Thomson scattering calibration with ultra-bright Supercontinuum Light Source

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Recent developments in non-linear optics have resulted in the production of an ultra-bright pulsed light source covering the spectral range of 550-1600nm, named Supercontinuum Light Source (SLS). This new source finds a useful application in the calibration of a Thomson scattering (TS) diagnostic, with specific use in the RFX-mod experiment. The TS diagnostic in RFX-mod measures the entire electron temperature ($T_e$) profile in 84 spatial positions: each of the 28 filter polychromators accommodates three positions by means of fiber optic delay lines and waveform digitizers. The relative responsivity of the spectral channels, necessary to calculate $T_e$, is usually derived in most TS systems from the transmission curves of the different components of the collection and detection systems. These curves are generally measured with a CW halogen light source from the DC output of the detectors, normally dedicated to the detection of the plasma background light. In a system with optical delay lines, like in RFX-mod, a CW light source would not allow to determine differences between the relative responsivities of the three positions that share the same polychromator: this can be achieved with a pulsed white light source instead. In addition a pulsed source with a time response similar to the TS signals would avoid any frequency response problem, because the AC output of the detector could be used as for TS measurements. So far it was not easy to find a pulsed light source with a wide, stable and smooth spectrum, but the recently developed SLS is proving a viable solution. An SLS consists of a new breed of passively Q-switched Nd\textsuperscript{3+}-microchip laser and a non-linear element, Photonic Crystal Fibers (PCFs), in which a combination of non-linear effects broadens the narrow-band laser radiation, providing a bright pulsed continuous spectrum. It produces a 5ns gaussian pulse, similar to those generated by Q-switched lasers used in TS systems, with a wide spectrum that easily covers the bandpass filters range 900-1060nm of the main Nd:YLF based TS diagnostic in RFX-mod, as well as that of the ruby laser based Edge-TS system still under development. The SLS provides a light source sufficiently bright to measure simultaneously the transmission curves of all spectrometers. In this work we describe the experimental set-up used for calibration and obtained results. We also compare a commercial with a homemade SLS.