Mechanical Design for barrel TOF based on ceramic DRPC by ITEP group

Mechanical Design Session

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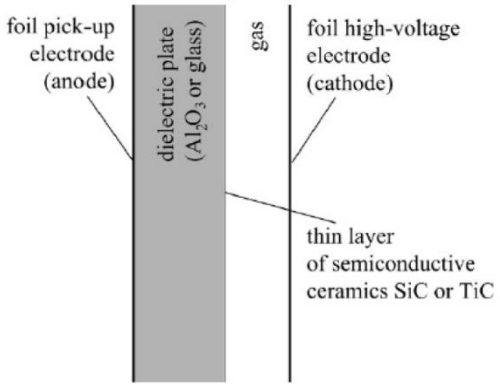
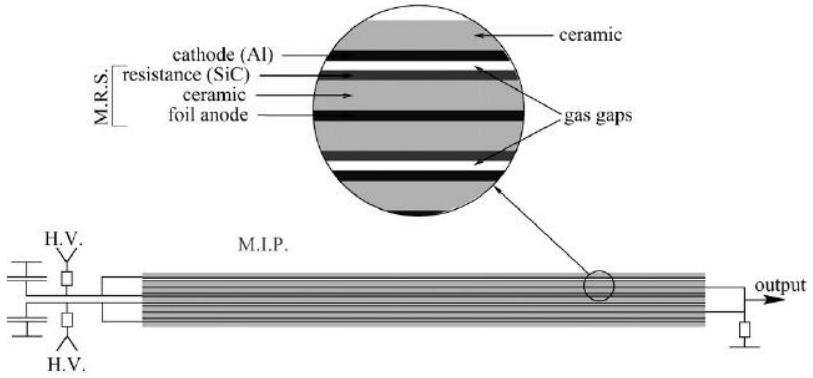
ITEP(Moscow)

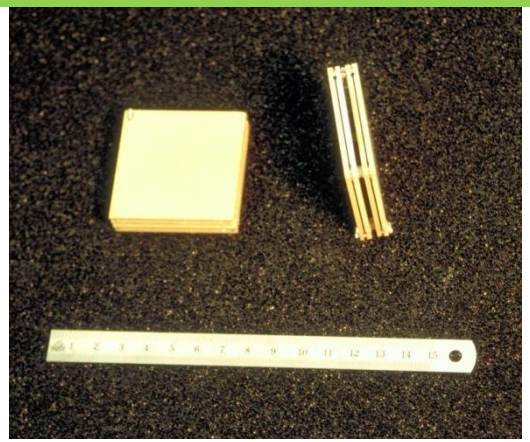
Panda collaboration meeting — March 08-12, 2010

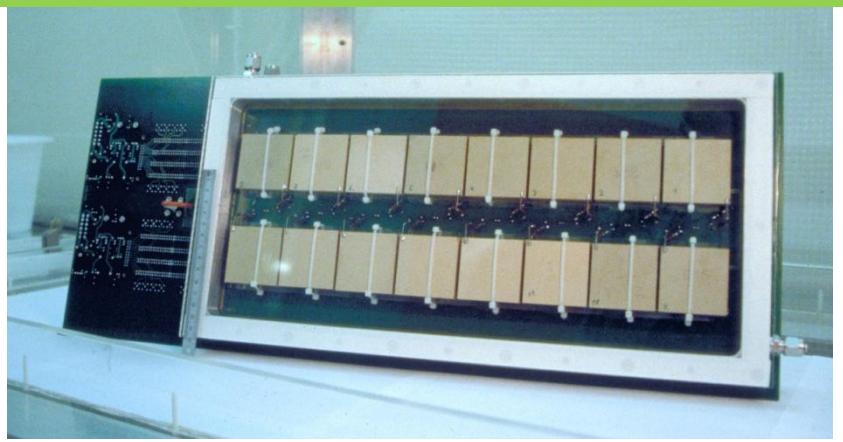
Experience of single cell design during ALICE-TOF R&D





RPC based on ceramic plates and surface resistivity (SiC). Radiation hard technology. Any surface (down to 10^7 Ohm) resistivity can be done for rate requirement.



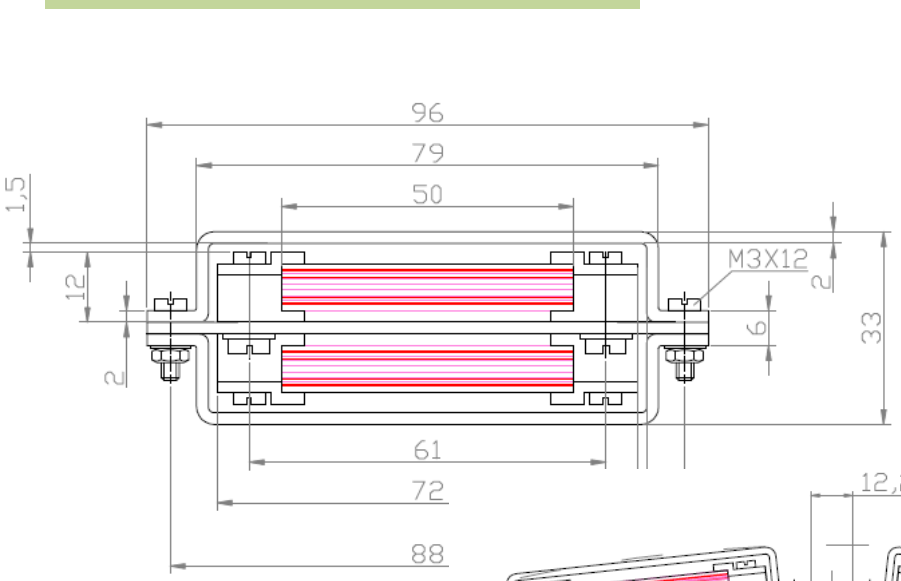


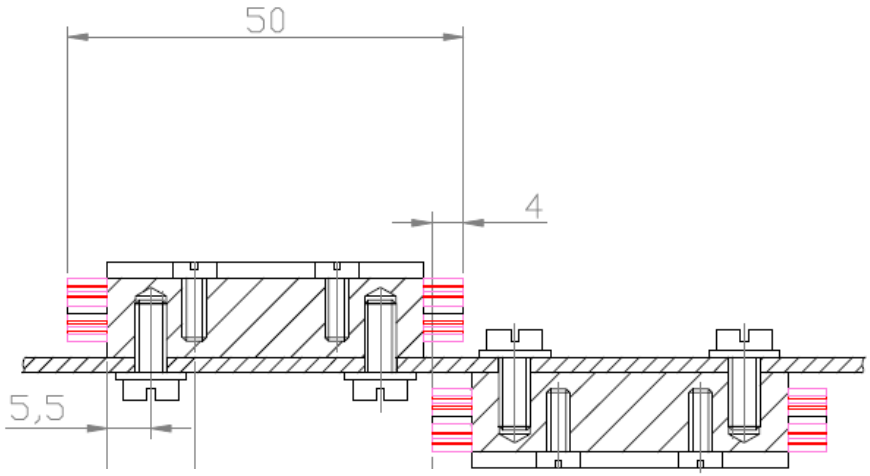
Module design based on multi layer PCB both for mechanical construction and signal routing (very low cross-talks and minimal radiation length, because of no cooling and cabling inside module)

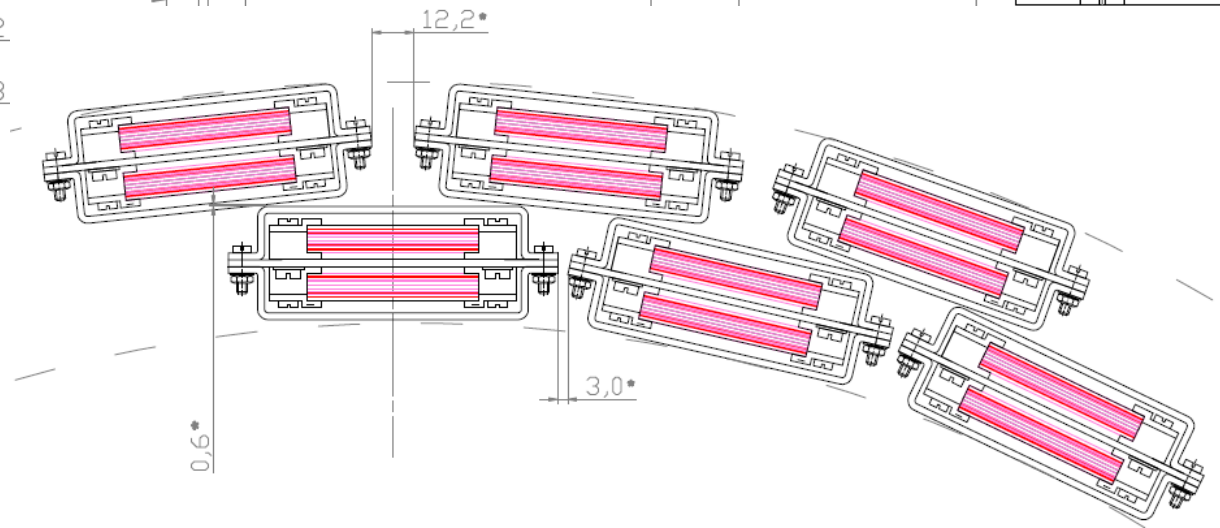
Requirements for PANDA

- Small radius ~ 50 cm
- Minimal radiation length
- “Holes” for pellet target
- About 100 % coverage

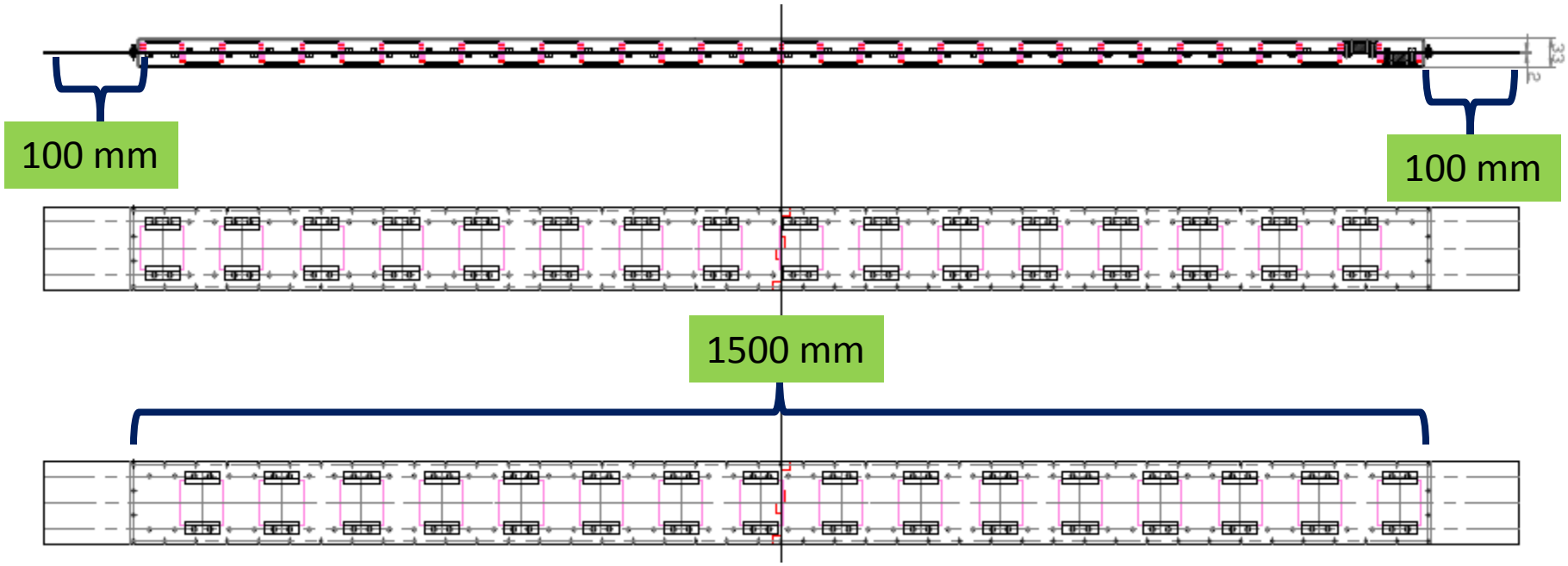
Strip design modules with plastic covers and chamber fixation

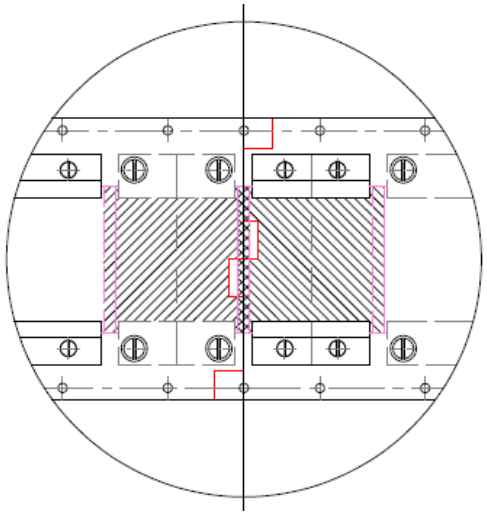






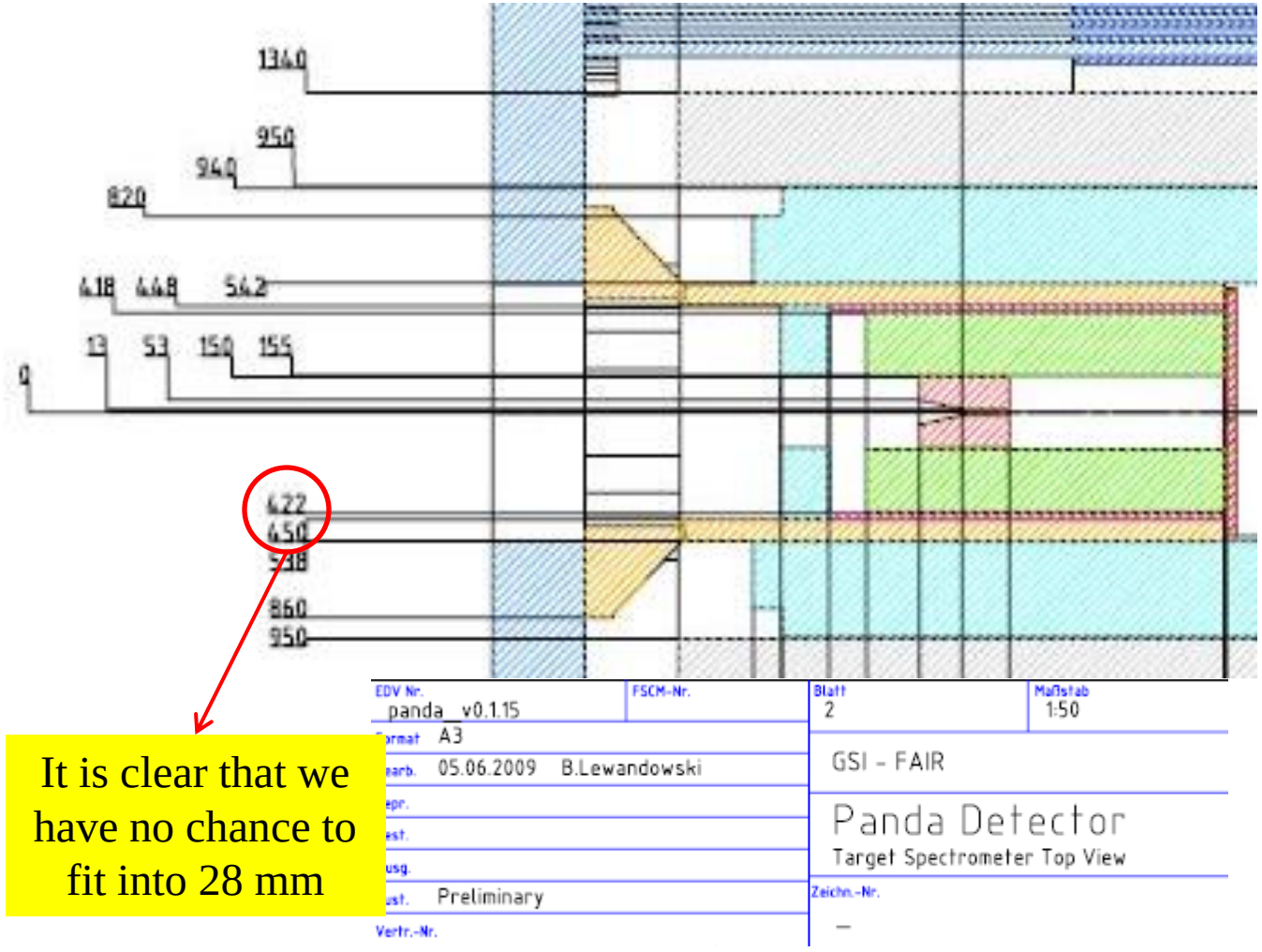
Strip design





Zoom view for place of PCBs merging region

Inputs for barrel design

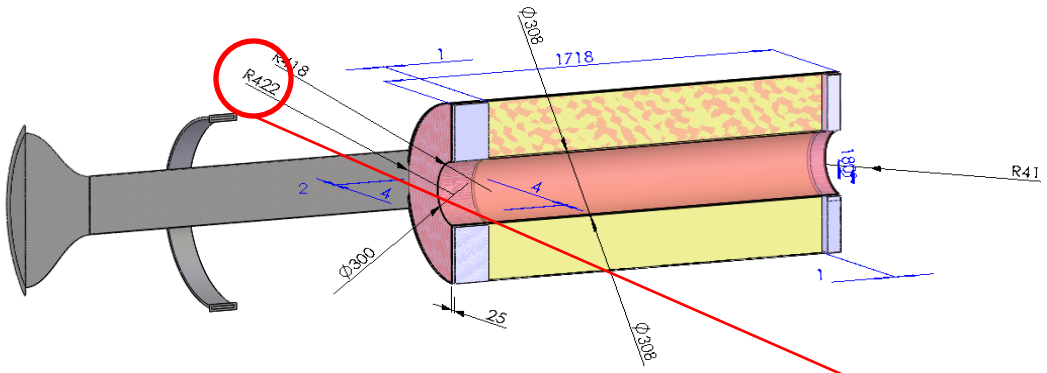


It is clear that we have no chance to fit into 28 mm

Inputs were taken from :

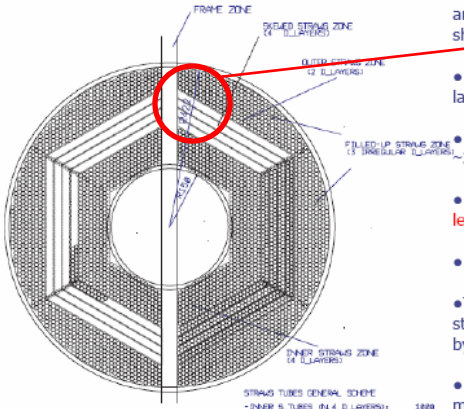
1.B. Lewandowski –
PANDA Technical Board report
10/09/2009
2.B. Voss -
GEM TPC design reported on collaboration meeting@FZJ
Julich Sep 7th 2009
3.P. Gianotti –
The Straw Tube Tracker report given 22/09/2008
4. D. Dutta-
DIRC dimension – Panda Collaboration Meeting Dec 2009

Inputs for our design – Inner radius limit (due to TPC/STT)



B. Voss PANDA GEM-TPC Collaboration Meeting@FZJ JÜLICH September 7th 2009

The Straw Tube Tracker

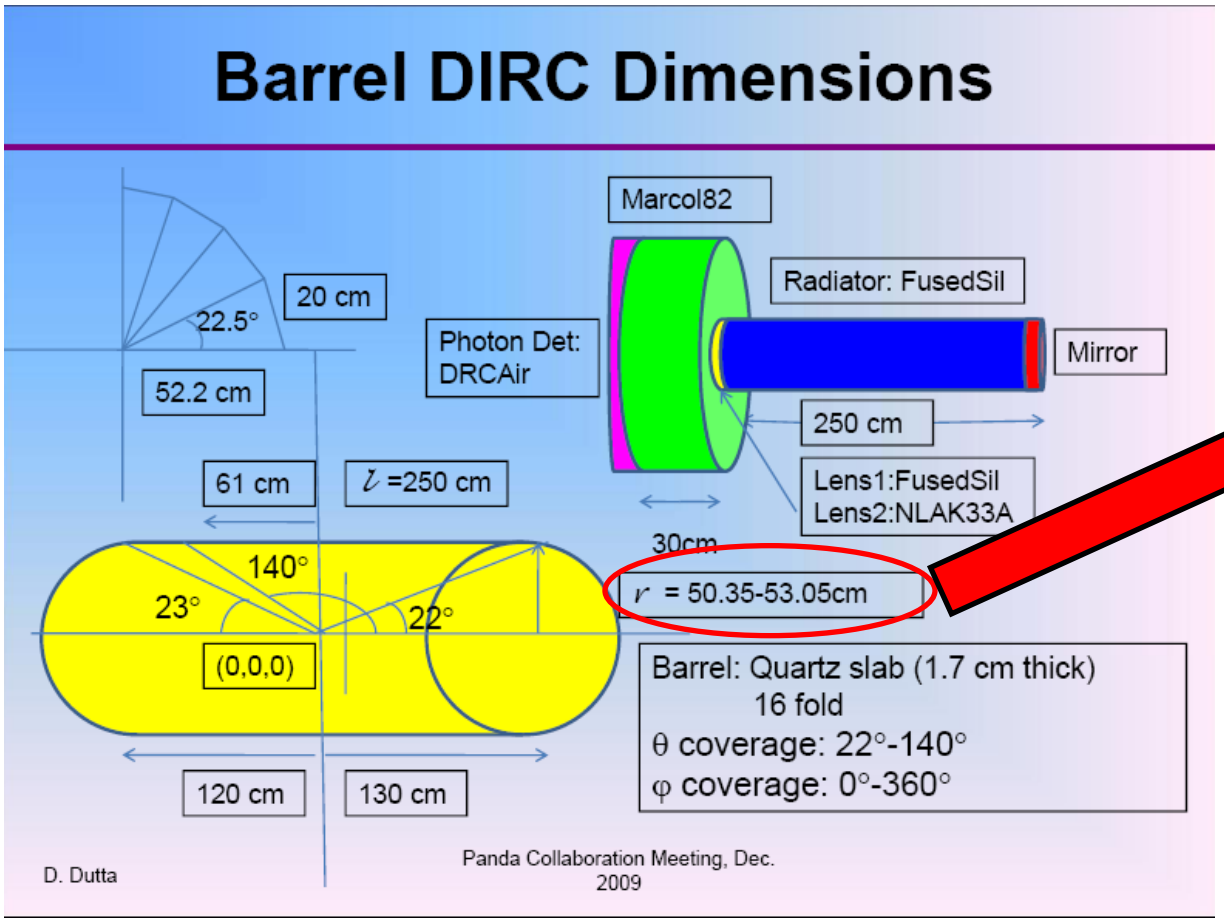


- The STT consists of planar straw tube double-layers arranged in a hexagonal layout to fit at best the cylindrical shape.
- A straw double-layer consist of 2 close-packed, staggered layers of tubes.
- Tube internal diameter is 10 mm, and tube film wall is ~27μm (2×12μm Mylar + 3μm glue),
- The length of the tubes is presently 1500mm (active length 14800mm + 2×10mm endplug size).
- No wire locator along the tube length is foreseen.
- The anode is a W97/Re3 gold-plated wire (20μm diameter) stretched in the tubes by 50g (expected maximum wire sag by gravitation of about 35μm) .
- Straws will be operated with an Ar+CO_2 (90+10) gas mixture with an overpressure in the range Δp ~ 700-1000mbar. Then a longitudinal elongation of 0.5-0.8mm and a diameter rise from 10.06mm to 10.09mm (max) is expected.

9 Paola Gianotti 22/09/2008

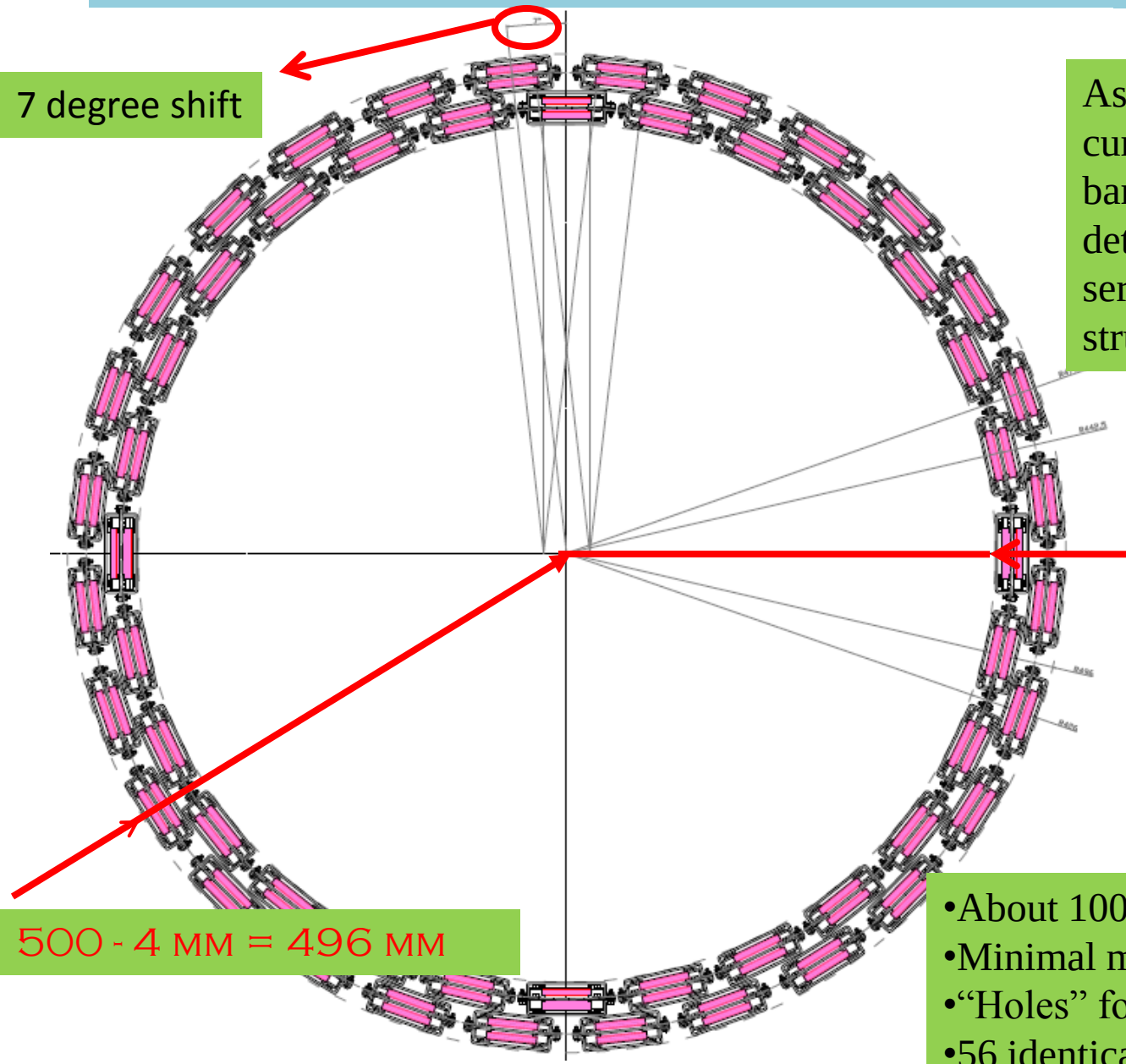
422 mm is an inner limit limit for our design

Inputs for our design – Outer radius limit (due to DIRC)



500 mm as a outer limit for our design (preliminary)

Our current design



7 degree shift

As we found out from current design of PANDA barrel 4 mm gap between detectors foreseen (space for service and installation structure + cabling and ect.)

422 + 4 мм= 426 мм

500 - 4 мм = 496 мм

- About 100% coverage
- Minimal material budget
- “Holes” for pellet target – to be done
- 56 identical modules in total

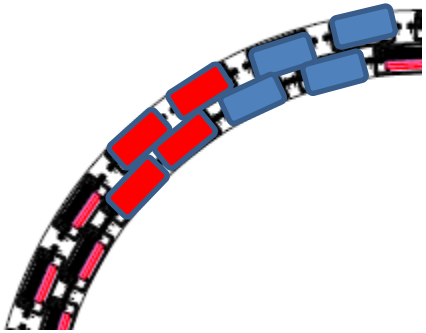
Some open questions

•We have some ideas how to fix strips, but we need to know common support structure for DIRC and TOF

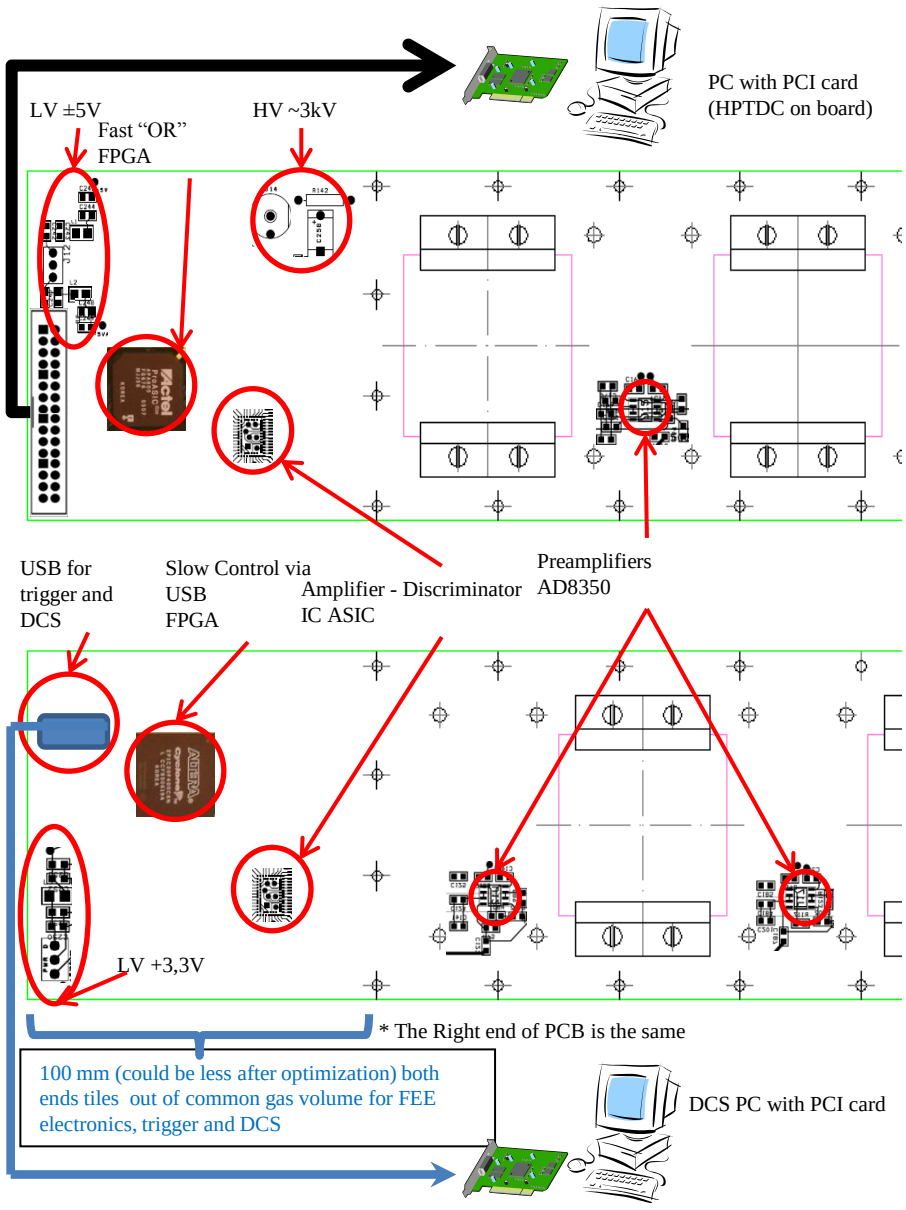
•From B. Lewandowski : "We have these 16 rectangular forms planned for quartz boxes. … It would be excellent, if you could start a design for the TOF in a way similar to the one for the DIRC quartz boxes, because the material of these two systems have to be as close as possible together to improve the situation for the EMC ". – As you can see TOF is as close to DIRC as possible, we'll redesign our current drawings to 16 sectors, but we need some time.

•From C. Schwarz: "Is it possible to have a single layer and optimized housings covering approx. 90% of the geometrical acceptance?" – We can do this, but we have to check if PCB (1.2x1.2 m^2) with parameters we need can be produced. In this case design will be very similar to IHEP-Dubna project. Also we need to redesign chamber support and chamber placement (4 rows).

We also can design 16 sector segmentation with two layers (strips in each sector fixed together mechanically)



A few words about services we need



Power we need

LV	+3,3V; ± 5V
HV	~3kV
GND	0

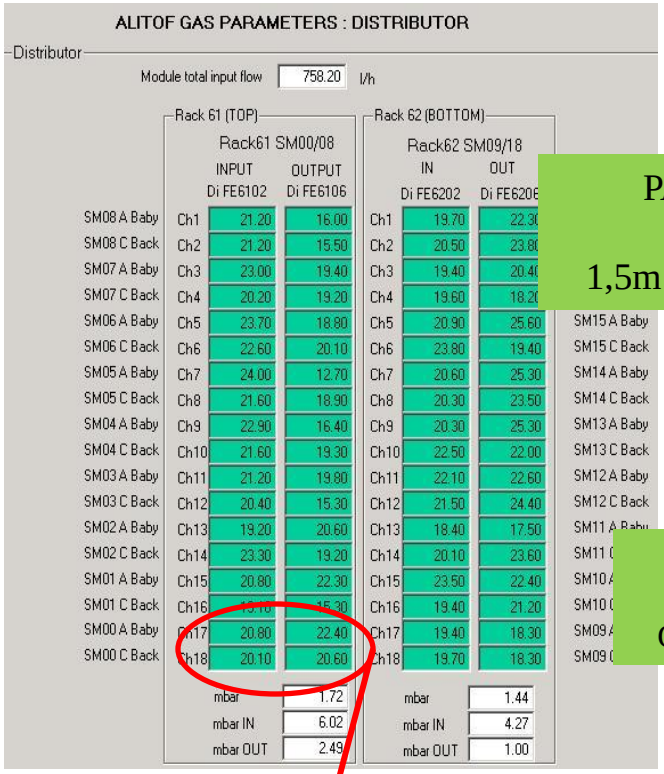
Some rough estimation

WHAT	TYPE	Consumption, mW	Quantity	Sum W
OpAmp	AD8350	140	32	4,5
AmpDiscr	ASIC(NINO used in ALICE)	400	4	1,6
Trigger with FAST OR function	FPGA ACTEL (Cyclone used in ALICE)	~400	2	0,8
Slow Control	FPGA ACTEL(APA600 used in ALICE)	~200	2	0,4
				~7,3 W

TOTAL FOR ALL STRIPS ~ 400 WT

Gas flow estimation for PANDA module based on ALICE TOF Gas System

Gas mixture:	$C_2H_2F_4$ / iC_4H_{10} / SF_6 90% / 5% / 5%
Total volume:	16 m^3
Total nom. circulation flow:	1.0 m^3/h
Max. circulation flow:	2.5 m^3/h
Nominal replenishing flow:	20 ltr./h (2%)
Max. replenishing flow	80 ltr./h (8%)
Chamber pressure	0.5 - 2.0 mbar
Hydrostatic Diff. (per height zone)	~ 1.3 mbar
Max. overpressure	3 mbar
No. of Channels	36
No. of Sub-Dis. Units	2
No. of UX Racks	2



PANDA strip gas volume:

1,5m x 0,8m x 0,033=>0,0396 m^3

$1m^3$ – 40 L/h
0,04 m^3 – x
Gas flow per PANDA strip~ 1L/h

Total for all strips ~ 56 L/h
Recirculation foreseen

ALICE gas volume:
1 SM ~ 0,9 m^3

Gas flow
per SM ~ 40 l/h

Cooling & ventilation

Too many questions for the moment:

1. Cooling for preamplifiers just by gas flux (?)
2. ASIC water cooling like in ALICE (?)
3. Pipe connectors each line for intallation/deinstallation (?)

We don’t know for the moment if we need water cooling for our electronics.

Summary

- First system design for barrel TOF was done.
- We are fit as well into space between tracker and DICR.
- We can rearrange number of strips to have 16 sectors.
- Some estimations for services were done.
- Still question - how many connectors we should have to install and remove detectors individually/sector.

See more in EDMS documents: https://edms.cern.ch/document/1063856/1 and https://edms.cern.ch/document/1064701/1

FEEDBACK FROM THE OTHER SUBDETECTORS &SUBSYSTEMS VERY IMPORTANT!!!!!