Evolution of Cometary Remnant Dusts in the Jovian Space Revealed by Jovian Decameter Radiations

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1. Introduction

After the crash of fragments of Shoemaker-Levy 9 comet on Jupiter there has been raised new radiation sources of Jovian decameter radio waves which have appeared mostly as the Non Io-B source. The radiation from new sources revealed unusual features called multi-coherent radio emissions, for the case of the observations using interferometer; the origin of the generation of peculiar pulsive features that deviate largely from the regular interferometer fringe is thought to be caused by the effects of cosmic dusts which were circulating in space surrounding Jupiter. The effect did not remain constantly in a stage but changes gradually during past nine years. For the case of observations in Dec 2003, it has been confirmed that the direct dust effects on the Jovian emission disappeared with sudden dipression of the regular type Jovian decameter wave radiations.

2. Multi-Coherent Radio Emissions

Cosmic dusts in plasma space are negatively charged due to the faster motion of electrons compared with ions in plasma and are surrounded by ions which behave as current carrier in the groups of dust clouds. Being induced by the electric fields generated by moving dust clouds that cross magnetic fields in the Jovian magnetosphere, the decameter radio wave are emitted from the topside of Jovian ionosphere. Because of multiple existence of groups of dust clouds there may exist multiple radio sources in the corresponding source regions magnetically connected to the moving dust groups. Furthermore, these radio sources are characterized by coherent radio wave emissions. When the radio emissions from multiple coherent-radio wave sources are observed using interferometer detected phase differences between a couple of stations are indicated being mixed with emissions from different sources; that is the fringe signal F(AB) for the baseline between A and B points of interferometer is expressed by,

F(AB)=(A^2+B^2)^(1/2)cos(Phai+Theta)

and

Theta=Arctan(B/A)

with

A=Sigma(i,j)P(ij) cos(theta(ij))

B=Sigma(i, j)P(ij) sin(theta(ij))

where i, and j are codes to identify radio sources among multiple existence of sources, and P(i,j) and theta(i,j) are respectively multiplied values of field intensity between i and j sources and phase difference of coherently emitted radio waves from i and j radio sources. Because randomness of phase difference between i and j sources the fringe phase angle 'Phai' takes all values between Phai-pai/2 and Phai+pai/2 corresponding to arrival times of pulsive radio emissions. When 'pai' stands for the circular constant, this shifts from 'Phai' results in large deviation of detected signal from the regular fringe phase value 'Phai'.

3. Evolution of the Emissions Caused by Cometary Dust

Since 2000, after 6 years from the occurrence of the radio emission caused by cometary remnant cosmic dust, the emissions were gradually decreased and the observation in December 2002 was the last one which showed the multiple coherent radio emissions that can be attributed to the cosmic dust origin. By the observations in November 2003 to January 2004, it has been clarified that Jovian decameter radio wave emissions from all kinds of emissions from already identified sources such as Io-A, Io-B and Non Io-A have been depressed compared with regular cases of Jovian decameter radiation. For this evidence we propose the effect of cometary remnant dust that may be falling into the source regions of Jovian decameter radio emission in the top-side ionosphere where the processes of Jovian decameter radiation are impeded by existing dust which may bother the electron cyclotron motion in local plasma.