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Status of Finnish in-kind components for accelerators (Super-FRS)

Tuomas Grahn
Helsinki Institute of Physics &
University of Jyväskylä

Super-FRS Experiment Collaboration meeting
Walldorf, 27 April 2023

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Beam indentification at Super-FRS

Measurements in the *Bρ*-TOF-*ΔE* method:

A and *Z*

$\Delta E \Longrightarrow Z$

$\frac{A}{q} = \frac{B\rho}{\beta\gamma}$

$B\rho = B\rho_0 \left(1 - \frac{x_1 - M x_2}{D}\right)$

Measured quantities

D is despersion, *M* is magnification and $B\rho_0$ is reference magnetic rigidity

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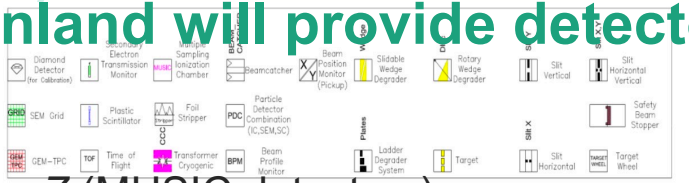
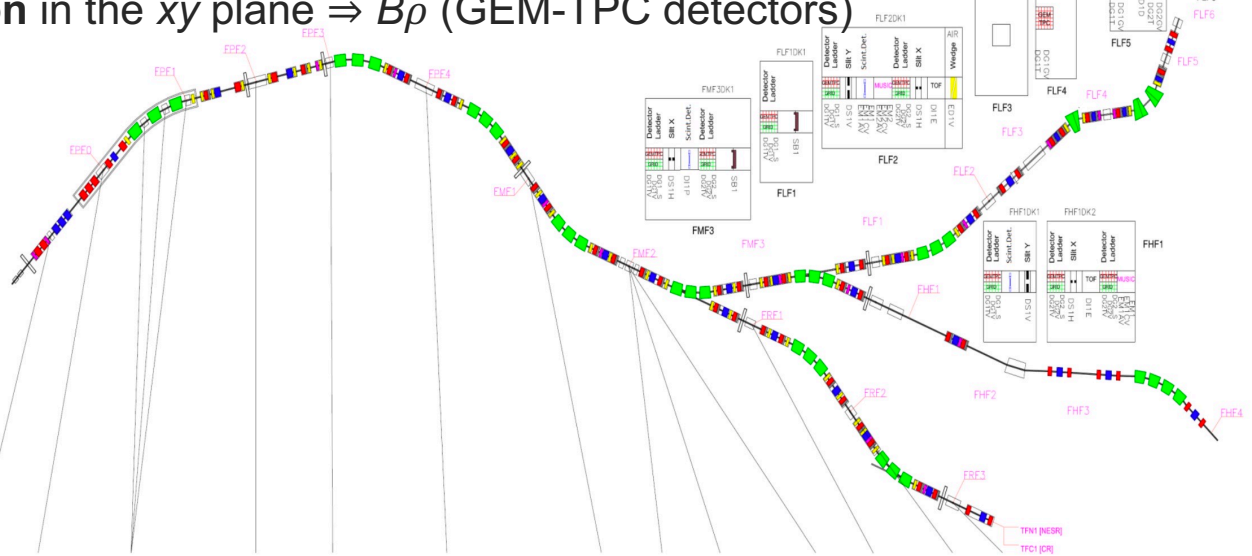
Finland will provide detectors…

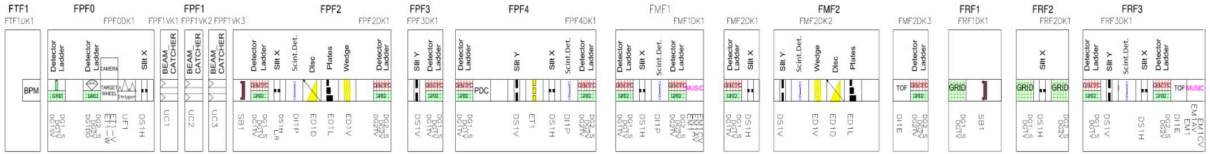
…that measure

- **Enegy loss** $\Delta E \Rightarrow Z$ (MUSIC detectors)
- **Particle position** in the xy plane $\Rightarrow B\rho$ (GEM-TPC detectors)

In addition, **beam profile** (SEM-grid) detectors are needed







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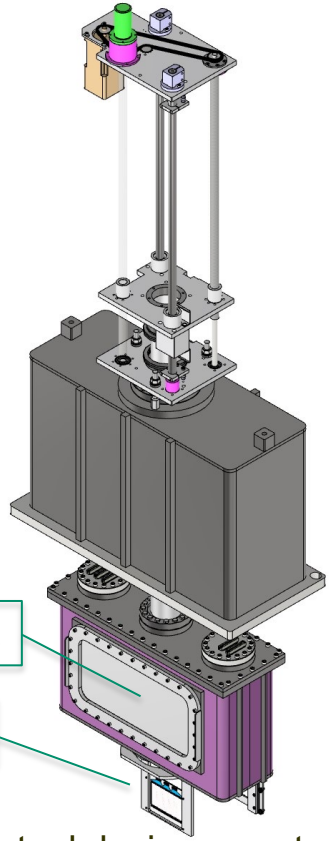
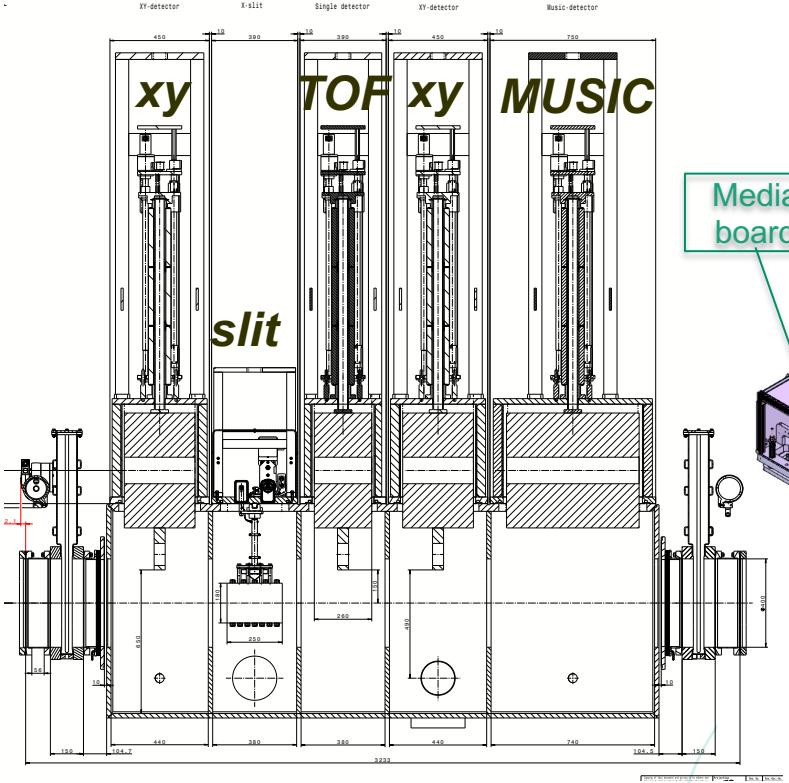
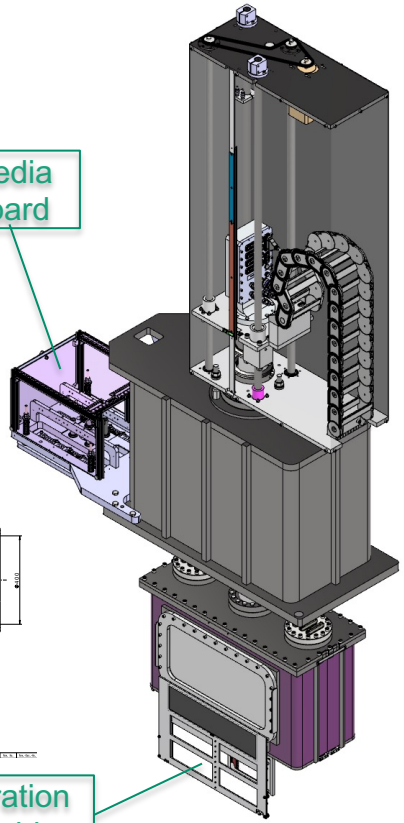
Beam insertion device

seven different variants







GEM-TPC

SEM-grid

Media board

Calibration tool holder

- Conceptual design report conditionally accepted.
- Mechanical design at University of Jyväskylä (J. Tuunanen)

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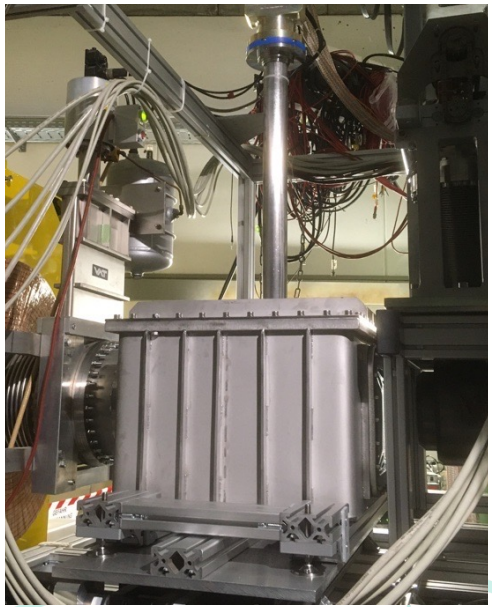
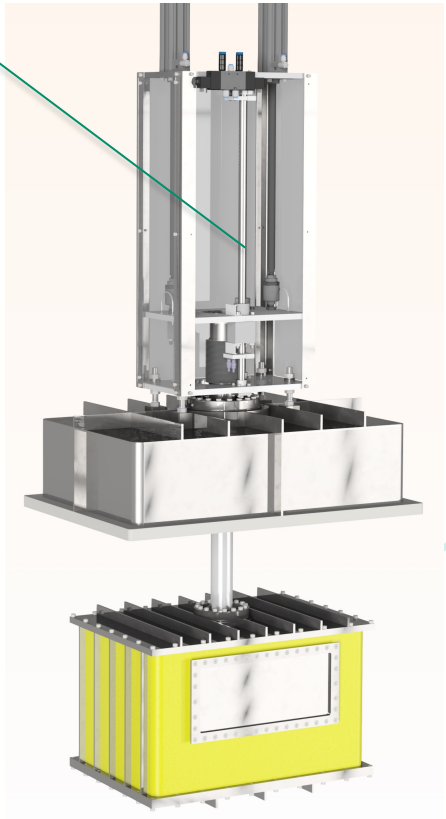
MUSIC ΔE detector

- The MUSIC detector is in final desing phase
- Mitigations to problems observed in summer 2022 beam time ongoing
- Design by GSI DL (B. Voss et al.)



Pneumatic drive



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GEM-TPC position detector

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Full Length Article

In-beam test results of the Super-FRS GEM-TPC detector prototype with relativistic uranium ion beam

M. Luoma [a,b,*], F. García [a], J. Äystö [a,b], T. Blatz [c], D. Chokheli [d], H. Flemming [c], K. Götzen [c], T. Grahn [a,b], A. Jokinen [a,b], C. Karagiannis [c], N. Kurz [c], S. Löchner [c], C. Nociforo [c], S. Rinta-Antila [a,b], C.J. Schmidt [c], H. Simon [c], R. Turpeinen [a], B. Voss [c], P. Wieczorek [c], M. Winkler [c]

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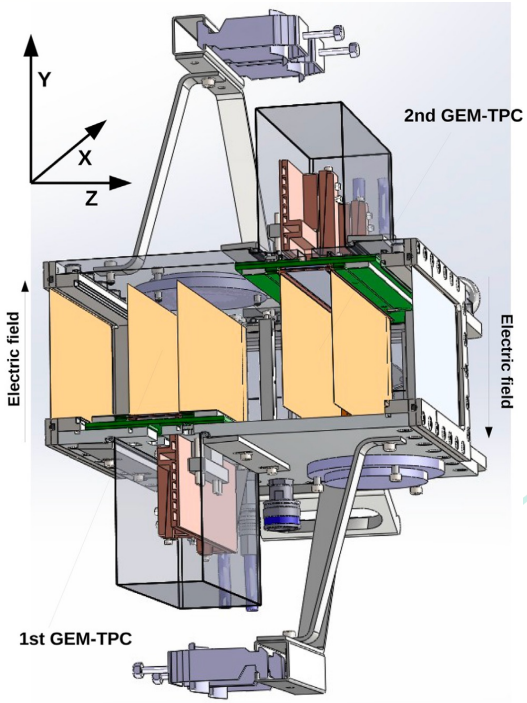
[b] University of Jyvaskyla, Department Of Physics, P.O Box 35, FI-40014, University of Jyvaskyla, Finland
[c] GSI Helmholzzentrum für Schwerionenforschung GmbH, Darmstadt 64291, Germany
[d] Georgian Technical University, Tbilisi, Georgia



- The project is in conceptual design phase
- In collaboration between HIP (F. Garcia) and GSI DL (B. Voss et al.)
- So far the readout electronics have been a problem, new test results just published (by M. Luoma et al.)

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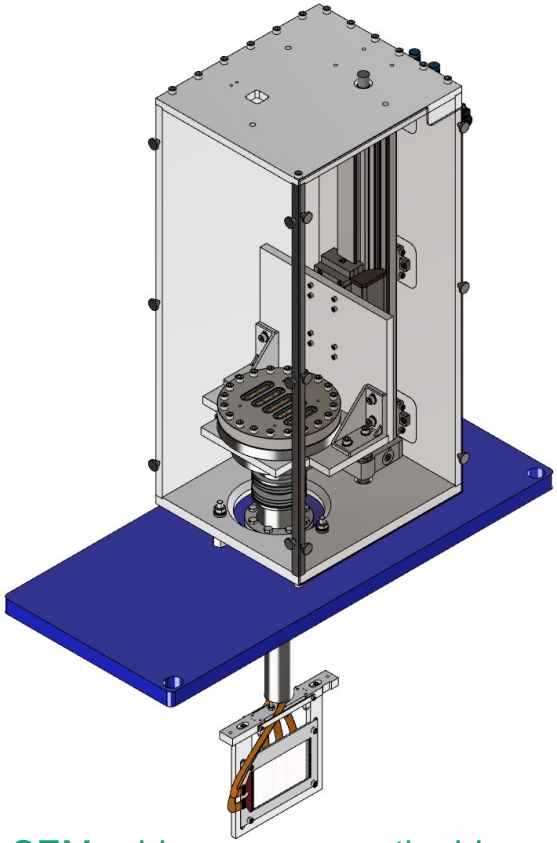
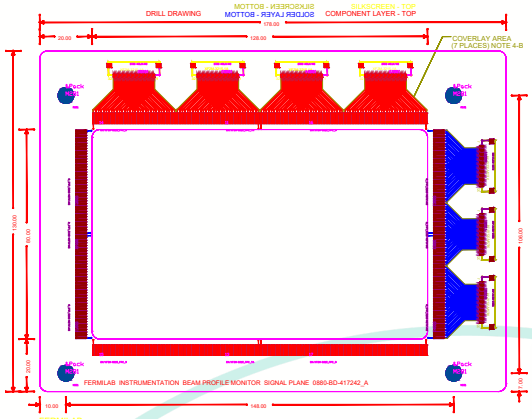
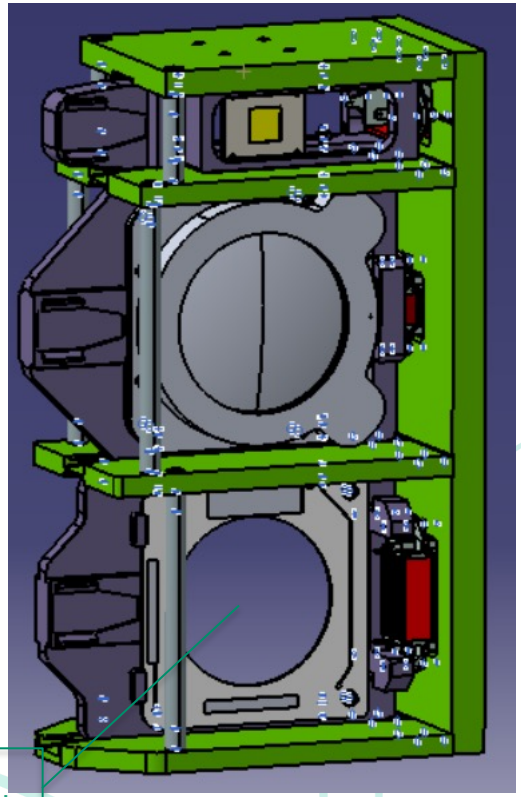
SEM-grid beam profile

- Based on the Fermilab design, produced by Hbar Technologies, LLC
- Holding structure designed by University of Jyväskylä (J. Tuunanen)
- 50-75 μm Au-plated W wires in *x* and *y*
- Signal readout through POLAND digitisers



SEM-grid on a pneumatic drive





Target SEM-grid

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Super-FRS flask

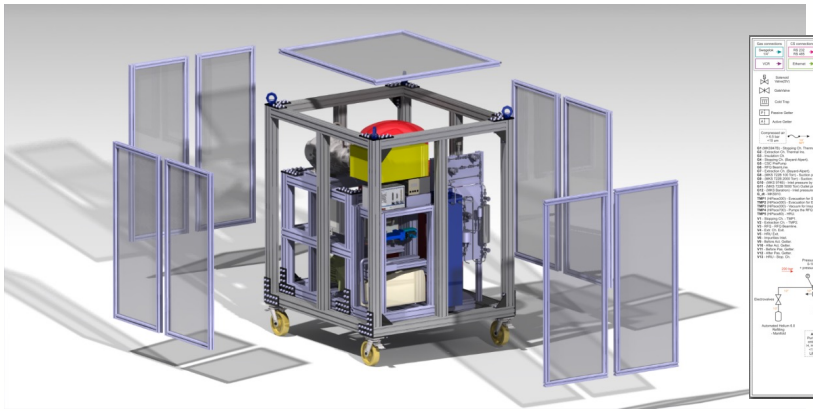
- The **Super-FRS flask** (Finland) and PANDA (Sweden) **pbar flask** were tendered together by FAIR. The contract was awarded to Billfinger Noell GmbH.
- We are now entering the production phase

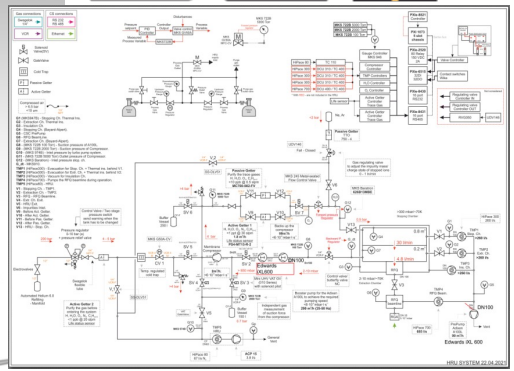
Status at the moment

PSI flask

Helium Recovery Unit

Developed in collaboration with GSI and ELI-NP





- Recovers >98% of (precious!) buffer gas He 6.0
- Purifies buffer gas at each cycle
- Final design report accepted
- Purchasing underway. Test and Assembly of first components starts in the coming weeks.
- Applied for beamtime in the GSI engineering run 2023