Comet 46P/Wirtanen Observers’ Workshop

48th DPS / 11th EPSC Meeting
17 October 2016
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
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
    \[ q = 1.055 \text{ AU}, \quad i = 11.7^\circ, \quad Q = 5.13 \text{ AU}, \quad P = 5.43 \text{ yr} \]
  – 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!
Wirtanen Visibility

MKO (North)

CTIO (South)

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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
  - $Q(\text{H}_2\text{O})_{\text{peak}} \sim 1-3 \times 10^{28} \text{ sec}^{-1}$
  - Suggests Wirtanen is a hyperactive comet
    - Active fraction $\sim 50 - 100+\%$
    - $A_{\text{fp}}_{\text{peak}} \sim 150 \text{ cm}$ (less dusty than Hartley 2)
    - No secular changes over last few apparitions
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 http://www.psi.edu/41P45P46P 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 41P45P46P@psi.edu regarding this global campaign.

Thank You.
Nalin Samaraninha, Beatrice Mueller, Matthew Knight, Tony Farnham, Walt Harris
Wirtanen & Amateur Astronomers:

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

- aop.astro.umd.edu
- wirtanen.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 (www2.jpl.nasa.gov/comet/)
- 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
    - aop.astro.umd.edu/
    - 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 observers to scientific campaigns!*
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