Upgrade of the gas puff imaging system by developing a relay optical system and its application in EAST

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Abstract

The gas puff imaging (GPI) system on EAST was developed in 2012 and upgraded in 2021. A new relay optical system, consisting of a front reflecting prism, a series of lenses and a filter, is developed for the GPI diagnostic. At the end of the relay optical system, the rays are focused on a thin image surface, which is captured by the sensor of a high-speed camera. In contrast with the previous optical system of GPI in which a coherent glass fiber bundle is used to transmit the image from the end of a telescope inside the vacuum vessel to the outside, the new relay optical system has much lower light loss, i.e., the emission intensity on the image plane is much higher in the new optical system. In consequence, the temporal resolution of GPI diagnostic on EAST can be raised significantly. The analysis of the optical design denotes that the imaging quality is high enough to ensure a spatial resolution of 2 mm on the objective plane. In the spring experimental campaign of 2021, the upgraded GPI system was commissioned in EAST. Clear poloidal and radial propagations of the edge fluctuations are measured directly by GPI with a high sampling rate of 530 kHz. The poloidal and radial velocities of the edge fluctuations are derived by the time-delay cross-correlation method, with the radial velocity propagating outward, and the poloidal velocity propagating in the ion-diamagnetic drift direction in the SOL and in the electron-diamagnetic drift direction inside the LCFS.

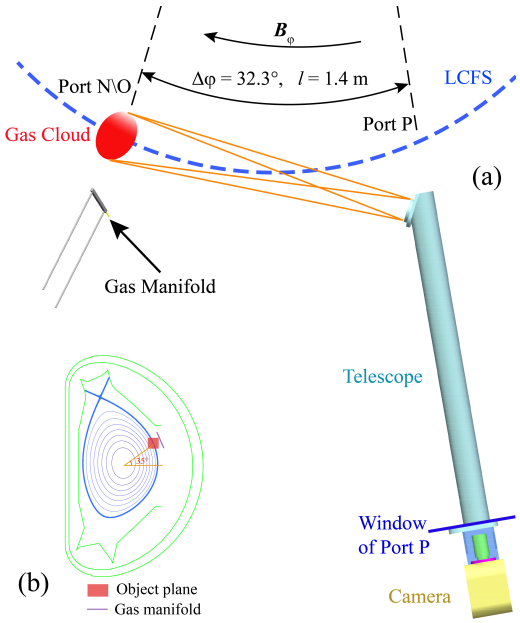

Figure 1 (a) The toroidal layout of the GPI on EAST viewed from the top; (b) poloidal layout.