CHEMICAL MODELING Of O_2 IN INTERSTELLAR CLOUDS

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In cold cores of interstellar clouds, molecular oxygen cannot be detected at all down to rather low upper limits. This has been a problem for chemistry modelers since steady-state results of their models always give high O_2 abundances. In chemical models, the reaction between O and OH is the main source of O_2 formation. Experimental studies have shown that the rate coefficient of this reaction down to 39 K is 3.5×10^{-11} cm^3 s^{-1}, which is almost one order of magnitude lower than values used by modelers. Two recent quantum calculations with an accurate HO_2 potential surface have suggested that at 10 K, this rate coefficient is even much smaller. This small rate coefficient might inhibit the production of O_2 and explain the negative results for O_2 towards cold interstellar clouds. In this work, we show how the interstellar O_2 abundance is affected when the rate coefficient is decreased. Under standard O-rich elemental abundances, the calculated O_2 abundance is sufficiently low to lie below the observed upper limit only at early times with all the rate coefficient values we investigated. Under C-rich abundances, both early-time and late-time solutions are possible.