Sun-Earth Day Highlights – Essays 66 - 69

[Opening Sound Clip]

[Troy Cline]
Over the centuries, there have been many important moments in the discovery of our sun as a star, and its influences upon Earth. This year, 2009, marks an interesting confluence of several of these important anniversaries in our understanding of the sun-earth connection. It is the **400th Anniversary** of Galileo Galilee having first sighted sunspots in 1610 using a telescope barely more powerful than a good pair of modern binoculars.

[sound clip]

I'm Troy Cline and in today's podcast we'll be hearing from Dr. Sten Odenwald, the chief author and editor of the Sun-Earth Day Technology Though Time series. Sten will fill us in on the most recent additions to the collection: The Chemistry of Stars , Happy Anniversary , Stellar Explosions; When good stars go bad and Star Mass; From Brown Dwarfs to Supermassive stars .

Now before we get started I want to tell you about the new Sun-Earth Day Facebook page that you can access from the Sun-Earth Day home page. Facebook is a free-access social networking website where you can connect and interact with other people who have already joined the Sun-Earth Day network. It's the perfect place to share ideas, ask questions and keep up with the latest Sun-Earth Day events.

So without any further delay…Here's Sten

[Sten Odenwald]

Figuring out the chemistry of stars is really one of the coolest things that astronomers have done in the last 200 years. It used to be that people thought that it was impossible to know what a star is made from, and for thousands of years people thought stars was made out of a strange, perfect essence that was full of light.

Back in the 1800's the spectra scope was invented and used for the first time to look at the light from stars; and low and behold they found that stars were emitting light that was similar to the elements that we know about, with the exception of a few. Figure 1 in the Technology Through Time essay #66 shows you what the spectra of the Sun looks like as sort of of top image. You see a wonderful rainbow of light that you get with a prism. But with a particular type of instrument you can see also see these very dark lines that cut across the spectrum. The neat thing is that those lines are not random. Each element has its own pattern of lines. By knowing the pattern that each element produces you can figure out what the more common and excited elements are in the atmosphere in different stars. People used to think that the elements you see in the spectra scope are the main constituents of the star. But it turned out that in the early 1900's there was a complicated relationship that was found between the temperature of a star and the strength and brightness of certain lines that you see. So it's a bit more complicated than just looking at the lines to figure out what a star is made from. I think it's cool none-the-less that you can do that with a spectra scope.

The next essay is an anniversary essay talking about some interesting anniversaries that happened 2008-2009. Of course Galileo's first use of the telescope that he created to look at astronomical objects; that is a 400^{th} anniversary event and without a telescope we wouldn't know a whole lot about the stars, the planets, and sunspots. The other curious anniversary is the 365^{th} anniversary of the start of Maunder Minimum. That was a period of very cold temperatures in norther Europe and England that, we think, was caused by the fact that there were no sunspots on the Sun, or no solar cycles that were observed for as much as 70 years. It was a strange circumstance. We don't quite know why that happens; and who knows, one could be in our future. I think one of the more interesting ones at least in my mind is this 2009 is also the 150^{th} anniversary of a major solar super storm that happened back in 1859. It was quite a dramatic storm. The kinds of aurora that were observed were seen all the way down in Cuba and the equatorial zone of the earth; which is a very odd and rare circumstance.

Beyond that we have essay #68: "Stellar Explosions: When Good Stars go Bad". It turns out that stars are not always behaved sometimes they flare up in brightness. Very often this can be caused by solar flares, similar to the type we see on the Sun but on a much larger scale. The super flare that we had in 1859 was an example of a modest flare for a G-type star. There are other stars that have even more spectacular flares that actually increase the luminosity of the star by 10 to 100 times or more. That is quite an enormous increase. If the Sun were to increase its luminosity by a factor of 10 the earth would largely be annihilated and uninhabitable. All of the icy bodies in the outer solar systems would instantly be melted and have very large oceans. So we have to be very thankful that our star, the Sun, is not the kind of star that belches out one of these super flares from time to time. The essay points to other types of stars that do become "flare stars", as we call them. Even our nearest star, Proximus Centauri, only 4.2 light years away is a red dwarf star; it produces flares that are about 10,000 times more intense than anything our own Sun produces. So even though it's a dwarf star compared to the Sun, it produces flares that are quite respectable, and in our particular case would be quite lethal to us if we lived there.

The next essay is about Star Mass. The whole question: How does the mass of our Sun (the nearest star) compare to the masses of other stars in the universe? We talk about things called super massive stars which are hundreds of times the mass of our own Sun. We think that the earliest generations of stars that formed after the big bang were super massive stars. They would explode and super novae within about a million or so years after formation. In our Milky Way galaxy we have probably a few dozen of these types of stars. It's very hard to make a star that has a mass that is a hundred times the mass of the Sun. The largest star that we know about is near the galactic center and is called the Pistol Star. It's obscure to me as to why it is named that, but an astronomer called it that because the nebulae surrounding the star looks like a pistol. We also have stars that are called brown dwarfs. These stars are maybe only maybe 20-30 times more massive than Jupiter is. There is some discussion about where the limit is for stars in terms of their masses. If they're about 50-80 times the mass of Jupiter, these things generally are massive enough to generate thermonuclear reactions in their cores. Things that are less massive than that we call Brown Dwarfs; and they are probably closer to being massive planets than they are to being stars. So the masses for stars can range over quite a range but the luminosity and brilliance of stars has a much wider spread from a thousandth the luminosity of our Sun up to ten million times. So mass is amongst the things that we talk about with stars that kind of have the narrowest range in terms of possible values. So this essay gives you a general idea of how that runs and how our own star the Sun fits into the grand scheme of things.

[Troy Cline]
I'd like to give a special thanks to Dr. Sten Odenwald for joining us today. When visiting our website you'll be able to browse through all of our Technology Through Time essays.

We're very interested in hearing your questions and comments. If you have something to say, just send an email to sunearthday@gmail.com .

For all other details about the Sun-Earth Day program including information about our past SED themes be sure to visit our website at sunearthday.nasa.gov.
While there, don't forget to register in order to receive Sun-Earth Day updates!
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Sun-Earth Day is brought to you by the Sun-Earth Connection Education Forum and the Space Sciences Laboratory at U.C. Berkley.