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MECHANICAL DESIGN OF THE NSTX HIGH-k SCATTERING DIAGNOSTIC*

R. Feder, E. Mazzucato, H. Park, D.R. Smith, T. Munsat, G. Labik, R. Ellis,
and C. Priniski
Princeton Plasma Physics Laboratory, PO Box 451 Princeton, NJ 08543-0451
rfeder@pppl.gov

The National Spherical Torus Experiment (NSTX) High-k Scattering Diagnostic measures small-scale density fluctuations by the heterodyne detection of waves scattered from a millimeter wave probe. Large scattering angles up to 20 deg are achieved with a millimeter wave source. The measured density fluctuations may be responsible for anomalous electron thermal transport. A major construction effort was undertaken on NSTX to provide a wide angle scan and multiple channels of detection. New port covers at Bay-H and Bay-K were constructed to house large metal steering mirrors. A large mid-plane gap in the Neutral Beam Armor was required to allow the diagnostic beam to pass from the Bay-H mirror into the plasma. This gap required the installation of 4 new graphite baffle tiles into the new Bay-H port cover. The baffle tiles were arranged to block the neutral beam while allowing adequate diagnostic aperture. The tiles were also designed to withstand the NSTX hot helium bake and meet the neutral beam duty cycle requirements. The flat mirror inside Bay-H has 2 degrees of freedom in-vacuum motion. The nearly 3 foot long spherical collection mirror inside Bay-K also has 2 degrees of freedom and can be moved between plasma shots. A 6 inch water free quartz CF window provides the vacuum interface at Bay-H and 5 water free quartz windows mounted on o-rings comprise the vacuum interface at Bay-K. Corrugated waveguide carries the signal into the NSTX test cell to a set of launching mirrors mounted on Bay-H. A beam splitter extracts a reference signal that is sent through additional waveguide to detection equipment underneath Bay-K. There are 6 input channels to the detection equipment; the one reference channel and 5 output channels of waveguide from Bay-K. The detection system, which was designed and built at UC Davis, is comprised of carefully arranged diplexers and beam splitters that facilitate the heterodyne mixing. Ten steering mirrors mounted outside of Bay-K redirect the scattered signal from the quartz windows into the waveguide.

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