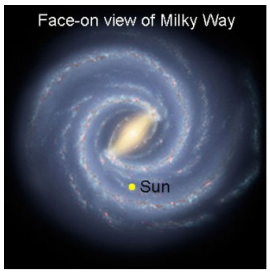
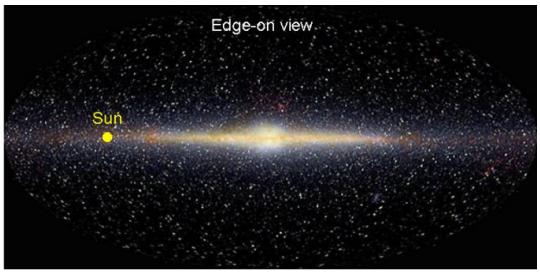
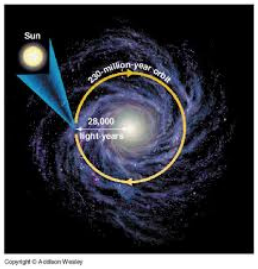
Sun – Part 5 - position and orbit





Sun's position in the Milky Way



Sun's orbit

Milky Way galaxy

The Milky Way galaxy is huge, around 100,000 light years (ly) across. It is known to be a spiral galaxy, with a central disk surrounded by a series of spiral arms. However, observations of its structure and measurements of the spiral arms are hampered by obscuring dust in the disk and the difficulty of estimating massive distances from within the structure.

The Sun is just one of around 200 billion stars within the galaxy. While the oldest parts of the Milky Way are estimated to be from 12-14 billions years old, the Sun, aged around 4.6 billion years, is one of the many younger stars in he galaxy.

Stars are classified into three populations on the basis of certain physical characteristics. Population lll stars were the oldest, and Population l stars are the youngest. The Sun is a Population l star: it lies in the thin disk which surrounds the central core of the Milky Way, it follows a roughly circular orbit, and it has a high content of heavy elements (those heavier than hydrogen and helium). The latter feature is a result of the availability of these elements released by dying older Population ll stars.

Position in the Milky Way galaxy

Within the galactic disk, the Sun currently lies close to inner rim of the Orion arm in the Local Interstellar Cloud (Gould Belt), 25,000-28,000 light years (ly) from the galactic centre. The Orion arm is positioned between the inner Sagittarius arm and the outer Peruses arm. The distance from the Orion arm to the Peruses arm, is about 6,500 ly. The Sun is contained within the Local Bubble, a space of rarefied hot gas, possibly produced by a supernova remnant.

The Sun and its planets are found in the galactic habitable zone, the region of a galaxy in which life is most likely to develop. It is hypothesised that such regions incorporate various factors, including the rate of major events like supernovas and the presence of elements heavier than hydrogen and helium ie metals which increase the likelihood of formation of the rocky planets suitable as locations for the development of life. The rate of major catastrophic events, like supernovae, and star numbers which can initiate avalanches of comet and asteroid impacts and liberate damaging levels of radiation are also important. This rate needs to be enough to liberate necessary amounts of heavier elements, but not so much that they pose a threat to any evolving life. In this respect, the Sun is in an advantageous position, being located on the edge of a spiral arm where stellar densities are relatively low.

Solar orbit

One solar orbit through the Milky Way, a galactic (or cosmic) year, takes about 225-250 million years to complete. So far, the Sun would have completed 20-25 orbits. Its orbit

around the galaxy is predicted to be roughly elliptical, with addition of perturbations due to the spiral arms and non-uniform mass distributions. It also oscillates up and down relative to the galactic plane approximately 2.7 times per orbit.

The orbital speed of the solar system is around 250 km/sec. It, thus, takes the Sun and planets around 1,190 years to travel 1 ly, or only days to travel 1 AU. The direction towards which the Sun travels through space within the Milky Way relative to other stars is called the solar apex. As a result of this motion, stars seem to be converging towards a point in the opposite direction, the solar antapex. The direction of the solar apex cannot be defined precisely because of the random motions of the stars themselves. The general direction of the Sun's galactic motion is towards Vega (Lyra) at an angle of around 60 sky degrees to the galactic centre.

Some have noted that mass extinctions on Earth have often coincided with the Sun's passage through the higher density spiral arms, possibly due to associated impact events.

Sources: Ridpath, I (Ed) (2012) Oxford dictionary of astronomy 2nd ed rev, www.en.wikipedia.org,