Galilean Satellites' Control of Jovian decametric radiation

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It has been well-known that the occurrence of Jovian decametric radiation (DAM) has clear dependence on the Io phase. However, it is still controversial whether there exists other Galilean satellites' control on the occurrence of DAM. Recently, new evidences have been found concerning the Galilean satellites: That is, Ganymede has its own magnetosphere; Europa has its own plasma torus like Io; and there are Europa and Ganymede footprint aurorae on the Jovian ionosphere as well as Io's. These evidences suggest strong electromagnetic interaction between Galilean satellites (in particular, Io, Europa and Ganymede) and Jovian polar ionosphere.

To examine a possible control by the Galilean satellites on the occurrence of DAM, we analyzed DAM databases of Tohoku University and Nancay Radioastronomy Observatory, both of which contain DAM occurrence data over 20 years. Statistical analyses have been carried out by using satellite phase angle vs. CML (central meridian longitudes) diagrams and satellites phase angle vs. satellite phase angle diagrams, to examine whether there exist significant control by Europa, Ganymede and Callisto.

As a result, the occurrence of DAM shows clear dependence on the orbital phases of Europa, Ganymede and Callisto like Io. These radio sources are here called Europa-A, -B, Ganymde-A, -B, and Callisto-A like Io-A or Io-B; and are given a generic name 'Single-Satellite-DAM (SS-DAM)'. It has been suggested that the SS-DAM radiates from the footprints of each satellite's flux tube as has been considered for the case of Io-DAM.

Another Galilean satellites' control on the occurrence of DAM has been found relating to the position of the first three Galilean satellites (Io, Europa and Ganymede). The orbital phase of the satellites satisfies the following relations:

Io phase = 2*Europa phase - 60 +- 120 + 360 * k (k: arbitrary integer)

Io phase = Europa phase + a; a = 80, 0, -60, -120, -220

Io phase = Ganymede phase + b; b = 30, -90, -180, -270, -60

Europa phase = Ganymede phase + c; c = -50, -90, -120, -150, -200

These relations show that there is a component of DAM which is generated when the inner three Galilean satellites take several specific positions in the Jovian magnetosphere. We call this DAM 'Resonance-DAM (R-DAM)'.

There is also a component in DAM which is not related to the orbital phase of the Galilean satellites. This component can be classified into a category of the 'non-Satellite-DAM (nS-DAM)'.

On the basis of the present analysis, it has been suggested that DAM is then divided into three categories; i.e., 'Single-Satellite-DAM (SS-DAM)', 'Resonance-DAM (R-DAM)' and 'non-Satellite-DAM (nS-DAM)'. The occurrence probability of each category of DAM is estimated to be: SS-DAM (Io = 0.43-0.58, Europa = 0.05-0.08, Ganymede = 0.07-0.11 and Callisto = 0.05-0.07), R-DAM = 0.10-0.43 and non-Satellite-DAM = 0.04-0.10, respectively.