A flexible search coil set-up for magnetic measurements of accelerator dipole magnets

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FAIR **GSI**

Search coils:

- Based on Faraday's law
- Measure flux change caused by either movement of coil or changing the magnetic field
- Dipole measurements with planar coils
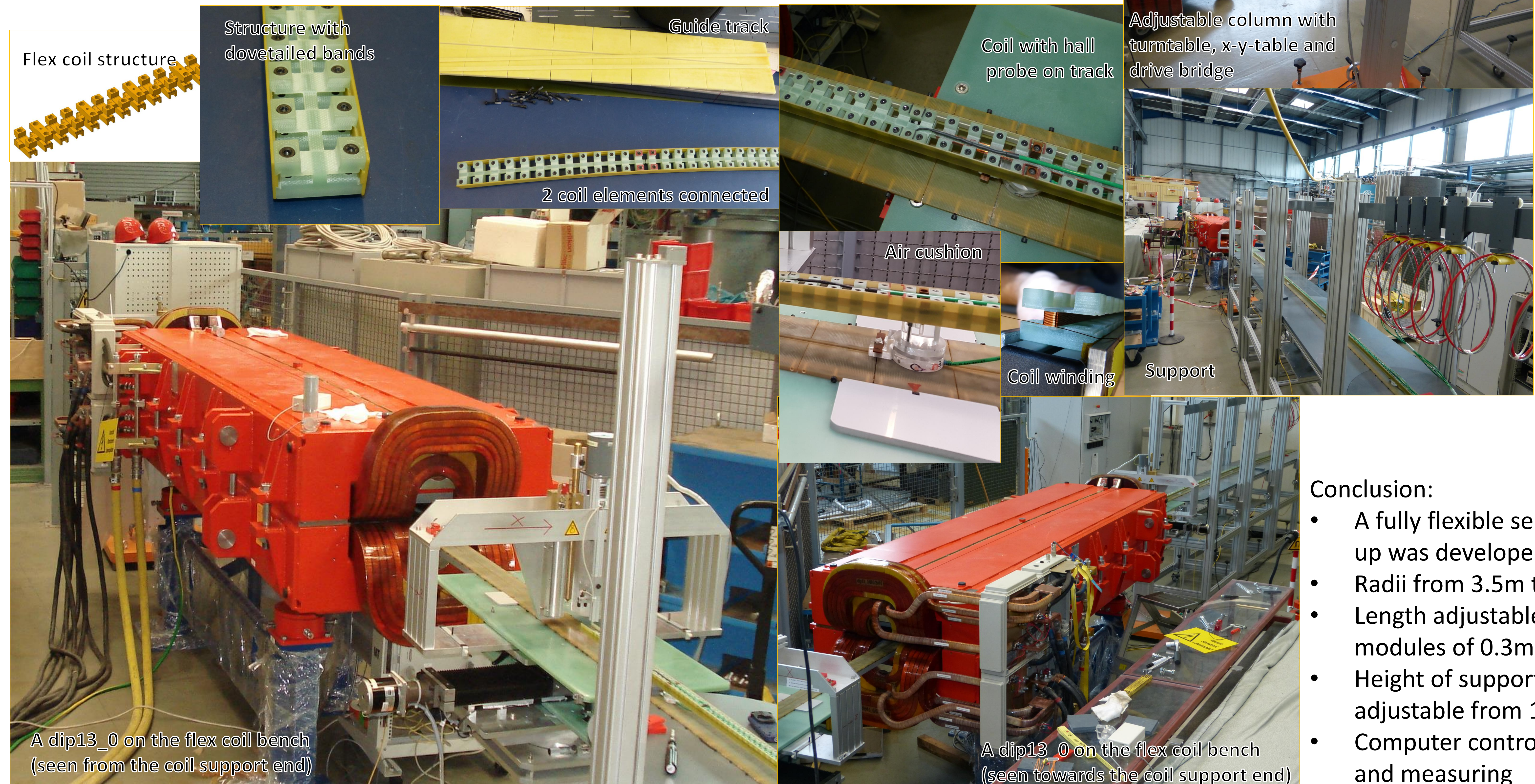- Curved according to bending radius of dipole

FAIR:

- Facility for Antiproton and Ion Research
- Currently being built at GSI
- One of largest research projects worldwide
- Consists of several synchrotrons and storage rings, production targets and separators
- Connection of all machines by High Energy Beam Transfer lines (HEBT)

Bending radii of dipole magnets in FAIR HEBT:

Beam rigidity / Tm	B / T	Bending radius / m
18	1.6	11.250
100	1.8	55.556
13	1.6	8.125
13	1.3	10.000
4.5	1.0	4.500
300	1.8	166.667

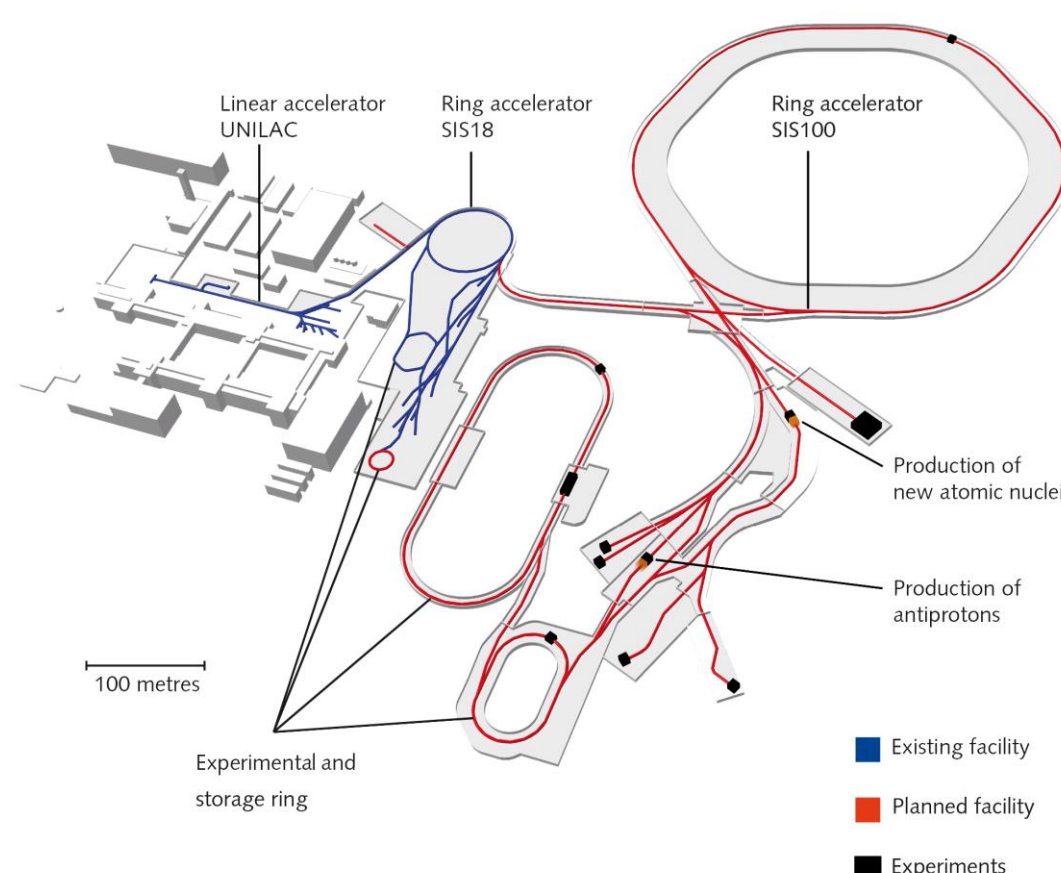Overview of the planned FAIR accelerator complex

Requirements on flex coil system :

- Continuous adjustment of the coil radius (within the requirements of the FAIR HEBT)
- Length adjustment of the coil in appropriate steps
- Adjustability of the height according to the different beam heights
- Computer controlled coil movement system for pulling the coil in and out as well as radial movement
- Adjustment for measurements at different vertical positions inside the magnet gap
- Easy calibration of the complete system

Flex coil structure

Structure with dovetailed bands

Guide track

2 coil elements connected

Coil with hall probe on track

Air cushion

Coil winding

Support

Adjustable column with turntable, x-y-table and drive bridge

A dip13_0 on the flex coil bench (seen from the coil support end)

A dip13_0 on the flex coil bench (seen towards the coil support end)

Measurements:

- FAIR HEBT dip13_0
- 100Tm, 1.8T, 55.556m
- Manufactured at NIIEFA
- Comparison with result of hall probe with x-y-z-mapper and with integrated hall probe on flex coil

Transfer function

Transfer function scaled with current

Integral homogeneity at full current
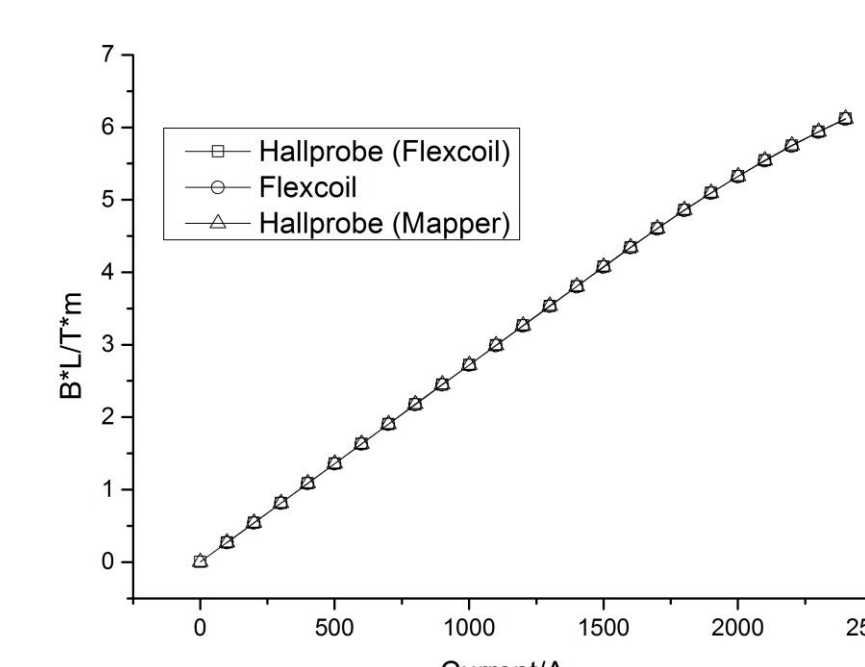
Conclusion:

- A fully flexible search coil set-up was developed.
- Radii from 3.5m to ∞ possible
- Length adjustable with modules of 0.3m and 1.0m
- Height of support structure adjustable from 1.2 m to 2.0m
- Computer controlled moving and measuring
- Spacers allow for different heights inside the gap
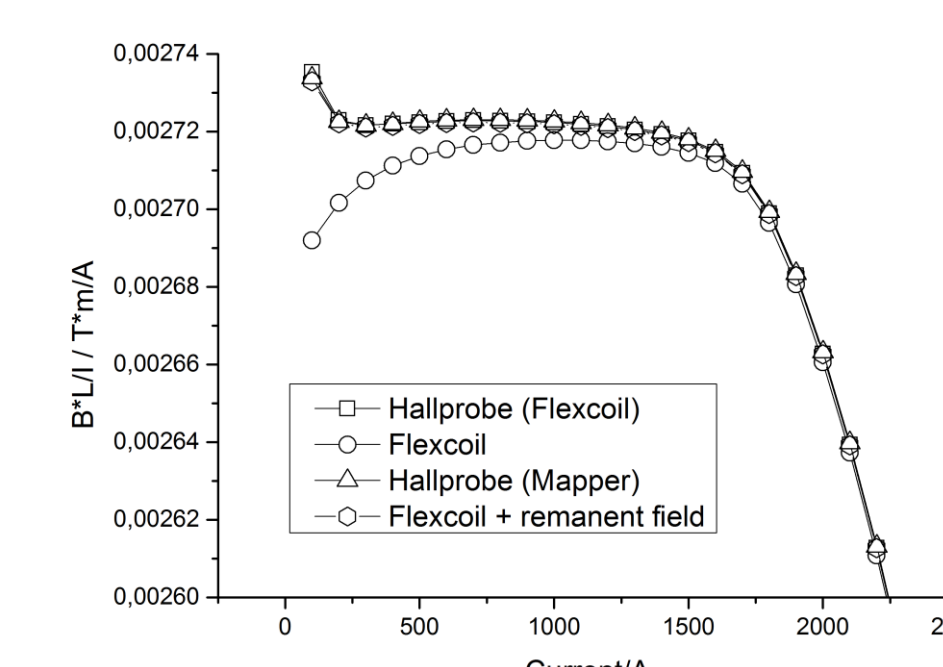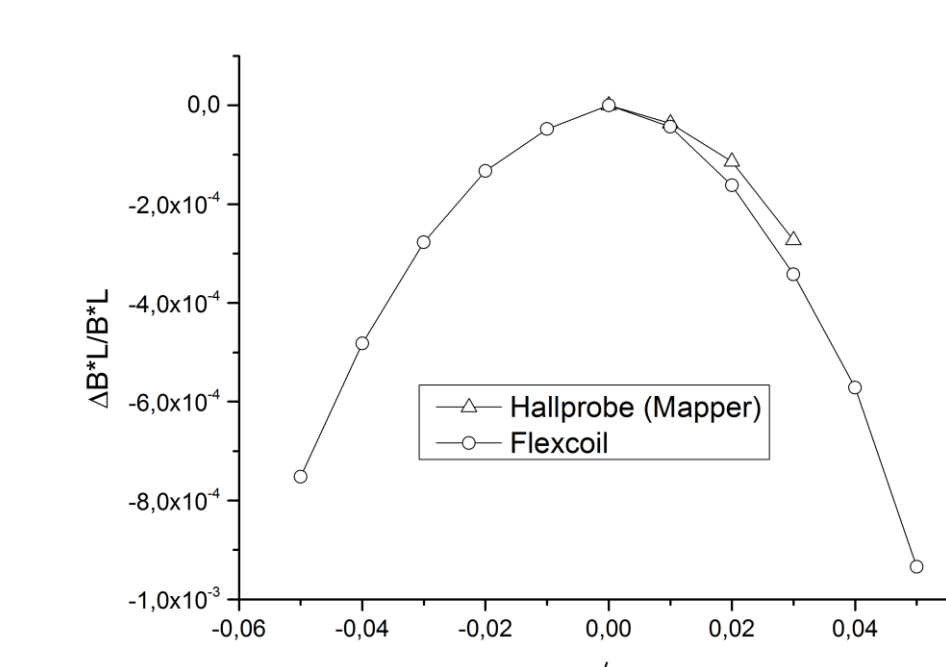- Built-in hall probe enables in situ calibration

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