Infrared characteristics of sources associated with OH, H₂O, SiO and CH₃OH masers

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Abstract. We collect all published OH, H₂O, SiO and CH₃OH masers in literature. The associated infrared sources of these four masers were identified with MSX PSC catalogues. We look for common infrared properties among the sources associated with four masers and make a statistical study. The MSX sources associated with stellar OH, stellar H₂O and SiO masers concentrated in a small regions and the MSX sources associated with interstellar OH, interstellar H₂O and CH₃OH masers also concentrated in a small regions in an [A]-[D] vs [A]-[E] diagram. These results give us new criterion to search for coexisting stellar maser samples for OH, H₂O and SiO masers and interstellar maser samples for OH, H₂O and CH₃OH masers.

Keywords. Masers, Interstellar, Stellar, Infrared radiation

1. The sample

We collect all 1602 published 43 GHz SiO maser sources (Deguchi et al. 2004a, 2004b, 2007, 2010; Fujii et al. 2006; Jiang et al. 2002; Nakashima et al. 2003a, 2003b), 1712 6.7 GHz CH₃OH maser sources (Pestalozzi et al. 2005; Green et al. 2010; Xu et al. 2003, 2010), 1417 22.235 GHz H₂O maser sources (Esimbek et al. 2005) and 3249 1612 MHz OH maser sources (Mu et al. 2010). The MSX mission surveyed the entire Galactic belt within b ≤ 45° in five infrared bands B, A, C, D and E at 4.8, 12, 15 and 21 μm (Price et al. 2001). 1155 of the 1602 SiO masers, and 585 of the 1712 CH₃OH masers associated with MSX PSC sources within 1°. Of the 743 H₂O masers associated with MSX PSC sources within 1°, 300 are interstellar, and 155 are stellar masers. Of the 1869 OH masers associated with MSX PSC sources within 1°, 63 are interstellar, and 1657 are stellar masers, others are unknown type.

2. Statistical results

OH, H₂O, SiO and CH₃OH are the strongest and most widespread astrophysical masers. OH and H₂O masers could occur in star forming regions and the envelopes of evolved stars. Most of the SiO masers are circumstellar maser and CH₃OH masers are interstellar (Elitzur 1992). Fig1. Presents color indexes [A]-[D] vs [A]-[E] associated with OH, H₂O, SiO and CH₃OH masers, respectively. Here, [A]-[D] and [A]-[E] denote log(FD/FA) and log (FE/FA). These mid-IR sources associated with these four masers are concentrated in small regions, while mid-IR sources associated with stellar OH masers are distributed in relatively larger region. Fig 2a. Presents color indexes [A]-[D] vs [A]-[E] associated with stellar OH, stellar H₂O and SiO masers, there 66%, 77%
and 95% mid-IR sources associated with three masers are located in a area (-0.2, 0.2), (0.1, 0.4), (0.4, 0.4) and (-0.2, -0.4). Fig 2b. Presents color indexes [A]-[D] vs. [A]-[E] associated with interstellar OH, interstellar H$_2$O and CH$_3$OH masers, there 81%, 75% and 92% mid-IR sources associated with three masers are located in a area (-0.2, 0.4), (0.5, 1.5), (1, 1.5) and (0.4, 0.4).

3. Summary

We collect all published OH maser, H$_2$O maser, SIO maser and CH$_3$OH maser in the literature and selected MSX PSC sources within 1' as the exciting sources. This results provide us new criterion to search for coexisting stellar OH, stellar H$_2$O and SIO masers and coexisting interstellar OH, interstellar H$_2$O and CH$_3$OH masers.

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References

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**Figure 1.** (Fig. 1; left) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with (a) OH (b) H$_2$O (c) SiO and (d) CH$_3$OH masers. (Fig. 2; right) (a) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with stellar OH, stellar H$_2$O and SiO masers. (b) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with interstellar OH, interstellar H$_2$O and CH$_3$OH masers.