Did you know?

Star chemistry

About the Interstellar Medium

The Interstellar Medium (ISM) is the space between the stars. When astronomers first looked at space, they only saw stars and planets becuase their telescopes were not powerful enough to see anything smaller. For years, the Interstellar Medium was thought to be cold and full of gas waiting to become stars. Later, astronomers built telescopes powerful enough to look at all areas of space. They noticed that ISM was not always the same - some areas appeared dark, others coloured. We know today that the ISM forms clouds called 'diffuse' and 'dense'. In diffuse clouds, the gas density is about 100 million atoms per m^3 (compared to more than the many millions of molecules per m^3 in breathable air). In dense clouds the gas density is 100–1000s of times higher than in diffuse clouds. The temperature in both is very low, between 10–30 K (-263 – -243 ^{o}C). Ultraviolet light (UV) light from nearby stars can get inside diffuse clouds but not dense clouds. In dense clouds, molecules (mainly water) can stick on the surface of dust grains, covering them with an 'icy mantle'. In diffuse clouds, dust grains stay bare because molecules are removed by UV light. Now, astronomers think that understanding chemical reactions in the ISM is very important for developing knowledge about the universe. The ISM is a bit like a soup of atoms and molecules, being stirred and heated up.

Questions

1. The pictures show that atomic and molecular hydrogen is in the ISM. What type of bond forms between two hydrogen atoms? Explain how this bond forms. Draw a dot and cross diagram of the hydrogen gas molecule.

2. Hydrogen atoms are tiny and much further apart than particles are in air. Explain why it may be more difficult for molecules to form in space than in the Earth's atmosphere.

3. Scientists do not know how the hydrogen atoms get close enough to make bonds between them. What is in the black part of the sky that might be involved?

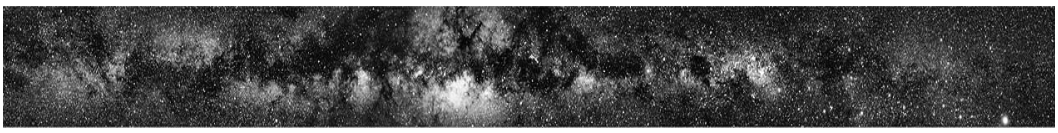

Figure 1 Section of Milky Way: Visible light
Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Axel Mellinger, University of Potsdam, Germany).

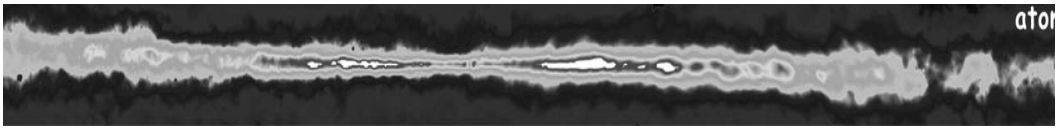

Figure 2 Section of Milky Way showing atomic hydrogen
Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Dap Hartmann, Leiden observatory, Netherlands).

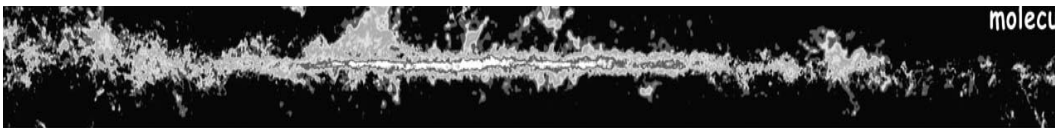

Figure 3 Section of Milky Way showing molecular hydrogen
Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Axel Mellinger, University of Potsdam, Germany).

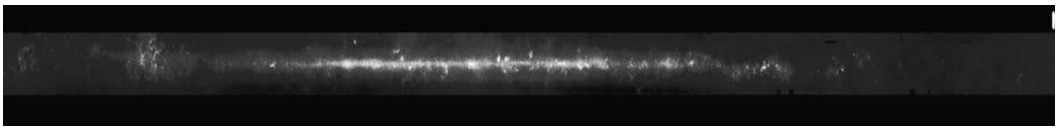

Figure 4 Section of Milky Way showing complex molecules under infrared
Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Steve Price, Air Force Research Laboratory, Hanscom, Massachusetts, USA).