A.2: Design, development and installation of beam position indicator for insertion devices in Indus-2

Recently, two insertion devices (undulators) have been installed in long straight sections LS-2 and LS-3 of Indus-2. For precise monitoring of electron beam position at the entry and exit of these insertion devices, 17 mm vertical low gap type insertion device beam position indicators (IDBPIs) have been designed, developed and installed by Beam Diagnostics Section of Accelerator Control & Beam Diagnostics Division. The water cooled RF shielded bellows have been designed, developed and integrated in IDBPI assembly by Ultra High Vacuum Technology Section.

The physics design of IDBPI was carried out by CST STUDIO SUIT simulation tool. The characteristic parameters like output signal, transfer impedance ~0.7 Ω at 505.8 MHz, normalized coupling impedance ~1e-3 Ω, fast decaying wakefield, resonance free structure up to 10 GHz and sensitivity ~0.125 mm^{-1} were obtained. The sensitivity graphs are shown in Fig.A.2.1.

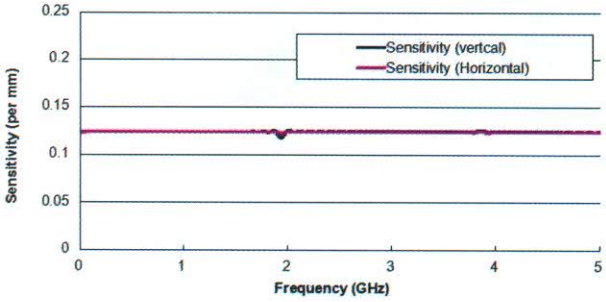

Fig. A.2.1: Positional sensitivity

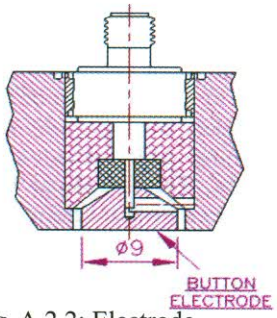

Fig. A.2.2: Electrode sub-assembly details

Fig.A.2.3: Laser welded electrode sub-assemblies

The IDBPI has 17 mm (V) x 81 mm (H) internal race track profile aperture same as of vacuum chamber of insertion device. It incorporates four numbers of electrode sub-assemblies directly welded (by TIG) to its vacuum chamber. The button diameter is 9 mm to reduce wakefield. The details of electrode sub-assembly are shown in Fig.A.2.2. For equal horizontal and vertical sensitivities, the horizontal separation between buttons has been optimized to be 12 mm. The longitudinal separation between buttons is 16 mm for welding feasibility. A machinable dielectric (Macor®) spacer is used to insulate button electrode from ground IDBPI body. Nd:YAG laser welding is used to integrate button electrode at the central conductor of SMA feedthrough due to the inaccessibility by TIG welding. Laser welded electrode sub-assemblies are shown in Fig.A.2.3. RF-shielded hydroformed bellow sub-assemblies were integrated at the both ends of vacuum chamber, which reduce mechanical coupling and ensure the electrical continuity at high frequencies. The complete assembly of IDBPI has been developed in the restricted space of 200 mm. A sectional 3D view of IDBPI with RF-shielded bellows is shown in Fig.A.2.4.

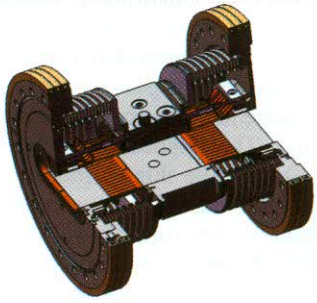

Fig. A.2.4: Sectional 3D view of IDBPI with RF-shielded bellows

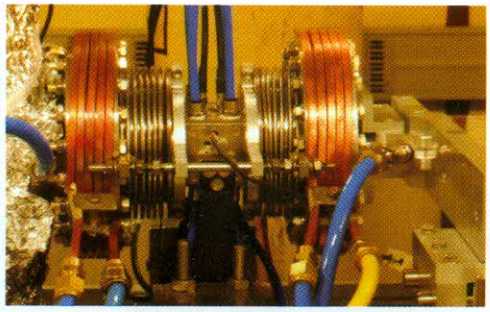

Fig. A.2.5: IDBPI installed with undulator in Indus-2

The flushing accuracy of button electrode, with respect to inner wall, is better than 50 µm. The vacuum chamber has both sides 1.5 mm thick of obround shaped weldable lip designed for full penetration TIG welding of bellow end plate. It has 0.6 mm thick circular lip for edge joint welding with 0.4 mm thick lip of SMA by TIG. IDBPI assembly has been vacuum characterized up to the ultimate vacuum ~$3x10^{-10}$ mbar. The installed IDBPI assembly is shown in Fig.A.2.5.

In the development of IDBPI, Solid State Laser Division, Accelerator Components Design & Fabrication Section and Chemical Treatment Facility have also contributed.

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