CXRS measurements of energetic helium ions in ASDEX Upgrade plasmas heated with a three-ion species ICRH scheme

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Fast ion physics is an active field of research in the fusion community, but the studies mostly focus on deuterium fast ions. The generation and investigation of energetic helium in present devices, however, provide significantly more insight on how fast alpha particles, produced from fusion reactions, will behave in future reactor plasmas. Apart from the fusion-produced helium studies carried out at TFTR [1], such investigations have been conducted in non-nuclear devices simulating the fast helium ion population either by helium neutral beam injection [2], or by accelerating either ^{4}He-beam ions [3] or ^{3}He ions [4] with ion cyclotron resonance heating (ICRH). Fast helium ion populations can be measured with charge exchange recombination spectroscopy (CXRS) in the wings of the helium spectral line (HeII n=4-3, 468.6nm), as was done in [1, 2, 4], providing information on their distribution function.

In the present work, we present CXRS measurements of energetic ^{3}He ions, obtained for the first time at ASDEX Upgrade. These measurements were part of experiments investigating the feasibility of a novel 'three-ion' ICRH scheme at ASDEX Upgrade [5, 6], namely heating hydrogen-deuterium plasmas with a small amount of energetic ^{3}He ions generated with ICRH (energies on the order of 1MeV). The challenges of interpreting the complex CXRS spectra are discussed. The information obtained is compared with the theoretical predictions obtained with the TORIC-SSFPQL code [7]. Possible applications of these measurements for energetic helium transport studies are considered.

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