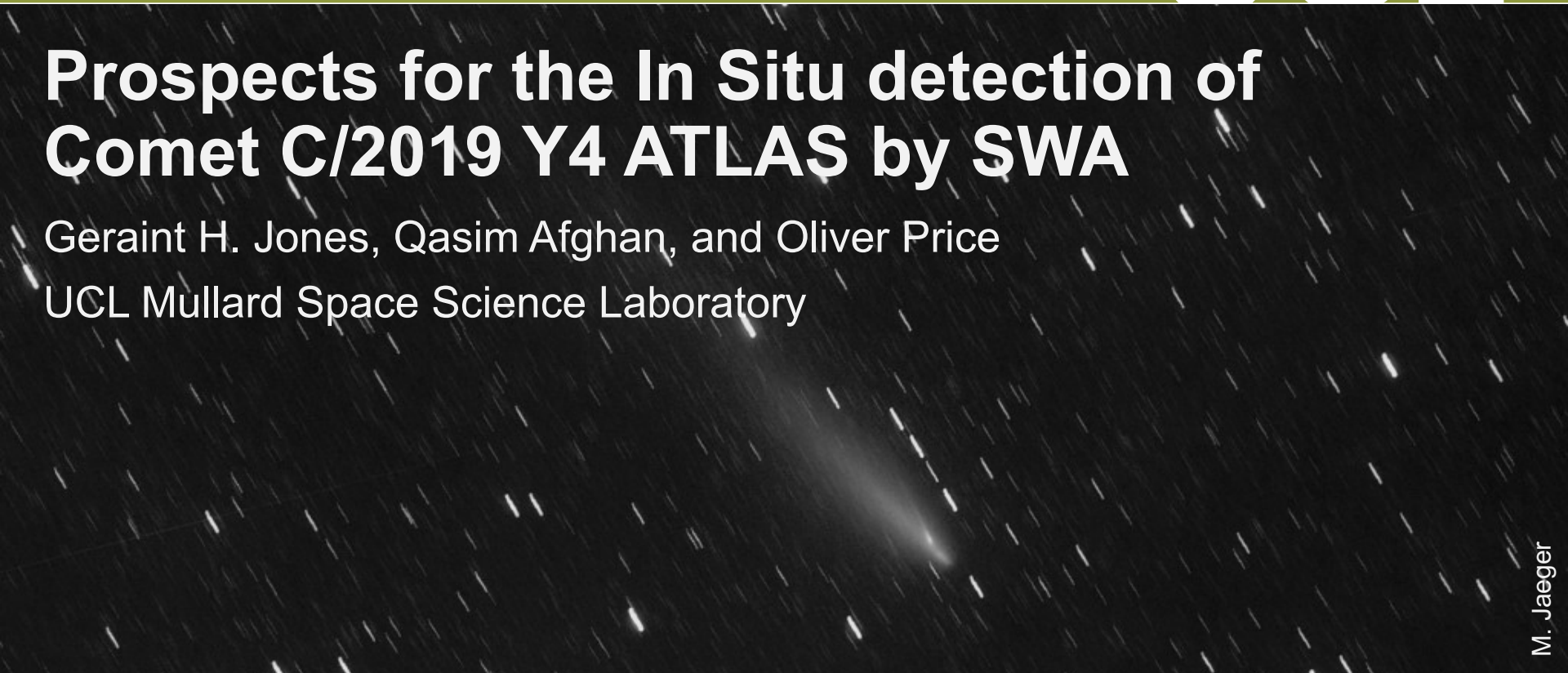
Prospects for the In Situ detection of Comet C/2019 Y4 ATLAS by SWA

Geraint H. Jones, Qasim Afghan, and Oliver Price

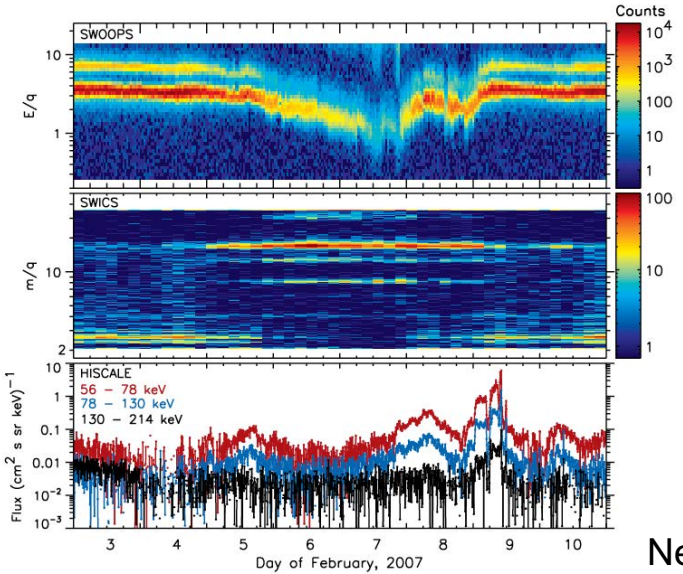
UCL Mullard Space Science Laboratory

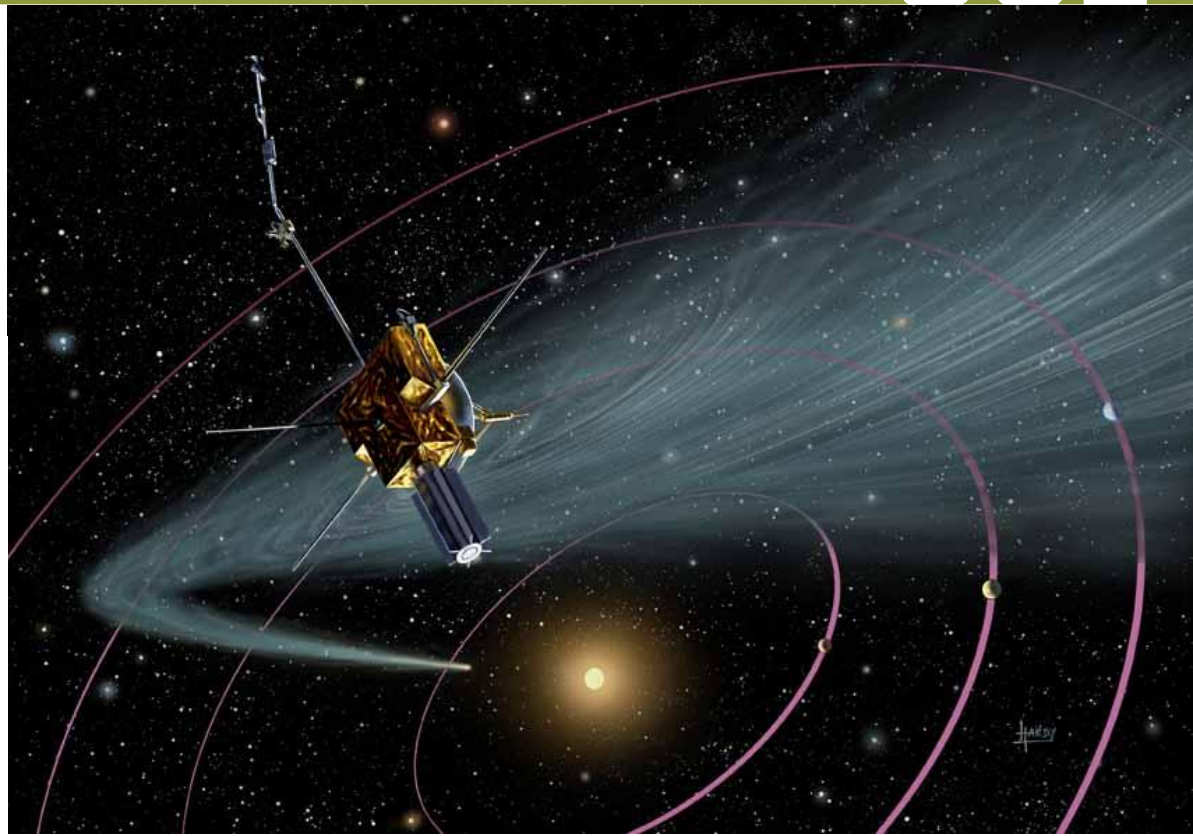


M. Jaeger

G. Rhemann

- First known ion tail crossing by Ulysses in May 1996 (Jones+ 2000, Gloeckler+ 2007)
- C/2006 P1 below





Neugebauer et al. 2007

RNAAS RESEARCH NOTES OF THE AAS

Prospects for the In Situ detection of Comet C/2019 Y4 ATLAS by Solar Orbiter

Geraint H. Jones[1,2], Qasim Afghan[1,2], and Oliver Price[1,2]

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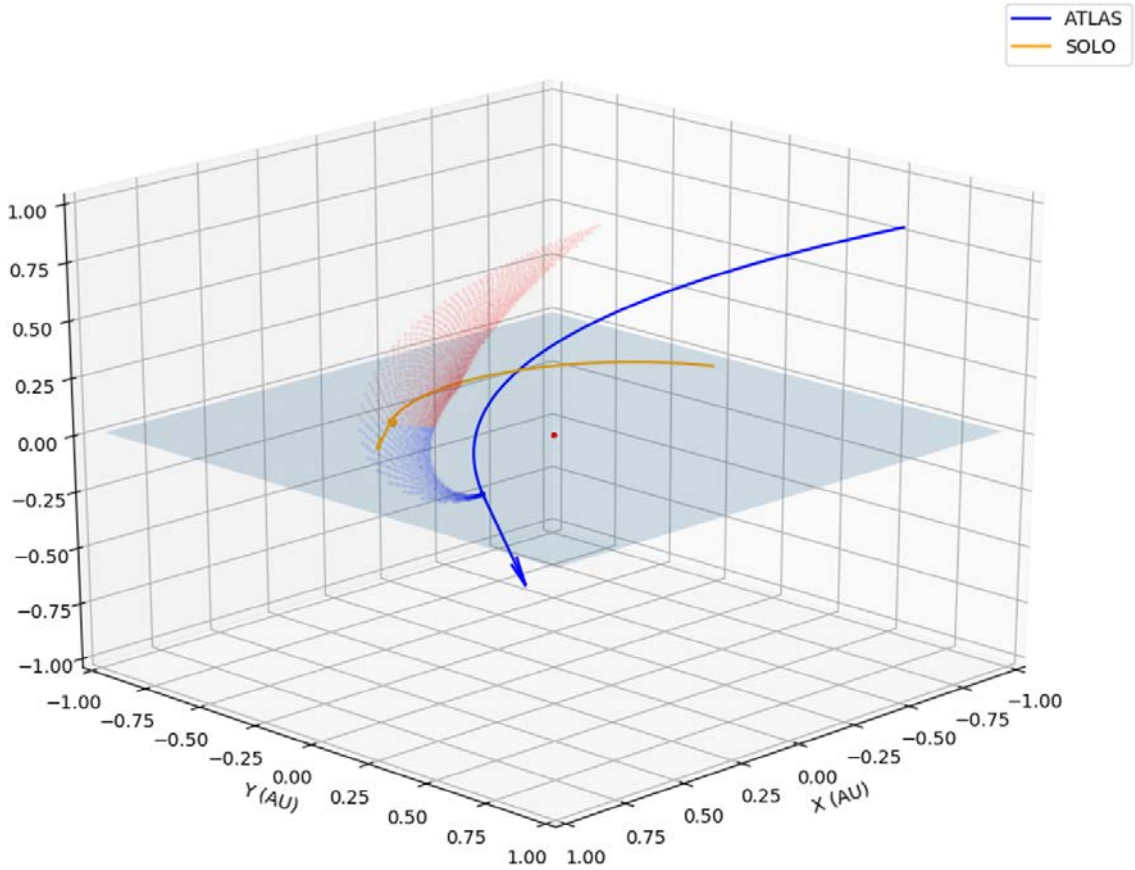
Figures References

+ Article information

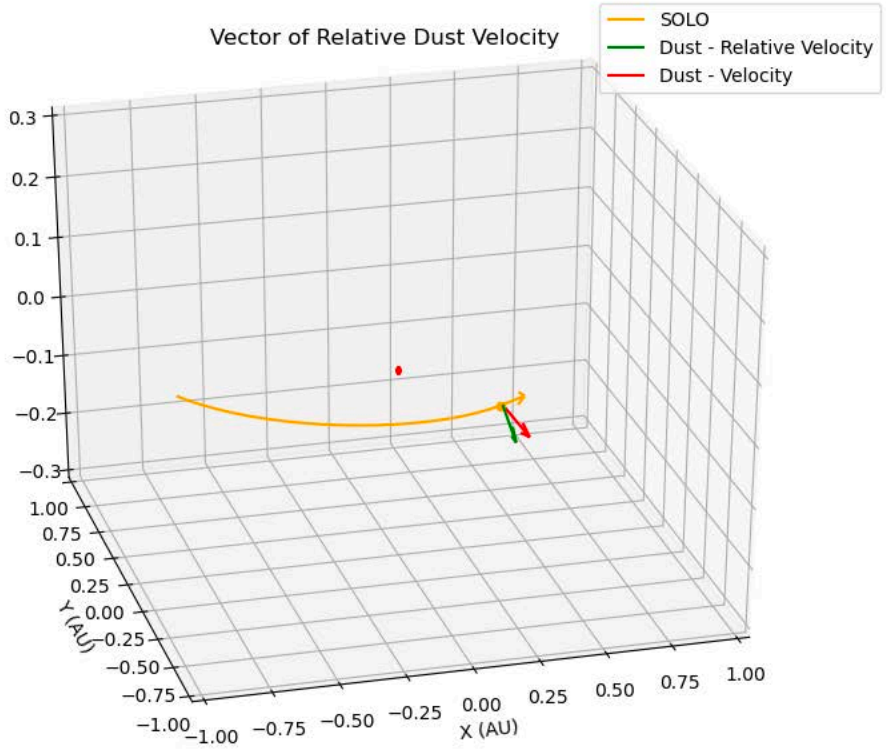
Abstract

The European Space Agency's Solar Orbiter spacecraft will pass approximately downstream of the position of comet C/2019 Y4 (ATLAS) in late May and early June 2020. We predict that the spacecraft may encounter the comet's ion tail around 2020 May 31—June 1, and that the comet's dust tail may be crossed on 2020 June 6. We outline the solar wind features and dust grain collisions that the spacecraft's instruments may detect when crossing the comet's two tails. Solar Orbiter will also pass close to the orbital path of C/2020 F8 (SWAN) on 2020 May 22, but we believe that it is unlikely to detect any material associated with that comet.

C/2019 Y4



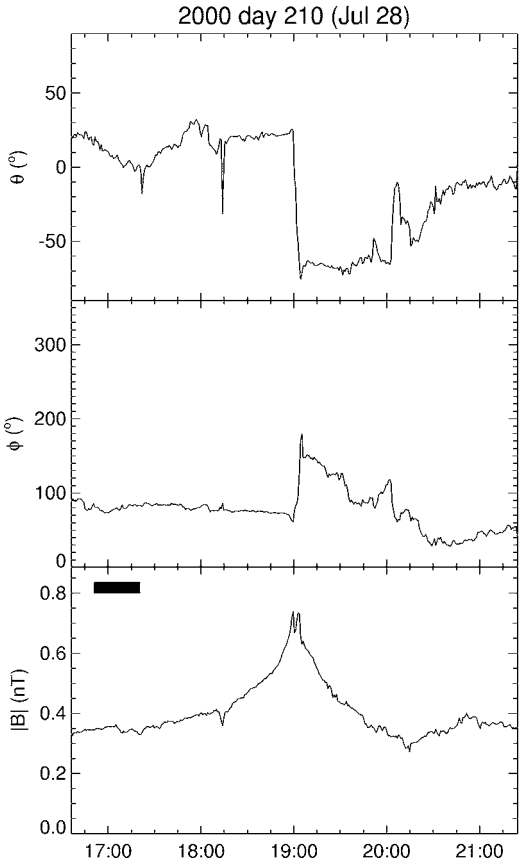
- Likelihood of the signature of a clear, discrete ion tail probably significantly reduced compared to ~10 days ago
- However, dust/debris cloud still present – if outgassing, ions detectable by SWA around May 30/June 1?
- Localised decrease in solar wind speed?



- Dust tail crossing will take place on June 6
- Dust grains released from comet on May 20.
- ~66 km/s relative velocity
- If impacts occur on spacecraft, SWA may detect impact plasma clouds?

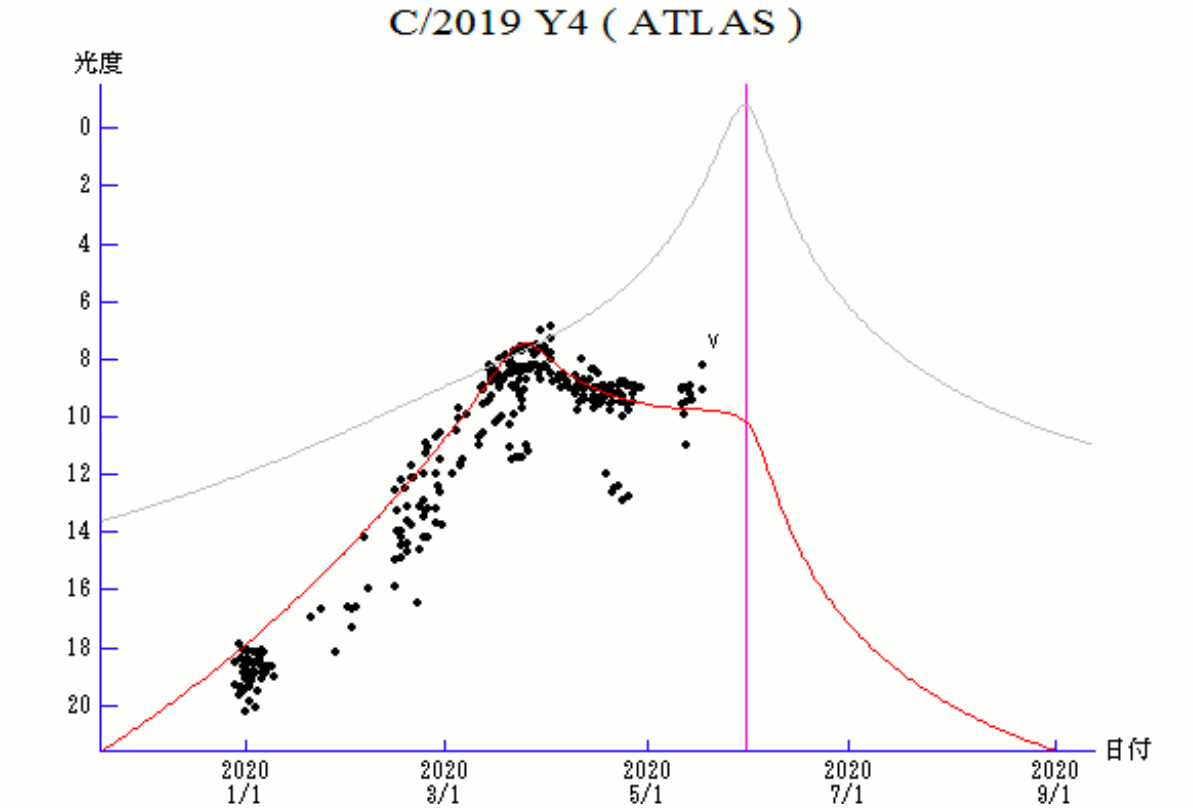
Other instruments

- Magnetometer
  - Signs of magnetic field draping?
  - Interplanetary Field Enhancements? (pictured)
  - Dust impacts?
- RPW
  - Dust impacts?



Jones+ 2003

What will we detect?



Seiichi Yoshida
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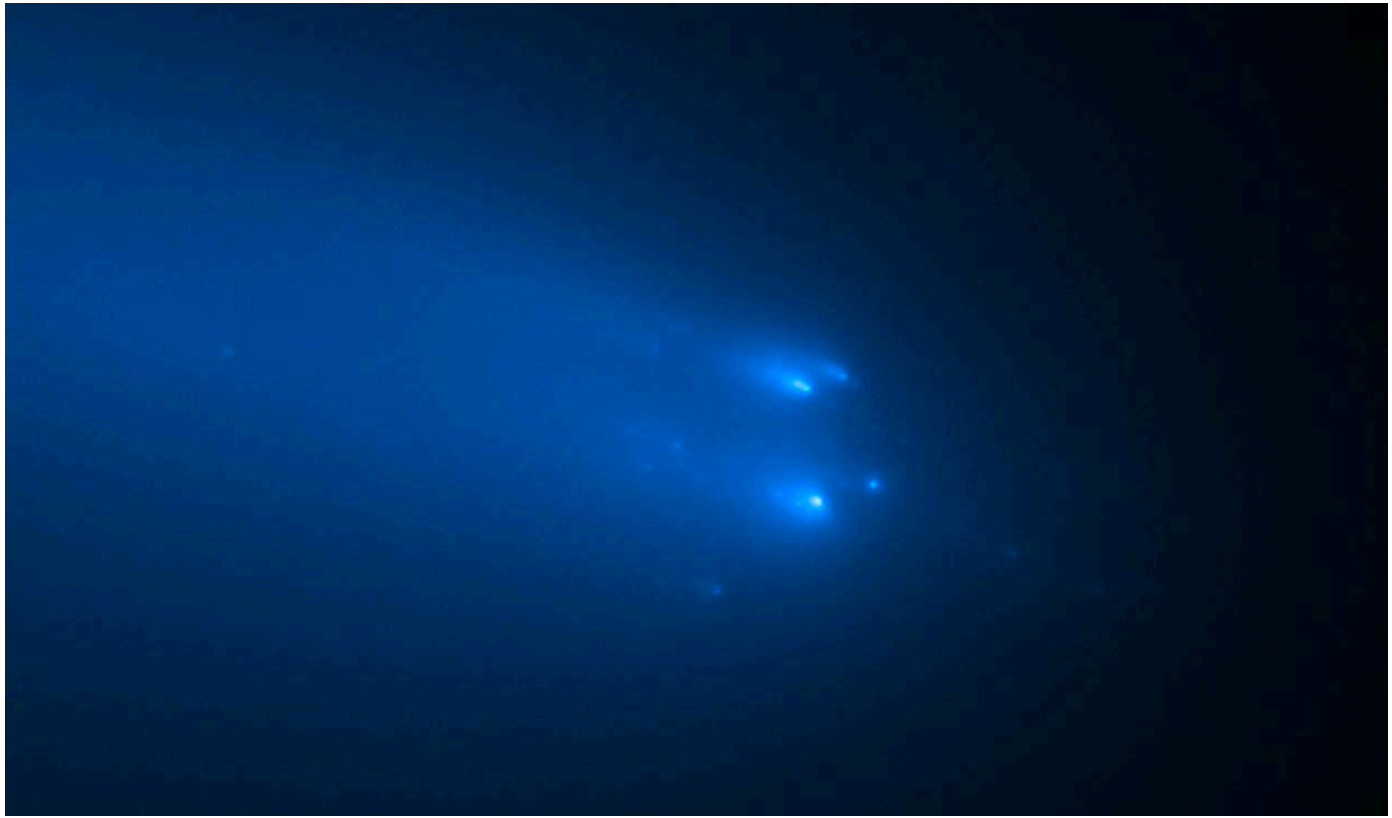
C/2019 Y4 (ATLAS)



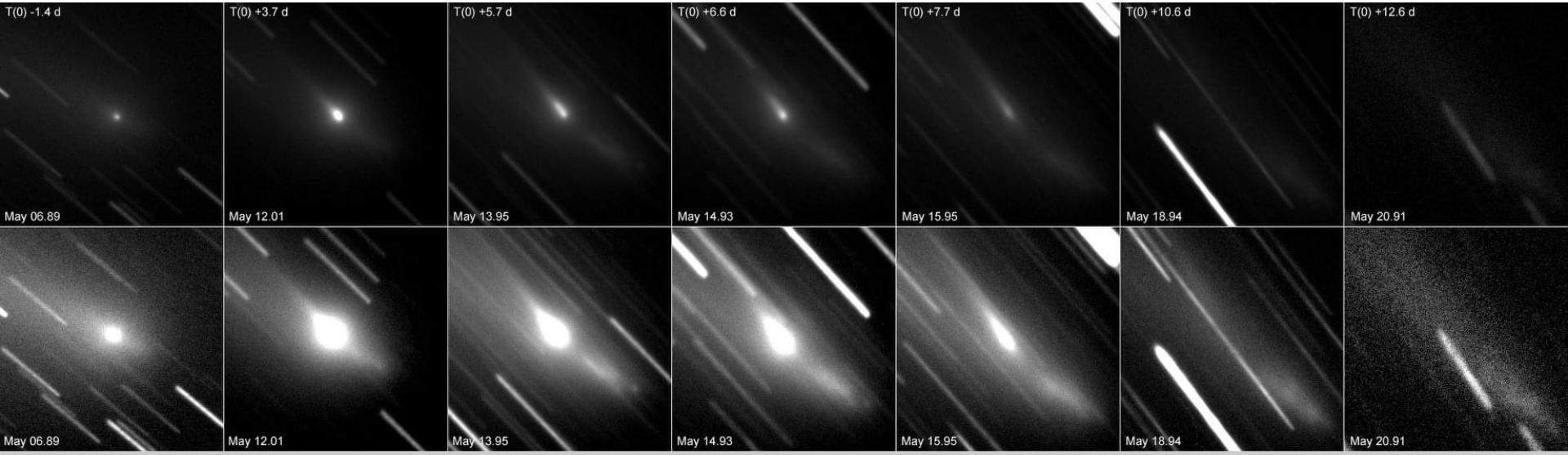
Hubble Space Telescope image of comet C/2019 Y4 (ATLAS) on April 20, 2020.

NASA, ESA, STScI, and D. Jewitt (UCLA)

C/2019 Y4 (ATLAS)

M. Jaeger, May 16.0

C/2019 Y4 (ATLAS)



Final outburst and disruption of Comet C/2019 Y4 (ATLAS) 2020 May 06.9 – May 20.9

This comet underwent an intitial fragmentation in late March and the evolution of the debris creating short-lived condensations in the coma were followed through April including with the HST. Component 'B' contained most of the remaining mass and this survived surrounded by a debris cloud (see first image). However on May 08.3 ± 0.3, 'B' underwent an explosive outburst ejecting material sunwards with apparent separation velocities of up to 100 m/s as can be seen in the montage above.

0.35-m f/7.7 Schmidt-Cassegrain, unfiltered; Scale: 0.68"/pixel; Field of view: 3.4' square; Orientation: Rotated -10°

Date	Exposures	Delta (au)	r (au)	Elong.	PhA	Motion ("/min, p.a.)	Mean Altitude	Sky Brightness	R Magnitude (2.7" radius)	
May 06.89	63 x 30s	0.883	0.747	45.9°	76.0°	2.05 / 223°	32°	17.4 mag/sq.arcsec	16.2	
May 12.01	60 x 30s	0.845	0.628	38.2°	85.3°	2.60 / 216°	15°	19.0 mag/sq.arcsec	14.9	= 1.3 magnitude (300%) outburst amplitude
May 13.95	100 x 30s	0.830	0.581	35.1°	89.7°	2.91 / 214°	17°	19.1 mag/sq.arcsec	15.3	
May 14.93	80 x 30s	0.823	0.558	33.5°	92.1°	3.10 / 213°	17°	18.7 mag/sq.arcsec	15.4	
May 15.95	90 x 30s	0.816	0.533	31.7°	94.8°	3.30 / 211°	14°	18.7 mag/sq.arcsec	16.2	
May 18.94	283 x 20s	0.796	0.461	26.2°	104.0°	4.01 / 207°	9°	17.5 mag/sq.arcsec	—	
May 20.91	50 x 20s	0.786	0.413	22.4°	111.2°	4.58 / 204°	8°	16.1 mag/sq.arcsec	—	

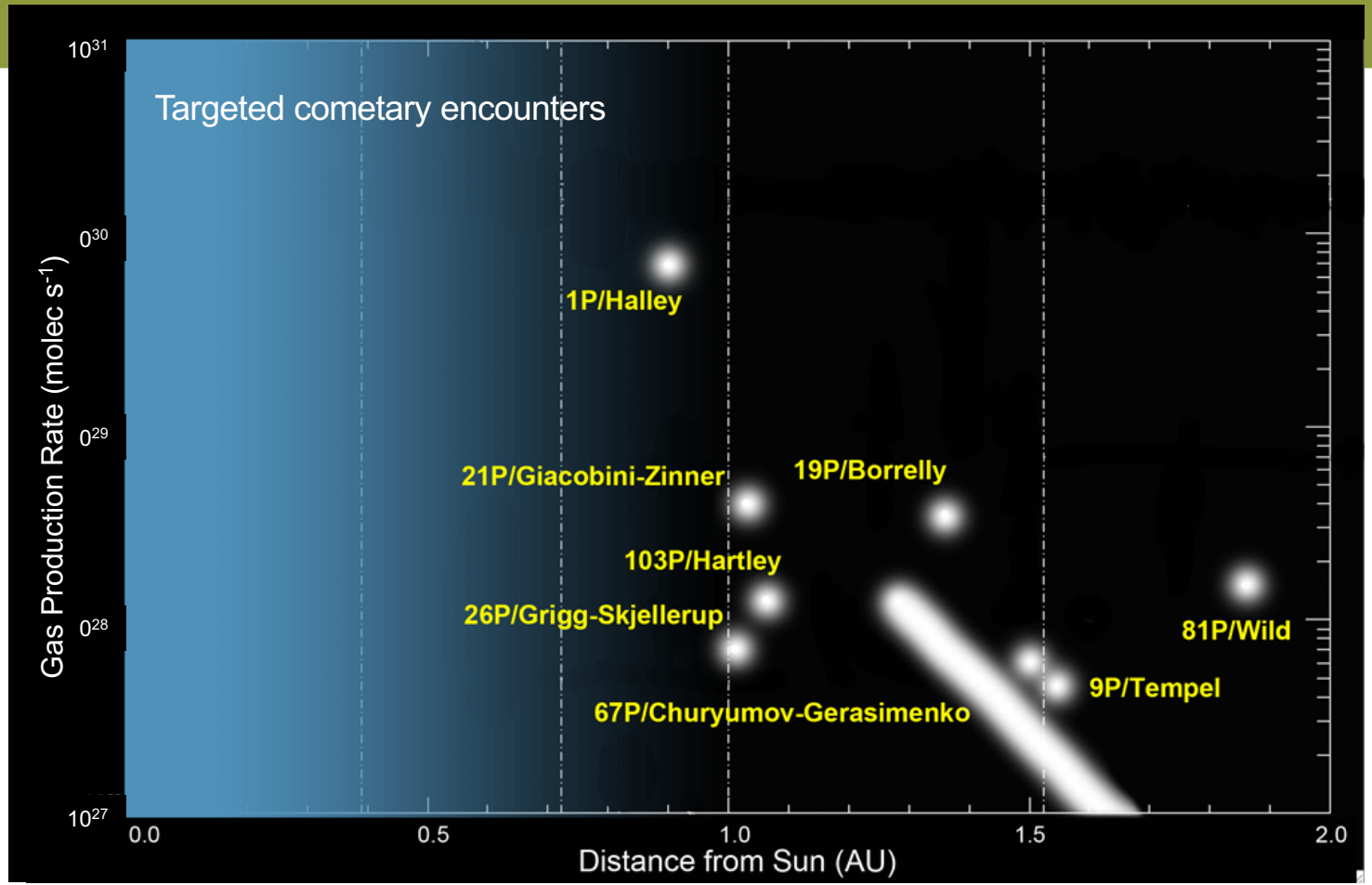
The series of images have been dark-subtracted, flat-fielded and linearly stretched by the same amount. This is done by stacking the same images at sidereal rate and measuring the zeropoint magnitude of each so that the degree of stretch can be calibrated. The lower series have been stretched exactly 4x more than the upper series, both with the background sky intensity set to (i.e. black).
The time labels along the top are the time intervals since the time of the May 8 outburst (±0.3 d), T(0)

Richard Miles, Golden Hill Observatory, Stourton Caundle, Dorset, UK (IAU Obs Code J77)

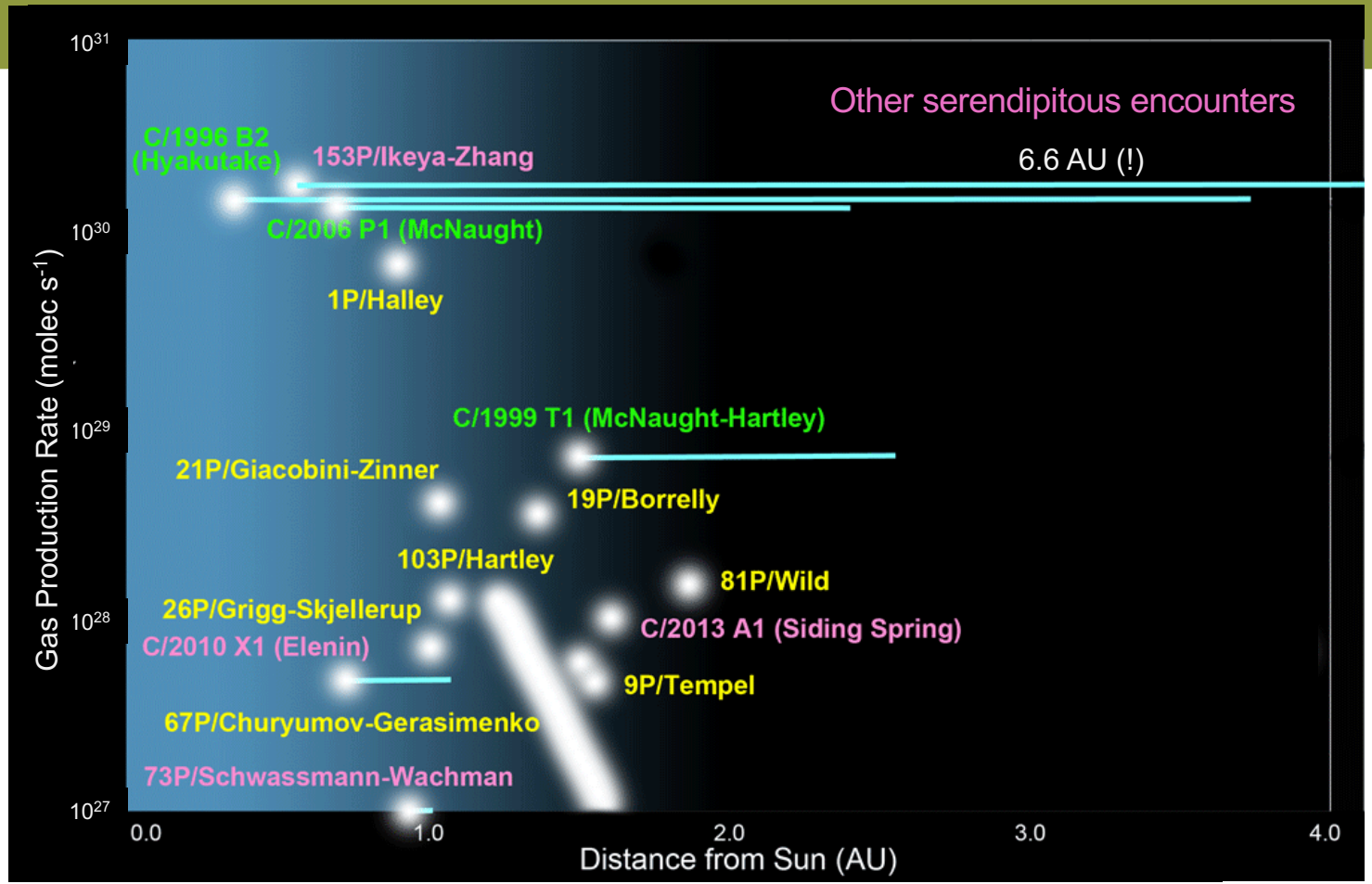
R. Miles

Consequences of fragmentation

- Likelihood of the signature of a clear, discrete ion tail probably significantly reduced compared to ~10 days ago
- However, dust/debris cloud still present – if outgassing, ions detectable by SWA around May 30/June 1?
- Localised decrease in solar wind speed?
- Still definitely worth carrying out these observations!



103P: Dello Russo+ (2011)
9P: Schleicher+ (2006)
81P:Fink+ (1999)
19P:Young+ 2004
1P:Krankowsky (1986)
26P: Johnstone+ (1993)
21P: Neugebauer+ (2007) & refs. therein



73P: Gilbert+ (2015)

C/2010 X1: Galvin+ (Fall AGU 2013)

C/2013 A1: Espley+

153P: Jones+ (subm.)

Not the last comet opportunity for Solar Orbiter!

- Search conducted for comet tail alignments in past and future missions
- Over 200 candidate periods identified, that are now being investigated
- For Solar Orbiter, potential ion tail crossing around 2021 October 22…
- Comet 342P/SOHO at 0.062 AU from Sun; Solar Orbiter 0.697 AU downstream of its location
- **Fingers crossed for the next 10 days!**