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Investigation of Complexity Dynamics in a DC Glow Discharge Magnetized Plasma Using Recurrence Quantification Analysis

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Abstract : Recurrence is a ubiquitous feature of any real dynamical system. The states in phase space trajectory of a system have an inherent tendency to return to the same state or its close state after certain time laps. Recurrence quantification analysis technique, based on this fundamental feature of a dynamical system, detects evaluation of state under variation of control parameter of the system. The paper presents the investigation of nonlinear dynamical behavior of plasma floating potential fluctuations obtained by using a Langmuir probe in different magnetic field under the variation of discharge voltages. The main measures of recurrence quantification analysis are considered as determinism, linemax and entropy. The increment of the DET and linemax variables asserts that the predictability and periodicity of the system is increasing. The variable linemax indicates that the chaoticity is being diminished with the slump of magnetic field while increase of magnetic field enhancing the chaotic behavior. Fractal property of the plasma time series estimated by DFA technique (Detrended fluctuation analysis) reflects that long-range correlation of plasma fluctuations is decreasing while fractal dimension is increasing with the enhancement of magnetic field which corroborates the RQA analysis.

Keywords : detrended fluctuation analysis, chaos, phase space, recurrence
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