Cosmic Masers - from OH to H_0
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Infrared characteristics of sources associated with OH, H_2O, SiO and CH_3OH masers

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Abstract. We collect all published OH, H_2O, SiO and CH_3OH masers in the 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 H_2O and SiO masers concentrated in a small regions and the MSX sources associated with interstellar OH, interstellar H_2O and CH_3OH 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, H_2O and SiO masers and interstellar maser samples for OH, H_2O and CH_3OH 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 CH_3OH maser sources (Pestalozzi *et al.* 2005; Green *et al.* 2010; Xu *et al.* 2003, 2010), 1417 22.235 GHz H_2O 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 $|b| \leqslant 4.5°$ 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 885 of the 1712 CH_3OH masers are associated with MSX PSC sources within $1'$. Of the 743 H_2O 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, H_2O, SiO and CH_3OH are the strongest and most widespread astrophysical masers. OH and H_2O masers could occur in star forming regions and the envelopes of evolved stars. Most of the SiO masers are circumstellar and CH_3OH masers are interstellar (Elitzur 1992). Fig. 1 presents color indices [A]-[D] vs. [A]-[E] associated with OH, H_2O, SiO and CH_3OH masers, respectively. Here, [A]-[D] and [A]-[E] denote $\log(F_D/F_A)$ and $\log(F_E/F_A)$. 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 H_2O 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)

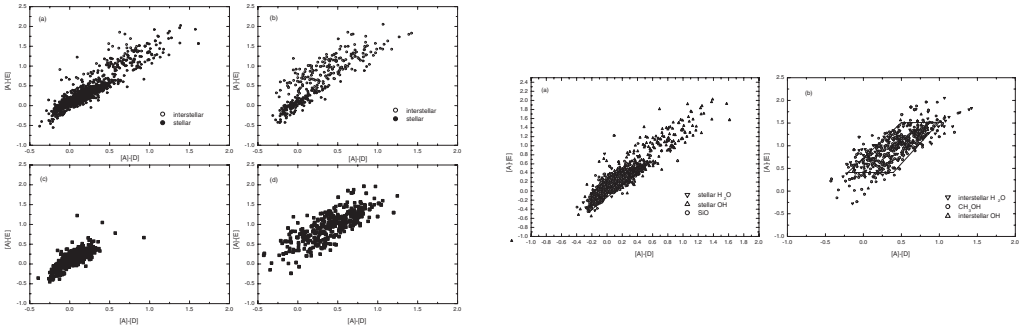

Figure 1. (Fig. 1; left) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with (a) OH (b) H_2O (c) SiO and (d) CH_3OH masers. (Fig. 2; right) (a) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with stellar OH, stellar H_2O and SiO masers. (b) MSX color-color diagram of [A]-[D] vs. [A]-[E] associated with interstellar OH, interstellar H_2O and CH_3OH masers.

and (−0.2,−0.4). Fig. 2b presents color indexes [A]-[D] vs. [A]-[E] associated with interstellar OH, interstellar H_2O and CH_3OH 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_2O maser, SiO maser and CH_3OH maser in the literature and selected MSX PSC sources within 1′ as the exciting sources. The results provide us new criterion to search for coexisting stellar OH, stellar H_2O and SiO masers and coexisting interstellar OH, interstellar H_2O and CH_3OH masers.

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