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Progress in physics and system integration of ITER Core X Ray Crystal Spectrometer

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The paper summarizes the studies carried out on a novel arrangement of the core X Ray Crystal Spectroscopy (XRCS) system for ITER, particularly with respect to physics analysis and system integration in a different equatorial port in ITER. The XRCS Core diagnostic is the only one available for ITER at PFPO-1 (Pre-Fusion Power Operation-1) phase, and offers key parameters like core ion temperature profile and toroidal plasma rotation, among others.
The XRCS Core diagnostic was located originally at ITER's equatorial port (EP) 17. Its concept was based on a direct imaging of a dominantly poloidal plasma cross section on a curved crystal in a Johann spectrometer configuration. Due to a reconfiguration of the Disruption Mitigation System (DMS) locations in ITER, the XRCS Core diagnostic has now to move to EP.02, which imposes different boundary conditions on the arrangement of this system than EP.17. The XRCS Core system configuration had thus to be changed by relocating the crystals and detectors at the back end of the Interspace Support Structure (ISS –area between the vacuum vessel boundary and the concrete bioshield) while adding pre-reflectors in the port plug (PP –insert in the vacuum vessel containing diagnostic components and neutron shielding). Such updated configuration forces a re-optimization of the X-ray optical design, which now involves a double Bragg angle reflection (one with a wide rocking curve on the pre-reflector, one with a narrow rocking curve on the analyzing crystal) and a discrete rather than continuous imaging, and on top of that a reassessment of the measurement performance is required. Additionally, the relocation of the XRCS Core system demands further engineering activities particularly the design of pre-reflectors, and an overall plausible integration scenario in EP.02.
This paper highlights the most updated physics and port integration studies for the XRCS core system, aiming to demonstrate an updated configuration of this system with a trade-off between the physics measurements and port integration requirements.
The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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