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イメージングによるプラズマ発光分布の三次元構造計測

Measurements of 3-D luminosity distribution in plasmas with imaging technique

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Three-dimensional (3D) information not only for plasma itself but also for plasma faced material and levitating particles are important for a wide range of plasma research fields. Recent progresses have shown the importance of helically deformed configurations and 3D mode structures in high temperature plasmas [1]. 3D information about the positions of fine particles in a plasma is important for plasma processings as well as for studying physical processes in Coulomb crystals [2]. Among the various devices, separated two or more detectors with computed tomography are widely used to determine the 3D information. However, many experimental devices are faced with a limitation of the number of viewing ports and viewing areas. It is required that a method distinguishing 3D structure of plasma from a certain image obtained from one viewing port.

Recently, the integral photography technique [3] has been applied to dusty plasma in order to estimate 3D positions of small number of levitating particles in plasmas. Applying the method to a system containing many point light sources, it tends to generate many ghost particles as a reconstruction result. Moreover, applying above method to translucent plasma, out of focus parts of the plasma structure at the front and rear of the plasma region obscure the sharp. In this study, we try to develop a 3D imaging system for plasma with integral photography and Richardson-Lucy deconvolution (RLD) techniques [4, 5].

Developed system has been applied to dusty plasma and reversed field pinch experiments. Figure 1 shows experimental result from dusty plasma. An enlarged experimentally obtained elemental image array for a dusty plasma experiment is shown in Fig. 1 (a). The 3D particles positions determined from Fig. 1 (a) are shown in Fig 1 (b) and (c). After applying RLD, ghost particles has been vanished and the distribution of true dust particles in Fig. 1 (b) is in good agreement with the appearance of dust particles in Fig. 1 (a) [6] .

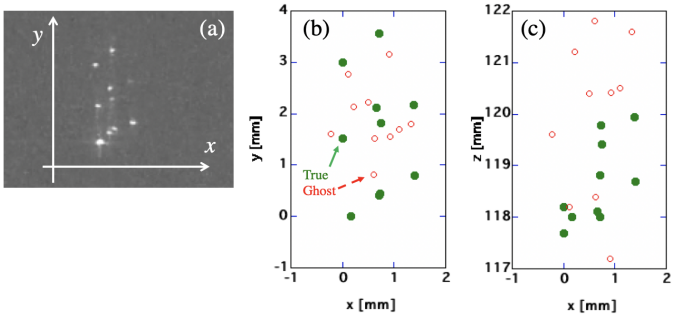

Fig. 1: (a) Enlarged experimentally obtained array of 54 elemental images after subtraction of a background image. (b) Projection of the $x-y$ plane. (c) Projection of the $x-z$ plane.

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