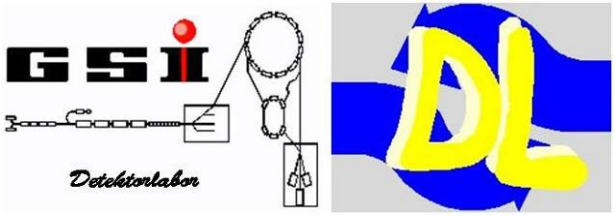
FAIR Facility for Antiproton and Ion Research

Design studies on the PANDA GEM-TPC

(Cabling infrastructure – Routing & interfaces)



Outline

‘’Cabling’ infrastructure – Routing & interfaces’

PANDA

GEM-TPC Infrastructure

Conduit System

- The Concept
- Pros & Cons

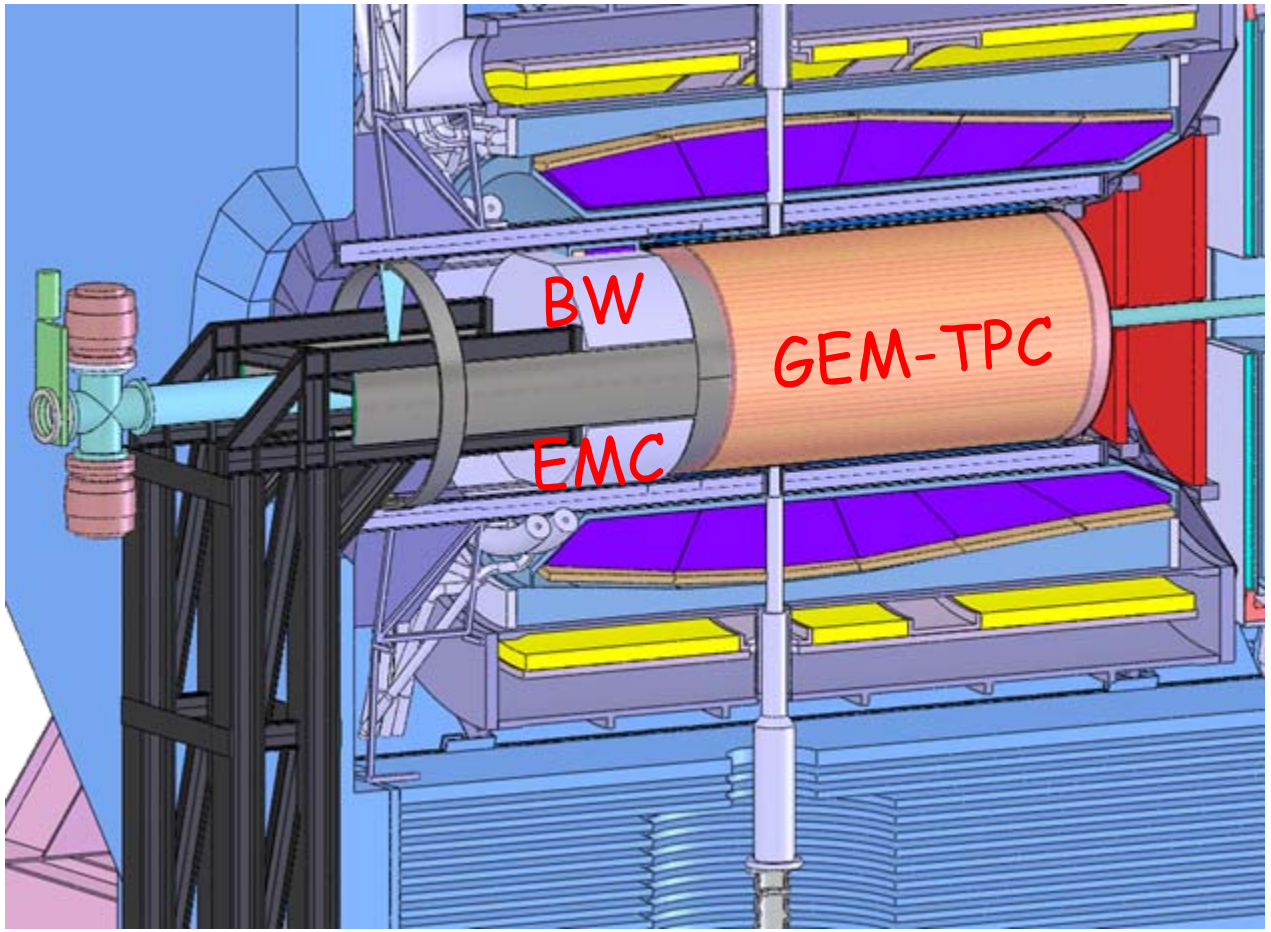
BW-EMC

- The Conflict
- Implications

Open Questions & Work to do

The environment & its challenges

How to connect ?

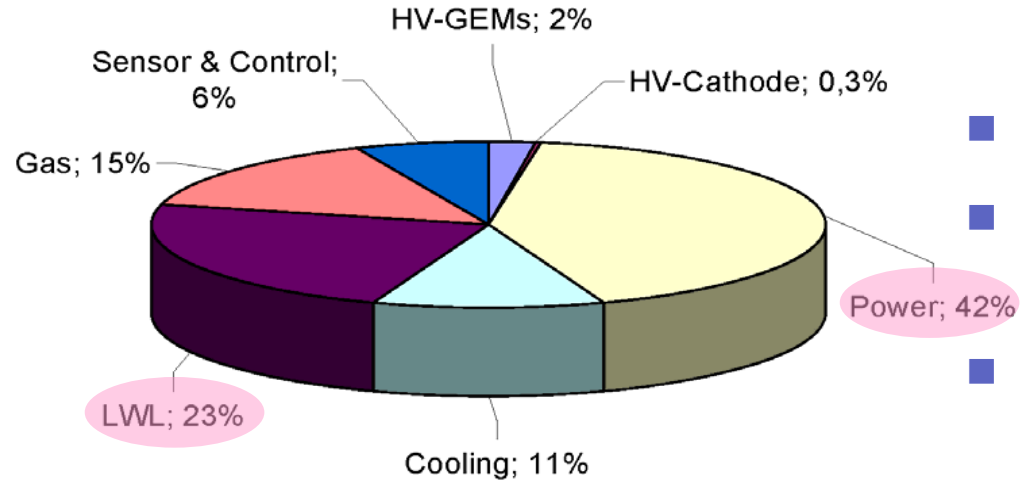


- Very restricted space to reach the GEM-TPC
- The 'Unknown':
  - Nearby systems detailed design, e.g.:
    - BW-EMC Cabling requirements
    - TOF design Length
    - Beam-pipe Support structures
  - Mounting conditions
  - General PANDA infrastructure conditions
  - Characteristic of FEE

Possible solution: Design the conduit system as integral part of the detector

Space requirements for cables… Contributions

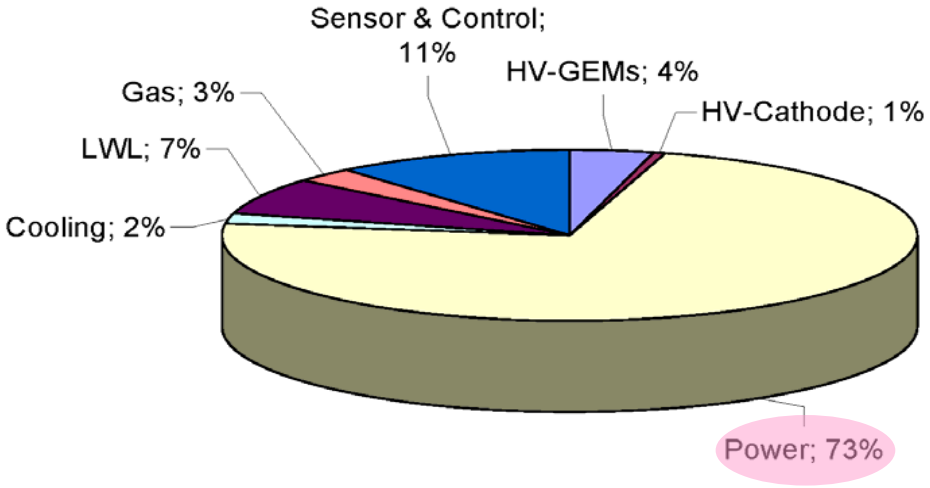
Cross section:



for ½ GEM-TPC:

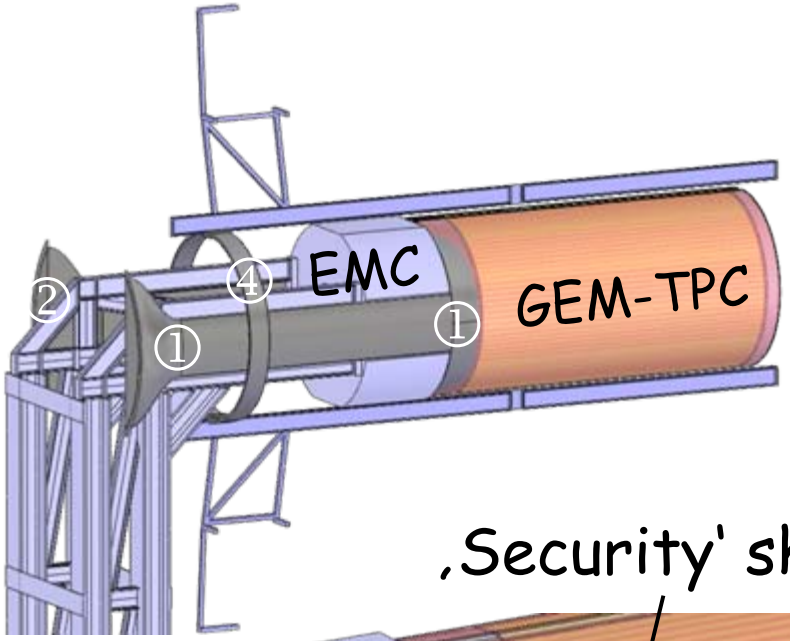
- Total cross section ≅ 6800 mm^2
- Incl. reduction of the current FEE power consumption (½)
- One further integration level (ROE) partially included

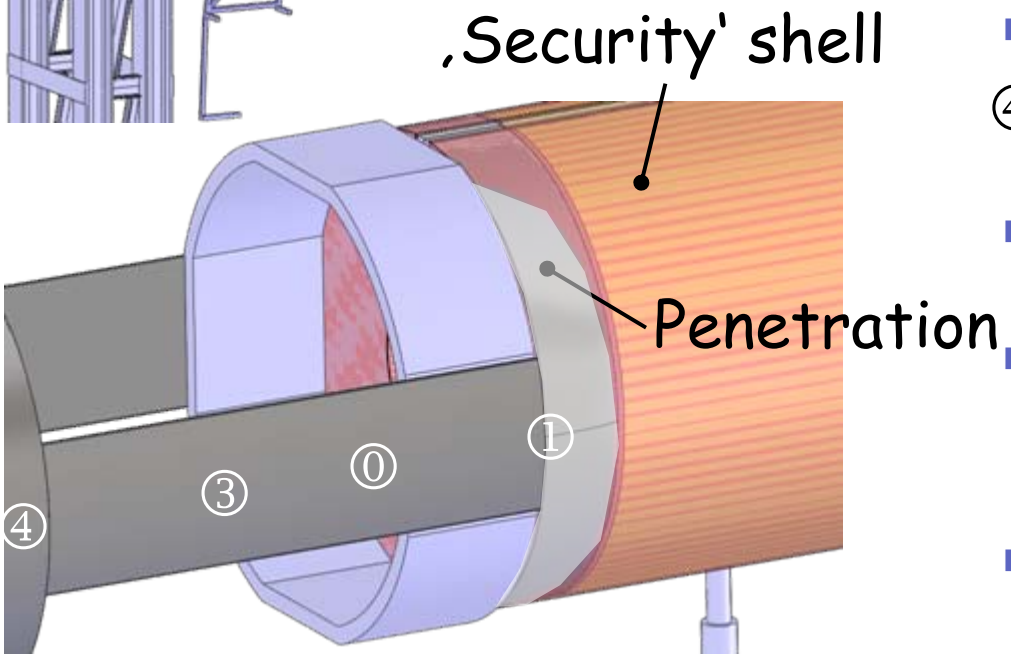
Weight:



- Total weight ≅ 51kg (without panel)

Conduit System for the GEM-TPC Concept

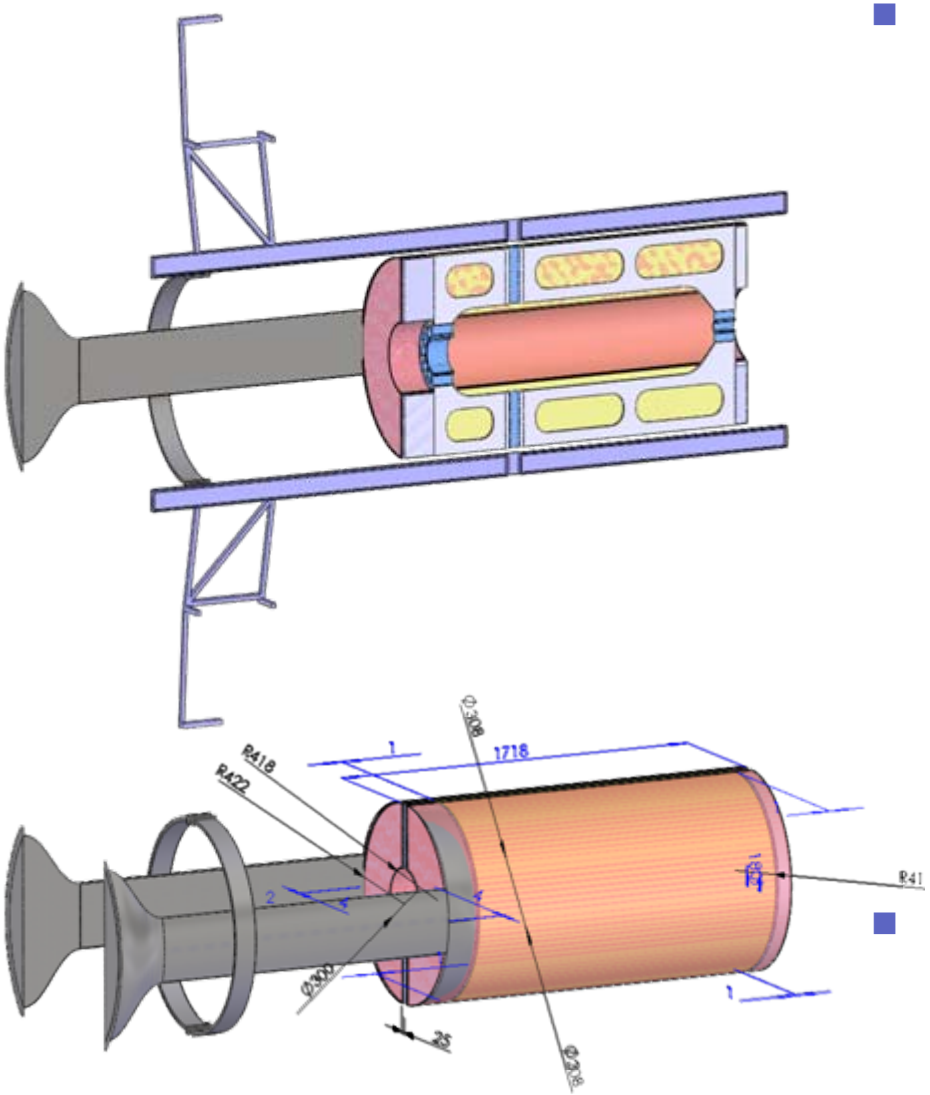




- Use the symmetries
- ⓪ Shape conformal & stiff design
- ① ‘Smooth’ sections & junctions
- ② Integrally molded patch panels (one per ½-detector, outside magnet)
- ③ Thin-walled cable guide (CRP/GRP)
- Make multiple use of functionalities
- Fully shielded electrical tubing
- ④ Additional support structure interfacing to ‘existing’ rails
- Preserve possibility of sequential mounting of BW-EMC & GEM-TPC
- Requires Irregular & non-standard sub-structures, tubes & cabling

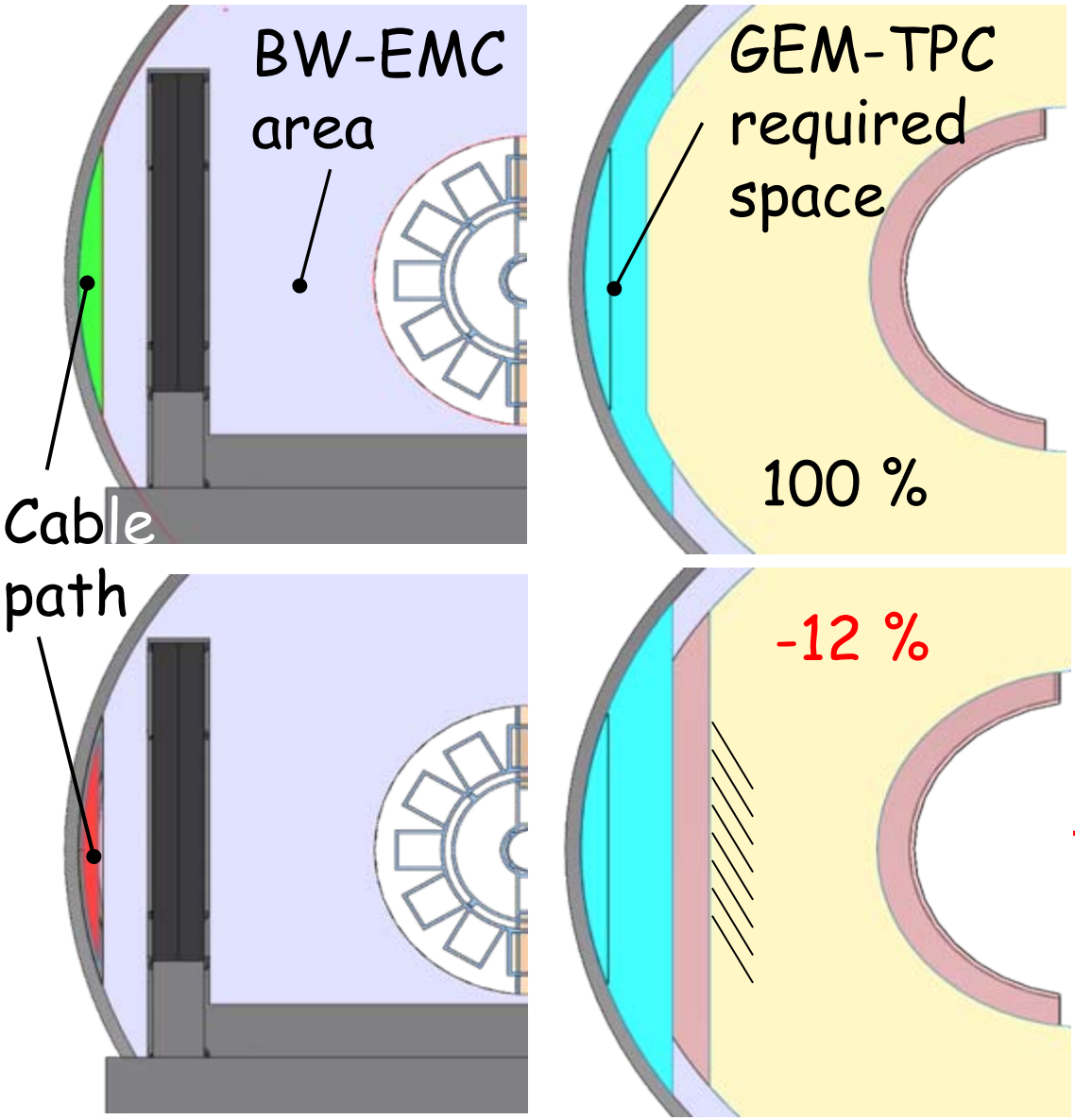
- Note the GEM-TPCs ‘security’ layer and the ‘hull’ breaches…into TOF space

Conduit System for the GEM-TPC Pros & Cons



- Advantages:
  - Reduced #plugs inside the valuable volume inside the magnet
  - No ‘hanging around’ cables
    (high security, reliability)
  - Pre-mountable, minimized cabling effort
  - The ONLY way to nearly stay inside requested volumes
  - Optimized usage of space
    (min. security rim, fluids in irregular shaped conduits)
  - Optimized weight balance
  - Non-magnetic panel components applicable
    (‚standards‘ plugs, costs, maintenance)
  - Integral strain relief
  - Integral (mech.) coded fool proofing
    (high connection security)
- Disadvantages:
  - No easy exchange of faulty connections
    (if any)
  - Additional costs

Installation space for Cabling… The Conflict



driven by BW-EMC design:

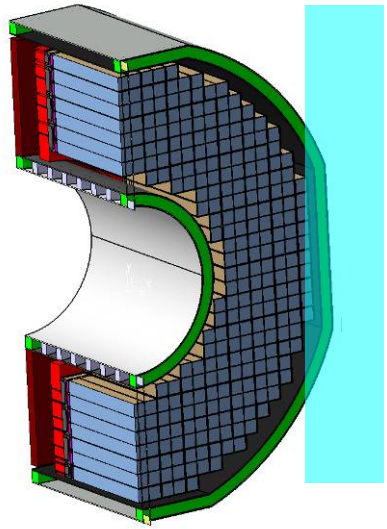
- Reserved: 4600 mm²
- Available (4mm rim): 2500 mm²

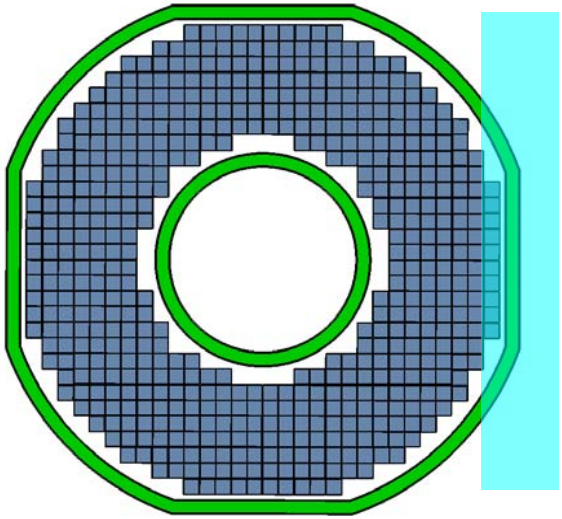
➔ Not at all sufficient !

- Cables / Tubes: 5905 mm²
+ (Sub-)Structures: 6200 mm²
+ Insulation: 6820 mm²
+ Security (rim): 7000 mm²
~~✳ Safety factor: 14000 mm²~~

➔ Cut 2..12% into BW-EMC ‘active’ cross section

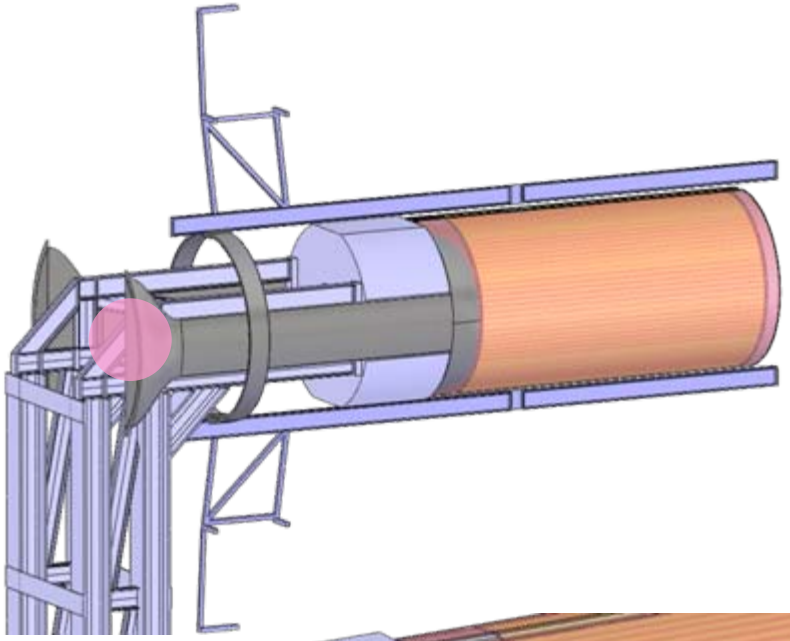
Implications on BW-EMC

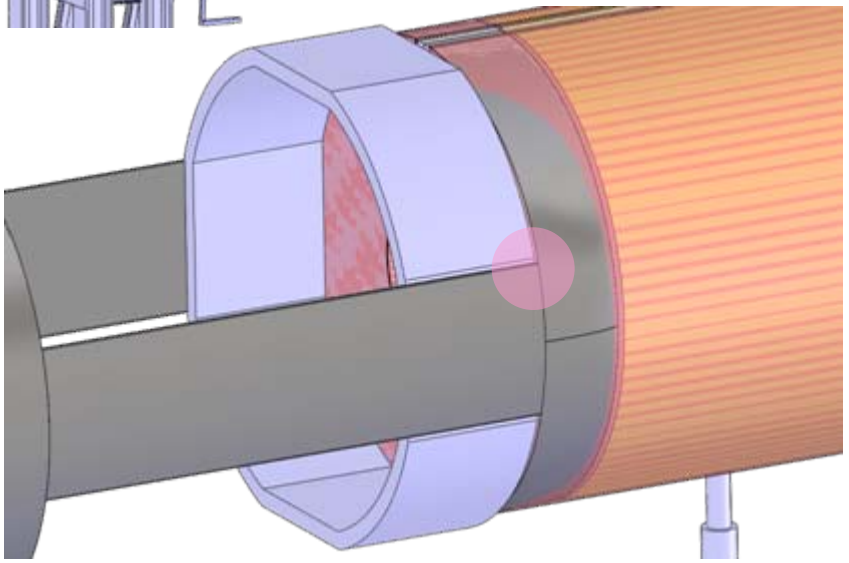




- ‘Power’ has the dominant requirement
- Assuming:
  - already ½ reduced power consumption requirements
  - New, space-optimization techniques in cabling
- there is NO WAY that the GEM-TPC supplies could fit into the volume offered
- at least a cut of min. 2%, max. 12% into the active BW-EMC area seems necessary
- Physical implications need to be checked

Open Questions and other issues, Work to do…





- Open Questions:
  - Non-magnetic components at the panels required?
  - Costs? (40..50k€ / paired interface, ½ detector)
  - Fixation of panels required? (@ BW EMC structure?)
  - Shape-conformation & Stress-free junction (abrupt change esp. nearby BW-EMC front)
- We NEED:
  - Design of the inner structure / compartments
  - FEM-Simulations for the structures
  - Design the patch panels & connectors
  - Detailed designs of nearby & interfacing structures SOON (BW-EMC, Rail system, TOF, Magnet)
  - Work on FEE power requirements

Discussion

- Should we go this way?
- Is there a chance to increase the space offered?
- What about the additional loads (100 kg) put to the guiding system?

GEM-TPC GSI crew members & tasks

Rahul Arora	Testing setup
Jörg Hehner	Aging tests
Markus Henske	Material tests, sensors, infrastructure, purchase
Volker Kleipa	Front-End Electronics (XYTER)
Jochen Kunkel	Mechanics, drawings, simulations, assembly, tooling
Christian Schmidt	Front-End Electronics (XYTER)
Sandra Schwab	Part production, tooling , FOPI environment
Daniel Soyk	Simulations & FOPI Integration
Ufuk Tuey	General mechanics, drawings
Bernd Voss	‚**All** & nothing', ideas & concepts, project & logistics
Jan Voss	General mechanics, material tests
Joachim Weinert	Part production, tooling

… other members of the GEM-TPC Collaboration

Backup slides