A possible Straw-Tube Detector Prototype for the Vacuum Vessel

SHiP Joint Physics and Detector Meeting – Vacuum Vessel Workshop

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DER FORSCHUNG | DER LEHRE | DER BILDUNG

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Objectives / Disclaimer

- Have not been following the vacuum vessel discussion very closely during the last months
- This talk will not cover the concept for a straw tracker inside the vacuum vessel
- However, we could very well test a planned 64-straw SST module prototype at an early stage in a possible vacuum vessel prototype

Main Goal of the Presentation

- Figure out what (if any) vacuum vessel prototypes are planned
- Make you aware of our interest to collaborate on any prototype vessels
- Briefly remind you what kind of straw tube modules we're working on
  - ▷ so they can be considered in the design

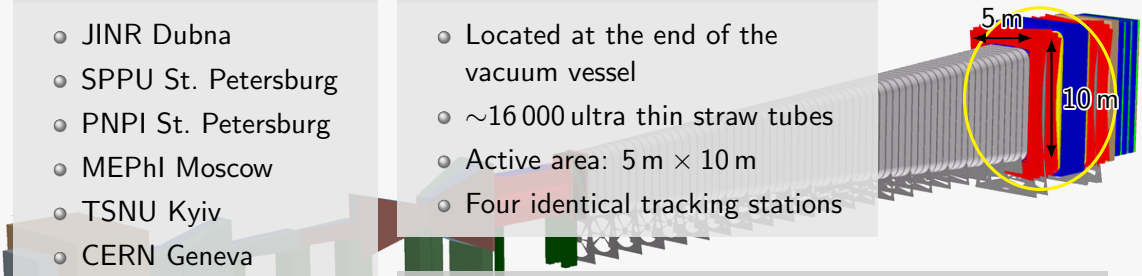
SST in a Nutshell

SST Institutes

- JINR Dubna
- SPPU St. Petersburg
- PNPI St. Petersburg
- MEPhI Moscow
- TSNU Kyiv
- CERN Geneva
- FZJ Jülich
- UHH Hamburg

SST Detector

- Located at the end of the vacuum vessel
- ∼16 000 ultra thin straw tubes
- Active area: 5 m × 10 m
- Four identical tracking stations

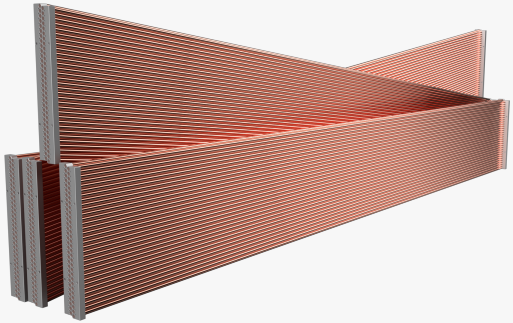


Three+ design options

- Expandable frame, cemented pack, carbon fiber suspension
- Modular setup for some designs

SST R&D activities for module prototypes

- Generic straw tube detector development driven by SHiP design
- 5 m long Mylar tubes, 36 µm thick foil, 2 cm tube diameter (made by JINR Dubna)
- Horizontal operation → 5 m aperture
- Novel readout (combined chip development for SBT and SST → see David's talk)



Modular Design

- 64 tubes per module (32×2)
- Module size: $5\,\text{m} \times 0.64\,\text{m} \times 0.1\,\text{m}$
- Plans for prototype, joint effort:
  - FZJ ZEA-1 (Engineering)
  - FZJ ZEA-2 (Electronics)
  - UHH

Connection of SST to Vacuum Vessel

This can mean two things:

1. How is SST R&D **connected** to the vacuum vessel R&D
   - Only detector inside the vessel
   - Need for interfaces (LV, HV, gas supply, data)
   - Common SBT and SST readout electronics development
2. How will the SST physically be **connected** to the vacuum vessel
   - Strategy so far: use a separate structure (frame) to hold the detector
   - ▷ Detector design itself more or less decoupled from vacuum vessel (so not many details here)
   - Rough concept: insert it through opening in the top and hang it on the flange

Impact of SST to vacuum vessel

- Allow access, hanging (weight) and interfaces → spectrometer section

Impact of vacuum vessel to SST

- Vacuum influences detector operation
  (pressure difference, resulting forces, leak tightness, electronics cooling)

Opportunities for the SST

Clearly, the vacuum vessel and the SST influence each other!
A prototype vacuum tank offers great opportunities for testing a SST module prototype

Obvious

- Test of performance and mechanical stability under real vacuum conditions
- Data taking with cosmics always possible. Test beam?
- Test of interfaces / Vac-Tank feed-throughs (LV, HV, gas, readout)
- Cooling of electronics

Might be possible

- Monitor movement/deformation of straws during evacuation
- Check gas emission (need of mass spectrometer)
  - Leak testing
  - Outgassing of glue and other materials
- Monitor module during evacuation, e.g. with laser scanner (need of a vieing window)

Conclusions – Outlook

- SST prototype should be tested under realistic vacuum conditions
- Any vacuum vessel prototyping would be interesting for this
  - adding a SST module should be considered
- If the full-size prototype would not fit, it is possible to build a shorter one.
  - Use same endplates, just with shorter tubes
  - Full size preferred
- Even a few short tubes would be interesting
  - probably not so much for mechanics but for operation and characterization