The Shielding Flask System at Super-FRS

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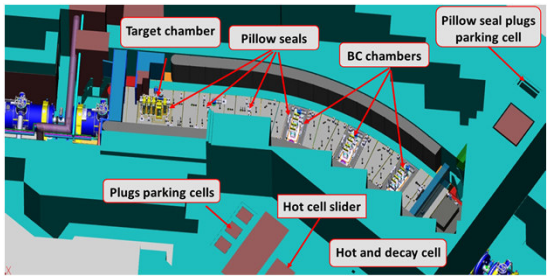
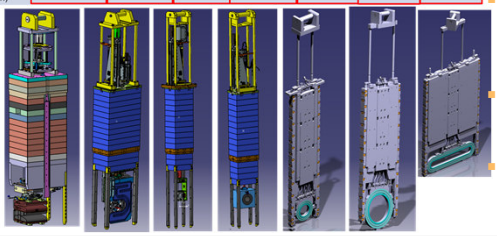
Introduction

- The Superconducting Fragment Separator (Super-FRS) [1] at the Facility for Antiproton and Ion Research (FAIR) at GSI Darmstadt is a large acceptance in-flight separator for exotic nuclei, with planned commissioning for early science in 2027.
- The Super-FRS target area beamline inserts (plugs) will be activated due to the production of rare isotopes of all elements up to uranium via fission or fragmentation in flight.
- The shielding flask enables the essential remote transfer of plugs between the beamline and hot cell, ensuring smooth facility operation and operator safety.
- The Super-FRS flask is designed and manufactured in cooperation with **Bilfinger Noell GmbH**.



	Beam Catcher	Target	Detector	Collimator	Pillow seal 200	Pillow seal 500	Pillow seal 1200
Mass (kg)	7234 - 7769	4300	1636-1700	1820	1022	1522	2930
Length (mm)	3649 - 3646	3995(4045*)	3955	3746	3818	3986	3822
Distance lower end to lift shaft center (mm)	3552(BC1-2) 3549 (BC3)	3895 3945	3895	3686	3758	3926	3762

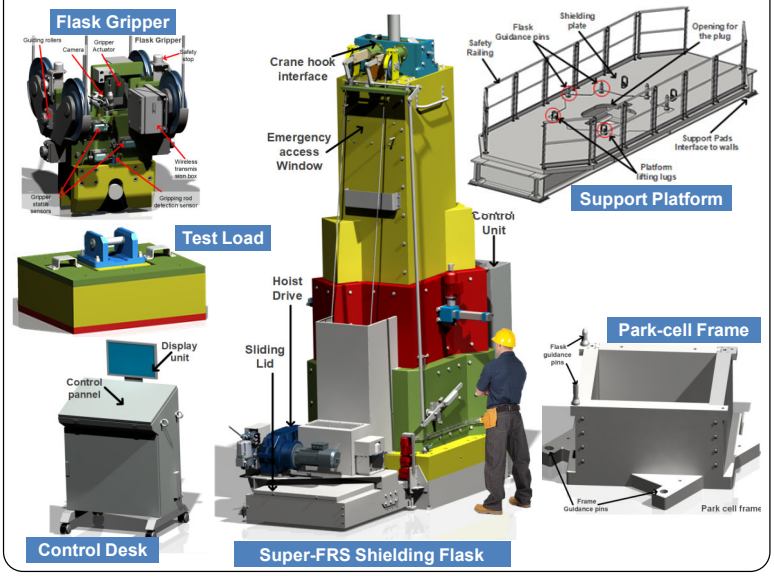


What Is Transported by the Shielding Flask and Where?

- The Super-FRS shielding flask system will remotely handle **21 plugs** in total, which can be categorized into **7 distinct types** based on their dimensions and weight.
- In the Super-FRS target hall, a total of **28 interface** locations are designated for accommodating the flask and facilitating remote handling.
- The remote handling operation includes positioning, lifting, securing, transportation, lowering and storage of the plugs.

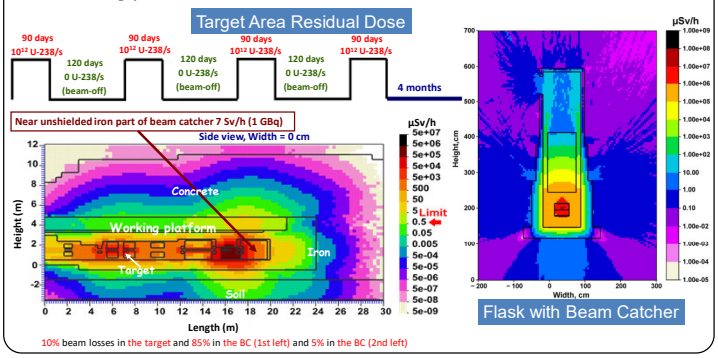
Shielding Flask System components

ITEM	Weight	H x L x W	Shielding Thickness
Shielding Flask	56 Tons	5.6m x 4.3m x 2.5m	upto 35 cm
Support Platform	22 Tons	2m x 8m x 3m	10 cm
Park Cell Frame	15 Tons	1.2m x 2.8m x 2.8m	20 cm
Test Load	8-10 Tons	0.8m x 1.5m x 1.3m	N-R



Radiation Environment

- The Super-FRS beam catcher plugs beam interacting parts will have residual dose rates up to **7 Sv/h** [2]. These can be safely transported using shielding flask with wall thickness up to **35 cm**.
- The tunnel's working platform region is a restricted area with a high prompt dose rate, exceeding **500 mSv/h**. Consequently, the target area is shielded with iron and concrete.
- After a four-month cooldown period, the work platform area measures **5-50 µSv/h.** To facilitate the positioning of the flask on top of the beamline, the support platform is equipped with a 10 cm thick shielding plate.



10% beam losses in the target and 85% in the BC (1st left) and 5% in the BC (2nd left)

Shielding Flask Design Attributes

- The Germany KTA standards are taken as guidelines for the shielding flask system design.
- The flask hoisting drive is equipped with redundancy features and has a lifting capacity of up to 10 tons.
- The gripper is equipped with an actuator, end switches, a wireless camera, optional lighting, and mechanical features to ensure precise positioning and guidance.
- The support platform is used to position the flask on beamline.
- The park cell frame is used to position the flask on top of the pillow seal park cell position and serves as a base for commissioning and testing the flask hoisting system every three years.
- **92** Remote hoisting sequences with variable speed, are programmed into flask control system to handle Super-FRS target area plugs.
- The control system offers both touchscreen, joy stick, and panel button operation.
- The control system has control and managerial interlocks ensure the shielding flask safe operation.
- The control system offers both "semi-automatic" and "manual" operation modes to accommodate regular and emergency situations. Additionally, it includes "configuration" and "testing" modes specifically designed for flask commissioning and Testing.

Project status and challenges

- Flask components are presently in production with delivery scheduled for Q4-2024.
- Extended FAT and SAT testing may be necessary due to the intricate interface positions and stringent positioning precision demands.
- Both FAT and SAT require complete assembly and disassembly of the flask.
- Flask SAT and commissioning is contingent on the availability of Super-FRS beamline components and scheduling.
- The supplier will develop a control system with customized software interface that will undergo rigorous testing, including adjustable hoisting sequences.

References

1. H. Geissel, H. Weick, M. Winkler, et al., The Super-FRS project at GSI, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, Volume 204, 2003, Pages 71-85s
2. Amjad F, Weick H, Mattila J, et al. Survey on Remote Handling Logistics for Super-FRS. International Journal of Advanced Robotic Systems. 2013;10(10). doi:10.5772/56848