Isolated Planetary-Mass Objects

Jonathan Gagné

Carnegie Institution for Science
Department of Terrestrial Magnetism

Abstract: I will present new developments on the discovery and characterization of giant planet analogs that are not in orbit around a star, also called isolated planetary-mass objects. These objects may have formed alone like stars do, or in a gas disk around a star like regular planets, only to be later ejected from their planetary systems. We only know a handful of isolated planetary-mass objects yet, but we already have high quality spectroscopic data that will allow us to perform a detailed characterization of their atmospheric properties. I will focus my talk on our methodology to identify such new isolated planetary-mass objects, and the spectroscopic follow-up that I am leading at Las Campanas Observatory in Chile.

Artistic conception of SIMP J013656.5+093347. SIMP stands for Sondage Infrarouge de Mouvement Propre, a near-infrared all-sky survey that began in 2005. The purpose of the survey was to find brown dwarfs with large proper motions (angular motions across the sky). SIMP J013656.5+093347 is now considered to most likely be a planetary-mass object. (Image is courtesy of NASA/JPL, slightly modified by Jonathan Gagné.)
Recent Astronomy Highlights

Jupiter’s Deep, Long-Lived Storms
Gravitational measurements from NASA’s Juno probe have shown that the weather layer of the planet extends down 1900 miles. At the poles, that layer contains storms that can be over 4000 miles in diameter with winds of up to 220 miles per hour. Those same gravitational measurements show that below the weather layer, Jupiter seems to rotate as a rigid body. More information on these and other findings of the Juno mission can be found at: www.sciencedaily.com/releases/2018/03/180307183418.htm

Infrared Image from the Juno probe shows eight storms surrounding a massive central storm at Jupiter’s North Pole. Image Credit: NASA/JPL-Caltech/SwRI/ASI/INAF/JIRAM

Oumuamua Likely Originated in a Binary-Star System
Astronomers were surprised in discovering that the first detected interstellar visitor was an asteroid and not a comet. Since comets develop farther out from stars they are therefore less gravitationally bound and more likely to be ejected from a star’s system. But a recent study shows that binary star systems are more efficient at ejecting their closer-in asteroids. A paper from the study is at - arxiv.org/abs/1712.04435

Biographical Sketch:
Jonathan Gagné completed his PhD thesis at Université de Montréal in Canada, where he worked on statistical algorithms to discover young brown dwarfs in nearby stellar associations. During his PhD, he also spent 6 months at Caltech with the team of Peter Plavchan to detect exoplanets with the method of precise near-infrared radial velocities as part of the IPAC fellowships. After his PhD, he moved to Carnegie DTM as a Sagan Fellow to work on the detection and kinematic characterization of cold isolated planetary-mass objects.

Editor’s Note - Dr. Gagné’s paper concerning SIMP J013656.5+093347 can be found at - arxiv.org/abs/1705.01625

The Auction of Joe Morris’ Equipment
At the March 10th meeting of the National Capital Astronomers, Guy Brandenburg led a discussion about how the organization would sell the telescopes and pieces of astronomical equipment donated to the NCA as part of long-time member Joe Morris’ estate. By a large margin, the members of NCA voted to have a 3-step sale. The first step was to put the equipment up for internet auction exclusively among NCA members. The second step would have involved a more open internet auction of any remaining equipment among local clubs. And finally, any equipment still remaining unsold would have been put up for sale on sites such as Astromart and Cloudy Nights.

continued on page 4

A Star Dust © 2017. Star Dust may be reproduced with credit to National Capital Astronomers, Inc.
**Exploring the Sky**

"Exploring the Sky" is an informal program that, for over 60 years, has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia.

Presented by the National Park Service and National Capital Astronomers, sessions are held in Rock Creek Park once each month on a Saturday night from April through November. Beginners (including children) and experienced stargazers are all welcome—and it’s free!

Hosted by: National Capital Astronomers, Inc and Rock Creek Park

### 2018 Exploring the Sky Sessions

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 May</td>
<td>9:00 p.m. – Jupiter, Beehive Cluster</td>
</tr>
<tr>
<td>2 June</td>
<td>9:00 p.m. – Jupiter, M13</td>
</tr>
<tr>
<td>14 July</td>
<td>9:00 p.m. – Jupiter, Saturn, M13</td>
</tr>
<tr>
<td>11 Aug.</td>
<td>8:30 p.m. – Jupiter, Saturn, M13</td>
</tr>
<tr>
<td>1 Sep.</td>
<td>8:00 p.m. – Jupiter, Saturn, Mars</td>
</tr>
<tr>
<td>6 Oct.</td>
<td>7:30 p.m. – Saturn, Mars</td>
</tr>
<tr>
<td>17 Nov.</td>
<td>7:00 p.m. – Saturn, Mars, Uranus, Moon</td>
</tr>
</tbody>
</table>

More information can be found at NCA’s web site, [www.capitalastronomers.org](http://www.capitalastronomers.org) or the Rock Creek Park web site, [www.nps.gov/rocr/planyourvisit/expsky.htm](http://www.nps.gov/rocr/planyourvisit/expsky.htm). You can also call the Nature Center at (202) 895-6070. For general information on local astronomical events visit [www.astronomyindc.org](http://www.astronomyindc.org).

---

**Sky Watchers**

Among the planets visible to the naked eye, Venus has the early Spring evening sky all to itself as it rises toward its maximum elongation which will take place in August. Jupiter rises in the early evening with Saturn rising approximately three hours later and Mars following soon after. Mercury rises shortly before dawn on its way to its greatest elongation as listed below.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/22-23</td>
<td>The Lyrids Meteor Shower peaks with approximately 20 meteors per hour. Conditions will be ideal for viewing in the early morning hours after the Moon sets.</td>
</tr>
<tr>
<td>4/29</td>
<td>Mercury reaches greatest Western Elongation. It will be 27 degrees from the Sun and the highest in the sky for pre-dawn viewing.</td>
</tr>
<tr>
<td>4/29</td>
<td>Full Moon. Full Pink Moon 8:58 p.m. (also known as the Sprouting Grass Moon, the Growing Moon and the Egg Moon)</td>
</tr>
<tr>
<td>5/6-7</td>
<td>The Eta Aquarids Meteor Shower peaks with approximately 30 meteors per hour. Unfortunately, a waning gibbous Moon will interfere with viewing of fainter meteors.</td>
</tr>
<tr>
<td>5/9</td>
<td>Jupiter reaches opposition (the opposite side of the sky from the Sun and the closest to Earth). The planet will be its brightest of the year and will be visible for the entire night.</td>
</tr>
</tbody>
</table>
Occultation by Asteroid 372 Palma
For approximately twelve seconds on the night of February 20th, a star in the constellation of Auriga known as TYC 2933-01592-1 appeared to blink out in the Washington area, its light blocked by Asteroid 372 Palma. The event certainly didn’t receive the fanfare that accompanied the Great American Eclipse of August 21, 2017. Indeed, few people knew about it, and certainly nobody would have noticed it if they weren’t looking for the event with a very good telescope. However, Elizabeth Warner and three of her students were doing just that at the UMD Observatory as part of a collaborative effort with other members of the International Occultation Timing Association (IOTA) to provide data for determining the size and profile of 372 Palma more accurately than had previously been done. The length of the occultation, along with an asteroid’s orbital velocity, go into calculating the size of that asteroid and determining its profile.

Discovered by August Charlois in 1893, 372 Palma is a B-type, or carbonaceous, asteroid. It is also one of the largest main belt asteroids at approximately 190 kilometers in diameter, with an uncertainty of several kilometers.

To record the occultation, Elizabeth and her students used a Point Grey Grasshopper Express Camera mounted on a 152mm f/9 Astrophysics Refractor telescope. The software used to collect the pictures taken was ADVS – Astronomical Digital Video System, while the software later used to process and analyze those images was Tangra 3. Lots of high-tech equipment, but ultimately one of the biggest challenges, making sure the telescope is pointed at the right star, generally involved comparing paper star field charts with what was displayed on a screen hooked up to the camera. Confirming the location, everyone watched as the asteroid approached the star. The recording of the starfield began well before the actual occultation.

continued on page 6
Occultation Notes

- D following the time denotes a disappearance, while R indicates that the event is a reappearance.
- When a power (x; actually, zoom factor) is given in the notes, the event can probably be recorded directly with a camcorder of that power with no telescope needed.
- The times are for Greenbelt, MD, and will be good to within +/-1 min. for other locations in the Washington-Baltimore metropolitan area unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region.

- Some stars in Flamsteed's catalog are in the wrong constellation, according to the official IAU constellation boundaries that were established well after Flamsteed's catalog was published. In these cases, Flamsteed's constellation is in parentheses near the star's name.
- If the star is in the Kepler 2 exoplanet search program so lightcurves of it are in the interest asteroidal occultations of the ESO Large Programme.
- For double (or triple) stars, it might be indicated with "mg2" or "m3"

Mid-Atlantic Occultations

David Dunham

Asteroidal Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EDT</th>
<th>Star</th>
<th>Mag.</th>
<th>Asteroid</th>
<th>dMag</th>
<th>s</th>
<th>Ap.</th>
<th>Location &amp; Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 12 Sat</td>
<td>5:33</td>
<td>2UC30033315</td>
<td>12.1</td>
<td>Chaldea</td>
<td>0.8</td>
<td>11</td>
<td>8</td>
<td>e&amp;nVA, w&amp;CMD, DC</td>
<td></td>
</tr>
<tr>
<td>Apr 16 Mon</td>
<td>5:33</td>
<td>2UC30033315</td>
<td>12.1</td>
<td>Chaldea</td>
<td>0.8</td>
<td>11</td>
<td>8</td>
<td>e&amp;nVA, w&amp;CMD, DC</td>
<td></td>
</tr>
<tr>
<td>Apr 16 Mon</td>
<td>23:58</td>
<td>4UC53143258</td>
<td>11.9</td>
<td>Ottaggea</td>
<td>3.3</td>
<td>2</td>
<td>2</td>
<td>SOH, nw, nVA, sMD</td>
<td></td>
</tr>
<tr>
<td>Apr 20 Fri</td>
<td>23:53</td>
<td>4UC61236804</td>
<td>12.5</td>
<td>Arabis</td>
<td>3.0</td>
<td>2</td>
<td>9</td>
<td>n&amp;nVA; DC, wMD?</td>
<td></td>
</tr>
<tr>
<td>Apr 22 Sun</td>
<td>2:19</td>
<td>4UC43357099</td>
<td>12.6</td>
<td>Eurynome</td>
<td>0.5</td>
<td>7</td>
<td>9</td>
<td>DE, MD, s&amp;nVA; DC?</td>
<td></td>
</tr>
<tr>
<td>Apr 22 Sun</td>
<td>22:20</td>
<td>4UC60131413</td>
<td>13.4</td>
<td>Arosa</td>
<td>2.2</td>
<td>10</td>
<td>10</td>
<td>COH, nw, nBeVA</td>
<td></td>
</tr>
<tr>
<td>Apr 24 Tue</td>
<td>5:33</td>
<td>4UC32286385</td>
<td>13.1</td>
<td>Ottilla</td>
<td>1.7</td>
<td>12</td>
<td>10</td>
<td>nw Penn., Ohio</td>
<td></td>
</tr>
<tr>
<td>Apr 27 Fri</td>
<td>20:50</td>
<td>SAO 117802</td>
<td>8.2</td>
<td>Heney</td>
<td>7.4</td>
<td>2</td>
<td>2</td>
<td>nPA, nNJ, NY, LI</td>
<td></td>
</tr>
<tr>
<td>Apr 29 Sat</td>
<td>2:57</td>
<td>2UC25392579</td>
<td>11.9</td>
<td>Asterope</td>
<td>1.3</td>
<td>18</td>
<td>7</td>
<td>AL, CKY, wOH, IN</td>
<td></td>
</tr>
<tr>
<td>Apr 30 Mon</td>
<td>22:46</td>
<td>TYC04110597</td>
<td>10.7</td>
<td>Elektra</td>
<td>2.2</td>
<td>18</td>
<td>5</td>
<td>NC, SVA, nsC, TN</td>
<td></td>
</tr>
<tr>
<td>May 4 Fri</td>
<td>0:32</td>
<td>3UC35573548</td>
<td>12.4</td>
<td>Thuringia</td>
<td>3.2</td>
<td>6</td>
<td>8</td>
<td>COH, cWV, cS &amp; ERA</td>
<td></td>
</tr>
<tr>
<td>May 5 Sat</td>
<td>21:31</td>
<td>TYC13560370</td>
<td>9.9</td>
<td>Virginia</td>
<td>4.9</td>
<td>3</td>
<td>4</td>
<td>nw-sePA, c&amp;nSN</td>
<td></td>
</tr>
<tr>
<td>May 6 Sun</td>
<td>2:07</td>
<td>TYC49720102</td>
<td>11.4</td>
<td>Circe</td>
<td>1.1</td>
<td>14</td>
<td>7</td>
<td>s&amp;nWC, neSC, sVA</td>
<td></td>
</tr>
</tbody>
</table>

* before the asteroid name indicates an event in the list of high-interest asteroidal occultations of the ESO Large Programme.

Lunar Grazing Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EDT</th>
<th>Star</th>
<th>Mag</th>
<th>% alt</th>
<th>CA Location &amp; Remarks</th>
</tr>
</thead>
</table>

Total Lunar Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EDT</th>
<th>Ph</th>
<th>Star</th>
<th>Mag</th>
<th>% alt</th>
<th>CA Sp. Notes</th>
</tr>
</thead>
</table>

Further explanations & more information is at iota.ihua1.edu/exped.htm.

David Dunham, dunham@starpower.net.
Occultation by Asteroid 372 Palma – continued from page 4

Then all that was left was to watch as the asteroid blocked the star. Or didn’t block the star. Even with the most sophisticated techniques, predictions can be off from the actual paths of occultations. Fortunately, while the path of 372 Palma’s occultation was off some, the Observatory was still well within that path, as the light curve below attests.

Light curve of the star TYC 2933-01592-1 (top) with three comparison stars. Several other observers had success as well. Their data were combined with those from the UMD Observatory by IOTA to come up with a best-fit profile for the size and shape 372 Palma, shown below.

The multicolored lines represent the recording locations across the width of the occultation path. The oval represents the best-fit size and profile for Asteroid 372 Palma. Image credit – asteroidoccultation.com

Profiles for many asteroids, calculated from their occultations of stars, can be found at www.asteroidoccultation.com/observations/Results/. Just don’t be surprised, if you look at the page, at seeing how often the names J. Dunham and D. Dunham, the NCA’s very own Joan and David Dunham, appear among the occultation results. Indeed, at the time of the Palma occultation, they were in Arizona and Australia, working on other occultations.
Spring 2018 Hopewell Observatory Open House and Star Party

Members of the National Capital Astronomers and the general public are invited to Hopewell Observatory for its Spring 2018 Open House and Star Party on Saturday, May 5th into the morning hours of May 6th. The backup date, in case of bad weather, is May 12th.

Located 30 miles from the Beltway, the Observatory is on Bull Run Mountain. More details can be found at Guy Brandenburg’s website - guysmathastro.wordpress.com/2017/11/17/fall-2017-hopewell-observatory-open-house-and-star-party-november-25-26/.

Do you have an astronomy story to share with your fellow NCA members? The submission deadline for May’s Star Dust, is April 20th.

Clear Skies!

Calendar of Events

- **NCA Mirror- or Telescope-making Classes**: Tuesdays AND Fridays, from 6:30 to 9:45 pm at the Chevy Chase Community Center (intersection of McKinley Street and Connecticut Avenue, N.W.) Contact instructor Guy Brandenburg at 202-635-1860 or at gfbrandenburg@yahoo.com
- **Open house talks and observing at the University of Maryland Observatory** in College Park on the 5th and 20th of every month at 8:00 pm (Nov.-Apr.) or 9:00 pm (May-Oct.). Details: www.astro.umd.edu/openhouse
- **Mid-Atlantic Senior Physicists Group**: “Prospects for Life & Human Habitability Around Nearby Stars - Many Possible Homes - But the Likely Neighbors Are Microbes” with Carey M. Lisse, Principal Staff Scientist, Planetary Exploration Group - Applied Physics Laboratory, Johns Hopkins University. Wed. Apr. 25, at 1 pm at the American Center for Physics (1st floor conference room) with Q&A to follow. 1 Physics Ellipse, College Park, MD-- off River Rd., between Kenilworth Ave. and Paint Branch Parkway. www.aps.org/units/maspg/
- **Montgomery College’s Planetarium**: “Quantum Gravity or how c (the speed of causality), G (the universal gravitational constant), & h (Planck’s constant) create the fabric of Reality” Saturday, April 21st at 7:00 p.m. For directions and information, go to the following website: www2.montgomerycollege.edu/departments/planet/
- **Upcoming NCA Meeting** at the University of Maryland Observatory: 12 May: 7:30 p.m Brian Morsony (UMD), Relativistic Jets Stir Things Up

National Capital Astronomers Membership Form

Name: _____________________________________________ Date: ___/___/___

Address: ___________________________________________ ZIP Code: ______

Home Phone: _____ - _____ - ____ E-mail: _____________________ Print / E-mail Star Dust (circle one)

Membership (circle one): Student….. $ 5; Individual / Family…..$10; Optional Contribution…..$__

Please indicate which activities interest you:

- Attending monthly scientific lectures on some aspect of astronomy
- Making scientific astronomical observations
- Observing astronomical objects for personal pleasure at relatively dark sites
- Attending large regional star parties
- Doing outreach events to educate the public, such as Exploring the Sky
- Building or modifying telescopes
- Participating in travel/expeditions to view eclipses or occultations
- Combating light pollution

Do you have any special skills, such as videography, graphic arts, science education, electronics, machining, etc.?

Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

Please mail this form with check payable to National Capital Astronomers to:
Henry Bofinger, NCA Treasurer; 727 Massachusetts Ave. NE, Washington, DC 20002-6007

A Star Dust © 2017. Star Dust may be reproduced with credit to National Capital Astronomers, Inc.
Next NCA Meeting:
2018 April 14th
7:30 pm
@ UMD Observatory

Dr. Jonathan Gagné

Inside This Issue

Preview of April 2018 Talk .................. 1
Recent Astronomy Highlights ............. 2
Joe Morris’s Equipment ..................... 2
Sky Watchers ................................. 3
Asteroid 372 Palma ......................... 4
Occultations ................................. 5
Calendar of Events ......................... 7