The Spectrogram

Newsletter for the Society of Telescopy, Astronomy, and Radio

April 2015

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S*T*A*R
P.O. Box 863
Red Bank, NJ 07701
On the web at:
http://www.starastronomy.org

April Meeting

The next meeting of S*T*A*R will be held Thursday, April 2 at 8 p.m. at Monmouth Museum. The speaker will be Professor William Gutsch of St. Peter's University, who will describe the process by which solar flares and coronal mass ejections interact with earth's magnetic field to produce northern lights. He will also present images he took on a visit to the arctic.

Calendar

April 2, 2015 – S*T*A*R meeting

April 25, 2015 – Holmdel Park Star Party

March Meeting Minutes

By Rob Nunn

The March meeting of STAR was canceled because of bad weather.

What drives the solar cycle?

Mar 30, 2015 by David Dickinson, Universe Today

You can be thankful that we bask in the glow of a relatively placid star. Currently about halfway along its 10 billion year career on the Main Sequence, our sun fuses hydrogen into helium in a battle against gravitational collapse. This balancing act produces energy via the proton-proton chain process, which in turn, fuels the drama of life on Earth.

Looking out into the universe, we see stars that are much more brash and impulsive, such as red dwarf upstarts unleashing huge planet-sterilizing flares, and massive stars destined to live fast and die young.

Our sun gives us the unprecedented chance to study a star up close, and our modern day technological society depends on keeping a close watch on what the sun might do next. But did you know that some of the key mechanisms powering the solar cycle are still not completely understood?

One such mystery confronting solar dynamics is exactly what drives the periodicity related to the solar cycle. Follow our star with a backyard telescope over a period of years, and you'll see sunspots ebb and flow in an 11 year period of activity. The dazzling 'surface' of the sun where these spots are embedded is actually the photosphere, and using a small telescope tuned to hydrogen-alpha wavelengths you can pick up prominences in the warmer chromosphere above.

This cycle is actually is 22 years in length (that's 11 years times two), as the sun flips polarity each time. A hallmark of the start of each solar cycle is the appearance of sunspots at high solar latitudes, which then move closer to the solar equator as the cycle progresses. You can actually chart this distribution in a butterfly diagram known as a Spörer chart, and this pattern was first recognized by Gustav Spörer in the late 19th century and is known as Spörer's Law.

We're currently in the midst of solar cycle #24, and the measurement of solar cycles dates all the way back to 1755. Galileo observed sunspots via projection (the tale that he went blind observing the sun in apocryphal). We also have Chinese records going back to 364 BC, though historical records of sunspot activity are, well, spotty at best. The infamous Maunder Minimum occurred from 1645 to 1717 just as the age of telescopic astronomy was gaining steam. This dearth of sunspot activity actually led to the idea that sunspots were a mythical creation by astronomers of the time.

But sunspots are a true reality. Spots can grow larger than the Earth, such as sunspot active region 2192, which appeared just before a partial solar eclipse in 2014 and could be seen with the unaided (protected) eye. The sun is actually a big ball of gas, and the equatorial regions rotate once every 25 days, 9 days faster than the rotational period near the poles. And speaking of which, it is not fully understood why we never see sunspots at the solar poles, which are tipped 7.25 degrees relative to the ecliptic.

Other solar mysteries persist. One amazing fact about our sun is the true age of the sunlight shining in our living room window. Though it raced from the convective zone and through the photosphere of the sun at 300,000 km per second and only took 8 minutes to get to your sunbeam-loving cat here on Earth, it took an estimated 10,000 to 170,000 years to escape the solar core where fusion is taking place. This is due to the terrific density at the sun's center, over seven times that of gold.

Another amazing fact is that we can actually model the happenings on the farside of the sun utilizing a new fangled method known as helioseismology.

Another key mystery is why the current solar cycle is so weak… it has even been proposed that solar cycle 25 and 26 might be absent all together. Are there larger solar cycles waiting discovery? Again, we haven't been watching the sun close enough for long enough to truly ferret these 'Grand Cycles' out.

Are sunspot numbers telling us the whole picture? sunspot numbers are calculated using formula that includes a visual count of sunspot groups and the individual sunspots in them that are currently facing Earthward, and has long served as the gold standard to gauge solar activity. Research conducted by the University of Michigan in Ann Arbor in 2013 has suggested that the orientation of the heliospheric current sheet might actually provide a better picture as to the goings on of the sun.

Another major mystery is why the sun has this 22/11 year cycle of activity in the first place. The differential rotation of the solar interior and convective zone known as the solar tachocline drives the powerful solar dynamo. But why the activity cycle is the exact length that it is is still anyone's guess. Perhaps the fossil field of the sun was simply 'frozen' in the current cycle as we see it today.

There are ideas out there that Jupiter drives the solar cycle. A 2012 paper suggested just that. It's an enticing theory for sure, as Jupiter orbits the sun once every 11.9 years.

And a recent paper has even proposed that Uranus and Neptune might drive much longer cycles…

Color us skeptical on these ideas. Although Jupiter accounts for over 70% of the planetary mass in the solar system, it's 1/1000th as massive as the sun. The barycenter of Jupiter versus the sun sits 36,000 kilometres above the solar surface, tugging the sun at a rate of 12.4 metres per second.

I suspect this is a case of coincidence: the solar system provides lots of orbital periods of varying lengths, offering up lots of chances for possible mutual occurrences. A similar mathematical curiosity can be seen in Bode's Law describing the mathematical spacing of the planets, which to date, has no known basis in reality. It appears to be just a neat play on numbers. Roll the cosmic dice long enough, and coincidences will occur. A good test for both ideas would be the discovery of similar relationships in other planetary systems. We can currently detect both starspots and large exoplanets: is there a similar link between stellar activity and exoplanet orbits? Demonstrate it dozens of times over, and a theory could become law.

Dusty substructure in a galaxy far far away

April 1, by Hannelore Hämmerle

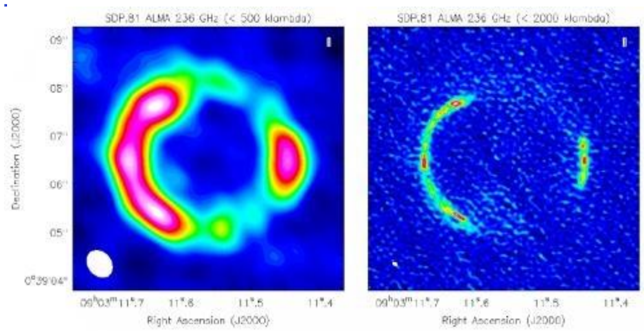

Fig. 1 The ALMA image of the continuum emission at 236 GHz of the lensed galaxy SDP.81 at two angular resolutions. The lensed system consists of four images with an extended, low-surface brightness Einstein ring.

Scientists at the Max Planck Institute for Astrophysics (MPA) have combined high-resolution images from the ALMA telescopes with a new scheme for undoing the distorting effects of a powerful gravitational lens in order to provide the first detailed picture of a young and distant galaxy, over 11 billion light-years from Earth. The reconstructed images show that star formation is heating interstellar dust and making it glow strongly in three distinct clumps embedded in a broader distribution, suggesting that object may be a rotating disk galaxy seen nearly edge-on.

Galaxies are constantly forming new stars within dense clouds of interstellar material. The star formation rate in today's galaxies is, however, much lower than it used to be. When the universe was about a quarter its current age, star formation was at its peak, and so astronomers are keen to learn about this period. Looking back in time is possible because of the finite speed of light, but only by looking out to great distances, which in turn means that young galaxies appear very small and very faint. In addition, most of their new-born stars cannot be seen directly, because their radiation is absorbed by dust in the surrounding gas cloud and is re-emitted at far-infrared wavelengths.
As a result, star-forming regions in distant galaxies are one of the prime targets for the Atacama Large Millimetre/submillimetre Array. ALMA will consist of 66 high precision antennas, located on the Chajnantor plateau at 5000 meters altitude in northern Chile. The data from the individual antennas can be combined interferometrically, and the 15 kilometre span of the telescope provides

resolution of better than a tenth of an arc-second. On its own, however, even this capability is not sufficient to make detailed pictures of young galaxies at the peak of their star formation.

"At a recent conference, ALMA scientists presented data they had used to verify the scientific capabilities of their array, among them an image of a strongly gravitationally lensed system, which immediately raised our interest", remembers Simona Vegetti, postdoctoral scientist at MPA. "Because of the lensing, the background galaxy is strongly magnified, by 17 times actually, which is why we can see it at all. Together with ALMA's unique angular resolution, this gave us the chance to try and see details in the distribution of dust in such a far-away galaxy for the first time."

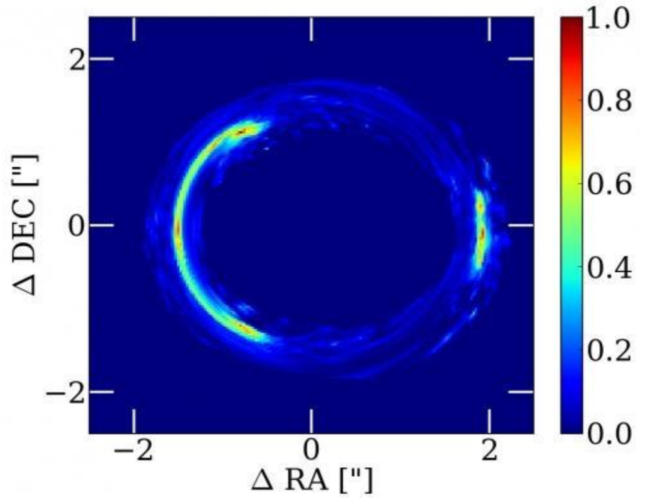

Fig. 2 The modelled sky-brightness distribution for the image in Fig. 1 (left) and the reconstructed surface brightness distribution (right) of the background galaxy. There are three areas with enhanced emission, which could indicate a disk galaxy seen edge-on.

Strong gravitational lensing happens when a background galaxy is closely aligned with a foreground mass concentration such as a cluster of galaxies, which bends light-rays from the source on their way to the observer. The foreground lens is, however, an imperfect optical system, leading to very large distortions (see Fig. 1). Nevertheless, from the properties of the lensed images, the mass distribution of the lensing system can be determined and a "true" (i.e. undistorted) image of the distant galaxy can be reconstructed. "Previous attempts to do this had assumed the background galaxies to be smooth and regular", explains Matus Rybak, who carried out the computer modelling at MPA. "This seems likely to be a very poor approximation to the structure of a strongly star-forming galaxy, and the raw ALMA images gave clear hints that this background source is complex. The new, more general approach we have developed is much better suited to irregular systems."

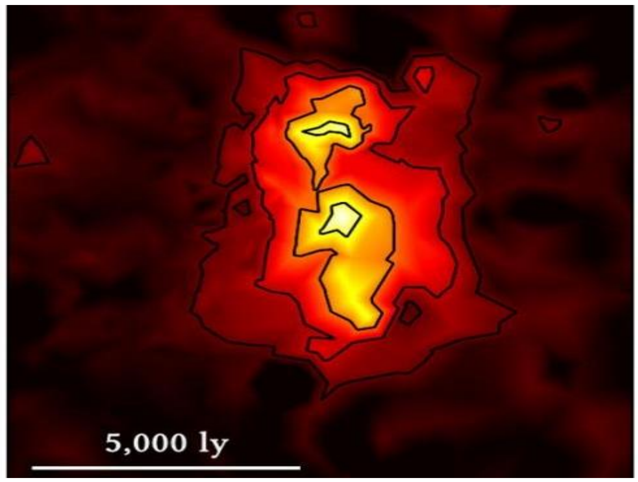

Fig. 3 This map shows the reconstructed star formation rate of the distant galaxy, which is actually quite small (as indicated by the length scale in light-years). The colour coding shows the amount of dust heated by radiation from the young stars.

This intuition is borne out by the reconstructed image of the galaxy SDP.81 which shows star formation to be concentrated in three distinct regions (see Fig. 2). "This is the first time, that we can see structure in the dust emission of a z=3 galaxy on scales smaller than 150 light-years", points out Simona Vegetti. At this cosmic time, typical galaxies were forming stars at their peak rate, and indeed SDP.81 is forming about 300 solar masses of stars every year. (In our Milky Way, the star formation rate is about 3 solar masses per year.) The complex structure of the galaxy may indicate that it is a rotating disk with a central bulge that is seen (and lensed) edge-on; alternatively it may be a system which is undergoing a merger in which the separate components are still visible. To distinguish between these possibilities, data on the motions of gas within the galaxy are needed, so the next step for the MPA team together with their colleagues Paola Andreani at ESO and John McKean at the University of Groningen and the Netherlands Institute for Radio Astronomy (ASTRON) will be to analyse the molecular line observations of this system which ALMA has also obtained.

Are you a S*T*A*R Member?

S*T*A*R meets the first Thursday of each month, except July and August, at 8:00 p.m. at Monmouth Museum on the campus of Brookdale Community College in Lincroft, NJ. Meetings usually include a presentation of about one hour by a guest speaker, a break for refreshments and socializing, a description of interesting objects to view, and a discussion of club business.

Memberships:
( )Individual...$35
( ) Family...$45
( ) Student…$15

Name____________________________

Address__________________________

City_______________________State___Zip________

Phone___________________________

Email__________________________

Make checks payable to: STAR Astronomy Society, Inc. and mail to P.O. Box 863, Red Bank, NJ 07701

The club owns 8" f/8, and 13" f/4.5 Dobsonian telescopes which are available for use by members. To borrow a telescope, please contact the Vice President.

The officers of S*T*A*R are:
President Kevin Gallagher
Vice President Rob Nunn
Secretary Michelle Paci
Treasurer Arturo Cisneros
Member at Large Dave Britz

S*T*A*R members can join the Astronomical League (AL) for a small fee. Members receive the AL publication Reflector.

In the Eyepiece

Here is a list of objects for this month. This is reproduced from www.skyhound.com with the kind permission of its creator and author of SkyTools Greg Crinklaw.

Object(s)	Class	Con	RA	Dec	Mag
Y CVn	Variable Star	Canes Venatici	12h45m07.8s	+45°26'25"	4.9
Black Eye	Galaxy	Coma Berenices	12h56m43.9s	+21°41'00"	9.3
Sombrero	Galaxy	Virgo	12h39m59.3s	-11°37'22"	9.1
Downtown Virgo & M87 Jet!	Galaxy Cluster	Virgo	12h26m12.2s	+12°56'45"	9+
M 106	Galaxy	Canes Venatici	12h18m57.5s	+47°18'14"	9.1
M 108	Galaxy	Ursa Major	11h11m31.3s	+55°40'31"	10.9
M65	Galaxy	Leo	11h18m55.8s	+13°05'32"	10.2
M 66	Galaxy	Leo	11h20m15.1s	+12°59'22"	9.6
Owl	Planetary Nebula	Ursa Major	11h14m46.1s	+55°01'07"	12.0
NGC 4631 (The Whale)	Galaxy	Canes Venatici	12h42m07.8s	+32°32'27"	9.7
NGC 4656	Galaxy	Canes Venatici	12h43m58.2s	+32°10'09"	11.4
NGC 4244	Galaxy	Canes Venatici	12h17m29.5s	+37°48'26"	10.8
NGC 4013	Galaxy	Ursa Major	11h58m31.5s	+43°56'51"	12.3
NGC 4762	Galaxy	Virgo	12h52m55.9s	+11°13'57"	11.3
NGC 4236	Galaxy	Draco	12h16m41.8s	+69°28'10"	10.1
Hickson 61	Galaxy Group	Coma Berenices	12h12m23.9s	+29°10'40"	11.1
NGC 3607	Galaxy	Leo	11h16m54.8s	+18°03'06"	10.9
Focus On Gliese 433.1	White Dwarf Star	Ursa Major	11h37m05.1s	+29°47'58"	12.5
Antennae/Ring Tail	Galaxy	Corvus	12h01m52.8s	-18°51'54"	10.9
NGC 4490	Galaxy	Canes Venatici	12h30m36.7s	+41°38'27"	10.1
NGC 4361	Planetary Nebula	Corvus	12h24m30.8s	-18°47'05"	10.3
NGC 4027	Galaxy	Corvus	11h59m30.1s	-19°16'05"	11.7
NGC 4094	Galaxy	Corvus	12h05m53.9s	-14°31'36"	12.7
NGC 4782 & 4783	Galaxy	Corvus	12h54m35.8s	-12°34'06"	12.4
NGC 4462	Galaxy	Corvus	12h29m21.2s	-23°09'59"	12.8
NGC 3987	Galaxy	Leo	11h57m20.9s	+25°11'42"	13.8
Siamese Twins	Interacting Galaxy Pair	Virgo	12h36m34.4s	+11°14'18"	11.7+12.1
NGC 3628	Galaxy	Leo	11h20m16.9s	+13°35'14"	10.3
NGC 4565	Galaxy	Coma Berenices	12h36m21.1s	+25°59'13"	10.6
Abell Galaxy Cluster 1631	Galaxy	Corvus	12h52m52.6s	-15°24'47"	13.3
Palomar 4	Globular Cluster	UMa	11h29m16.0s	28°58'24"	14.2
Abell 35	Planetary Nebula	Hydra	12h53m34.2s	-22°52'17"	12.0

Coordinates are epoch 2000.0