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2.35 Initial Beam Emission Spectroscopy diagnostic system on the HL-2A tokamak

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A Beam Emission Spectroscopy system is being developed and deployed at the HL-2A tokamak to measure local low wavenumber ($k_{\perp} \rho_{I<1}$) density fluctuations by observing Doppler-shifted emission from a 50 kV deuterium heating neutral beam. High spatial resolution ($\Delta r \leq 1 \text{ cm}$, $\Delta z \leq 1.5 \text{ cm}$) measurements are obtained with a 2 MHz sampling rate. An $f/1.6$, $f=280 \text{ mm}$ radiation-resistant in-vacuum objective lens couples with an off-axis field lens to image the beam to a curved surface with an appropriate angle for coupling to optical fibers. A 2x3 bundle of 1-mm diameter, 10-meter fibers conveys light for each spatial channel to detector arrays. A collimating lens passes light to a 1-nm bandwidth (659.2-660.2 nm, Doppler-shifted D-alpha emission) interference filter. An aspheric lens focuses light to a 2.65 mm square photodiode. High frequency, high-gain, low-noise preamplifiers sample the light intensity at a Nyquist frequency of 1 MHz with a high S/N ratio. A first set of 16 detector channels (12 plasma observing channels, configured in a 6(radial) x 2(poloidal) array) were installed and tested at HL-2A, covering the radial zone $r/a=0.7-1.05$. The frequency and wavenumber spectra have been measured during various plasma conditions, and primary measurements will be presented.

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