INTRODUCTION

The new IBA Proteus One will be equipped with the newly developed Super Conducting Synchro-Cyclotron. Contrary to other IBA accelerators, this accelerator utilizes a superconducting coil and is the first non-isochronous cyclotron. The much higher magnetic field (5.8 T) in the S2C2 should be measured at a relative precision of $10^{-3}$-$10^{-4}$. A search coil has been foreseen as magnetic probe. Preliminary tests with this search coil have been performed both in a calibration magnet and in the S2C2, equipped with resistive coils.

MAPPING WHEEL

- **Mechanics**
  
  In Figure 1, the mechanical layout of the S2C2 mapping wheel is shown. The three magnetic probes are indicated in the picture.

- **Magnetic probes**
  
  In the center of the S2C2, the homogeneity of the field is suitable to use a NMR probe. The accurate field value in the center will be used as reference for the integrated voltage from the search coil.

- **Integrator**
  
  The search coil is connected to an integrator (PDI5025, Metrolab) which integrates the induced voltage in the moving search coil between two positions, determined by a linear optical encoder. The integration points are 0.05 mm apart. The magnetic field is obtained from

\[
\Delta B_{\text{eff}} = B_{i} - B_{f} = \int_{t_{f}}^{t_{i}} V_{d} \, dt
\]

where $t_{i}$ and $t_{f}$ are determined by the optical encoder.

SEARCH COIL CALIBRATION

The effective surface of the search coil was calibrated by rotating the search coil in static homogeneous magnetic fields in the range 1 to 2 T. The effective surface was determined at several temperatures (also taking into account the changing coil resistance). The temperature coefficient is 13 ppm/°C. The effective surface at 20°C was determined to be $0.30433(3) \text{ m}^2$ (error = 94 ppm).

MEASUREMENT SEQUENCE

- **NMR measurement in the center of the S2C2 (10°)**
- **Offset measurement (10°) - stationary coil**
- **Data transfer (25°)**
- **Radial track (trigger interval = 500 µm - max. 50 cm/s) from the center to the outer radius (5°)**
- **Data transfer (25°)**
- **Radial track from the outer radius to the center (5°)**
- **Data transfer (25°)**
- **Azimuthal rotation**

Mapping time (360 degrees) = 11 hours

MEASUREMENTS IN THE S2C2

A first measurement was made in the S2C2 which was equipped with resistive coils, yielding a central field of 0.82 T and a maximum field of 1.12 T. Radial tracks were measured with a Hall probe and the search coil. The measured profiles and their difference is shown in Figure 3 and 4 below. In Figure 3 also the calculated field profile, obtained with OPERA2D is shown.

CONCLUSION

Theoretical and experimental investigations have been performed at IBA to allow a reliable and accurate usage of a search coil during the magnetic mapping of the S2C2 in the course of 2012.