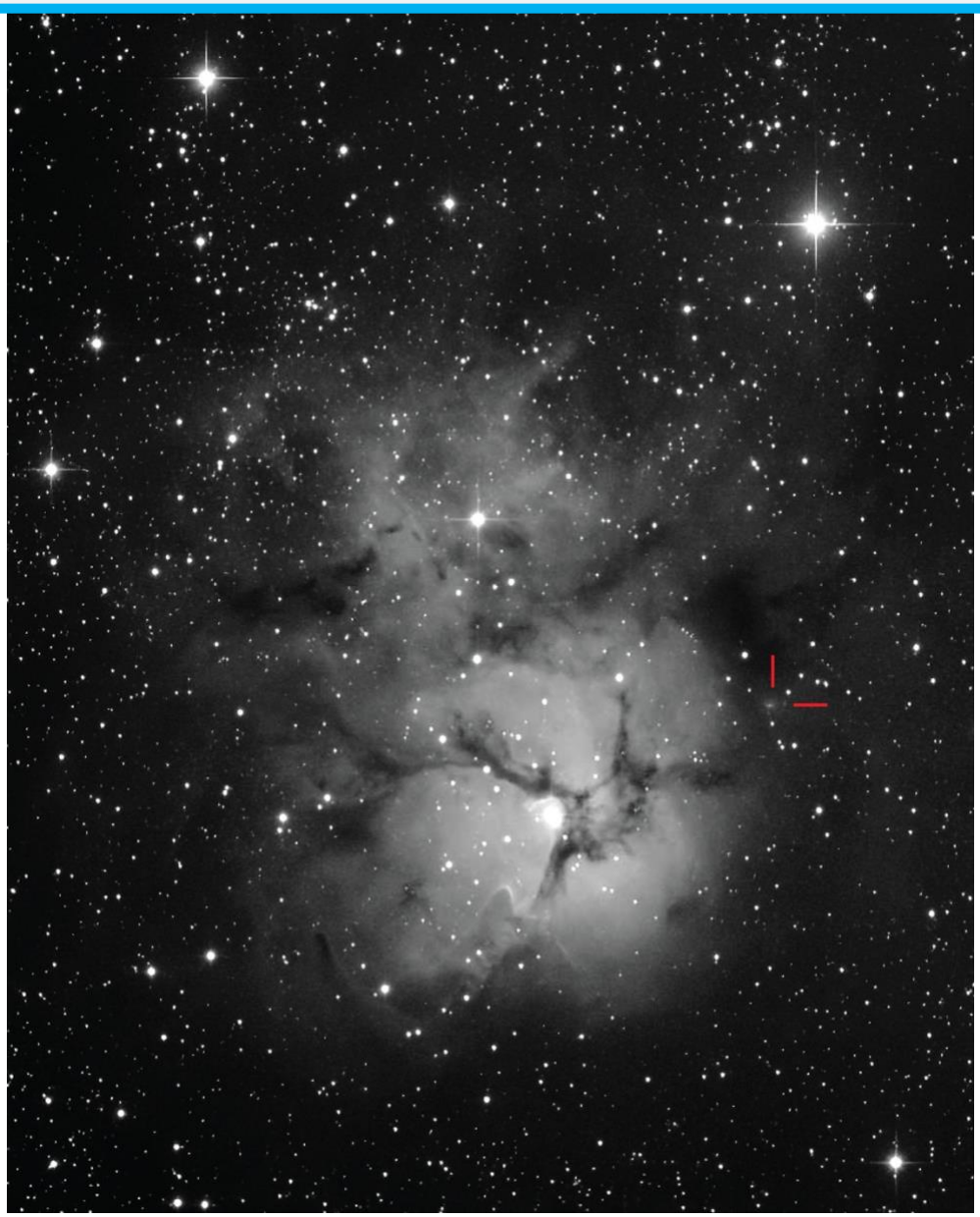
ALPO COMET NEWS

A Publication of the Comets Section of the Association of Lunar and Planetary Observers

October 2021
alpo-astronomy.org
comets@alpo-astronomy.org



Periodic comet 6P/d'Arrest spent September running a gauntlet of deep sky objects in Sagittarius. In this image, Eliot Herman caught 6P (between the red tick marks) as it was about to move across M20, the Trifid Nebula.

The image was taken with the T11 iTelescope (0.50-m f/6.8 reflector + CCD + f/4.5 focal reducer + FLI ProLine PL11002M CCD camera) in Mayhill NM. The image is a stack of three x 180 sec.

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The monthly ALPO Comet News PDF can be found on the ALPO Comets Section website (http://www.alpo-astronomy.org/cometblog/). A shorter version of this report is posted on a dedicated Cloudy Nights forum (https://www.cloudynights.com/topic/792282-alpo-comet-news-for-october-2021/). All are encouraged to join the discussion over at Cloudy Nights. The ALPO Comet Section welcomes all comet related articles, observations, images, drawings, magnitude estimates, or spectra. One does not have to be a member of ALPO to submit material, though membership is encouraged.

Please send your observations to the Comets Section at < comets@alpo-astronomy.org >, Coordinator Carl Hergenrother < carl.hergenrother@alpo-astronomy.org > and/or Acting Assistant Coordinator Michel Deconinck < michel.deconinck@alpo-astronomy.org >.

To learn more about the ALPO, please visit us @ http://www.alpo-astronomy.org.

Summary

Magnitude 9 to 10 may not be everyone's idea of "bright" when it comes to comets. After months of no comets getting brighter than 10th magnitude, we finally have a few objects breaking the 10th magnitude barrier. The target of the European Space Agency's Rosetta mission, 67P/Churyumov-Gerasimenko may brighten to around magnitude 9 this month. It will be observable from both hemispheres in the morning sky. 8P/Tuttle will start the month around 8-9th magnitude but is limited to southern hemisphere observers. C/2019 L3 (PANSTARRS) could become brighter than magnitude 10 though it will mainly be a northern object.

29P/Schwassmann-Wachmann experienced 4 outbursts in quick succession in late September. As a result, it is brighter than it has become in years with visual observers placing it between magnitude 10 and 11.

We continue to watch C/2021 A1 (Leonard) develop as it heads towards a December encounter with Earth. Recent observations show a rapid brightening trend, so imagers and large aperture visual observers are encouraged to observe it this month as it may brighten to magnitude 11 by the end of the month.

Comets Section News

During September, the ALPO Comets Section received 51 images and/or sketches from Dan Bartlett, Denis Buczynski, Eliot Herman, Gianluca Masi, Martin Mobberley, Uwe Pilz, Efrain Morales Rivera, Gregg Ruppel, and Chris Schur and 67 visual and CCD magnitude measurements from Michel Deconinck, J. J. Gonzalez, Mike Olason, and Chris Wyatt of the following comets: P/2021 Q5 (ATLAS), C/2021 O3 (PANSTARRS), C/2021 A1 (Leonard), C/2020 T2 (Palomar), C/2020 PV6 (PANSTARRS), C/2020 F5 (MASTER), C/2019 O3 (PANSTARRS), C/2019 L3 (ATLAS), C/2019 F1 (ATLAS-Africano), C/2018 U1 (Lemmon), C/2020 T2 (PANSTARRS), C/2017 K2 (PANSTARRS), 284P/McNaught, 193P/LINEAR-NEAT, 106P/Schuster, 67P/Churyumov-Gerasimenko, 29P/Schwassmann-Wachmann, 19P/Borrelly, 15P/Finlay, 8P/Tuttle, 7P/Pons-Winnecke, 6P/d'Arrest, and 4P/Faye.

We've tried to include lightcurves for most of the objects discussed in this report as well as applying aperture corrections to the visual observations. All magnitude estimates are affected by many factors including instrumental (aperture, focal length, magnification, type of optics), environmental (sky brightness due to moonlight, light pollution, twilight, aurora activity, zodiacal light, etc), cometary (degree of condensation, coma color, strength and type of gas emission lines, coma-tail interface) and personal (sensitivity to different wavelengths, personal technique, observational biases). The correction used here only corrects for differences in aperture [C. S. Morris, On Aperture Corrections for Comet Magnitude Estimates. Publ Astron Soc Pac 85, 470, 1973]. Visual observations are corrected to a standard aperture of 6.78 cm by 0.019 magnitudes per centimeter for refractors and 0.066 magnitudes per centimeter for reflectors. As our work develops, we will investigate determing individual corrections for each observer for each individual comet as well as for digital observations.

In addition to observations submitted directly to the ALPO, we occasionally use data from other sources to augment our analysis. We would like to acknowledge with thanks observations submitted directly to the ALPO as well as those originally submitted to the International Comet Quarterly, Minor Planet Center, and COBS Comet Observation Database. We would also like to thank the Jet Propulsion Laboratory for making available their Small-Body Browser and Orbit Visualizer and Seiichi Yoshida for his Comets for Windows programs that is used to produce the lightcurves in these pages. And last but not least, we'd like to thank Syuichi Nakano and the Minor Planet Center for their comet orbital elements, the asteroid surveys and dedicated comet hunters for their discoveries, and all of the observers who volunteer their time to adding to our knowledge of these amazing objects.

Comets Calendar for October 2021

Oct 01 – C/2020 H6 (ATLAS) at perihelion (q = 4.70 au, long-period, V~13-14)
Oct 02-09 – C/2020 T2 (Palomar) passes in front of the large area of nebulosity near Antares and rho Oph
Oct 03-05 – 4P/Faye passes in front of Sh2-261 emission nebula
Oct 05 – 52P/Harrington-Abell at perihelion (q = 1.78 au, 7.6-year orbit, V~16)
Oct 06 – New Moon
Oct 12 – First Quarter Moon
Oct 15 – 6P/d'Arrest passes within 10' of bright globular cluster M55
Oct 15-16 – 67P/Churyumov-Gerasimenko passes within 15' of bright open cluster M35
Oct 17 – 57P/du Toit-Neujmin-Delporte at perihelion (q = 1.72 au, 6.4-year orbit, V ~ 15-16)
Oct 17 – 418P/LINEAR at perihelion (q = 1.70 au, 11.4-year orbit, V ~ 16-17)
Oct 18 – 110P/Hartley at perihelion (q = 2.46 au, 6.8-year orbit, V ~ 15-16)
Oct 18 – C/2021 G3 (PANSTARRS) at perihelion (q = 5.18 au, long-period, V ~ 21)
Oct 19 – 342P/SOHO at perihelion (q = 0.05 au, 5.3-year orbit, may be visible in SOHO data at perihelion)
Oct 20 – Full Moon
Oct 21 – P/2012 TK8 (Tenagra) at perihelion (q = 3.00 au, 8.4-year orbit, not seen since discovery apparition in 2012/2013 when it peaked at V ~19)
Oct 27 – 419P/PANSTARRS at perihelion (q = 2.54 au, 6.6-year orbit, V ~ 19-20)
Oct 27 – C/2020 T2 (Palomar) passes within 20-25' of 9th mag globular cluster NGC 6304
Oct 28 – Last Quarter Moon
Oct 29 – 6P/d'Arrest passes within 10' of 11th mag galaxy NGC 6925
Oct 31 – 424P/La Sagra at perihelion (q = 1.36 au, 9.3-year orbit, V ~ 17-18)

Comets Brighter Than Magnitude 10

8P/Tuttle

Discovered on 1790 January 9 by Pierre F. A. Mechain
Rediscovered on 1858 January 5 by Horace Tuttle

Orbit (from Minor Planet Center, MPEC 2021-S45)

```
   8P/Tuttle
Epoch 2021 July 5.0 TT = JDT 2459400.5
T 2021 Aug. 27.73743 TT                                  Rudenko
q   1.0260106            (2000.0)            P               Q
n   0.07228558     Peri.  207.48894     -0.26849292     -0.50829781
a   5.7073554      Node   270.20405     +0.96326319     -0.13641373
e   0.8202301      Incl.   54.91123     +0.00596493     -0.85030855
P  13.6
From 231 observations 2008 Feb. 12-2021 Sept. 16, mean residual 0".5.
     Nongravitational parameters A1 = +0.40, A2 = +0.2133.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
8P/Tuttle                                                          Max El
                                                                    (deg)
    Date      R.A.   Decl.     r       d    Elong  Const  Mag   40N  40S
2021-Oct-01  10 36  -21 40   1.150   1.852    33M   Hya   8.6     0   15
2021-Oct-06  10 53  -25 14   1.186   1.878    33M   Hya   8.8     0   16
2021-Oct-11  11 11  -28 35   1.224   1.910    34M   Hya   9.0     0   16
2021-Oct-16  11 29  -31 42   1.265   1.946    34M   Hya   9.2     0   17
2021-Oct-21  11 48  -34 34   1.308   1.986    35M   Hya   9.5     0   17
2021-Oct-26  12 06  -37 12   1.353   2.030    35M   Cen   9.8     0   18
2021-Oct-31  12 25  -39 34   1.399   2.076    35M   Cen  10.1     0   18
2021-Nov-05  12 44  -41 42   1.447   2.124    36M   Cen  10.4     0   18
```

Comet Magnitude Formula

```
m1 = 7.0 + 5 log d + 20 log r(t-25) [Ref: Seiichi Yoshida]
```

Magnitude Measurements Submitted to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                      T         Dia  DC  LENG  PA
  8        2021 09 11.77 xM  8.9 TK 40.0L 4  59   3.1  5            ICQ XX WYA   Christopher Wyatt
  8        2021 09 07.77 xM  9.0 TK 40.0L 4  59   2.8  5            ICQ XX WYA   Christopher Wyatt
```

There is not too much new to report regarding 8P/Tuttle this month. The current return is limited to observers in the southern hemisphere and even there it is a low morning object as it moves through Hydra (Oct 1-23) and Centaurus (23-31). Chris Wyatt visually observed Tuttle on September 7 and 11 from Australia at magnitude 9.0 and 8.9, respectively. Chris used a 0.4-m telescope reflector, meaning with a nominal aperture correction, Tuttle may be ~0.6 magnitudes brighter than Chris' report. Now over a month after its August 27 perihelion at 1.03 au, Tuttle should be fading this month from around magnitude 8.5 to 10.0.

Tuttle was discovered during two widely separated apparitions. Pierre François André Méchain made the first discovery on 1790 January 9. Sixty-eight years and 5 orbits later, 8P was re-discovered by Horace Parnell Tuttle on 1858 January 5. With a 13.6-year period, 8P/Tuttle is making its 13th observed return and 18th return going back to the initial 1790 discovery apparition. Tuttle's relatively large semi-major axis of 5.7 au and inclination of 54.9° makes it a Halley-type rather than a Jupiter-family comet. Its orbit currently passes 0.096 au from Earth and a relatively safe 0.74 au from Jupiter.

The comet's best observed apparitions occurred in 1980/1981 when it reached 6th magnitude and at its previous return in 2007/2008 when it passed 0.25 au from Earth and reached 5th magnitude. This year's return is rather poor with a minimum Earth-comet distance of 1.81 au (last month on September 12). The next return in 2035 will be slightly better with a marginally closer Earth-comet distance of 1.54 au. Tuttle should put on a nice show 27 years (or 2 orbits) from now when it will pass within 0.18 au of Earth on 2048 December 28 and brighten to 4th magnitude.

Comet Fun Fact: Tuttle has one of the few nuclei to be detected by Earth-based radar. The now defunct Arecibo radio telescope observed the Tuttle's nucleus in 2007-2008. It found a contact binary shape rotating with a 11.4-hr period. The larger lobe has dimensions of 5.8x4.1 km with the smaller having dimensions of 4.3x3.3 km. [Ref: John K. Harmon et al., Radar observations of 8P/Tuttle: A contact-binary comet, Icarus, Vol. 207, Issue 1, 2010, Pages 499-502, https://doi.org/10.1016/j.icarus.2009.12.026.]

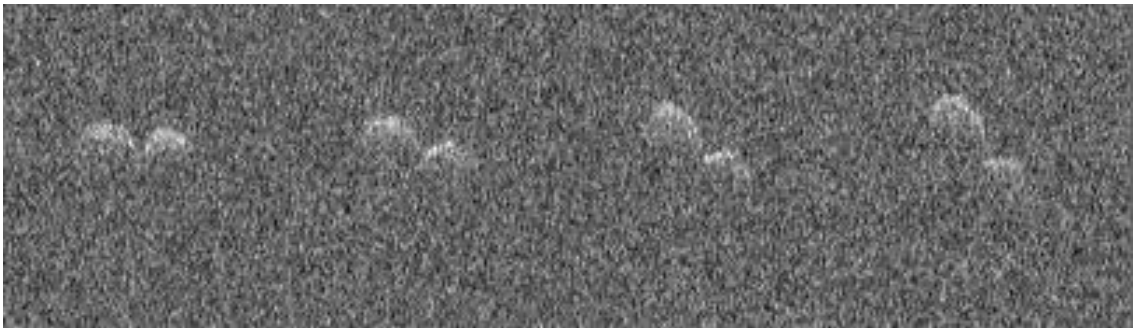


Figure 1 - Arecibo images of the nucleus of 8P/Tuttle taken on 2008 January 4.9. Credit: Mike Nolan, NAIC, Univ. of Arizona, http://www.naic.edu/~pradar/comets/8P/.

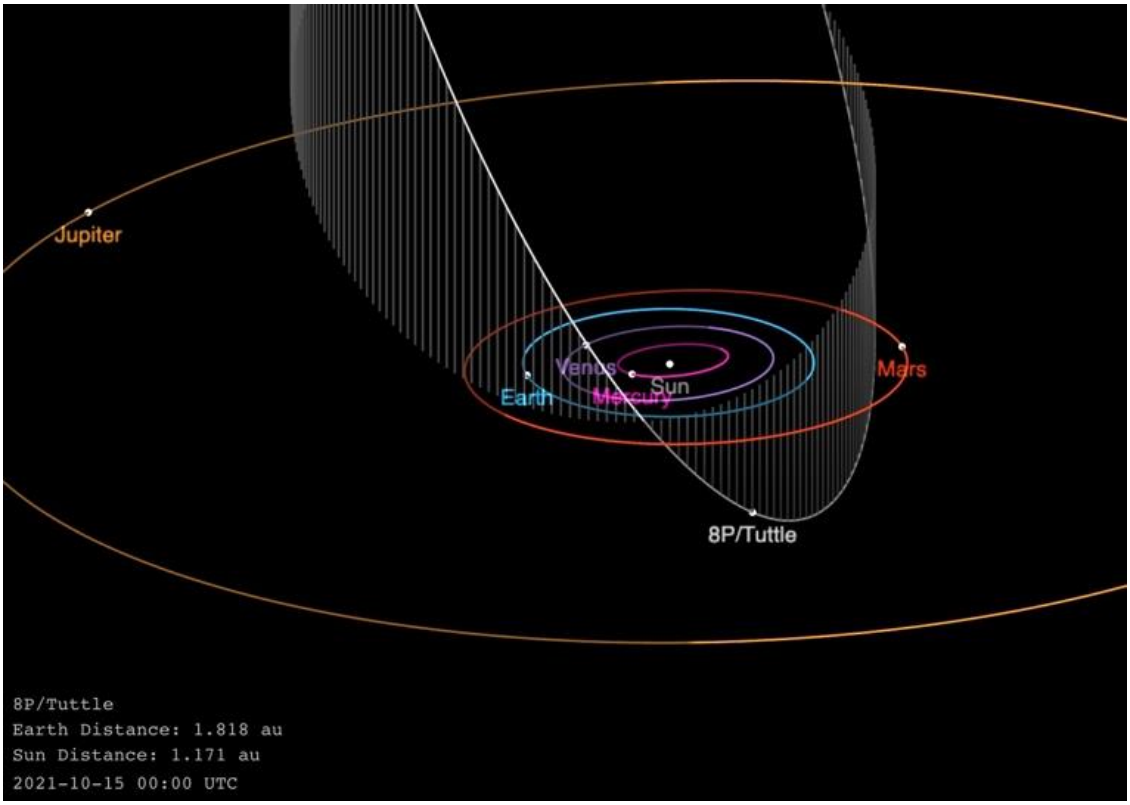


Figure 2 - Orbit of 8P/Tuttle valid for mid-October. Made with the JPL Small-Body Browser.

67P/Churyumov-Gerasimenko

Discovered 1969 September 11 by the Klim Ivanovic Churyumov and Svetlana Ivanovna Gerasimenko

Orbit (from Minor Planet Center, MPEC 2021-S45)

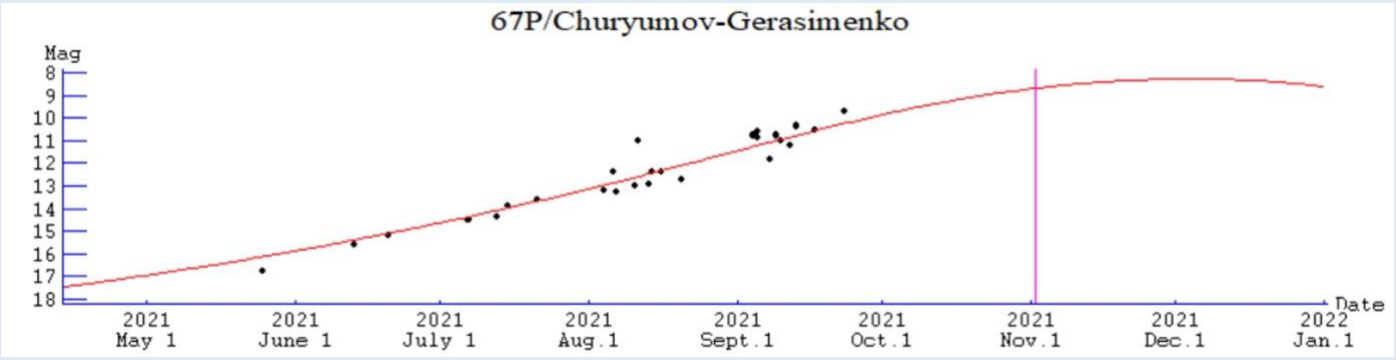
```
  67P/Churyumov-Gerasimenko
Epoch 2021 July 5.0 TT = JDT 2459400.5
T 2021 Nov. 2.05205 TT                                  Rudenko
q   1.2106427            (2000.0)            P              Q
n   0.15333185     Peri.   22.12292     +0.52361232     -0.85101687
a   3.4571201      Node    36.33644     +0.77119272     +0.45349613
e   0.6498118      Incl.    3.87136     +0.36206620     +0.26478586
P   6.43
From 7400 observations 1995 July 3-2021 Sept. 18, mean residual 0".7.
     Nongravitational parameters A1 = +0.07, A2 = +0.0108.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
67P/Churyumov-Gerasimenko                                          Max El
                                                                   (deg)
    Date       R.A.    Decl.      r        d     Elong  Const  Mag   40N  40S
2021-Oct-01  04 59  +21 27   1.274    0.500    111M   Tau    9.8    72   28
2021-Oct-06  05 22  +22 38   1.256    0.479    111M   Tau    9.6    73   27
2021-Oct-11  05 45  +23 40   1.241    0.462    110M   Tau    9.5    74   25
2021-Oct-16  06 08  +24 33   1.228    0.448    110M   Gem    9.3    75   24
2021-Oct-21  06 31  +25 15   1.219    0.437    110M   Gem    9.2    75   23
2021-Oct-26  06 53  +25 48   1.213    0.429    110M   Gem    9.1    76   22
2021-Oct-31  07 14  +26 11   1.210    0.424    110M   Gem    9.1    76   21
2021-Nov-05  07 34  +26 26   1.210    0.421    111M   Gem    9.1    76   20
```

Comet Magnitude Formula (modified from Seiichi Yoshida, H value brighter by 0.6 mag) & Lightcurve

```
m1 = 8.9 + 5 log d + 14.0 log r(t-40)
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                    T          Dia  DC  LENG  PA
 67        2021 09 17.08  S 10.8 TK 20.3T10 100   4    4            ICQ XX GON05 Juan Jose Gonzalez Suarez
 67        2021 09 13.01  S 11.8 TI 29.8B 4 108   1.5 s4    3.0m265 ICQ XX HAR11 Christian Harder
 67        2021 09 11.73 xM 11.8 AQ 40.0L 4  59   1.2  6    6.2m260 ICQ XX WYA   Christopher Wyatt
 67        2021 09 09.94  S 11.4 TI 29.8L 4 108   1.8  4            ICQ XX HAR11 Christian Harder
 67        2021 09 08.99  S 11.2 TI 29.8L 4 108   2    4            ICQ XX HAR11 Christian Harder
 67        2021 09 07.72 xM 12.4 AQ 40.0L 4 108   1.0  6    3.5m260 ICQ XX WYA   Christopher Wyatt
 67        2021 09 05.00  S 10.9 TK 20.3T10 100   5    3/           ICQ XX GON05 Juan Jose Gonzalez Suarez
 67        2021 09 04.98  S 11.3 TI 29.8L 4 108   1.5  4            ICQ XX HAR11 Christian Harder
 67        2021 09 04.06  S 12.0 TK 32.0L 5  80   0.6  7   0.02 263      PIL01 Uwe Pilz
 67        2021 09 03.99  S 11.1 TI 29.8L 4 108   1.3  4            ICQ XX HAR11 Christian Harder
```

While 8P/Tuttle is limited to southern observers, 67P/Churyumov-Gerasimenko is better placed for observers in both hemispheres. Last month visual observations were submitted by J. J. Gonzalez, Christian Harder, Uwe Pilz, and Chris Wyatt who all found the comet to be as bright as magnitude 10.8 and as faint as 12.4. After

applying aperture and bias corrections, the magnitude range tightened slightly to between 10.5 and 11.8. As is the case with many short-period comets, 67P experiences a seasonal bias in activity resulting in peak activity occurring weeks after perihelion. As a result, maximum brightness may not occur till December. This month should see 67P break magnitude 10.0 and could be close to magnitude 9.0 by the end of the month as its moves through Taurus (Oct 1-14) and Gemini (14-31) in the morning sky.

Orbit plane crossing happens on October 29. As we approach the end of the month, imagers are encouraged to be on the lookout for a strong dust trail along the comet's orbit.

67P was discovered on photographic plates taken on 1969 September 11 by Kiev University Astronomical Observatory astronomers Klim Ivanovic Churyumov and Svetlana Ivanovna Gerasimenko working with a 50-cm Maksutov astrograph at the Alma-Ata Astrophysical Institute in current day Kazakhstan. The current apparition is 67P's 9th observed return with perihelion occurring on 2021 November 2 at 1.21 au. A close approach to Earth at 0.42 au on November 12 makes this the comet's best return since 1982 when it came marginally closer to Earth at 0.39 au. At that return, a peak brightness of 9th magnitude was reached. 67P was famously the target of the ESA Rosetta/Philae mission, the only spacecraft to have orbited and landed on a comet. This will be 67P's first return since Rosetta ended its mission by soft landing onto the comet's surface.

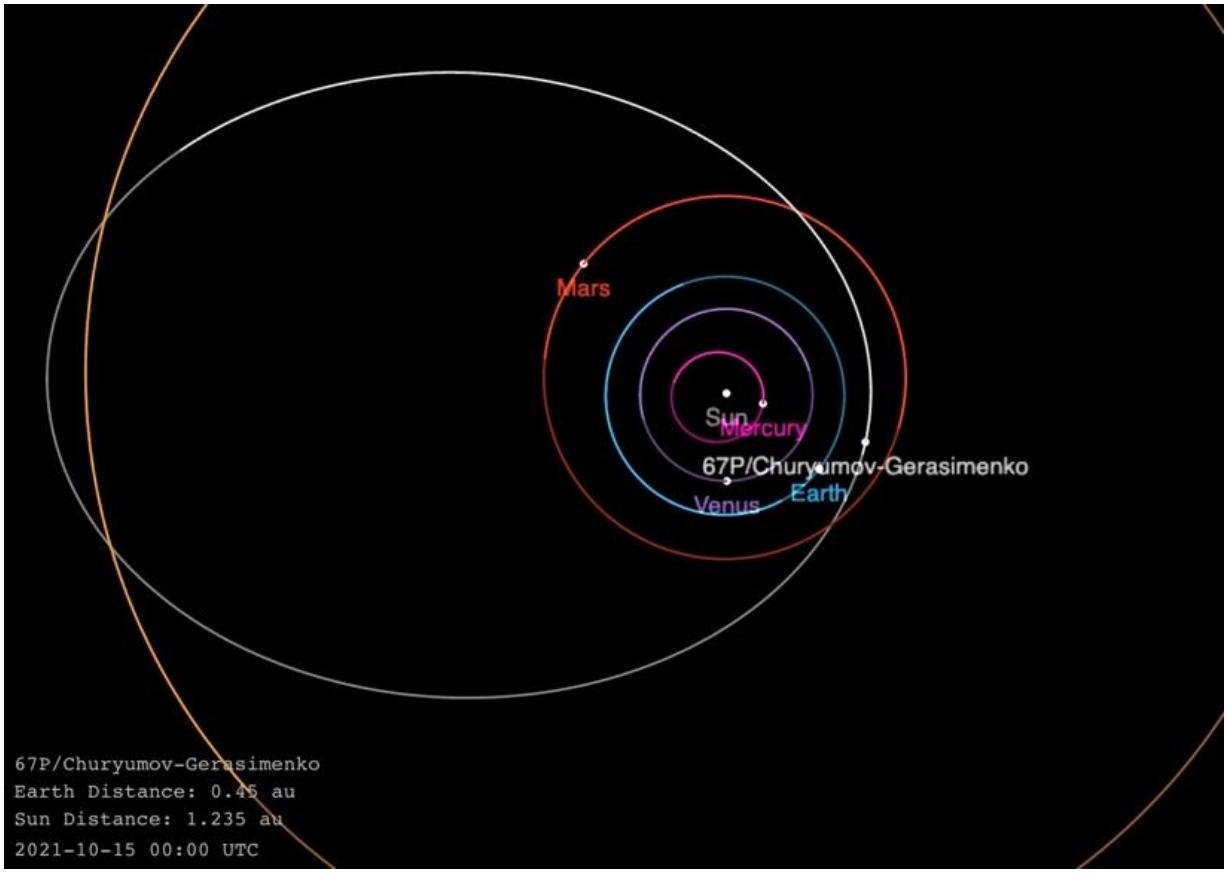


Figure 3 – Orbit of 67P/C-G from the JPL Small-Body-Browser.

Figure 4 – Images of 67P/C-G. Top: Image on 2021 September 11 by Chris Schur with a 10" f3.9 Orion astrograph. Bottom: Image taken by Dan Bartlett on 2021 September 14 with a RASA11 and ASI183mcP camera. The image is a co-add of 63x90s unfiltered exposures.

C/2019 L3 (ATLAS)

Discovered 2019 June 10 by the ATLAS survey with one of their 0.5-m f/2 Schmidt
Dynamically old long-period comet

Orbit (from Syuichi Nakano, Nakano Note NK 4342)

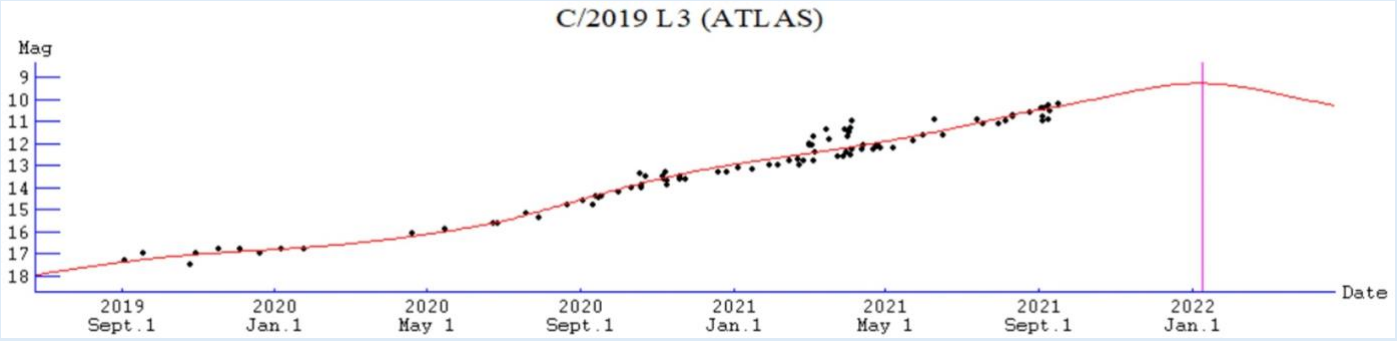
```
   C/2019 L3 (ATLAS)
Epoch 2022 Jan. 21.0 TT = JDT 2459600.5
T 2022 Jan. 9.61848 TT                                  Nakano
q   3.5544913            (2000.0)            P             Q
z  -0.0004539      Peri.  171.61068     -0.26052581     -0.66630775
 +/-0.0000010      Node   290.79047     +0.83675882     +0.20517556
e   1.0016135      Incl.   48.36122     +0.48162328     -0.71689398
From 1281 observations 2019 June 10-2021 Jan. 4, mean residual 0".36.
  (1/a)org.= +0.000021, (1/a)fut.= -0.000735 (+/-0.000001), Q= 8.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
C/2019 L3 (ATLAS)                                                    Max El
                                                                     (deg)
    Date      R.A.   Decl.     r       d    Elong  Const  Mag    40N  40S
2021-Oct-01  07 30  +43 07   3.671   3.692    80M   Aur  10.2     63    0
2021-Oct-06  07 34  +42 42   3.660   3.613    84M   Lyn  10.1     67    0
2021-Oct-11  07 37  +42 17   3.649   3.533    88M   Lyn  10.0     71    1
2021-Oct-16  07 40  +41 52   3.639   3.454    92M   Lyn  10.0     75    2
2021-Oct-21  07 43  +41 27   3.630   3.374    96M   Lyn   9.9     79    3
2021-Oct-26  07 45  +41 01   3.621   3.296   101M   Lyn   9.9     83    4
2021-Oct-31  07 46  +40 35   3.612   3.218   105M   Lyn   9.8     88    5
2021-Nov-05  07 47  +40 08   3.604   3.142   110M   Lyn   9.7     90    6
```

Comet Magnitude Formula and Lightcurve (from ALPO and COBS data)

```
m1 =  2.0 + 5 log d + 12.3 log r [through T-550 days; T = date of perihelion]
m1 = -4.6 + 5 log d + 20.8 log r [T-550 to T-150 days]
m1 =  2.8 + 5 log d +  8.0 log r [T-150 days and onwards]
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                    T          Dia  DC  LENG  PA
   2019L3  2021 09 17.12  S 10.5 TK 20.3T10  77    5    4            ICQ XX GON05 Juan Jose Gonzalez Suarez
   2019L3  2021 09 09.93  S 10.9 TI 29.8L 4 108    1.4  3/           ICQ XX HAR11 Christian Harder
   2019L3  2021 09 08.94  S 11.3 TI 29.8L 4 108    1.5  4            ICQ XX HAR11 Christian Harder
   2019L3  2021 09 05.02  S 10.7 TK 20.3T10 100    5    3/           ICQ XX GON05 Juan Jose Gonzalez Suarez
   2019L3  2021 09 04.96  S 11.2 TI 29.8L 4 108    1.7  4            ICQ XX HAR11 Christian Harder
   2019L3  2021 09 04.08  S 12.1 HS 32.0L 5  80    1    6/                PIL01 Uwe Pilz
   2019L3  2021 09 03.95  S 11.4 TI 29.8L 4  92    2.4  4    2.5m330 ICQ XX HAR11 Christian Harder
```

C/2019 L3 (ATLAS) is a far northern object in Auriga (Oct 1) and Lynx (Oct 1-31) in the morning sky. Though well placed for northern observers, folks in the southern hemisphere may get their first look at the comet this month though it will never be far from the horizon in a dark sky until later in the year. Seven measurements

were submitted to the ALPO from J. J. Gonzalez, Christian Harder, and Uwe Pilz. Observations taken during the 2nd half of the month found the comet between magnitude 10.5 and 11.3 (aperture corrected magnitude range from 9.6 to 10.3) with a coma between 1.4' and 5' in diameter.

C/2019 L3 is still three months from its 2022 January 9 perihelion at 3.57 au. The large perihelion distance means C/2019 L3 should remain a visual object well into 2022 and possibly even 2023. The comet has been brightening at rapid rate since discovery. If we assume a slow down to a more conservative 2.5n = 8 brightening rate from now till perihelion, it could brighten to between magnitude 9.0 and 9.5 between December and February.

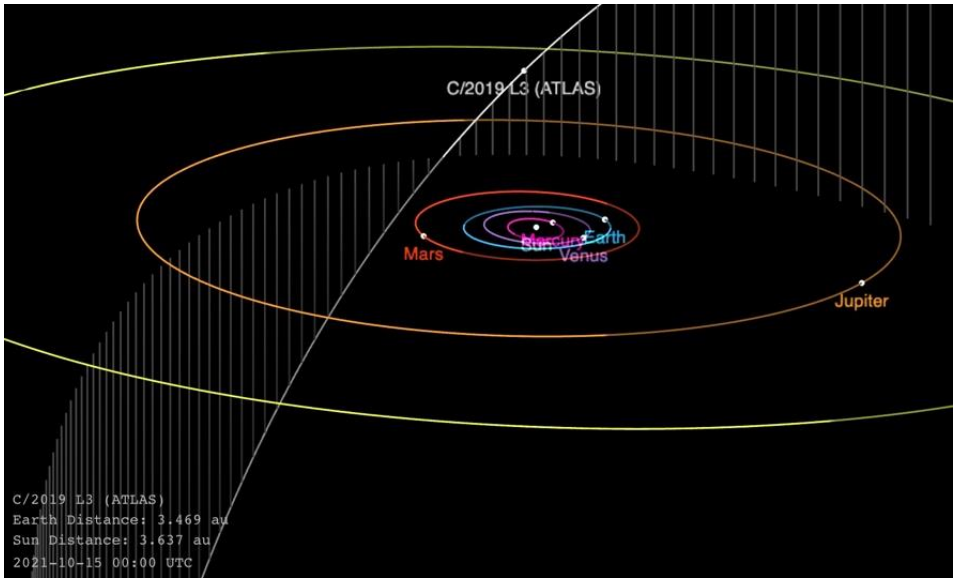


Figure 5 - Orbit of C/2019 L3 (ATLAS) from the JPL Small-Body Browser.

Figure 6 - C/2019 L3 (PANSTARRS) as imaged on 2021 September 14 by Dan Bartlett. Image is a co-add of 89x120s exposures with a RASA11 + ASI183mcP camera.

Comets Between Magnitude 10 and 13

C/2020 T2 (Palomar)

Discovered 2020 October 7 at 19th magnitude by the Zwicky Transient Facility (ZTF)
Discovery Telescope: 1.2-m Samuel Oschin Schmidt on Mount Palomar
Dynamically old long-period comet with orbital period of 5560 years

Orbit (from Syuichi Nakano, Nakano Note NK 4449)

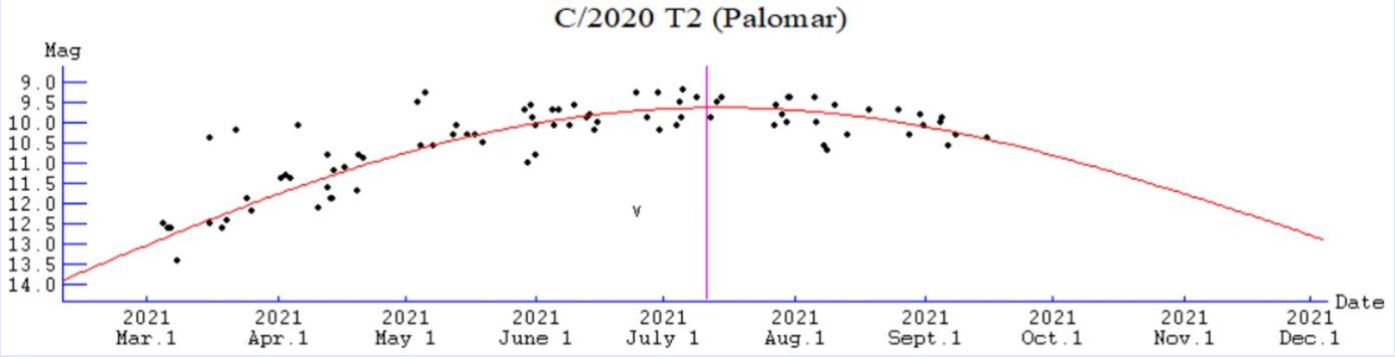
```
   C/2020 T2 (Palomar)
Epoch 2021 July 5.0 TT = JDT 2459400.5
T 2021 July 11.14758 TT                                  Nakano
q   2.0546863            (2000.0)            P              Q
z  +0.0032038      Peri.  150.38316     -0.53887199     +0.70302914
 +/-0.0000009      Node    83.04827     -0.83514131     -0.37375209
e   0.9934172      Incl.   27.87301     -0.11025416     -0.60502843
From 682 observations 2019 Dec. 11-2021 Apr. 2, mean residual 0".37.
  (1/a)org.= +0.002916, (1/a)fut.= +0.003827 (+/-0.000001), Q= 8.
  The comet will pass 3.10 AU from Jupiter on 2022 June 7 UT.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
C/2020 T2 (Palomar)                                                  Max El
                                                                     (deg)
    Date      R.A.    Decl.     r       d     Elong  Const  Mag    40N  40S
2021-Oct-01  16 17  -23 59   2.272   2.622    58E    Sco    10.8     9   39
2021-Oct-06  16 27  -25 07   2.298   2.692    56E    Sco    11.0     8   36
2021-Oct-11  16 38  -26 10   2.324   2.763    54E    Sco    11.1     7   34
2021-Oct-16  16 49  -27 08   2.352   2.833    51E    Sco    11.3     6   32
2021-Oct-21  17 00  -28 01   2.381   2.904    49E    Oph    11.4     5   29
2021-Oct-26  17 11  -28 50   2.410   2.975    47E    Oph    11.6     4   26
2021-Oct-31  17 22  -29 34   2.441   3.045    44E    Oph    11.7     4   24
2021-Nov-05  17 33  -30 13   2.472   3.114    42E    Sco    11.9     3   21
```

Comet Magnitude Formula (from fit to ALPO and COBS data)

```
m1 = 0.6 + 5 log d +24.7 log r(t-34)
```



Magnitude Measurements Submitted to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                      T         Dia  DC  LENG  PA
   2020T2  2021 09 08.42 xM 10.9 AQ 40.0L 4  59   3.7  6                ICQ XX WYA   Christopher Wyatt
   2020T2  2021 09 06.40 xM 10.9 AQ 25.0L 5  40   3.9  5                ICQ XX WYA   Christopher Wyatt
```

C/2020 T2 (PANSTARRS) peaked between magnitude 9.5 and 10.0 brightness in July. Though some months after perihelion, it has only faded by a magnitude or two. Chris Wyatt visually observed PANSTARRS on September 6 and 8 at magnitude 10.9 on both dates. Aperture correction yielded a brightness of 10.4 on the 6th and 10.1 on the 8th. The different amount of aperture correction was due to Chris using a 0.25-m (10") reflector

on one night and a 0.40-m (16”) on another. The larger aperture instrument requiring a larger aperture correction. Both observations found a moderately condensed (DC = 5-6) 3.7’ to 3.9’ coma. Michael Lehmann reported an imaging observation to the COBS site on September 15th which found the comet at magnitude 10.9 with a 7.5’ coma.

C/2020 T2 should fade by another magnitude during October. Due to the comet’s location in Scorpius (Oct 1-17) and Ophiuchus (17-31), it will be well-placed for southern hemisphere observers, but a rather low object for northern observers.

Photo Op Alert: C/2020 T2 will pass in front of the photogenic nebulosity of the Antares/Rho Ophiuchi area during the first week of October. Later in the month on the 27th, it will pass within 20-25’ of 9th mag globular cluster NGC 6304.

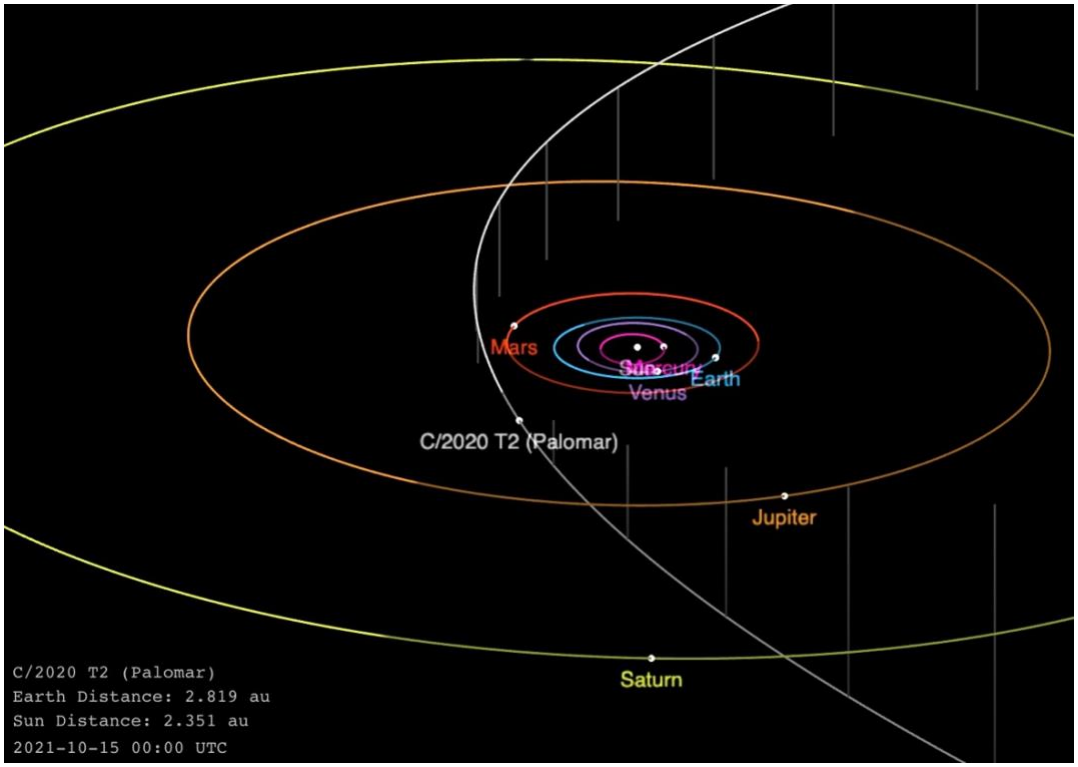


Figure 7 - Orbit of C/2020 T2 (Palomar) for mid-September. Made with the JPL Small-Body Browser.

4P/Faye

Discovered visually on 1843 November 23 by the Herve Faye

Orbit (from Syuichi Nakano, Nakano Note NK 4500)

```
  4P/Faye
Epoch 2021 Sept. 23.0 TT = JDT 2459480.5
T 2021 Sept. 8.83079 TT                                  Nakano
q   1.6188553            (2000.0)            P             Q
n   0.13183220     Peri.  206.99673     +0.76783984     -0.63988277
a   3.8234467      Node   192.93148     +0.61006246     +0.74517843
e   0.5765979      Incl.    8.00830     +0.19556526     +0.18777418
P   7.48
From 4264 observations 2006 Aug.-2021, mean residual 0".76.
  Nongravitational parameters A1 = +0.64 +/- 0.01, A2 = -0.0389 +/- 0.0003.
  The comet has passed 0.63 AU from Jupiter on 2018 Mar. 7 UT.
```

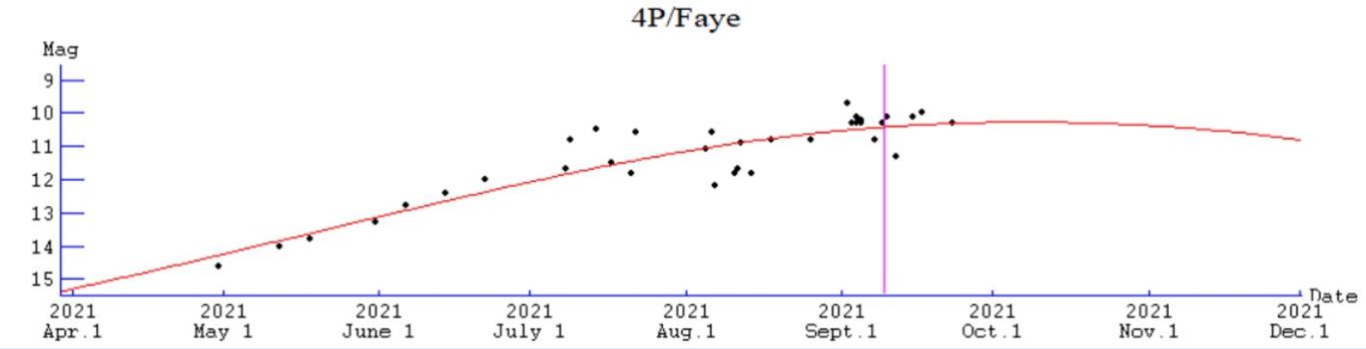
Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

4P/Faye

Date	R.A.	Decl.	r	d	Elong	Const	Mag	Max El (deg) 40N	40S
2021-Sep-01	04 48	+18 49	1.621	1.352	85M	Tau	10.8	54	29
2021-Sep-06	05 01	+18 36	1.619	1.318	87M	Tau	10.7	56	29
2021-Sep-11	05 14	+18 17	1.619	1.285	89M	Tau	10.7	58	29
2021-Sep-16	05 26	+17 54	1.620	1.254	90M	Tau	10.6	60	29
2021-Sep-21	05 38	+17 25	1.623	1.224	93M	Tau	10.6	61	30
2021-Sep-26	05 49	+16 52	1.628	1.194	95M	Ori	10.6	62	30
2021-Oct-01	06 00	+16 14	1.634	1.166	97M	Ori	10.6	63	31
2021-Oct-06	06 10	+15 34	1.642	1.139	100M	Ori	10.6	64	32

Comet Magnitude Formula (from fit to ALPO and COBS data)

$$m1 = 5.4 + 5 \log d + 21.3 \log r$$



Recent Magnitude Measurements Contributed to the ALPO Comets Section

Recent Magnitude Measurements in ICQ format:

Comet Des	YYYY MM DD.DD (UT)	Mag	SC	APER	FL	POW	COMA Dia	COMA DC	TAIL LENG	TAIL PA	ICQ CODE	Observer Name
4	2021 09 17.13	S 10.3	TK	20.3T10		77	5	3			ICQ XX GON05	J J Gonzalez Suarez
4	2021 09 11.75	xM 11.9	AQ	40.0L	4	108	1.1	6	5.2m	267	ICQ XX WYA	Christopher Wyatt
4	2021 09 10.01	S 10.5	TI	29.8L	4	108	2.1	2/			ICQ XX HAR11	Christian Harder
4	2021 09 09.04	S 10.4	TK	32.0L	5	43		6	0.05	236	PIL01	Uwe Pilz
4	2021 09 07.74	xM 11.4	AQ	40.0L	4	108	1.2	6	5.0m	267	ICQ XX WYA	Christopher Wyatt
4	2021 09 05.03	S 10.5	TK	20.3T10		77	4	3			ICQ XX GON05	J J Gonzalez Suarez
4	2021 09 04.99	S 10.7	TI	29.8L	4	108	1.8	4			ICQ XX HAR11	Christian Harder
4	2021 09 04.00	S 10.7	TI	29.8L	4	108	1.8	3			ICQ XX HAR11	Christian Harder
4	2021 09 02.02	S 11.2	TI	29.8B	4	108	1.2	4			ICQ XX HAR11	Christian Harder

4P/Faye was a visual discovery by Herve Faye (Royal Observatory, Paris, France) on 1843 November 23. The comet was abnormally bright and reported to be visible to the naked eye only days after discovery. Since then, it has only peaked at 9th magnitude even during its best returns (as in 1991 and 2006).

This year's apparition is Faye's 22nd observed return with the comet having been missed at its 1903 and 1918 returns. 2021 is a moderately good, but not great, apparition with perihelion on 2021 September 8 at 1.62 au. October should see Faye at its brightest at around magnitude 10.6. Even though perihelion was a month ago, the comet will continue to move closer to the Earth until December 5 (0.94 au). As a result, it will stay close to maximum brightness through November.

Visual observations submitted by J. J. Gonzalez, Christian Harder, Uwe Pilz, and Chris Wyatt found Faye to be a moderately condensed object with a coma diameter between 1.2' and 5'. Pilz and Wyatt reported a tail up to 5' in length. The tail is a major feature in images taken of Faye. Images continue to show an asymmetric coma with a persistent anti-sunward jet-like feature.

Faye is a morning object observable from both hemispheres as its moves through Orion (Oct 1-13), Gemini (13-30), and Monoceros (30-31).

Photo Op: Faye passes in front of the large emission nebula Sh2-261 on October 3-5. Sh2-261 is located in the club of Orion. [Editor's Note: I mistakenly called this nebula to the Rosette Nebula in last month's Comet News. Embarrassing!].

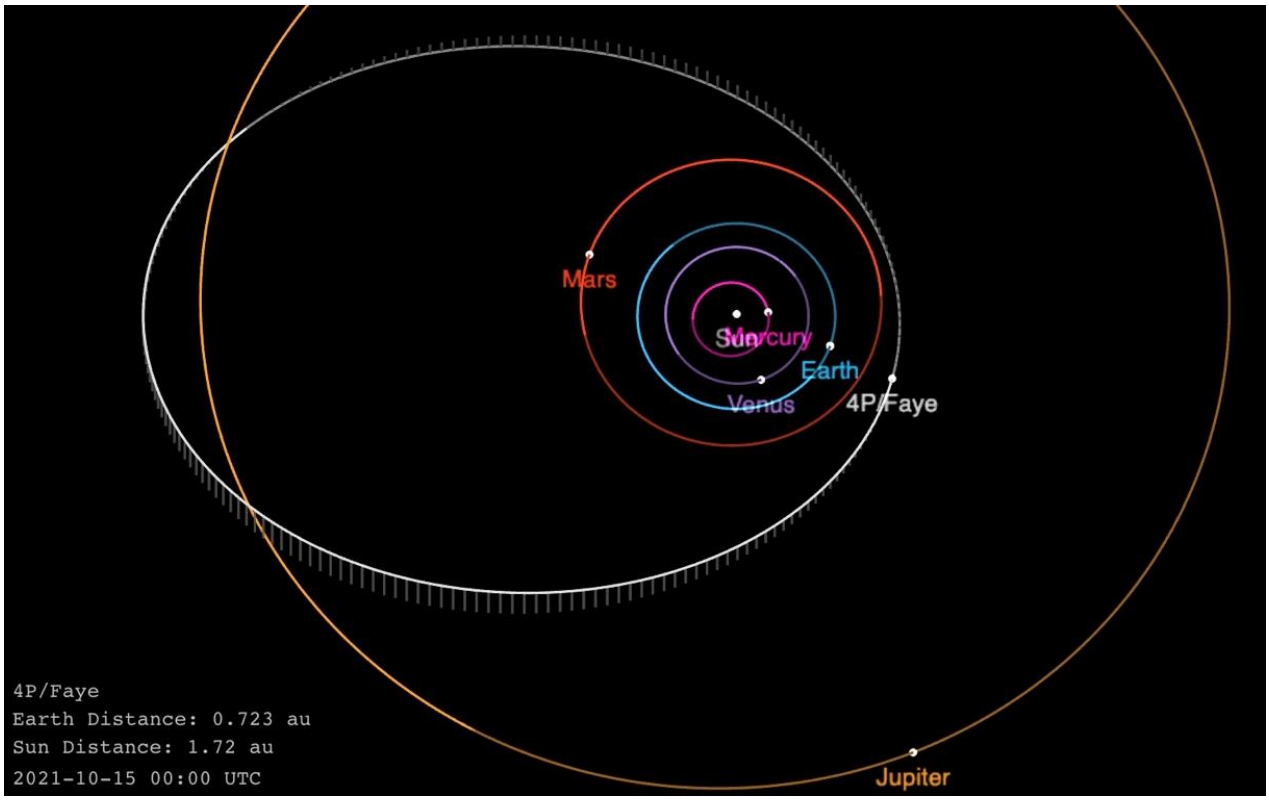


Figure 8 - Orbit of 4P/Faye from the JPL Small-Body Browser.

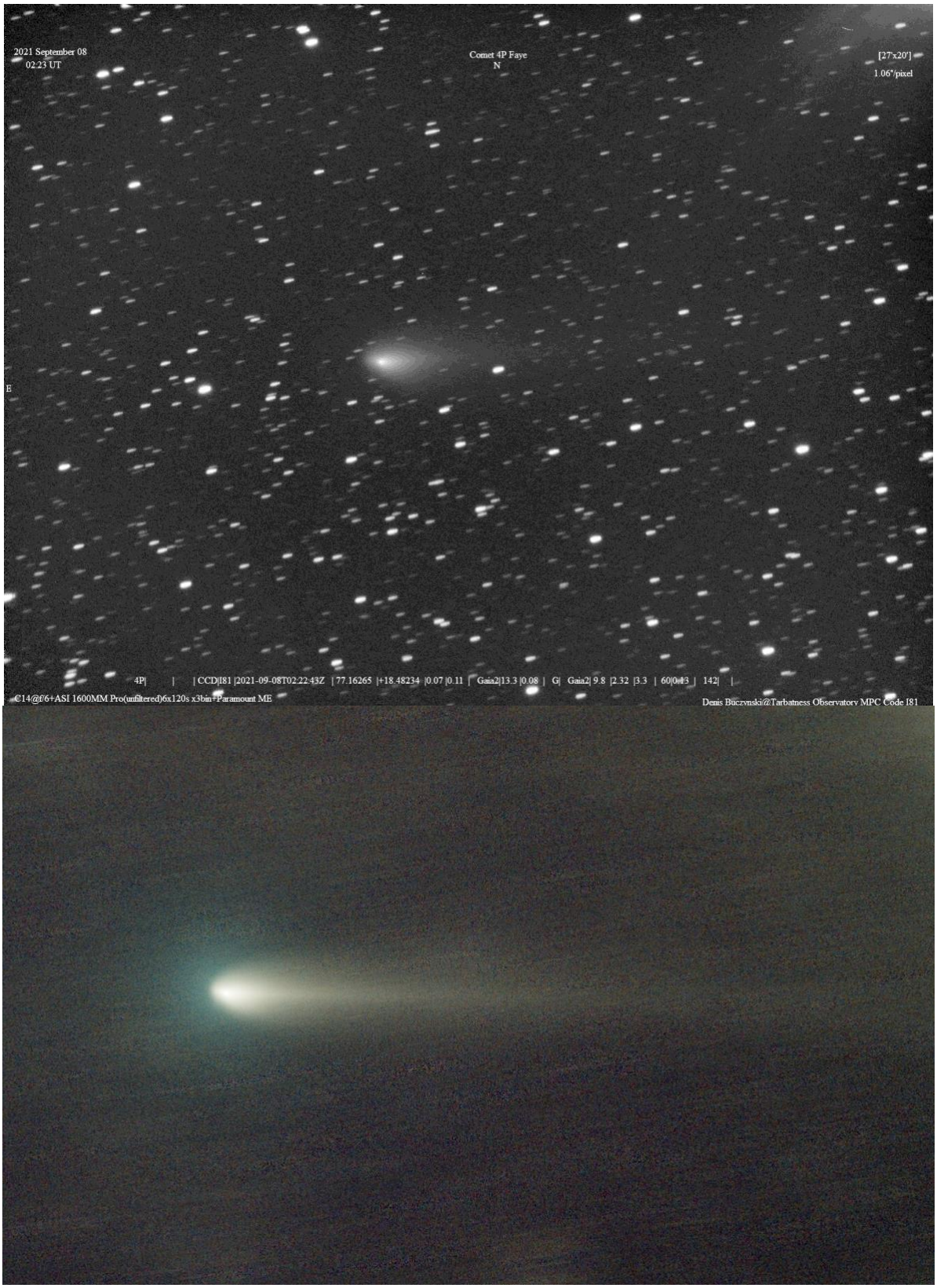


Figure 9 – Two images of 4P/Faye from the same night, 2021 September 8. Top: Image by Denis Buczynski with a C14 f/6 and ASI 1600MM Pro camera (6x120s exposure). Bottom: Color image by Dan Bartlett with a RASA11 and ASI2600MC-P camera (65x120s exposure).

6P/d'Arrest

Discovered on 1851 June 28 by the Heinrich Ludwig d'Arrest

Orbit (from Syuichi Nakano, Nakano Note NK 4445)

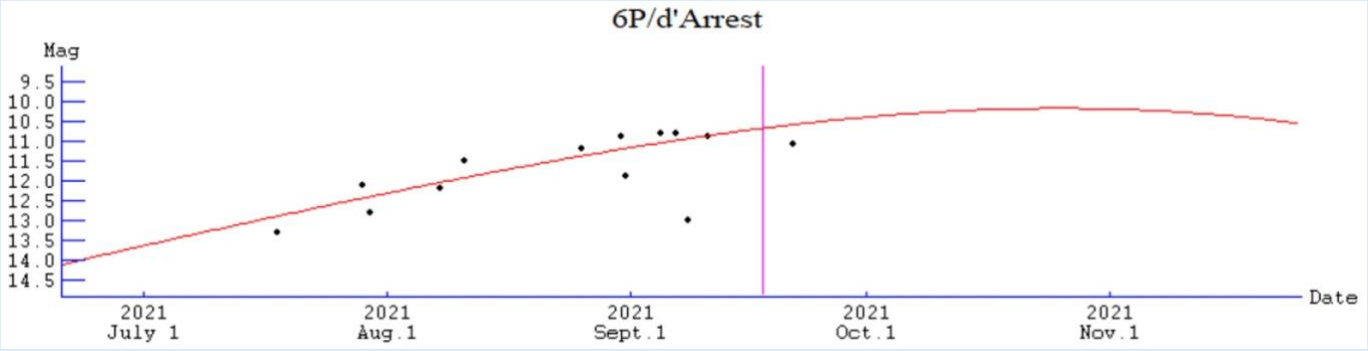
```
  6P/d'Arrest
Epoch 2021 Sept. 23.0 TT = JDT 2459480.5
T 2021 Sept. 17.78204 TT                                  Nakano
q   1.3546116            (2000.0)            P              Q
n   0.15061475     Peri.  178.10208     +0.73305041     +0.64381249
a   3.4985739      Node   138.93551     -0.62836543     +0.76449697
e   0.6128103      Incl.   19.51238     -0.26037278     -0.03240149
P   6.54
From 1865 observations 2008-2021, mean residual 0".66.
  Nongravitational parameters A1 = +0.35 +/- 0.01, A2 = +0.1180 +/- 0.0005.
  The comet has made 21 appearances since AD 1678 (IAUC 5283).
  Comet will pass 0.97 AU from Jupiter on 2039 Apr. 1 UT.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
6P/d'Arrest                                                          Max El
                                                                     (deg)
    Date       R.A.    Decl.      r        d     Elong  Const  Mag   40N  40S
2021-Oct-01  18 43   -27 25    1.363    0.892     91E    Sgr  10.4    21   68
2021-Oct-06  19 02   -28 51    1.371    0.920     91E    Sgr  10.3    20   68
2021-Oct-11  19 21   -30 00    1.381    0.951     90E    Sgr  10.3    19   67
2021-Oct-16  19 41   -30 52    1.393    0.985     89E    Sgr  10.2    19   66
2021-Oct-21  20 01   -31 26    1.408    1.022     88E    Sgr  10.2    18   65
2021-Oct-26  20 20   -31 44    1.424    1.061     87E    Sgr  10.2    18   64
2021-Oct-31  20 40   -31 47    1.443    1.103     86E    Mic  10.2    18   62
2021-Nov-05  20 59   -31 35    1.463    1.148     85E    Mic  10.2    18   60
```

Comet Magnitude Formula (from fit to ALPO and COBS data, seasonal offset fixed at T+60 days)

```
m1 = 6.6 + 5 log d + 24.8 log r(t-60)
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                    T         Dia  DC  LENG  PA
  6        2021 09 08.44 xM 13.6 AQ 40.0L 4 261   0.8  2           ICQ XX WYA   Christopher Wyatt
  6        2021 09 04.85  S 11.1 TK 20.3T10 100   5    2           ICQ XX GON05 J J Gonzalez Suarez
```

Heinrich Louis d'Arrest discovered 6P visually in June 1851. We now know that it had also been observed by Phillipe la Hire in 1678. Long-time comet watchers may remember this comet's excellent apparition in 1976 when it passed 0.15 au from Earth and reached 5th magnitude. d'Arrest's perihelion distance is larger now (1.35 au) so such close approaches are no longer possible. This year, closest approach to Earth was on August 2 at 0.75 au and perihelion on September 17.

d’Arrest usually possesses an asymmetrical lightcurve with respect to perihelion. In d’Arrest’s case, it means the comet is at its brightest nearly a month after perihelion. If this is true this return, it should peak in brightness this month at around magnitude 10.2. Last month we received magnitude estimates from Chris Wyatt, original mag 13.6, aperture corrected mag 13.0, on September 8 and J. J. Gonzalez, original mag 11.1, aperture corrected mag on 10.8, on September 8. COBS CCD observations by Michael Lehmann are more in line with the brightness reported by Gonzalez. The difference in brightness may be a function of the observed coma diameter. Gonzalez and Lehmann reported coma diameters on the order of 5’ while Wyatt saw a much smaller coma (0.8’).

d’Arrest should peak in brightness later this month at around magnitude 10.2 as it moves through the evening constellations of Sagittarius (Oct 1-27) and Microscopium (27-31).

Photo Op Alert: 6P passes within 10’ of bright globular cluster M55 on October 15 and within 10’ of 11th mag galaxy NGC 6925 on the 29th.

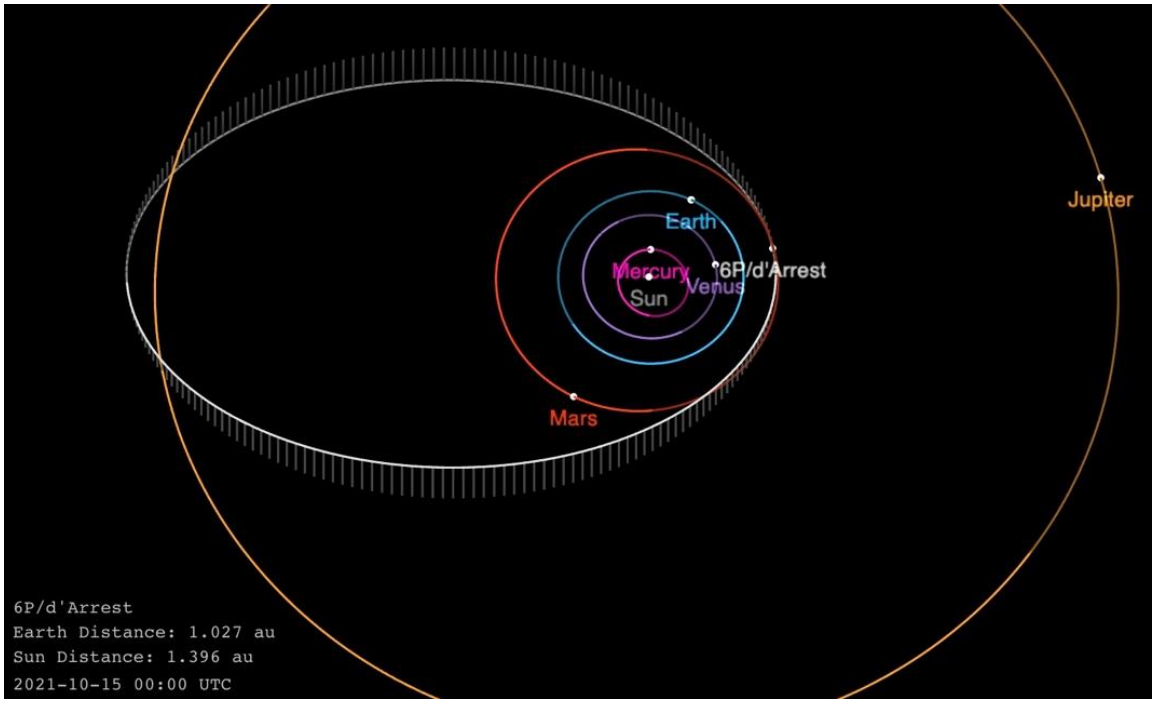


Figure 10 - Orbit of 6P/d'Arrest from JPL Small-Body Browser.

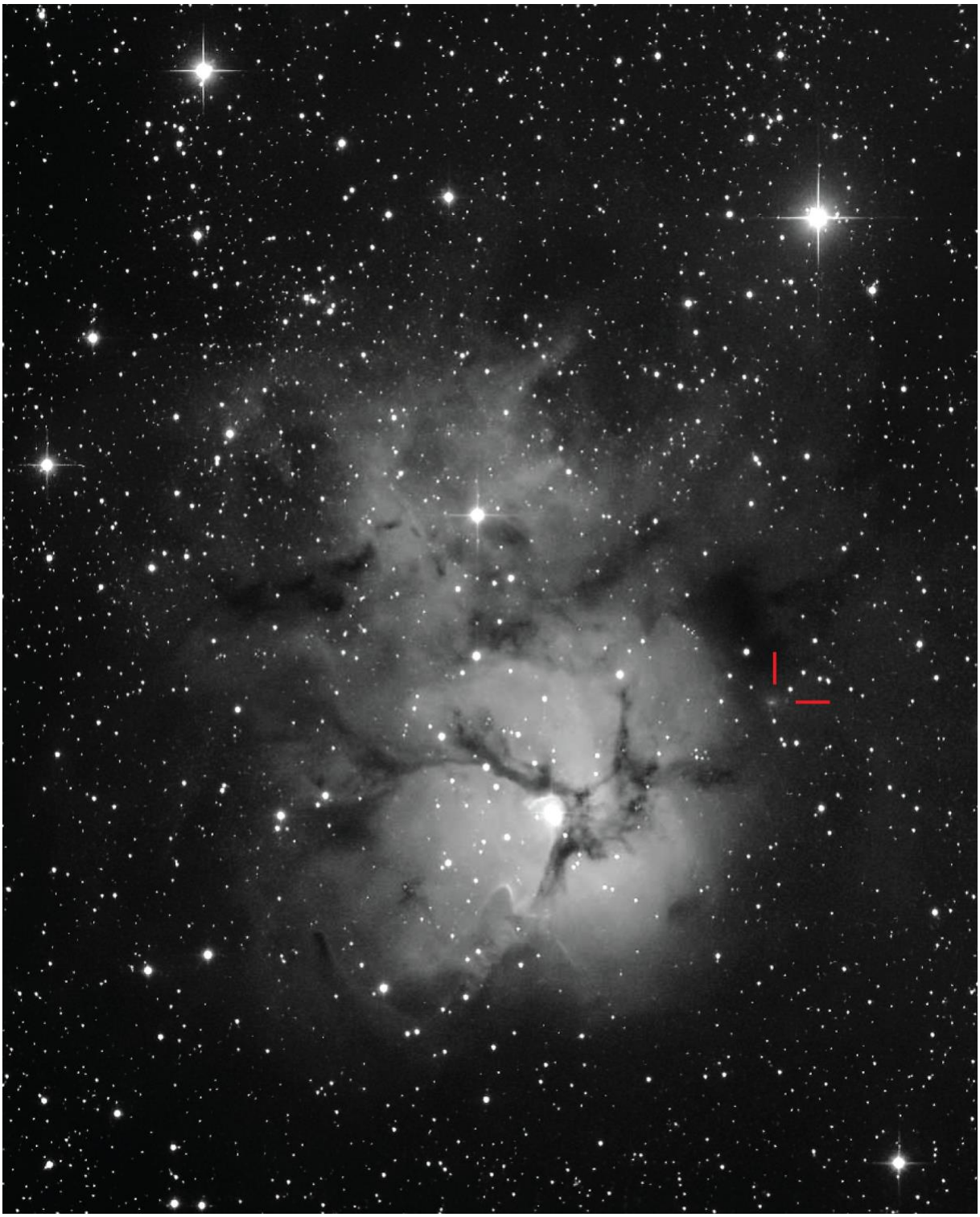


Figure 11 -Though this image adorns the cover of this month's Comet News, I thought it was worth placing here at a slightly larger scale.

19P/Borrelly

Discovered 1904 December 28 by the Alphonse Borrelly
Short-period comet with orbital period of ~6.85 years

Orbit (from Minor Planet Center, MPEC 2021-S45)

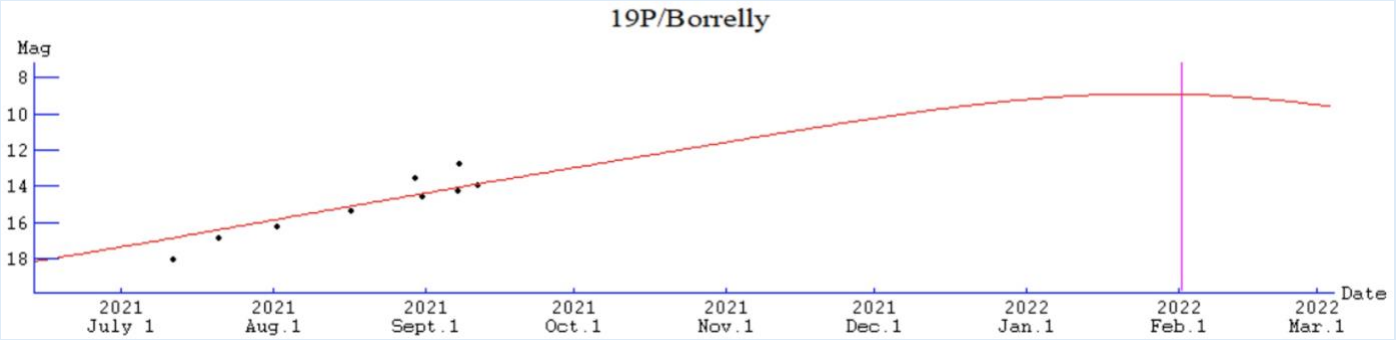
```
  19P/Borrelly
Epoch 2022 Jan. 21.0 TT = JDT 2459600.5
T 2022 Feb. 2.01452 TT                                  Rudenko
q   1.3064503            (2000.0)            P             Q
n   0.14398101     Peri.  351.91587     +0.38679938     -0.79274184
a   3.6052266      Node    74.24796     +0.87108982     +0.14643746
e   0.6376232      Incl.   29.30738     +0.30263636     +0.59170638
P   6.85
From 1655 observations 2000 May 2-2017 Mar. 30, mean residual 1".3.
     Nongravitational parameters A1 = +0.20, A2 = -0.0380.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
19P/Borrelly                                                          Max El
                                                                       (deg)
    Date      R.A.    Decl.     r       d     Elong  Const  Mag    40N  40S
2021-Oct-01  23 29  -58 49   1.910   1.235   116E   Tuc  13.0      0   71
2021-Oct-06  23 21  -58 23   1.873   1.225   114E   Tuc  12.8      0   72
2021-Oct-11  23 15  -57 41   1.837   1.216   111E   Tuc  12.5      0   72
2021-Oct-16  23 10  -56 43   1.801   1.209   109E   Tuc  12.3      0   73
2021-Oct-21  23 07  -55 31   1.765   1.203   106E   Gru  12.1      0   75
2021-Oct-26  23 04  -54 04   1.730   1.198   103E   Gru  11.8      0   76
2021-Oct-31  23 04  -52 25   1.696   1.194   101E   Gru  11.6      0   78
2021-Nov-05  23 04  -50 34   1.662   1.190    98E   Gru  11.4      0   79
```

Comet Magnitude Formula (from Seiichi Yoshida)

```
m1 = 5.5 + 5 log d + 25.0 log r
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                    T         Dia  DC  LENG  PA
 19        2021 09 11.71 xM 14.6 AQ 40.0L 4 182   0.6  6           ICQ XX WYA   Christopher Wyatt
 19        2021 09 08.48 xM 15.0 AQ 40.0L 4 261   0.3  6           ICQ XX WYA   Christopher Wyatt
```

2021 has seen a few low numbered short-period comets come within range of typical backyard telescopes. Tough perihelion isn't till next February 2nd, 19P/Borrelly should become brighter than 10th magnitude this December on its way to a peak around magnitude 9.0.

Alphonse Borrelly discovered 10 comets and 18 Main Belt asteroids from the Marseille Observatory. In addition to his discovery of periodic comet 19P/Borrelly in 1904, Borrelly also discovered C/1873 Q1

(Borrelly), C/1874 O1 (Borrelly), C/1874 X1 (Borrelly), C/1877 C1 (Borrelly), C/1889 X1 (Borrelly), C/1900 O1 (Borrelly-Brooks), C/1903 M1 (Borrelly), C/1909 L1 (Borrelly-Daniel), C/1912 V1 (Borrelly).

The current apparition marks the comet's 16th observed return. 19P's orbit has been stable since discovery with perihelion staying between 1.30 and 1.46 au (this year it is at 1.31 au so nearly as close as it's been since discovery). The comet approached within 1 au of Earth during its first 4 observed returns (1904, 1911, 1918 and 1925) and peaked between 8th and 10th magnitude. There was a stretch of 6 perihelion passages between 1938 and 1974 when the comet arrived at perihelion almost directly behind the Sun at ~2.3 to 2.5 au from Earth. Returns in 1987 and 1994 were much better with approaches to 0.48 and 0.62 au of Earth and peaks at magnitude 7 and 7.5, respectively. 2022 starts a new cycle of good apparitions. Though still a distant 1.18 au from Earth at its closest this time around, it will come closer in 2028 (0.41 au) and 2035 (0.62 au). The 2028 will be Borrelly's best observed return.

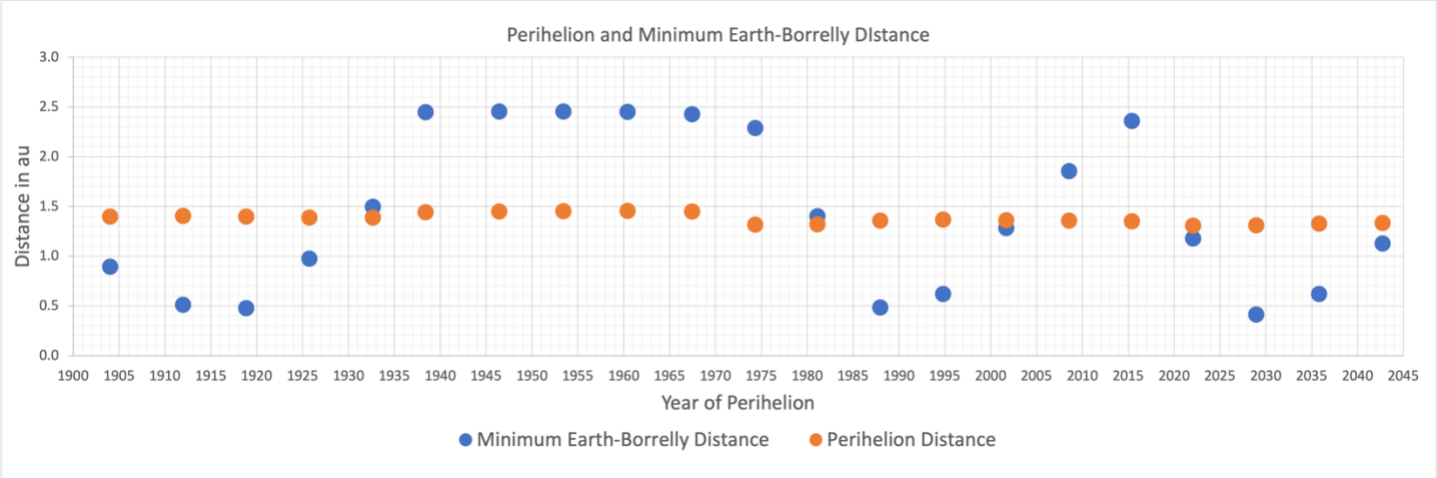


Figure 12 - Perihelion and minimum Earth-comet distances for 19P/Borrelly between 1904 and 2042.

October sees 19P limited to observers in the southern hemisphere as it moves through the southern constellations of Tucana (Oct 1-17) and Grus (17-31). It should begin the month around magnitude 13.0 and end the month close to 11.5. A peak brightness of magnitude 9 or so should be reached in January and February.

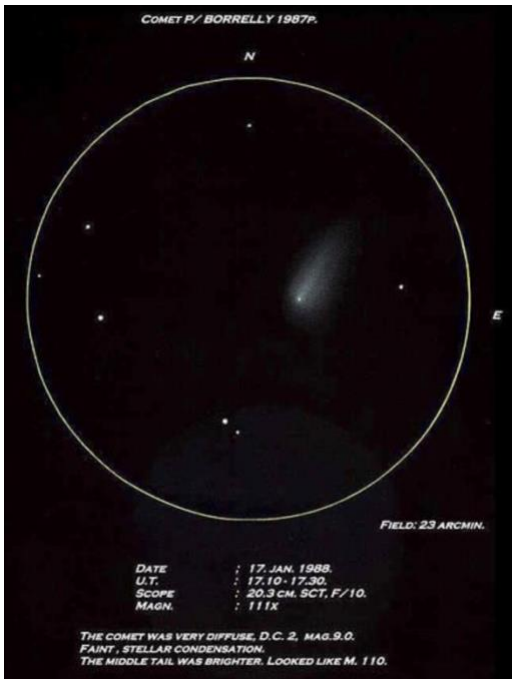


Figure 13 - Per-Jonny Bremseth sketched 19P/Borrelly with a 0.2-m SCT back in January 1988.

29P/Schwassmann-Wachmann

Discovered 1927 November 15 by the Arnold Schwassmann and Arno Arthur Wachmann at the Hamburg Observatory in Bergedorf, Germany
Centaur comet with orbital period of ~14.8 years

Orbit (from Minor Planet Center, MPEC 2021-S45)

```
  29P/Schwassmann-Wachmann
Epoch 2021 July 5.0 TT = JDT 2459400.5
T 2019 Mar. 26.66253 TT                                  Rudenko
q   5.7691447            (2000.0)            P              Q
n   0.06642072     Peri.   49.15125     +0.99219414     -0.03308628
a   6.0385641      Node   312.37551     -0.03076331     +0.86941959
e   0.0446165      Incl.    9.36679     +0.12084872     +0.49296539
P  14.8
From 9998 observations 2018 June 18-2021 Aug. 11, mean residual 0".6.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

29P/Schwassmann-Wachmann

Date	R.A.	Decl.	r	d	Elong	Const	Mag	Max El (deg) 40N	40S
2021-Oct-01	04 57	+31 53	5.918	5.488	110M	Aur		82	18
2021-Oct-06	04 57	+31 59	5.919	5.417	115M	Aur		82	18
2021-Oct-11	04 57	+32 04	5.921	5.350	120M	Aur		82	18
2021-Oct-16	04 56	+32 08	5.922	5.286	125M	Aur		82	18
2021-Oct-21	04 55	+32 11	5.923	5.227	130M	Aur		82	18
2021-Oct-26	04 54	+32 14	5.925	5.172	135M	Aur		82	18
2021-Oct-31	04 52	+32 15	5.926	5.123	140M	Aur		82	18
2021-Nov-05	04 50	+32 16	5.928	5.079	146M	Aur		82	18

Comet Magnitude Formula

None, due to frequent outbursts.

Recent Magnitude Measurements Contributed to the ALPO Comets Section

Recent Magnitude Measurements in ICQ format:

Comet Des	YYYY MM DD.DD (UT)	Mag	SC	APER	FL	POW	COMA Dia	COMA DC	TAIL LENG	TAIL PA	ICQ CODE	Observer Name
29	2021 09 28.93	I 11.2	TK	20.3T10		77		8			ICQ XX GON05	Juan Jose Gonzalez Suarez
29	2021 09 17.10	S 12.9	AQ	20.3T10		166	1.5	3			ICQ XX GON05	Juan Jose Gonzalez Suarez
29	2021 09 11.76	xS 14.8	AQ	40.0L	4	182	0.4	2/			ICQ XX WYA	Christopher Wyatt

29P/Schwassmann-Wachmann was discovered photographically on 1927 November 15 by German observing team Arnold Schwassmann and Arno Arthur Wachmann. The duo discovered 4 comets together, three short-period comets (29P/Schwassmann-Wachmann, 31P/Schwassmann-Wachmann, and 73P/Schwassmann-Wachmann) and a long-period comet shared with Leslie Peltier [C/1930 D1 (Peltier-Schwassmann-Wachmann)].

29P is one of the more enigmatic comets. It is always active and rarely fainter than 17th-18th magnitude. Multiple times per year outbursts occur resulting in a peak brightness that can reach 10th magnitude though most peaks fall in the 11th to 14th magnitude range. Richard Miles (Director of the British Astronomical Society's Asteroids and Remote Planets Section) has published a series of papers on 29P and its outbursts. He found that as many as 6 active areas are producing outbursts on a nucleus with a rotation period of ~57-58 days.
29P is also considered a member of the Centaur population. Different organizations have different definitions for what constitutes a member of the Centaurs. The two most common definitions are from the Minor Planet Center (perihelion beyond the orbit of Jupiter and semi-major axis within the orbit of Neptune) and the Jet Propulsion Laboratory (semi-major axis between the orbits of Jupiter and Neptune). Both definitions would classify 29P as a Centaur.

29P has experienced a rare quadruple outburst on the nights of September 25 and 27. As a result, visual observations reported to the COBS site are reporting the comet to be as bright as magnitude 10.7. The comet is a morning object in Auriga and observable from both hemispheres. If you observe 29P, please consider contributing to two pro-am efforts to better understand this object: the British Astronomical Society's (BAA) Mission 29P monitoring program coordinated by Richard Miles. (https://britastro.org/node/18562 & https://britastro.org/node/25120) and the University of Maryland's 29P Observation campaign (https://wirtanen.astro.umd.edu/29P/29P_obs.shtml).

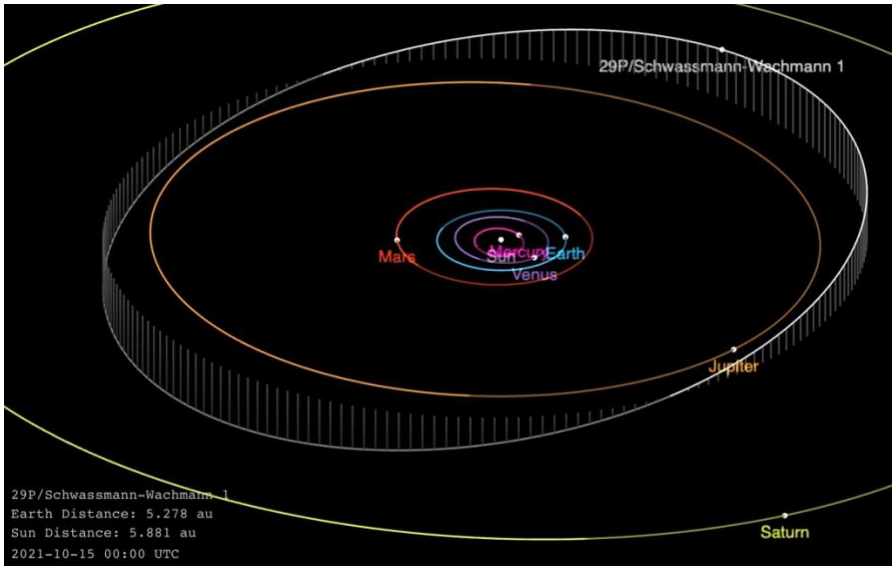


Figure 14 - Orbit of 29P from the JPL Small-Body Browser.

Figure 15 - A very condensed 29P as imaged by Martin Mobberley on 2021 October 3 with an iTelescopes 0.51-m f/4.5 CDK.

C/2017 K2 (PANSTARRS)

Discovered 2017 May 21 by the Pan-STARRS survey with the Pan-STARRS1 1.8-m on Haleakala
Dynamically old long-period comet

Orbit (from Syuichi Nakano, Nakano Note NK 4448)

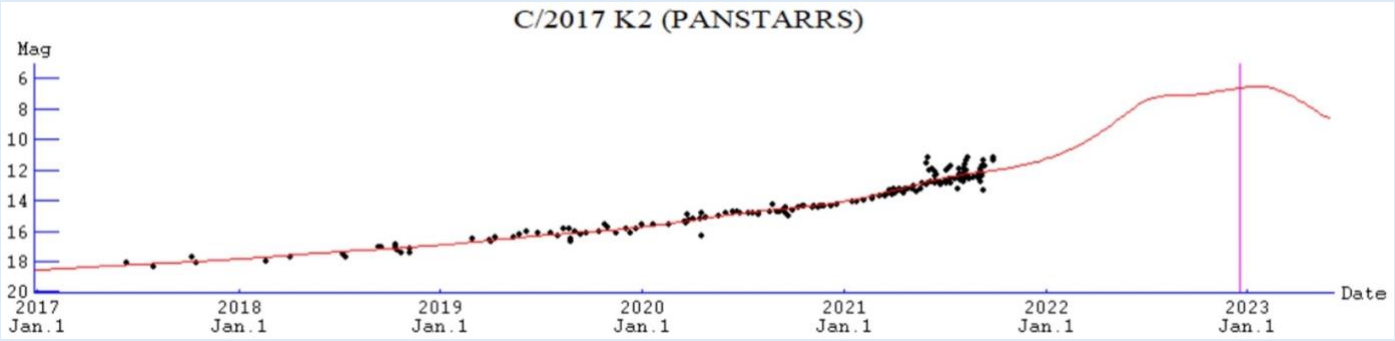
```
   C/2017 K2 (PANSTARRS)
Epoch 2022 Dec. 7.0 TT = JDT 2459920.5
T 2022 Dec. 19.67178 TT                                  Nakano
q   1.7969443           (2000.0)            P              Q
z  -0.0004734      Peri.  236.19715     +0.01818315     +0.04923207
 +/-0.0000004      Node    88.23537     -0.18094861     +0.98245608
e   1.0008506      Incl.   87.56309     -0.98332445     -0.17987844
From 4213 observations 2013 May 12-2021 May 3, mean residual 0".44.
  (1/a)org.= +0.000028, (1/a)fut.= +0.001121 (+/-0.000000), Q= 9.
  The comet will pass 2.66 AU from Jupiter on 2024 Oct. 15 and
  7.88 AU from Uranus on 2029 Oct. 16 UT.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
C/2017 K2 (PANSTARRS)                                                  Max El
                                                                       (deg)
    Date      R.A.    Decl.     r       d     Elong  Const  Mag    40N  40S
2021-Oct-01  16 59  +26 25   5.204   5.430    71E    Her   12.0     53   10
2021-Oct-06  17 01  +25 26   5.160   5.437    68E    Her   12.0     50    7
2021-Oct-11  17 02  +24 27   5.117   5.443    65E    Her   12.0     48    5
2021-Oct-16  17 05  +23 30   5.074   5.448    63E    Her   11.9     45    1
2021-Oct-21  17 07  +22 35   5.030   5.450    60E    Her   11.9     43    0
2021-Oct-26  17 09  +21 42   4.987   5.451    57E    Her   11.9     40    0
2021-Oct-31  17 12  +20 50   4.943   5.449    54E    Her   11.8     37    0
2021-Nov-05  17 15  +20 01   4.899   5.444    52E    Her   11.8     35    0
```

Comet Magnitude Formula (from ALPO and COBS data)

```
m1 =  2.6 + 5 log d + 8.0 log r
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                      T         Dia  DC  LENG  PA
   2017K2  2021 09 28.85  S 11.7 TK 20.3T10 133   2.2  4           ICQ XX GON05 Juan Jose Gonzalez Suarez
   2017K2  2021 09 28.81  S 11.6 TI 29.8L 4 108   1.5  3/          ICQ XX HAR11 Christian Harder
   2017K2  2021 09 12.90  S 12.2 TI 29.8L 4 108   1.5  3           ICQ XX HAR11 Christian Harder
   2017K2  2021 09 10.15  V 13.3 U4 10.6R 5a600   1.4       1.2m 20 ICQ xx HER02 Carl Hergenrother
   2017K2  2021 09 09.85  S 11.8 TI 29.8L 4  92   2    3           ICQ XX HAR11 Christian Harder
   2017K2  2021 09 08.86  S 12.2 TI 29.8L 4 108   1.5  3           ICQ XX HAR11 Christian Harder
   2017K2  2021 09 08.40 xM 12.3 AQ 40.0L 4 182   1.5  5/          ICQ XX WYA   Chris Wyatt
   2017K2  2021 09 06.41 xM 12.8 AQ 25.0L 5 125   1.2  4/          ICQ XX WYA   Chris Wyatt
   2017K2  2021 09 04.92  S 12.2 AQ 20.3T10 133   1.5  4/          ICQ XX GON05 Juan Jose Gonzalez Suarez
   2017K2  2021 09 04.86  S 12.5 TI 29.8L 4 132   1.4  3           ICQ XX HAR11 Christian Harder
   2017K2  2021 09 03.88  S 12.9 TI 29.8L 4 108   1.2  3           ICQ XX HAR11 Christian Harder
```

C/2017 K2 (PANSTARRS) was discovered on 2017 May 21 by the Pan-STARRS1 1.8-m telescope at Haleakala on the Hawaiian island of Maui. At discovery the comet was around 21st magnitude and located at 16.1 au from the Sun. Pre-discovery observations were found back to May of 2013 when the comet was 23.7 au from the Sun. For comparison Uranus has a semi-major axis of 19.2 au.

C/2017 K2 (PANSTARRS) is over a year from its 2022 December 19 perihelion at 1.80 au when it should reach 6-7th magnitude. Several visual observations were made in September by J. J. Gonzalez, Christian Harder and Chris Wyatt as well as a CCD measurement by Carl Hergenrother. The visual measurements ranged between 11.6 and 12.9 (corrected magnitudes between 11.2 and 12.8). All observers found a small slightly condensed coma of ~1.2-2.2'.

C/2017 K2 is an evening object in Hercules and is better placed for northern observers though it also visible from the southern hemisphere. The comet will continue to slowly brighten throughout the remainder of 2021 and all of 2022.

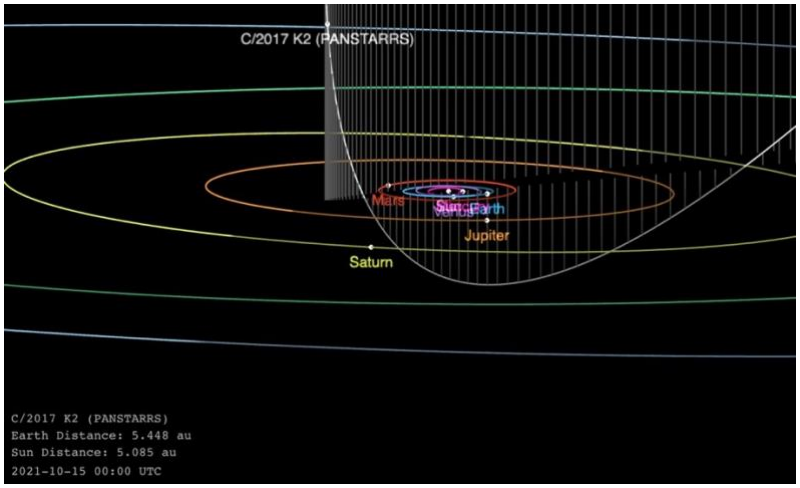


Figure 16 - Orbit of C/2017 K2 (PANSTARRS) from the JPL Small-Body Browser.

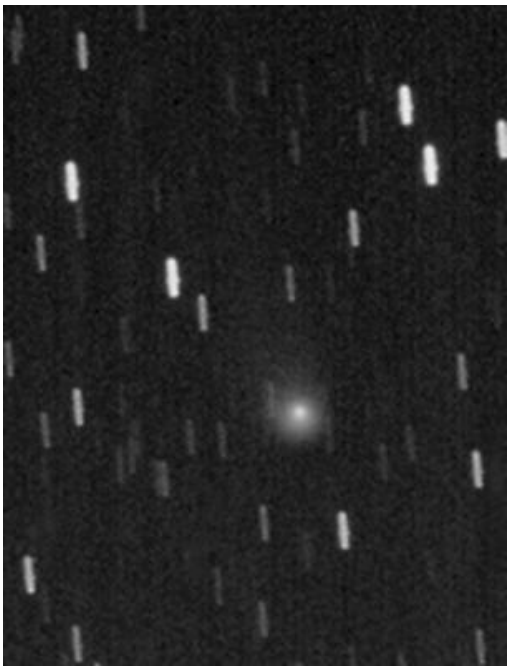


Figure 17 – Gregg Ruppel caught C/2017 K2 (PANSTARRS) glowing faintly around magnitude 12 in Hercules in a cropped luminance 48 minutes total exposure from Dark Sky New Mexico

C/2021 A1 (Leonard)

Discovered 2021 January 3 by Greg Leonard of the Catalina Sky Survey with the 1.5-m on Mount Lemmon
Dynamically old long-period comet

Orbit (from Syuichi Nakano, private email)

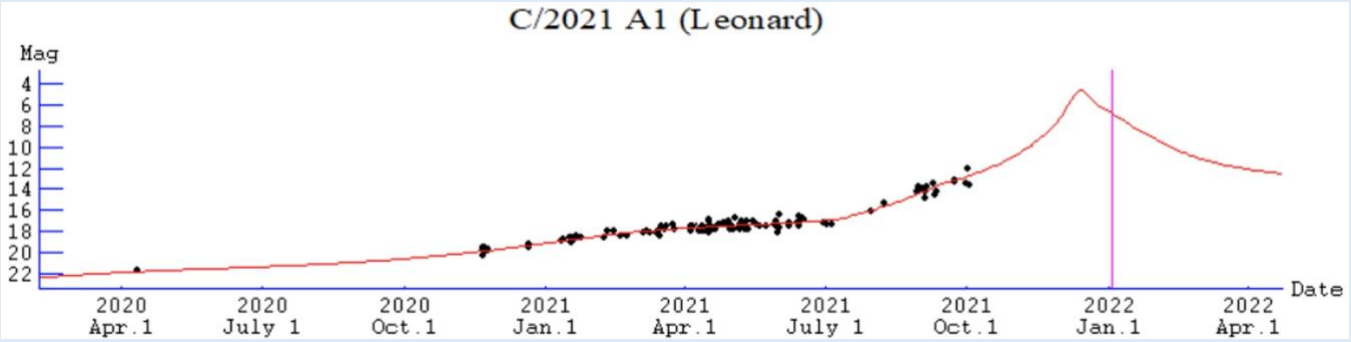
```
   C/2021 A1 (Leonard)
Epoch 2022 Jan. 21.0 TT = JDT 2459600.5
T 2022 Jan. 3.30335 TT                                  Nakano
q   0.6152670            (2000.0)            P             Q
z  -0.0000212      Peri.  225.09253     +0.63774456     +0.29160589
+/-0.0000016       Node   255.89525     +0.72790936     -0.53080844
e   1.0000131      Incl.  132.68634     -0.25185283     -0.79574393
From 1054 observations 2020 Apr. 11-2021 Sept. 29, mean residual 0".54.
  (1/a)org.= +0.000524, (1/a)fut.= -0.000081 (+/-0.000002), Q= 8.
  The comet will pass 0.23 AU from the Earth on 2021 Dec. 12.5 UT.
  Also comet will pass 0.029 AU from Venus on 2021 Dec. 18.0 UT.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
C/2021 A1 (Leonard)                                                  Max El
                                                                     (deg)
    Date      R.A.    Decl.     r       d     Elong  Const  Mag    40N  40S
2021-Oct-01  11 18  +37 43   1.858   2.445    43M    UMa   12.8     21    0
2021-Oct-06  11 23  +37 12   1.784   2.319    46M    UMa   12.5     24    0
2021-Oct-11  11 27  +36 42   1.710   2.187    49M    UMa   12.3     27    0
2021-Oct-16  11 32  +36 14   1.635   2.049    51M    UMa   12.0     31    0
2021-Oct-21  11 38  +35 47   1.560   1.904    54M    UMa   11.6     34    0
2021-Oct-26  11 43  +35 22   1.484   1.753    57M    UMa   11.3     37    0
2021-Oct-31  11 49  +34 57   1.407   1.597    60M    UMa   10.9     40    0
2021-Nov-05  11 56  +34 34   1.330   1.435    63M    UMa   10.5     43    0
```

Comet Magnitude Formula (from ALPO and COBS data)

```
m1 =  7.4 + 5 log d + 11.7 log r [through T-325 days, where T = date of perihelion]
m1 = 11.4 + 5 log d +  5.7 log r [T-325 to T-178 days]
m1 =  5.2 + 5 log d + 18.8 log r [T-178 to T-112 days]
m1 =  8.7 + 5 log d +  8.0 log r [from T-112 days onward]
```



Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
               (UT)                    T         Dia  DC  LENG  PA
None
```

While no comet as spectacular as C/2020 F3 (NEOWISE) is predicted to happen anytime soon, there is hope that C/2021 A1 (Leonard) will at least be a nice binocular or even faint naked eye comet this December. Catalina Sky Survey astronomer Greg Leonard found C/2021 A1 on 2021 January 3 with the Mount Lemmon 1.5-m reflector when the comet was around magnitude 19 and 5.1 au from the Sun at discovery. Pre-discovery

observations from Mount Lemmon and PANSTARRS were found back to April 2020 (when the comet was 7.5 au from the Sun).

An analysis of magnitude estimates submitted to the Minor Planet Center (MPC) in 2020, Comet Observation Database (COBS) and the ALPO in 2021 finds an object that has changed its rate of brightening at least twice already. The 2020 MPC data showed a healthy brightening of 2.5n = 11.7. That rate slowed to dramatically to 2.5n = 5.7 for most of 2021 up till July. A 2.5n = 5 rate means steady state so for the first half of 2021, C/2021 A1 was experiencing little, if any, increase in dust production. Since July, the comet has kicked back into high gear brightening at a 2.5n = 18.8 rate.

So far, all magnitude measurements have been from CCD/CMOS cameras with no visual observations submitted to the COBS site or the ALPO. Hopefully with the comet becoming better placed in the morning sky and brighter, visual observers will be able to measure its brightness. Unfortunately, the comet is located far to the north in Ursa Major and only visible from the northern hemisphere. Southern observers will have to wait till mid-December to catch a glimpse of Leonard.

Assuming a conservative 2.5n ~ 8 brightening rate from here on out would see Leonard around magnitude 13 at the start of October and magnitude 11 at the end of the month. The comet could be even brighter if its recent rapid brightening trend continues. A conservative 2.5n value of 8 would result in a peak brightness around magnitude 4.5 when the comet approaches within 0.233 au from Earth on December 12. With a large phase angle reaching 160 degrees at that time, forward scattering of light by cometary dust may increase Leonard's brightness by an additional 1-3 magnitudes. Working against it are very difficult observing circumstance due to a small solar elongation at the time of maximum brightness (minimum elongation of 15 deg) resulting in the possibility that the comet may be too faint to be seen while so close to the Sun. We should have a much better idea of how bright Leonard is getting by the end of October.

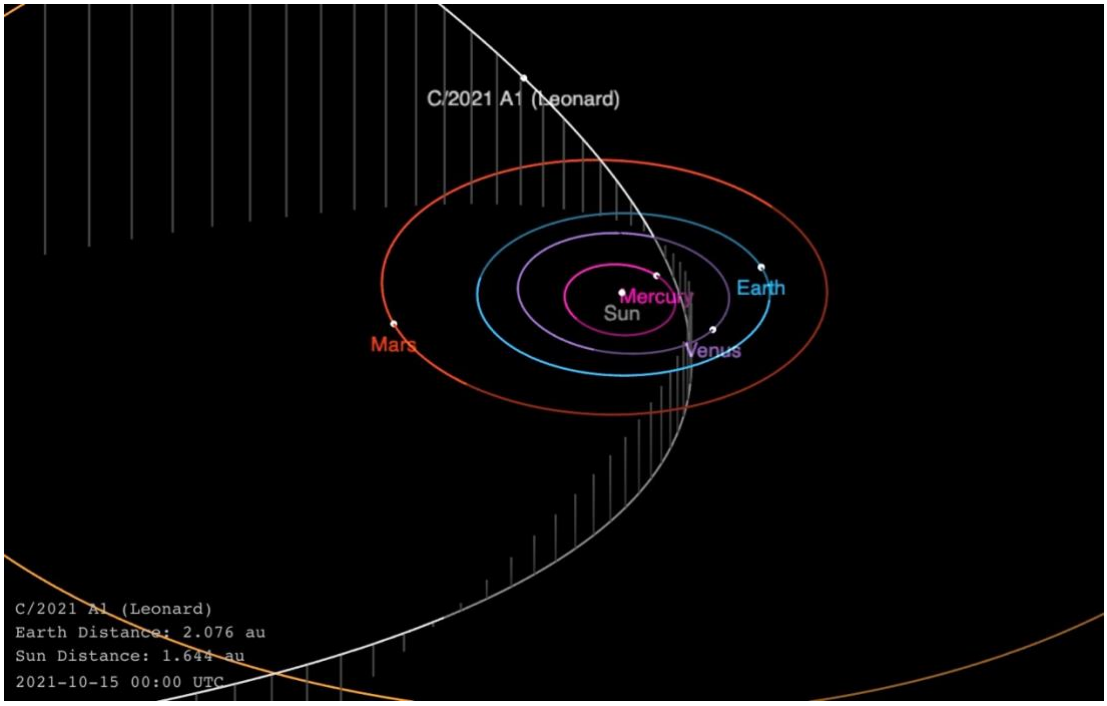


Figure 18 - Orbit of C/2021 A1 (Leonard) from the JPL Small-Body Browser.

Fainter Comets of Interest (Fainter than 13.0)

C/2021 O3 (PANSTARRS)

Discovered 2021 July 26 by Pan-STARRS with the 1.8-m Pan-STARRS1 1.8-m on Haleakala

Orbit (from Syuichi Nakano, private email)

```
   C/2021 O3 (PANSTARRS)
T 2022 Apr. 21.06633 TT                                  Nakano
q   0.2875278            (2000.0)            P               Q
                  Peri.  299.96269     -0.56813846     -0.81232240
                  Node   189.06692     +0.64671103     -0.53970622
e   1.0           Incl.   56.70663     -0.50890425     +0.22101925
From 277 observations 2021 July 26-Sept. 24.
```

Ephemerides (produced with Seiichi Yoshida's Comets for Windows program)

```
C/2021 O3 (PANSTARRS)                                                  Max El
                                                                       (deg)
    Date      R.A.   Decl.     r       d    Elong  Const  Mag    40N  40S
2021-Oct-01  22 25  +22 33   3.527   2.665   144E   Peg  17.6     73   27
2021-Oct-06  22 19  +21 25   3.465   2.631   140E   Peg  17.5     71   29
2021-Oct-11  22 14  +20 13   3.402   2.605   136E   Peg  17.4     70   30
2021-Oct-16  22 10  +18 57   3.338   2.586   132E   Peg  17.4     69   31
2021-Oct-21  22 06  +17 40   3.274   2.573   127E   Peg  17.3     68   32
2021-Oct-26  22 02  +16 22   3.210   2.566   122E   Peg  17.2     66   33
2021-Oct-31  22 00  +15 04   3.145   2.564   117E   Peg  17.1     65   33
2021-Nov-05  21 57  +13 47   3.079   2.567   112E   Peg  17.1     64   33
```

Comet Magnitude Formula (based on data submitted to the COBS and the MPC)

```
m1 = 11.1 + 5 log d + 8 log r
```

Recent Magnitude Measurements Contributed to the ALPO Comets Section

```
Recent Magnitude Measurements in ICQ format:
Comet Des  YYYY MM DD.DD     Mag SC APER FL POW    COMA     TAIL        ICQ CODE Observer Name
              (UT)                    T         Dia  DC  LENG  PA
   2021O3  2021 09 08.27  C 18.7 U4 50.0Y 5A200   0.3              ICQ xx HER02 Carl Hergenrother
```

C/2021 O3 (PANSTARRS) was first seen on July 26 at 19th magnitude by the Pan-STARRS1 1.8-m Ritchey-Chretien on Haleakala. Perihelion will occur on 2022 April 21 at a small distance of 0.29 au from the Sun. C/2021 O3 will experience some of the same observational issues as C/2021 A1 (Leonard). On the plus side, PANSTARRS will reach a relatively large phase angle though not as large as Leonard (only ~136 vs 160 deg). But PANSTARRS will also be located at very small solar elongations near perihelion which will make it a VERY difficult object to observe until a few weeks after perihelion and then only for northern observers. Not helping matters is C/2020 O3's faintness.

C/2021 O3 is currently a 17th magnitude evening object in Pegasus in the evening sky for observers in both hemispheres. Southern hemisphere observers should be able to follow PANSTARRS till the end of the year when the comet could be around 15-16th magnitude. Northern hemisphere observers will be able to follow it for another month or two till mid-February when it could be as bright as 13-14th magnitude. The comet will then spend the next two and a half months within 20 deg of the Sun.

The comet's orbit is aligned in such a way that the comet will be mainly a northern hemisphere object except for a week or so centered on perihelion. On the date of perihelion C/2021 O3 will be an evening object located only 16 deg from the Sun. Northern hemisphere observers (for +40N) will not be able to observe it at that time as it will still be 7 deg below the horizon at the start of nautical twilight. It will be observable from the southern

hemisphere (-40S) when it will be at an elevation of 5 deg at the start of nautical twilight and only 1 deg below the horizon at the start of astronomical twilight. If its rate of brightening is 2.5n ~ 8, it will be at 6-7th magnitude. The combination of faintness and poor placement near the Sun will make observing this comet very difficult. The comet becomes observable in a dark sky (after the end of astronomical twilight) by the first few nights of May. This is around the time of maximum phase angle (135 deg) which may provide a 1-2 magnitude boost in brightness. Still, we are talking about an object that may only be around 4th-6th magnitude and still located ~20 deg from the Sun. Though it will be fading fast, the comet will quickly move north and become circumpolar by mid-May. Note, that this all assumes this apparently intrinsically faint comet survives its close brush with the Sun. Time will tell.

Imagers and photometrists are highly encouraged to observe PANSTARRS over the coming months.

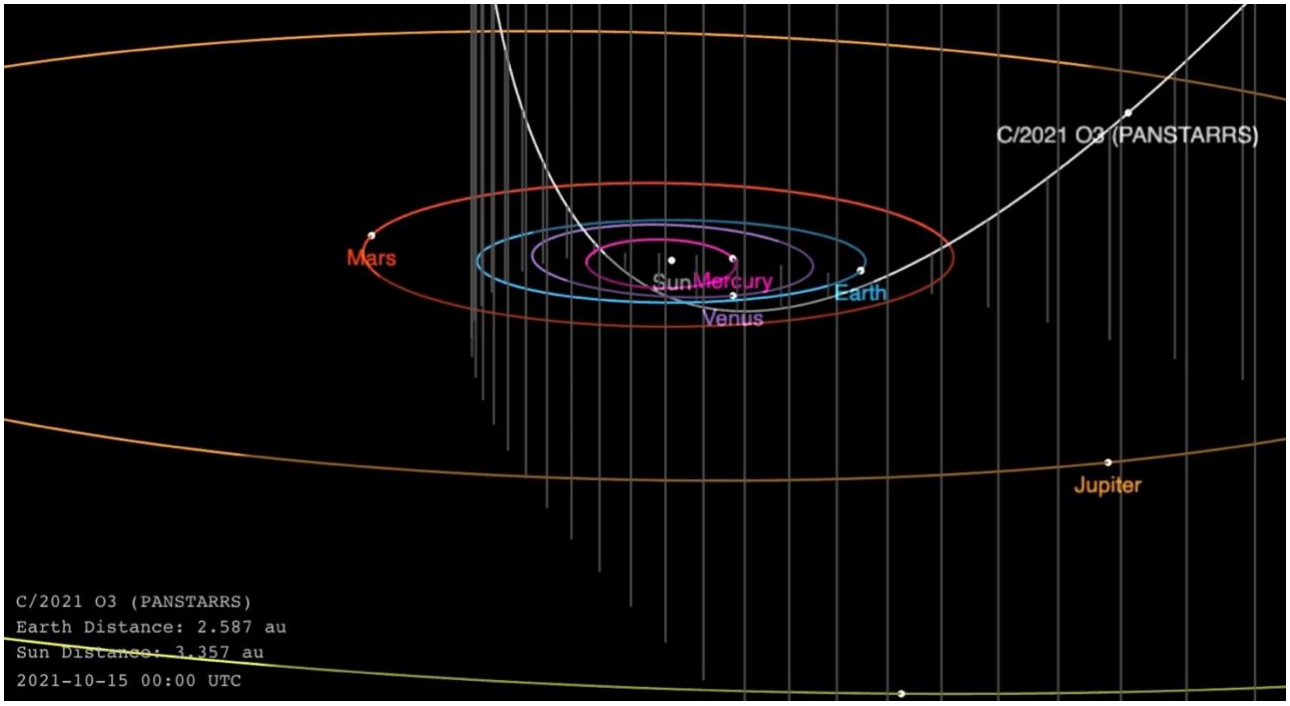


Figure 19 - Orbit of C/2021 O3 (PANSTARRS) from the JPL Small-Body Browser.

New Discoveries, Recoveries and Other Comets News

15P/Finlay – After reaching magnitude 10.0-10.5 in July, short-period comet 15P/Finlay is now fainter than magnitude 13 and fading fast. A mystery surrounding Finlay is its lack of an associated meteor shower even though its orbit that comes within 0.01 au of Earth. CBET 5046 reports the detection of a newly recognized meteor shower on 2021 September 28 and 29 by CAMS video cameras in New Zealand and Chile and the Southern Argentina Agile MEteor Radar Orbital System (SAAMER-OS). A total of 13 meteors were detected though the CAMS team reports that the outburst is ongoing. The observed meteors were released during Finlay's 1995 return. Two additional outbursts are predicted to occur on 2021 October 7 with activity centered at 00:35m UT (from its 2008 perihelion) and 03h55m (from its 2014 perihelion) though peak times could be .

Astronomical Telegram #14947 contains predictions for the 2021 October 6/7 activity from a number of different sources. While ZHR rates of 100s to 1000s are predicted, the shower is expected to consist mainly of meteors fainter than naked eye visibility. Still visual observers are encouraged to try and observe any activity.

The newly found shower is officially called the Arid meteor shower due to its radiant's location at R.A. = 262.7 deg and Dec. = -57.8 deg in the southern constellation of Ara. The far southern radiant should make this a very difficult shower to observe from the northern hemisphere.

P/2021 R6 (Groeller) – Hannes Groeller of the Catalina Sky Survey used the Mount Lemmon 1.5-m to discover a new short-period comet on 2021 September 12 at 20th magnitude. Pre-discovery observations by Pan-STARRS were found from 2021 August 31 and September 4. P/2021 R6 has a 15.72-year orbital period and will arrive at perihelion on Halloween (2021 October 31) at 2.55 au. The comet is not likely to get any brighter. This is the 3rd comet to be named after Groeller. The other two also being short-period comets [P/2019 B2 (Groeller) and P/2019 V2 (Groeller)]. [CBET 5045, MPEC 2021-S113]

P/2021 R5 (Rankin) – Catalina Sky Survey observer David Rankin found his 8th comet (to be named for him) on 2021 September 9. Like P/2021 R6, P/2021 R5 was also discovered with the Mount Lemmon 1.5-m. Pre-discovery observations by Pan-STARRS and Catalina were found back to 2021 June 26. The newest Rankin comet was 19th magnitude at discovery and close to its peak in brightness. Perihelion will be on 2022 January 9 at 3.33 au. [CBET 5035, MPEC 2021-R257]

P/2021 R4 (Wierzchos) – The third Catalina short-period discovery of September was made by Kacper W. Wierzchos. Like the other two Catalina finds, this one was also found with the Mount Lemmon 1.5-m. P/2021 R4 was 20th magnitude at discovery on 2021 September 6. Pre-discovery observations by Pan-STARRS were found from two nights prior to discovery. The comet has a 13.4-year period and a perihelion on 2021 October 13 at 2.33 au. This is Kacper's second amed comet after C/2020 H3 (Wierzchos). [CBET 5034, MPEC 2021-R256]

P/2021 R3 (PANSTARRS) – The Pan-STARRS1 1.8-m was used to discover this 21st magnitude comet on 2021 September 5. Pan-STARRS pre-discovery observations were found back to 2021 July 9. Syuichi Nakano's orbit published on CBET 5033 found a possible close approach to Jupiter of 0.36 au in September 2002. The current orbit has perihelion on 2021 May 27 at 2.53 au. It is likely that the comet has already peaked in brightness. [CBET 5033, CBET 2021-R255]

C/2021 R2 (PANSTARRS) – On 2021 September 5, C/2021 R2 was found in three 45-s w-band images taken with the Pan-STARRS1 1.8-m. The comet was 20th magnitude at discovery which is likely as bright as it will get. Perihelion occurs on 2022 January 4 at 7.31 au. [CBET 5031, CBET 2021-R151]

P/2021 R1 (PANSTARRS) – Four 45-s w-band images taken on 2021 September 4 with the Pan-STARRS1 1.8-m were used to discover this 20th magnitude short-period comet. Perihelion occurs on 2021 December 17 at 4.89 au. The comet is likely as bright as it will get. Perhaps it will be brighter at its next return in 2045. [Ref: MPEC 2021-R150, CBET 5030]

C/2021 Q6 (PANSTARRS) – A new 21st magnitude comet was identified in four 120-s z-band images taken with the Pan-STARRS1 1.8-m on 2021 August 22. Numerous pre-discovery observations back to January 2021 were also found. C/2021 Q6 is another large perihelion object (T = 2024 March 24, q = 8.71 au). It should reach a peak brightness near magnitude 20 in 2023-2024. [Ref: MPEC 2021-R167, CBET 5032]

P/2021 HS (PANSTARRS) – Back on 2021 April 16, Pan-STARRS found 2021 HS, an apparently asteroidal 20th magnitude object. H. Sato was the first to notice cometary activity on images taken July 4 with a 0.51-m f/6.8 astrograph resulting in a new cometary designation of P/2021 HS (PANSTARRS). Perihelion occurred on 2021 August 6 at 0.80 au when it was near its peak brightness of 18th magnitude. With an 8.6-year period, it will be back at perihelion in 2030. [CBET 5043, MPEC 2021-S44]

As always, the Comet Section is happy to receive all comet observations, whether textual descriptions, images, drawings, magnitude estimates, or spectra. Please send your observations via email to the Comets Section < comets @ alpo-astronomy .org >, Comets Section Coordinator Carl Hergenrother < carl.hergenrother @ alpo-astronomy .org > and/or Comets Section Acting Assistant Coordinator Michel Deconinck < michel.deconinck @ alpo-astronomy .org >.

Thank you to everyone who contributed to the ALPO Comets Section!

Stay safe and enjoy the sky!
- Carl Hergenrother

Recent Magnitudes Contributed to the ALPO Comets Section

Comet Des	YYYY MM DD.DD (UT)	Mag	SC	APER	FL	POW	COMA Dia	COMA DC	TAIL LENG	TAIL PA	ICQ CODE	Observer Name
P/2021 Q5 (ATLAS)												
2021Q5	2021 09 17.14	S 11.6	TK	20.3T10	133		4	1/			ICQ XX GON05	Juan Jose Gonzalez Suarez
2021Q5	2021 09 05.19	S 11.5	TK	20.3T10	100		4	1/			ICQ XX GON05	Juan Jose Gonzalez Suarez
C/2021 O3 (PANSTARRS)												
2021O3	2021 09 08.27	C 18.7	U4	50.0Y	5A	200	0.3				ICQ xx HER02	Carl Hergenrother
C/2020 T2 (Palomar)												
2020T2	2021 09 08.42	xM 10.9	AQ	40.0L	4	59	3.7	6			ICQ XX WYA	Christopher Wyatt
2020T2	2021 09 06.40	xM 10.9	AQ	25.0L	5	40	3.9	5			ICQ XX WYA	Christopher Wyatt
C/2020 PV6 (PANSTARRS)												
2020PV6	2021 09 08.42	xM 14.6	AQ	40.0L	4	182	0.9	4/			ICQ XX WYA	Christopher Wyatt
2020PV6	2021 09 04.91	S 13.3	AQ	20.3T10	133		1.5	4			ICQ XX GON05	Juan Jose Gonzalez Suarez
C/2020 F5 (MASTER)												
2020F5	2021 09 11.69	xM 14.8	AQ	40.0L	4	261	0.4	5/			ICQ XX WYA	Christopher Wyatt
2020F5	2021 09 08.46	xM 14.7	AQ	40.0L	4	182	0.7	6			ICQ XX WYA	Christopher Wyatt
2020F5	2021 09 07.68	xM 14.6	AQ	40.0L	4	182	0.4	6			ICQ XX WYA	Christopher Wyatt
C/2019 L3 (ATLAS)												
2019L3	2021 09 17.12	S 10.5	TK	20.3T10		77	5	4			ICQ XX GON05	Juan Jose Gonzalez Suarez
2019L3	2021 09 09.93	S 10.9	TI	29.8L	4	108	1.4	3/			ICQ XX HAR11	Christian Harder
2019L3	2021 09 08.94	S 11.3	TI	29.8L	4	108	1.5	4			ICQ XX HAR11	Christian Harder
2019L3	2021 09 05.02	S 10.7	TK	20.3T10	100		5	3/			ICQ XX GON05	Juan Jose Gonzalez Suarez
2019L3	2021 09 04.96	S 11.2	TI	29.8L	4	108	1.7	4			ICQ XX HAR11	Christian Harder
2019L3	2021 09 04.08	S 12.1	HS	32.0L	5	80	1	6/			PIL01	Uwe Pilz
2019L3	2021 09 03.95	S 11.4	TI	29.8L	4	92	2.4	4	2.5m	330	ICQ XX HAR11	Christian Harder
C/2019 F1 (ATLAS-Africano)												
2019F1	2021 09 11.68	xM 14.8	AQ	40.0L	4	261	0.7	5/			ICQ XX WYA	Christopher Wyatt
2019F1	2021 09 08.46	xM 14.9	AQ	40.0L	4	261	0.6	6			ICQ XX WYA	Christopher Wyatt
2019F1	2021 09 07.71	xM 14.7	AQ	40.0L	4	261	0.4	6			ICQ XX WYA	Christopher Wyatt
C/2018 U1 (Lemmon)												
2018U1	2021 09 08.43	xS 15.2	AQ	40.0L	4	261	0.3	4			ICQ XX WYA	Christopher Wyatt
C/2017 K2 (PANSTARRS)												
2017K2	2021 09 28.85	S 11.7	TK	20.3T10	133		2.2	4			ICQ XX GON05	Juan Jose Gonzalez Suarez
2017K2	2021 09 28.81	S 11.6	TI	29.8L	4	108	1.5	3/			ICQ XX HAR11	Christian Harder
2017K2	2021 09 12.90	S 12.2	TI	29.8L	4	108	1.5	3			ICQ XX HAR11	Christian Harder
2017K2	2021 09 10.15	V 13.3	U4	10.6R	5a	600	1.4		1.2m	20	ICQ xx HER02	Carl Hergenrother
2017K2	2021 09 09.85	S 11.8	TI	29.8L	4	92	2	3			ICQ XX HAR11	Christian Harder
2017K2	2021 09 08.86	S 12.2	TI	29.8L	4	108	1.5	3			ICQ XX HAR11	Christian Harder
2017K2	2021 09 08.40	xM 12.3	AQ	40.0L	4	182	1.5	5/			ICQ XX WYA	Chris Wyatt
2017K2	2021 09 06.41	xM 12.8	AQ	25.0L	5	125	1.2	4/			ICQ XX WYA	Chris Wyatt
2017K2	2021 09 04.92	S 12.2	AQ	20.3T10	133		1.5	4/			ICQ XX GON05	Juan Jose Gonzalez Suarez
2017K2	2021 09 04.86	S 12.5	TI	29.8L	4	132	1.4	3			ICQ XX HAR11	Christian Harder
2017K2	2021 09 03.88	S 12.9	TI	29.8L	4	108	1.2	3			ICQ XX HAR11	Christian Harder
284P/McNaught												
284	2021 09 11.72	xM 14.7	AQ	40.0L	4	182	0.6	5/			ICQ XX WYA	Christopher Wyatt
67P/Churyumov-Gerasimenko												
67	2021 09 17.08	S 10.8	TK	20.3T10	100		4	4			ICQ XX GON05	Juan Jose Gonzalez Suarez
67	2021 09 13.01	S 11.8	TI	29.8B	4	108	1.5	s4	3.0m	265	ICQ XX HAR11	Christian Harder
67	2021 09 11.73	xM 11.8	AQ	40.0L	4	59	1.2	6	6.2m	260	ICQ XX WYA	Christopher Wyatt
67	2021 09 09.94	S 11.4	TI	29.8L	4	108	1.8	4			ICQ XX HAR11	Christian Harder
67	2021 09 08.99	S 11.2	TI	29.8L	4	108	2	4			ICQ XX HAR11	Christian Harder
67	2021 09 07.72	xM 12.4	AQ	40.0L	4	108	1.0	6	3.5m	260	ICQ XX WYA	Christopher Wyatt
67	2021 09 05.00	S 10.9	TK	20.3T10	100		5	3/			ICQ XX GON05	Juan Jose Gonzalez Suarez
67	2021 09 04.98	S 11.3	TI	29.8L	4	108	1.5	4			ICQ XX HAR11	Christian Harder
67	2021 09 04.06	S 12.0	TK	32.0L	5	80	0.6	7	0.02	263	PIL01	Uwe Pilz
67	2021 09 03.99	S 11.1	TI	29.8L	4	108	1.3	4			ICQ XX HAR11	Christian Harder
29P/Schwassmann-Wachmann												
29	2021 09 28.93	I 11.2	TK	20.3T10		77		8			ICQ XX GON05	Juan Jose Gonzalez Suarez
29	2021 09 17.10	S 12.9	AQ	20.3T10	166		1.5	3			ICQ XX GON05	Juan Jose Gonzalez Suarez
29	2021 09 11.76	xS 14.8	AQ	40.0L	4	182	0.4	2/			ICQ XX WYA	Christopher Wyatt
19P/Borrelly												
19	2021 09 11.71	xM 14.6	AQ	40.0L	4	182	0.6	6			ICQ XX WYA	Christopher Wyatt
19	2021 09 08.48	xM 15.0	AQ	40.0L	4	261	0.3	6			ICQ XX WYA	Christopher Wyatt
15P/Finlay												
15	2021 09 05.12	S 11.3	TK	20.3T10	100		3	2			ICQ XX GON05	Juan Jose Gonzalez Suarez
15	2021 09 04.10	S 10.8	TK	32.0L	5	80	1.7	1			PIL01	Uwe Pilz
8P/Tuttle												
8	2021 09 11.77	xM 8.9	TK	40.0L	4	59	3.1	5			ICQ XX WYA	Christopher Wyatt
8	2021 09 07.77	xM 9.0	TK	40.0L	4	59	2.8	5			ICQ XX WYA	Christopher Wyatt
7P/Pons-Winnecke												

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  7        2021 09 11.70 xS 14.1 AQ 40.0L 4 182   1.3  3            ICQ XX WYA   Christopher Wyatt
  7        2021 09 08.47 xS 13.6 AQ 40.0L 4 108   1.5  2/           ICQ XX WYA   Christopher Wyatt
  7        2021 09 07.69 xM 14.0 AQ 40.0L 4 182   0.9  4            ICQ XX WYA   Christopher Wyatt
6P/d'Arrest
  6        2021 09 08.44 xM 13.6 AQ 40.0L 4 261   0.8  2            ICQ XX WYA   Christopher Wyatt
  6        2021 09 04.85  S 11.1 TK 20.3T10 100   5    2            ICQ XX GON05 Juan Jose Gonzalez Suarez
4P/Faye
  4        2021 09 17.13  S 10.3 TK 20.3T10  77   5    3            ICQ XX GON05 Juan Jose Gonzalez Suarez
  4        2021 09 11.75 xM 11.9 AQ 40.0L 4 108   1.1  6    5.2m267 ICQ XX WYA   Christopher Wyatt
  4        2021 09 10.01  S 10.5 TI 29.8L 4 108   2.1  2/           ICQ XX HAR11 Christian Harder
  4        2021 09 09.04  S 10.4 TK 32.0L 5  43         6   0.05 236        PIL01 Uwe Pilz
  4        2021 09 07.74 xM 11.4 AQ 40.0L 4 108   1.2  6    5.0m267 ICQ XX WYA   Christopher Wyatt
  4        2021 09 05.03  S 10.5 TK 20.3T10  77   4    3            ICQ XX GON05 J J Gonzalez Suarez
  4        2021 09 04.99  S 10.7 TI 29.8L 4 108   1.8  4            ICQ XX HAR11 Christian Harder
  4        2021 09 04.00  S 10.7 TI 29.8L 4 108   1.8  3            ICQ XX HAR11 Christian Harder
  4        2021 09 02.02  S 11.2 TI 29.8B 4 108   1.2  4            ICQ XX HAR11 Christian Harder
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