FAS Newsletter

Federation of Astronomical Societies http://www.fedastro.org.uk

BLACKPOOL WEBSITE VOTED THE BEST

With the almost universal use of websites to publicise and inform, the FAS Council felt it would be a good idea to review the websites of member societies and pick what it thought to be the best.

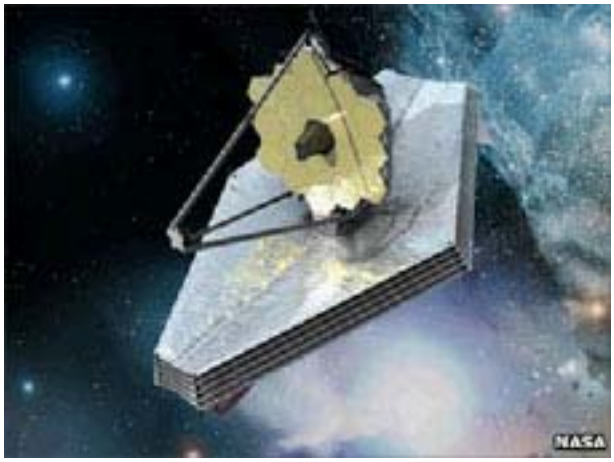
All active websites were reviewed against a set of criteria, as listed on Page 2. As a result, we are pleased to announce that the website of Blackpool & District AS was selected as *'First in Show'*. They will receive a prize of £150. They were closely followed by Derby AS and Stratford upon Avon AS, who will get £100 and £50 respectively.

Whilst this was a one-off event, we will see if it can be repeated, or even made annual. So—you webmasters—review the criteria and go back to the drawing board.

Future of James Webb Telescope in Peril

NASA chief Charlie Bolden went to bat for the agency's imperiled next-generation space telescope recently, telling members of Congress that the instrument has greater potential for discovery than the iconic Hubble Space Telescope.

A proposed congressional budget bill announced last week would terminate NASA's James Webb Space Telescope (JWST), an ambitious instrument with a history of delays and cost overruns. But NASA says it can deliver JWST to space for about the same price as Hubble, Bolden said — and the science returns would be even greater.



FAS ANNUAL CONVENTION 2011

The FAS AGM & Annual Convention will again be held at The Institute of Astromomy, Madingley Road, Cambridge on Saturday 15th October. *(–see poster on Page 2)*

In addition to an excellent array of speakers there will be trade stands and by popular demand, during the lunch break there will be a tour of the historic scopes and domes.

We are privileged to have the Astronomer Royal, Lord Martin Rees participating. Nik Szymanek will dazzle us with his superb photographs, perhaps letting us into some of his secrets and Dr Nick Hewitt will be talking about how amateurs can observe galactic nuclei.

We are also pleased to hear that Dr Carolyn Crawford and Professor Albert Zijlstra will discuss X-Ray astronomy and planetary nebulae respectively.

You are all encouraged to attend the convention and to participate in the AGM of the FAS.

It promises to be a great event again.

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Presidents Spot

Greetings to my fellow amateur astronomers! I have a couple of things to bring to your attention. Firstly I want to encourage you to attend the 2011 FAS Convention & AGM at the Institute of Astronomy in Cambridge on Saturday, 15th October. Elsewhere in this newsletter you will find more details of the excellent programme of speakers arranged for the day, along with the usual trade stands and society exhibits. It will be a great astronomy day out and worth the effort of attending, so I hope to see you there.

The second thing I want to mention is the FAS Member Societies Websites competition that we have just run! Most of the astronomical societies in the FAS operate their own websites. So the FAS Council decided to review all the member societies websites and pick what it thought were the top 3 websites. We did not tell you about this in advance because we wanted to judge the websites as they currently are. It is my pleasure to announce that the winners (and prizes) of the website competition are as follows:

1st prize (£150) goes to Blackpool & District AS

2nd prize (£100) goes to Derby AS

3rd prize (£50) goes to Stratford upon Avon AS

Our congratulations go to the winners but it was a very difficult job to pick the top 3 as the standard and quality of society websites is generally very good indeed. Our evaluation of websites included the following criteria:

- The aesthetics and general appearance of the website, was it welcoming or daunting
- were there sensible and clear menus and was it easy to navigate the pages and quickly find the information you wanted – when and where the society met, what happened at meetings, what the society did/offered to its members.
- did the website allow society members to display their astrophotography and/or articles. Could one download past newsletters of the society.
- were any additional services or information offered by the website e.g. 'how to' articles for newcomers, what's on in the night sky, choosing a telescope.
- were there links to the BAA, SPA and CfDS websites. Was there additional information about light pollution on the website.
- was there a link to the FAS website (additional point scored if on the society's home page!) No such link meant disqualification!
- was the link on the FAS's website to the society's website up to date and working. If not the society was eliminated from the competition – hey it's up to your nominated society officers to provide and keep this link up to date!
- no clashing colour schemes or small fonts or weird animations that made it harder to find and see the info on screen

We have not yet decided if and when to run the competition again but if you want your society to be in with a chance of winning make sure your society's website manager checks the website content against the above criteria.

That's all from me for this newsletter, but I wish you clear and dark night skies in the months to come.

Richard Sargent

Blackpool & District AS and the Perseids

The Perseids of 2011: a great barbecue but unfortunately not many Perseids - none in fact!
The barbeque - skilfully tended to by Alison - produced some mouth-watering food and the normal smoke which follows you around.

Unfortunately although there were enough breaks in the cloud to see the ISS, the Moon and a few stars - there were no Perseids seen.

You can't be lucky all the time!

Brief Editorial

First of all apologies for the slightly later publication of this edition of the Newsletter. Personal complications were the prime cause. However the couple of weeks delay did mean that I could include the results of the Website competition.

During the course of the examination of websites it was seen that several societies provide links to download the FAS Newsletter. Doing this goes against the current FAS policy so we would ask the relevant societies to remove such links.

This policy may well be reviewed and you will be informed if there is any change.

Wishing you clear skies

Frank Johns

Liverpool Astronomical Society's - Leighton Observatory Open Day

On Sat. April 9th 2011 we held our now annual open day at Leighton Observatory, I arrived quite early to set up for the day and was pleased the weather looked as though it was going to be like previous years, sunny and warm. The only problem we foresaw was that the Aintree Grand National was the same day and although visitor numbers were down on previous years we still had over 150 visitors.

We gave a couple of talks through the day, I gave a talk on "A Stars Life" and Geoff Regan gave a talk on "Our Place in Space". Dave Galvin set up a projector in the Observatory with a webcam on the Meade telescope so he could show the Sun and later the Moon as visitors were given a tour of the observatory, also outside there were PST solar scopes showing the Sun in H alpha. Unfortunately the clear skies did not last for the evening session and thin hazy cloud obscured all but the brightest objects. A big thank you to all the members who helped on the day without you it would not be possible to hold these events.

By Brendan Martin

Courtesy: LAS Newsletter

New Lights bring lower light pollution

- but might have a sting in the tail !!

You may recall the article in the FAS Newsletter two years ago about new street-lights. Well I can now report on the results so far.

To recap:

Cornwall Council embarked on a project which could have implications for astronomers everywhere. They decided to renew all of its street lights over a period of 3 years, the old sodium lights being replaced with new-generation metal halide lamps mounted in a new design of luminaire.

Whilst the principal objective of this project is cost saving, it seemed certain that the levels of light pollution should be significantly reduced.

The lights on the main roads were a mixture of high and low-pressure sodium and were similar to those in Figures 1 & 2.

It will be seen that the glass of the lamp extends the full length of the luminaire and from the direct light pollution point of view it projects down a long way from the casing.

This means that the 'side spill' of light is very significant—and it is this 'direct' light which is a real problem, specially to the visual observer.

The new luminaire is shown in Figure 3. The glass projection below the frame is small, which significantly reduces the side spill of light.

Well in the past couple of weeks the lights in my immediate area have been changed and in many respects they are a distinct improvement.

When looked at directly they seem to be more intense than the old ones, and in fact they are. The reason being the new lamps are only 10-15 cms long for the same wattage as the sodium ones which are 30-40 cms long. Inevitably this results in higher brightness per unit length.

However if you are away from the direct cone of light then the light spill is dramatically reduced. The photos Figures 4 & 5 give some idea of how little light spill comes from the new lights compared with the old. These were taken from the door of my observatory using similar camera settings so are reasonably representative.

It is not all good news for me however, there is a smaller lamp on a walkway that runs about 15-20 metres from my observatory and the light there shines directly over the dome area. I am currently in discussions with the local authority about getting this changed around.

As I ventured into spectroscopy about a year ago and built one of Ken Harrison's Spectro L-200 kits, I decided that it would be worth seeing what the spectra of both types light look like, so I took the sodium lights about a year ago and the new ones, recently. The results are compared in Figure 6. These data show the possible 'sting in the tail'.

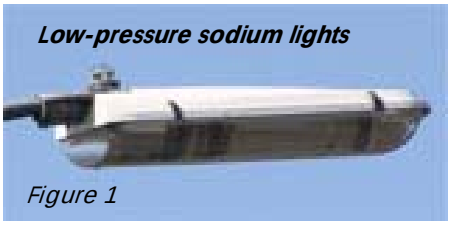
The sodium lights give a number of distinct emission lines, which are all very narrow. This means that the filter manufacturer can produce filters which will block those frequencies.

On the other hand the 'white light' lamps show a very broad emission covering the range 5900 to 6150 Ångstroms. Whether this proves to be a problem only time will tell.

For what it is worth, my view is that these lights significantly improve the lot of the astronomer, because the amount of light thrown upwards is much less than before, resulting in much lower level of skyglow.

I'd be interested in hearing of the experience of others.

Frank Johns



Low-pressure sodium lights

Figure 1

Low-pressure sodium lights

Figure 2

New Luminaire

Figure 3

The sodium lights

Figure 4

The new lights

Figure 5

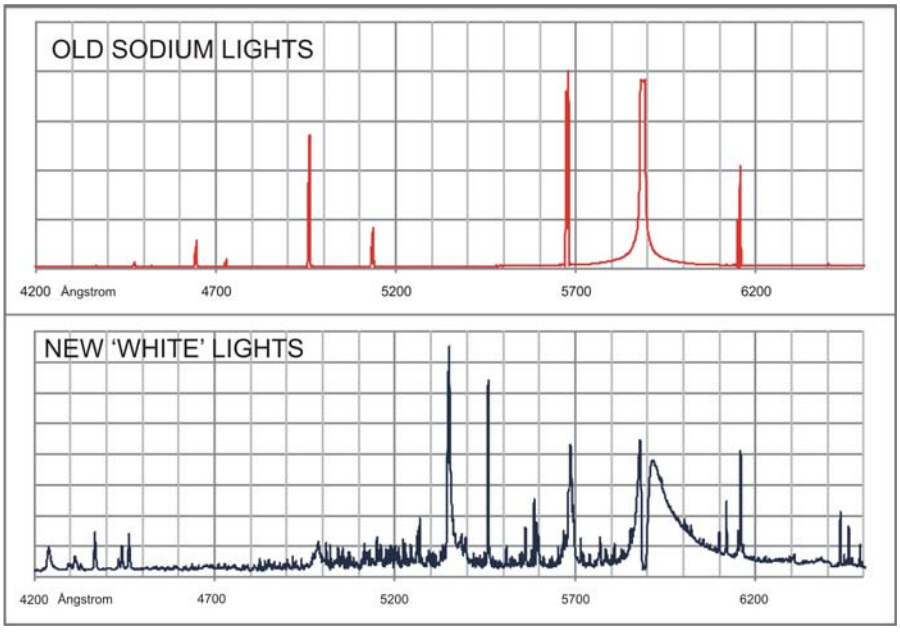


Figure 6: Spectra of sodium and new lights taken with Atik 314L camera through a Spectra-L200 Spectrograph

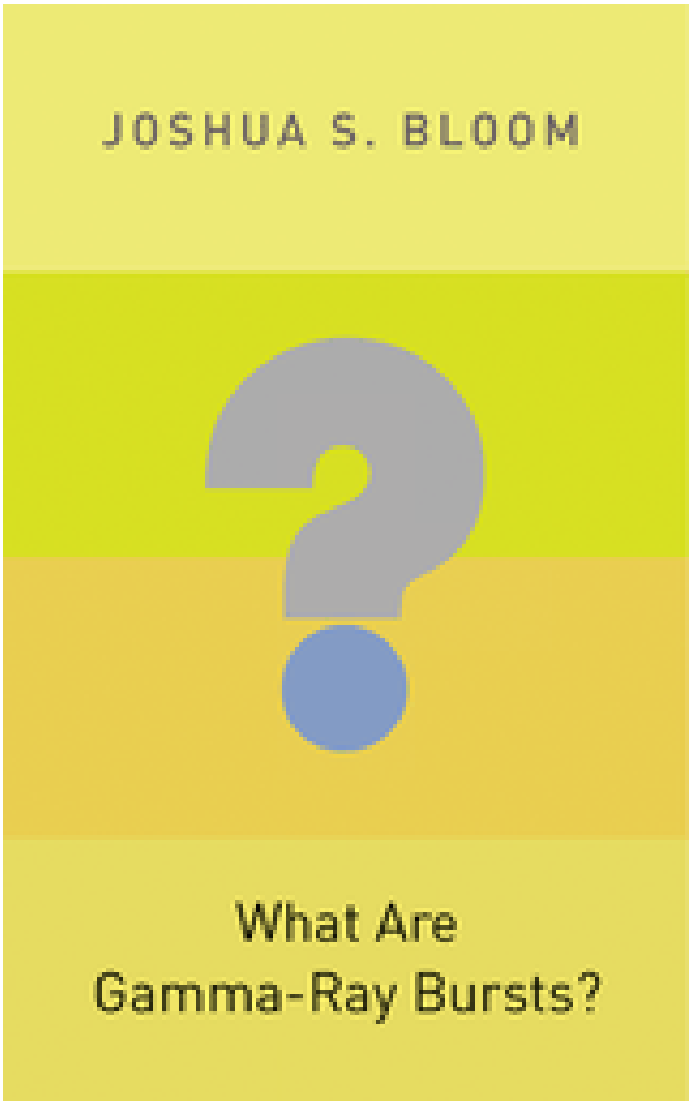
Book Reviews

WHAT ARE GAMMA-RAY BURSTS? by JOSHUA S. BLOOM

Published by Princeton University Press - 2011 Paperback - ISBN: 9780691145570 - £19.95

Joshua Bloom's book is directed at the astrophysicist wishing to keep up to date with a rapidly developing field of study, at professionals in other branches of physics who wish to keep abreast with developing ideas in astrophysics and at amateur astronomers willing themselves to find out about the biggest bangs in the Universe. This latter group will need to have a solid background in physics and a passing acquaintance with technospeak to gain fully from this book. The author is a professional astrophysicist who has worked in the field of Gamma Ray Bursts (GRBs) for many years and he uses the language and presentational tools of physics, including some mathematics, freely throughout the book. A word of warning to the innocent new reader - he/she should make a note of the meaning of the numerous abbreviations and acronyms which pepper the early chapters. Some are easily recalled or guessed at. SN, BH and NS are Supernova, Black Hole and Neutron Star - easy ! but what are IPN and CBM ? Amateurs might find themselves spending much time scouring the glossary or leafing through early chapters to rediscover that these are the Interplanetary Network (of satellites) and the Circumburst Material. This reader's tendency, in view of the manner of discovery of GRBs, was to think immediately that CBM must stand for Continental Ballistic Missile ! The appearance of unremembered abbreviations does tend to interrupt free flow reading, but this is to criticise an otherwise splendid book. Bloom tells it like the detective story that it really is, from suspected nuclear tests to star forming-regions in distant galaxies.

Chapter 1 briefly traces the history of GRBs from discovery to the present day. Much space is devoted here and in later chapters to discussions of the technological developments in satellite and earth-based telescopic hardware which enabled the detailed investigation of what are essentially very short lived transient events. The development of systems whereby GRBs could be detected, pinpointed in the sky and their coordinates relayed quickly to fast slewing ground-based optical telescopes is identified as the key to spectroscopic analysis of short lived GRB afterglows, thence to the measurement of redshift and thus to distance. The vast majority, but not all, GRBs, have thus been identified as occurring in distant galaxies. Those few events identified as occurring in nearby galaxies, or within the Milky Way, are thought to involve different physics. The author considers the circus of likely progenitor events leading to the prompt burst of gamma ray emission and broadly classifies GRBs in terms of their duration. There is detailed discussion of the interaction between the explosive by-products of the initiating event and the circumburst material. It is this interaction evidently, occurring at relativistic speeds with very high Lorentz factors and in the presence of dense magnetic flux, which for many distant GRB events leads to the gamma ray emission. The initiating events for the longer lived GRBs he associates with core collapse in giant stars. There are, however, more such supernovae than there are GRB's and Bloom discusses the specific properties of those supernovae which lead to the GRB end game. Shorter lived GRBs he associates more tentatively with the merger of degenerate objects such as neutron stars. Within this simplified overview there is a great deal of physics, some of it speculative, but much of it founded on a wealth of experimental data. The author reviews and dissects each aspect of the range of investigated GRB and afterglow properties to support these general proposals.



The investigative techniques, many of them developed specifically to study GRB phenomena, span the entire electromagnetic spectrum and the numbers which emerge in quantifying these events put GRBs at the very edge of physical theory. Looking to the future Bloom anticipates the detection of gravitational waves from GRB progenitor events and looks to the use of this new window on the Universe as an investigative tool in the cosmological arena.

The book provides an interesting insight into the birth and subsequent development of a scientific investigation. The loose ends, together with instances where current proposals provide an understanding of some GRB features or of some individual GRB events but not of others are discussed honestly and in a manner which clearly conveys both the youth of the subject and the challenges inherent in such a field of study. Professional astrophysicists will no doubt be able to read this book and put it down. The rest of us will have to read it again ! No matter – 'Tis a good read.

Brian Parsons.

August. 2011.

Supernova in M51

By Brendan Martin

On the morning of 4th June 2011 whilst checking the previous nights supernova run images I came to M51 (NGC5194) and straight away spotted an anomaly, was it a supernova? Well it certainly looked like one, further checks followed, no minor planets where in the vicinity and no recorded repeating novae so it looked positive, a quick trawl of the internet showed no claims on the s/n so we might have our first, we had started to prepare the email to the IAU (CBAT) and do the astrometrics when I received a phone call from Dave Thomson, some French guys had just announced the discovery. Tom Reiland; Thomas Griga; Amedee Riou; and Stephane Lamotte Bailey had discovered it a couple of days earlier 31/05/2011.

It is a type11b supernova which is a result of a core collapse in a large star of at least 8 solar masses, A *type IIb supernova* has a weak hydrogen line in its initial spectrum, which is why it is classified as a type II.

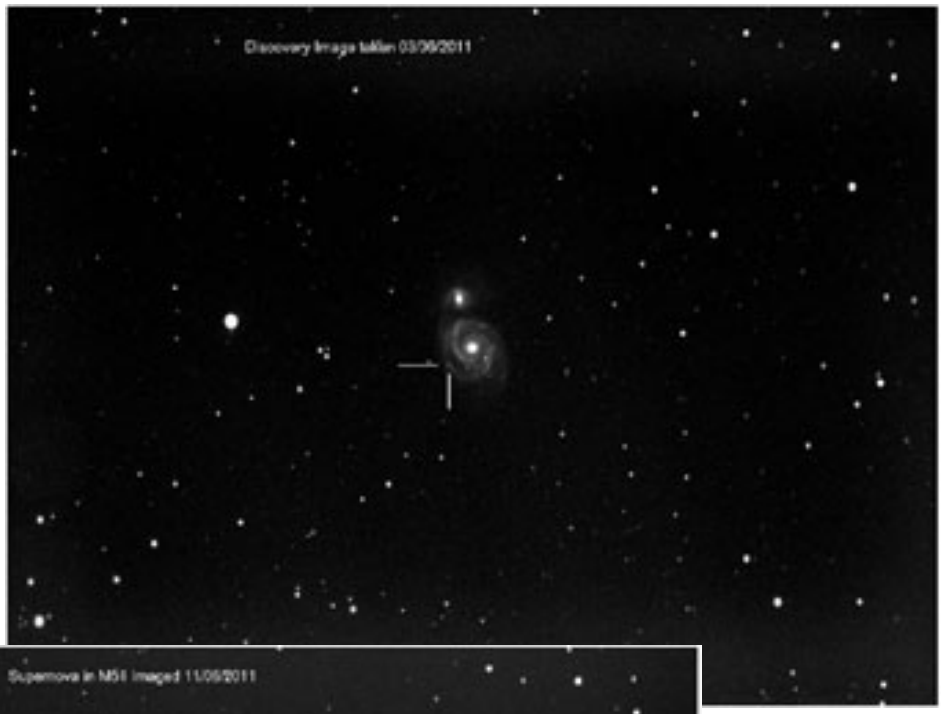
After the initial peak in its light curve there is a second peak that has a spectrum which more closely resembles a type Ib supernova. The progenitor could have been a giant star which lost most of its hydrogen envelope due to interactions with a companion in a binary system, leaving behind the core that consisted almost entirely of helium. As the ejecta of a Type IIb expands, the hydrogen layer quickly becomes more transparent and reveals the deeper layers. The classic example of a type IIb supernova is Supernova

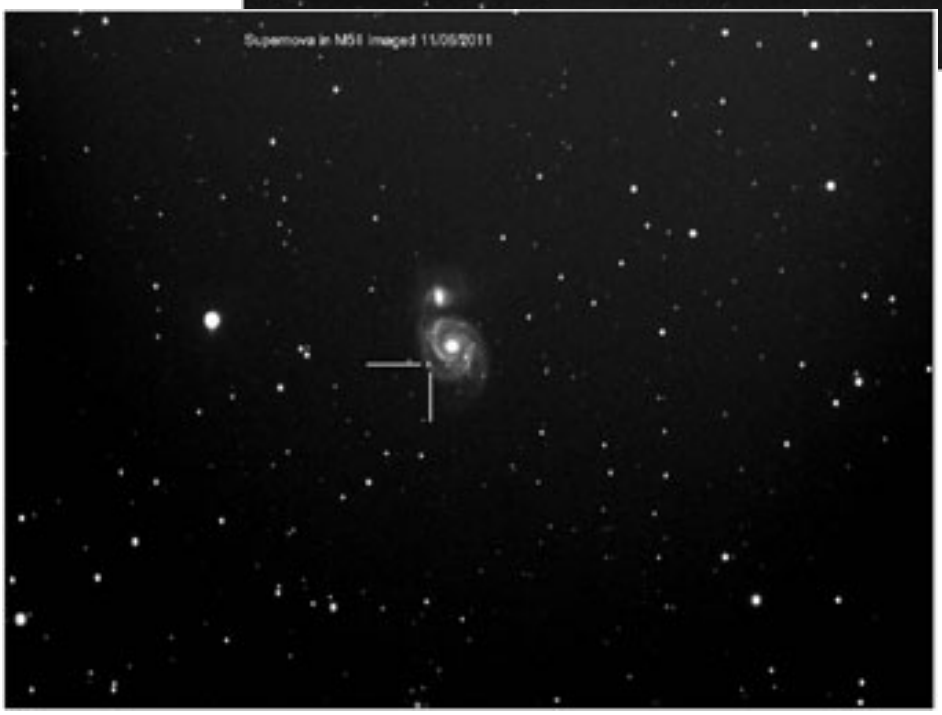
1993J, while another example is Cassiopeia A.

The images below show how the supernova has brightened over an eight day period, at its discovery it was estimated at mag 14 and in the second image it has reached mag 13.

These images were taken with the wide-field imager which is a 10" f1.5 telescope with an Atik320e ccd camera.

Courtesy: LAS Newsletter





RAS National Astronomy Meeting

Recently the RAS held their National Astronomy Meetings in Llandudno, North Wales and asked local societies to come along with telescopes on the outreach day, the Liverpool Astronomical Society duly obliged and below are images from the event, taken by members of the LAS.

Sun and *(no)* Stars at Bedruthan Steps

When members of Brannel Astronomy gathered at the National Trust's Bedruthan Steps location for their ***SUN & STARS*** event, it was bright sunlight.

This venue was chosen because of its great horizon, lack of light pollution and not least—the enthusiastic welcome by the NT.

With a crescent Moon we were all hopeful that club members and public alike would have excellent viewing.

Unfortunately after counting the increasing sunspot activity, the clouds formed and by sunset the cloud cover was total.

All attending agreed that this was a great site and it is hoped that we will have better co-operation from the 'cloudy lady' next year!!

Phil Brotherwood

NORTH ESSEX ASTRONOMICAL SOCIETY
PRESENTS

STARFEST

The Essex Astronomy Convention

Saturday 19th November 2011

Join us for a day of astronomy, featuring some of the best astronomy speakers in the UK, plus exhibits, displays and tradestands.
The convention will also feature the inaugural **"Les Sayer Memorial Lecture"**.

Speakers:
We have put together a great line-up of astronomy speakers:

Dr Stuart Clark - *"The Sky's Dark Labyrinth"*
(ESA Senior Editor for Space Science)

Andrew Green - *"Impacts"*
(StarDome - Astronomy & Astronautics, BBC Radio)

Pete Lawrence - *"Title TBC"*
(BBC Sky at Night)

Paul Abel - *"Black Holes"*
(BBC Sky at Night, University of Leicester)

Kelvin Long - *"Interstellar Travel, Project Icarus, & Flying Closer to Another Star"*
(British Interplanetary Society, Project Icarus)

Tickets are priced at £12 each.
To order tickets for STARFEST - simply print on our website at: http://www.neas.me.uk/starfest/ and complete the order form, and return it with payment.

The Astronomer Annual Meeting 2011

This year's meeting will take place at St. Mary's Church Hall Complex, Goat lane Basingstoke on Saturday 2011 October 8 starting at 11am with coffee served from 10.30am. The provisional agenda and speakers are:

- ***Dr. Christian Knigge***: Recent breakthroughs in our understanding of Cataclysmic Variables.
- ***Paul Hyde***: In the Radio - 80 years of developments in Radio Astronomy
- ***Roger Dymock***: Comets - where are they?
- ***Tony Markham***: The Challenge of Observing Meteors and Fireballs visually
- ***Derrick Ward***: Bringing Astronomy and the Public together
- ***Mark Kidger***: Herschel's History of Star formation in the Universe,

A booking form can be found on our website, at: http://www.theastronomer.org/agm2011/AGMBooking2011.pdf.

LETTERS

Dear All,
As some of you have already noticed we have changed the way that you can tell us about your society events. We hope that this is easier and that more of you will do so. Here are a few of our improvements:

- You can now edit your events - no needing to come through us
- Easier submission and more detailed forms
- New events by default already have your society venue (from our membership database)
- Integrated with your FAS society ID
- Better integration with our twitter feed

We don't have that many societies taking advantage of this service but its a great way to publicise your events (I know that at least one of the national magazines looks at this list for events). Go ahead and give it a try: http://goo.gl/Cetj2 (you will need your FAS Society ID and code)
Best wishes,

Sam George

Dear Colleagues
I am contacting you to invite your society to participate in a meeting we are organising at the Rutherford Appleton Laboratory in south Oxfordshire on Saturday 22nd October with the theme of Communicating Astronomy. This meeting will provide an excellent opportunity to meet and talk with others who are actively involved in astronomy outreach. Please pass on information about the meeting to any of your members, or other societies, that you think might be interested in attending.

The programme includes speakers from the Faulkes Telescope Project, Intech Planetarium, Dark Sky Discovery, the Zooniverse Project and Astronomy Now. To round off the day we will have a presentation by Professor Mike Edmunds of Cardiff University. The talks will take place in the main lecture theatre at RAL. There is also an exhibition area nearby where we hope many of the organizations and societies taking part will set up displays about their outreach activities. If you would like to bring along a display or other information about your society and any outreach that you do, we will be pleased to allocate space for you in the exhibition area. There will be a two hour break at lunchtime so that participants have plenty of opportunity to visit the exhibits. The site restaurant, near the lecture theatre, will be open for lunch on the day.

The meeting will be held on Saturday 22nd October 2011 from 10 a.m. to 5.30 p.m. Entry is free, but it is a security requirement of the Laboratory that all attendees must register in advance. For more information about the meeting, and details of how to register, please visit our website at www.newburyas.org.uk/commastro .

We would like as many different societies and organisations as possible to participate in this event, but of course the facilities do have a limit so we recommend early registration.

If you have any questions about the event please contact me on this email address: commastro@newburyas.org.uk.

I hope you will be able to join us for what we expect will be a very stimulating and rewarding day.

Chris Hooker
Chairman
Newbury Astronomical Society

Young Stars Take a Turn in the Spotlight

ScienceDaily

The European Southern Observatory's New Technology Telescope (NTT) has captured a striking image of the open cluster NGC 2100. This brilliant star cluster is around 15 million years old, and located in the Large Magellanic Cloud, a nearby satellite galaxy of the Milky Way. The cluster is surrounded by glowing gas from the nearby Tarantula Nebula.

The brilliant star cluster NGC 2100 lies in the Large Magellanic Cloud, a small satellite galaxy of the Milky Way. This image was taken with the EMMI instrument on the ESO New Technology Telescope (NTT) at the La Silla Observatory in Chile. This star cluster lies close to

Observers often overlook NGC 2100 because of its close proximity to the impressive Tarantula Nebula (eso0650) and the super star cluster RMC 136 (eso1030). The glowing gas of the Tarantula Nebula even tries to steal the limelight in this image -- the bright colours here are the nebula's outskirts. This new picture was created from exposures through several different colour filters using the EMMI instrument [1] on the New Technology Telescope at ESO's La Silla Observatory in Chile. The stars are shown in their natural colours, while light from glowing ionised hydrogen (shown here in red) and oxygen (shown in blue) is overlaid.

The colours that appear in nebulae depend on the temperatures of the stars lighting them up. The hot young stars in the Tarantula Nebula, which lie in the super star cluster RMC 136, are above and to the right of this image, and are powerful enough to cause oxygen to glow [2] showing up as blue nebulosity in this picture. Below NGC 2100 the red glow indicates either that the outer reaches of the influence of the hot stars of RMC 136 has been reached, or that cooler, and older, stars, that are only able to excite hydrogen are the dominant influence in this region. The stars that make up NGC 2100 are older and less energetic, and hence have little or no nebulosity associated with them.

Star clusters are groups of stars that formed around the same time from a single cloud of gas and dust. The stars with the most mass tend to form in the centre of the cluster, while those with less mass dominate the outer regions. This, along with the greater number of stars concentrated in the centre, makes the middle of the cluster brighter than the outer regions.

NGC 2100 is an open cluster, which means its stars are relatively loosely bound by gravity. These clusters have a lifespan measured in tens or hundreds of millions of years, as they eventually disperse through gravitational interaction with other bodies. Globular clusters, which look similar to the untrained eye, contain many more older stars and are much more tightly bound, and so have far longer lifespans: many globular clusters have been measured to be almost as old as the Universe itself. So while NGC 2100 might be older than its neighbours in the Large Magellanic Cloud, it is still a youngster by the standards of star clusters.

Data for this image of the under-appreciated young cluster were selected from the depths of ESO's data archives by Hidden Treasures entrant David Roma as part of the astrophotography competition held by ESO in 2010 [3].

Notes

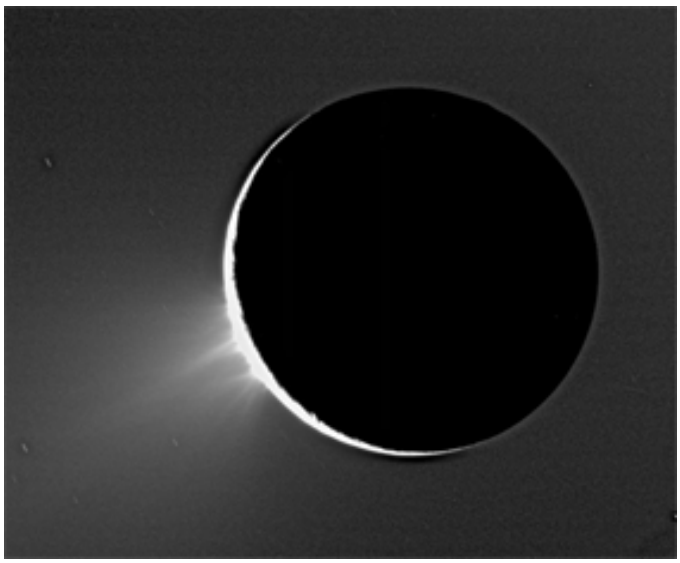
[1] EMMI stands for ESO Multi Mode Instrument. It is both a camera for imaging and a spectrograph.

[2] Most of the glow from oxygen comes from oxygen atoms that have lost two electrons. This strong emission is very common in nebulae but was mysterious to early astronomical spectroscopists and was initially thought to be coming from a new element given the name Nebulium.

[3] ESO's Hidden Treasures 2010 competition gave amateur astronomers the opportunity to search through ESO's vast archives of astronomical data, hoping to find a well-hidden gem that needed polishing by the entrants. To find out more about Hidden Treasures, visit (http://www.eso.org/public/outreach/hiddentreasures/).

Saturn's Moon Enceladus Spreads Its Influence

Chalk up one more feat for Saturn's intriguing moon Enceladus. The small, dynamic moon spews out dramatic plumes of water vapor and ice -- first seen by NASA's Cassini spacecraft in 2005. It possesses simple organic particles and may house liquid water beneath its surface. Its geyser-like jets create a gigantic halo of ice, dust and gas around Enceladus that helps feed Saturn's E ring. Now, thanks again to those icy jets, Enceladus is the only moon in our solar system known to influence substantially the chemical composition of its parent planet.



Water vapor and ice erupt from Saturn's moon Enceladus, the source of a newly discovered donut-shaped cloud around Saturn. (Credit: NASA/JPL/Space Science Institute)

In June, the European Space Agency announced that its Herschel Space Observatory, which has important NASA contributions, had found a huge donut-shaped cloud, or torus, of water vapor created by Enceladus encircling Saturn. The torus is more than 373,000 miles (600,000 kilometers) across and about 37,000 miles (60,000 kilometers) thick. It appears to be the source of water in Saturn's upper atmosphere.

Though it is enormous, the cloud had not been seen before because water vapor is transparent at most visible wavelengths of light. But Herschel could see the cloud with its infrared detectors. "Herschel is providing dramatic new information about everything from planets in our own solar system to galaxies billions of light-years away," said Paul Goldsmith, the NASA Herschel project scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

The discovery of the torus around Saturn did not come as a complete surprise. NASA's Voyager and Hubble missions had given scientists hints of the existence of water-bearing clouds around Saturn. Then in 1997, the European Space Agency's Infrared Space Observatory confirmed the presence of water in Saturn's upper atmosphere. NASA's Submillimeter Wave Astronomy Satellite also observed water emission from Saturn at far-infrared wavelengths in 1999.

While a small amount of gaseous water is locked in the warm, lower layers of Saturn's atmosphere, it can't rise to the colder, higher levels. To get to the upper atmosphere, water molecules must be entering Saturn's atmosphere from somewhere in space. But from where and how? Those were mysteries until now.

Build the model and the data will come.

The answer came by combining Herschel's observations of the giant cloud of water vapor created by Enceladus' plumes with computer models that researchers had already been developing to describe the behavior of water molecules in clouds around Saturn.

One of these researchers is Tim Cassidy, a recent post-doctoral researcher at JPL who is now at the University of Colorado's Laboratory for Atmospheric and Space Physics, Boulder. "What's amazing is that the model," said Cassidy, "which is one iteration in a long line of cloud models, was built without knowledge of the observation. Those of us in this small modeling community were using data from Cassini, Voyager and the Hubble telescope, along with established physics. We weren't expecting such detailed 'images' of the torus, and the match between model and data was a wonderful surprise."

The results show that, though most of the water in the torus is lost to space, some of the water molecules fall and freeze on Saturn's rings, while a small amount -- about 3 to 5 percent -- gets through the rings to Saturn's atmosphere. This is just enough to account for the water that has been observed there.

Herschel's measurements combined with the cloud models also provided new information about the rate at which water vapor is erupting out of the dark fractures, known as "tiger stripes," on Enceladus' southern polar region. Previous measurements by the Ultraviolet Imaging Spectrograph (UVIS) instrument aboard the Cassini spacecraft showed that every second the moon is ejecting about 440 pounds (200 kilograms) of water vapor.

"With the Herschel measurements of the torus from 2009 and 2010 and our cloud model, we were

(Continued on page 11)

(Continued from page 10)

able to calculate a source rate for water vapor coming from Enceladus," said Cassidy. "It agrees very closely with the UVIS finding, which used a completely different method."

"We can see the water leaving Enceladus and we can detect the end product -- atomic oxygen -- in the Saturn system," said Cassini UVIS science team member Candy Hansen, of the Planetary Science Institute, Tucson, Ariz. "It's very nice with Herschel to track where it goes in the meantime."

While a small fraction of the water molecules inside the torus end up in Saturn's atmosphere, most are broken down into separate atoms of hydrogen and oxygen. "When water hangs out in the torus, it is subject to the processes that dissociate water molecules," said Hansen, "first to hydrogen and hydroxide, and then the hydroxide dissociates into hydrogen and atomic oxygen." This oxygen is dispersed through the Saturn system. "Cassini discovered atomic oxygen on its approach to Saturn, before it went into orbit insertion. At the time, no one knew where it was coming from. Now we do."

"The profound effect this little moon Enceladus has on Saturn and its environment is astonishing," said Hansen.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate in Washington. The Cassini orbiter and several of its instruments were designed, developed and assembled at JPL.

Herschel is a European Space Agency cornerstone mission, with science instruments provided by consortia of European institutes and with important participation by NASA. NASA's Herschel Project Office is based at JPL. JPL contributed mission-enabling technology for two of Herschel's three science instruments. The NASA Herschel Science Center, part of the Infrared Processing and Analysis Center at Caltech, supports the United States astronomical community.

ScienceDaily

Astronomers spot Star Wars-like planet with two suns

Astronomers have identified the first circumbinary planet, a planet orbiting two stars, similar to the one seen in the 30-year-old Star Wars film.

The planet, which has been dubbed Kepler-16b, is located some 200 light-years from Earth and has been described as cold, gaseous and not thought to harbor life. The planet was detected during NASA's Kepler mission and its discovery is significant as it demonstrates the diversity of planets within the galaxy.

The existence of circumbinary planets had been previously hinted by earlier researches, but the detection now confirms such planets. Kepler detected the planet by observing transits, where the brightness of a parent star dims from the planet crossing in front of it.

According to astronomers, Kepler-16b is an inhospitable, cold world about the size of Saturn and thought to be made up of about half rock and half gas.

The parent stars are smaller than our sun. One is 69 percent the mass of the sun and the other only 20 percent. The research also showed that Kepler-16b orbits around both stars every 229 days, similar to Venus' 225-day orbit, but lies outside the system's habitable zone, where liquid water could exist on the surface, because the stars are cooler than our sun.

A research team led by Laurance Doyle of the SETI Institute in Mountain View, California, used data from the Kepler space telescope, which measures dips in the brightness of more than 150,000 stars, to search for transiting planets. Kepler is the first NASA mission capable of finding Earth-size planets in or near the "habitable zone," the region in a planetary system where liquid water can exist on the surface of the orbiting planet.

"This discovery confirms a new class of planetary systems that could harbor life," Kepler principal investigator William Borucki said. "Given that most stars in our galaxy are part of a binary system, this means the opportunities for life are much broader than if planets form only around single stars. This milestone discovery confirms a theory that scientists have had for decades but could not prove until now."

From our vantage point on Earth, scientists detected a pair of orbiting stars that eclipse each other and the new planet in the Kepler-16 system. When the smaller star partially blocks the larger star, a primary eclipse occurs, and a secondary eclipse occurs when the smaller star is occulted, or completely blocked, by the larger star.

However, astronomers said a third body could exist since observations showed that the brightness of the system dipped even when the stars were not eclipsing one another.

The additional dimming in brightness events, called the tertiary and quaternary eclipses, reappeared at irregular intervals of time, indicating the stars were in different positions in their orbit each time the third body passed. This showed the third body was circling, not just one, but both stars, in a wide circumbinary orbit.

In addition, another good indicator of the mass of the third body was the gravitational tug on the stars, measured by changes in their eclipse times. Only a very slight gravitational pull was detected, one that only could be caused by a small mass.

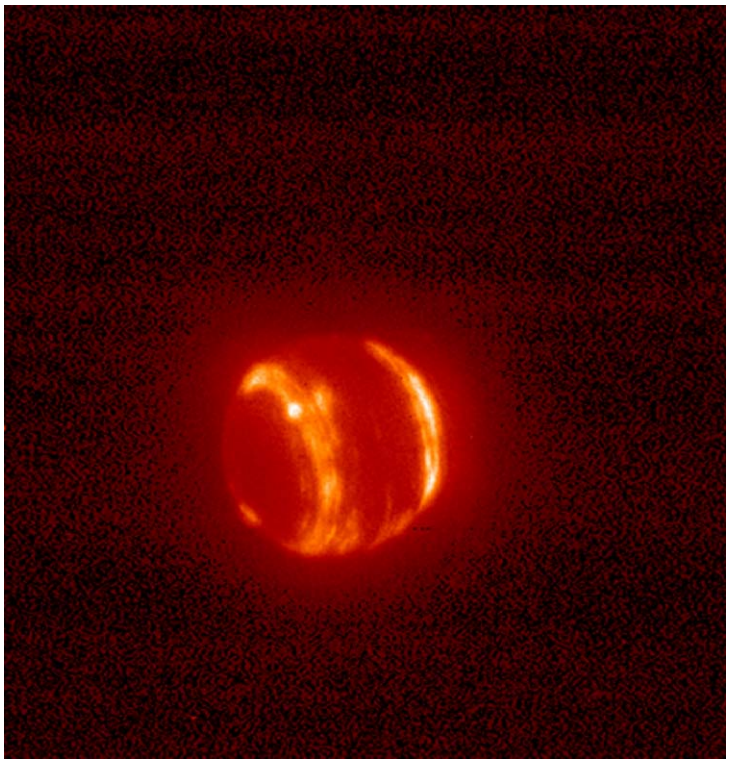
New Photos Show Blazingly Bright Uranus & Neptune in Infrared

The distant "ice giant" planets Uranus and Neptune look like worlds aflame in new photos captured by Hawaii's Keck Observatory.

To the naked eye, Neptune would appear blue and Uranus bluish-green. But Caltech astronomer Mike Brown snapped the new pictures in infrared light, using Keck's adaptive optics system. So the two planets blaze reddish-orange, like embers glowing in the dark night of deep space.

Brown posted the pictures via Twitter from Sept. 18 to Sept. 20. Two shots show bright streaks on Neptune, which is about 17 times as massive as Earth and orbits 30 times farther from the sun than our planet does.

These streaks represent high-altitude clouds that are reflecting a lot of light. Neptune is a stormy place, hosting some of the most violent maelstroms in the solar system.



A shot of faraway Neptune in infrared light, captured using the adaptive optics system at Hawaii's Keck Observatory.
CREDIT: Mike Brown/Caltech

Neptune and Triton

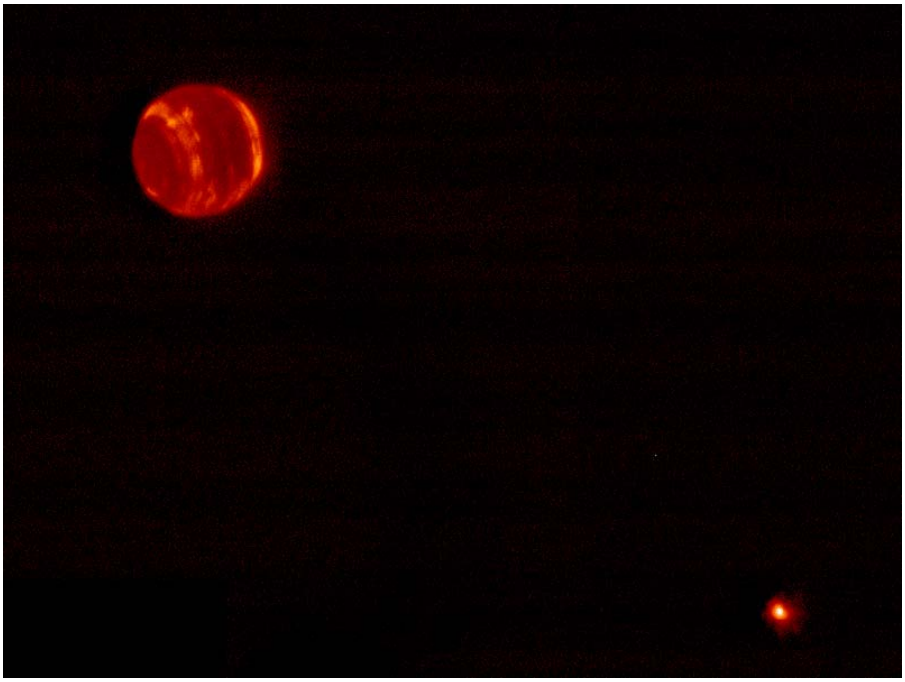
One image captures Neptune along with its largest moon, Triton, which is about 80 percent as big as Earth's moon.

Triton's composition is similar to that of objects in the Kuiper Belt, the ring of icy, rocky bodies beyond Neptune's orbit. As a result, many astronomers believe that Triton is a former Kuiper Belt object that the planet's gravity captured long ago.

Brown studies objects in the frigid outer reaches of the solar system, both in the Kuiper Belt and beyond. He has discovered a number of dwarf planets way out there, including the Pluto-size Eris in 2005 — a find that spurred astronomers to rethink just what a planet is (and, ultimately, to demote Pluto to "dwarf planet" status in 2006).

During the recent Keck observing session, Brown and his team were more interested in Triton than Neptune.

"We were studying Triton at the time, trying to see if we could make a crude map of its surface composition," Brown told SPACE.com in an email. "But Neptune is a little too spectacular to not stop and take a picture of it as long as you're nearby."



This shot, taken in infrared light using the adaptive optics system at Hawaii's Keck Observatory, shows Neptune and its moon Triton (lower right).
CREDIT: Mike Brown/Caltech

The rings of Uranus

Other photos show Uranus — which is 14.5 times as massive as Earth and orbits 19 times farther away than Earth does — in a whole new light. In particular, the pictures highlight Uranus' rings, which were discovered only in 1977.

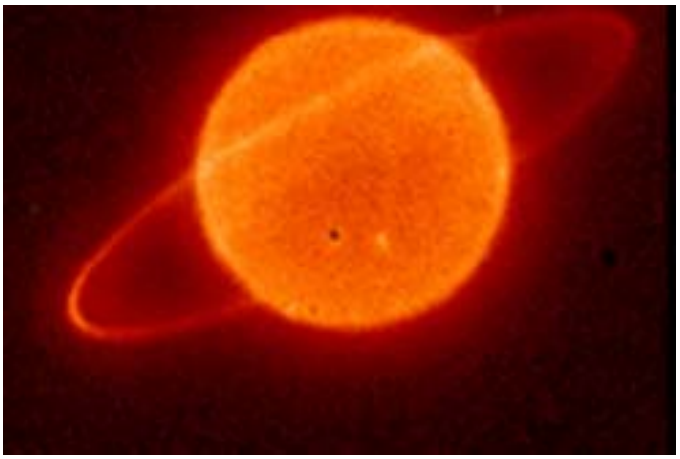
"The rings are faint and really tough to see and not even discovered until moderately recently, but Uranus is so dark at these wavelengths that the rings are quite easy to see," Brown said.

One Uranus image shows several of the planet's 27 known moons, including one known as Miranda, which blazes bright above and to the left of Uranus. Despite being just one-seventh as big as Earth's moon, Miranda boasts canyons 12 times deeper than the Grand Canyon, as well as numerous other interesting geological features.

Again, the moon drew Brown's attention more than the planet.

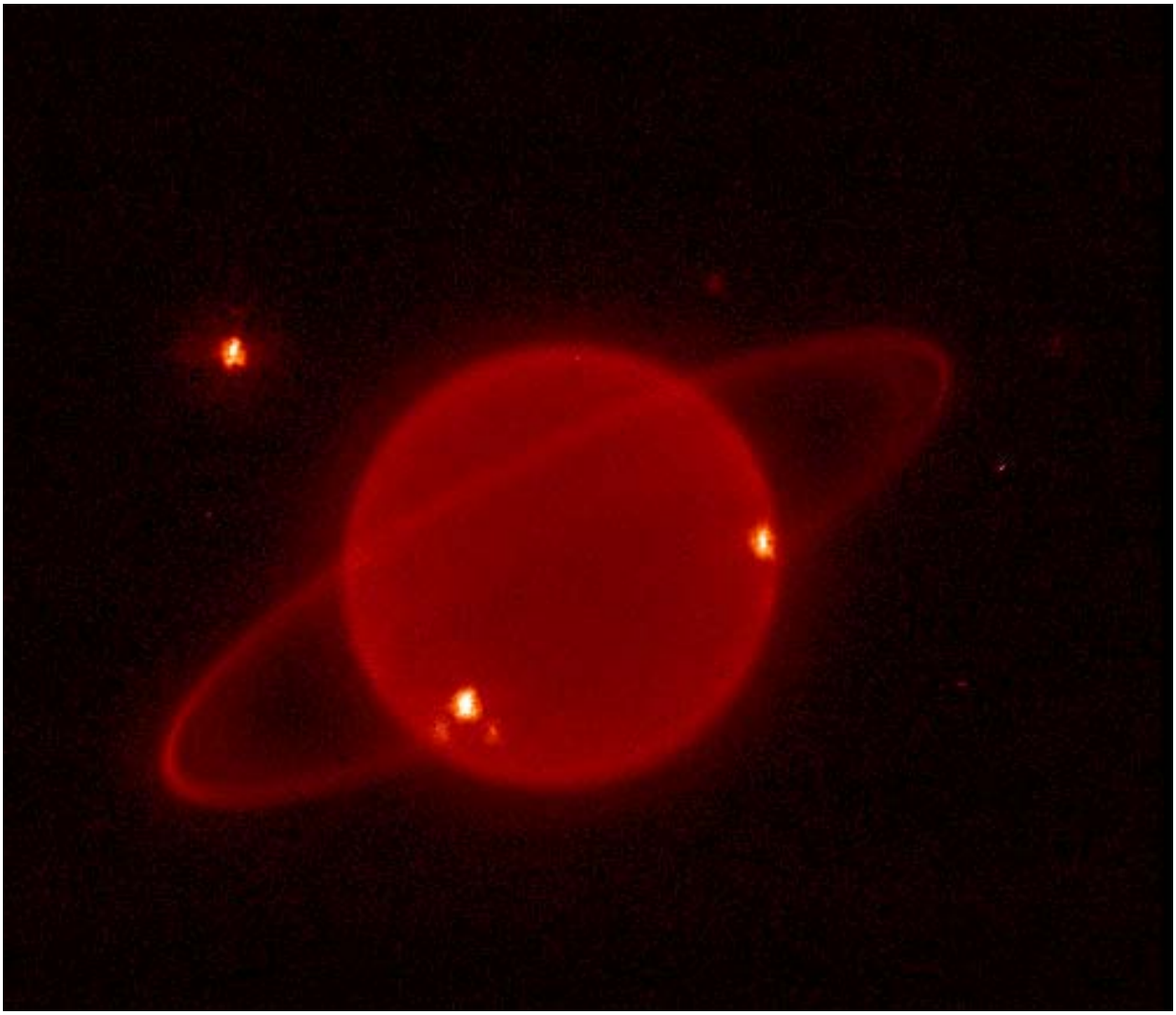
"Here we were looking at Miranda, which is quite close to Uranus," Brown said. "But, again, we couldn't resist the photo opportunity."

Also visible in the photo is another, fainter moon, Puck,



to Uranus' upper right. The bright spots on the planet's disk are high clouds, Brown said.

You can follow SPACE.com senior writer Mike Wall on Twitter: @michaeldwall. Follow SPACE.com for the latest in space science and exploration news on Twitter @Spacedotcom and on Facebook.



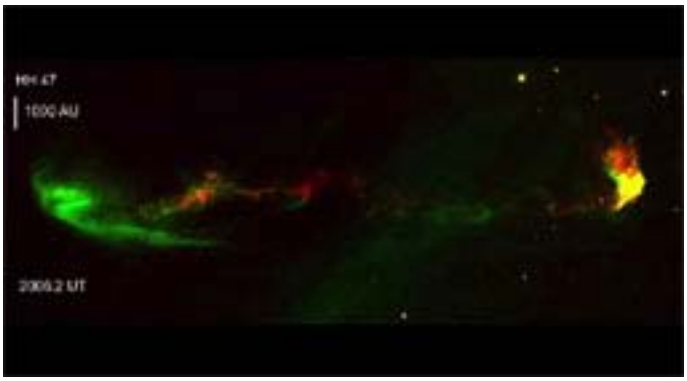
A view of Uranus in infrared light, captured by Hawaii's Keck Observatory. The moon Miranda is to the upper left of Uranus, and the moon Puck is a faint smudge to the upper right. The bright splotches on Uranus' disk are clouds.
CREDIT: Mike Brown/Caltech

by Mike Wall, SPACE.com Senior Writer

Hubble Movies Reveal Solar-System-Sized Traffic Jams: Giant Jets Spewing from Newborn Stars Revealed in Telescope's Images

ScienceDaily

When it comes to big-budget action movies, Rice University astronomer Patrick Hartigan prefers Hubble to Hollywood.



Astronomers have created time-lapse movies that offer astronomers their first glimpse of the dynamic behavior of stellar jets, huge torrents of gas and particles that spew from the poles of newborn stars. (Credit: Image courtesy of Rice University)

Using Hubble Space Telescope images collected over 14 years, Hartigan has created time-lapse movies that offer astronomers their first glimpse of the dynamic behavior of stellar jets, huge torrents of gas and particles that spew from the poles of newborn stars.

An analysis of the movies that was published in The Astrophysical Journal is forcing astronomers to rethink some of the processes that occur during the latter stages of star birth. And in an effort to learn even more, Hartigan and colleagues are using powerful lasers to recreate a small-scale version of the solar-system-sized jets in a lab in upstate New York.

"The Hubble's given us spectacular images," said Hartigan, professor of physics and astronomy at Rice. "In the nebulae where stars are born, for instance, we can see beautiful filaments and detailed structure. We know these images are frozen snapshots in time, but we would need to watch for hundreds of thousands of years to see how things actually play out."

Hartigan said stellar jets are different because they move very quickly. Stellar jets blast out into space from the poles of newly formed stars at about 600,000 miles an hour. Astronomers first noticed them about 50 years ago, and they believe the sun probably had stellar jets when it formed about 4.5 billion years ago.

Hartigan began using Hubble to collect still frames of stellar jets in 1994. The jets emerge from each pole of a young star, and Hartigan used Hubble to revisit the jets from three stars in 1994, 1998 and 2008. All three stars are about 1,350 light years from Earth. Two are near the Orion Nebula, and the third is in the southern sky in the constellation Vela.

By lacing the images together and using a computer to fill in what occurred between still frames, Hartigan and his collaborators created time-lapse movies. The movies clearly showed something that wasn't obvious in any of the still images; clouds of dust and gas within the jets move at different speeds.

"The bulk motion of the jet is about 300 kilometers per second," Hartigan said. "That's really fast, but it's kind of like watching a stock car race; if all the cars are going the same speed, it's fairly boring. The interesting stuff happens when things are jumbling around, blowing past one another or slamming into slower moving parts and causing shockwaves."

Understanding what happens in those huge collisions is another challenge. The phenomena didn't look like anything that Hartigan and his astronomer colleagues had seen. But when he showed them to colleagues who were familiar with the physics of nuclear explosions, they immediately saw patterns in the shockwaves that looked familiar.

"The fluid dynamicists immediately picked up on an aspect of the physics that astronomers typically overlook, and that led to a different interpretation for some of the features we were seeing," Hartigan explained. "The scientists from each discipline bring their own unique perspectives to the project, and having that range of expertise has proved invaluable for learning about this critical phase of stellar evolution."

Motivated by the results from Hubble, Hartigan and colleagues are conducting experiments at the Omega Laser Facility in Rochester, New York, to recreate small-scale versions of the solar-system-sized features captured in the movies.

"It's one more tool we have to better understand the underlying physics," Hartigan said.

In addition to Hartigan, the research team includes Adam Frank of the University of Rochester; John Foster and Paula Rosen of the Atomic Weapons Establishment in Aldermaston, U.K.; Bernie Wilde, Rob Coker and Melissa Douglas of Los Alamos National Laboratory in New Mexico; and Brent Blue and Freddy Hansen of General Atomics in San Diego, Calif.

The research is funded by NASA and the National Nuclear Security Administration.

A video illustrating the research is available at:http://www.youtube.com/watch?v=0Yf_O-S4FM8

Hartigan's Hubble Space Telescope movies are available at:http://sparky.rice.edu/~hartigan/movies.html

The Star That Should Not Exist

ScienceDaily

A faint star in the constellation of Leo (The Lion), called SDSS J102915+172927 [1], has been found to have the lowest amount of elements heavier than helium (what astronomers call "metals") of all stars yet studied. It has a mass smaller than that of the Sun and is probably more than 13 billion years old.

"A widely accepted theory predicts that stars like this, with low mass and extremely low quantities of metals, shouldn't exist because the clouds of material from which they formed could never have condensed," [2] said Elisabetta Caffau (Zentrum fur Astronomie der Universitat Heidelberg, Germany and Observatoire de Paris, France), lead author of the paper. "It was surprising to find, for the first time, a star in this 'forbidden zone', and it means we may have to revisit some of the star formation models."

The team analysed the properties of the star using the X-shooter and UVES instruments on the VLT [3]. This allowed them to measure how abundant the various chemical elements were in the star. They found that the proportion of metals in SDSS J102915+172927 is more than 20 000 times smaller than that of the Sun [4][5].

"The star is faint, and so metal-poor that we could only detect the signature of one element heavier than helium -- calcium -- in our first observations," said Piercarlo Bonifacio (Observatoire de Paris, France), who supervised the project. "We had to ask for additional telescope time from ESO's Director General to study the star's light in even more detail, and with a long exposure time, to try to find other metals."

Cosmologists believe that the lightest chemical elements -- hydrogen and helium -- were created shortly after the Big Bang, together with some lithium [6], while almost all other elements were formed later in stars. Supernova explosions spread the stellar material into the interstellar medium, making it richer in metals. New stars form from this enriched medium so they have higher amounts of metals in their composition than the older stars. Therefore, the proportion of metals in a star tells us how old it is.

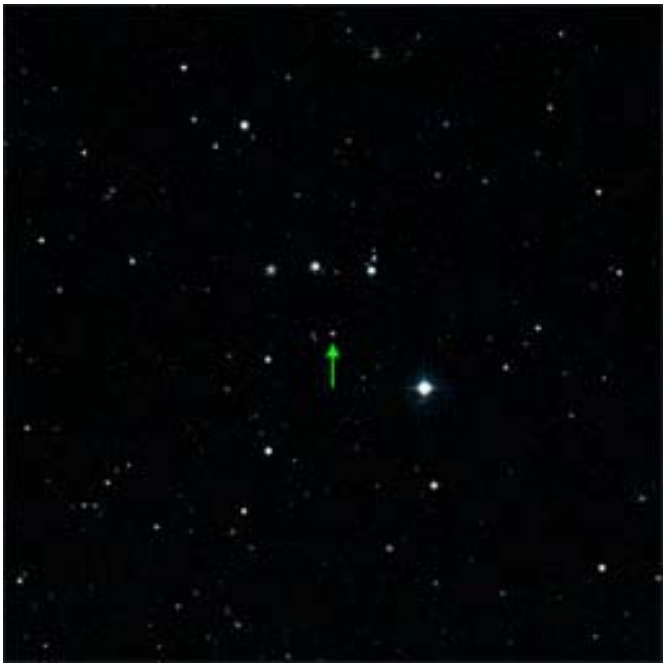
"The star we have studied is extremely metal-poor, meaning it is very primitive. It could be one of the oldest stars ever found," adds Lorenzo Monaco (ESO, Chile), also involved in the study.

Also very surprising was the lack of lithium in SDSS J102915+172927. Such an old star should have a composition similar to that of the Universe shortly after the Big Bang, with a few more metals in it. But the team found that the proportion of lithium in the star was at least fifty times less than expected in the material produced by the Big Bang.

"It is a mystery how the lithium that formed just after the beginning of the Universe was destroyed in this star." Bonifacio added.

The researchers also point out that this freakish star is probably not unique. "We have identified several more candidate stars that might have metal levels similar to, or even lower than, those in SDSS J102915+172927. We are now planning to observe them with the VLT to see if this is the case," concludes Caffau.

Notes



At the center of this picture is a very unremarkable looking faint star, too faint to be seen through all but the largest amateur telescopes. This ancient star, in the constellation of Leo (The Lion), is called SDSS J102915+172927 and has been found to have the lowest amount of elements heavier than helium of all stars yet studied. It has a mass smaller than that of the Sun and is probably more than 13 billion years old. (Credit: ESO/Digitized Sky Survey 2)

[1] The star is catalogued in the Sloan Digital Sky Survey or SDSS. The numbers refer to the object's position in the sky.

[2] Widely accepted star formation theories state that stars with a mass as low as SDSS J102915+172927 (about 0.8 solar masses or less) could only have formed after supernova explosions enriched the interstellar medium above a critical value. This is because the heavier elements act as "cooling agents," helping to radiate away the heat of gas clouds in this medium, which can then collapse to form stars. Without these metals, the pressure due to heating would be too strong, and the gravity of the cloud would be too weak to overcome it and make the cloud collapse. One theory in particular identifies carbon and oxygen as the main cooling agents, and in SDSS J102915+172927 the amount of carbon is lower than the minimum deemed necessary for this cooling to be effective.

[3] X-shooter (http://www.eso.org/public/news/eso0920/) and UVES (http://www.eso.org/sci/facilities/paranal/instruments/uves/) are VLT spectrographs -- instruments used to separate the light from celestial objects into its component colours and allow detailed analysis of the chemical composition. X-shooter can capture a very wide range of wavelengths in the spectrum of an object in one shot (from the ultraviolet to the near-infrared). UVES is the Ultraviolet and Visual Echelle Spectrograph, a high-resolution optical instrument.

[4] The star HE 1327-2326, discovered in 2005, has the lowest known iron abundance, but it is rich in carbon. The star now analysed has the lowest proportion of metals when all chemical elements heavier than helium are considered.

[5] ESO telescopes have been deeply involved in many of the discoveries of the most metal-poor stars. Some of the earlier results were reported in eso0228

(Continued on page 16)

No Evacuation Plans for ISS Yet

by NANCY ATKINSON —*Universe Today*

The International Space Station has had a continual human presence for nearly 11 years, and so the astronauts now aboard the ISS are holding out hope that they won't have to break that streak and turn out the lights and close all the hatches when they leave. Ron Garan and Mike Fossum said in a news conference with reporters on Tuesday that they have not yet been training for the possibility that they will have to leave the ISS unmanned due to a problem with the Soyuz rocket, the only ride astronauts and cosmonauts currently have to space.

"It's too early for us to get too worried about that, frankly," said Fossum, "and we haven't started to do anything specific up here,except for documenting things we do on video. Fossum added that teams in mission control in Houston and Moscow are figuring out the procedures of what needs to be done if a problem with the Soyuz rockets can't be figured out by November. "It will take us a few weeks to finish that up, but we have another nine or so weeks here, my crew of three. So we've got plenty of time for those kinds of things."

Fossum said the ground crews are in the preliminary stages of deciding everything, "from what ventilation we're going to leave running, what lights we're going to leave on, what condition each particular experiment will be on, every tank, every valve, every hatch."

A Russian rocket carrying a Progress resupply ship failed just after the third stage ignition two weeks ago and crashed into Siberia. While the Progress cargo ships launch on a Soyuz-U rocket and the Soyuz crew capsules — the Soyuz TMA — launches on a Soyuz-FG, the third stages of the two rockets are virtually identical.

Russian engineers said last week a malfunction in the third stage engine's gas generator occurred; now they need to find out why and launch a couple of unmanned rockets before putting humans on board.

Right now a crew of six is on the station, with three of them scheduled to depart late next week – a week later than originally planned — to keep the station fully staffed as long as possible. A new crew of three was supposed arrive later this month, but that flight is on hold at least until early November, depending on the outcome of the investigation by the Russian engineers.

Since the space shuttles are no longer flying, the Soyuz is the only ride in town. While SpaceX is scheduled to send an unmanned Dragon capsule in a test run for bringing cargo to the station, the station would have to

Ron Garan and Mike Fossum during the news conference on Sept. 6, 2011. Credit: NASA TV

be abandoned if the Soyuz rocket isn't cleared by November.

"It's a complicated thing, when a rocket shuts down. It is a big deal," said Fossum. "We're not part of that investigation but we know what is going on. It's not a fundamental design flaw, as this rocket has had hundreds of successful fights. But they are looking for what has changed."

So, ground teams are now looking ahead for all the possible "what ifs" that might occur and Fossum and Garan said the big problem would be a short time span to do a crew handover – training in the new crew – or if they have to leave the station unmanned. They've started videotaping procedures and intricacies they've discovered about the station, just in case they aren't there when a new crew arrives.

But it's been a source of pride that there have been crews up here for over 4,000 days straight. "I think it is important," said Fossum, "the station requires some care and feeding, and it is important for us to be here if we possibly can. If we have to shut it down for awhile, we will do our best to leave it in the best possible condition for the next crew to open the doors and turn the lights and and get back to work."

The astronauts said if they do have to leave the station unmanned for a short period, it shouldn't be a problem, but if the short gap turns into months, "the probability starts to stack up against you and leads to possibility that you would have a problem that could be significant without anyone up here to take action," said Fossum.

Meanwhile, science operations are going full speed ahead. "We're breaking records every week with crew-based research, over and above the autonomous research," Garan said. "It's important to note, that in the event we have to leave, there will still be science operations on board."

(Continued from page 15)

(http://www.eso.org/public/news/eso0920/) and eso0723 (http://www.eso.org/public/news/eso0723/) and the new discovery shows that observations with ESO telescopes have let astronomers make a further step closer to finding the first generation of stars.

[6] Primordial nucleosynthesis refers to the production of chemical elements with more than one proton a few moments after the Big Bang. This production happened in a very short time, allowing only hydrogen, helium and lithium to form, but no heavier elements. The Big Bang theory predicts, and observations confirm, that the primordial matter was composed of about 75% (by mass) of hydrogen, 25% of helium, and trace amounts of lithium.

More information

This research was presented in a paper, "An extremely primitive halo star," by Caffau et al. to appear in the 1 September 2011 issue of the journal *Nature*.

The team is composed of Elisabetta Caffau (Zentrum fur Astronomie der Universitat Heidelberg [ZAH], Germany and GEPI -- Observatoire de Paris, Universite Paris Diderot, CNRS, France [GEPI]), Piercarlo Bonifacio (GEPI), Patrick François (GEPI and Universite de Picardie Jules Verne, Amiens, France), Luca Sbordone (ZAH, Max-Planck Institut fur Astrophysik, Garching, Germany, and

Where's the debris for transiting planets?

By Jon Voisey, Universe Today

For many exoplanet systems that have been discovered by the radial velocity method, astronomers have found excess emission in the infrared portion of the spectrum. This has generally been interpreted as remnants of a disk or collection of objects similar to our own Kupier belt, a ring of icy bodies beyond the orbit of Pluto. But as Kepler and other exoplanet finding missions rake in the candidates though transits of the parent star, astronomers began noticing something unusual: None of the exoplanet systems discovered through this method were known to have debris disks. Was this an odd selection effect, perhaps induced by the fact that transiting planets often orbit close to their parent stars, making them more likely to pass along the line of sight which could in turn, betray different formation scenarios? Or were astronomers simply not looking hard enough? A recent paper by astronomers at the Astrophysikalisches Institut in Germany attempts to answer that question.

In order to do so, the team compared the (at the time) 93 known transitingexoplanets to stars for which archival data was available through infrared missions such has IRAS, ISO, AKARI, and WISE. The team then searched the data looking for a previously unrecognized bump in the emission in the infrared. Many of the stars they searched were faint, due to distance, so most of the IR telescopes did not have images with sufficient depth to draw much in the way of conclusions. Between IRAS, ISO, Spitzer, and AKARI, the team was only able to examine three stars, and all of those came from Spitzer observations.

The most plentiful return came from the WISE telescope which had 53 entries that overlapped with known transiting systems, one of which was excluded due to image defects. From these 52 candidates, the team found four that may have contained excess emission. To follow up, the team added observations from other observatories that lied in the near infrared (the 2MASS survey) and the visual portion of the spectrum. This allowed them to build a more complete picture of the brightness of the stars at various wavelengths which would make the excess stand out even more. While all four systems deviated from an ideal blackbody in the portion of the spectrum expected for a debris disk, only two of them, TrES-2, and XO-5, did so in a manner that did so in a statistically significant manner.

While this study shows that debris disks are possible around transiting stars, it was only able to confirm their presence in two stars out of 52, or just under 4% of their sample. But how does that compare to systems discovered by other methods? One of the studies cited in the paper used a similar method of comparing archival data from IR observatories to known exoplanet system discovered by other methods in 2009. In this study, the team found debris disks around 10 of the 150 planet-bearing stars, which is roughly 7%. Due to the low return rate on both of these studies, the inherent uncertainty puts these two figures within a plausible range of one another, but certainly, more studies will be in order in the future. They will help astronomers determine just what difference exists, if any, as well as giving more insight into how planetary system form and evolve.

Our galaxy might hold thousands of ticking 'time bombs'

(PhysOrg.com) - Harvard-Smithsonian Center for Astrophysics

In the Hollywood blockbuster "Speed," a bomb on a bus is rigged to blow up if the bus slows down below 50 miles per hour. The premise - slow down and you explode - makes for a great action movie plot, and also happens to have a cosmic equivalent.

New research shows that some old stars might be held up by their rapid spins, and when they slow down, they explode as supernovae. Thousands of these "time bombs" could be scattered throughout our Galaxy.

"We haven't found one of these 'time bomb' stars yet in the Milky Way, but this research suggests that we've been looking for the wrong signs. Our work points to a new way of searching for supernova precursors," said astrophysicistRosanne Di Stefano of the Harvard-Smithsonian Center for Astrophysics (CfA).

The specific type of stellar explosion Di Stefano and her colleagues studied is called a Type Ia supernova. It occurs when an old, compact star known as a white dwarf destabilizes.

A white dwarf is a stellar remnant that has ceased nuclear fusion. It typically can weigh up to 1.4 times as much as our Sun - a figure called the Chandrasekhar mass after the astronomer who first calculated it. Any heavier, and gravity overwhelms the forces supporting the white dwarf, compacting it and igniting runaway nuclear fusion that blows the star apart.

There are two possible ways for a white dwarf to exceed the Chandrasekhar mass and explode as a Type Ia supernova. It can accrete gas from a donor star, or two white dwarfs can collide. Most astronomers favor the first scenario as the more likely explanation. But we would expect to see certain signs if the theory is correct, and we don't for most Type Ia supernovae.

For example, we should detect small amounts of hydrogen and helium gas near the explosion, but we don't. That gas would come from matter that wasn't accreted by the white dwarf, or from the disruption of the companion star in the explosion. Astronomers also have looked for the donor star after the supernova faded from sight, without success.

Di Stefano and her colleagues suggest that white dwarf spin might solve this puzzle. A spin-up/spin-down process would introduce a long delay between the time of accretion and the explosion. As a white dwarf gains mass, it also gains angular momentum, which speeds up its spin. If the white dwarf rotates fast enough, its spin can help support it, allowing it to cross the 1.4-solar-mass barrier and become a super-Chandrasekhar-mass star.

Once accretion stops, the white dwarf will gradually slow down. Eventually, the spin isn't enough to counteract gravity, leading to a Type Ia supernova.

New research shows that some old stars known as white dwarfs might be held up by their rapid spins, and when they slow down, they explode as Type Ia supernovae. Thousands of these "time bombs" could be scattered throughout our Galaxy. In this artist's conception, a supernova explosion is about to obliterate an orbiting Saturn-like planet. Credit: David A. Aguilar (CfA)

"Our work is new because we show that spin-up and spin-down of the white dwarf have important consequences. Astronomers therefore must take angular momentum of accreting white dwarfs seriously, even though it's very difficult science," explained Di Stefano.

The spin-down process could produce a time delay of up to a billion years between the end of accretion and the supernova explosion. This would allow thecompanion star to age and evolve into a second white dwarf, and any surrounding material to dissipate.

In our Galaxy, scientists estimate that there are three Type Ia supernovae every thousand years. If a typical super-Chandrasekhar-mass white dwarf takes millions of years to spin down and explode, then calculations suggest that there should be dozens of pre-explosion systems within a few thousand light-years of Earth.

Those supernova precursors will be difficult to detect. However, upcoming wide-field surveys conducted at facilities like Pan-STARRS and the Large Synoptic Survey Telescope should be able to spot them.

"We don't know of any super-Chandrasekhar-mass white dwarfs in the Milky Way yet, but we're looking forward to hunting them out," said co-author Rasmus Voss of Radboud University Nijmegen, The Netherlands.
More information: This research appears in a paper in the Sept. 1 issue of *The Astrophysical Journal Letters* and is available online.