Measurement of ion temperature profile

based on CXRS in HL-2A tokamak

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1. Abstract

Spatially resolved measurements of ion temperature are critical for understanding plasma dynamics, and in most present-day magnetic fusion devices, charge exchange recombination spectroscopy (CXRS) has become the basis for one of the standard diagnostic equipped with neutral beam injection (NBI)[1, 2]. A heating NBI (50kV extraction voltage, 24A beam current) has been installed on the HL-2A Tokamak. In accordance with the actual geometry of HL-2A, a CXRS diagnostic system, in particular the optical collection system, is designed. In the 2008 experimental campaign, the CVI 5292-Å \( (n=8–7) \) charge-exchange recombination (CXR) line is chosen for ion temperature and profile measurements during NBI. Initial measurements show that the CX signals have enough SNR to obtain ion temperature and it’s profiles. A code that intends to be fast and reasonably accurate have been developed to perform a fitting analysis of the measured spectrum.

2. Set-up of CXRS and it’s optical system in HL-2A

As shown in Fig.1, a wide-view CXRS diagnostic which will span \( 0 \leq \rho \leq 1 \) is needed in HL-2A to measure the ion temperature and profile in the equatorial mid-plane. Direct detection of the NBI-plasma interaction is not possible with the port geometry, so a specially designed collective optical system is needed. Fig.2 is the schematic diagram of the collective optical system. A part of collective system was installed inside the vacuum chamber, which can effectively converge light flux and change the light direction for measurement, composed of a metal mirror and a lens. All lenses out of vacuum are coated to