What's Out There

A Quick Tour of The Universe

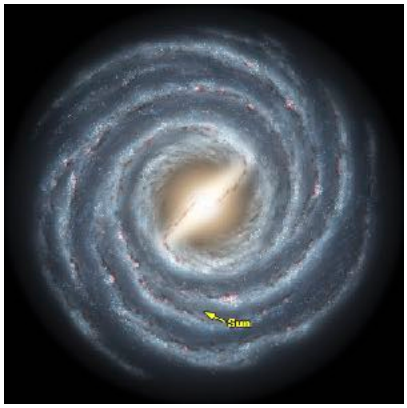
Before we begin I must give you my "disclaimer" that I am an amateur astronomer, not a "real" one. It is my opinion that there are two types of astronomers in the amateur world; scientific and esthetic. I fall into the later category. I observe in order to see the sheer beauty and wonder of what's out there. I hope that after this presentation you too will seek out our celestial wonders.

Also, before we get started, you need to know what a light year is. A light year is a measure of distance not time. A L.Y. (light year) is 5.8 trillion miles, often rounded to 6 trillion miles to make the math "easier."

A part of a prose work by the late Robert Burnham Jr. with which he begins a three volume work which he calls his "Celestial Handbook" nicely sets the stage for our tour

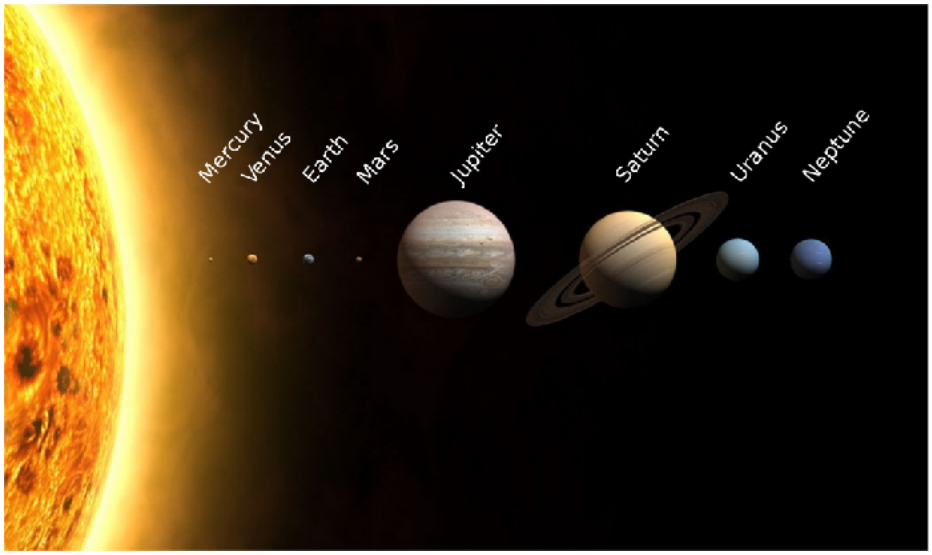
"Look, skyward now…. And see above… INFINITY vast and dark and deep and endless…. Your heritage: Silent clouds of stars, other worlds uncountable and other suns beyond numbering, and realms of fire-mist and star-cities as grains of sand…. drifting… across the void….across the gulf of night…. Across the endless rain of years…. Across the ages. Listen! Were you the star born you should hear that silent music of which the ancient sages spoke Though in silent words… Here then is our quest and our world and our home. come with me now pilgrim of the stars, For our time is upon us and our eyes shall see the far country and the shining cities of infinity which the wise men knew in ages past, and shall know again in ages yet to be."

Let us begin close to home i.e. our own Solar System within our own Milky Way galaxy.



At its center is our sun, a rather ordinary star as stars go, classified as a G2 dwarf star. It's about 93 million miles from Earth. Fortunately for us, we are in what astronomers call the "Goldilocks Zone:" Not too hot and not too cold for life as we know it to survive. 93 Million miles sounds like a long way and it is. Even traveling at the speed of light, a solar photon would take about 8 1/2 minutes to get here. So if the Sun were to wink out, we would not know it for those 8 1/2 minutes.

Next, let's examine the relative scale of our Solar System.



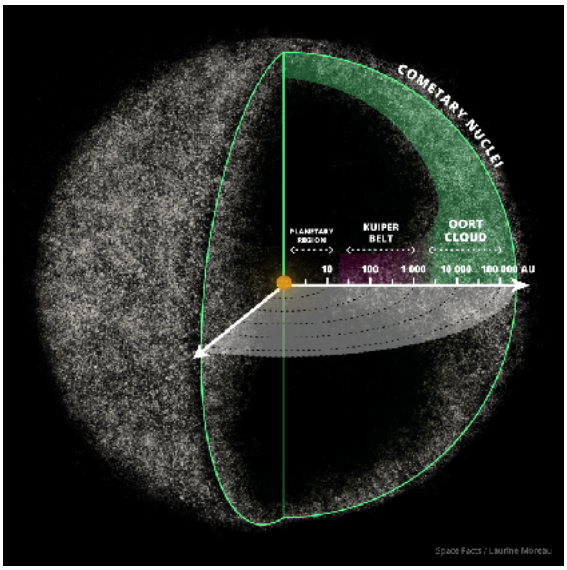
The four inner planets are rocky planets. Poor Mercury and Venus. Both are barren and broiling hot. Earth is, as I said, in the "Goldilocks Zone." And Mars, seemingly barren and cold, lost its strong magnetic field early on and had its atmosphere stripped away by the solar wind. The remaining four are gas giants with unbreathable atmospheres and crushing gravity. Between the inner and outer planets is the Asteroid Belt. It's kind of the junk yard of the inner Solar System. The massive gravitational effect of Jupiter and Saturn keeps most of it relatively in place but every once in a while one comes by to pay us an uninvited visit, either waving as it passes by of dropping in for dinner. I believe most of you are familiar with Meteor Crater in Arizona. Its impactor was only about 160 feet in diameter leaving a hole just under 3/4 mile in diameter and 560 feet deep. Then, of course, there is Chicxulub Crater down on the Yucatan. This one was a bit bigger than Meteor Crater's impactor. Chicxulub's is estimated to have been between 6.8 and 50.3 miles across and left a hole 93 miles wide and 12 miles deep.

Meteor Crater

Chicxulub Crater

As we travel farther outward beyond the gas giants, we come to the Kuiper Belt (K.B.). This is where our former ninth planet Pluto is to be found.

The Kuiper belt is the "junkyard" of the outer Solar System. It's made up of bodies of mostly ice and some rocky debris orbitally influenced by the gas giants, particularly Uranus and Neptune. Rather than being a "belt" similar to the Asteroid Belt its shape is more like a crumbly donut. It is thought that the gravitational effects of the orbits of Neptune and Uranus kept the debris in the Kuiper belt from coalescing into one or more large planets. Astronomers estimate that there are hundreds of thousands of these rocky/icy objects in the K.B. ranging in size from around 45 miles to 60 miles in diameter. There are likely some that are larger but the K.B. remains a relatively unexplored area. Also, the K.B. is thought to be the home of the long conjectured "planet X."



At nearly 4 billion miles we still haven't left our Solar System. There remains the Oort Cloud. This is a sphere of mostly icy bodies that surrounds our Solar System. This is the home of the comets. It's possible that a comet could come from somewhere

beyond the Oort Cloud but so far it seems that our regular ghost like visitors come from the Oort Cloud.

From our little Solar System we move out into our galaxy, the Milky Way, and its neighbors in the Local Group. Our home galaxy is roughly 100,000 light years across and contains 200 billion+ stars. It is now thought to be in the form of a barred spiral disc with an elliptical central bulge 12,000 light years in diameter. If you are familiar with the "Tea Pot" asterism in the constellation Sagittarius, look at the area just above the spout you will be looking roughly toward the center of our galaxy.

Our local group consists of over thirty galaxies, large and small, spread over an area of about 10 million light years in diameter. The "center" of the group is somewhere between the Milky Way and Andromeda galaxies. The largest in the group is Andromeda, second is the Milky Way and third is M33, the Triangulum Galaxy.

Andromeda Galaxy at 2.5 million light years is the farthest object in space observable with the naked eye. On a clear, still, dark night you can see its faint smudge glowing between the constellations Cassiopeia and Andromeda.

Galaxies come in all shapes and sizes. From beautiful classic pin-wheels to barred spirals like that in the opening photo. Some appear as irregular cottony balls of mist while others are giant balls of dust and light like Centaurus A.

Galaxies are in constant motion moving across space and in time cannibalizing smaller galaxies and being cannibalized by larger galaxies. The Milky Way's next meal will likely be the Large Magellanic Cloud (visible from the southern hemisphere). This will take place in about 2.5 billion years. The big event will be in about 4.5 billion years when the Milky Way does a cosmic dance with Andromeda Galaxy. There are three scenarios for this event. Either they will spin round each other trading gas and dust, triggering new star formation in both and then spin apart, or Andromeda will "eat" a good size piece of the Milky Way and spin off, or Andromeda and the Milky Way will merge into one very large galaxy. You might be thinking of massive star collisions during this cosmic crash. But it's not very likely as the distances between stars is so great physical contact is remote. Gravity and motion will be the big movers and shakers.

And then we have nebulae. Nebulae are formed in two ways; dust and gas being being blown about and "clumping" together until enough material is aggregated to ignite the gasses and a star (or stars) begins to form. The Orion Nebula is an example of this. You can see it with the naked eye on a clear night. It appears as the middle "star" in Orion's sword.

Another type is called a planetary nebula. These are formed by a star going nova or super nova. A good example of this type is the Crab Nebula also known as M1.

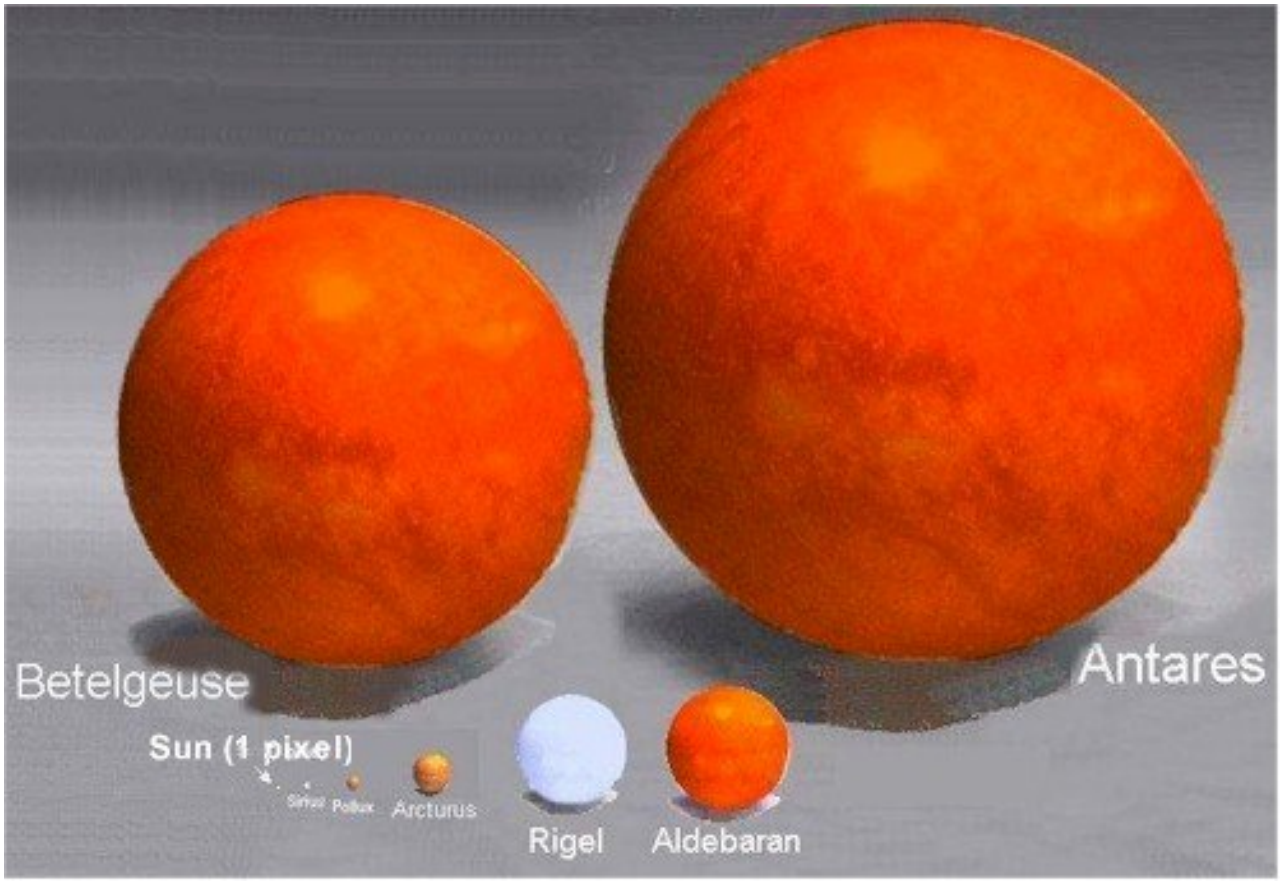
The Crab Nebula was formed when a star went super nova in AD 1054. It was so bright that it was visible during daylight. It was recorded by Chinese,

Japanese, Korean and Arab astronomers and some petroglyphs in the western U.S. point to it having been seen by native Americans.

Some planetary nebulae are created by a star going nova and blowing off just the outer shell of gas. The Helix Nebula is an example of this.

In this image you can see what is left of the central star which cast off its outer shell approximately 10,000 years ago. Its appearance is very striking and once seen, with your own eye, is not to be forgotten. It is also often called “the eye of God.”

Here we should talk about stars. Our sun is obviously quite a bit larger than our planets — even mighty Jupiter. Now let’s compare our sun with some of the larger stars we know of.



Just like us, stars have a certain life span. And just like human beings, their composition and "life style" plays a major role in their longevity. The image above shows us some red giants. Note that our Sun only shows as a mere pixel when compared to these. There are also blue giants. Blue giants tend to be very hot and very active, many spinning so fast that they distort into an oblate spheroid shape. They also tend to burn out when relatively young. Our own sun has about four and a half billion years to go before it grows to be a red giant, expanding its surface out to about the orbit of Mars.

To look at a single star even through the Hubble Space Telescope would only reveal a bright point of light just as you would see it with the naked eye — only a little larger. The real beauty of stars is seen when you view clusters of them. There are three types of star clusters globular, open and apparent. Globular clusters contain several hundred to tens of thousands of tightly packed stars most of which are relatively old.

Open clusters, on the other hand, generally contain between 75 to several hundred stars in a loose aggregation. Some examples are Omega Centauri, a globular, and the Pleiades (also known as the Seven Sisters) an open cluster.

Omega Centauri

Pleiades

As if all the preceding wasn't wondrous enough, we now come to some of the real oddities in the universe. The late scientist J.B.S. Haldane once said "now my own suspicion is that the universe is not only queerer than we suppose but queerer than we can suppose."

Pulsars. The prevailing theory describes a pulsar as a celestial object, thought to be a rapidly rotating neutron star, that emits regular pulses of radio waves and other electromagnetic radiation at rates up to one thousand pulses per second. These pulses are emitted from the poles of the star and are detectible only when the poles are "pointed" toward Earth. Neutron stars are quite small, somewhere between 12 and 25 miles in diameter and consist of densely packed neutrons. The hypothesis is that they form in the aftermath of a super nova when the remaining solid elements of the star gravitationally collapse into a dense ball. It

is thought that it is so dense that a cubic centimeter would weigh something near a million tons.

Another form of neutron star is the Magnatar. Like other neutron stars, Magnetars are around 12+ miles in diameter and have a mass roughly equal to 1–2 times that of our Sun. The density of the interior of a Magnetar is such that a tablespoon of its substance would have a mass of over 100 million tons. The gravity of such an object is, of course, immense. Magnetars are different from other neutron stars in that they have much stronger magnetic fields, and rotate faster. Most neutron stars rotate once every one to ten seconds, whereas Magnetars rotate once in less than one second. A Magnetar's magnetic field emits very strong bursts of X-rays and gamma rays. The active life of a Magnetar is short. Their strong magnetic fields decay after about 10,000 years, after which most activity and strong X-ray emissions cease. Astrophysicists estimate the number of inactive Magnetars in the Milky Way at 30 million or more. The only object that comes close to, and indeed exceeds, this level of gravity is a black hole.

Black holes. These are the stuff of some great science fiction plots but they are very real! It is now thought that every major galaxy has at its heart a super massive black hole. The following is a quote from NASA's web site:

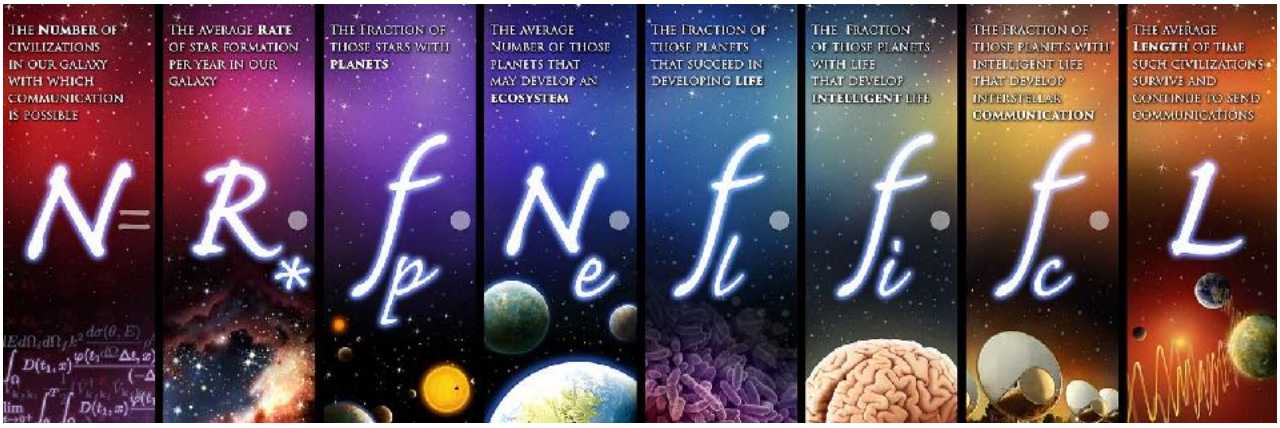
"Don't let the name fool you: a black hole is anything but empty space. Rather, it is a great amount of matter packed into a very small area - think of a star ten times more massive than the Sun squeezed into a sphere approximately the diameter of New York City. The result is a gravitational field so strong that nothing, not even light, can escape. In recent years, NASA instruments have painted a new picture of these strange objects that are, to many, the most fascinating objects in space.

Scientists can't directly observe black holes with telescopes that detect x-rays, light, or other forms of electromagnetic radiation. We can, however, infer the presence of black holes and study them by detecting their effect on other matter nearby. If a black hole passes through a cloud of interstellar matter, for example, it will draw matter inward in a process known as accretion. A similar process can occur if a normal star passes close to a black hole. In this case, the black hole can tear the star apart as it pulls it toward itself. As the attracted matter accelerates and heats up, it emits x-rays that radiate into space. Recent discoveries offer some tantalizing evidence that black holes have a dramatic influence on the neighborhoods around them - emitting powerful gamma ray bursts, devouring nearby stars, and spurring the growth of new stars in some areas while stalling it in others."

And then there are quasars. Quasars are the brightest and most distant objects in the known universe. They are very mysterious objects. Astronomers today are still not sure exactly what these objects are. I have seen quasar 3C273 through my own four inch telescope. It appeared as a tiny, almost indistinguishable point of light — not very impressive. Not very impressive until you realize that the photons your eye is seeing started their journey before oxygen had formed on the Earth. 3C273 is roughly two billion light years away.

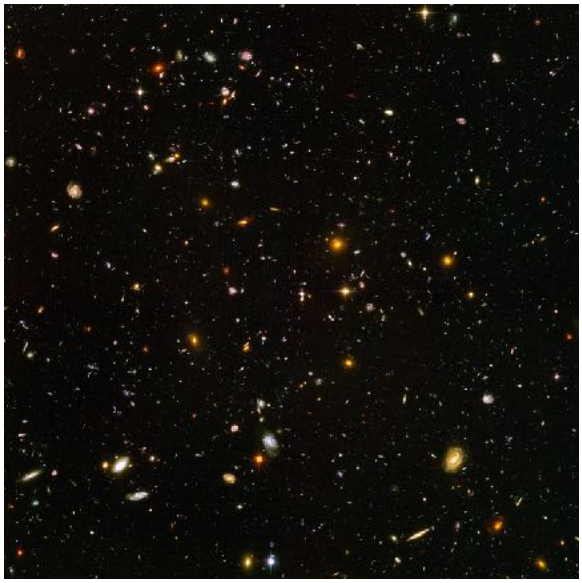
Some theories suggest that quasars are a form of very early galaxies. Their brilliance likely caused by a super-massive black hole violently stirring its surrounding matter. The only thing we currently know for sure is that no one knows for sure.

This ends our little "quick tour." Usually at this point someone raises the question "are we alone?" Recent estimates now put the number of galaxies in the known universe at somewhere around 2 trillion. In 1961, radio astronomer Dr. Frank Drake formulated an equation by which other scientists might estimate the number of technological civilizations that may exist in just our galaxy. The equation identifies specific factors thought to play a role in the development of such civilizations. As the elements of the equation move to the right, the more speculative the assumptions become.



While the equation is highly speculative it is a generally accepted tool used by the scientific community to examine these factors.

So — are we alone? My personal opinion is that we are not — not in our galaxy and certainly not in the universe. Have we been visited? Well… I maintain a skeptical but open mind.



In this image the Hubble Space Telescope was pointed at a dark and rather uninteresting part of the sky. The area photographed is equivalent to the area of sky you would see looking up through a soda straw. In this image there are 10,000 points of light and each of those points of light is a galaxy. So, are we alone? What are the odds?

As we contemplate all this, now realizing that our sprawling Milky Way galaxy doesn't register as even a pixel on the great screen of the universe, and our Earth not as big as a dust mote we might consider our place and like the 14th century mystic and theologian Meister Eckhart conclude that there is life that we do not know of and ask how aware are we of all consciousness in this universe? What percent of space is this earth in the infinite realm? What percent of time is one second in eternity?

Earth: Carl Sagan's "Pale Blue Dot," a mote of dust, floating in a sunbeam.
Look again at that dot. That's here. That's home. That's us.

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Jim Sommer

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