WARM AND DIFFUSE GAS AND HIGH IONIZATION RATE NEAR THE GALACTIC CENTER

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Using 12 newly found bright dust-embedded stars distributed from 140 pc West to 120 pc East of Sgr A* [a], we have observed spectra of H_3^+ and CO in the Central Molecular Zone of the Galactic center. Sightlines toward the 12 stars have been observed at the Gemini South Observatory on Cerro Pachon, Chile, and those for 2 of the stars at the Subaru Telescope on Mauna Kea Hawaii [b]. This has extended our previous longitudinal coverage by a factor of 7. Although complete coverage of various transitions have yet to be made for some stars, almost all sightlines showed high total column densities of H_3^+ and highly populated $(J, K) = (3, 3)$ metastable level, demonstrating the prevalence of the warm and diffuse gas previously observed from the center to 30 pc East and high ionization rate in the environment. A few sightlines did not show strong H_3^+ absorptions. It remains to be seen whether this is due to the radial and transverse location of the stars or lack of H_3^+.

While the velocity profiles of H_3^+ toward stars from the center to 30 pc East are similar apart from subtle variations, the velocity profiles of the wider regions vary greatly [a]. A remarkable similarity has been noted between the velocity profile of H_3^+ toward a star nicknamed Iota and those of H_2O^+ [c] and $^{13}CH^+$ [d] observed toward Sgr B2 by the HIFI instrument of the Herschel Space Observatory. Although all these ions exist in diffuse environment, this is surprising since H_3^+ favors environments with high H_2 fraction $f(H_2)$ while H_2O^+ and CH^+ favors low $f(H_2)$. Also the peak of Sgr B2 and Iota are separated by 17 pc. Possible interpretations of this will be discussed.

[a] T. R. Geballe and T. Oka, ApJ, 709, L70 (2010).
[b] M. Goto, T. Usuda, T. R. Geballe, N. Indriolo, B. J. McCall, Th. Henning, and T. Oka, PASJ (2011) in press.
[c] P. Schilke, et al., A&A, 521, L11 (2010).
[d] E. Falgarone, private communication.