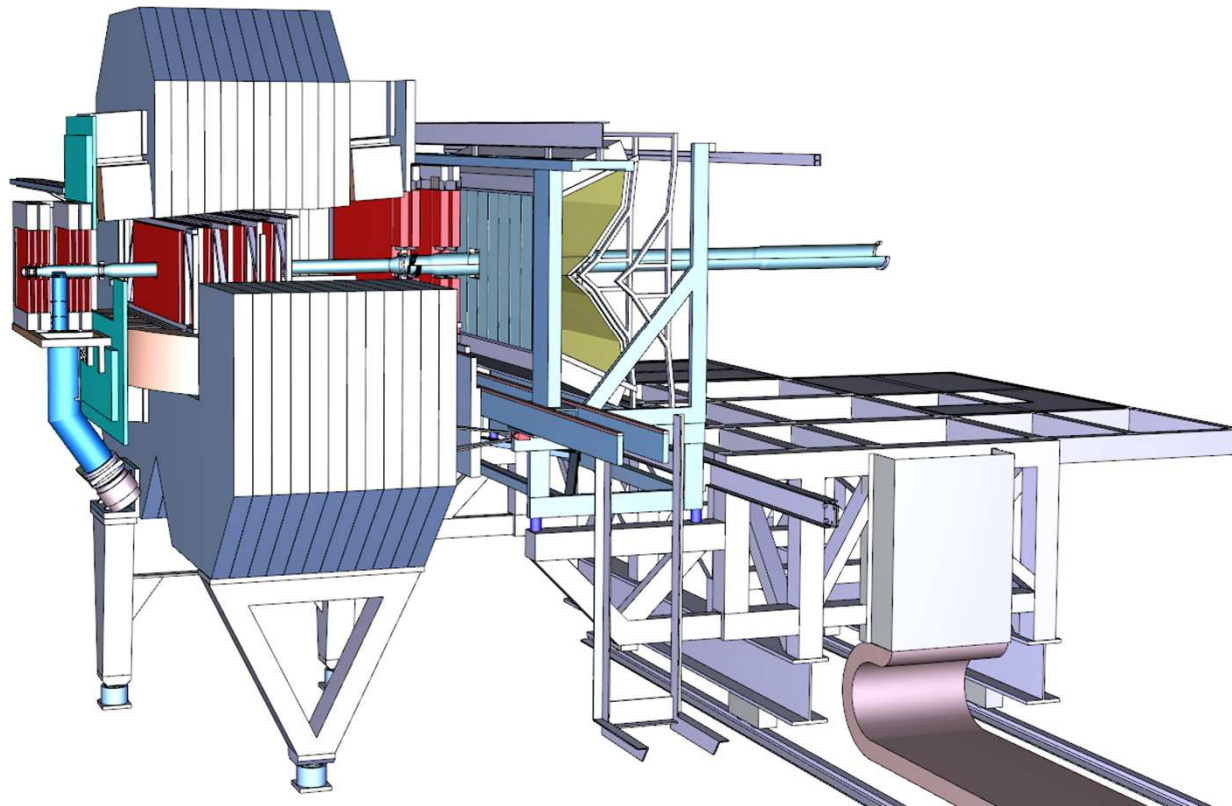
LHCb OT Module - Detail

Straw tubes are arranged in a gas-tight module, made of panels sealed with 400 μm thick carbon fiber.

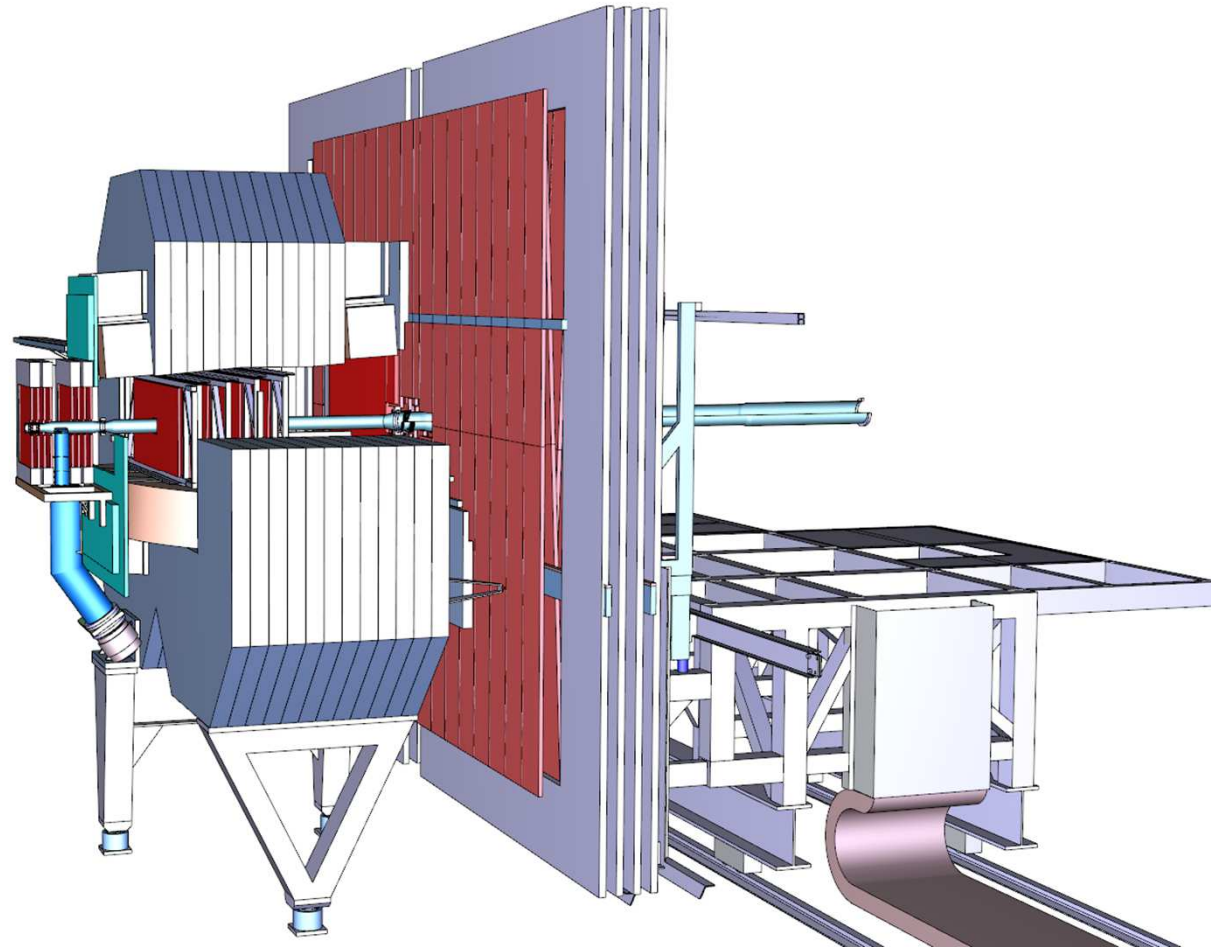
- Cathode wall
 - Inner layer: Kapton XC-160
 - Non-conductive Kapton
 - Outer layer: aluminium foil (12.5 μm)
- Anode wire (+1550V)
 - Gold plated tungsten (25 μm)
- Gas mixture:
 - Ar/CO₂/O₂ (70/28.5/1.5)
- Drift time <50ns
- Single hit resolution 200 μm (x)
- Radiation length: only $\sim 2\% X_0$



PANDA Forward Tracking - FT1-FT6

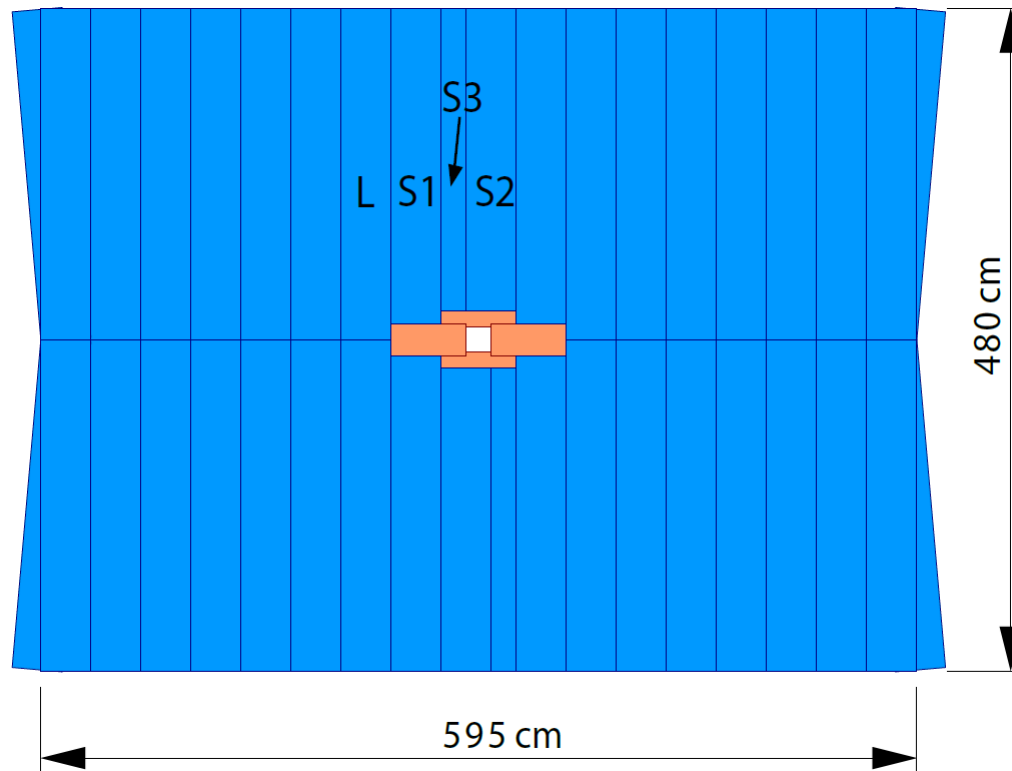


PANDA Forward Tracking – OT as FT5/FT6



LHCb OT station - Front view

Depicted is a x layer with the Inner Tracker in the center. Part of the outermost modules of the stereo layers are visible too.

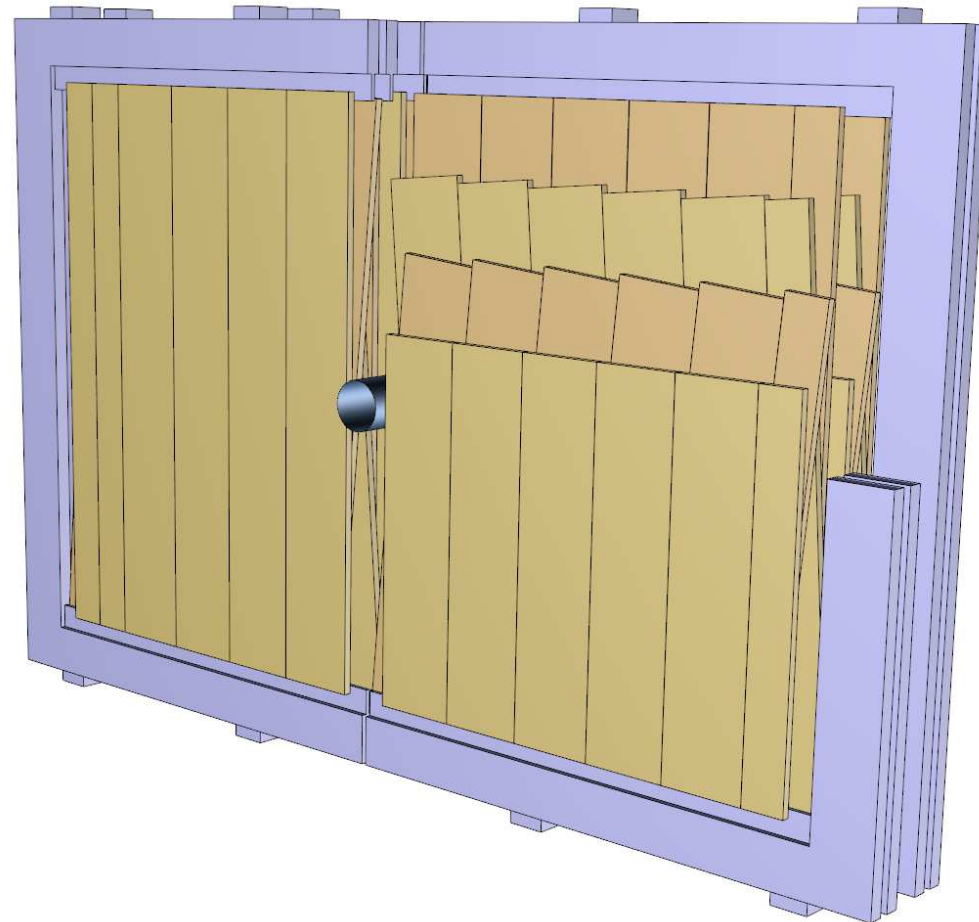


Detector layer: area $\sim 6 \times 5 \text{ m}^2$, with 22 modules; 14 long (4.8m) and 8 short (2.4m)

Long module: 128 upper and 128 lower tubes, contiguous within enclosure

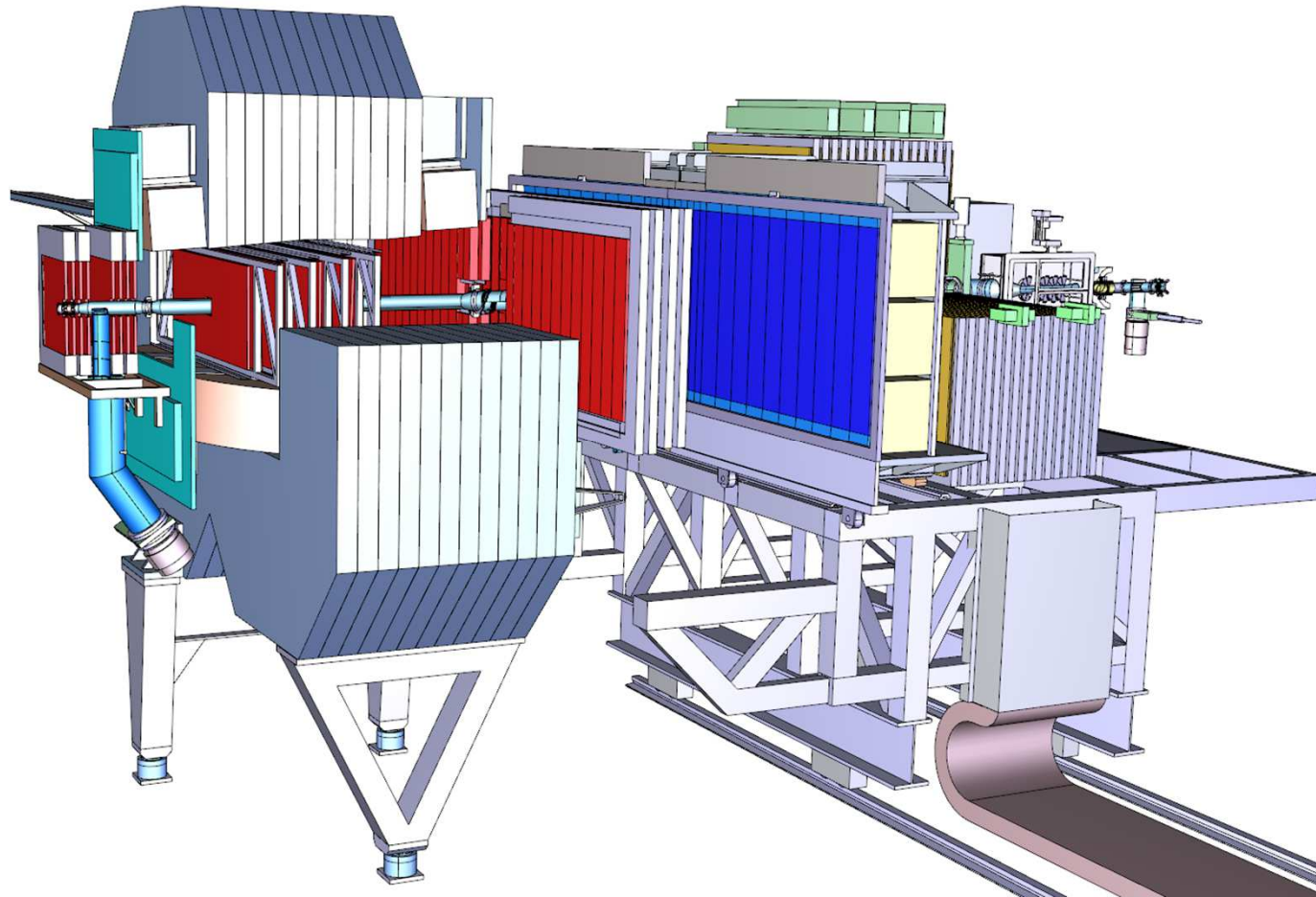
Short module: 128 upper separated from 128 lower tubes, within enclosure **← can be split**

PANDA Forward Tracking – OT Short modules

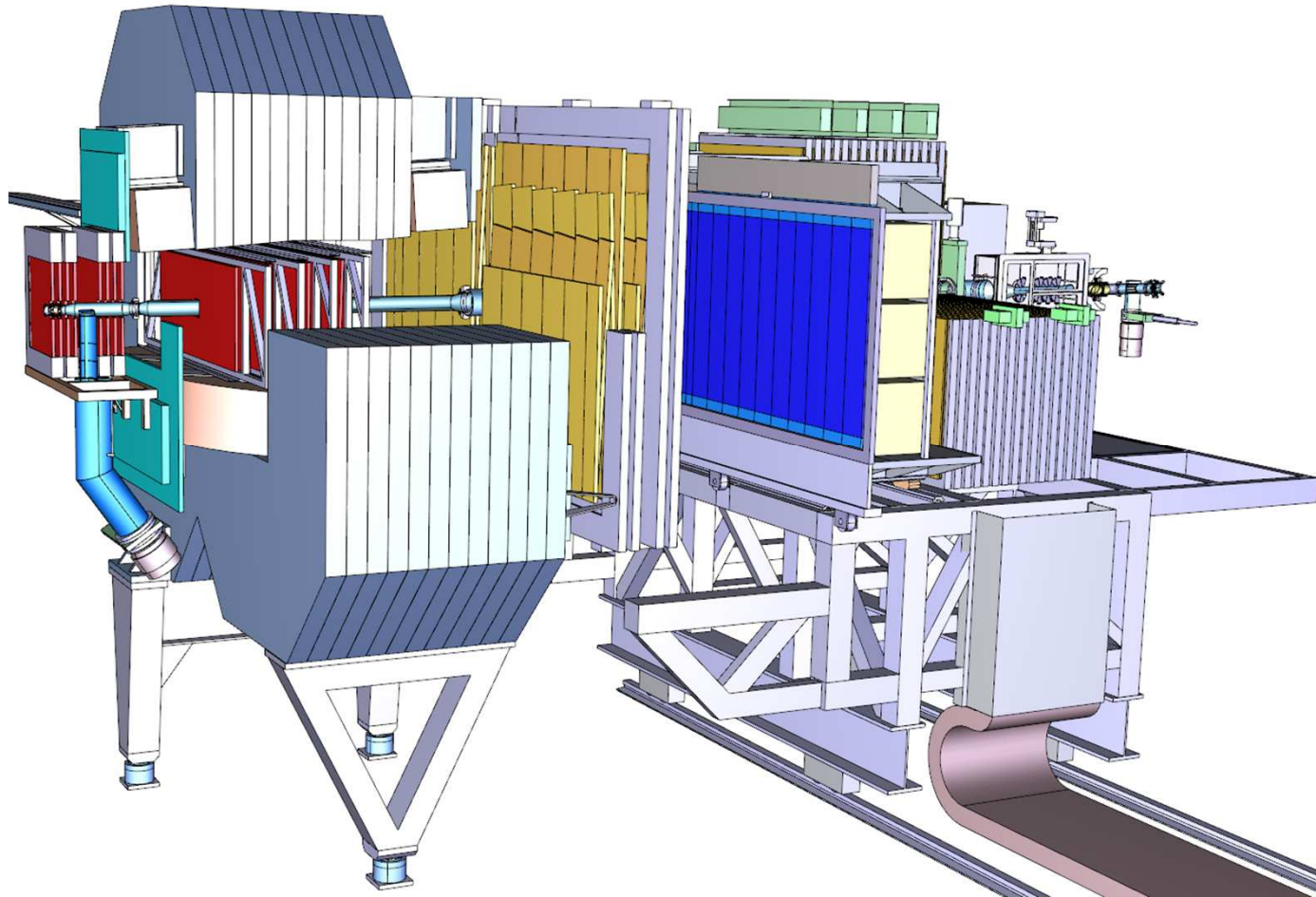


A C-frame, the supporting structure of the short modules.
Here, one C-frame comprises one x and one stereo half detector layer.

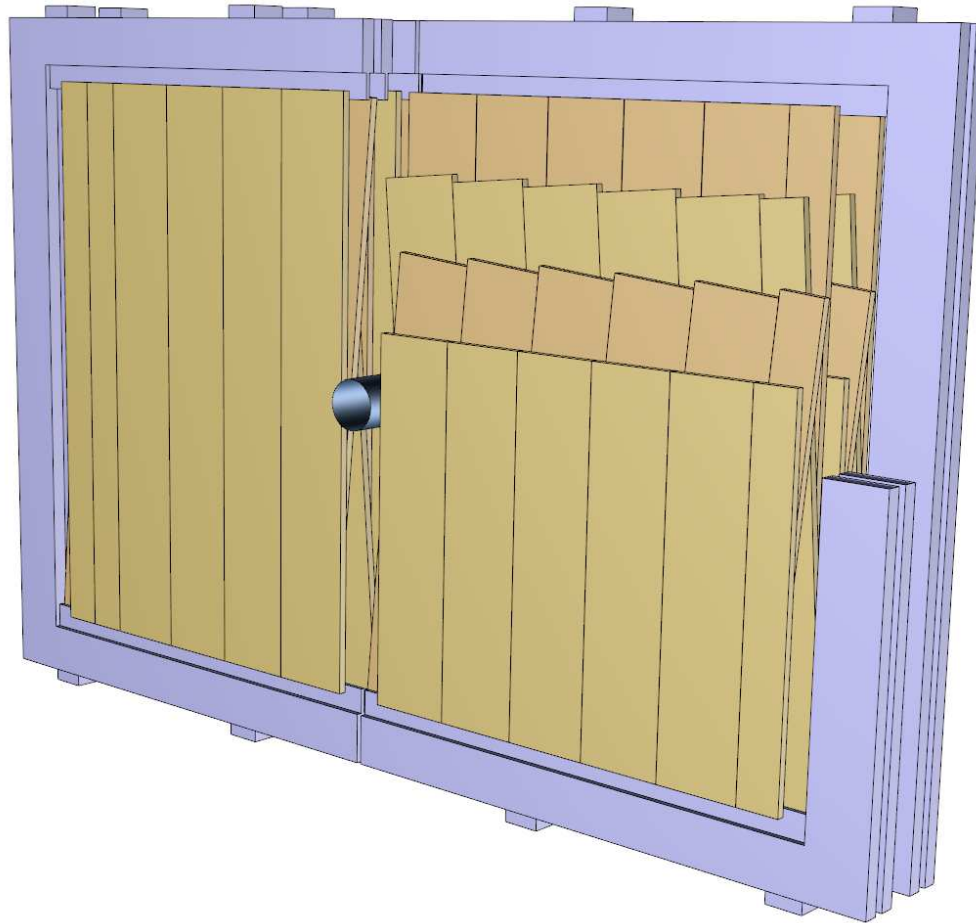
PANDA Forward Tracking - FT1-FT6



PANDA Forward Tracking – OT_S FT5/FT6



PANDA Forward Tracking – OT Short modules



Count of short modules

In use: 96 parts, available ~2021

Spares: 20 parts, available NOW

Transport of spares to GSI soon.

Area coverage (w x h)

Sum total: $35360 \times h \text{ mm}^2$

Arrangement in 8 planes:

Per plane: $4420 \times h \text{ mm}^2$

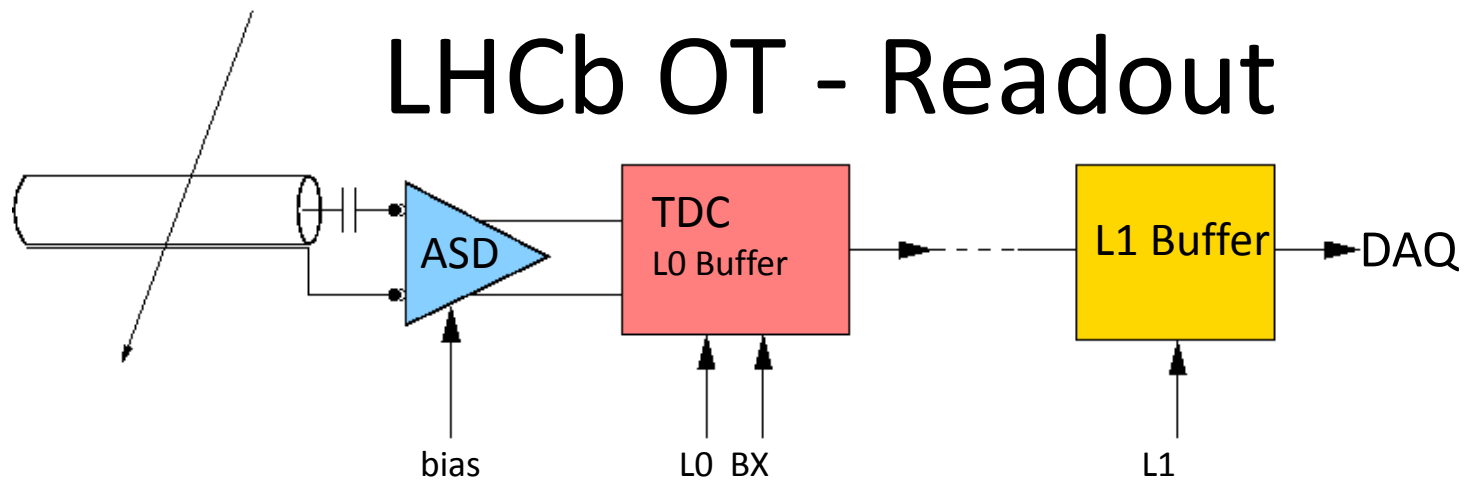
cf. FT5/6: $3923 \times h \text{ mm}^2$

A C-frame, the supporting structure of the short modules.

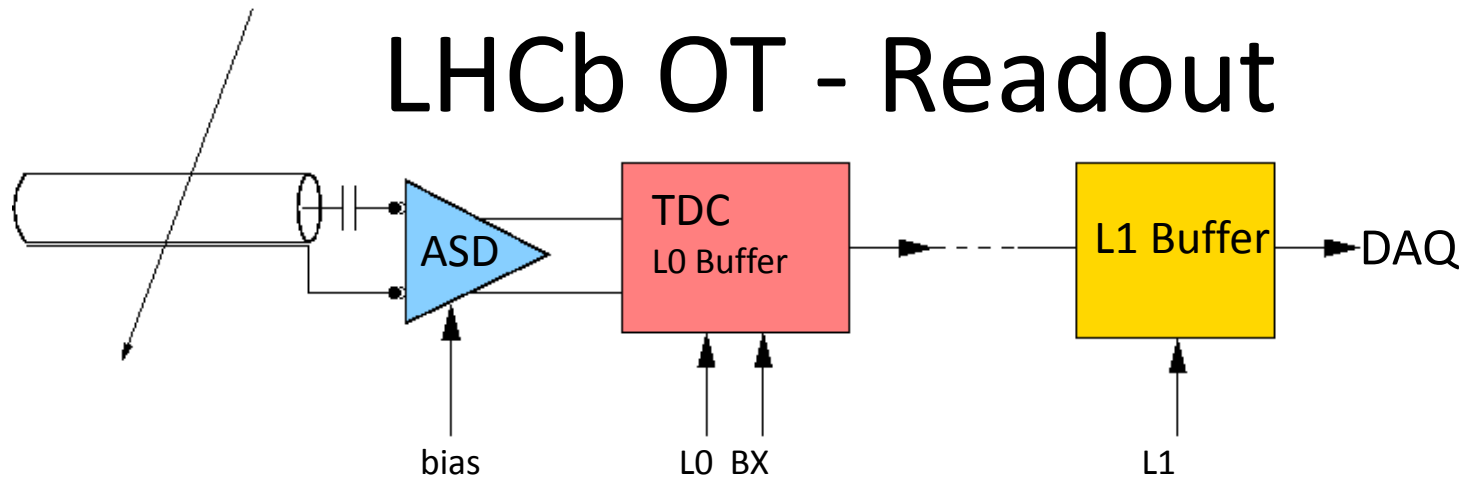
Here, one C-frame comprises one x and one stereo half detector layer.

C-frames design and construction by groups in Thailand; Proposal in progress!

LHCb OT - Readout



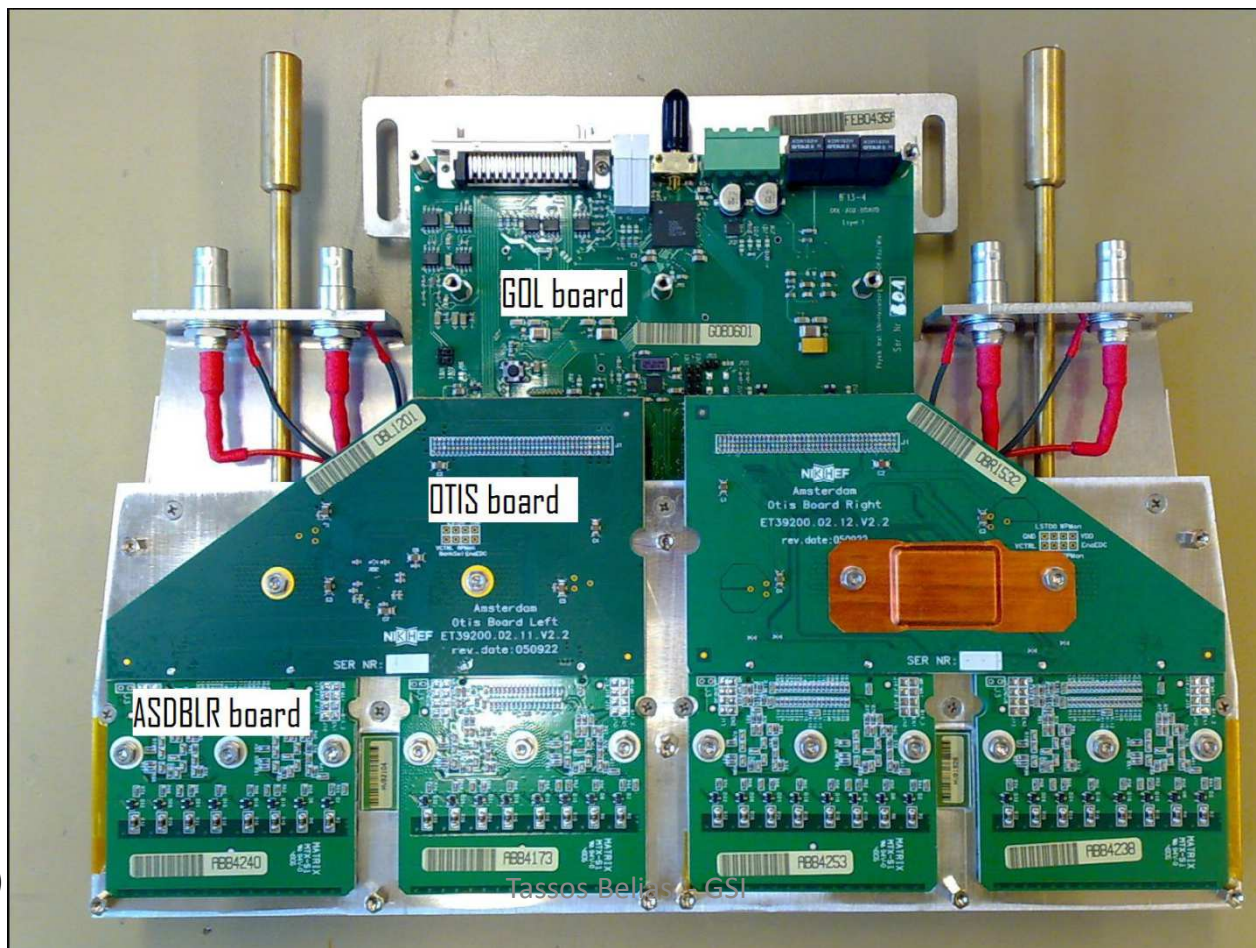
LHCb OT - Readout



GOL - opt. link out,
interface controls
and power

OTIS - TDC ASIC,
32 input ch., drift
time measure, keep
data until LO trig.

Amplifier Shaper
Discriminator BLR
ASIC, 8 input ch., dig.
drift time signals out
(thr.: 3fC / 40mW/ch.)



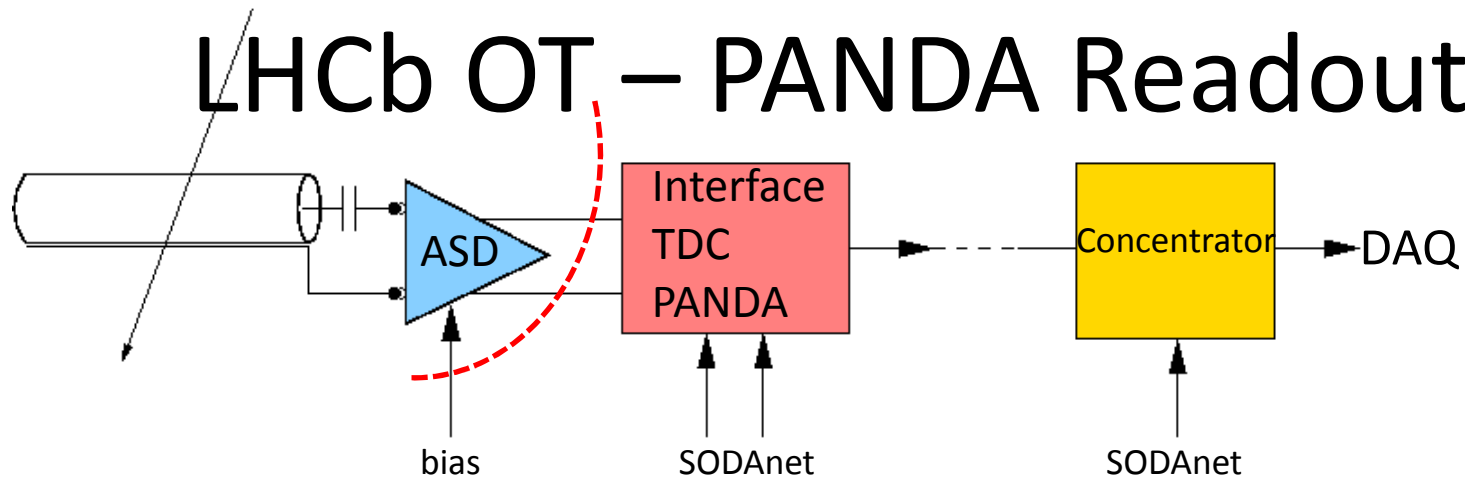
1 optical link,
1.28 Gbit/s

4 OTIS TDC chips,
32 ch./chip

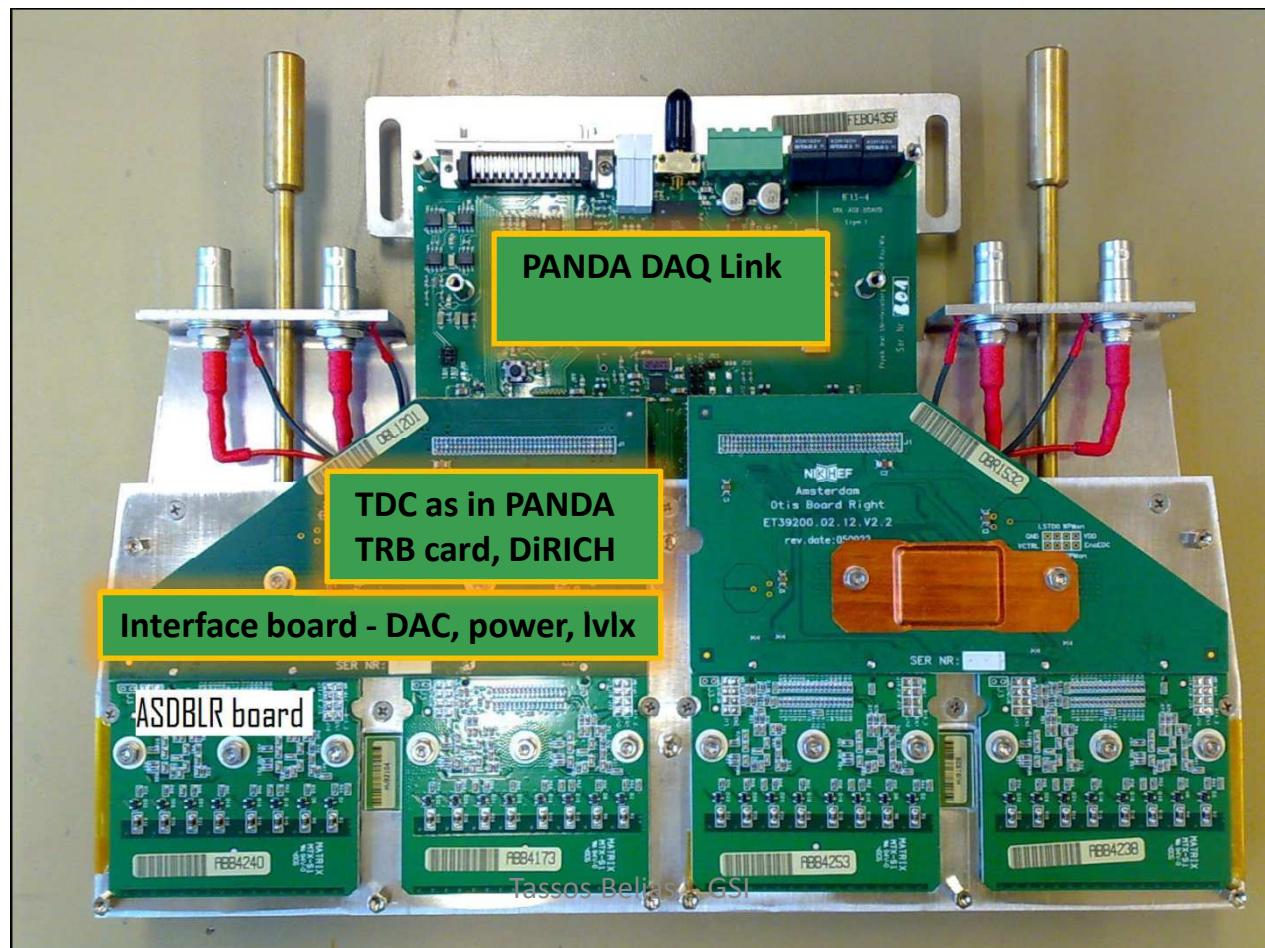
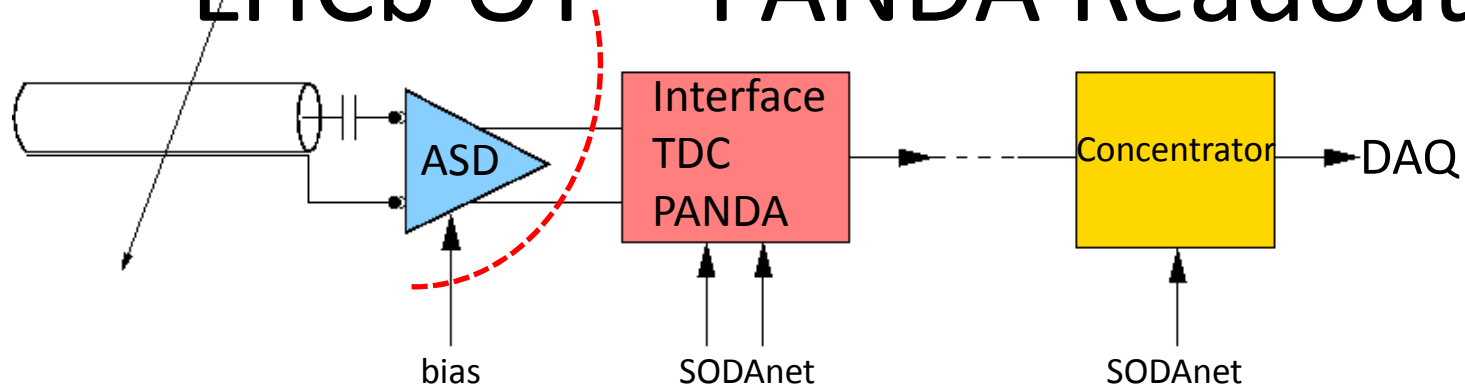
16 ASDBLR chips,
8 ch./chip
(2 chip/board)

16
Input: 128 ch.

LHCb OT – PANDA Readout



LHCb OT – PANDA Readout



Opportunity for PANDA

- **LHCb Outer Tracker, straw tube detector, is available for PANDA**
- Check the possible use of Outer Tracker modules in the PANDA Forward Spectrometer as substitutes for FT5 and FT6 in Day-1
- **Mechanics**
 - Short modules sufficient to cover FT5 and FT6 area
 - Short modules (spares) transport to GSI, in progress
 - C-frames design and construction by groups in Thailand; Proposal in progress!
- **Readout electronics**
 - Strategy: Keep straw-to-ASIC readout (ASDBLR chip)
 - Interface to TDC (TRB / DiRICH) systems possible; Discussions with Electronics Dept. at GSI (M. Traxler) are in progress
- **Needs project management!! Opportunity!!!**