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同一視線上でのプラズマ放射パワーの波長帯分離計測手法　−分光ボロメータの開発検討−

Wave length separation bolometry “development of spectro-bolometer”

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Plasma radiation is one of major paths of energy loss from fusion plasmas. The enhancement of the radiation power in divertor region is required to achieve plasma detachment, which is a promised procedure to reduce huge heat load on divertor target plates. To control the plasma radiation, radiation processes should be understand with adequate measurement and analysis. For this purpose, a quantitative comparison of radiative power in the visible, the VUV, and the X-ray range is useful. This requires simultaneous measurement with photon energy separated along an identical viewing chord.

A new measurement instrument for bolometric measurement with photon energy separation, “spectro-bolometer”, is proposed. Figure 1 shows a conceptual diagram of the spectro-bolometer. The spectro-bolometer selectively detects the radiative power in the visible, VUV, and X ray range by three film detectors. The first film detector absorbs VUV photons and transmits through visible and x-ray photons. Similarly, the second and the third film detector absorb visible and x-ray photons, respectively. A temperature rise on each film detector by the absorbed power is measured by a micro thermocouple. The three film detectors have different materials and thickness. The three film detectors separate incident photons with photon energy by different spectral transmittance of each film detector. The spectral transmittance of materials for each film detector has been evaluated with synchrotron radiation and a known light source. The evaluated spectral transmittance shows that each film detector have a required spectral transmittance. From the temperature rise, the first film detector provides the power of VUV photons. Similarly, the second film detector and the third film detector provide the power of visible and x-ray photons. Therefore, the spectro-bolometer allows a quantitative comparison of the radiation power of each particular energy range along an identical FoV with a single measurement instrument.

To examine selective detection by each film detector, a visible laser was injected to a prototype of the spectro-bolometer. With this injection of the visible laser, the second film detector showed a clear temperature rise. The first and the third film detector did not show clear temperature changes. The result indicates that the spectro-bolometer using the three film detectors can allow the selective detection.

The calculation flow for the power of each energy range and limit of detection of the spectro-bolometer will also be presented in this meeting.

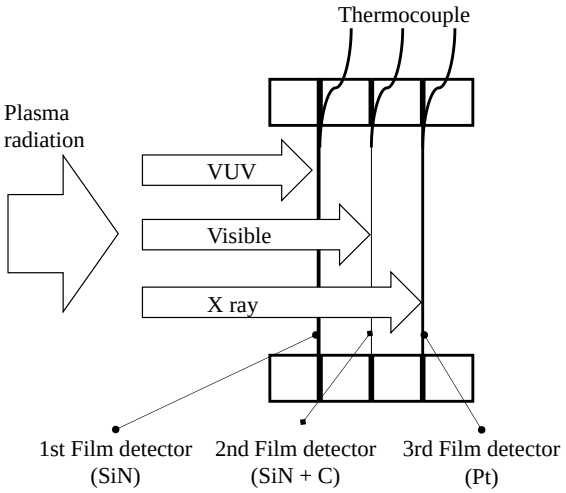

Figure 1 Conceptual diagram of spectro-bolometer.

[1] N. Asakura, K. Shimizu et.al, Nucl. Fusion **53**, 123013