25E03

On Analysis of Fluctuation Spectrum in Fine Particle Plasma
微粒子プラズマの揺動スペクトル解析について

Hiroo Totsuji[1] and Chieko Totsuji[2]
東辻浩夫, 東辻千枝子

[1]*Okayama University, 3-1-1, Tsushimanaka, Kitaku, Okayama 700-8530, Japan*
[2]*Kogakuin University, 1-24-2, Nishishinjyuku, Shijyukuku, Tokyo 464-0073, Japan*
[1]岡山大学，〒700-8530　岡山市北区津島中3-1-1
[2]工学院大学，〒163-8677　新宿区西新宿1-24-2

Among various kinetic level information obtained in fine particle plasma experiments, the density fluctuation spectrum is one of most interesting data to understand collective phenomena in strongly coupled charge systems. In comparing observational results with those of theoretical predictions, we have to take into account the effects of the dimensionality of observations and the non-uniformity of the observed systems which are closely related. Based on the numerical simulation of observations, we discuss these effects and possible relations to observations in PK-3+ on the International Space Station.

1. Introduction

In fine particle plasmas, various phenomena related to the strong coupling between particles can be observed directly through images of CCD cameras. Since these data give us kinetic level information, one of most interesting quantities may be those related to the collective phenomena such as critical fluctuations. The possibility of critical point in fine particle plasmas associated with the divergence of the isothermal compressibility of one-component plasmas has been pointed out[1].

2. Two- and three-dimensional observations and non-uniformity

The observations by CCD cameras are usually performed under the illumination of sheet laser beam. Three-dimensional (3d) positions of particles are captured by scanning vertically to the plane of laser beam. We may have, however, cases where the latter is not available. We have shown that 3d pair correlation function and the structure factor can be restored from two-dimensional (2d) ones[2,3].

Our basic assumption is that the system is uniform and isotropic: Otherwise, it is clearly impossible. Conversely, if the system is uniform and isotropic, *the same amount of information is included in 2d observations.* Mathematically, 2d functions are given by integral transforms from 3d ones and they can be inverted.

We have inversion formulas as expansions with respect to a parameter. These transformations are compared with simulations where both 2d and 3d functions are obtained exactly. Examples are shown in Figs.1 and 2.

In Fig.2, we have the apparent increase of long-wavelength fluctuations in 2d observation in contrast to the real behavior $S(k;\ 3d)\sim 0$: In 2d observations of a part of the uniform system, the non-uniformity is effectively enhanced.

Non-uniformity seems to have similar effects to fluctuation spectrum. Possible relations to the results of PK-3+ observations will be discussed in the presentation.

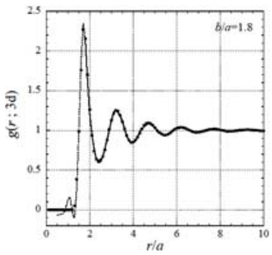

Fig.1. Pair distribution function. Dots are simulations and the solid line is the restoration formula.

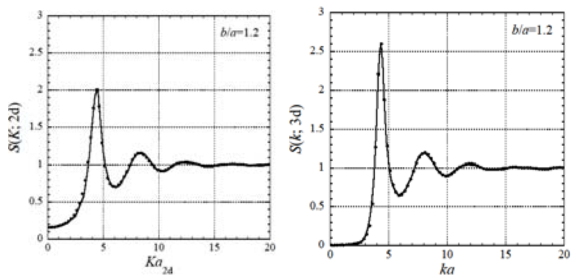

Fig.2. 2d (left) and 3d (right) structure factors. Note that *S(K, 2d)* is finite at *K~0,* while *S(k, 3d) ~0.*

References

[1] For example, H. Totsuji: Phys. Plasmas **15**(2008)072111.

[2] H. Totsuji: J. Phys. Soc. Japan **78**(2009)065004.

[3] H. Totsuji: J. Phys. Soc. Japan **79**(2010)064002-1.