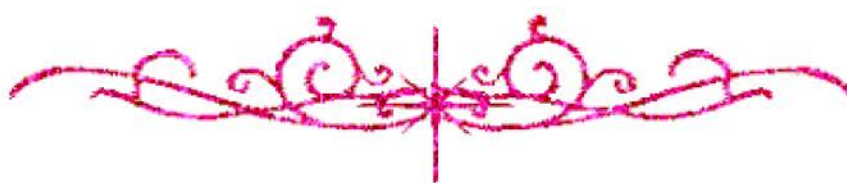


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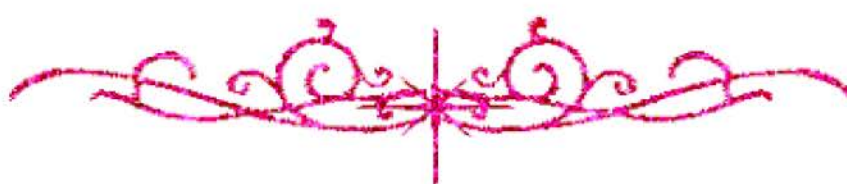
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شبكة المعلومات الجامعية



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

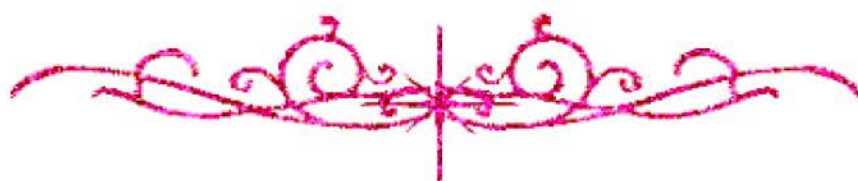
قسم

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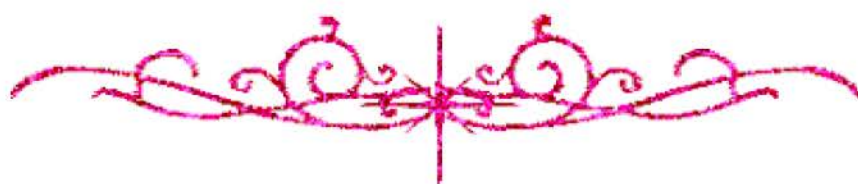
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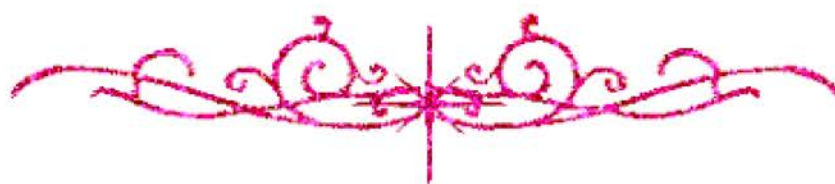
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بالرسالة صفحات لم ترد بالأصل



Ionization State Within interstellar clouds

THESIS

Submitted in partial fulfillment required for
the degree of **M.Sc in Astronomy.**
to Cairo University

By

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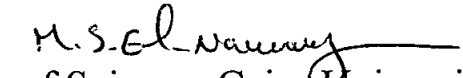
Ionization State Within Interstellar Clouds

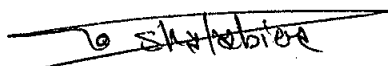
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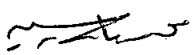
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Abstract

We have studied the chemical evolution in some interstellar clouds, focussing on their charge density. The objects that have been treated are of different physical and chemical structures. IC 63 is studied as one of the PDRs regions. TMC-1 and NGC 2264 are studied as examples of dense clouds. ζ Ophiuchi is considered as a famous example of a diffuse cloud. For each object the study includes the following points;

- 1- We discussed the main physical and chemical features of the object.
- 2-The calculated chemical abundances of atomic and molecular species are investigated and compared with observations.
- 3- The electron density and the dominant ionic species are also studied.

The main conclusions are summarized in the following:

In the photo-dominated region (IC 63 cloud), the chemical structure and ionization state depend directly on the intensity of the incident UV radiation. The electron density is also affected by the incident UV radiation. It decreases gradually with the increase of the cloud depth. It ranges between 5.9×10^{-5} , at the cloud surface, and 9.6×10^{-9} , at the cloud interiors. The ionic carbon (C^+) in the outer region dominates the electron density, while in the deepest region, the ionic metals and some other ions (H^+ , CH_2D^+ and HCO^+) are the most dominant.

In dense clouds, we have studied the chemical evolution in contracting interstellar clouds. Two cloud objects are studied, TMC-1 and NGC 2264. Most of the resulting fractional abundances are in good agreement with the observations. As expected, most of the observed species increase with ζ , in particularly the ionic species, hence the electron density. Most of the molecular species increase also with the increase of the initial abundance of PAH, while the electron density decreases. The effect of changing the abundance of deuterium on

the chemistry of TMC-1 is also tested. The charge density variation with increasing density during contraction is also discussed. The results indicate that the electron density decrease with contraction according to the simple relation $x(e) \propto n^{-k}$ with $k \sim 0.5-0.6$. The electron fractional abundance ranges between 2.2×10^{-8} and 6.7×10^{-7} in TMC-1, while in NGC 226, it ranges between 1.7×10^{-9} and 2.3×10^{-8} .

In the diffuse cloud (ζ Ophiuchi), the chemistry has been investigated with changing the intensity of UV radiation, the temperature and the dust grain effects. We get reasonable results as we simulate the effect of grain surface chemistry. The ionization state is dominated by the ionic carbon C^+ and metal ions. The photo-ionization of neutral carbon is a significant source of the gas phase ions. The fractional abundance of electrons ranges between 4.5×10^{-5} and 1.4×10^{-4} . It also found that $x(e)$ increases with the increase of both the intensity of UV radiation and the temperature.

CHAPTER 1

GENERAL INTRODUCTION

Chapter 1

General introduction

There are many various clouds of interstellar matter that fills our Galaxy. These clouds have different physical properties and chemical structures, based on the observations of various kinds of radiation emitted and absorbed by atoms and molecules. Theoretical modeling of the chemical evolution of both stable and collapsing interstellar clouds is crucial for understanding astronomical observations, which, in turn, are useful diagnostic probes of astrophysical environments. From these models, we can understand the chemical evolution of different clouds. For stable interstellar clouds, pseudo-time dependent models are used to describe their chemical structure at any given time. For collapsing clouds, the so-called real time dependent model is used in which the dynamical and chemical evolutions of the cloud are going simultaneously. These models allow us to predict the existence and abundances of observed and unobservable species.

In this introduction, the main outline of this thesis is summarized in Section (1.1). We review the numerical treatment of the chemistry and the dynamics in Sections (1.2) and (1.3), receptively.

1.1 Main outline of the thesis

In this study we focused on the chemical structure of interstellar clouds, in particular, the ionization-state of these clouds.

In Chapter 2, models of photo-dominated region (IC 63 cloud) are achieved by pseudo time-dependent model. We explained the main features of the chemical composition and the morphology of this cloud. Our results of column densities of different species are compared