ROLE OF ITER CORE XRCS
• Measuring line emission from highly ionized heavy element (impurity)
• Measurement
  - Ion temperature, Plasma rotation
  - Doppler shift and broadening
• Spatial coverage: 0-0.35a
• Purpose
  - To support advanced plasma control and improve understanding of plasma transport in burning plasma
  - Categorized as EE (Essential for execution of the IRP experimental programme)

BACKGROUND
• Original location and layout at EP17
  - Imaging concept with 3 continuous views in predominantly poloidal plane
  - Spectral diffraction in toroidal direction at closure plate location
  - Present location at EP2
  - Sandwiched by two DMS units. Narrow but enough space toroidally
  - Previous layout no longer fits the space in EP02. A radial layout is now assumed (see right)

CHALLENGES & SOLUTION
• High neutron dosage in port plug
• No space for horizontal spectral dispersion
• Pre-reflectors → Space allocation and viewing coverage
• Johann spectrometer → Imaging
• More compact

LINE AND CRYSTAL SELECTION
• Bragg Angle of Pre-reflector in the range of 10° (to view central region) to 35° (to view outer region) according to ITER Port Plug dimension
• Bragg Angle of crystal ~50° for better spatial resolution
• Germanium crystals are chosen due to relatively wide rocking curve

PERFORMANCE ASSESSMENT
• Analytical-raytracing mixed code XRSA developed to evaluate double-reflection x-ray spectral system; Validated with full raytracing code XICSRT
• Real coordinates adopted
• Images on PILATUS detector is simulated, which are used to evaluate the band pass and spectral resolution evaluation

SUMMARY
• ITER XRCS Core has been redesigned by introducing pre-reflectors to fit the present space allocation
• X-ray spectrometers are moved to the back part of interspace structure behind bio-shield, with pre-reflector in port plug
• Lines from Xe44+ and Xe51+ are chosen for the measurement, available at core and outer region respectively
• Analytical-raytracing mixed code XRSA is developed aiding design optimization and performance assessment
• System band pass and spectral resolution are evaluated using XRSA

REFERENCES

SYSTEM DESIGN AND LAYOUT
• Pre-reflectors in PP near to DFW, and analysing crystals in rear of I5S behind Bio-shield
• 4 sets * 4 sight lines (Xe44+ and Xe51+) + 1 set * 3 sight lines (W54+)
  - Each set composed with 3 pre-reflectors (or 2 for W54+) and one straight as reference/flex channel
  - Xe44+ and Xe51+ sets follow same path after pre-reflection → only 3 vacuum extensions
  - Sight lines ‘converge’ in DFW to minimize and simplify cut-out

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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