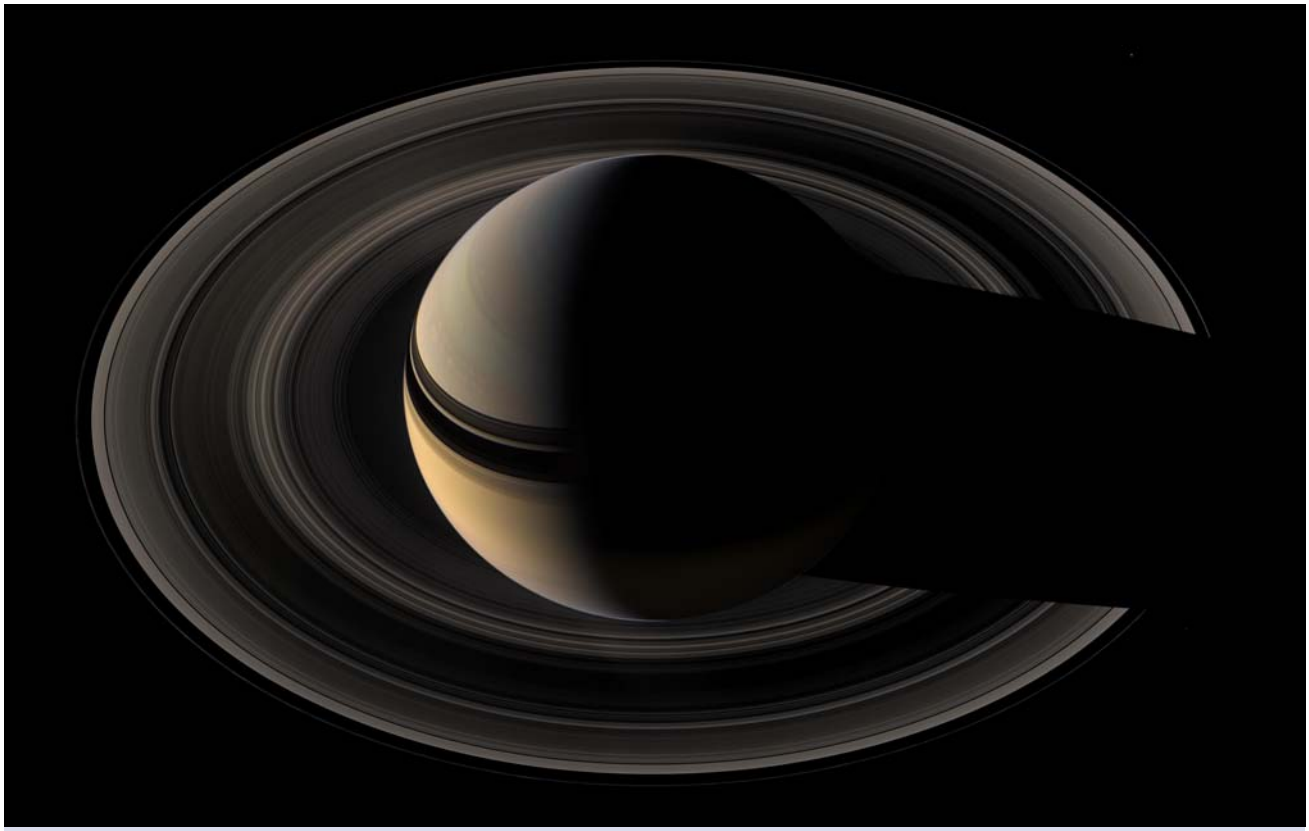
Carry on *Cassini*: NASA extends spacecraft's active life for two more years

On April 15 NASA announced that the *Cassini* spacecraft, currently surveying Saturn and its satellites, will have its mission extended by two further years. It was originally scheduled to end this July. The two-year extension will include 60 additional orbits of Saturn, 26 flybys of Titan, seven of Enceladus, and one each of Dione, Rhea and Helene. The extension also includes further studies of Saturn's rings, its complex magnetosphere, and the planet itself, and will enable imaging of the system as the Sun crosses the ring plane in 2009.

'The spacecraft is performing exceptionally well and the team is highly motivated, so we're excited at the prospect of another two years,' said Bob Mitchell, *Cassini* program manager at NASA's Jet Propulsion Laboratory in Pasadena, California. Launched on 1997 October 15 from Cape Canaveral, Florida, *Cassini* is one of the most successful and scientifically capable spacecraft ever launched, with 12 instruments on the orbiter and six more on the European Space Agency's *Huygens* probe, which hitch-hiked a ride to Titan on *Cassini*. The orbiter is powered by three radioisotope thermoelectric generators, which generate electricity from heat produced by the natural decay of plutonium. It was captured into Saturn orbit in 2004 June and immediately began returning data to Earth.

One of *Cassini*'s most significant discoveries has been the existence of geysers of water-ice jetting from the surface of Enceladus, a tiny moon only one-tenth the size of Titan. The geysers, which shoot out to a distance three times the satellite's diameter, indicate the possibility of lakes of liquid water beneath its surface. Enceladus is one of the highest priorities for *Cassini*'s extended mission; the spacecraft may come as close as 25km to the moon's surface.

A full-size mockup of the* Cassini *orbiter photographed by Hazel McGee at JPL in 2004 July.



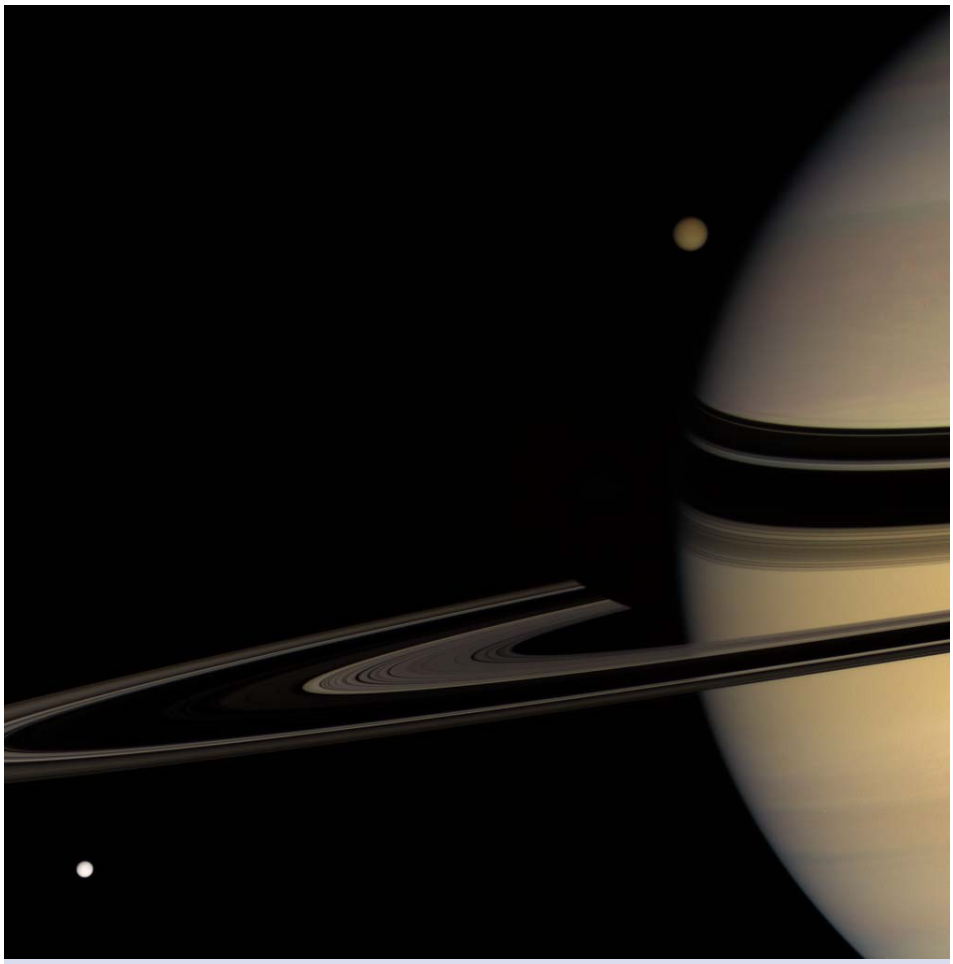
A unique natural colour mosaic acquired by* Cassini *on 2007 May 9 from a position 39° above the unilluminated side of Saturn's ring system, at a distance of approximately 1.1 million km from the planet. The view combines 45 red, green and blue images taken over the course of about two hours. NASA/JPL/Space Science Institute

Observations of Titan by both *Cassini* and *Huygens* have shown that the satellite possesses many parallels to Earth, including lakes, rivers, channels, dunes, rain, snow, clouds, mountains and possibly volcanoes. The lakes, rivers and rain are composed of methane and ethane, and temperatures fall as low as –180°C. Optical imaging of the surface of Titan is limited by the dense atmosphere, so observations are made by *Cassini*'s infrared spectrometer and high-resolution radar.

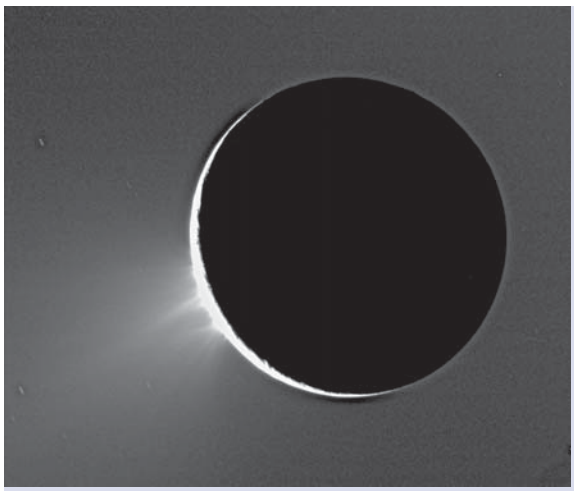
Cassini has already returned nearly 140,000 images and datasets gathered during 62 revolutions round Saturn, 43 flybys of Titan and 12 close flybys of the minor satellites. According to NASA, 'More than 10 years after launch and almost four years after entering into orbit around Saturn, *Cassini* is a healthy and robust spacecraft. Three of its science instruments have minor ailments, but the impact on science-gathering is minimal. The spacecraft will have enough propellant left after the extended mission to potentially allow a third phase of operations. Data from the extended mission could lay the groundwork for possible new missions to Titan and Enceladus.'

More information and the complete archive of images and data can be found at **http://www.nasa.gov/cassini.**

Hazel McGee



This recent image from **Cassini** *looks towards the unilluminated side of Saturn's rings from about three degrees above the ringplane. Titan emerges from behind the planet, with Tethys in the foreground, while Saturn's shadow darkens the far arm of the rings near the planet's limb. Red, green and blue images to create this natural colour view were acquired with the* **Cassini** *wide-angle camera on 2008 January 30 at a distance of approximately 1.3 million km from Saturn. NASA/JPL/Space Science Institute.*



Images from **Cassini** *of Saturn's moon Enceladus backlit by the Sun show 'fountains' of liquid water above the south polar region. Imaging scientists believe the jets are geysers erupting from pressurised subsurface water reservoirs. NASA/JPL/Space Science Institute.*

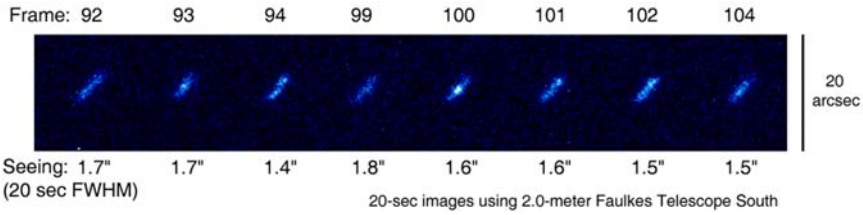
A view of Enceladus' surface looking towards the terminator, showing a distinctive pattern of continuous ridged and roughly parallel faults within the moon's southern polar latitudes. These surface features appear to be the source of the geyser eruptions. This image was obtained in visible light with **Cassini***'s narrow-angle camera on 2005 July 14, at a distance of about 20,720km from the surface. Contrast has been enhanced to aid visibility of surface features. NASA/JPL/Space Science Institute.*

Asteroids & Remote Planets Section

Schools use Faulkes Telescope to investigate near-Earth asteroid

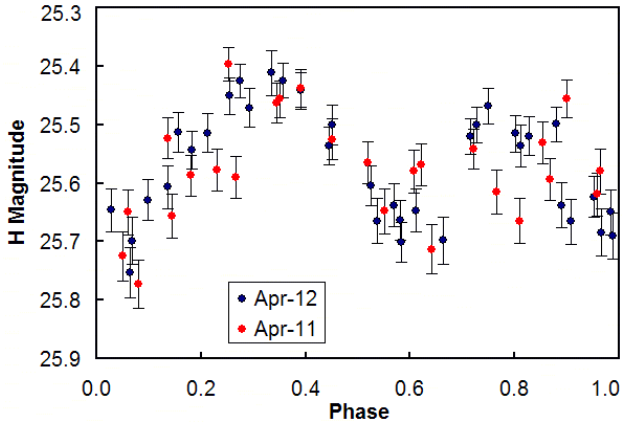
The 2.0-metre aperture Faulkes telescopes, comprising the FT North on Maui, Hawaii and the FT South at Siding Spring Observatory, Australia, are both used by schools and colleges to facilitate science learning. Classes are typically allocated 30-minute observing sessions, so the challenge is to find observing projects that yield results in a short space of time. One proposal from the BAA ARPS has been to initiate an ongoing examination of newly-discovered asteroids that are less than about 150m across (absolute magnitude H>22) with a view to establishing their rotation rates. Determining the distribution of spin rates is valuable for understanding the evolution of the asteroids and the role they have played in the formation of the solar system and its present dynamics. Small objects tend to be fragments produced by the collision of larger asteroids, and as such are likely to rotate on their axis more quickly than larger bodies. In contrast, asteroids located in the Main Belt between Mars and Jupiter typically exhibit longer rotation periods of 4–12 hours.

An announcement of the discovery of the near-Earth asteroid 2008 GP3 was issued by the Minor Planet Center on 2008 April 10 ahead of its closest approach a few days later. The writer, Assistant Director of the Asteroids and Remote Planets Section (ARPS) with responsibility for photometry, contacted Dr Paul Roche and Daniel Duggan of the Faulkes Telescope team the same day alerting them to the observing opportunity. Dan subsequently issued an alert to schools, including those who had booked sessions on the FT South.

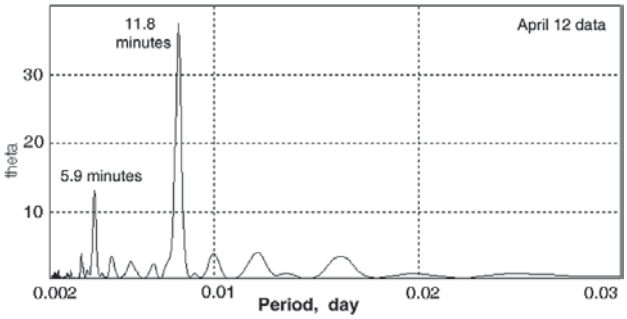


Are these trails examples of an asteroid glinting in the sun? Images of 2008 GP3 taken with the 2.0m f/10 Faulkes Telescope South on 2008 April 11.

Three groups in addition to the BAA responded and were able to take images of the newly-discovered asteroid on April 11 and April 12. Since 2008 GP3 is a small object, probably only about 30m across (H=25.4), there is a good chance that it spins quickly on its axis. Observations by Paulet High School (Burton on Trent), Lord Wilson School (Southampton), TU-Darmstadt and ARPS did indeed confirm this, in that the 17th magnitude object was found to rotate once every 11.78 minutes.



Composite lightcurve of 2008 GP3 showing a rotation period of 11.78 minutes. Images by R. Miles, G. Faillance (BAA ARPS), Paulet High School, Lord Wilson School & TU-Darmstadt using the Faulkes Telescope South.



Periodogram of 2008 GP3 based on observations with the Faulkes Telescope South.

Period analysis of photometry from three consecutive observing sessions performed on April 12 (13:34–14:57 UT) revealed the period solution as depicted in the plot. The composite lightcurve of all of the data folded on a 'best-fit' 11.78-minute period shows two unequal maxima and minima having an extreme amplitude of about 0.28 magnitudes.

This is a particularly good example of schools working together to maximise the value of observing opportunities. Just two or three consecutive observing sessions can be enough to derive an unambiguous period, and it is hoped in future that some of these sessions will reveal 'superfast' rotators which turn 360° in a matter of minutes. Our knowledge of the near-Earth population of small asteroids is sparse, so schools can contribute directly to our understanding of these nearest neighbours of ours. We believe that most of these objects are probably fragments ejected from collisions between larger bodies which took place some time in the distant past. However, other objects may have originated when the solar nebula was formed billions of years ago.

One important clue in the case of 2008 GP3 may come from the different appearance of its lightcurve on April 11 compared to that on April 12. It seems that the lightcurve was of lower amplitude and much more noisy on April 11. Closer examination of the short trails depicting the fast-moving object on April 11 revealed the presence of bright 'knots' in some trails, which may be evidence of specular reflection of sunlight from faceted regions, similar to the occasional glints that are produced by some Earth-orbiting satellites.

Such a phenomenon has never been reported and confirmed for an asteroid before now. Telescope drive errors can easily mimic the effect in the trail of a fast-mover; whether this is the case here requires further study and calibration of the star fields which the asteroid passed through. One positive indication is that on April 11, 2008 GP3 was located at a small phase angle of just 10° relative to the Sun, which would favour the specular reflection hypothesis. On April 12 the phase angle had grown to 20°, so less back reflection of sunlight would be expected on that day. 2008 GP3 may indeed have been glinting in the sunlight as it spun and may therefore have a somewhat faceted surface, such as might be created when a piece of rock is splintered off a larger body through a collision.

This first-time success for the project has been a great boost and it is now planned to follow up other suitable targets as soon as possible after their discovery.

Richard Miles, *Assistant Director*

Solar Section

2008 January

January saw a decrease in solar activity in the southern hemisphere which led to an overall fall for the total disk. All observers reported a blank disk on January 7 and from Jan 12 to 28 inclusive and most recorded a blank disk on Jan 5, 6, 8, 9, 10, 11 and 29. However the month was not without note as the first visible sunspot of Cycle 24 appeared on the disk at N30º/246º, recorded as AR981.

AR980, S08º/236º was first reported to the Section on Jan 3 as Cro type and could well have been a revival of AR978. The group was not seen on Jan 5 but briefly re-appeared on Jan 8 & 9 type Axx.

AR981, N30º/246º. Several reports came in on January 5 announcing the arrival of the first spot of Cycle 24, type Axx. The group was seen unchanged the next day but was not seen thereafter.

AR982, S09º/246º was first seen on Jan 30 as a collection of 5 small spots type Bxo belonging to Cycle 23. The group was still present at the month's end, type Dso, containing a penumbral follower.

BAA sunspot data, 2008 January – February

	January		*February*	
Day	*g*	*R*	*g*	*R*
1	1	8	1	14
2	1	11	0	7
3	1	12	1	11
4	1	14	0	4
5	0	7	0	2
6	0	2	0	0
7	0	0	0	0
8	0	4	0	0
9	0	2	0	2
10	0	5	0	0
11	0	5	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
21	0	0	0	0
22	0	0	0	0
23	0	0	0	0
24	0	0	0	0
25	0	0	0	4
26	0	0	1	10
27	0	0	1	7
28	0	0	0	0
29	0	4	0	0
30	1	12		
31	1	14		
MDFg	0.23 (44)		0.14 (45)	
Mean R	3.19 (38)		2.14 (39)	

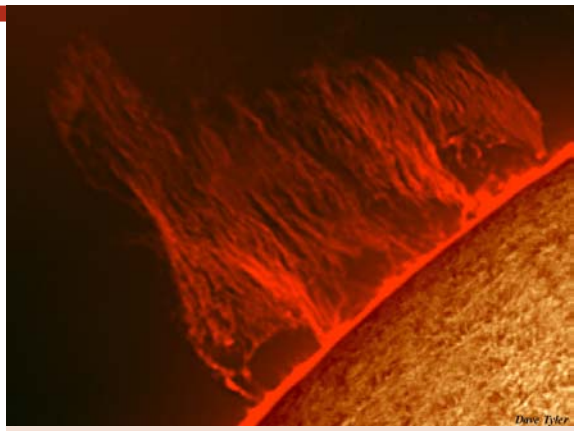
Two observers reported a sunspot Quality number of 0.19.

H-alpha

Prominences

14 observers reported a prominence MDF of 2.49 for January.

Monty Leventhal saw an arch prominence on the SE limb rising to a height of 74,000km on January 2 and a further arch prominence on the NE limb rising to 56,000km on Jan 3.



Flame prominence at 12:37 UT on February 04 by Dave Tyler.

A high spire prominence was seen on the W limb at 30ºS on Jan 6 by Eric Strach.

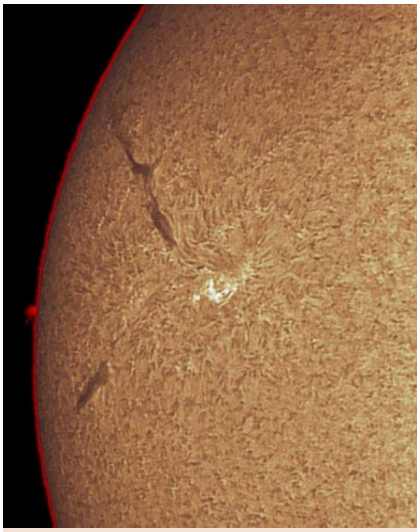
On Jan 9 Ken Medway reported a tall slender pillar on the SW limb. Monty Leventhal noted an active prominence with ejecta rising to 149,000km later the same day. The next day Monty saw a spike prominence on the NW limb rising to 93,000km.

On Jan 16 Lee Macdonald reported a small but bright prominence on the S limb and a larger one to the West at least twice the height of the southern one. Alan Heath also confirmed a bright prominence on this date.

Peter Meadows reported an arch prominence on Jan 27 on the SE limb and Ken Medway reported an 'impressive arch prominence' on the NE limb at N20º.

Eric Strach reported 'an abundance' of prominences on the E limb between Jan 26 and 30.

On Jan 28 Bill Leatherbarrow reported a large complex prominence group just S of the E limb point, spread over 10º of the limb. He saw a continuous curtain of prominence activity of around 5 individual prominences with a large arched projection that had detached from the limb by 12:05 UT. He also reported another complex area of prominence activity over a 10º area just north of the E limb point.



Filaments around AR982 imaged by Pete Lawrence at 13:04 UT on January 30.

North & south MDF of active areas g

	MDFNg	*MDFSg*
January	0.04	0.16 (32)
February	0.01	0.12 (30)

g = active areas (AAs)
MDF = mean daily frequency
R = relative sunspot number
The no. of observers is given in brackets.

Filaments

3 observers reported a filament MDF of 0.34

Few filaments were seen during the month. Brian Mitchell reported a strong filament on January 9 at S10º/235º. On Jan 30 and 31 two long filaments were seen in association with AR982. Bright plage was seen on Jan 5 around the high latitude spot AR981 by Eric Strach and also around the now disappeared group AR980.

CaK

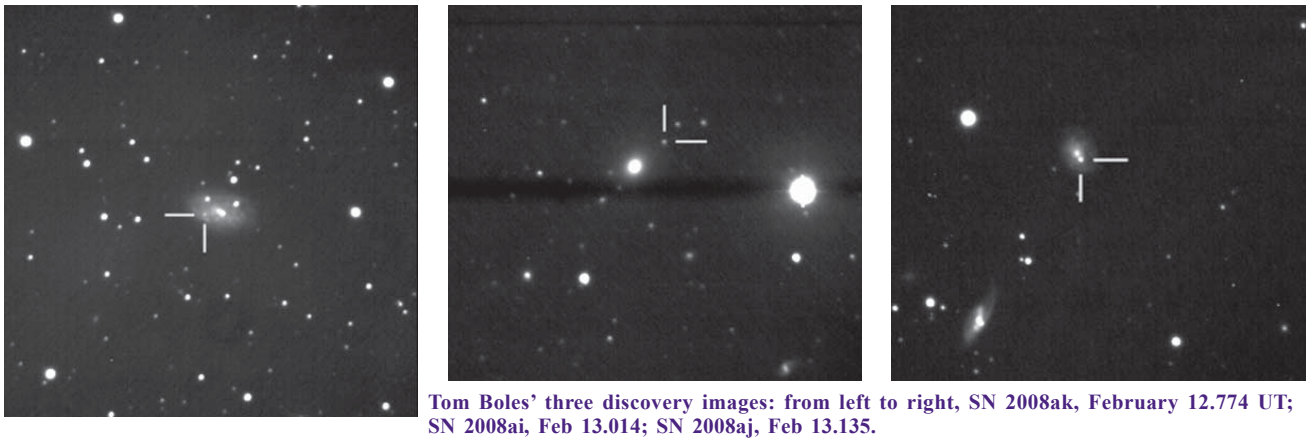
Ken Medway reported a large K-plage just E of the CM in the northern hemisphere on January 6. Brian Mitchell followed a very large dense patch of 'speckles' centred at approx. S10º/200º but covering an area 20º×10º from Jan 5 to 7 and also on 9 and 12.

A small patch was also followed on Jan 5, 6, 7 and 9 at N30º/250º which could have been associated with the new cycle spot AR981.

On January 29 a patch was seen at S10º/240º at the same location of a faint two-part filament.

2008 February

February saw a decrease in solar activity for the third month in a row, with MDFg below 1 for a full 12 months. All observers reported a blank disk on Feb 6, 7, 8, 28 and 29 and from Feb 10 to 24 inclusive. Most also recorded a blank disk on 2, 4, 5, 9, 25 and 27.



Tom Boles' three discovery images: from left to right, SN 2008ak, February 12.774 UT; SN 2008ai, Feb 13.014; SN 2008aj, Feb 13.135.

Deep Sky Section

Three in one night again for Tom Boles

As briefly reported in the April *Journal*, former BAA President Tom Boles has had further success with his supernova search programme. Following discoveries on February 7 and 9, which were fully reported in that *Journal*, he discovered three more on the night of February 12/13. This is the fourth time that Tom has discovered three in a row, with previous successes in 2003 (twice) and 2006. The discoveries were announced on *CBET* 1256, 1259 and 1260 and on TA *Circulars* E2421, E2422 and E2423, from which some of this information is taken.

His first discovery that night, 2008ak in galaxy UGC 2519, was recorded at Feb 12.774UT. At magnitude 18.5 it was the faintest of the three. Its position at RA 3h 9m 25.2s and Dec +80° 7' 48.4" (2000.0) put it approximately 17" east and 1.8" south of the centre of the galaxy. This supernova has now been determined as a Type II. (A confirmatory image was not obtained until Feb 15, leading this supernova to have a later designation than the other two discoveries.) Magnitude 17.7 SN2008ai in obscure galaxy MCG +06-24-39 followed at Feb 13.014UT. At RA 10h 57m39.97s and Dec +37° 39' 41.9" it lay 29.7" west and 25.3" north of the galaxy centre. This SN has been determined as a Type Ia and at discovery was about one week past maximum.

Shortly after these two discoveries, on Feb 13.135UT, SN2008aj in another obscure galaxy, MCG +06-30-34, was detected at magnitude 16.9. This supernova, which has been determined as a type IIn, was at position RA 13h 33m 6.33s and Dec +33° 8' 59" putting it approximately 3.3" west and 7.3" south of the centre of the galaxy.

Tom's discovery images for the three supernovae are shown here. All the discoveries were made from his observatory in Coddenham, Suffolk using a 35cm Schmidt–Cassegrain telescope and Apogee AP7 CCD camera. These latest discoveries bring Tom's personal total to 113, a remarkable achievement.

Stewart L. Moore, *Director*

AR982 at S09°/246° remained on the disk from the previous month. The group was seen on Feb 2 as an Axx group consisting of two small spots and was not seen from Feb 5 onwards.

Unclassified N03°/118° was seen on Feb 9 only as a short-lived Bxo group and was not registered by the Space Weather Prediction Centre (formerly NOAA).

AR983 at S07°/343° was first seen on Feb 26 as a Bxo type group towards the western limb. The group soon decayed and was not seen on Feb 28.

Three observers reported a sunspot Quality MDF of 0.32.

H-alpha

Prominences

12 observers reported a prominence MDF of 2.99 for February.

Several observers reported fluctuating prominence activity on the SW limb around 70° latitude between Feb 4 and 11.

On Feb 12 Ken Medway reported a tall prominence on the NE limb resembling smoke billowing from a chimney.

A 'large complex curtain' of prominences was reported on the NNE limb on Feb 16 by Bill Leatherbarrow, spanning 10–12° of solar circumference. Bill also reported a 'magnificent curtain of complex prominence activity' on the NNE limb on Feb 17 covering about 15°. Lee Macdonald reported a similar observation.

Brian Mitchell observed a prominence on the NE limb at 60° latitude between Feb 15–19 becoming larger as the days progressed.

On Feb 20 Monty Leventhal reported a prominence on the NW limb rising to 56,000km.

Bill Leatherbarrow observed a 'spectacular prominence group' just N of the E limb point on Feb 23 consisting of 3 prominences, the middle one being a 'huge towering flame'.

Filaments

3 observers reported a filament MDF of 1.17

2 large filaments were seen on the disk on February 1 and 2 in association with AR982 and again on 4 and 5.

A strong filament was seen on Feb 6 to the SE which was very small by Feb 8.

On Feb 26 a small bright arch filament was evident next to AR983. 3 filaments were present on Feb 27, two of which appeared 'like spots'.

CaK

Brian Mitchell followed the progress of a large calcium patch from Feb 1 to 8. He also noted speckling strongly concentrated within about 5° either side of the equator with almost no activity at higher latitudes.

Lyn Smith, *Director*

Radio Astronomy Group

Observing the Sun in VLF

Since the radio astronomy group of the BAA was reformed in 2004, there has been a group of observers monitoring flare activity on the Sun by means of its effect at Very Low radio Frequencies (VLF) on the Earth's ionosphere. I started collecting these observations for the group in early 2005, and present here the results recorded so far.

A solar flare is an energetic event that releases a broad spectrum of electromagnetic radiation. In particular, the ultraviolet and X-ray components have a direct ionising effect on the lowest levels of the ionosphere, producing Sudden Ionospheric Disturbances (SIDs). Monitoring the signal from a remote terrestrial VLF transmitter, these SIDs are easily detected as sudden fades or enhancements in signal strength. As the Sun needs to be in the sky at the time, only local day-time activity is recorded. Such observations are not affected by the weather, and can be made with simple equipment, left unattended.

We have ten observers recording these events, monitoring four or five frequencies. The SIDs recorded are generally the result of solar flares of C, M, or X class, covering all but the weakest B-class flares. To correlate these recordings with genuine solar activity, I compare the observations that I receive against the GOES flare data. The data list all flares detected by the GOES satellite, with strength and timing information.

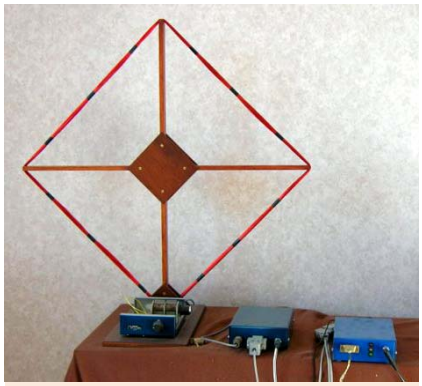
The chart given here simply plots the number of SIDs (i.e. solar flares) detected by the group each month. Any record of solar activity tends to show marked variation from one month to the next, and is often smoothed to show a general trend. With less than three years of data, smoothing is not really possible here yet. The decay of solar cycle 23 is shown, from the high levels of activity in 2005 to generally lower levels in 2006/07, fading to almost nothing since 2007 September.

One feature that stands out is the rapid change from 2005 September to October. 2005 September had the highest level of this record at 54 SIDs (including four X-class), while October produced just one event. The September record included the X17 flare recorded on September 7, amongst the most energetic flares recorded with modern instrumentation. The decay phase of a solar cycle can sometimes produce these larger than expected events, followed by a quieter period as the magnetic structure of the Sun recovers. Also seen are periodic bursts of activity for a few months followed by blank periods. This trend is common in records of solar activity, such as the relative sunspot number, 'R', although usually masked by the longer period-smoothing employed. The current blank period in early 2008 probably marks the solar minimum.

As a simple introduction to radio astronomy, a VLF receiver and aerial provides an interesting record of solar activity that is not easy to see in any other way. I hope to be able to build on this record as cycle 24 begins, comparing it with other solar indices and it is hoped, other radio observations.

Anyone interested in making VLF recordings is welcome to contact me.

John Cook *[jacook@clara.co.uk]*



Equipment used for VLF radio observation of the Sun. *J. A. Cook*

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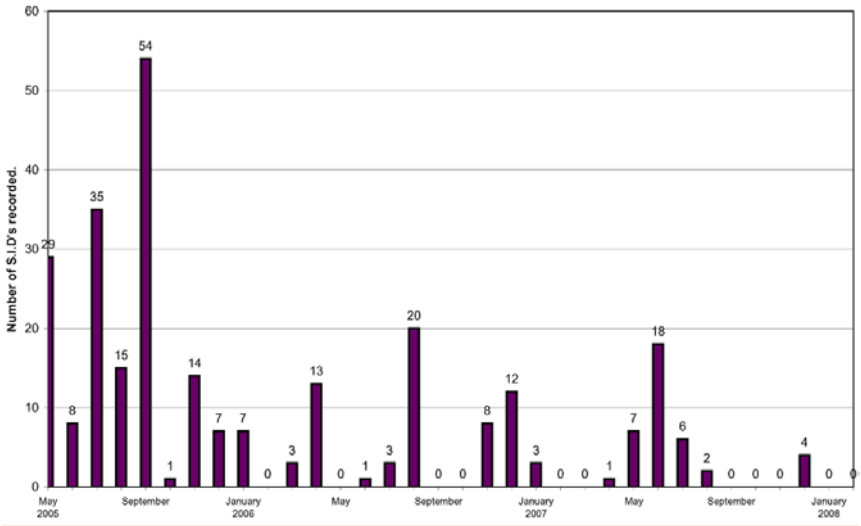
Flare classification: *The Cambridge Encyclopaedia of the Sun*, Kenneth R. Lang, Cambridge University Press, 2001, p. 124

Observers

John Wardle, Bob Middlefell, Peter King, Mike King, Karen Holland, Mark Edwards, Nigel Curtis, Colin Clements, John Cook, Roberto Battaiola.



Unsmoothed chart of solar activity detected by the RAG from May 2005 to Jan 2008