4.11 The Open Axial Field Magnet: Barrier-Free Access

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During the discussions in 1976 on a new facility for the ISR much emphasis was put on the importance of “openness” — both for minimising material in the path of particles produced by the collisions, and to allow good access for installation and maintenance of detectors during the short time allocated between runs. This led to the novel proposal of a normal conducting magnet, providing better access than either the superconducting solenoid or the toroid that were being discussed.

The concept was seized upon to figure in the proposal for an experiment presented in January 1977. By then basic field calculations and cost estimates for the Open Axial Field Magnet (OAFM) had been prepared, and it was confirmed to be an interesting alternative to the superconducting option. The field was lower, but it was shaped to be more efficient for momentum measurements than in a regular solenoid, the access was far better, and the cost would be less by a factor of 5. The design was optimised and the experiment was approved in March 1977. The magnet with its dimensions and field shape is shown in Fig. 4.23. The field is cylindrically symmetric out to a radius of 1.5 m, simplifying analysis of particle tracks. Small dipole and skew quadrupole correction magnets were installed close by to render the OAFM transparent for the circulating beams.

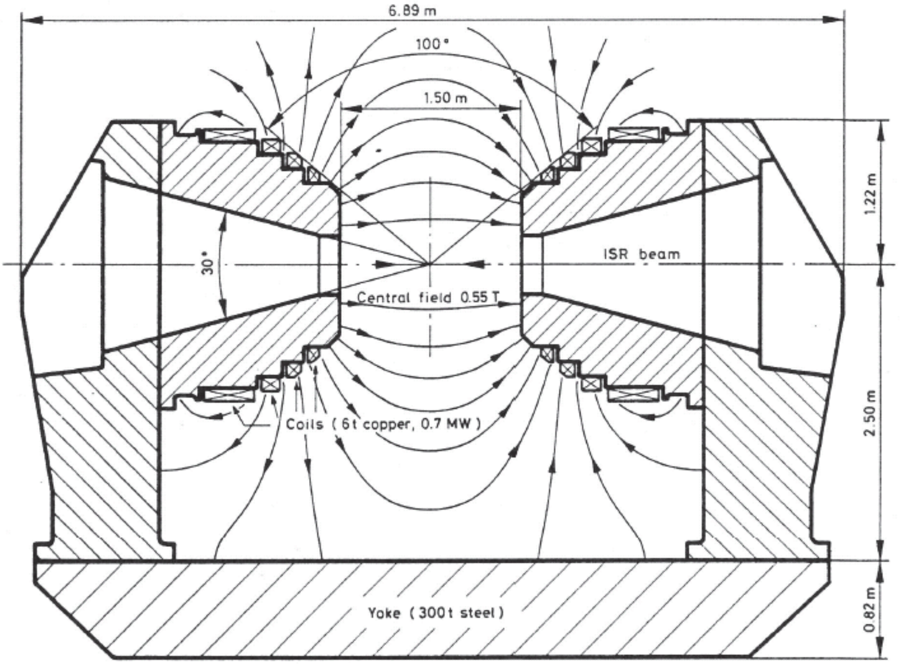

Fig. 4.23. Longitudinal cross-section of the OAFM, showing dimensions and field lines.

The field, 0.55 T at the centre, is produced by circular water-cooled copper coils clamped to hollow conical steel poles; it provides free access through azimuthal angles 0° to 15°, 40° to 140°, and 165° to 180°. The pole separation is 1.5 m. The magnetic flux is returned from the poles via cast low-carbon steel upright pieces, shaped to optimise the distribution of magnetic flux and bolted to a rectangular steel base. The base consists of two 60 ton castings, the uprights are also 60 tons each, and the total mass of the magnet is about 300 tons. The yoke and coils were bought from industry to CERN specifications. Power consumption was 700 kW.

The magnet was assembled and tested, and the field mapped at ISR point 8 during the 1978–9 winter shutdown (Fig. 4.24), to be used by The Axial Field Spectrometer Collaboration (R807) [26], in conjunction with the superconducting high luminosity insertion [Highlight 4.4] until the ISR was closed in 1983. It was later installed at LEAR as the magnetic spectrometer for the OBELIX experiment. The field-shaping concept was further developed [63], was adopted by the PHENIX collaboration for the "Relativistic Heavy Ion Collider" RHIC at Brookhaven [64], and featured in proposals for experiments at high energy hadron colliders (SSC and LHC) [63, 65].

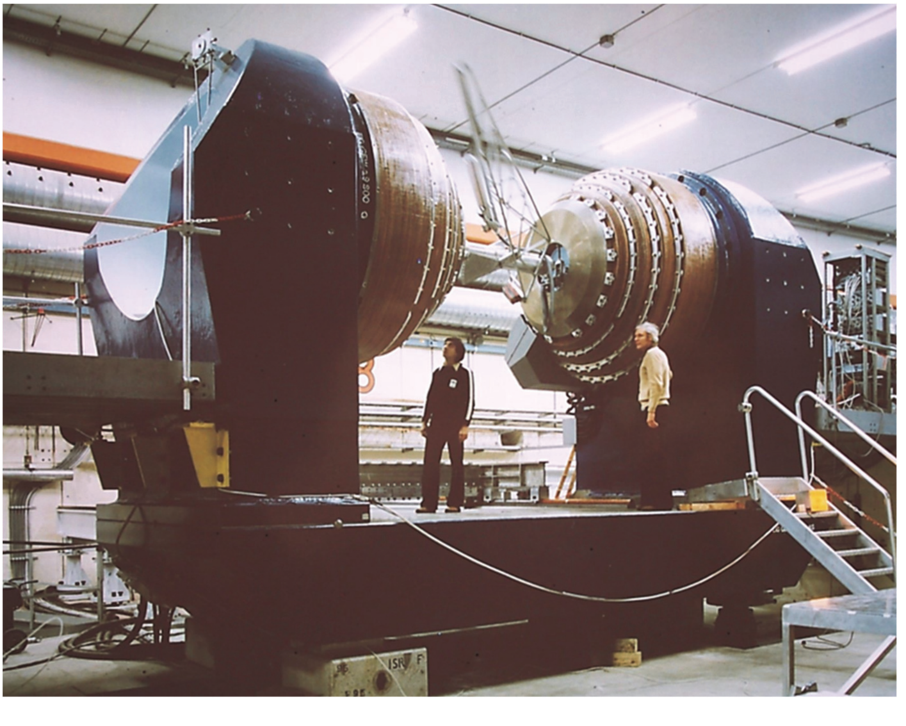

Fig. 4.24. OAFM during the field mapping campaign.

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