eROSITA Working Group

Solar System

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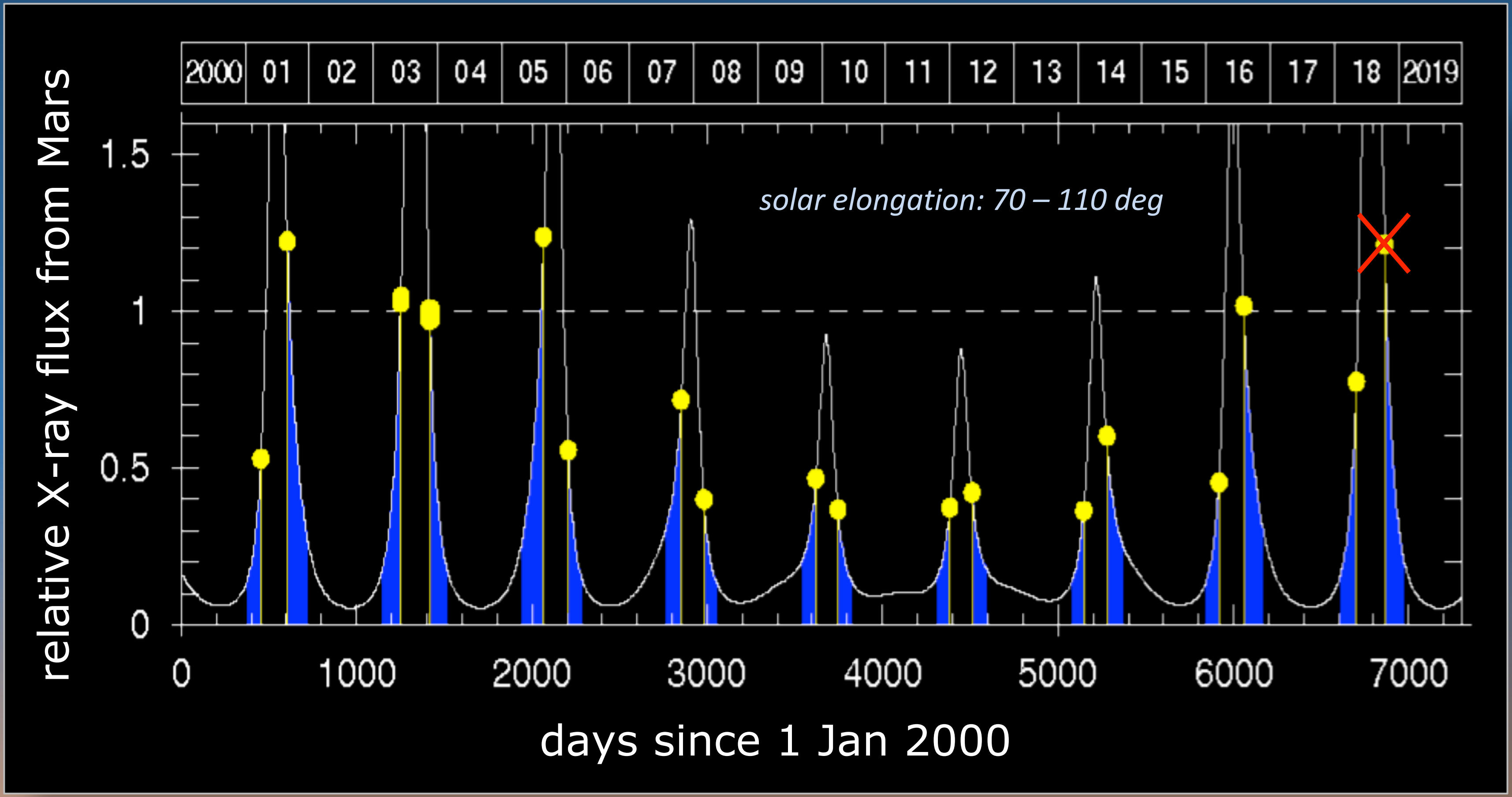
Solar System:

Planets, Comets, Heliosphere

eROSITA and Mars

plans for early science



Mars

eROSITA CalPV proposal: **Mars** (K. Dennerl)

Note: Because of visibility constraints, this proposal is only relevant if the CalPV phase overlaps with the time interval **2018-Oct-15 to 2019-Jan-26**. Mars will afterwards be unobservable for eROSITA until April 2020.

1. Scientific justification

X–rays from Mars contain information about its atmosphere and exosphere which are difficult or impossible to obtain by any other means. Thanks to observations with Chandra and XMM–Newton we know that they are a superposition of two different components, caused by scattered solar X–rays and by solar wind charge exchange. The first component originates predominantly at heights of 100 – 140 km above the surface (Dennerl 2002) and thus contains information about atmospheric layers which are difficult to study in other wavelengths. Also in–situ measurements by space probes are facing severe problems, because the atmospheric drag is too high at such low altitudes to allow stable orbits. The challenge in studying the second component is the very low particle density. Here X–rays have opened up a completely new window, because the charge exchange process is characterized by very high cross sections, which makes them the perfect means for studying the distribution of tenuous amounts of gas. XMM–Newton observations have already demonstrated that it is possible to trace the exospheric X–ray emission out to a height of 8 Martian radii, proceeding into regions beyond those which had been observationally explored before (Dennerl et al. 2006). In contrast to in–situ observations, which can only be done at one particular location and time, remote X–ray observations give us a global, instantaneous picture. In view of the temporal variations which

Mars: no CalPV target anymore

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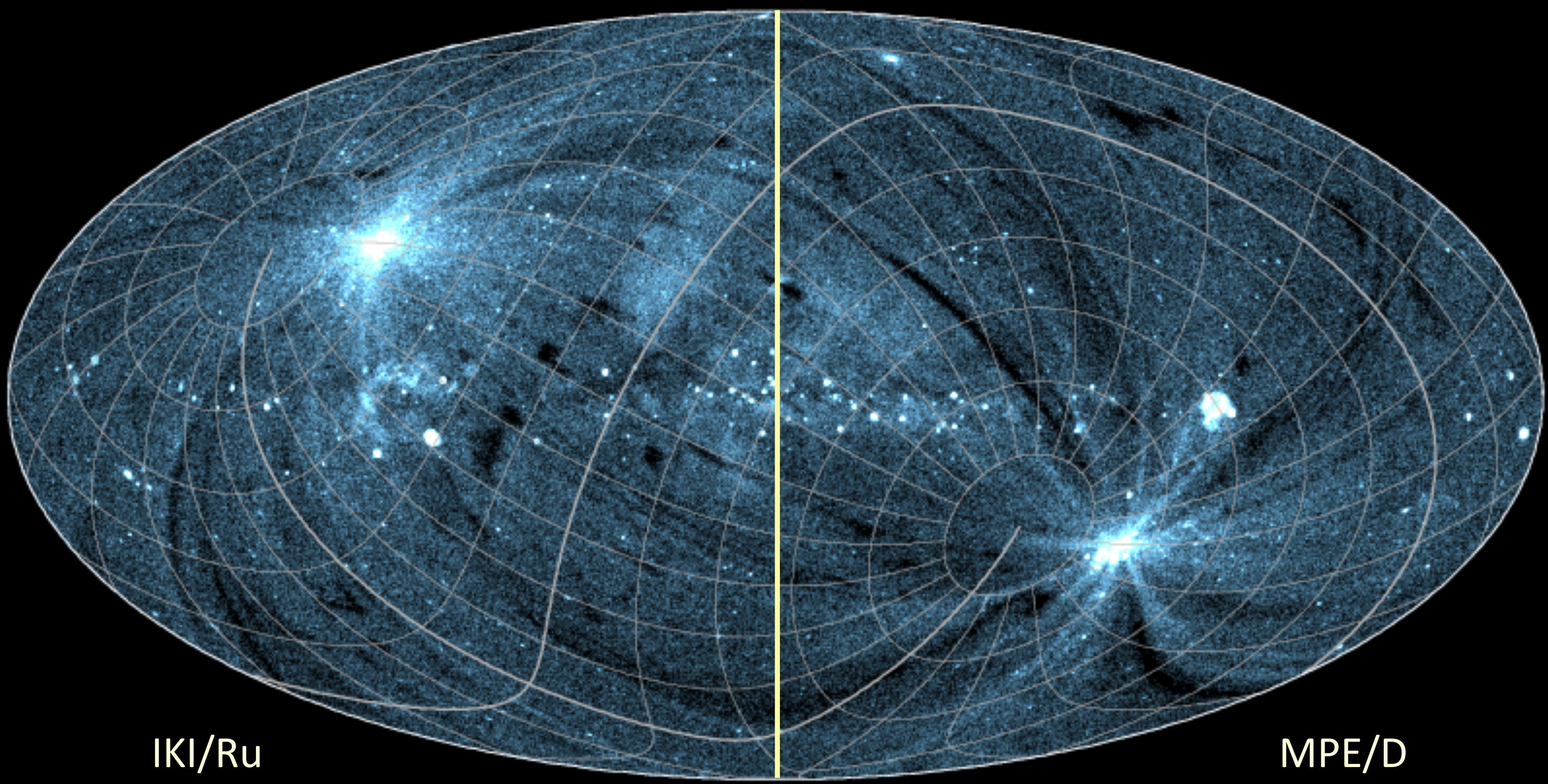
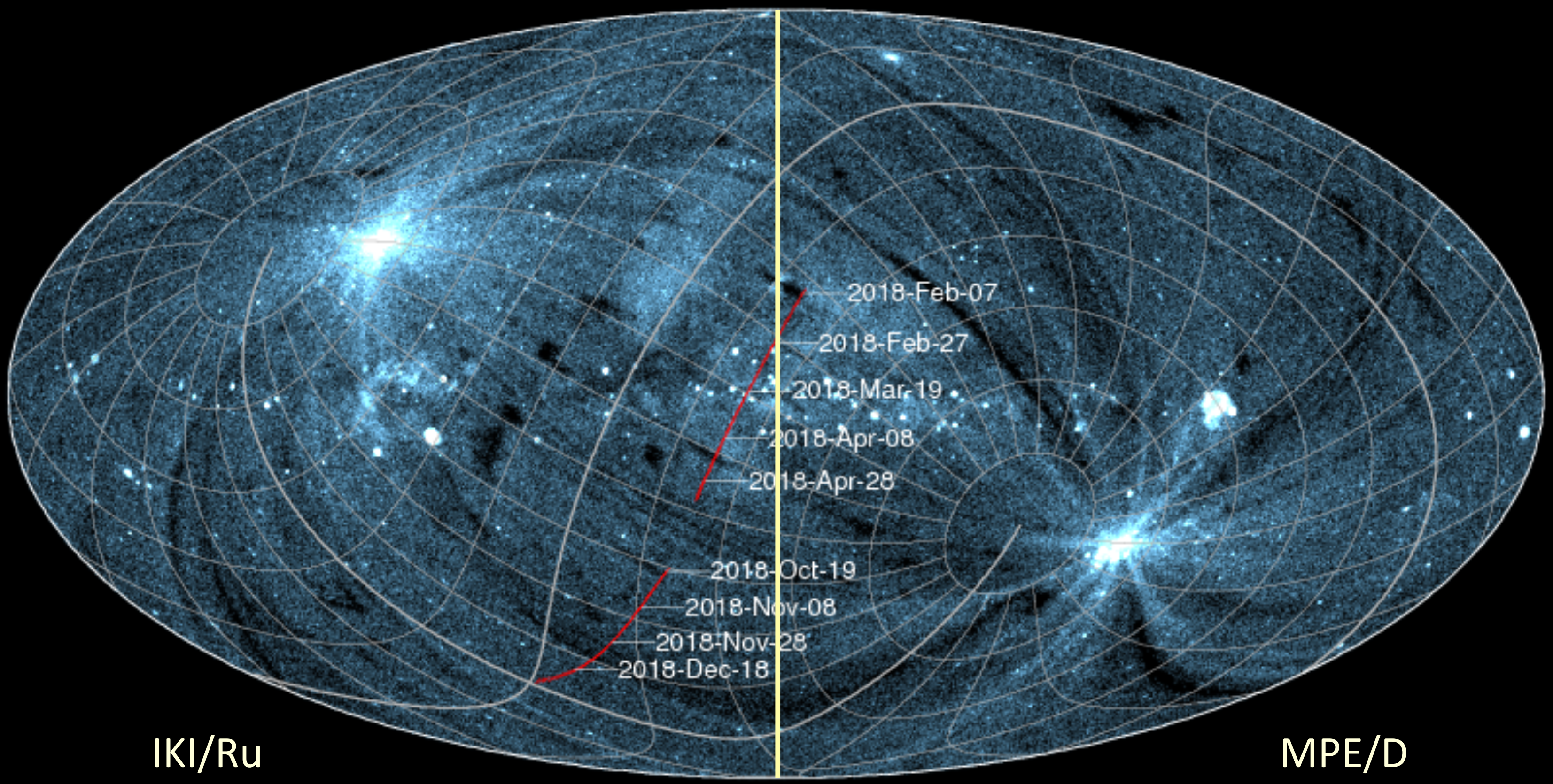


solar elongation: 70 – 110 deg

eROSITA and Planets

Mars 2018



solar elongation: 70 – 110 deg

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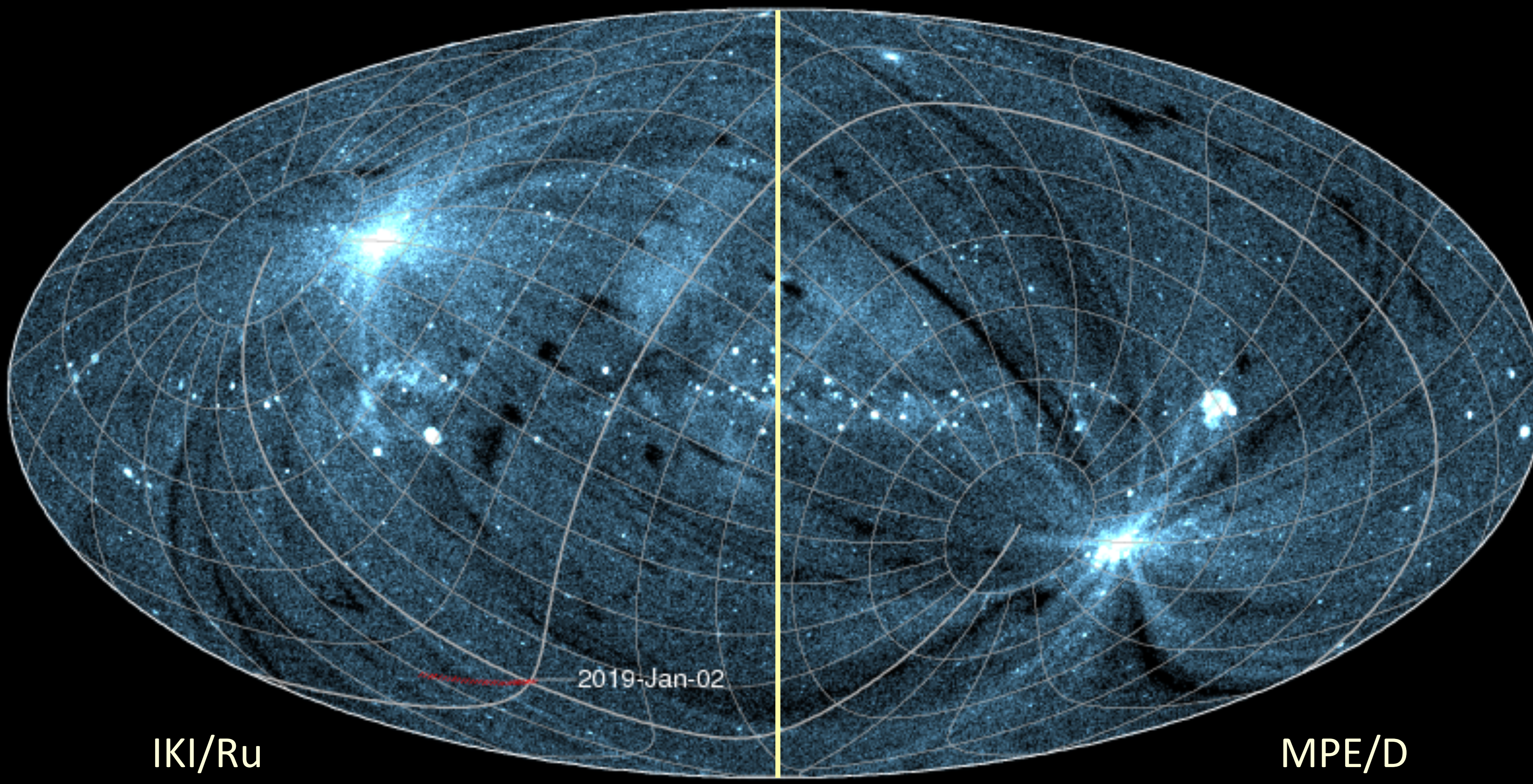
Mars 2019



solar elongation: 70 – 110 deg

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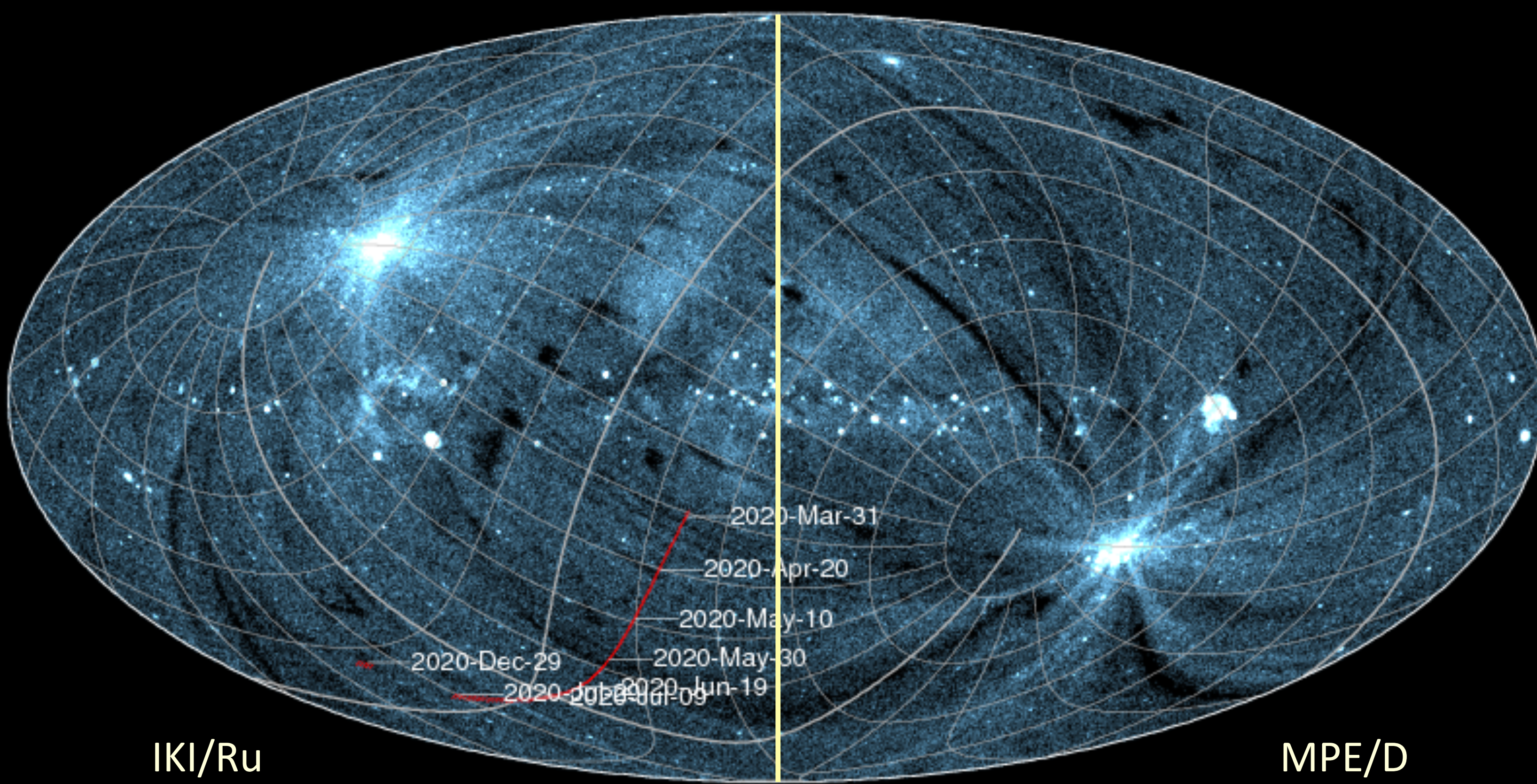
Mars 2020



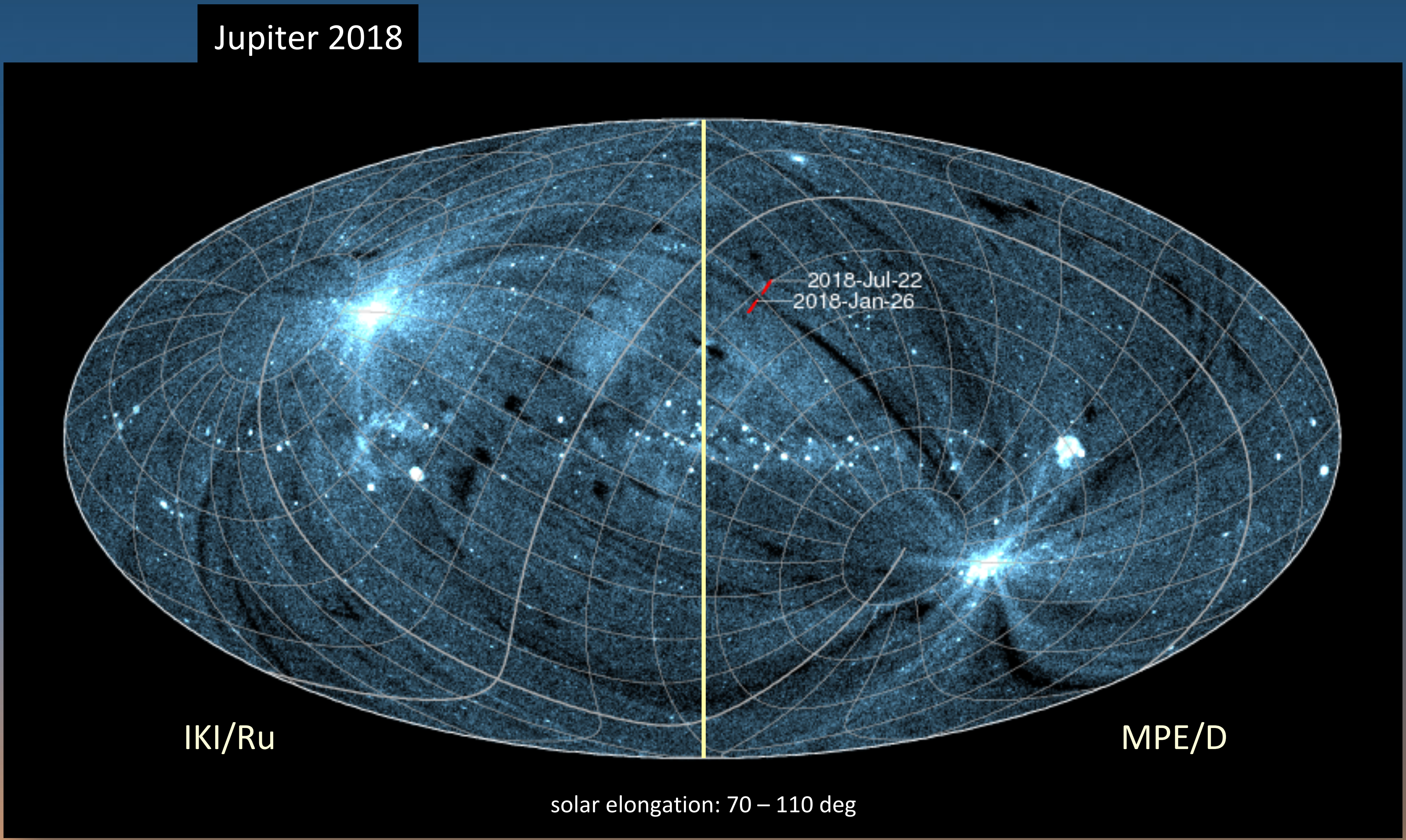
solar elongation: 70 – 110 deg

eROSITA and Planets

Mars: eROSITA visibilities 2018 - 2025

~~2018-Feb-05~~	~~..~~	~~2018-Feb-23~~	~~MPE~~
~~2018-Feb-24~~	~~..~~	~~2018-May-06~~	~~IKI~~
~~2018-Oct-17~~	~~..~~	~~2019-Jan-29~~	~~IKI~~
2020-Mar-29	..	2020-Jul-30	IKI
2020-Dec-27	..	2021-Mar-19	IKI
2022-Jun-22	..	2022-Sep-20	IKI
2022-Sep-21	..	2022-Oct-04	MPE
2023-Feb-13	..	2023-Mar-07	IKI
2023-Mar-08	..	2023-Apr-27	MPE
2024-Aug-29	..	2024-Nov-15	MPE
2025-Mar-21	..	2025-Jun-01	MPE

eROSITA and Planets



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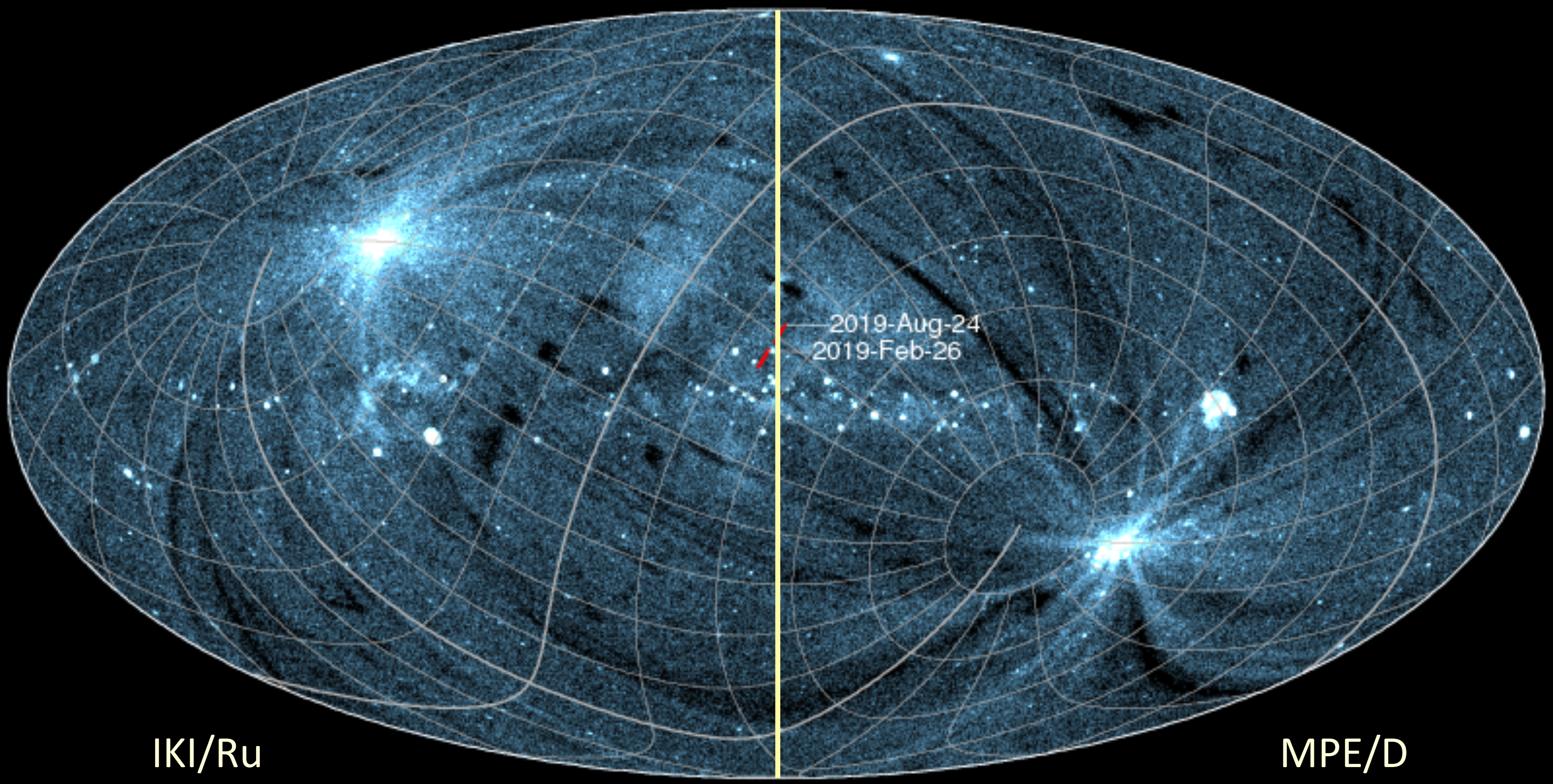
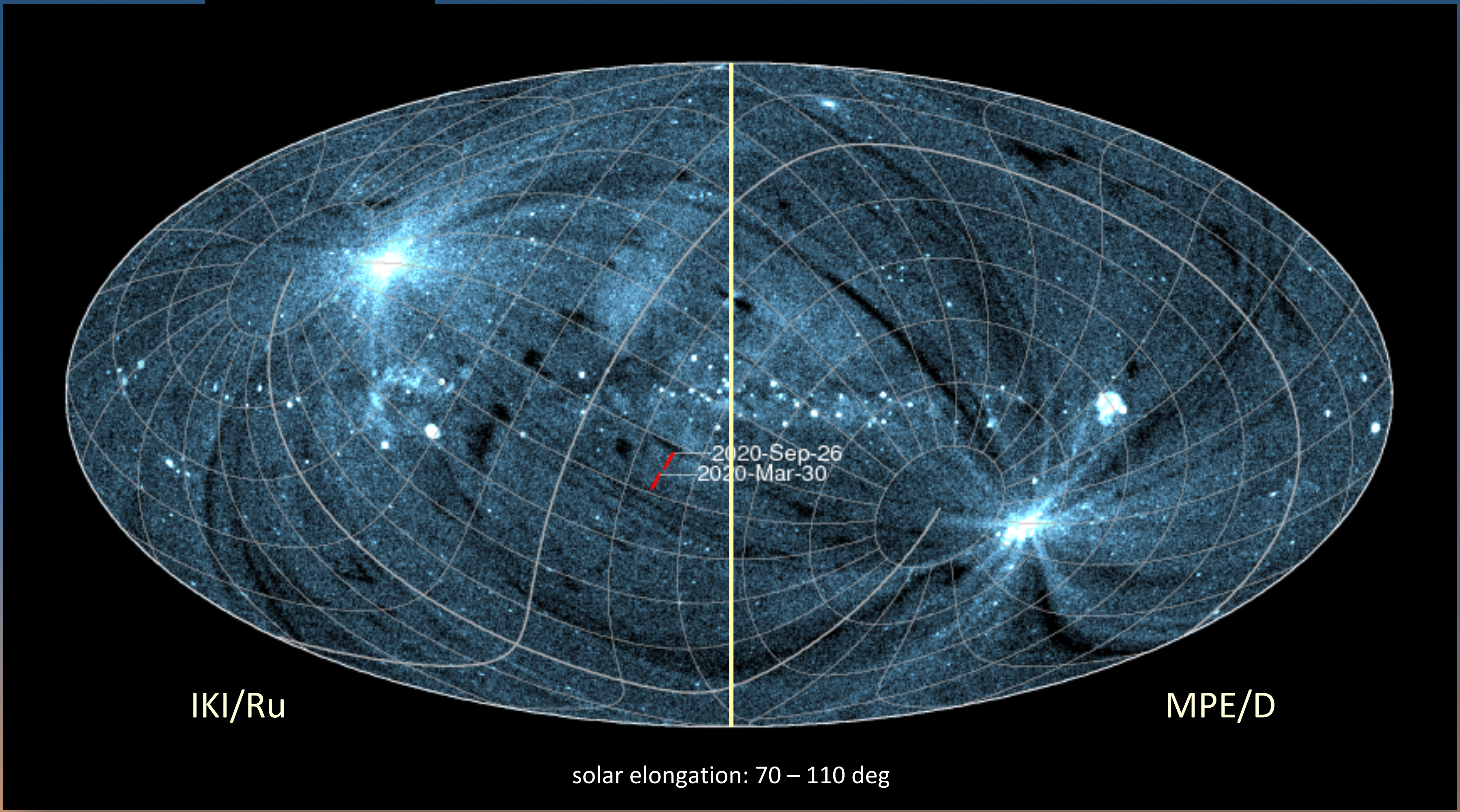
Jupiter 2019



solar elongation: 70 – 110 deg

eROSITA and Planets

Jupiter 2020



solar elongation: 70 – 110 deg

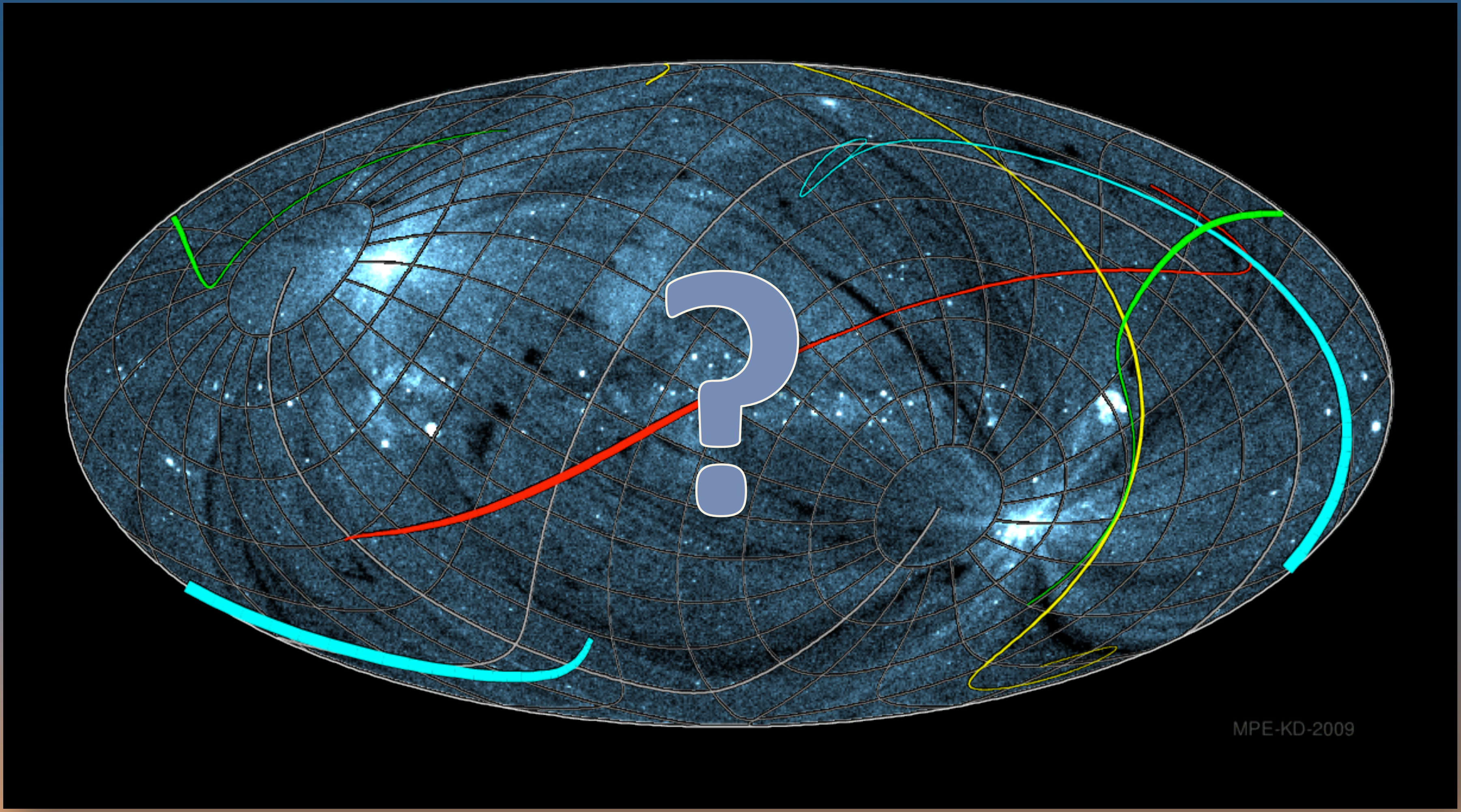
eROSITA and Planets

Jupiter: eROSITA visibilities 2018 - 2025

~~2018-Jan-20 .. 2018-Mar-03 MPE~~
~~2018-Jul-16 .. 2018-Aug-30 MPE~~
~~2019-Feb-20 .. 2019-Apr-04 IKI~~
2019-Aug-18 .. 2019-Sep-22 MPE
2019-Sep-23 .. 2019-Oct-01 IKI
2020-Mar-24 .. 2020-May-07 IKI
2020-Sep-20 .. 2020-Nov-03 IKI
2021-Apr-28 .. 2021-Jun-12 IKI
2021-Oct-26 .. 2021-Dec-08 IKI
2022-Jun-06 .. 2022-Jul-21 IKI
2022-Dec-02 .. 2023-Jan-13 IKI
2023-Jul-15 .. 2023-Aug-29 IKI
2024-Jan-07 .. 2024-Feb-18 IKI
2024-Aug-20 .. 2024-Oct-04 MPE
2025-Feb-10 .. 2025-Mar-25 IKI

eROSITA and Comets

plans for early science

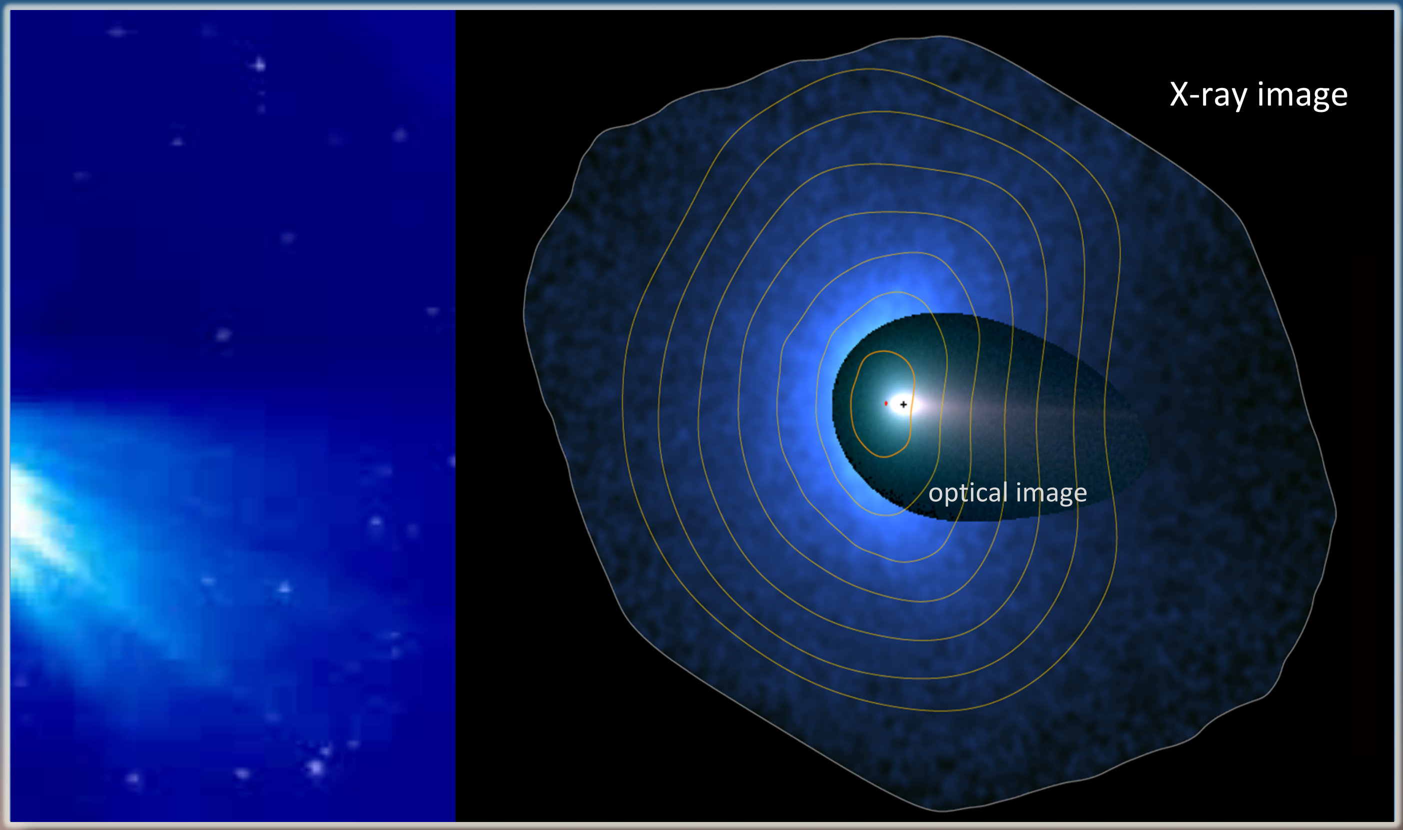


eROSITA and Comets

2019 - 2126

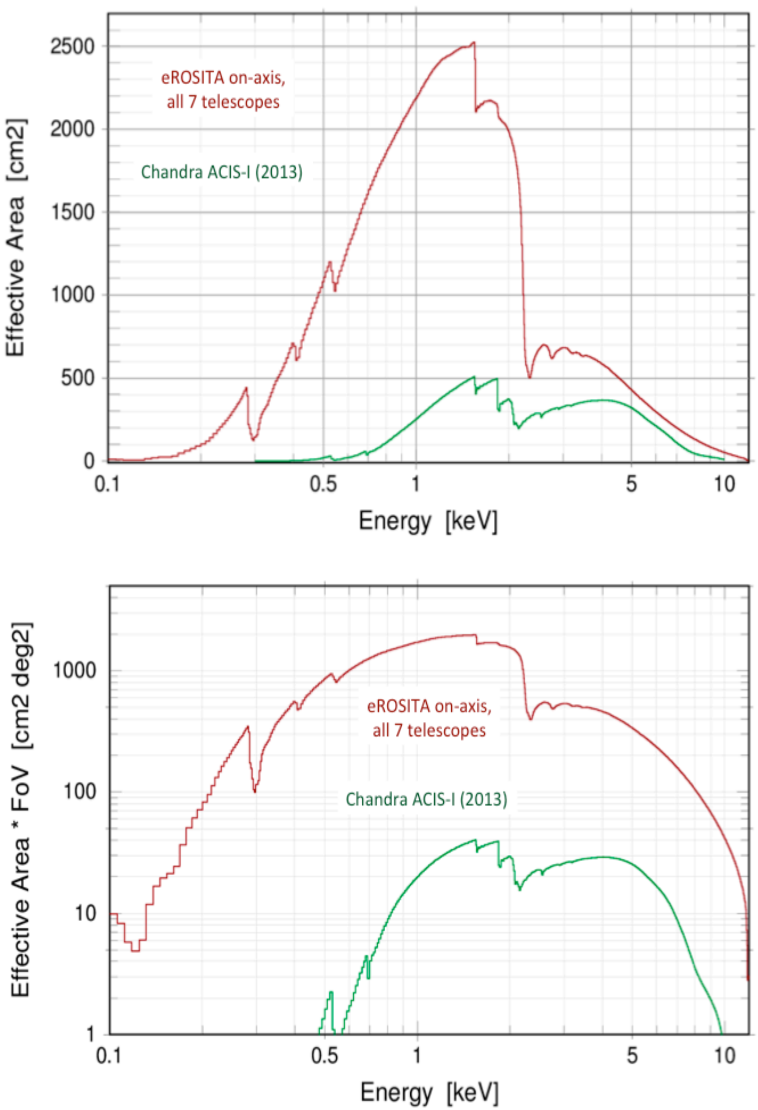
Formal Name (Designation)	Informal Name	Discovery	Next Perihelion	Orbit (yrs)	Diameter
29P/Schwassmann-Wachmann 1	Comet Schwassmann-Wachmann 1	1927/11/15	2019/03/07	14.65	30.8 km
69P/Taylor	Comet Taylor	1915/11/24	2019/03/18	6.95	
78P/Gehrels 2	Comet Gehrels 2	1973/09/29	2019/04/02	7.22	
31P/Schwassmann-Wachmann 2	Comet Schwassmann-Wachmann 2	1929/01/17	2019/07/06	8.7	6.2 km
25D/Neujmin 2	Comet Neujmin 2	1916/02/24	2019/08/17	5.43	
68P/Klemola	Comet Klemola	1965/11/01	2019/11/09	10.82	4.4 km
101P/Chernykh	Comet Chernykh	1977/08/19	2020/01/13		5.6 km
36P/Whipple	Comet Whipple	1933/10/15	2020/05/31	8.5	4.56 km
28P/Neujmin 1	Comet Neujmin 1	1913/09/04	2021/03/11	18.17	21.4 km
8P/Tuttle	Comet Tuttle	1790/01/09	2021/08/27	13.6	4.5 km
99P/Kowal 1	Comet Kowal 1	1977/04/24	2022/04/12	15.06	10.2 km
39P/Oterma	Comet Oterma	1943/04/08	2023/07/11	19.43	
12P/Pons-Brooks	Comet Pons-Brooks	1812/07/21	2024/04/21	70.85	
13P/Olbers	Comet Olbers	1815/03/06	2024/06/30	69.5	
55P/Tempel-Tuttle	Comet Tempel-Tuttle	1866/01/06	2031/05/20	33.22	3.6 km
27P/Crommelin	Comet Crommelin	1818/02/23	2039/05/27	27.4	
23P/Brorsen-Metcalf	Comet Brorsen-Metcalf	1847/07/20	2059/06/08	70.52	
1P/Halley	Comet Halley (Halley's Comet)	1758/12/25	2061/07/28	75.3	11.0 km
35P/Herschel-Rigollet	Comet Herschel-Rigollet	1788/12/21	2092/02/17	155	
109P/Swift-Tuttle	Comet Swift-Tuttle	1862/07/16	2126/07/12	133.28	27.0 km

Charge Exchange at a Comet

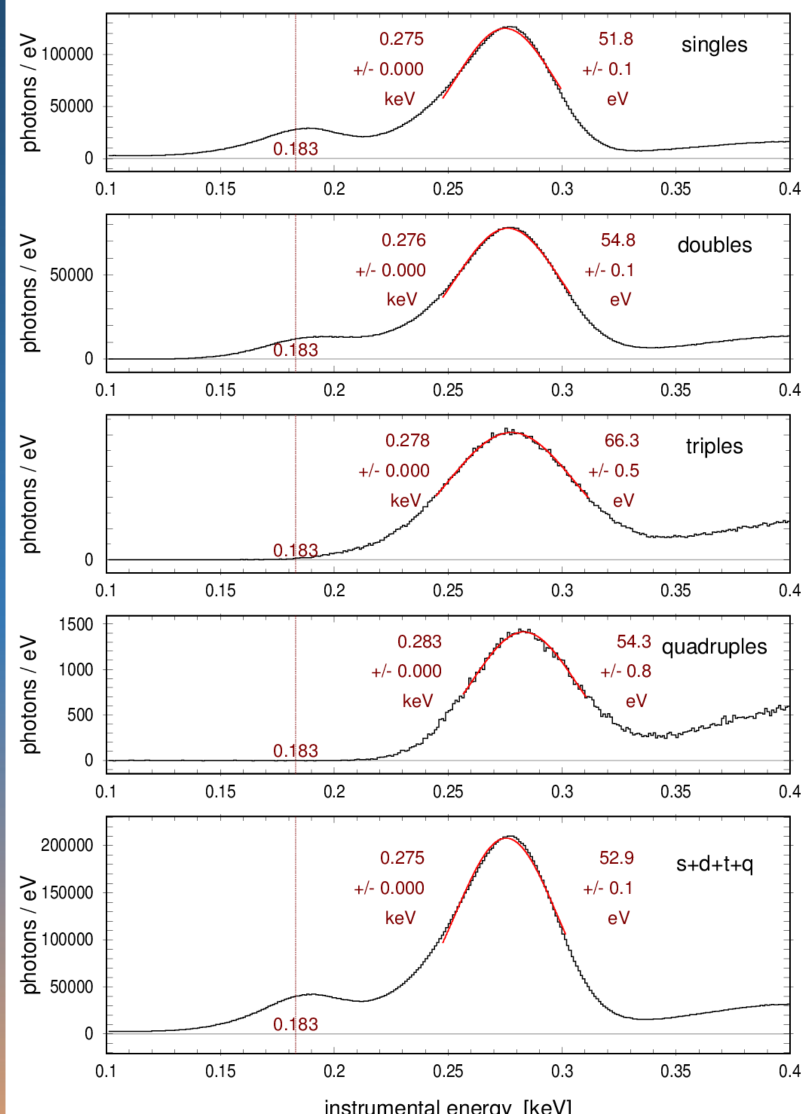


Cravens 1997 (GRL 24), Cravens 2002 (Science 296) Dennerl et al. 2002

eROSITA sensitivity



eROSITA spectral resolution (CA-FM1)



Comet C/2016 R2 Panstarrs
Taken by Gerald Rhemann on January 9, 2018 @ Farm Tivoli, Namibia SW-Africa

The Astrophysical Journal Letters, 854:L10 (4pp), 2018 February 10
https://doi.org/10.3847/2041-8213/aaab57

CrossMark

Strong CO^+ and N_2^+ Emission in Comet C/2016 R2 (Pan-STARRS)*

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Received 2018 January 3; revised 2018 January 24; accepted 2018 January 29; published 2018 February 9

Abstract

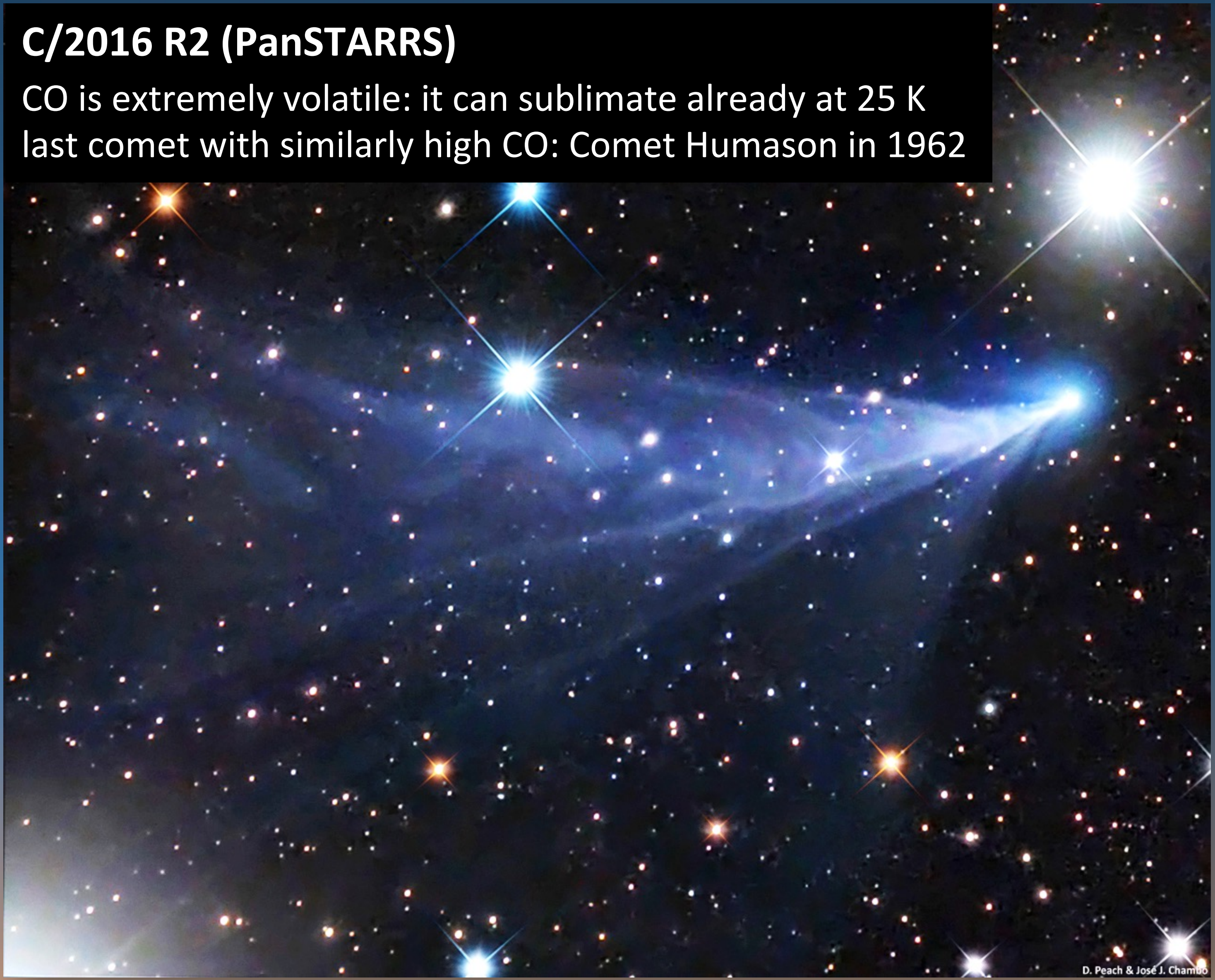
We report on imaging and spectroscopic observations of comet C/2016 R2 (Pan-STARRS) obtained with the 0.8 m and 2.7 m telescopes of McDonald Observatory in 2017 November and December, respectively. The comet was at a heliocentric distance greater than 3 au during both sets of observations. The images showed a well-developed tail with properties that suggested it was an ion tail. The spectra confirmed that we were observing well-developed bands of CO^+ and N_2^+. The N_2^+ detection was unequivocally cometary and was one of the strongest bands of N_2^+ detected in a comet spectrum. We derived the ratio of these two ions and from that we were able to derive that $N_2/CO = 0.15$. This is the highest such ratio reported for a comet.

Key words: comets: individual (2016 R2) – molecular processes – protoplanetary disks

Comet C/2016 R2 (Pan-STARRS) showed an unusual optical spectrum with strong CO^+ and N_2^+ emissions and none of the usual neutrals seen in most cometary spectra. This intriguing object showed the strongest and clearest N_2^+ emissions ever detected with modern digital spectra. Faced with this unusual spectrum, we have alerted many members of the cometary community and they (and we) are requesting follow-up observations with a variety of instruments at all wavelengths in order to try to understand this unusual comet.

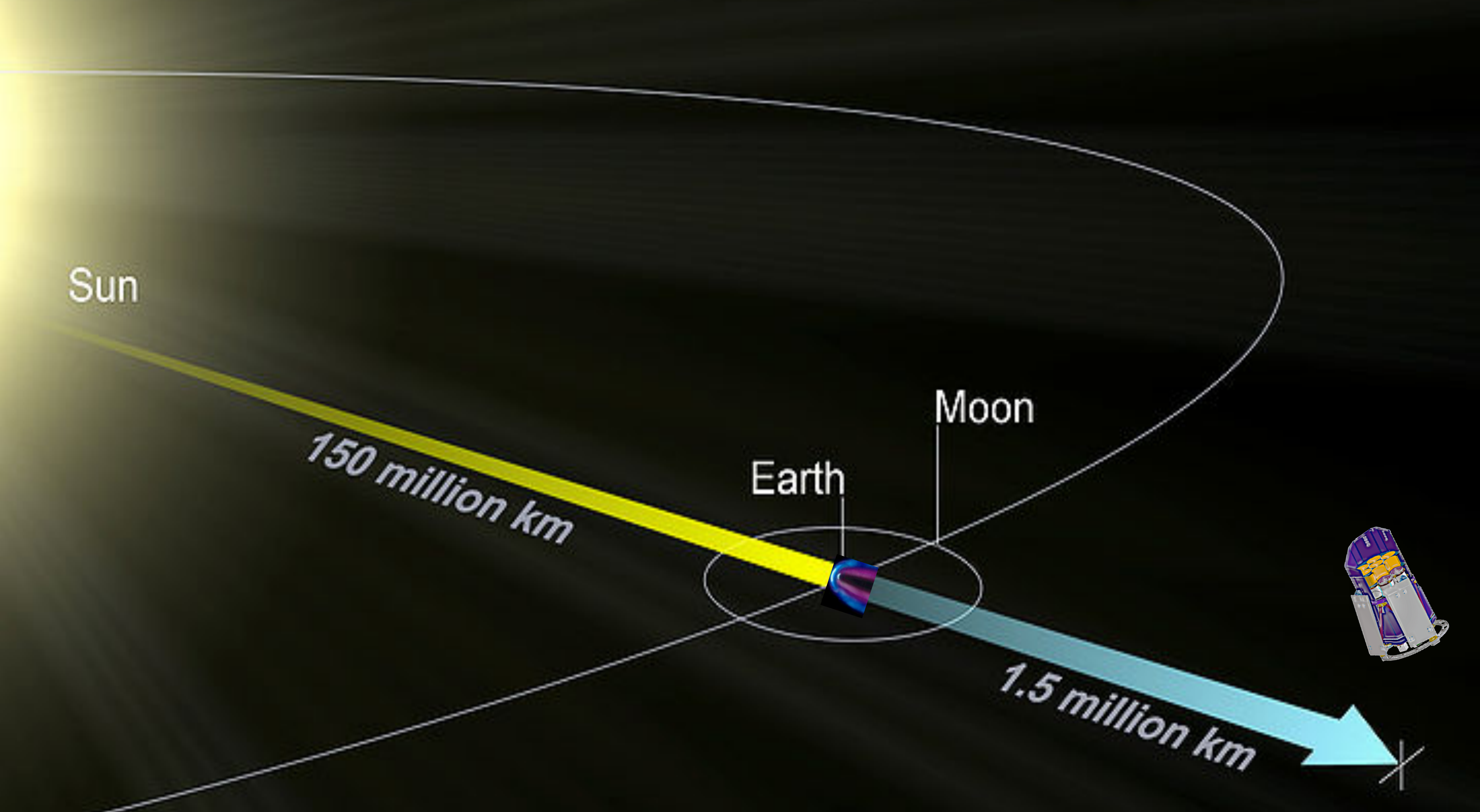
C/2016 R2 (PanSTARRS)

CO is extremely volatile: it can sublimate already at 25 K
last comet with similarly high CO: Comet Humason in 1962



Damian Peach, Jose J. Chambo, APOD 2018 Jan 12

eROSITA and the Heliosphere

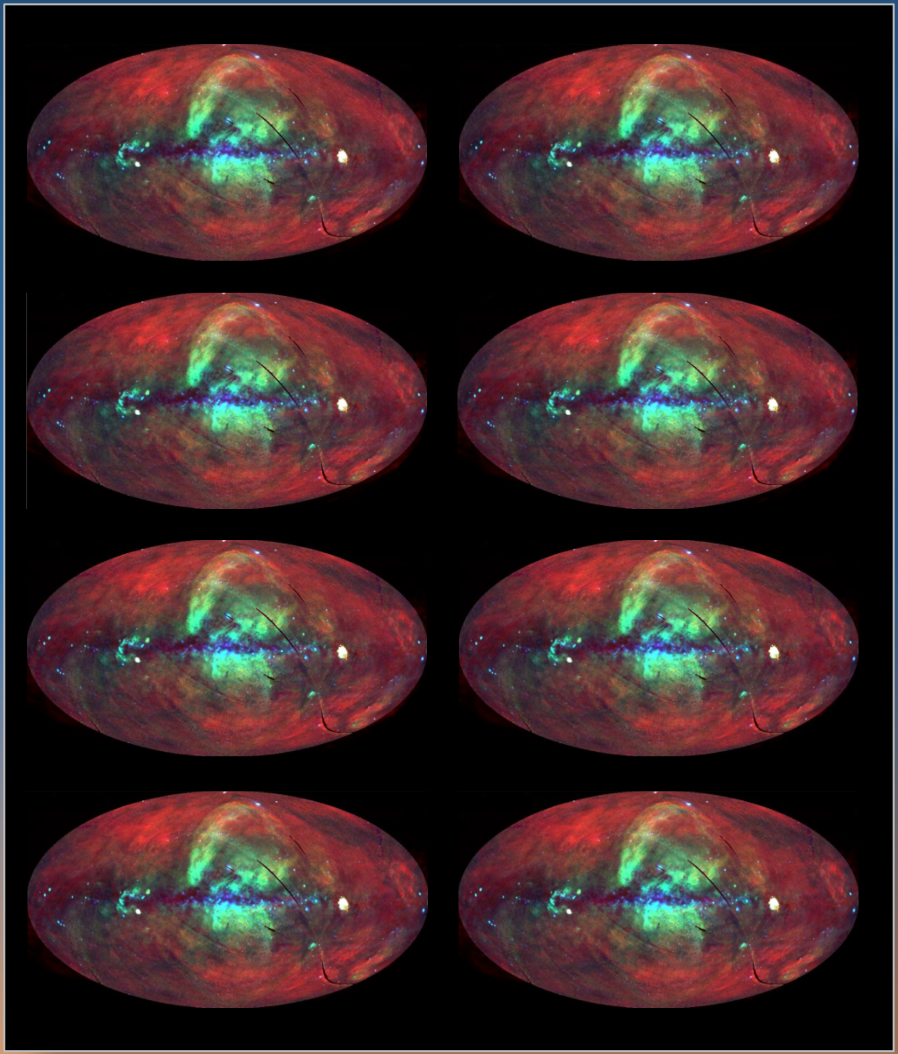


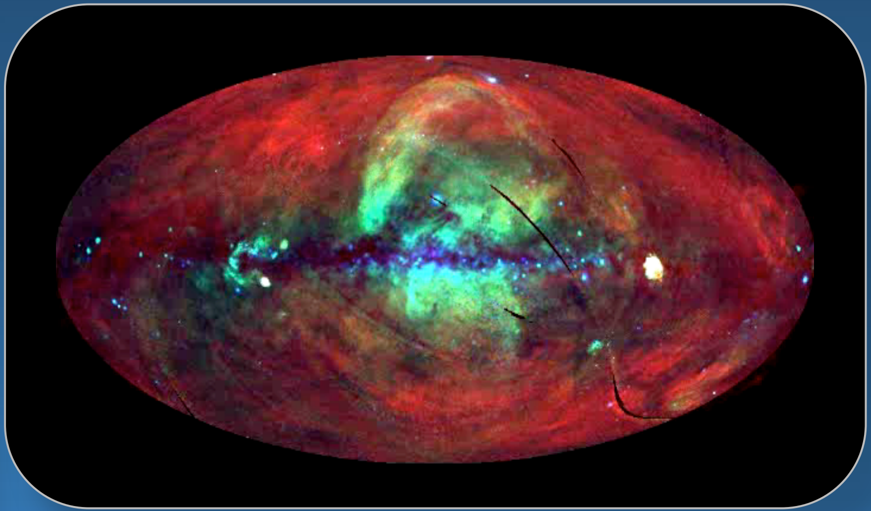
L2: CX contribution from geocorona negligible

8 all-sky surveys in 4 years (1/3 solar cycle)

→ possibility to disentangle heliospheric CX emission from diffuse galactic emission

Heliospheric Charge Exchange Emission





- ✓ L2: CX contribution from geocorona negligible
- ✓ 8 all-sky surveys in 4 years (1/3 solar cycle)
- ✓ X-ray CCD spectral resolution
- → **possibility to disentangle heliospheric CX emission from diffuse galactic emission**

reduced sensitivity with „5+2“ filter choice

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Solar System