WEYMOUTH ASTRONOMY

Sky Watcher

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Trips / Events

Ideas for trips and events always welcome!

events@weymouthastronomy.co.uk

- **21 June CADAS—Steve Tonkin: Ten ways the universe tries to kill you**
- **4 July WAS—David Bacon: Probing the Dark Universe**
- **19 July CADAS—Mike Witt: Tales from the Darkside of the universe**
- **1Aug WAS—Guy Hurst: Guest Stars, Ancient and Modern**
- **16 Aug CADAS—Bill Combes: The International Space Station**

More events to come… 2017.

Programmes for many local Societies will be available in the near future. Check their websites for more details.

If you are interested in giving a talk or workshop, let the organisers know. They like to offer new titles in their programme line-up.

WAC Upcoming Events:

14 July—Strife among the canals: James Fradgley

11 Aug—Open evening at SACC

8 Sept—USA Eclipse of 2017: Chris Bowden

13 Oct—Binocular Astronomy: Stephen Tonkin

10 Nov—Impacts: Bob Mizon

8 Dec—Christmas Quiz Night

Plans for informal viewing nights will take place after the monthly meetings, weather permitting.

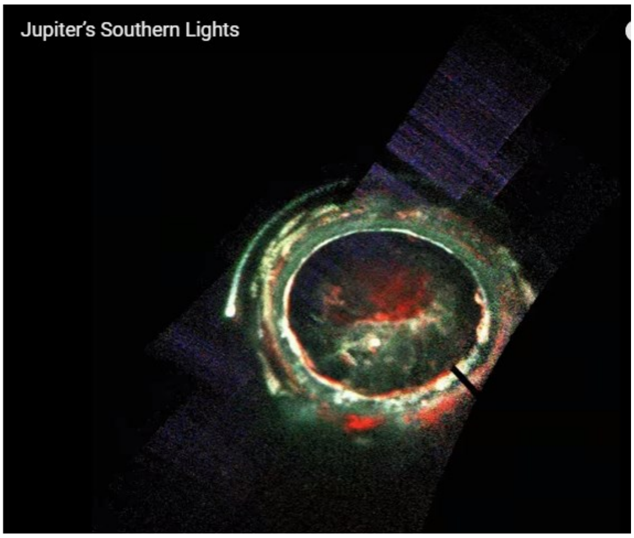
WAC News—

POSTCARDS FROM JUNO - IN ORBIT AROUND JUPITER

Have a look at this ‘eye-popping, never-before-seen sequence of Jupiter's aurorae, captured by Juno's Ultraviolet Spectrograph. The long-tailed "comet" on the left is the footprint of an electromagnetic connection to the moon Io’ as recently released in the publication *Geophysical Research Letters*. Follow the link to see the full sequence.

With the summer solstice almost upon us, enjoy the early evening views of Jupiter as twilight appears.

Until next month ~SK



https://youtu.be/BWOSGI1WrNA

The Fizzy Seas Of Titan By Marcus Woo

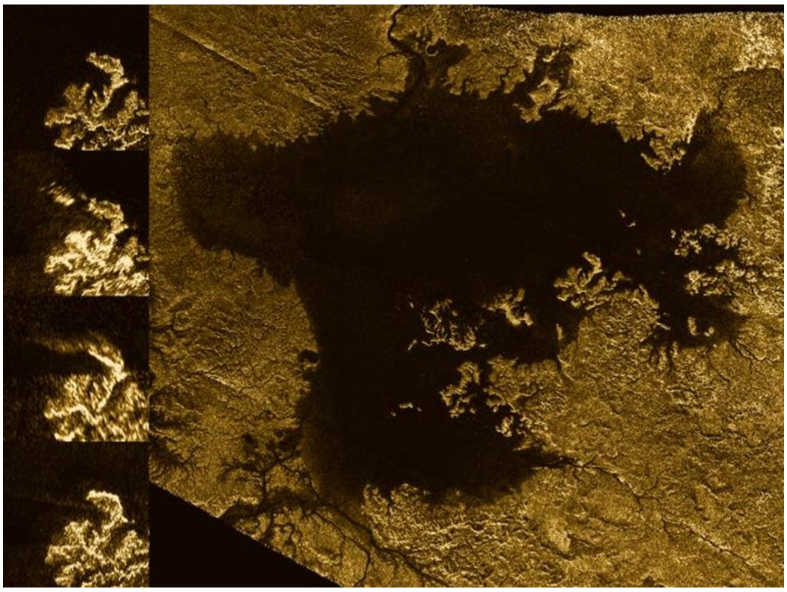
With clouds, rain, seas, lakes and a nitrogen-filled atmosphere, Saturn's moon Titan appears to be one of the worlds most similar to Earth in the solar system. But it's still alien; its seas and lakes are full not of water but liquid methane and ethane.

At the temperatures and pressures found on Titan’s surface, methane can evaporate and fall back down as rain, just like water on Earth. The methane rain flows into rivers and channels, filling lakes and seas.

Nitrogen makes up a larger portion of the atmosphere on Titan than on Earth. The gas also dissolves in methane, just like carbon dioxide in soda. And similar to when you shake an open soda bottle, disturbing a Titan lake can make the nitrogen bubble out.

But now it turns out the seas and lakes might be fizzier than previously thought. Researchers at NASA's Jet Propulsion Laboratory recently experimented with dissolved nitrogen in mixtures of liquid methane and ethane under a variety of temperatures and pressures that would exist on Titan. They measured how different conditions would trigger nitrogen bubbles. A fizzy lake, they found, would be a common sight.

On Titan, the liquid methane always contains dissolved nitrogen. So when it rains, a methane-nitrogen solution pours into the seas and lakes, either directly from rain or via stream runoff. But if the lake also contains some ethane—which doesn't dissolve nitrogen as well as methane does—mixing the liquids will force some of the nitrogen out of solution, and the lake will



Caption: Radar images from Cassini showed a strange island-like feature in one of Titan's hydrocarbon seas that appeared to change over time. One possible explanation for this "magic island" is bubbles. Image credits: NASA/JPL-Caltech/ASI/Cornell

Titan (continued)

effervesce. "It will be a big frothy mess," says Michael Malaska of JPL. "It's neat because it makes Earth look really boring by comparison." Bubbles could also arise from a lake that contains more ethane than methane. The two will normally mix, but a less-dense layer of methane with dissolved nitrogen—from a gentle rain, for example--could settle on top of an ethane layer. In this case, any disturbance—even a breeze—could mix the methane with dissolved nitrogen and the ethane below. The nitrogen would become less soluble and bubbles of gas would fizz out.

Heat, the researchers found, can also cause nitrogen to bubble out of solution while cold will coax more nitrogen to dissolve. As the seasons and climate change on Titan, the seas and lakes will inhale and exhale nitrogen. But such warmth-induced bubbles could pose a challenge for future sea-faring spacecraft, which will have an energy source, and thus heat. "You may have this spacecraft sitting there, and it's just going to be fizzing the whole time," Malaska says. "That may actually be a problem for stability control or sampling."

Bubbles might also explain the so-called magic islands discovered by NASA's Cassini spacecraft in the last few years. Radar images revealed island-like features that appear and disappear over time. Scientists still aren't sure what the islands are, but nitrogen bubbles seem increasingly likely.

Cosmic Muons Reveal the Land Hidden Under Ice

By: Jenny Lunn

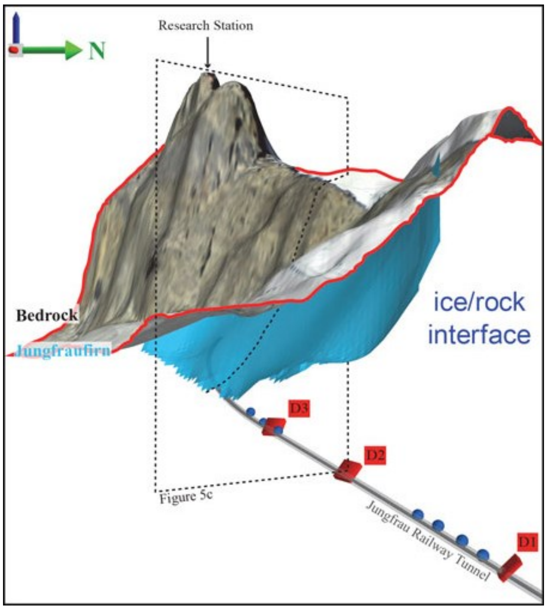
The land surface under a glacier is sculpted and shaped by the ice passing over it. Data about the shape of the bedrock yield information crucial to understanding erosional processes underneath a glacier. However, the inaccessibility of sites where glacial erosion currently occurs presents big challenges for advancing this understanding. A range of techniques has been used to map the bedrock beneath glaciers, including drilling, seismic surveys, multibeam bathymetry, gravity measurements, and radio-echo soundings. The accuracy of results has been limited, so *Nishiyama et al.* tested a different technique: emulsion film muon radiography.

Muons are formed when cosmic rays collide with atoms in Earth's upper atmosphere. They descend toward Earth, with about 10,000 muons reaching each square meter of Earth's surface every minute. One of their significant properties is that they can pass through matter, even dense and solid objects on Earth. Particle detectors can be used to measure the quantity of muons and their trajectories, which can reveal information about the materials that they have passed through. Because cosmic muons travel only downward, detectors need to be located below the objects to be surveyed. This technique has been used by geophysicists to scan the interior architecture of volcanoes, seismic faults, and caves and to detect carbon leaks, but it has posed a challenge for surveying the bedrock beneath glaciers.

The team of researchers found a solution in the central Swiss Alps: the Jungfrau railway tunnel, which runs through the bedrock beneath the Aletsch glacier. They set up three particle detectors in the tunnel that are oriented upward with a view of the bedrock beneath the base of the largest glacier of Europe. Different types of particle detectors are available for muon radiography, but the team selected emulsion films, a special type of photographic film that can be used in remote and harsh environments because it does not require any electric power or computers for operation. Because of the density contrast between ice and rock, the patterns of muons captured on the film over a 47-day period could be used to accurately map the shape of the bedrock below the glacier.

Using this technique, the researchers were able to map the bedrock-ice interface beneath the glacier over a 4000-square-meter area. They were also able to infer the glacier's response to global warming. In particular, the team predicts a larger frequency of rock avalanches as the ice shrinks, exacerbated by reconstructed bedrock geometry beneath the glacier. This increase is of particular concern because buildings are situated on top of the bedrock. These include tourist facilities, a research station, and communications infrastructure, as well as the railway tunnel itself, which cuts through the bedrock.

The use of cosmic muon radiography is spreading in various fields, including geophysics and civil engineering. This first application of the technique in glacial geology complements data collected by other methods and has the potential to be applied in other glacial locations underlain by a tunnel. (*Geophysical Research Letters*, https://doi.org/10.1002/2017GL073599, 2017)



Three-dimensional reconstructed bedrock shape (blue) under the uppermost part of the Aletsch glacier. The shape of the interface was determined from the cosmic ray muon measurement performed at three muon detectors (D1, D2, and D3) along the railway tunnel (gray line). Bedrock that pokes through ice is in gray tones. Jungfraufirn is a small glacier that feeds the Aletsch glacier. Blue dots on the gray line represent points where scientists sampled rocks within the tunnel. The image is Figure 5b in *Nishiyama et al.*; dashed lines outline a cross section of this 3-D map that can be found in Figure 5c. Credit: *Nishiyama et al.*; base map from SWISSIMAGE, reproduced by permission of swisstopo (BA17061)