

Constituents of the ISM

This will include the following topics:



Info: This should serve as a review/check of what you heard in the lecture and have to read in the book. Fill out the gaps on your own and proof your answers with the lecture notes or the book.

1 Introduction

In order to describe and understand the Interstellar Medium, we will need a description and considerations of the physical components that make up the medium between the stars in our galaxy. The main ingredients are:

1. Baryonic Matter

(a) *gas*

The gas consists of ions, electrons, atoms & molecules in the gas phase. We find the velocity distributions to be near thermal. We can differentiate between:

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-
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(b) *...*

These are small, solid particles ("smoke") that mix with the interstellar gas. They have a size of $\sim 1 \mu\text{m}$.

(c) *cosmic rays*

..... ions & electrons with energies up to 10^{21} eV coming from random directions.

2.

The ISM is affected by photons from various sources, including:

- cosmic microwave background (CMB);
- stellar emission;
- emission from ISM gas (thermal, free-free, synchrotron, ...)

3. Magnetic Field

Results from electric currents in ISM. Cosmic rays get scattered due to the magnetic field. However, usually not strong enough to be dynamically important for ISM.

4.

The accumulation of the mass of the stars, gas & dark matter in the galaxy produces this field.

5. Dark Matter

It is currently unknown how the dark matter particles interact non-gravitationally with the baryonic matter in the ISM or the the magnetic field. Potential (non-gravitational) interactions are weak enough to be neglected in the study of the ISM.

The full description of the ISM rather complex because there are:

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About ... % of the baryons in our Milky Way are estimated to be in the ISM and there is a constant inflow and outflow of mass going on.

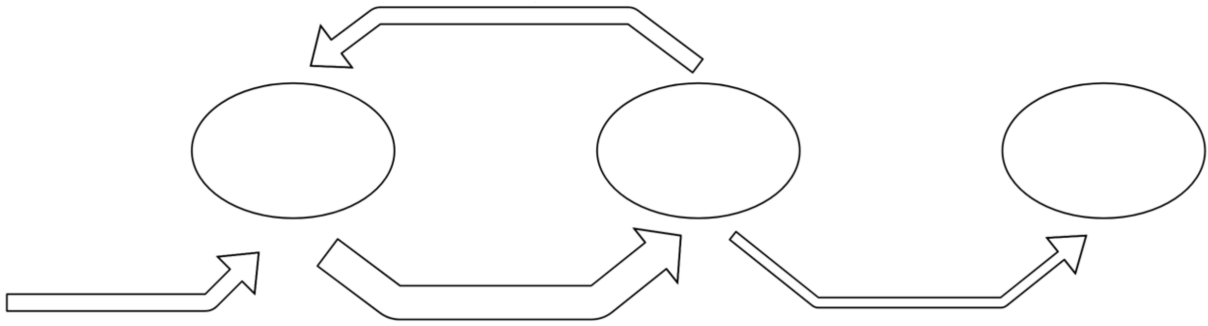


Figure 1: The cycle of baryonic matter in the Milky Way.

1.1 Elemental Composition

The composition of the ISM is slightly different from gas from the Big Bang, as it is constantly being enriched by stellar feedback. It has a slightly lower H, but higher He and heavier elements from C to U abundance. The exact composition is dependent on the galaxy itself, the position within the galaxy and time. Figure 2 show the abundances of the elements as found in the sun.

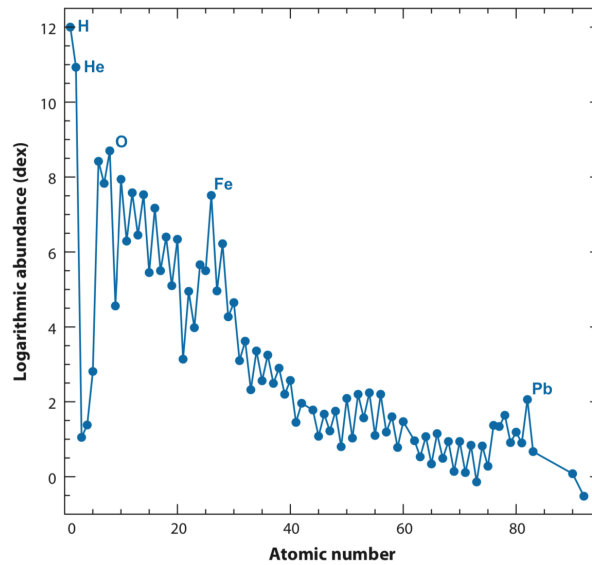


Figure 2: Solar chemical abundances, thought to be representable of the ISM abundances in the solar neighbourhood. Figure adopted from Asplund et al., 2009.

1.2 Interstellar Dust