Occurrence characteristics of Jupiter's quasi-periodic decametric radio emission in the magnetospheric plasma enhancement period

H. Misawa, and F. Tsuchiya
Planetary Plasma and Atmospheric Research Center, Tohoku University, Japan

ABSTRACT

Around Jupiter's oppositions to the earth in 2014 and 2015, remote observations for Jupiter had been made continuously by the HISAKI satellite in the UV range. In particular in the 2015 campaign period, sudden enhancement of Iogenic plasma emissions occurred in the middle of Jan. and the enhancement had lasted for more than two months. This sudden change of Io volcanic eruption was also detected from the ground-based optical observation for Na-D emissions (Yoneda et al., Icarus, 2015). This phenomenon would give a valuable opportunity to investigate what parameters and/or processes affect magnetosphere's variations.

So far, we showed some occurrence features of Jupiter's auroral radiations in the hectometric wave range (HOM) for this Iogenic plasma enhancement period, particularly for their occurrence probability/intensity (see Misawa et al., Proc. 17th SPS, 2016). On the other hand, occurrence features and relation with such the particular event in the decametric wave range (DAM) have not been known well. In this study, we introduce occurrence timing and/or spectral features of Jupiter's auroral radio emission in DAM in particular non Io-DAM's "QP burst" (see Panchenko et al., GRL, 2010, PSS, 2013) for this particular period based on the analyses of Jupiter's radio emission data observed with the WIND/WAVES radio instrument. A preliminary analysis shows that the recurrence period of the QP bursts was shorter during the Iogenic plasma enhance period. This recurrence period variation is similar to the variation of plasma emission from Io plasma torus for the plasma enhancement period in 2015 (Arakawa et al., private communication). Although the sense of the variation seems to contradict to the known recurrent feature of the Iogenic plasma (i.e. the System-IV phenomenon) in Nozawa et al., JGR, 2004), such a recurrent characteristic would give a clue for future studies to reveal unknown source region and process of non Io QP DAM bursts.

Acknowledgement: The WIND/WAVES data were obtained from the NASA WIND/WAVES team page. We would like to thank M. L. Kaiser and the WIND/WAVES team for providing the data.

SPS2017-P18

Occurrence characteristics of Jupiter's quasi-periodic auroral radio emission in the magnetospheric plasma enhancement period

H. Misawa and F. Tsuchiya

Planetary Plasma and Atmospheric Research Center,
Graduate School of Science, Tohoku University

Outstanding Questions on Jupiter's magnetosphere

EARTH:
Solar wind driven

Jupiter:
Rotationally driven ・・・
Roll of logenic plasma?
Roll of solar wind variation?

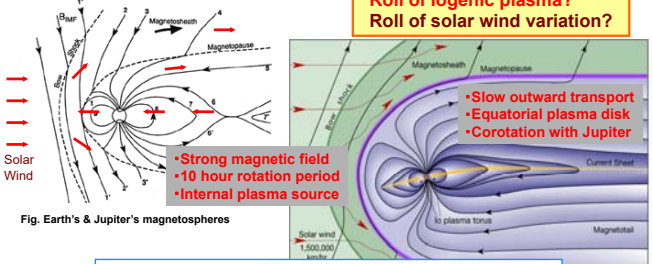
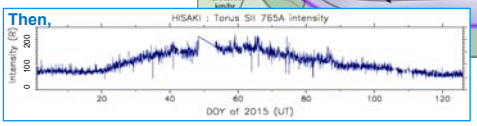


Fig. Earth's & Jupiter's magnetospheres



(after F. Bagenal)

Fig. HISAKI and the detected plasma enhancement in 2015 (courtesy of F. Tsuchiya)

Jupiter's DAM (DecA-Metric radiation)

DAM: (3)〜40MHz

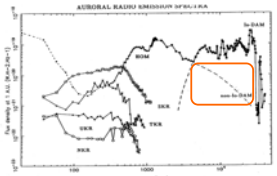


Fig. Power spectrum of planetary non thermal radio emission. (Zarka, 1992)

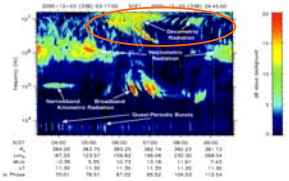


Fig. f-t diagram measured by Cassini.(Gurnett+, 2002)

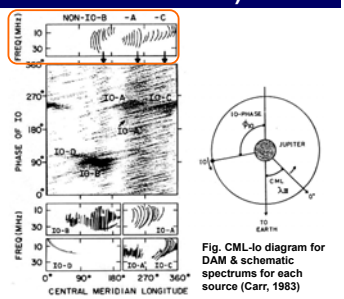
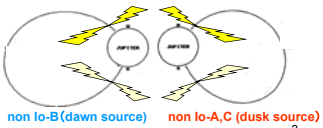
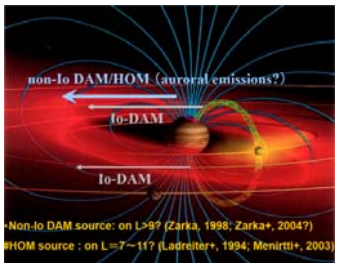


Fig. CML-Io diagram for DAM & schematic spectrums for each source (Carr, 1983)



Jupiter's auroral radio emissions



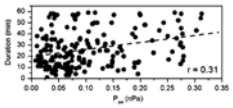


Fig. Relation between solar wind pressure (derived from mSWIM (1D MHD) & occurrence duration of non-Io DAM for the 1996-1999 data. (Hess+, 2012)

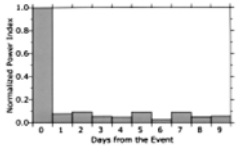


Fig. Statistical power index profile of non-Io DAM after the onset of huge DAM storm for the 1974-1990 data. (Morioka+, 2002)

Recently identified non-Io DAM: QP nature

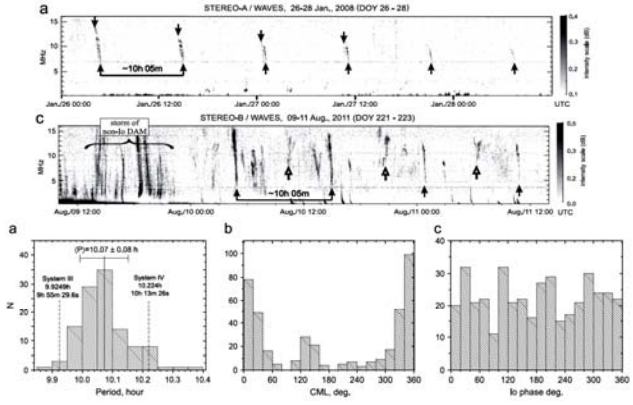
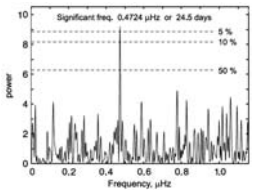


Fig. [Upper & Middle] Examples of f-t diagrams for the QP non-Io DAM. [Bottom] Their statistical occurrence characteristics. (Panchenko+, 2010, 2013)

Recently identified non-Io DAM: QP nature



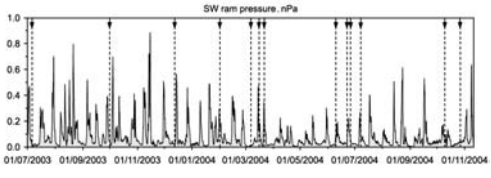
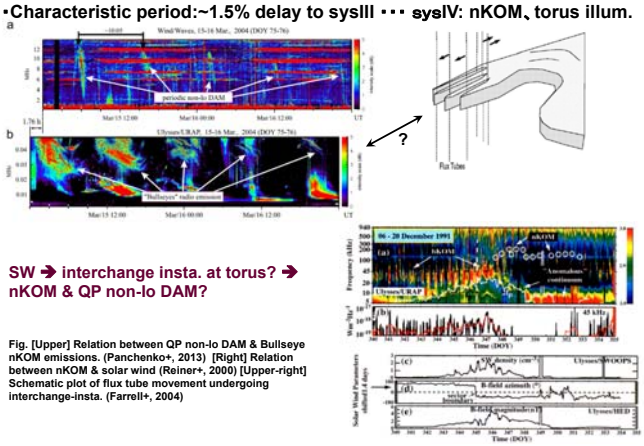


Fig. Relation between QP non-Io DAM & solar wind pressure (Panchenko+, 2013)

Expected origin of QP non-Io DAM:（？）

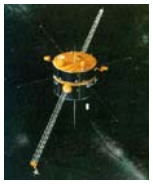
・Characteristic period:~1.5% delay to sysIII ・・・ sysIV: nKOM、torus illum.



SW ➔ interchange insta. at torus? ➔ nKOM & QP non-Io DAM?

Fig. [Upper] Relation between QP non-Io DAM & Bullseye nKOM emissions. (Panchenko+, 2013) [Right] Relation between nKOM & solar wind (Reiner+, 2000) [Upper-right] Schematic plot of flux tube movement undergoing interchange-insta. (Farrell+, 2004)

HOM data: WIND/WAVES



WIND: launched on Nov. 1, 1994

WAVES: Radio and Plasma Wave Investigation

・Radio Receiver Band 1 (RAD1) & 2 (RAD2)

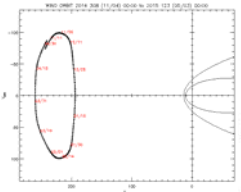
Inputs: Ey(100m)+Ex(15m), Ez(12m)

Frequency range: 20KHz-1.04MHz (RAD1), 1.075MHz - 13.825 MHz(RAD2)

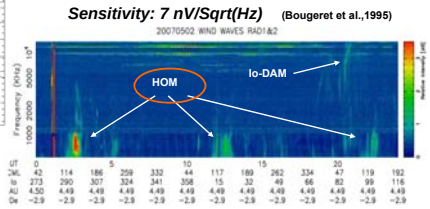
No. of channels: 256 each

Frequency step: 4KHz(RAD1), 50KHz(RAD2)

Sensitivity: 7 nV/Sqrt(Hz) (Bougeret et al.,1995)



†Fig. View of the WIND satellite and the orbit for Nov. 2014 to May 2015.

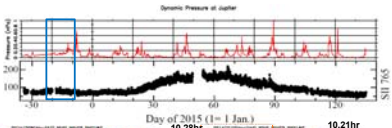


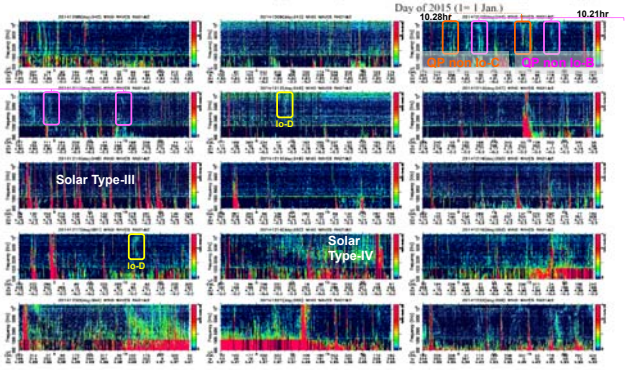
→ Fig. Example of WAVES data,

QP DAM search 2014/12/8-22

Solar wind pressure

Torus SII luminosity

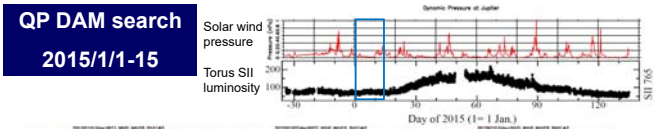


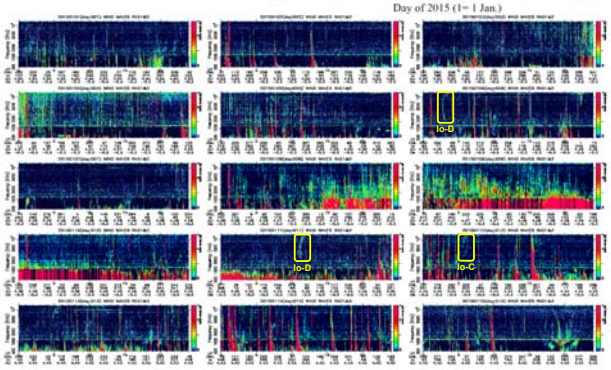


QP DAM search 2015/1/1-15

Solar wind pressure

Torus SII luminosity

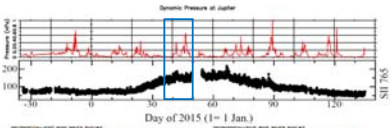


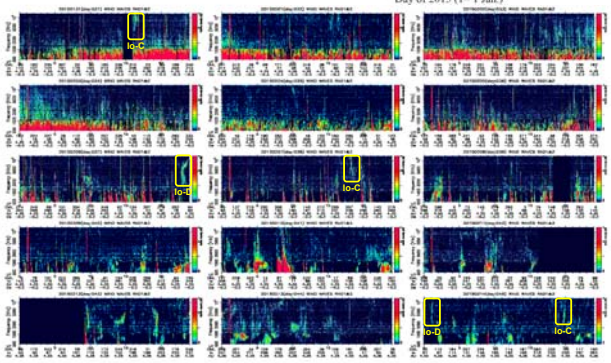


QP DAM search 2015/1/31-2/14

Solar wind pressure

Torus SII luminosity

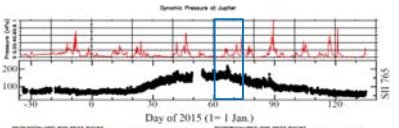


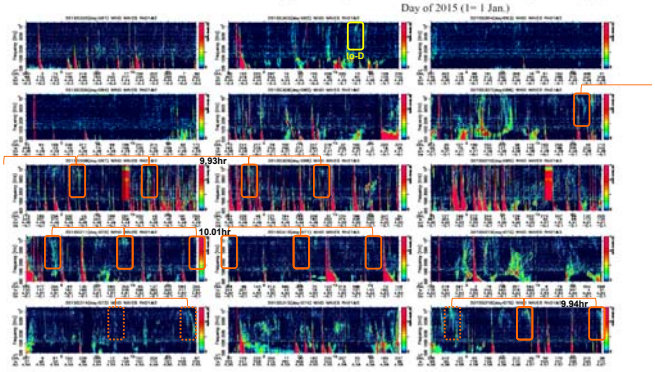


QP DAM search 2015/3/2-16

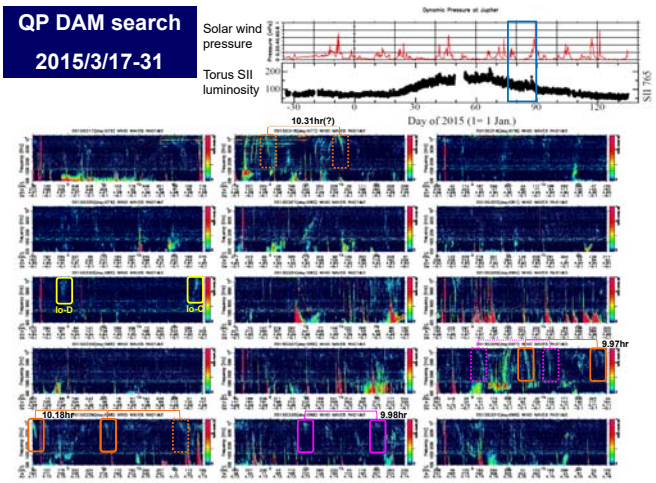
Solar wind pressure

Torus SII luminosity

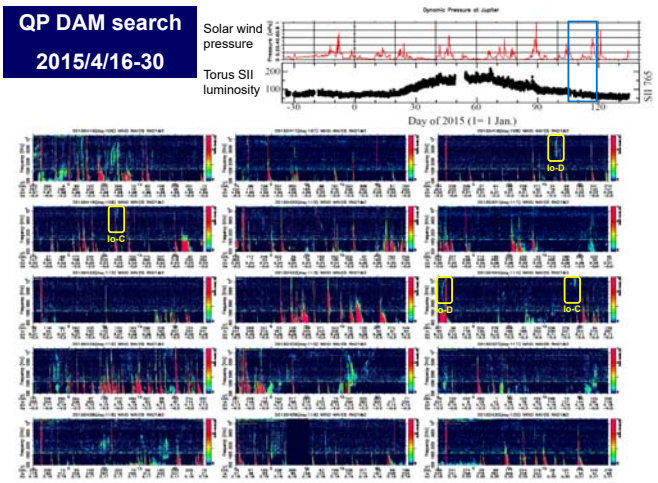




QP DAM search 2015/3/17-31



QP DAM search 2015/4/16-30



System IV nature in Torus SII luminosity

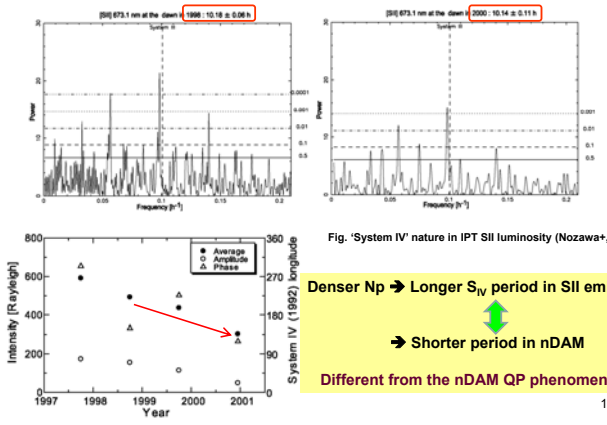


Fig. 'System IV' nature in IPT SII luminosity (Nozawa+, 2004)

Denser Np ➔ Longer S_{IV} period in SII emiss.

➔ Shorter period in nDAM

Different from the nDAM QP phenomena ??

Summary

●Purpose:

- **How the Jovian magnetosphere responded during the campaign?**
- **How did Torus plasma affect to (non-Io) DAM?**
  - **・・・ What parameters and/or processes control the magnetosphere's variations?**

●Method:

- **Comparison of continuously observed data : Torus Plasma(HISAKI), (solar wind) vs. 'QP'-DAM (WIND/WAVES)**

●Results:

- **QP period is shorter during the IPT enhance period.**
  - **➔ Different from the known IPT plasma System-IV nature ??**

●Future studies:

- **Confirming the other periods ・・・ under analysis**
- **Considering contributed processes (really relating to interchange process??**
  - **➔ Seemingly no relation to substorm like event・・・)**

References

Boischot, A. et al., Astron. Astrophys., 175, 287-288, 1987.
Bougeret, J.-L., Space Sci. Rev., 71, 231-263, 1995.
Carr, T., in *Phys. Jovian Magnetosphere*, Cambridge Univ. Press, pp.226-284, 1983.
Escher, E. et al., Astron. Astrophys., 519, doi:10.1051/0004-6361/200913305, 2010.
Farrell, W.M. et al., J. Geophys. Res., 109, doi:10.1029/2003JA010130, 2004.
Grodent, D. et al., J. Geophys. Res., 108, doi:10.1029/2003JA010017, 2003.
Gurnett, D. A. et al., Nature, 415, 985-987, 2002.
Hess, S. L. G. et al., Planet. Space Sci., 70, 114-125, 2012.
Ladreiter, H. P. et al., Planet. Space Sci., 42, 919-931, 1994.
Menietti, J. D. et al., Planet. Space Sci., 51, 533-540, 2003.
Morioka, A. et al., Earth Planets Space, 54, 1277-1281, 2002.
Panchenko, M. et al., Geophys. Res. Lett., 37, 5106, 2010.
Panchenko, M. et al., Planet. Space Sci., 77, 3-11, 2013.
Reiner, M. J. et al., Geophys. Res. Lett., 27, 297-300, 2000.
Terasawa, T. et al., Nature, 273, 131-132, 1978.
Zarka, P., J. Geophys. Res., 103, 20159-10194, 1998.
Zarka, P., J. Geophys. Res., 109, doi:10.1029/2003JA010260, 2004.