Sun-Earth Day Highlights – Happy New Year

[Opening Sound Clip]

[Troy Cline]

The realization that a star like our sun is a heated body took many thousands of years. Eventually its temperature was determined to be around 11,000 degrees Fahrenheit. Astronomers classify our sun as a G2 dwarf star on the basis of its temperature, power and details of its spectrum. Now with that in mind, how do astronomers gain the information they need in order to classify other stars?

[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 65th Technology Through Time mystery, "Surface Temperature and Spectral Class".

[Sten Odenwald]
Well the current essay in Technology Through Time is about surface temperate and spectral class. It sounds somewhat strange but we're talking about how astronomers figure out the surface temperature for stars and how the surface temperature relates to the classification we give to stars. For instance, our own sun is a G-type star with a surface temperature of 5770 degrees Kelvin.
So how is it we figure this out for the other stars in the sky that we can't go to and stick a thermometer into. The essay begins with the whole idea of the Sun emitting energy. We can go back to the time of ancient Egypt when pharaoh Ahknatun actually created an entire religion that talked about the heat emanations from the sun as being actually extremely mystical and exciting. Well today we actually measure those heat emanations.
As the Technology Through Time essay describes, the emanations are not random in energy or wavelength but they form a patter. We can actually use that pattern, called the plank black body curve, to figure out the temperature of the sun. In fact, we can do that for any object that is heated that gives off electromagnetic radiation.
I think, as an astronomer, this is one of the most amazing things in physics; that you can look at the color of something or the heat emanations, the electromagnetic energy of an object, and figure out how hot the thing is within a fraction of a degree.
Of course in Astronomy we want to do that for other stars because we want to see just how peculiar our own star is. As it turns out it is a pretty average star and there are quite a few that are much colder. In fact some of the red super giant stars are down there at about 3600 degrees Kelvin. But there are also stars that are extremely hot like white dwarfs, for instance, they can be up to 50,000 degrees hot at their surface. In between we have essentially all the rest of the

stars in the sky and most of them are at about five to ten thousand degrees Kelvin and that constitutes most of what we see in the sky as stars.
The other things we can do with stars is we can look at the spectra. You take the light from the star and break it up into its colors. You'll discover these spectra have a number of lines in them; you can think of them as barcodes and each one of the codes represents the barcode for a particular element. So we can use atomic fingerprints that we see in starlight to also help us classify the stars.
So the whole intent of the Technology Through Time essay, number 65, is to talk about how we use basic physics principals to measure the surface temperatures of stars like our sun, determine their spectral classes and put our own sun into a broader context of not just an isolated body that just happens to be near us in space; but also as a member of a much larger population of incandescent self luminous bodies in the universe.
The images that we have for this section are fairly straight forward. We have an image that shows the point curves for a selection of temperatures and you can see the very coolest things they tend to peak in the red part of the spectrum and the very hottest things tend to peak in the blue part of the spectrum. Hence when you look at an object that is blue hot it is much hotter that is something that is only red hot. Even though colloquially we keep thinking in terms of red hot as being incredibly hot. In fact, it isn't.
Also there is some images of stellar spectra in the various classes from O to M. The spectral class sequence is actually kind of interesting; it was developed roughly the turn of the nineteenth century by Harvard Astronomers and workers based on something like one hundred spectra that were taken of stars in the sky. They noticed they could put these spectra in classifications in a particular order. Originally they had twenty six letters to the alphabet and twenty six spectra in classifications in a particular order. They eventually discovered that many of these classes were redundant to each other. Now we have the sequence O, B, A, F, G, K, M as sort of the principal spectral classifications for stars and there have been many pneumonic that have been developed through this particular odd sequence of letters. I can't repeat many of them because some of them are really pretty strange; and dated from very early times. They were developed by under graduate students to help them cram for a final exam in astronomy. Our own sun is a G-type star and so it's sort of towards the end of the sequence in the cooler part of the sequence.
There is also an image that shows the Hertzsprung-Russel Diagram where you plot the temperature of a star on the horizontal axis and the luminous power of the star going in the vertical axis. One finds that stars select themselves or group themselves in particular ways. In many cases the ways that they group themselves have a lot to do with how stars evolve through time.
There are a number of tools we use in astronomy to study stars remotely. This essay is devoted to surface temperature and spectral class. The next essays are going to talk about how we measure speed and movement in stars using the Dopler shift. Particularly we have to look at the spectra of stars and the lines produced, the barcodes, and we can analyze the motion of star's surfaces using

the Dopler shift. So that will be the next essay that will debut sometime in Janurary.

[Troy Cline]
When visiting our website you'll be able to browse through all of our Technology Through Time essays and the new Sun-Earth Day image gallery. That gallery contains a variety of images associated with the Technology Through Time series.

We're very interested in hearing your questions and comments. If you have something to say, just send an email to sunearthday@gmail.com . If selected we'll share it on one of our upcoming podcasts!

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