New Polychromator System Design For KSTAR Thomson Scattering

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The polychromator is a crucial component in Thomson scattering diagnostics used for estimating electron temperature and density profiles. Its optimization plays a significant role in accurately measuring these parameters. Researchers have conducted extensive studies to design the most optimized polychromator, and KSTAR (Korea Superconducting Tokamak Advanced Research) has also developed an optimized design for this purpose [1]. In a recent development, the KSTAR Thomson polychromator incorporated a special function that allowed for the simultaneous measurement of Zeff (effective ionic charge) and Thomson signals by including a bremsstrahlung measurement part [2]. However, modifying the structure of the existing polychromator to add this function proved to be challenging. Therefore, a new polychromator was designed, taking into account the inclusion of the bremsstrahlung measurement part right from the beginning of the design process. In addition to the bremsstrahlung measurement part, a white LED was installed inside the new polychromator to serve as an alignment backlight. By providing visual assistance, the LED aids in achieving accurate alignment of the collection optics in the KSTAR vacuum vessel. Another notable feature of the new polychromator design is the inclusion of an Avalanche Photodiode (APD) temperature error correction. APDs are sensitive to temperature variations, which can introduce measurement errors. To address this issue, a temperature compensation circuit was incorporated into the design. This circuit helps mitigate the impact of temperature changes on the APD, enhancing the accuracy of the measurements. Overall, the new polychromator design integrates the bremsstrahlung measurement part, a white LED for alignment backlight, and a temperature compensation circuit for the APD. These additions aim to improve the functionality and performance of the polychromator in measuring electron temperature and electron density distribution using Thomson scattering.

[1] J. H. Lee *et al.*, RSI. **81** (2010) 10D528.

[2] Jong-ha Lee *et al*., FED. **123** (2017) 838.

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