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Radial profiles of turbulence level in Texas Helimak

My masters dissertation, which titles this work, had the main goal was to reproduce existing results regarding plasma radial density profiles in the Texas Helimak device and expand such results for data not analyzed before.
In the Texas Helimak, a set of 96 Langmuir probes connected to a digitizer device of 500 kHz of sampling frequency register the data of the plasma's ionic saturation current for plasma discharges of about 10 seconds of typical length. In order to obtain the density profile, it is first necessary to treat the original data of ion saturation current and extract coherent information about its mean, standard deviation, skewness and curtosis. For the analysis in question, only the probes of higher vertical positions are of interest and once the data set of each discharge contais about 5 million data per probe, it's convenient to divide the full set of data into a series of subsequent smaller windows of 1000 data each, calculate the relevant statistical estimators for each window and take the median over the calculations for every window to avoid distortions caused by the measure fluctuation. Figure 1 shows the comparison of the statistical estimators calculated over the full time series and via median of smaller windows for one of the analyzed discharges
Fig.1: https://drive.google.com/file/d/1eMFZAwdyu4Peclf24L3CE19h41yfx1sX/view?usp=drive_link
With this, it's possible to introduce the estimator for the turbulence level of the plasma confinement, calculated as the reason between the ion saturation current's standard deviation and its mean. By adjusting the radial position Rmax of the occurrence of maximum mean ion saturation current through a second-degree polynomial, it's possible to centralize the radial profiles of mean ion saturation current (proportional to plasma density), its standard deviation and the turbulence level over the radial position relative to Rmax for different discharges with different electric current (Ic) values. Figure 2 shows the comparison of those three statistical estimators for five different discharges, where a shared tendency regarding the Rmax position in both growth of turbulence level and peak of standard deviation are observed for all the discharges.
Fig.2: https://drive.google.com/file/d/1a__o6KzkEiK1XZoWm0nj4j4w7dJ4kEYf/view?usp=drive_link
After that, the Probability Density Functions for the ion saturation current can be estimated as the contour of the histogram of normalized ion saturation current for some radial position. Probes in the radial positions immediately to the left and to the right of Rmax were chosen as representatives for, respectively, the high field and low field sides of the confinement, and figure 3 shows the comparison of those representative PDFs for five different discharges.
Fig.3: https://drive.google.com/file/d/12i5L6p_EiwILTFYbt3lHx0tOHf8SuU8M/view?usp=drive_link
Those analysis methods were then applied for other sets of discharges of the Texas Helimak, obtaining equivalent results for the turbulence and density profiles. This poster presentation will discuss the applied methods and the results obtained for the discharges analyzed.

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