

A SEARCH FOR WATER MASERS IN ICY BODIES OF THE SOLAR SYSTEM.

S. Takahashi¹, S. Deguchi¹, N. Kuno¹, T. Iino², T. Hamura³, S.V. Pogrebenko⁴, L.I. Gurvits^{4,5} and F. Yoshida⁶,
¹Nobeyama Radio Observatory, National Astronomical Observatory of Japan (Nobeyama Radio Observatory, National Astronomical Observatory of Japan, 462-2 Nobeyama, Minamimaki, Minamisaku, Nagano 384-1305 shigeru@nro.nao.ac.jp), ²Solar-Terrestrial Environment Laboratory, Nagoya University (Furo-cho, Chikusa-ku, Nagoya 464-8601 Japan), ³Dept. of Complexity Sci. and Eng., University of Tokyo (5-1-5 Kashiwanoha, Kashiwa-shi, Chiba 277-8561 Japan), ⁴Joint Institute for VLBI in Europe (P.O. Box 2, 7990 AA, Dwingeloo, The Netherlands), ⁵Department of Astrodynamics & Space Missions, Delft University of Technology (Kluyverweg 1, 2629 HS Delft, The Netherlands), ⁶National Astronomical Observatory of Japan (National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan)

Abstract: Maser phenomena are widely observed in celestial objects. Dense cores of molecular clouds and circumstellar envelopes of late-type stars are examples of such maser sources. These masers have been used as probes of gases with the H_2 number density of typically 10^4 - 10^{10} cm^{-3} .

Maser and laser phenomena (OH, H_2O , CO_2) have been observed in some solar system objects. Each phenomenon would be induced by different physical processes.

As for H_2O maser, the first detection was reported during the catastrophic impact of comet Shoemaker-Levy 9 and Jupiter [1]. A recent report showed that H_2O maser phenomena existed in the system of Saturnian moons [2]. The study indicated that water maser emissions at 22.235 GHz were seen from the vicinities of Titan, Hyperion, Enceladus and most notably Atlas. The observations were conducted with the Medicina 32 m and Metsahovi 14 m telescopes.

In May 2009, we tried to detect the maser emission from several Saturnian moons with the Nobeyama 45 m radio telescope [3]. Observations were carried out for Titan, Hyperion, Enceladus and Atlas, in which detections were reported previously [2], and in addition for Iapetus and other inner satellites. However, we could not detect any water maser emission in all the listed sources. The typical daily observing sensitivity of these results (3sigma \sim 200-700 mJy) was comparable to, or even better than those of the previous studies.

In 2011, we have repeated the search for the water maser lines in Saturnian system with the same sensitivity. We also attempted to detect the water maser line from other icy bodies in the Solar System (Makemake, Haumea, and Varuna). Fig. 1 and 2 illustrate typical one day results on Titan and Makemake, respectively. At this conference, we report the results of the 2011 observations. Although we are not in the position to confirm earlier detections [2], our new results would offer the clue on hypothetical water maser phenomena, and would give us the hints of maser emission mechanism. We note, that the (apparent) non-detection of the water maser emission is a preliminary result. In any

case, the emission is likely to have a transient character, at least due to an eruptive mechanism of water vapour supply into the Saturnian system and narrow beaming of maser emission.

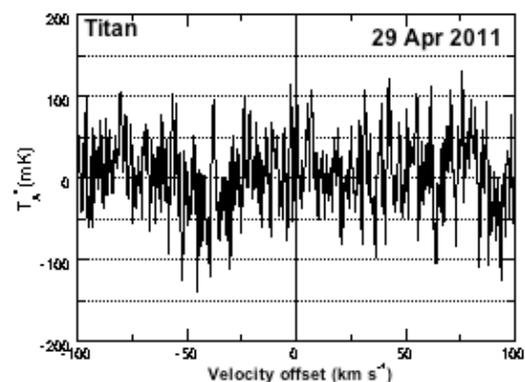


Fig. 1

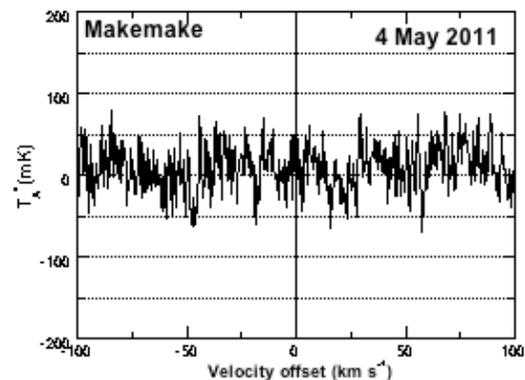


Fig. 2

References: [1] Cosmovici et al. (1996) *Planet. Space Sci.*, 44, 735. [2] Pogrebenko et al. (2009) *A&A*, 494, L1. [3] Takahashi et al. (2010) *PASJ*, 62, L17-L21.