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A survey for OH masers in H_2O maser galaxies with the Effelsberg and Green Bank radio telescopes

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Abstract. We present a search for OH maser emission in galaxies hosting H_2O masers with the 100-m Effelsberg radio telescope and the Green Bank Telescope (GBT). This survey is aimed at investigating the apparent rarity and/or possible mutual exclusion of megamaser emission from OH and H_2O in the same galaxy. Our study establishes new and better upper limits on the OH maser luminosity. Our work duplicates the number of H_2O masers searched for OH emission. No new maser detections have been found. OH absorption, both in the 1667 and 1665 MHz transitions, is instead detected in two galaxies of the sample, IC342 and NGG5793.

Keywords. masers, techniques:spectroscopic, surveys, ISM:molecules, galaxies:active

1. Introduction

Luminous extragalactic masers are traditionally referred to as megamasers and, so far, are mostly seen in radio lines of either hydroxyl or water vapour. These species have been very rarely observed in the same galaxy. This peculiarity gives rise to different hypotheses mainly related to the extreme and different physical conditions for OH and H_2O maser emission and/or different (nuclear) evolutionary phases of the host galaxies, e.g., Tarchi *et al.* (2011). In this work, we present a search for OH maser emission in galaxies hosting H_2O masers observed with the Effelsberg radio telescope and the GBT. This survey is aimed at providing new clues to the debated rarity of the simultaneous presence of megamaser emission from OH and H_2O in the same galaxy, see, e.g., Wagner (2013) and Wiggins *et al.* (2016).

2. Observation and Data Reduction

The sample, comprising all water maser sources visible by Effelsberg (Dec. > -30°) that were never searched for OH maser emission, was observed in a search for 1.6-GHz OH maser emission. A subset of the aforementioned sample, mainly constituted by those sources affected by RFI in the Effelsberg data, was then observed also with the GBT. The bandwidth is 20 MHz for Effelsberg and 12.5 MHz for the GBT respectively, centered at the recessional velocity of the galaxy. The analysis of the Effelsberg data was performed using the GILDAS software (IRAM), while for the GBT data, we used the software GBTIDL (NRAO).

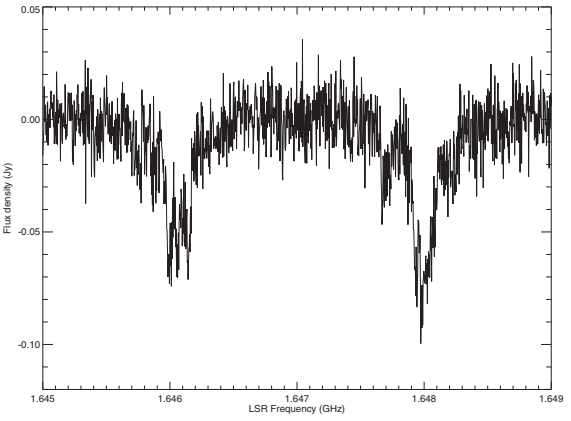

Figure 1. Spectrum of the galaxy NGC 5793 obtained with the GBT. The absorption lines are produced by the OH molecule at 1665 and 1667 MHz.

3. Results and Summary

In this work, we observed a total of 45 galaxies. For 10 of them, spectra were corrupted by RFI at the Effelsberg and GBT sites. Hence, our work establishes new upper limits on the OH maser luminosity for 35 galaxies, out of which 27 had no OH measurements reported, while for 8 galaxies we improved the upper limits. This work duplicates the number of extragalactic H_2O masers searched for OH emission. OH absorption features, both in the 1667 and 1665 MHz transitions, are detected for two galaxies in the sample: IC 342, for the first time, and NGC 5793 (see Fig. 1) confirming that reported, for the 1667-MHz transition only, by Hagiwara *et al.* (1997, and references therein). These detections provide promising targets for follow-up interferometric measurements useful to investigate the molecular gas in the (likely) nuclear regions of the hosts. No new OH maser detections have been found confirming the paucity of objects hosting (mega)maser emission from both molecular species and hinting at the necessity of extending the samples where maser emission from both molecular species are searched for and of detailed observations of the few objects known, so far, to host simultaneous hydroxyl and water megamaser emission. In this framework, an important role may be that played by the 64-m Sardinia Radio Telescope (SRT), since at L band the different RFI environment would allow for observations of those targets affected by RFI at the other sites. In addition, the sensitivity of the SRT at L and K bands makes it a very suitable instrument to pursue the aforementioned studies.

4. Acknowledgements

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