The Spectrogram

June 2013

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June meeting:

The next meeting of STAR will be held Thursday June 5 at 8 pm at Monmouth Museum. This meeting will be the annual business meeting at which members of the board will be elected. There will be no speaker.

Inside this issue:

Calendar:

June 6 – Oak Hill Association star party at Bayonet Farm
September 4 – STAR meeting

May Meeting Minutes

The STAR meeting of May 1, 2014 was held at Monmouth Museum. The meeting began at 8:15 pm and was chaired by president Kevin Gallagher. There were 25 people in attendance, and three new attendees.

Kevin reviewed the agenda for the evening, then introduced the evening's speaker. Sarbmeet Kanwal, who is a member of STAR, studied physics at California Institute of Technology, then worked at Bell Laboratories. He now teaches at Brookdale Community College. The title of his talk was “Large-Scale Structure of the Universe.” The talk described the structure formed by the distribution of galaxies through the universe.

Sarbmeet began by noting that cosmologists have been trying to understand how the universe evolved from the big bang into the structure that we observe today. He said the results of observations show a structure that can be likened to a sponge: it has many cavities with thin walls and nodes and filaments. The structure is also called a honeycomb or web. The nodes and filaments are comprised of many thousands of galaxies. In this view of the universe a galaxy is a particle.

He then presented a video created by Nobel-winning cosmologist George Smoot, called “Design of the Universe.” The video showed a complex structure that is the result of many measurements of positions of galaxies. He pointed out that the overall structure corresponds to distribution of dark matter. Ordinary matter follows along. The large structure of the universe was established when its age was 10 to the -43 seconds, which is the Planck time. That structure was preserved through the period of inflation.

An important reason to study the structure is to understand the laws of physics. By analogy, physicists learned quantum mechanics by studying behavior of matter at small scales. Scales of the universe are: 10 to the 5 Light Years – galaxy, 10 to the 6 LY – group, 10 to the 7 LY – cluster, 10 to the 8 LY – supercluster, 10 to the 9 LY – walls and voids, 10 to the 10 LY – universe.

The first indication of the structure of the universe was a result of observations by William and John Herschel (1786 and 1864), who discovered clusters of galaxies, which they called nebulae. In 1888 John Dreyer categorized galaxies. In 1908 Carl Charlier predicted the existence of groups of galaxies, and in 1922 J. H. Reynolds observed filaments of galaxies. Hubble finally showed the existence of a third dimension in the universe by measurements of the distances to galaxies in 1929. Gerard de Vancouleurs established the existence of clusters of galaxies, although some argued that they were imagined. In the 1960s Jerzy Neynam and Jim Peebles used methods of statistics to show that clusters are real, and in the 1970s large scale red shifts surveys provided an improved method of detecting clusters. In 1982 the first super clusters were studied.

Developments in technology have provided a great increase in our knowledge of the universe. A multi-fiber telescope observes many red shifts simultaneously, and has measured 200,000 galaxies. The Sloan Digital Sky Survey has measured a large number of galaxies, but covers only a few percent of the sky. There are several other surveys in progress. The Hologium-Reticulum super cluster has 5000 galaxy clusters and is 550 million light years in diameter. A super cluster complex is the next largest scale. The Eridanus supervoid has a diameter of a billion light years. Voids are visible in the cosmic microwave background radiation (CMBR). The great wall is a sheet of galaxies with a size of 1.38 billion light years (2% of the diameter of the universe). A large quasar group is the most massive structure in the universe.

Sarbmeet concluded by describing motions through the universe. Measurements show a region of galaxies in motion called the cosmic river. The CMBR shows a wavelength dipole, indicating that Earth is moving through the universe. The Virgo cluster is moving in the same direction. Earth is moving toward a region that is called the great attractor. Dust of the Milky Way makes observations of that part of the universe difficult, and no one has yet determined what constitutes the great attractor.

Following a break Ken Legal presented events of the month. Saturn will be at opposition May 10, and Mercury will be visible at dusk May 15-28. Mars will fade to magnitude -0.5 in May. A new meteor shower associated with comet 209P/Linear should be visible on May 23-24. There will be a new comet Panstarr in Ursa Major May 7-8.

Steve Seigel announced a star party at Monmouth University for May 2 and a solar party at Bayonet Farms on May 4. Middletown Library will have a star party May 5, and Oak Hill Association will have one at Bayonet Farms May 16.

Finally, Dave Britz showed images he took of the moon and Jupiter using a HD camera, and Kevin awarded certificates of appreciation to Dave Britz, Steve Seigel, Ken Legal, and Mike Kozic.

The meeting concluded at 10:25.

Rob Nunn

Milky Way may bear 100 million life-giving planets

A new computation method to examine planets orbiting other stars suggests the Milky Way galaxy may house 100 million other places that could support complex life. Credit: Planetary Habitability Laboratory, University of Puerto Rico at Arecibo

(Phys.org) —There are some 100 million other places in the Milky Way galaxy that could support complex life, report a group of university astronomers in the journal *Challenges*. They have developed a new computation method to examine data from planets orbiting other stars in the universe.

Their study provides the first quantitative estimate of the number of worlds in our galaxy that could harbor life above the microbial level.

"This study does not indicate that complex life exists on that many planets. We're saying that there are planetary conditions that could support it. Origin of life questions are not addressed – only the conditions to support life," according to the paper's authors Alberto Fairén, Cornell research associate; Louis Irwin, University of Texas at El Paso (lead author); Abel Méndez, University of Puerto Rico at Arecibo; and Dirk Schulze-Makuch, Washington State University.

"Complex life doesn't mean intelligent life – though it doesn't rule it out or even animal life – but simply that organisms larger and more complex than microbes could exist in a number of different forms. For example, organisms that form stable food webs like those found in ecosystems on Earth," the researchers explain in an auxiliary statement.

The scientists surveyed more than 1,000 planets and used a formula that considers planet density, temperature, substrate (liquid, solid or gas), chemistry, distance from its central star and age. From this information, they developed and computed the Biological Complexity Index (BCI).

The BCI calculation revealed that 1 to 2 percent of the planets showed a BCI rating higher than Europa, a moon of Jupiter thought to have a subsurface global ocean that may harbor forms of life. With about 10 billion stars in the Milky Way galaxy, the BCI yields 100 million plausible planets.

Despite the large number of planets that could harbor complex life, the Milky Way is so vast that planets with high BCI values are very far apart, according to the scientists. One of the closest and most promising extrasolar systems, called Gliese 581, has two planets with the apparent, possible capacity to host complex biospheres. The distance from Earth to Gliese 581 is about 20 light years.

"It seems highly unlikely that we are alone," say the researchers. "We are likely so far away from life at our level of complexity that a meeting with such alien forms might be improbable for the foreseeable future."

The research, "Assessing the Possibility of Biological Complexity on Other Worlds, With an Estimate of the Occurrence of Complex Life in the Milky Way Galaxy," in Challenges, received no external funding.

Rosetta comet comes alive

Close-up of comet 67P/C-G on 30 April 2014. Credit: ESA/ Rosetta/ MPS for OSIRIS Team MPS/ UPD / LAM/ IAA/ SSO/ INTA/ UPM/ DASP/ IDA

(Phys.org) – A spacecraft from Earth is about to do something no spacecraft has ever done before: orbit a comet and land on its surface.

Right now, the European Space Agency's Rosetta probe is hurtling toward Comet 67P/Churyumov-Gerasimenko. The spacecraft's mission is to study the comet at close-range as it transforms from a quiet nugget of ice and rock, frozen solid by years spent in deep space, to a sun-warmed dynamo spewing jets of gas and dust into a magnificently evolving tail.

News flash: The metamorphosis has begun.

"Comet 67P is coming alive," says Claudia Alexander, project scientist for the U.S. Rosetta Project at JPL. "And it is even more active than I expected."

Launched in 2004, Rosetta has spent the past few years in hibernation as it chased the comet across the Solar System. In January of 2014, with its destination in sight, Rosetta woke up and turned on its cameras. At first, the comet looked like a dimensionless pinprick, inactive except for its quiet motion through space. Then, on May 4th a bright cloud appeared around the nucleus.

"It's beginning to look like a real comet," says Holger Sierks of the Max Planck Institute for Solar System Research in Germany where Rosetta's OSIRIS science camera was built. "It is hard to believe," he says, "that only a few months from now, Rosetta will be deep inside this cloud of dust and en route to the origin of the comet's activity."

Spacecraft from NASA, ESA and other space agencies have flown by comets before. A whole armada of spacecraft visited Comet Halley in the mid-1980s, an international event which still serves as a touchstone of comet research. Other notable examples include NASA's Stardust mission, which flew through the tail of Comet Wild in 2004 and returned the samples to Earth two years later; and the Deep Impact spacecraft, which in 2005 dropped a projectile into Comet 9P/Tempel, blowing a hole in its nucleus so that researchers could look inside.

Flybys are informative, but Rosetta will do much more.

"A flyby is just a tantalizing glimpse of a comet at one stage in its evolution," points out Alexander. "Rosetta is different. It will orbit 67P for 17 months. We'll see this comet evolve right before our eyes as we accompany it toward the sun and back out again."

The most exciting moment of the mission will likely come in November when a European-built lander descends from the spacecraft and touches down on the comet's surface. The lander's name is "Philae" after an island in the Nile, the site of an obelisk that helped decipher—you guessed it—the Rosetta Stone.

Because a comet has little gravity, the lander will anchor itself with harpoons. "The feet may drill into something crunchy like permafrost, or maybe into something rock solid," Alexander speculates.

Once it is fastened, the lander will commence an