Impactors from the Sky

Melissa N. Hayes-Gehrke, University of Maryland

Abstract: An asteroid impact is an astronomical threat that could become reality. However, past impacts of several specific asteroids on Earth and other planets have provided key information to scientists. The source of the greatest threat to Earth is unlikely to be from the millions of asteroids that exist in the main asteroid belt, but from the thousands of asteroids that orbit in the inner Solar System.

Astronomers are searching for these high-threat asteroids, but the search is far from complete. If an asteroid is discovered to be on a course to impact the Earth, scientists have explored several possible techniques for preventing the impact; and, although none has been tested yet on the necessary scale, the most plausible strategies for such an event will be discussed.

Chelyabinsk Meteor exploding over the southwest region of Russia on February 15, 2013. Its airburst was observed by an unprecedented number of people.

continued on page 2
Reminder

After the meeting, everyone is invited to join us at Plato's Diner in College Park. Plato's is located at 7150 Baltimore Ave. (US Rt. 1 at Calvert Rd.), just south of the university's campus. What if it's clear and you want to stick around and observe? No problem -- just come over when you're through. This is very informal, and we fully expect people to wander in and out.

Asteroids in the Solar System

The Main Asteroid Belt between Mars & Jupiter as well as “Trojans,” “Hildas,” & “Greeks.”

Brief Space Rock Primer

Composition Type C (Chondrite)
Dark, clay & silicate rocks that are most common as well as the oldest items in the Solar System
Composition Type S (Stony)
Nickel-iron & silicate rocks
Composition Type M (Metallic)
Nickel-iron rocks
Trojans
Asteroids trailing Jupiter in its orbit at Lagrangian points 4 or 5 (60° offset)
Greeks
Asteroids ahead of Jupiter in its orbit at Lagrangian points 4 or 5 (60° offset)
Hildas
(Hildian Group)
Asteroids opposite Jupiter in its orbit or at Lagrangian points 4 or 5 (60° offset)

Impactors from the Sky – continued from page 1

Biographical Sketch:
Dr. Melissa N. Hayes-Gehrke developed a love of the stars and astronomy as a child in rural Pennsylvania. She completed undergraduate degrees in Physics and Earth, Atmospheric, and Planetary Sciences at the Massachusetts Institute of Technology in 1996. She received her doctorate in Astronomy from Boston University in 2004. Since that time, she has been an instructor at the University of Maryland, specializing in teaching astronomy to non-science majors, as Senior Lecturer. She has developed two new and innovative courses for non-science majors that focus on observing asteroids and the threat of asteroid impacts.

“Veg-01” Update

It has been 4 months since the Space X Dragon delivered the Veg-01 experiment and the plant facility (called “Veggie”) to the Expedition 39 crew of the International Space Station (ISS). On May 7th, NASA astronauts Steve Swanson & Rick Mastracchio installed Veggie in the Columbus module of ISS. The experiment contains 6 plant pillows of outd rageous red romaine lettuce seeds (a hearty variety) on a rooting mat. Each pillow was given 100 milliliters of water before Swanson hit the Veggie lights (red, green & blue LEDs) on May 8th, initiating Veg-01.

A control group of lettuce seeds was activated simultaneously on Earth for comparison with the space lettuce clippings that will be frozen and shipped home for study and verification that the ISS plants are safe to eat. This is a timely experiment in light of future goals for human travel continued on page 4
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!

For more information, check:

National Capital Astronomers, Inc: http://capitalastronomers.org/

Rock Creek Park: http://www.nps.gov/rocr/planyourvisit/expsky.htm

Planet-Building

Clouds of dust near NGC 2547-ID8 (in Constellation Vela) were detected with infrared sensors by the Spitzer telescope a year ago. The hypothesis, recently reported in Science, is that two asteroids collided in 2547’s terrestrial zone where planets like Earth might be made in a similar manner.

Source: Large impacts around a solar-analog star in the era of terrestrial planet formation. Science (29 August 2014), 345 (6200), 1032-1035, DOI: 10.1126/science.1255153

Sky Watchers

Autumn Schedule

September

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>8:38 pm – Full Moon, Global. Other Moon Names: Harvest Moon, Full Corn Moon (corn, squash, beans &amp; rice are ready for harvest)</td>
</tr>
<tr>
<td>10</td>
<td>10:00 pm – Planets, N. Hemisphere. Moon 1.1° north of Uranus</td>
</tr>
<tr>
<td>8-30</td>
<td>Morning – Comet (C/2012 K1 – PANSTARRS, +6 mag), N. Hemisphere. (Constellation Hydra, near Alphard)</td>
</tr>
<tr>
<td>20</td>
<td>8:00 pm - Exploring the Sky, Local. Features: Andromeda Galaxy Rising</td>
</tr>
<tr>
<td>22</td>
<td>10:29 pm – Autumnal Equinox, N. Hemisphere</td>
</tr>
<tr>
<td>24</td>
<td>2:14 am – New Moon, Global.</td>
</tr>
<tr>
<td>26</td>
<td>6:00 am – Planets, N. Hemisphere. Mercury 6° south of Moon</td>
</tr>
<tr>
<td>27</td>
<td>5:00 pm – Planets, N. Hemisphere. Mars 3° north of Antares Midnight – Planets, N. Hemisphere. Saturn 0.7° south of Moon</td>
</tr>
<tr>
<td>All month</td>
<td>Double Cluster, N. Hemisphere. NGC 869 &amp; 884 (Constellation Pegasus, viewable with binoculars) Globular Cluster, N. Hemisphere. M15 (Constellation Pegasus, viewable with medium-sized telescope) Double Star, N. Hemisphere. Albireo (Constellation Cygnus, viewable with binoculars or small telescope)</td>
</tr>
</tbody>
</table>

October

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5:15 – 8:34 am – Lunar Eclipse, N. Hemisphere.</td>
</tr>
</tbody>
</table>

Times EDT
Veg-01 Update – continued from page 2

into deeper space:

“The farther and longer humans go away from Earth, the greater the need to be able to grow plants for food, atmosphere recycling and psychological benefits…I think plant systems will become important components of any long-duration exploration scenario.”

(Gioia D. Massa, Kennedy Space Center & principal investigator of Veg-01)

Profusion zinnia seed pillows were also sent to ISS for the pleasure of Expedition 39 while they wait for the go-ahead to eat the Veg-01 lettuce.

Gerard Newsham, a Veggie payload support specialist, made an optimistic statement about growing plants in space that is a familiar sentiment in regard to space exploration in general, “This is just the beginning.”

____________________

Rhea & SAO159034

David Dunham

Saturn’s satellite, Rhea (V), will occult the 7.8-magnitude star SAO 159034 (HIP 74007) on Friday evening, Sept. 12 around 8:39 pm EDT (that’s 0:39 UT of Sept. 13 UT) (see Asteroidal & Planetary Occultations on page 5). The star will be the brightest object near Saturn. With Rhea, it will be just over 1 arc minute east of the planet.

The figure above shows the region of visibility of the event. In the Washington DC region, the altitude will be 13° in the southwest (azimuth 237°). Therefore, to observe this event, you will need to find 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 areas 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 and the actual constellation is given in the notes following a /.
- Mag is the star's magnitude.
- % is the percent of the Moon's visible disk that is sunlit, followed by a + indicating that the Moon is waxing and showing that it is waning. So 0 is new moon, 50% is first quarter, 100% or -is full moon, and 50% is last quarter. The Moon is crescent if % is less than 50 and is gibbous if it is more than 50.
- Cusp Angle is described more fully at the main IOTA Web site.
- Sp. is the star's spectral type (color), O,B,blue; A,F,white; G,yellow; K,orange; M,N,S,C red.
- Also in the notes, information about double stars is often given. "Close double" without other information usually means nearly equal components with a separation less than 0.2". "mg2" or "m2" means the magnitude of the secondary component, followed by its separation in arc seconds ("), and sometimes its PA from the primary. If there is a 3rd component (for a triple star), it might be indicated with "mg3" or "m3". Double is sometime abbreviated "dbl".
- Sometimes the Watts angle (WA) is given; it is aligned with the Moon's rotation axis and can be used to estimate where a star will reappear relative to lunar features. The selenographic latitude is WA -270. For example, WA 305 - 310 is near Mare Crisium.

Mid-Atlantic Occultations

David Dunham

Asteroidal and Planetary Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EDT</th>
<th>Star</th>
<th>Mag</th>
<th>Satellite/</th>
<th>Asteroid</th>
<th>Phrag</th>
<th>dur. Ap.</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep 12 Fri 20:39</td>
<td>SAO 1508034</td>
<td>7.8</td>
<td>Rhea (V)</td>
<td>3.2 58 2</td>
<td>ne USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 18 Thu 20:34</td>
<td>4UC44130878</td>
<td>14.5</td>
<td>Chiron</td>
<td>4.2 12 12</td>
<td>Cuba; e. USA?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 30 Tue 1:40</td>
<td>2UC42900457</td>
<td>12.5</td>
<td>Terpsichore</td>
<td>0.9 9 8</td>
<td>w&amp;nVA, DC, MD, ePA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 30 Tue 2:32</td>
<td>TYC1420016</td>
<td>11.2</td>
<td>Spiridoni a</td>
<td>4.6 4 7</td>
<td>OH, MD, NJ; DC, nVA?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 1 Wed 23:00</td>
<td>TYC62662813</td>
<td>10.8C</td>
<td>Laetitia</td>
<td>0.4 12 9</td>
<td>Al M dAx, not SC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 2 Thu 22:53</td>
<td>2UC3239021</td>
<td>12.2</td>
<td>Hera</td>
<td>0.9 5 8</td>
<td>VA, DC, eMD, DE, sNJ</td>
<td></td>
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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</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>Oct 1 Wed 21:21</td>
<td>SAO 161825</td>
<td>8.3</td>
<td>52 25</td>
<td>8S</td>
<td>*Hantlsn, VA; MtAliry&amp;Finksbrg, MD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 1 Wed 21:59</td>
<td>SAO 161847</td>
<td>8.4</td>
<td>53+ 20</td>
<td>8S</td>
<td>*CearSp, MD; Md dl twn, Bangr, PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 12 Sun 1:04</td>
<td>SAO 93927</td>
<td>7.5</td>
<td>83- 44</td>
<td>8N</td>
<td>Chrltsv, Qntco, VA; Brndywn, n, MD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct 14 Tue 6:42</td>
<td>ZC 977</td>
<td>6.8</td>
<td>63- 66</td>
<td>3S</td>
<td>Scot land, Loganville, PA; Sun - 7</td>
<td></td>
<td></td>
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</tbody>
</table>

Interactive detailed maps at http://www.t.jmerson.net/LOTA/
*, no expedition planned from DC area

Total Lunar Occultations

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>EDT</th>
<th>Ph Star</th>
<th>Mag</th>
<th>% alt</th>
<th>CA</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Sep 11 Thu 5:56</td>
<td>R zeta PscA</td>
<td>5.2</td>
<td>93- 39</td>
<td>37N A7</td>
<td>A325, ZC180, close dbl?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 11 Thu 5:59</td>
<td>R zeta PscB</td>
<td>6.3</td>
<td>93- 39</td>
<td>37N F7</td>
<td>Sun-10, AA 326, ZC 181</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 13 Sat 1:16</td>
<td>R ZC 437</td>
<td>7.3</td>
<td>78- 39</td>
<td>15S G5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 13 Sat 4:56</td>
<td>R ZC 449</td>
<td>7.9</td>
<td>77- 66</td>
<td>52N K0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 15 Mon 2:20</td>
<td>R SAO 94132</td>
<td>8.1</td>
<td>58- 34</td>
<td>58N F2</td>
<td>mg2 10, sep. 9&quot;, PA318</td>
<td></td>
<td></td>
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<tr>
<td>Sep 17 Wed 1:30</td>
<td>R SAO 95771</td>
<td>7.3</td>
<td>38- 6</td>
<td>49S K0</td>
<td>Az. 73, mg2 11, 24&quot;, PA 6</td>
<td></td>
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<tr>
<td>Sep 17 Wed 1:50</td>
<td>R 21 Gem</td>
<td>6.3</td>
<td>38- 10</td>
<td>38N F6</td>
<td>Az 75, ZC1003, dbl, pr ime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 17 Wed 1:50</td>
<td>R 20 Gem</td>
<td>6.9</td>
<td>38- 10</td>
<td>40N GB 21Gem24s, ZC1002, 2ndary</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sep 17 Wed 1:53</td>
<td>R SAO 95791</td>
<td>7.9</td>
<td>38- 10</td>
<td>73N K0</td>
<td>Az. 76</td>
<td></td>
<td></td>
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<tr>
<td>Sep 17 Wed 3:52</td>
<td>R ZC 1011</td>
<td>7.3</td>
<td>37- 33</td>
<td>74N K0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 18 Thu 5:57</td>
<td>R ZC 1136</td>
<td>8.1</td>
<td>28- 46</td>
<td>79S A2</td>
<td>Sun alt. - 11 degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 19 Fri 6:21</td>
<td>R SAO 97727</td>
<td>7.9</td>
<td>20- 41</td>
<td>54N G0</td>
<td>Sun alt. - 7 deg.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 21 Sun 5:08</td>
<td>R SAO 117942</td>
<td>7.7</td>
<td>7- 7</td>
<td>57S G5</td>
<td>Az. 85, close double?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep 30 Tue 22:33</td>
<td>D ZC 2573</td>
<td>7.2</td>
<td>42+ 7</td>
<td>81N A0</td>
<td>Azi mth 238 degrees</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Explanations & more information is at http://iota.jhuapl.edu/exped.html
David Dunham dunham@starpower.net, phone 301-526-5590

The Pleiades Error

Some Europeans and Americans have a disagreement over the distance of the “Seven Sisters” (Pleiades) appearing in the Taurus Constellation. According to an August study, the Americans calculated the Pleiades distance ≈ 430 ly vs. the European calculation ≈ 390 ly. Both camps reported a small error rate. The American camp coordinated radio telescopes across the Earth into one planet-sized telescope and used a modified parallax approach in its distance calculations. The European Space Agency (ESA) used its Hipparcos satellite in its parallax method, but the satellite’s cameras weren’t sensitive enough to identify background galaxies as reference points. Therefore, a 100,000+ star catalog was compared to Hipparcos’ surveyed stars.

Neither side yielded. However, according to Nature, Pleiades is supposed to be made of young stars and a number of measurements are based on the characteristics of these stars. So, if the ESA distance is correct, scientists don’t understand young stars after all. Astronomer Carl Metis of UC-San Diego was quoted as saying, “If we don’t understand young stars, we’re kind of hosed.” Allegedly, the matter is settled with a recalculation of 443 ly (error = 1%).
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Rhea & SAO 159034 – continued from page 4

a location with a horizon low enough in that direction. Since the central line passes north of the Earth’s surface, the actual duration of the occultation will likely be much less than the 58-seconds central duration. Although Washington, DC is in the path of the predicted occultation, it is only a short distance north of the predicted southern limit. So, with the prediction uncertainties, we don’t know if an occultation will occur here or not; and, if it does occur, how long it will last. The duration could be more than 30 seconds. Within one standard deviation, the southern limit could be anywhere from central Florida to New Orleans, or as far north as central New England.

Planetary Destinations

Humans have their eyes set on the next giant leap: Mars. Projected launches are for the 2030s using gravity-assist maneuvers & cycler trajectories. In the meantime, don’t miss the National Air & Space Museum exhibit, “Spirit & Opportunity: 10 Years Roving across Mars.” The rover images are amazing and the last day of the exhibit is Sept. 14th.

While in Purgatory…Opportunity was stuck in the sand (a dune called “Purgatory”) on the Meridiani Plains for over a month, plenty of time to take this picture called “Rub Al Khali” (named after the Arabian Desert’s “empty quarter”)
Visiting Asteroids

Surface of the asteroid, Vesta
Courtesy NASA/JPL
http://dawn.jpl.nasa.gov/

Ion-propelled Dawn, launched in 2007, is the first spacecraft to orbit an asteroid in the main belt. Investigating how planets in our System formed, Dawn arrived at Vesta in 2011 and is scheduled to arrive at Ceres in 2015.

The submission deadline for the October issue of Star Dust is Sept. 27th.

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 email him at gbbrandenburg@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
- Phoebe Waterman Haas Public Observatory at the National Air & Space Museum, Solar viewing, Wed. - Sun., 12 - 3 pm (weather permitting).

Clear Skies!

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

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Next NCA Meeting:
2014 September 13th
7:30 pm
@ UMD Observatory

Dr. Melissa N. Hayes-Gehrke

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