A.3: Design, development and installation of vertical pinger magnet in Indus-2

Pinger magnet is a beam diagnostic tool for probing the linear and nonlinear dynamics of the beam by the way of generating betatron oscillations. The vertical pinger magnet installed in Indus-2 is a pulsed dipole magnet with ferrite core, which produces half-sinusoidal magnetic field pulse of nearly one microsecond duration.

The major parameters of the pinger magnet are given in Table A.3.1. The magnet has been designed, developed, characterized and installed in SS-7 of Indus-2. The window type geometry has been chosen to achieve better field uniformity in pole aperture, low leakage flux and to minimize the overall size of magnet, as the space is a prime constraint in the Indus-2 ring. The magnet consists of a single turn copper coil and high frequency Ni-Zn ferrite as the magnet core material. The magnet produces 958 ns wide half-sinusoidal magnetic field having a peak value of 650 gauss at 5.5 kA peak current, which is able to deflect the electron beam by 2 mrad in vertical direction.

Table A.3.1: Vertical pinger magnet parameters.

Beam energy	2.5 GeV
Peak magnetic field	650 G
Deflection angle (θ)	2.0 mrad
Pole aperture (H × V)	106 mm (pole gap) × 56 mm (pole width)
Effective magnetic length	250 mm
Inductance (L)	250 nH
Field uniformity ($\Delta B/B_0$)	$\pm 2 \times 10^{-3}$ (within ± 7 mm in mid plane)
Peak current	5.5 kA
Current pulse width	946 ns
Field pulse width	958 ns
Delay in peak magnetic field	20 ns (w.r.t. current peak)
Pulse shape	Half-sinusoidal
Average thickness of Ti coating	690 nm

Inner surface of the ceramic vacuum chamber has been coated with Ti to provide the path to image current. Thickness of this coating has been characterized using in-house developed co-centric circular probe. Ti coating thickness of 690 nm was found to be sufficient to pass the image current without producing significant distortion in the magnetic field.

The magnet was characterized with an alumina vacuum chamber coated with Ti on the inner surface. The magnetic field data from the search coil was acquired using PC based 14-bit digitizer. The pulse magnetic field uniformity achieved along pole width and pole gap is better than $\pm 2\times10^{-3}$. The magnetic field uniformity along pole width and pole gap are shown in Figure A.3.1 and Figure A.3.2, respectively. A photograph of characterization setup is shown in Figure A.3.3.

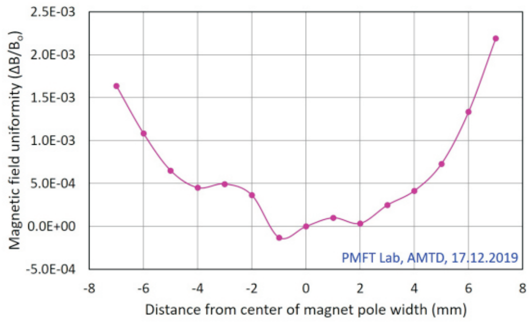

Fig. A.3.1: Magnetic field uniformity along pole width.

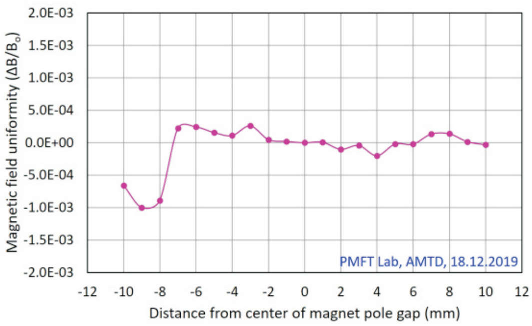

Fig. A.3.2: Magnetic field uniformity along pole gap.

Minimization of leakage inductance, optimization of Ti coating thickness inside the ceramic chamber, and handling the high voltages between various components of the magnet were some of the main challanges involved with this development. The magnet has been installed in the Indus-2 ring successfully.

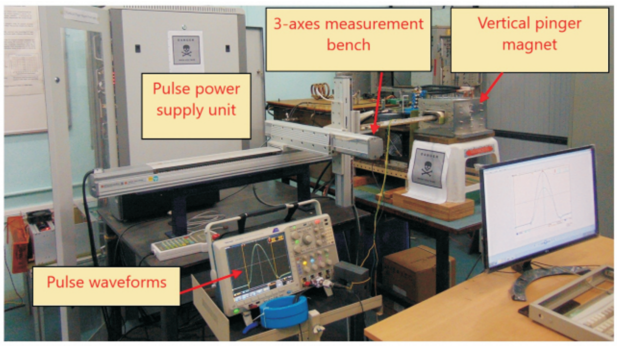

Fig. A.3.3: Photograph of vertical pinger magnet characterization setup.

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