Large Atomic Oxygen Abundances observed toward Molecular Clouds

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Oxygen is the most abundant element after hydrogen and helium in the Universe. It is therefore of key importance to know in which form oxygen is found in the different phases of the Interstellar Medium. We performed ISO-LWS observations of the [OI] (63μm and 145μm) lines towards the molecular cloud L1689N (Caux et al. 1999) and the high mass star formation region W49N (Vastel et al. 2000). From the analysis of the [OI] lines using a LVG model, we derived the physical parameters of the regions (mean gas temperature and [OI] column density). Combining these observations with CO observations, we obtain [O]/[CO] $\sim$ 50 towards L1689N and larger than 15 towards the molecular clouds on the line of sight of W49N.

In both observed regions, the derived [O]/[CO] ratio implies that up to 98% of gaseous oxygen is in atomic form in the gas phase. If we assume that all the gaseous carbon is locked into the CO (a reasonnable assomption), carbon has to be depleted by more than a factor of 6 with respect to the cosmic abundance.

No standard chemical models predicts such large [O]/[CO] ratios, neither the pseudo-time dependent nor in the steady state limits. Also, evidence is now mounting that CO depletion is a widespread characteristics of molecular clouds. Modeling efforts and new observations are clearly needed to make progress in this field. The 3 focal plane instruments of FIRST will allow to do that at high sensitivity and spectral resolution. FIRST will be the only instrument able to observe accurately the [OI] 145μm line which is of prime importance as the [OI] 63μm is generally optically thick. Indeed, the tremendeous improvement in the observation of these lines from the KAO to ISO showed the necessity of a space based instrument.