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DISTANT EKOS
The Kuiper Belt Electronic Newsletter



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NEWS & ANNOUNCEMENTS

Request for Nominations for 9th “Paolo Farinella” Prize

To honor the memory and the outstanding figure of Paolo Farinella (1953-2000), an extraordinary scientist and person, a prize has been established in recognition of significant contributions in one of the fields of interest of Paolo, which spanned from planetary sciences to space geodesy, fundamental physics, science popularization, security in space, weapons control and disarmament.

The prize has been proposed during the “International Workshop on Paolo Farinella, the scientist and the man”, held in Pisa in 2010, and the 2019 edition is supported by the “Observatoire de la Cote d’Azur” in France.

Previous recipients of the “Paolo Farinella Prize” were:

- 2011: William F. Bottke, for his contribution to the field of “Physics and dynamics of small solar system bodies”
- 2012: John Chambers, for his contribution to the field of “Formation and early evolution of the solar system ”
- 2013: Patrick Michel, for his contribution to the field of “Collisional processes in the Solar System”
- 2014: David Vokrouhlicky, for his contribution to the field of “Non gravitational forces in the Solar System”
- 2015: Nicolas Biver, for his contribution to the field of “Dynamics and physics of comets”
- 2016: Kleomenis Tsiganis, for his contribution to the field of “Applications of celestial mechanics to the natural bodies of our solar system”
- 2017: Simone Marchi, for his contribution to the field of “Physics and dynamics of the inner planets of the solar system and their satellites”
- 2018: Francis Nimmo, for his contribution to the field of “Giant planets and satellite systems”

The ninth Paolo Farinella Prize will be awarded to a young scientist with outstanding contributions in the field of planetary science concerning “The Trans-Neptunian Population”. The award ceremony will be hosted by the joint European Planetary Science Congress (EPSC) – Division for Planetary Sciences (DPS) meeting in Geneva, Switzerland (15th to 20st of September 2019).

For the 9th “Paolo Farinella” Prize the terms and rules are as follows:

1. A competition is announced to award the “Paolo Farinella” Prize for the year 2019. The prize consists of a plate, a certificate and the amount of 1500 euros. The winner is expected to give a Prize lecture at the EPSC/DPS awards special session.
2. The winner will be selected on the basis of his/her overall research results in the field of “The Trans-Neptunian Population”.
3. Nominations must be sent by email not later than April 15 to the following addresses: morby@oca.eu, acb@ua.es and david.lucchesi@inaf.it, using the form downloadable from https://www-n.oca.eu/morby/FORM_Paolo_Farinella_Prize_2019.docx
4. The nominations for the “Paolo Farinella” Prize can be made by any researcher that works in the field of planetary sciences following the indications in the form linked above. Self nominations are acceptable. The candidates should have international and interdisciplinary collaborations and should be not older than 47 years, the age of Paolo when he passed away, at the date of April 15, 2019.
5. The winner of the prize will be selected before May 20 by the “Paolo Farinella” Prize Committee composed of outstanding scientists in planetary sciences, with specific experience in the field.
6. The Prize Committee will consider all the nominations, but will be entitled to autonomously consider other candidates.

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There was 1 new TNO discovery announced since the previous issue of *Distant EKO*s:

2017 OG69

and 9 new Centaur/SDO discoveries:

2017 SN132, 2017 WH30, 2018 AX18, 2018 AY18, 2018 VM35, 2018 VO35, 2019 AB7,
2019 CR, 2019 CY4

Current number of TNOs: 2443 (including Pluto)

Current number of Centaurs/SDOs: 866

Current number of Neptune Trojans: 22

Out of a total of 3331 objects:

697 have measurements from only one opposition

690 of those have had no measurements for more than a year

368 of those have arcs shorter than 10 days

(for more details, see: http://www.boulder.swri.edu/ekonews/objects/recov_stats.jpg)

A Pluto-Charon Sonata: The Dynamical Architecture of the Circumbinary Satellite System

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Using a large suite of n-body simulations, we explore the discovery space for new satellites in the Pluto-Charon system. For the adopted masses and orbits of the known satellites, there are few stable prograde or polar orbits with semimajor axes $a \leq 1.1 a_H$, where a_H is the semimajor axis of the outermost moon Hydra. Small moons with radii $r \leq 2$ km and $a \leq 1.1 a_H$ are ejected on time scales ranging from several yr to more than 100 Myr. Orbits with $a \geq 1.1 a_H$ are stable on time scales exceeding 150–300 Myr. Near-IR and mid-IR imaging with several instruments on JWST and ground-based occultation campaigns with 2–3-m class telescopes can detect 1–2 km satellites outside the orbit of Hydra. Searches for these moons enable new constraints on the masses of the known satellites and on theories for circumbinary satellite formation.

Published in: The Astronomical Journal, 157, 79 (2019 February)

For preprints, contact `skenyon@cfa.harvard.edu`

or on the web at <https://arxiv.org/abs/1810.01277>

The Mutual Orbit, Mass, and Density of Transneptunian Binary G!kún||'hòmdímà (229762 2007 UK₁₂₆)

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We present high spatial resolution images of the binary transneptunian object G!kún||'hòmdímà (229762 2007 UK₁₂₆) obtained with the Hubble Space Telescope and with the Keck observatory on Mauna Kea to determine the orbit of G!ò'é !Hú, the much smaller and redder satellite. G!ò'é !Hú orbits in a prograde sense, on a circular or near-circular orbit with a period of 11.3 days and a semimajor axis of 6000 km. Tidal evolution is expected to be slow, so it is likely that the system formed already in a low-eccentricity configuration, and possibly also with the orbit plane of the satellite in or close to the plane of G!kún||'hòmdímà's equator. From the orbital parameters we can compute the system mass to be 1.4 ± 10^{20} kg. Combined with estimates of the size of G!kún||'hòmdímà from thermal observations and stellar occultations, we can estimate the bulk density as about 1 g cm^{-3} . This low density is indicative of an ice-rich composition, unless there is substantial internal porosity. We consider the hypothesis that the composition is not unusually ice-rich compared with larger TNOs and comet nuclei, and instead the porosity is high, suggesting that mid-sized objects in the 400 to 1000 km diameter range mark the transition between small, porous objects and larger objects that have collapsed their internal void space as a result of their much higher internal pressures and temperatures.

To appear in: Icarus (DOI 10.1016/j.icarus.2018.12.037)

Preprint available at <http://www2.lowell.edu/~grundy/abstracts/2019.G-G.html>

Crater Density Predictions for New Horizons Flyby Target 2014 MU69

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In preparation for the 2019 January 1 encounter between the New Horizons spacecraft and the Kuiper Belt object 2014 MU69, we provide estimates of the expected impact crater surface density on the Kuiper Belt object. Using the observed crater fields on Charon and Pluto down to the resolution limit of the 2015 New Horizons flyby of those bodies and estimates of the orbital distribution of the crater forming projectiles, we calculate the number of craters per unit area formed as a function of the time a surface on 2014 MU69 has been exposed to bombardment. We find that if the shallow crater size distribution from roughly 1-15 km exhibited on Pluto and Charon is indeed due to the sizes of Kuiper Belt projectiles, 2014 MU69 should exhibit a surface that is only lightly cratered below 1 km scale, despite being bombarded for ~ 4 billion years. Its surface should therefore be more clearly indicative of its accretionary environment. In addition, this object may be the first observed for which the majority of the bombardment is from exogenic projectiles moving at less than or near the speed of sound in the target materials, implying morphologies more akin to secondary craters elsewhere in the solar system. Lastly, if the shallow Kuiper Belt size distribution implied from the Pluto and Charon imaging is confirmed at 2014 MU69, then we conclude that this size distribution is a preserved relic of its state $\simeq 4.5$ Gyr ago and provides a direct constraint on the planetesimal formation process itself.

Published in: The Astrophysical Journal Letters, 872, 5 (2019 February 10)

Preprints available on the web at <https://arxiv.org/abs/1812.09785>

Fast Algorithms for Slow Moving Asteroids: Constraints on the Distribution of Kuiper Belt Objects

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We introduce a new computational technique for searching for faint moving sources in astronomical images. Starting from a maximum-likelihood estimate for the probability of the detection of a source within a series of images, we develop a massively parallel algorithm for searching through candidate asteroid trajectories that utilizes graphics processing units (GPU). This technique can search over 10^{10} possible asteroid trajectories in stacks of the order of 10-15 4K x 4K images in under a minute using a single consumer grade GPU. We apply this algorithm to data from the 2015 campaign of the High Cadence Transient Survey (HiTS) obtained with the Dark Energy Camera (DECam). We find 39 previously unknown Kuiper belt

objects (KBOs) in the 150 square degrees of the survey. Comparing these asteroids to an existing model for the inclination distribution of the Kuiper belt we demonstrate that we recover a KBO population above our detection limit consistent with previous studies. Software used in this analysis is made available as an open source package.

Published in: The Astronomical Journal, 157, 119 (2019 March)

Available online at <https://doi.org/10.3847/1538-3881/aafd2d>

or at <https://arxiv.org/abs/1901.02492>

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174P/Echeclus and Its Blue Coma Observed Post-outburst

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It has been suggested that centaurs may lose their red surfaces and become bluer due to the onset of cometary activity, but the way in which cometary outbursts affect the surface composition and albedo of active centaurs is poorly understood. We obtained consistent visual-near-infrared (VNIR) reflectance spectra of the sporadically active centaur 174P/Echeclus during a period of inactivity in 2014 and six weeks after its outburst in 2016 to see if activity had observably changed the surface properties of the nucleus. We observed no change in the surface reflectance properties of Echeclus following the outburst compared to before, indicating that, in this case, any surface changes due to cometary activity were not sufficiently large to be observable from Earth. Our spectra and post-outburst imaging have revealed, however, that the remaining dust coma is not only blue compared to Echeclus, but also bluer than solar, with a spectral gradient of $-7.7 \pm 0.6\%$ per $0.1 \mu m$ measured through the $0.61 - 0.88 \mu m$ wavelength range that appears to continue up to $\lambda \sim 1.3 \mu m$ before becoming neutral. We conclude that the blue visual color of the dust is likely not a scattering effect, and instead may be indicative of the dust’s carbon-rich composition. Deposition of such blue, carbon-rich, comatic dust onto a red active centaur may be a mechanism by which its surface color could be neutralized.

Published in: The Astronomical Journal, 157, 88 (2019 February)

Find preprints at <https://arxiv.org/abs/1811.11220>

or see the open access article at <https://iopscience.iop.org/article/10.3847/1538-3881/aafbe4>

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On the Location of the Ring Around the Dwarf Planet Haumea

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The recently discovered ring around the dwarf planet (136108) Haumea is located near the 1:3 resonance between the orbital motion of the ring particles and the spin of Haumea. In the current work is studied the dynamics of individual particles in the region where is located the ring. Using the Poincaré Surface of Section technique, the islands of stability associated with the 1:3 resonance are identified and studied. Along all its existence this resonance showed to be doubled, producing pairs of periodic and quasi-periodic orbits. The fact of being doubled introduces a separatrix, which generates a chaotic layer that significantly reduces the size of the stable regions of the 1:3 resonance. The results also show that there is a minimum equivalent eccentricity ($e_{1:3}$) for the existence of such resonance. This value seems to be too high to keep a particle within the borders of the ring. On the other hand, the Poincaré Surface of Sections show the existence of much larger stable regions, but associated with a family of first kind periodic orbits. They exist

with equivalent eccentricity values lower than $e_{1:3}$, and covering a large radial distance, which encompasses the region of the Haumea's ring. Therefore, this analysis suggests the Haumea's ring is in a stable region associated with a first kind periodic orbit instead of the 1:3 resonance.

**To appear in: Monthly Notices of the Royal Astronomical Society, 484, 3765
(2019 April 11)**

For preprints, contact othon.winter@unesp.br

or on the web at <https://arxiv.org/abs/1902.03363>

PAPERS RECENTLY SUBMITTED TO JOURNALS

On the Unknown Physical Parameters and Composition of the Interior Structure of Pluto and Charon

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Among the extensive data reported after the completion of The New Horizons mission there are still lacking enough comprehensive ones relevant to the basic physical parameters and a possible bulk composition of the interiors of Pluto and Charon. It is evident that currently no any other way of an overall determination of the unknown physical parameters of the core of Pluto and Charon exists apart from some semi-empirical one, as witnessed by the uncertainty in this issue practically for all planets of the Solar System except the Earth. Therefore, in this work we have used an original semi-empirical approach based on application to them the same simple harmonic relations as those revealed by us for the terrestrial planets of the Solar System. In so doing we have obtained new quite substantiated estimates characterizing these previously unknown physical parameters of cores as well as a possible chemical composition of the cores and rocky mantles of Pluto and Charon. Data on their rocky mass and icy mantles thickness that were found here as the secondary results fit respective The New Horizons mission data well.

Submitted to: Physics of the Earth and Planetary Interiors

For preprints, contact yrogozin@gmail.co

CONFERENCE CONTRIBUTIONS

Presentations at the 50th LPSC meeting

2019 March 18-22, The Woodlands, Texas, USA

The following are Kuiper belt related presentations compiled by Kelsi Singer from the LPSC program.

More information at the LPSC website: <https://www.hou.usra.edu/meetings/lpsc2019/>

Monday, March 18

Session M103 (8:30-11:45). New Horizons at KBO 2014 MU69 (Ultima Thule)

- Overview of Initial Results from the Reconnaissance Flyby of a Kuiper Belt Planetesimal: 2014 MU69 (Stern)
- The Geology of 2014 MU69 ('Ultima Thule'): Initial Results from The New Horizons Encounter (Moore)
- 486958 2014 MU69 Ultima Thule Surface Composition Overview (Grundy)
- A Pristine 'Contact Binary' in the Kuiper Belt: Implications from the New Horizons Encounter with 2014 MU69 ('Ultima Thule') (McKinnon)
- Stellar Occultation Results for (486958) 2014MU69: A Pathfinding Effort for the New Horizons Flyby (Buie)
- A Contact Binary in the Kuiper Belt: The Shape and Pole of (486958) 2014 MU69 (Porter)
- Topography of Ultima Thule (2014 MU69) at Local Scales: Surface Evolution of a Small Primitive Body (Schenk)
- The Mysterious Missing Light Curve of (486958) 2014 MU69, a Bi-Lobate Contact Binary Visited by New Horizons (Zangari)
- Colors of (486958) 2014 MU69 as Observed by New Horizons' Multi-Spectral Visible Imaging Camera (MVIC) (Howett)
- The Search for Moons and Rings of 2014 MU69 (Spencer)
- Comparing (486958) 2014 MU69 to Cometary Nuclei: Shapes and Surfaces (Weaver)
- Comparing Ultima Thule with Comet Nuclei: Colors and Composition (Protopapa)
- Impact Craters on 2014 MU69: Implications for the Geologic History of MU69 and Kuiper Belt Population Size-Frequency Distributions (Singer)

Monday, March 18

Session M153 (14:30-16:45). Kuiper Belt Objects: From Pluto to Eris and Ultima Thule

- Potential Implications of the Shape of 2014 MU69 for Interpreting Other KBO Lightcurves (Showalter)
- New Horizons Observations of Distant Kuiper Belt Objects: Rotational and Solar Phase Curves of (486958) 2014 MU69 and Other Cold Classical KBOs (Verbiscer)
- Potential Mapping Schemes and Reference Systems for MU69 (Beyer)
- Gravity, Rotation, and Hill Slopes of 2014 MU69 (Keane)
- Comets Sourced by KBOs – Comparison of SFDs Derived from Spitzer/Wise JFC Imaging and Pluto and Charon KBO Cratering Rates (Lisse)
- The Influence of Dwarf Planets on the Stability of Objects in the Kuiper Belt (Burgener)
- Eris: The Brightest (and Most Active?) Kuiper Belt Object (Hoffgartner)
- Interplanetary Dust Delivery of Water to the Atmospheres of Pluto and Triton (Poppe)
- Discovery of Remarkable Opposition Surges on Pluto and Charon (Buratti)

Tuesday, March 19

Session T305 (18:00-21:00). Posters — New Horizons At KBO 2014 MU69 (Ultima Thule)

- Deriving an Ultima Thule Digital Shape Kernel (Beddingfield)
- Limb Topography of 2014 MU69: First Results from the New Horizons Flyby (Bierson)
- Generating a 3D Shape Model of 2014 MU69 for Scientific Visualization and Public Outreach (Kinczyk)
- Shape of 2014 MU69: Contact Binary from Low Speed Merger? (Cheng)
- Crater Morphology on 2014 MU69 – Predictions for New Horizons High Resolution Imaging (Bray)
- Comparison of Near Infrared Spectra Between Pluto-System Objects and 486958 2014 MU69: Analysis of New Horizons Spectral Images (Cook)
- The Colors of 486958 2014 MU69 (‘Ultima Thule’): The Role of Synthetic Organic Solids (Tholins) (Cruikshank)
- Color and Albedo of Ultima Thule: A Comparison to TNOs and Centaurs (Dalle Ore)
- Kuiper Belt Object 2014 MU69: Correlation Between Albedo and Landforms (Dhingra)
- Searching for a Coma During the New Horizons Flyby of 2014 MU69 (Ultima Thule) (Gladstone)
- Photometry of Kuiper Belt Object Ultima Thule and Comparisons with Cognate Solar System Objects (Hofgartner)
- The Illustrated Guide to the New Horizons Flyby of 2014 MU69 (Keane)
- Highly Localized Seasonal Cold-Trapping in the Neck of 2014 MU69 ‘Ultima Thule’ (Binzel)
- The Search for Rings and Binary Companions of Kuiper Belt Objects by New Horizons (Parker)
- Spectral Properties of 486958 2014MU69 (Ultima Thule) Versus 67P/Churyumov-Gerasimenko (Quirico)
- Theoretical Underpinnings on Aeolian Transport on 2014 MU69 ‘Ultima Thule’ (Runyon)
- Ultima Thule, TNOs ,and the Irregular Satellites of the Outer Planets: Spectroscopic and Color Comparison (Scipioni)
- REX Radiometry at 4.2 cm During the New Horizons Encounter of Ultima Thule (Linscott)
- The Solar Wind, Pickup Ion, Energetic Particle, Cosmic Ray, and Dust Space Environment at 2014 MU69 (Ultima Thule) (Elliott)

Session T306 (18:00-21:00). Posters — Kuiper Belt Objects: From Pluto to Eris and Ultima Thule

- Lobate Debris Aprons Observed on Pluto from New Horizons (Ahrens)
- Spectral and Surface Characteristics of Carbon Monoxide on Pluto (Ahrens)
- Collisional Terminology For Cold Classical KBOs (Izenberg)
- Chaos Terrains on Pluto, Europa, and Mars – Morphological Comparison of Blocks (Skjetne)
- Analysis of Pluto’s Al-Idrisi Montes and the Adjacent Deep Trench Feature (Byers)
- The Orientation of the Bladed Terrain Feature in Tarturus Dorsa, Pluto and Possible Reorientation of Pluto (Wagner)
- Elastic Flexure Around Sputnik Planitia, Pluto, and Evidence for a Very High Heat Flux (Mills)

Wednesday, March 20

Session W453 (14:30). 50 Years Of Planetary Science: “One Giant Leap For Mankind”

- Fifty Years of Exploring Pluto: From Telescopes to the New Horizons Mission (Cruikshank)

Session W453 (13:30). Planetary Volcanism: A Song of Fire and Ice

- Stress-Enhanced Ascent of Cryomagmas Through Pluto’s Ice Shell from Nitrogen Ice Loading of a Sputnik Planitia Basin (McGovern)

Thursday, March 21

Session R504 (8:30-11:45). Presolar, Interplanetary, and Cometary Dust

- A Kuiper Belt Source for Solar Flare Track-Rich Interplanetary Dust Particles (Keller)

Session R641 (18:00-21:00). Posters — Visualizing Worlds: Outer Planets and Satellites Spatial Data and Infrastructure

- Triton, Europa, Enceladus, and Pluto, Oh my!: Topography of Active Icy Ocean Worlds (Kay)
- Intensity-Based Registration for Planetary Cartography: Application to New Horizons LEISA Approach Scans of Pluto (Gabasova)

Session T335 (18:00-21:00). Posters — Education and Public Engagement: Models, Opportunities, and Products for Engaging Audiences

- Using Computer-Generated Imagery (CGI) for Science and Outreach on Missions: New Horizons' Encounter with the Pluto-Charon System and (486958) 2014 MU69 (Robbins)
- Sketching the New Horizons 2014 MU69 Flyby Event (Gabasova)

The *Distant EKO*s Newsletter is dedicated to provide researchers with easy and rapid access to current work regarding the Kuiper belt (observational and theoretical studies), directly related objects (e.g., Pluto, Centaurs), and other areas of study when explicitly applied to the Kuiper belt.

We accept submissions for the following sections:

- ★ Abstracts of papers submitted, in press, or recently published in refereed journals
- ★ Titles of conference presentations
- ★ Thesis abstracts
- ★ Short articles, announcements, or editorials
- ★ Status reports of on-going programs
- ★ Requests for collaboration or observing coordination
- ★ Table of contents/outlines of books
- ★ Announcements for conferences
- ★ Job advertisements
- ★ General news items deemed of interest to the Kuiper belt community

A L^AT_EX template for submissions is appended to each issue of the newsletter, and is sent out regularly to the e-mail distribution list. Please use that template, and send your submission to:

`ekonews@boulder.swri.edu`

The *Distant EKO*s Newsletter is available on the World Wide Web at:

`http://www.boulder.swri.edu/ekonews`

Recent and back issues of the newsletter are archived there in various formats. The web pages also contain other related information and links.

*Distant EKO*s is not a refereed publication, but is a tool for furthering communication among people interested in Kuiper belt research. Publication or listing of an article in the newsletter or the web page does not constitute an endorsement of the article's results or imply validity of its contents. When referencing an article, please reference the original source; *Distant EKO*s is not a substitute for peer-reviewed journals.

Moving ... ??

If you move or your e-mail address changes, please send the editor your new address. If the newsletter bounces back from an address for three consecutive issues, the address will be deleted from the mailing list. All address changes, submissions, and other correspondence should be sent to:

`ekonews@boulder.swri.edu`