Comet 46P/Wirtanen Observers' Workshop

48th DPS / 11th EPSC Meeting 17 October 2016



Comet 46P/ Wirtanen

(c) Max-Planck-Institut für Aeronomie observed at Pik Terskol Observatory 3/11/1997 by K. Jockers, T. Credner, T. Bonev Red: H₂O⁺, Green: Dust, Blue: CN



Organization / Outline

- Why Wirtanen?
- Why now?
- What do we know about Wirtanen?
- Summary of the observing campaign
- Related campaigns
- Desired/suggested observations
- Discussion

Comet Wirtanen – The Name

Pronounced WERE-tuh-nun

 Confirmed by multiple sources from Lick Observatory who worked with Carl and Edie Wirtanen

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Why is Comet Wirtanen Special?

- Interesting comet
 - Small, hyperactive nucleus
 - "Twin" of Hartley 2
 - Could evolve into a PHO
- Potential (likely?) spacecraft mission target
 - Orbit is very favorable
 q = 1.055 AU, i = 11.7°,
 Q = 5.13 AU, P = 5.43 yr
 - Already selected as a target:
 - Rosetta, Comet Hopper, Others?
 - Strong possibility of being a future target





Why is Comet Wirtanen of Interest Now?

- 2018 is a historic apparition!
- Close approach to Earth 0.077 AU
 - 16 December 2018
 - One of the closest comets in modern era
 - Observing conditions are better than for other comets
- Comet will be bright
 - Predicted to reach naked eye brightness



- Geometric conditions allow long-duration observations
 - Up for many hours over most of a year,
 - Pre- and post-perihelion, North and South
- Excellent opportunity to characterize its behavior, learn about the comet and reduce risk and cost of future comet missions !

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What do we know now?

- Effective radius 0.58 km [Schulz & Schwehm 1999]
 - Axial ratio > 1.4 (HST lightcurve amplitude)

- Activity
 - Q(H₂O)_{peak} ~ 1-3 x 10²⁸ sec⁻¹
 - Suggests Wirtanen is a hyperactive comet
 - Active fraction ~50 100+%
 - $Af\rho_{peak} \approx 150 \text{ cm}$ (less dusty than Hartley 2)
 - No secular changes over last few apparitions
 - Carbon-chain taxonomy: "Typical" [Farnham & Schleicher 1998]



What do we know now?

- Rotation (Aug 1996, ~200 days pre-perihelion)
 - 7.6 hr [Meech et al. 1997]
 - "Possible rotation", double peaked
 - Amplitude 0.045 mag
 - 6.0 hr [Lamy et al. 1998]
 - Large uncertainty 8 data points
 - Amplitude 0.22 mag
 - Not enough data to evaluate details
 - No spin pole orientation
 - Samarasinha et al. (1996) suggest it is likely to be in a NPA rotation state





Wirtanen Campaign Objective

Provide a central clearinghouse for basic information regarding comet 46P/Wirtanen to encourage and facilitate the acquisition, analysis and interpretation of observations, and to promote collaborations between researchers.

Why is UMD Leading the Campaign?

- Organized at the University of Maryland
 - Tony Farnham (farnham at astro.umd.edu), lead
- Wirtanen is a "pet" comet of UMD
 - Known characteristics suggest it is the "twin" of Comet Hartley 2 (the DIXI target)
 - Wirtanen was the target of the Comet Hopper Discovery mission (Phase A)
 - We spent a lot of time trying to learn as much as we could about it
 - Planned to lead the effort as part of CHopper and simply following through on those plans
- Starting campaign now to prompt observations in the 2017 window

Wirtanen Campaign

- Campaign Home Page: wirtanen.astro.umd.edu
- Planned content:
 - Currently known characteristics of 46P/Wirtanen
 - Historical measurements
 - List of available publications
 - Geometric observing conditions for different sites
 - Secular lightcurve
 - Interesting results and events that might be of interest to the community
 - Information about Wirtanen observations
 - Links to other relevant sites of interest

Observations Record

- Record of the planned and collected observations of comet Wirtanen, to allow proposals for complementary observing and to prompt collaborations and interaction
- Linked from the main Campaign web page
 - Collect information about Wirtanen observations (voluntary submission)
 - Dates, observatories, instruments etc.
 - Status (proposed, scheduled, and/or completed)
 - Provide different formats for displaying the information (list, calendar, etc)

Other Potential Content

- Content on the Campaign will be expanded as warranted
 - Possible additions
 - Alert network exploder to inform about timely events
 - Information about additional bright comets
 - 41P, 45P, 62P, 21P and 64P are predicted to be bright and appear before 46P
 - Suggestions from the community are welcome
 - Telecons/blogs to discuss recent events
 - Contributions/suggestions from the community

Associated Campaigns

- 4*P/ Coma Observing Campaign (Nalin Samarasinha)
 - 45P/H-M-P, 41P/T-G-K and 46P/Wirtanen
 - Professional and high level amateurs contribute images of the coma for long duration monitoring
 - Related to this UMD members are evaluating a SemRock filter that may act as a relatively inexpensive CN filter
 - Results will be given on the web site when available
- Amateur Observers' Campaign (Elizabeth Warner)
 - Public interest website

4*P CAMPAIGN FOR COMA MORPHOLOGY

COMET 41P/TUTTLE-GIACOBINI-KRESAK PERIGEE ON APRIL 05, 2017 @ 0.148 AU

COMET 45P/HONDA-MRKOS-PAJDUSAKOVA PERIGEE ON FEBRUARY 11, 2017 @ 0.080 AU

COMET 46P/WIRTANEN PERIGEE ON DECEMBER 16, 2018 @ 0.078 AU

- INVITING BOTH PROFESSIONAL AND AMATEUR ASTRONOMERS
- THE PRIMARY GOAL IS TO OBTAIN GOOD TEMPORAL COVERAGE
- **BOTH CONTINUUM IMAGES AS WELL AS NARROWBAND IMAGES**
- CONTRIBUTORS WILL BE CO-AUTHORS OF THE RESULTING PUBLICATIONS (SIMILAR TO OUR COMET ISON CAMPAIGN)



More details will be available starting early November at <u>http://www.psi.edu/41P45P46P</u> and the campaign is similar to what we conducted for comet ISON (C/2012 S1) in 2013. This will also be announced via various newsletters (e.g., CSN & PEN).

You may contact us at <u>41P45P46P@psi.edu</u> regarding this global campaign.

Thank You.

Nalin Samarasinha, Beatrice Mueller, Matthew Knight, Tony Farnham, Walt Harris

Wirtanen & Amateur Astronomers:

Elizabeth Warner (UMD) Amateur Observers' Program (AOP) Coordinator

aop.astro.umd.eduwirtanen.astro.umd.edu





Amateur Astronomers

Many levels of amateurs

- Advanced (scientific quality)
- Sketchers, casual imagers (pretty pictures, APODs,...)
- Visual observing, E/PO
- Data miners (SOHO comets, Zooniverse,...)
- Armchair, magazine readers, social media groupies...
- □ What level are you?
 - Participate at any level
 - Use the campaign to improve skills

Past Comet Campaigns

- International Halley Watch
- □ Shoemaker-Levy 9
- Hale-Bopp (<u>www2.jpl.nasa.gov/comet/</u>)
- Deep Impact
 - Small Telescope Science Program (STSP), 1999-2006
 - Amateur Observers' Program (AOP), 2000 -- current
 - □ For 9P/Tempel, differentiated between advanced and casual imagers
 - □ For 103P/Hartley, combined programs
- Ongoing informal
 - comets-ml (tech.groups.yahoo.com/group/comets-ml/)
 - Comet-Images (tech.groups.yahoo.com/group/Comet-Images/)
 - CometChasing (tech.groups.yahoo.com/group/CometChasing/)
 - FlickR (www.flickr.com/groups/comet_images/ and others!)
 - Spaceweather.com
 - Numerous FB groups
- Recent Professional/amateur
 - CIOC
 - C/2012 S1 (ISON)
 - C/2013 A1 (Siding Spring)
 - Comet Coma Campaign
 - Comet tail images
- ESA/Rosetta
 - PACA

Why AOP?

- Incorporate the many lessons learned from past/recent campaigns
- Access to extensive network of amateurs from past campaigns as well as through numerous groups online (Yahoo, Facebook, AAVSO,...)
- Website-based format
 - Provides training (tutorial sections)
 - Observing resources (charts, ephemerides,...)
 - Way to collect/share data (logbook, gallery,...)
 - Identify amateurs from submitted observations to recommend to pro campaigns
- Social media to supplement
 - Twitter (@cometexplorer) for fast updates, reminders, notifications
 - Facebook (FB/cometexplorer) to highlight data, discussions

Advice to Amateurs

- READ the material!
 - Documents (sample FITS header, links to observing calls, ...) posted on
 - <u>aop.astro.umd.edu/</u>
 - wirtanen.astro.umd.edu
 - Specific Observing call information
 - As professional observers flesh out their observing details, they'll provide specifics on what is needed from amateurs

www.psi.edu/41P45P46P

- It's all in the details!
 - Fits headers
 - Take the time to go through your software and update settings!
 - Keep a good logbook
 - □ Date and times (start, end; specify UT or local!)
 - Exposures
 - □ Reference sample fits header for things to keep track of...
 - Procedure and processing notes (not always the same for `pretty pictures' vs. scientific data)

Be consistent

- Newer observers need to figure out their process now!
- You don't want to be experimenting with your equipment, exposures, filters, processing in the middle of the few clear nights you have... practice!

More Advice to Amateurs

□ KISS

- There are many things to keep track of and Murphy's Law will mean that things will go wrong at the worst possible time.
- So, streamline/simplify where you can.
- Prepare, practice now.
- Submit/share data
 - Many avenues, but there are no guarantees!
 - Share on AOP website, FB groups, Spaceweather.com
 - Submitting magnitude reports to MPC
 - AFp (only if you know how!)
 - Share data with pro observers (observing calls)
- Archive
 - At a minimum, make backups of your files
 - PDS-SBN

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Can train and funnel

campaigns!

observers to scientific

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Pro/Am Lessons Learned

For amateurs

- Do not try to do what you don't know how to do!
 - Submitting AFp values when you don't understand what they are or mean is not useful.
 - Learn/practice now, not in the middle of a campaign.
- Do well what you do know how to do!
- Don't let other amateurs intimidate you.
 - You do not need to put your image into a polyptych just because some other amateur does it.
- Provide what is asked for, not what you think the pros should use.
- Ask questions, but don't overdo it and pester the PI or technical POC.

For professionals

- Be clear about what you need from amateurs.
 - Certain filters, fields of view, exposure lengths,...
 - How much processing or analysis?
- Be clear about how you will use their data.
- Co-authors or contributors?
- Answer questions in a timely manner.
- Be patient with newer observers (maybe team them up with another, more experienced amateur in your network).

General Observation Strategies

- Maximize temporal coverage throughout the apparition
 - Obtain measurements as a function of time, whenever possible
 - Characterize long-term secular behavior
 - Characterize rotational phase dependence
- Exploit close approach
 - Obtain very high spatial resolution measurements
 - Obtain data that require a bright comet
 - Investigate the inner coma environment

Desired Observations

- Size and shape of the nucleus
 - Photometry, Radar
- Rotation State
 - Lightcurves, Coma morphology, Radar
- Activity levels and sources
 - Multiple types of observation
- Composition
 - Spectroscopy, NB filters, Radio
- Dust characteristics
 - NB filters, Polarimetry, Spectroscopy
- Outburst activity
 - Continuous monitoring
- Thermal characteristics
 - IR, Radio
- Plasma activity

Comments, Suggestions, Discussion

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