

**[7SF-05] A model of Photon Dominated Region(PDR) for the UV-heated outflow walls in the embedded protostellar objects**

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We have developed an self-consistent PDR model to synthesize warm CO lines of Herschel/PACS observations more accurately. The PDR model solves the FUV continuum radiative transfer, gas energetics, and chemistry simultaneously. A local FUV radiation flux is calculated by using a Monte Carlo method taking anisotropic scattering into account. A new  $(r, \delta)$  coordinate system was used, where the  $r$  is the distance from the origin and the  $\delta$  is  $z/R^2$  in the cylindrical coordinate of  $(R, z)$ . This is an adequate coordinate system to represent a power-law density of an envelope and a high spatial resolution near the outflow wall. The gas energetics and chemistry are solved locally and considered  $10^4$ K blackbody radiation field instead of the interstellar radiation field. This newly developed model can be used to analyze quantitatively the effect of UV-heated outflow walls on the warm molecular lines in the embedded proto-stellar objects.

**[7SF-06] Simultaneous 22GHz Water and 44GHz Methanol Maser Survey of Ultra-compact HII Regions**

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We have carried out simultaneous 22GHz H<sub>2</sub>O and 44GHz Class I CH<sub>3</sub>OH maser survey of 112 ultra-compact HII regions (UCHIIs) twice in 2010 and 2011. We detected H<sub>2</sub>O maser and CH<sub>3</sub>OH maser emission from 76(68%) and 49(44%) UCHIIs, respectively. Among them 15 H<sub>2</sub>O masers and 32 CH<sub>3</sub>OH masers are new detections.

These high detection rates suggest that the occurrence periods of both masers are significantly overlapped with the UCHII phase. CH<sub>3</sub>OH masers always have small (<10 km s<sup>-1</sup>) relative velocities with respect to the natal molecular cores, while H<sub>2</sub>O masers often show larger velocities. We find 20 UCHIIs with H<sub>2</sub>O maser lines at relative velocities >30 km s<sup>-1</sup>. The formation and disappearance of H<sub>2</sub>O masers is frequent over one-year time interval. In contrast, CH<sub>3</sub>OH masers usually do not show substantial variation in intensity, velocity, or shape. The isotropic luminosities of both masers well correlate with the bolometric luminosities of the central stars when data points of low- and intermediate-mass protostars are added:  $L_{H_2O} = 5.89 \times 10^{-9} (L_{bol})^{0.69}$  and  $L_{CH_3OH} = 4.27 \times 10^{-9} (L_{bol})^{0.62}$ . They also tend to increase with the 2cm radio continuum luminosity of UCHIIs and the 850 um continuum luminosity of the associated molecular cores. We discuss some individual sources.