40th anniversary of SOPIZ PTMA - Conference, 27-28.04.2019
Warsaw, Best Western Hotel PORTOS, ul. Mangalia 3a
28.04.2019, godz. 11.00

Automatic sky surveys - human versus machine

Adam Tużnik

Polish Society of Astronomy Lovers
(PTMA Kraków, Kielce); Comet Observers Section (SOK PTMA)

Faculty of Physics, Astronomy and Applied Computer Science
Jagiellonian University in Cracow, ul. Łojasiewicza 11

UNIWERSYTET JAGIELLOŃSKI
W KRAKOWIE

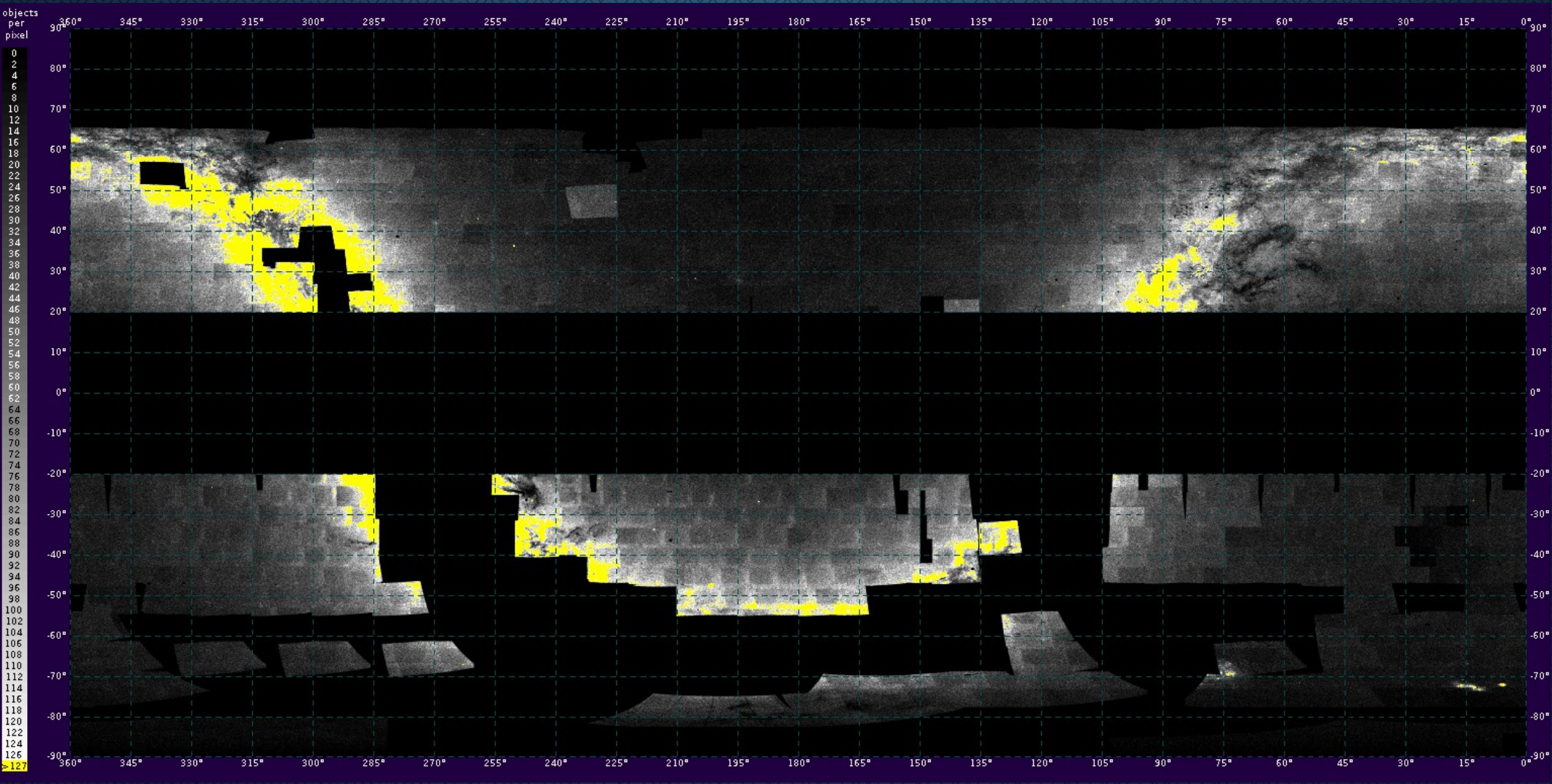
Automatic sky surveys

UNIWERSYTET JAGIELLOŃSKI
W KRAKOWIE

SuperWASP (Wide Angle Search for Planets)

Image Credit: **SuperWASP** project & David Anderson

SuperWASP (Wide Angle Search for Planets)



https://wasp.cerit-sc.cz/img/skycoverage.png


www.superwasp.org/gallery

Sloan Digital Sky Survey (SDSS)

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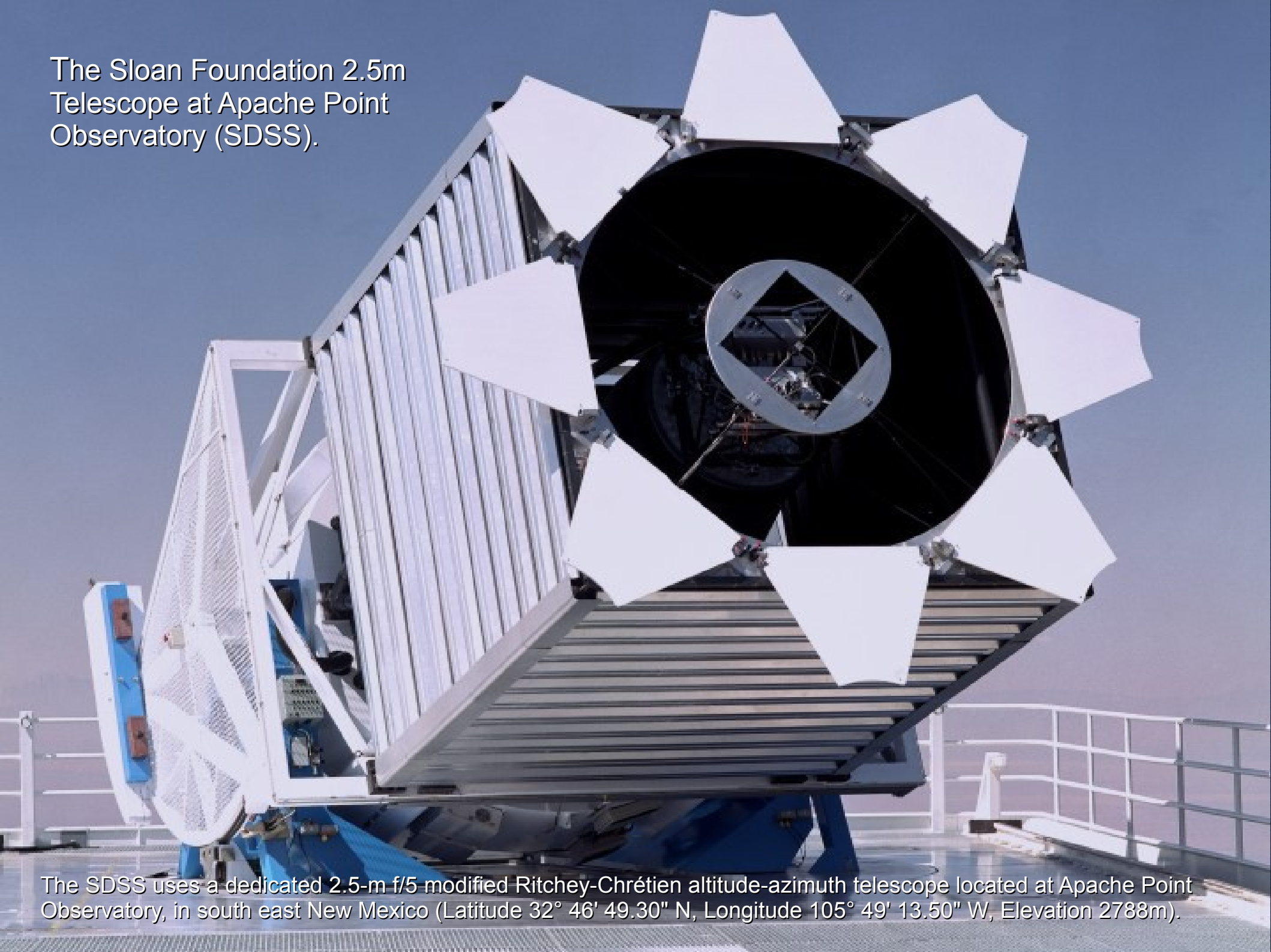
W KRAKOWIE



The Sloan Foundation 2.5m Telescope at Apache Point Observatory (SDSS).

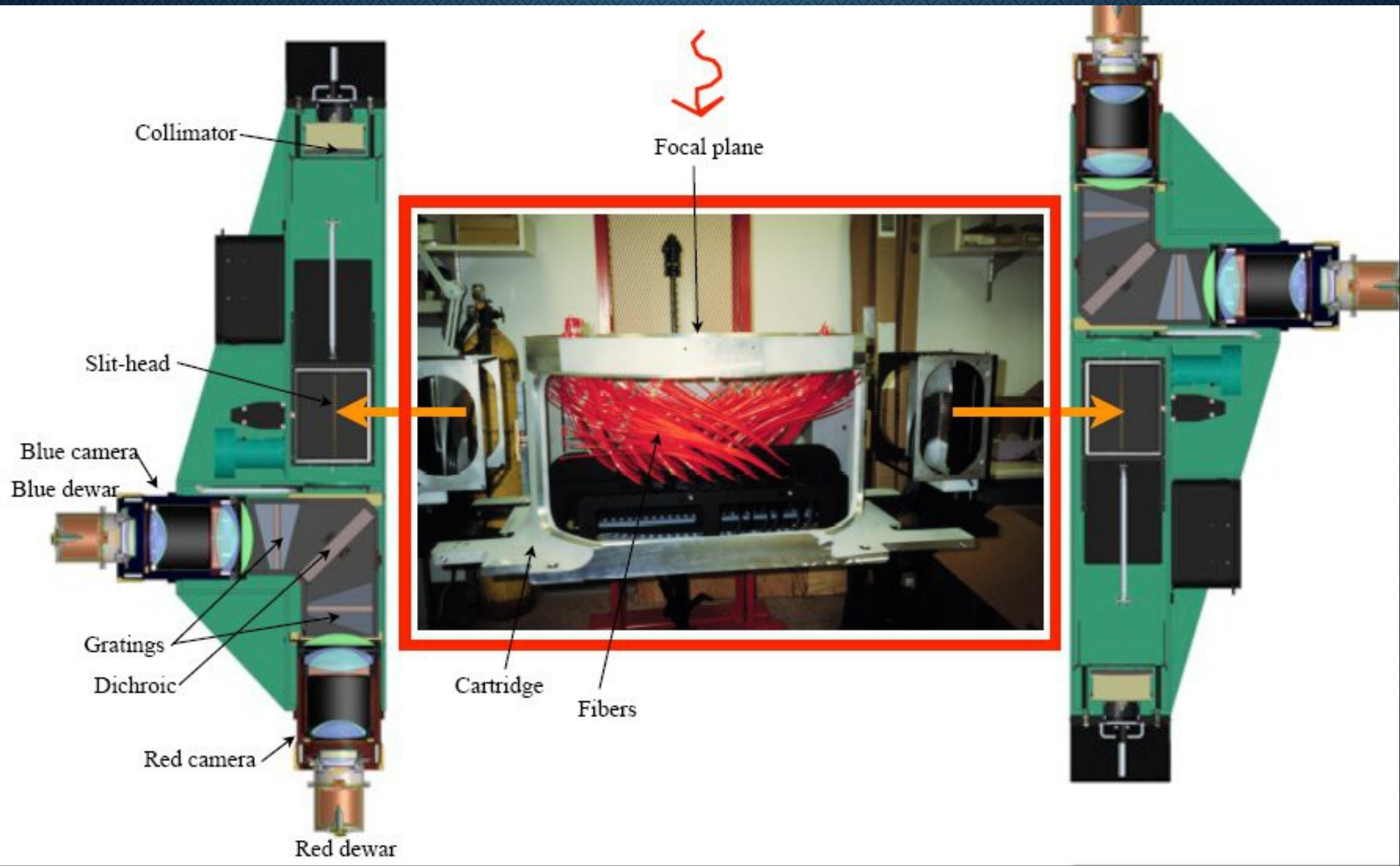
The SDSS uses a dedicated 2.5-m f/5 modified Ritchey-Chrétien altitude-azimuth telescope located at Apache Point Observatory, in south east New Mexico (Latitude 32° 46' 49.30" N, Longitude 105° 49' 13.50" W, Elevation 2788m).

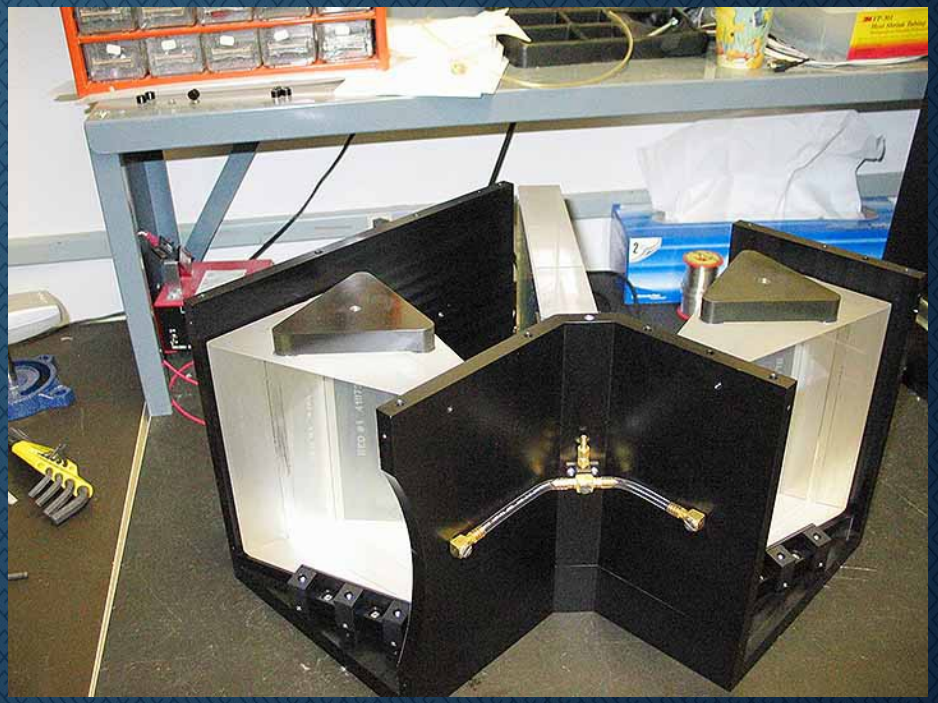
An illustration of the arrangement of the CCDs and filters on the SDSS-III camera. A detailed description of the imager can be found in Gunn et al. (1998) and in the SDSS-I project book.

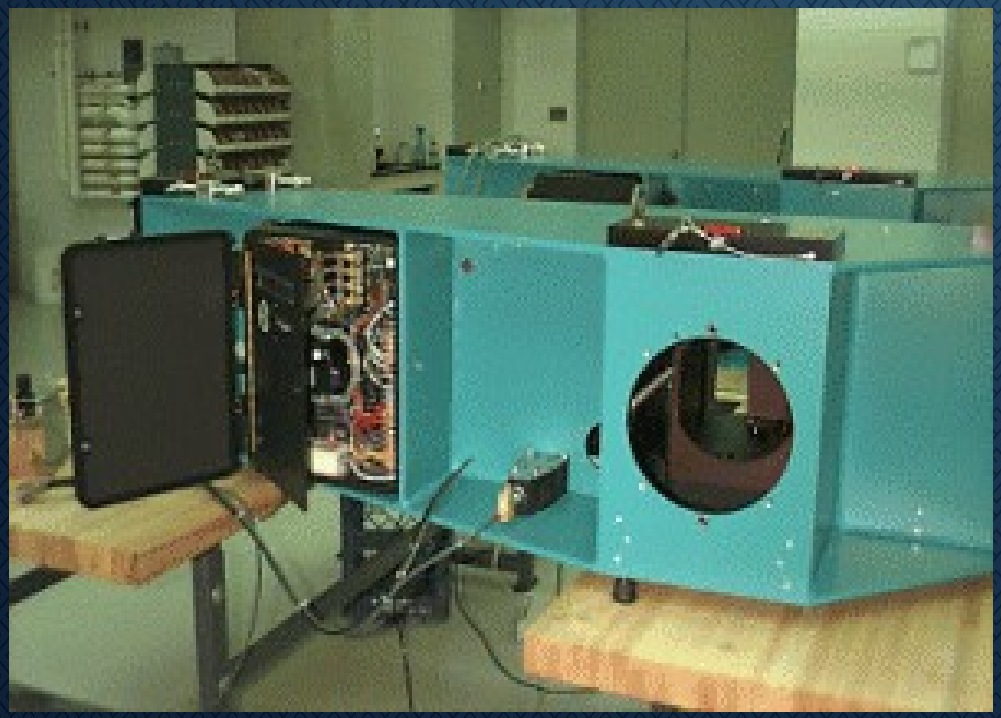
The Irénée du Pont Telescope at Las Campanas Observatory in Chile.

www.sdss.org/instruments/camera

BOSS is an SDSS-III spectroscopic survey that measured redshifts of 1.5 million luminous red galaxies and Lyman-alpha absorption towards 160,000 high redshift quasars.







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Main Parameter Summary

Number of spectrographs

2

Spectral resolution

1560-2270 in the blue channel, 1850-2650 in the red channel

Wavelength coverage

3600-10,400 Angstroms

Fiber diameter

2 arcsec

CCDs

4Kx4K fully-depleted LBNL CCDs with 15 micron pixels for the red side, blue-sensitive 4Kx4K e2V CCDs with 15 micron pixels for the blue side

Collimator coating reflectivity

>95% from 420 nm to 1000 nm

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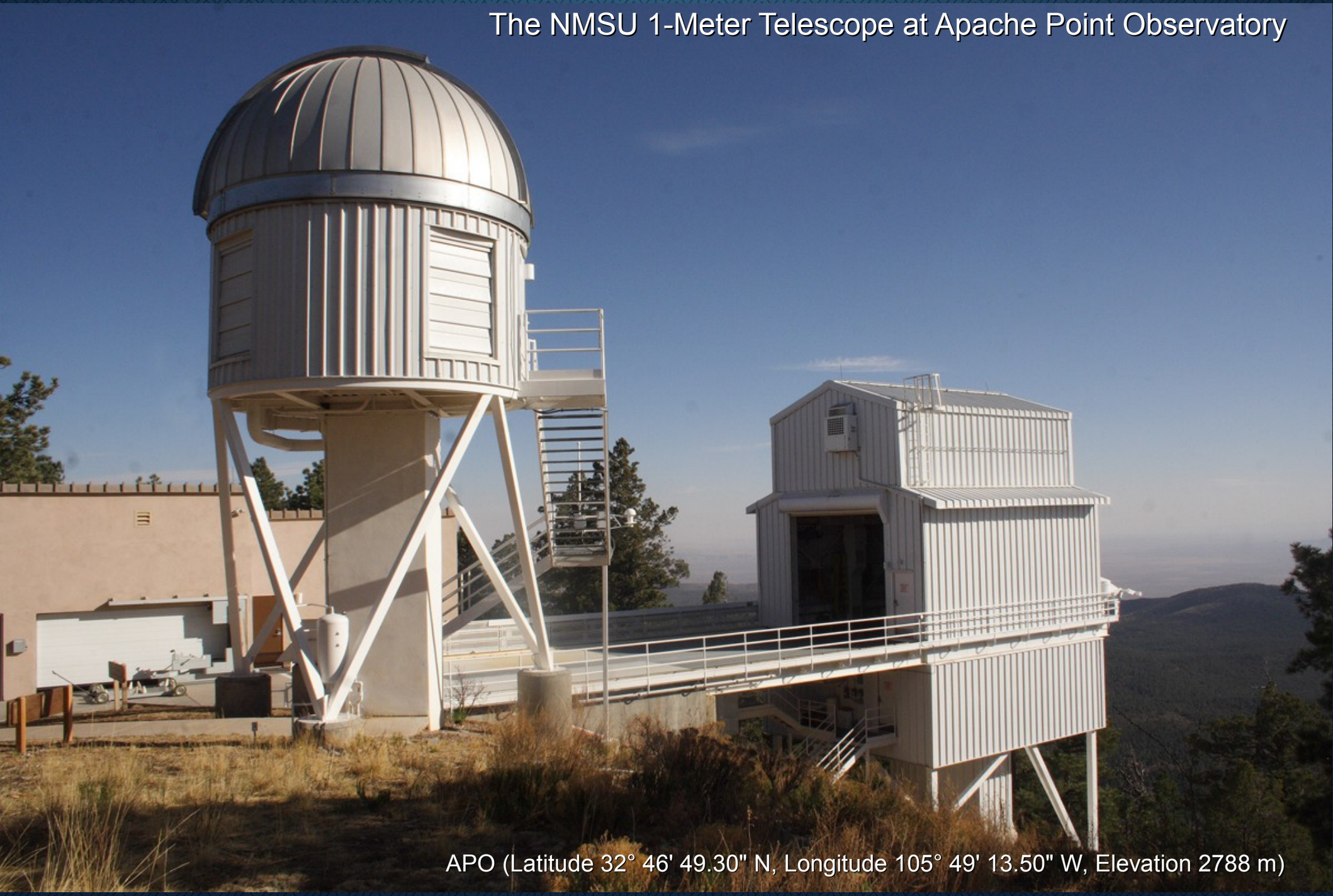
W KRAKOWIE

The NMSU 1-Meter Telescope at Apache Point Observatory



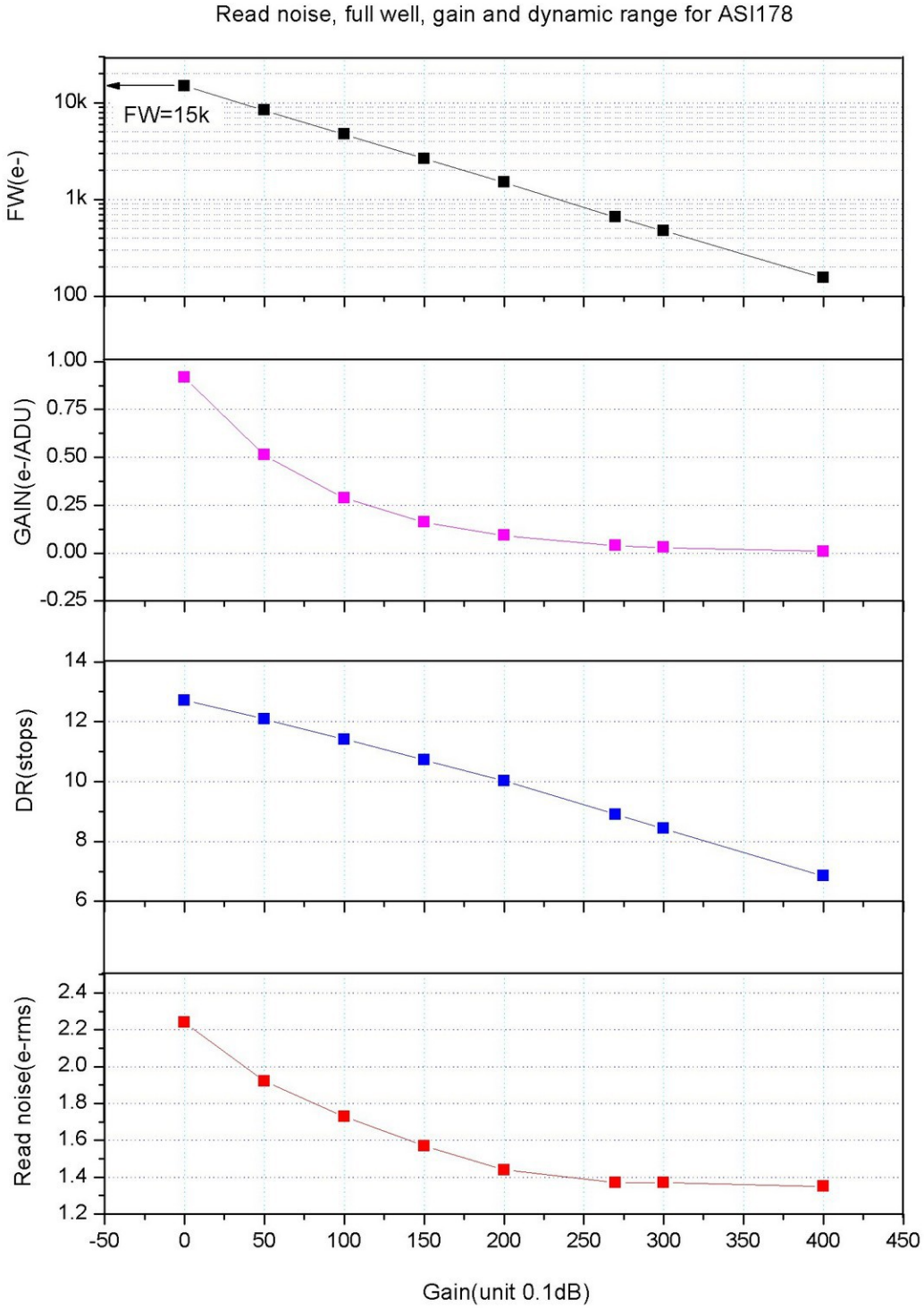
APO (Latitude 32° 46' 49.30" N, Longitude 105° 49' 13.50" W, Elevation 2788 m)

My observation station – Ożarów (Poland)

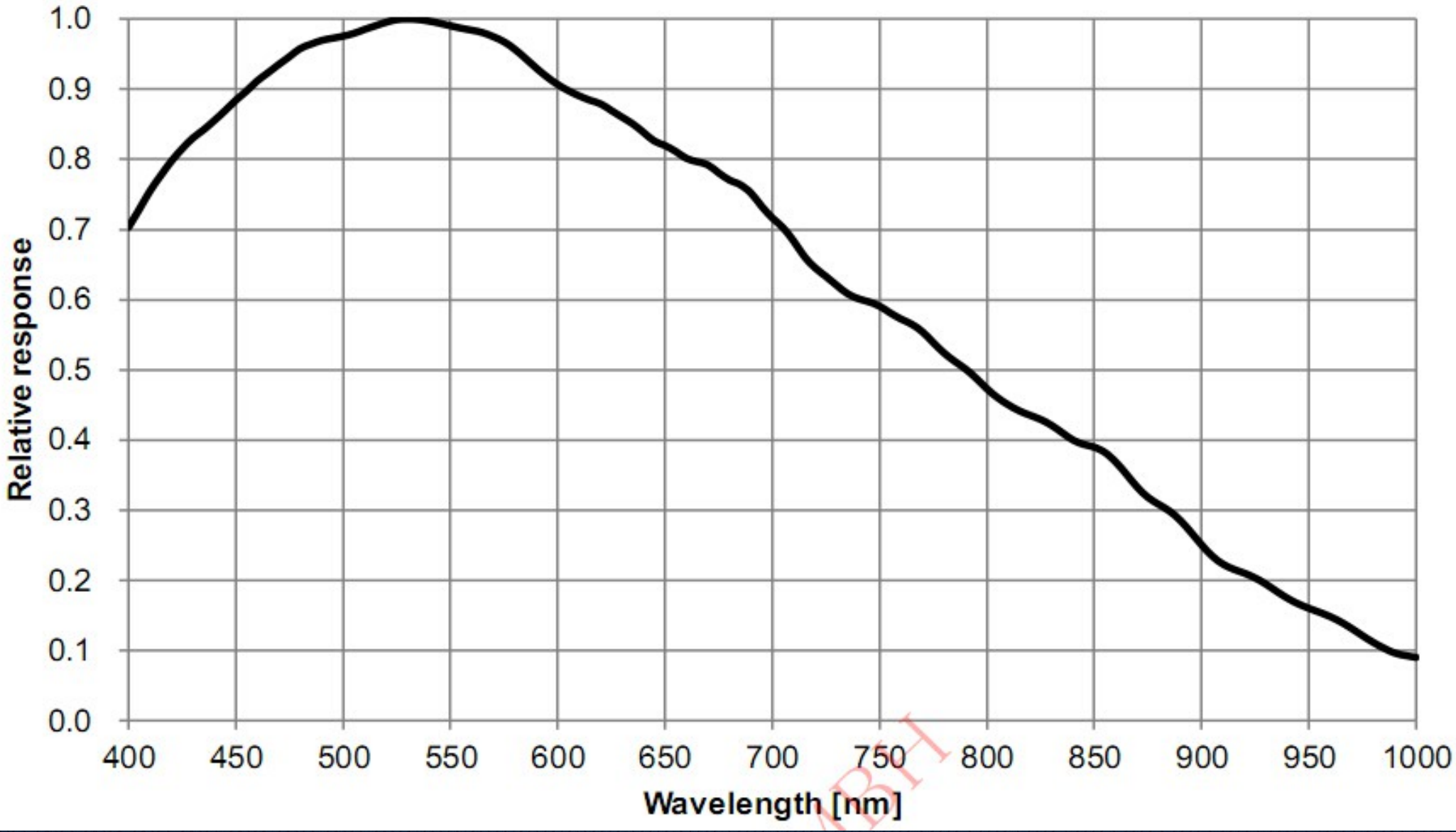
UNIWERSYTET JAGIELLOŃSKI
W KRAKOWIE

ZWO ASI178MM-C Cooled Monochrome Astronomy Camera

BRESSER Messier NT-203/1000 Hexafoc EXOS-2 GoTo Telescope

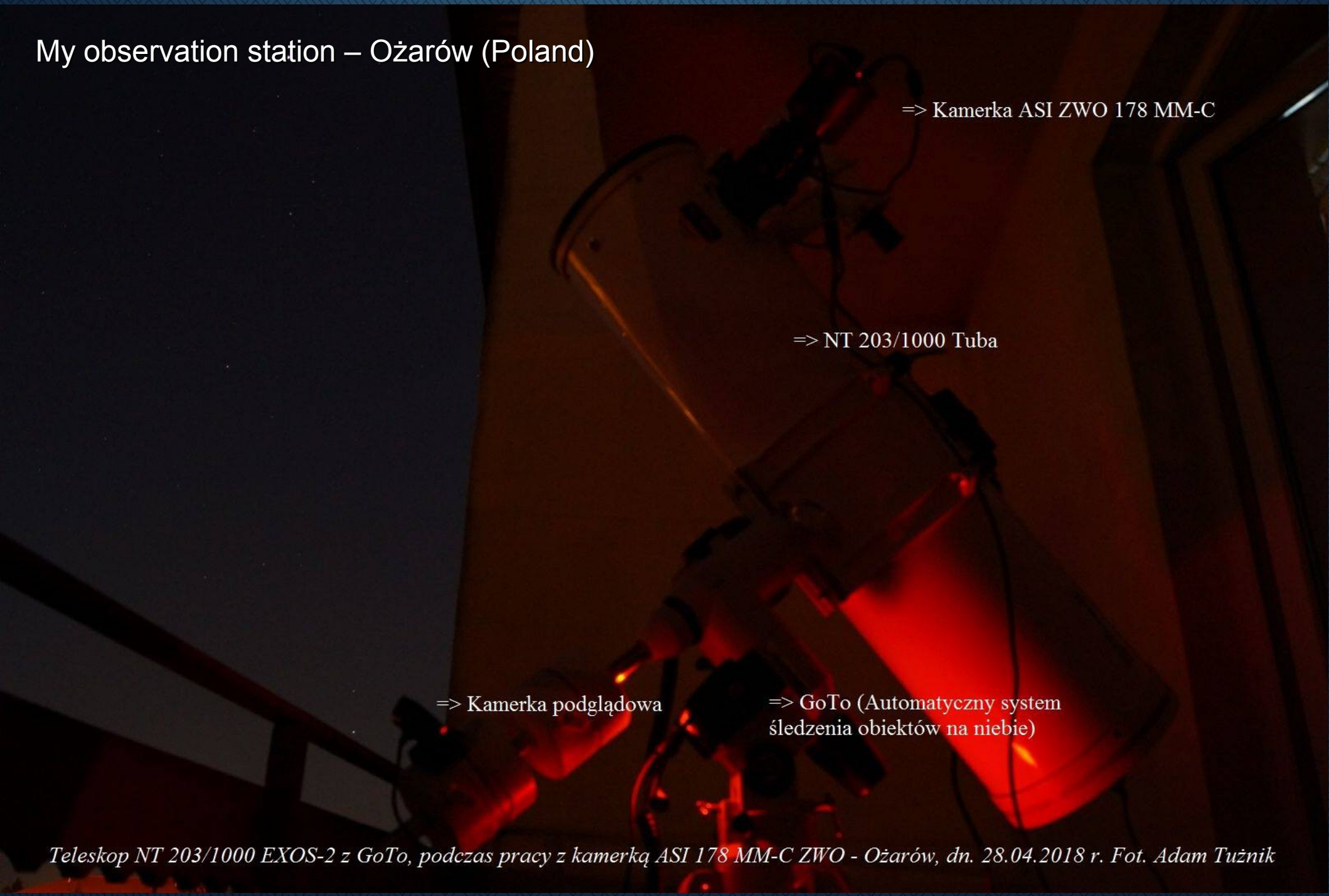

Read noise, full well, gain and dynamic range for ASI178
FW=15k
FW(e-)
10k
1k
100
GAIN(e-/ADU)
1.00
0.75
0.50
0.25
0.00
-0.25
DR(stops)
14
12
10
8
6
Read noise(e-rms)
2.4
2.2
2.0
1.8
1.6
1.4
1.2
-50
0
50
100
150
200
250
300
350
400
450
Gain(unit 0.1dB)

ASI178MM has a 1/1.8″ and 6.4M pixels sensor IMX178 with SONY STARVIS and Exmor R Technology

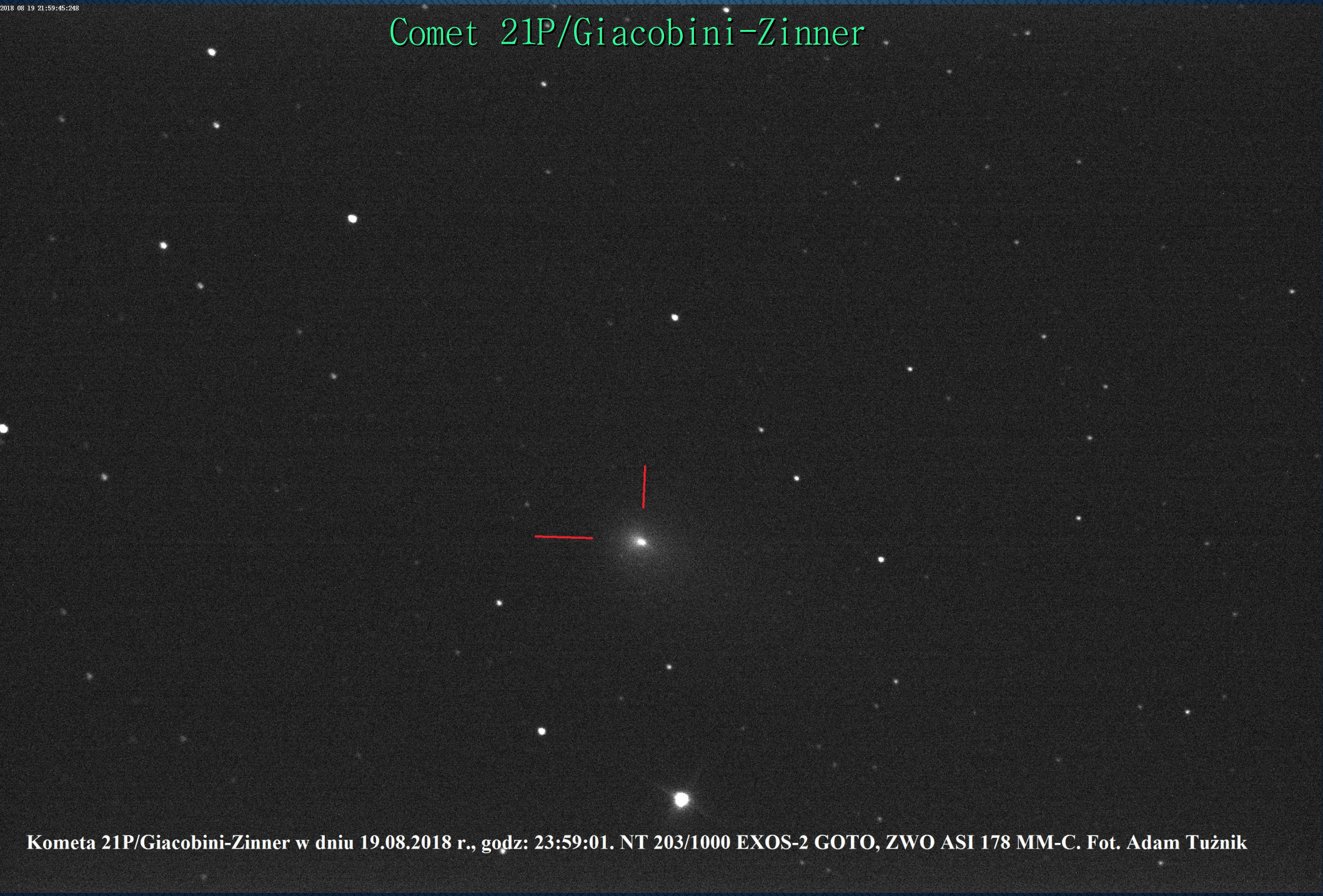


https://astronomy-imaging-camera.com/wp-content/uploads/ASI178MM-QE.jpg

My observation station – Ożarów (Poland)



Teleskop NT 203/1000 EXOS-2 z GoTo, podczas pracy z kamerką ASI 178 MM-C ZWO - Ożarów, dn. 28.04.2018 r. Fot. Adam Tużnik



Kometa 21P/Giacobini-Zinner w dniu 19.08.2018 r., godz: 23:59:01. NT 203/1000 EXOS-2 GOTO, ZWO ASI 178 MM-C. Fot. Adam Tużnik

Comet 21P/Giacobini-Zinner

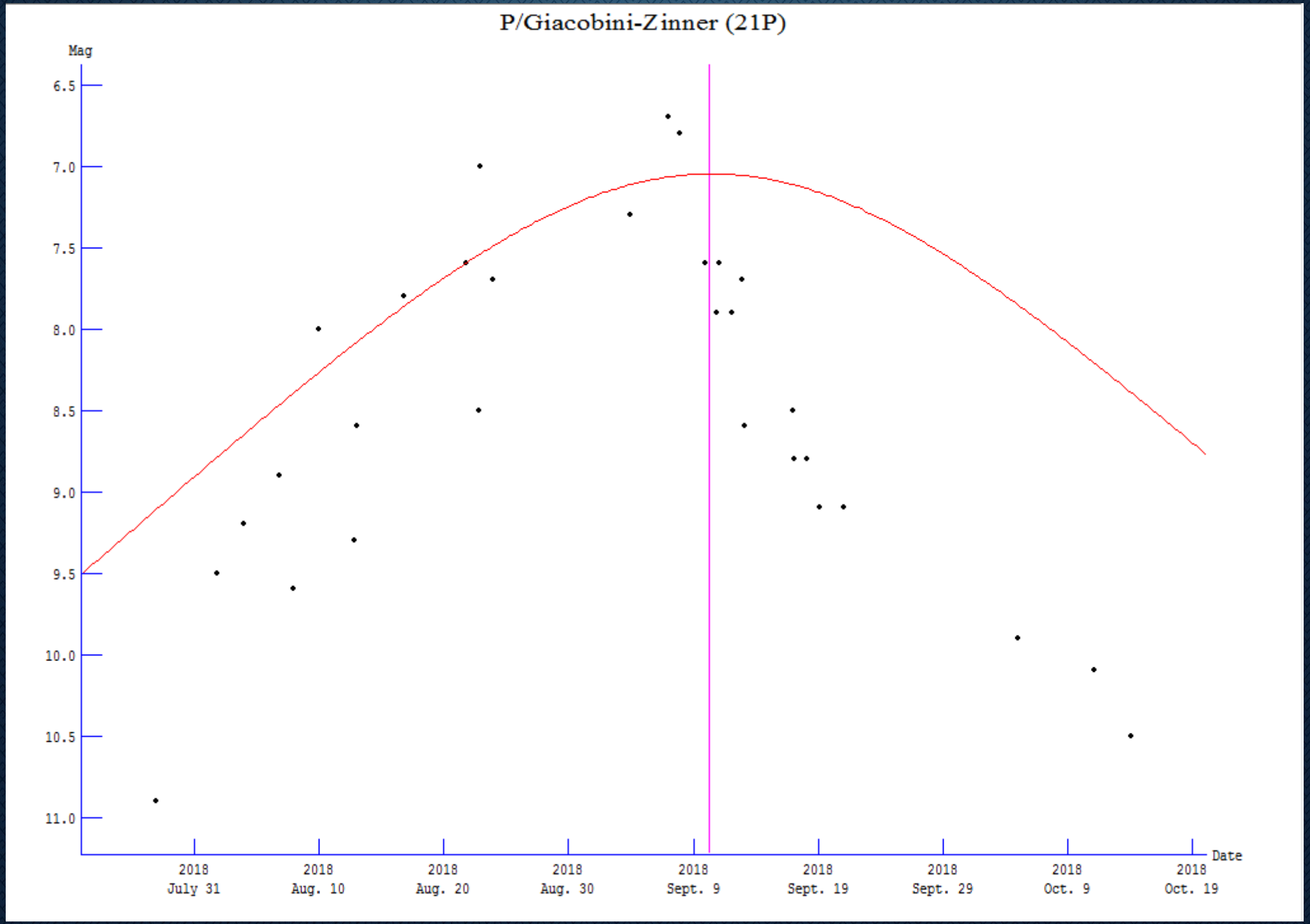
Observation results - POLAND

21P/Giacobini-Zinner

2018	7	27.97	S	10.9	4	4			20T	f/10	113x	M.Sabat (Kielce)
2018	8	1.85	S	9.5	3.9	s5	0.08	220	25L	f/ 5	98x	J.Bohusz (Myślin)
2018	8	3.96	S	9.2	3.2	s5	0.04	230	25L	f/ 5	98x	J.Bohusz (Myślin)
2018	8	6.89	B	8.9	&3.5	5/	&0.17	250	10B		25x	M.Filipek (Jerzmanowice)
2018	8	8.01	B	9.6	2.8	s6	0.07	250	25L	f/ 5	40x	L.Benedyktowicz (Kraków)
2018	8	10.01	B	8.0	&3.5	5/	&0.25	250	10B		25x	M.Filipek (Jerzmanowice)
2018	8	12.90	B	9.3	3	S4	0.13	248	25L	f/ 5	41x	L.Benedyktowicz (Kraków)
2018	8	13.03	sS	8.6	7	5	0.3	240	36L	f/ 5	55x	M.Sabat (Kielce) [Kokowiec k. Łopuszna]
2018	8	16.81	B	7.8	5.2	4/	0.5	265	25L	f/ 5	45x	J.Bohusz (Myślin)
2018	8	21.85	B	7.6	8	4			6B		20x	J.Powichrowski (Knyszyn)
2018	8	22.87	S	8.5	4.8	5	0.27	262	25L	f/ 5	53x	J.Bohusz (Myślin)
2018	8	22.94	B	7.0:	11	4			6B		20x	J.Powichrowski (Knyszyn)
2018	8	23.92	B	7.7:	8	4			6B		20x	J.Powichrowski (Knyszyn)
2018	9	3.92	B	7.3	10	4			6B		20x	J.Powichrowski (Knyszyn)
2018	9	6.98	B	6.7	4	d4	0.16	271	8B		10x	L.Benedyktowicz (Kraków) [Radachówka, na zach. od Mińska Maz]
2018	9	7.92	B	6.8	9	4			6B		20x	J.Powichrowski (Knyszyn)
2018	9	9.92	B	7.6	9	4			6B		20x	J.Powichrowski (Knyszyn)
2018	9	10.92	B	7.9	6	4	0.2	256	35L	f/ 4	50x	J.Powichrowski (Knyszyn)
2018	9	11.05	B	7.6	3	5			8B		10x	L.Benedyktowicz (Kraków) [Radachówka, na zach. od Mińska Maz]
2018	9	12.09	B	7.9	4	4			10B		25x	T.Ścieżor (Kraków)
2018	9	12.92	&S	7.7	&7	3/	&0.33	275	10B		25x	M.Filipek (Jerzmanowice)
2018	9	13.08	B	8.6	4	5	0.27	275	25L	f/ 5	41x	L.Benedyktowicz (Kraków) [Radachówka, na zach. od Mińska Maz]
2018	9	17.11	S	8.8:	4	3			10B		25x	T.Ścieżor (Kraków)
2018	9	17.03	B	8.5	4	4	0.18	273	25L	f/ 5	41x	L.Benedyktowicz (Kraków) [Radachówka, na zach. od Mińska Maz]
2018	9	18.10	S	8.8	4	3			10B		25x	T.Ścieżor (Kraków)
2018	9	19.10	S	9.1	5	3			10B		25x	T.Ścieżor (Kraków)
2018	9	21.09	S	9.1	4	3/			10B		25x	T.Ścieżor (Kraków)
2018	10	5.04	&S	9.9	&2	2/	&0.1	280	40L	f/ 5	60x	M.Filipek (Jerzmanowice) [Liszna, Bieszczady]
2018	10	11.08	S	10.1	4.8	2/			35L	f/ 4	50x	J.Powichrowski (Knyszyn)
2018	10	14.08	S	10.5	1.5	1/			35L	f/ 4	50x	J.Powichrowski (Knyszyn)

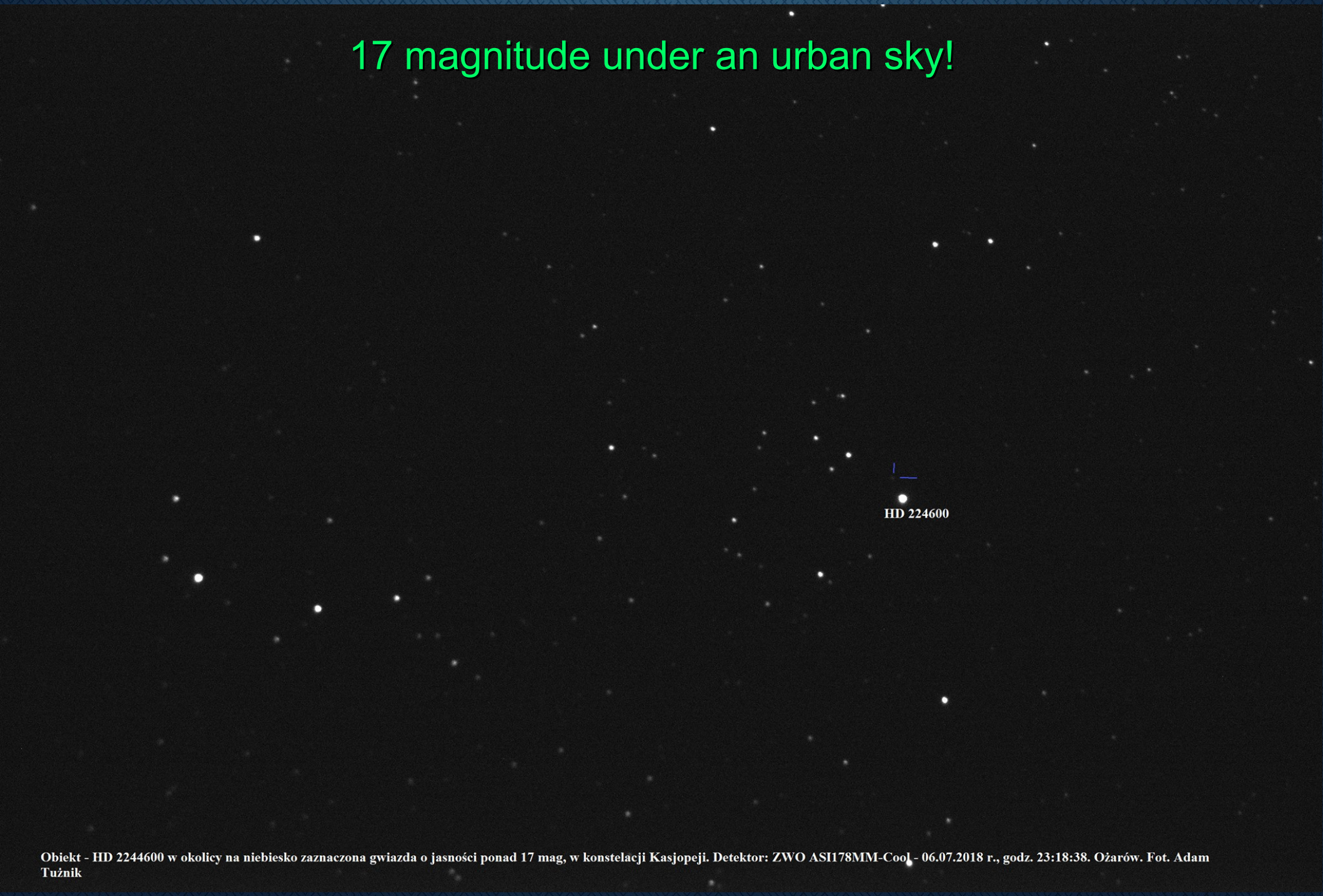
Data: sok.ptma.pl

Section of Comet Observers of the Polish Society of Astronomy Lovers (SOK PTMA)



http://cok.wis.pk.edu.pl/obserwacje/21p.gif

17 magnitude under an urban sky!



Obiekt - HD 2244600 w okolicy na niebiesko zaznaczona gwiazda o jasności ponad 17 mag, w konstelacji Kasjopeji. Detektor: ZWO ASI178MM-Cool - 06.07.2018 r., godz. 23:18:38. Ożarów. Fot. Adam Tużnik

Camera - ASI 178MM and Moon

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W KRAKOWIE

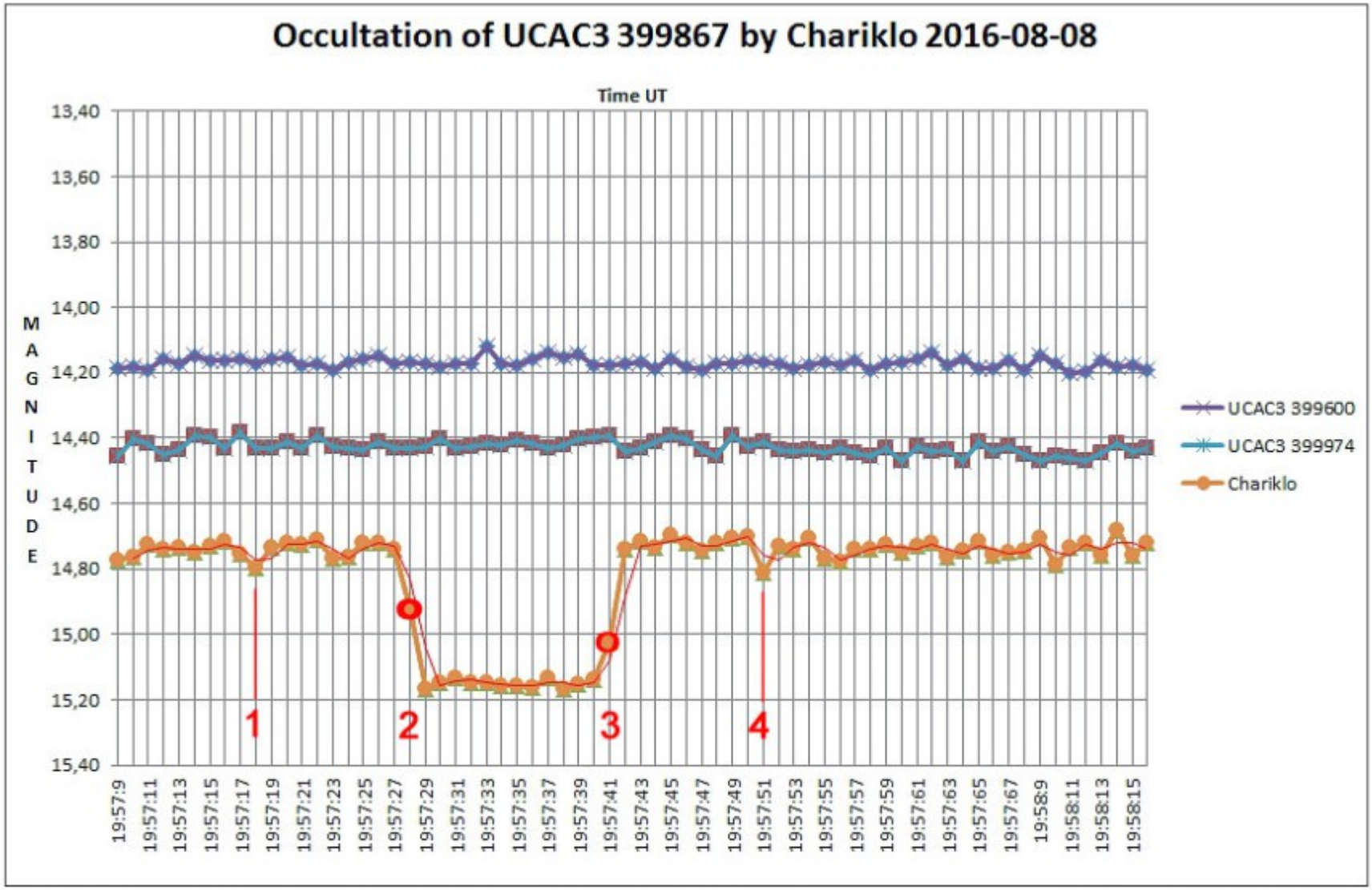
Photo: Adam Tużnik (POLAND)


2018 07 03 23:18:33:187
Photo: Adam Tużnik (POLAND)


2018 07 03 23:21:16:045
[ZWO ASI178MM-Cool]
Pan=0
Tilt=0
Output Format=PNG files (*.png)
Binning=1
Capture Area=3096x2080
Colour Space=MONO16
Hardware Binning=Off
High Speed Mode=On
Turbo USB=80(Auto)
Flip=None
Frame Rate Limit=Maximum
Gain=100
Exposure=0,0022
Timestamp Frames=On
Brightness=317
Gamma=37
Temperature=-9,7
Cooler Power=30
Target Temperature=-20
Cooler=On
Photo: Adam Tużnik (POLAND)

Observation of the position and cover

UNIWERSYTET JAGIELLOŃSKI
W KRAKOWIE



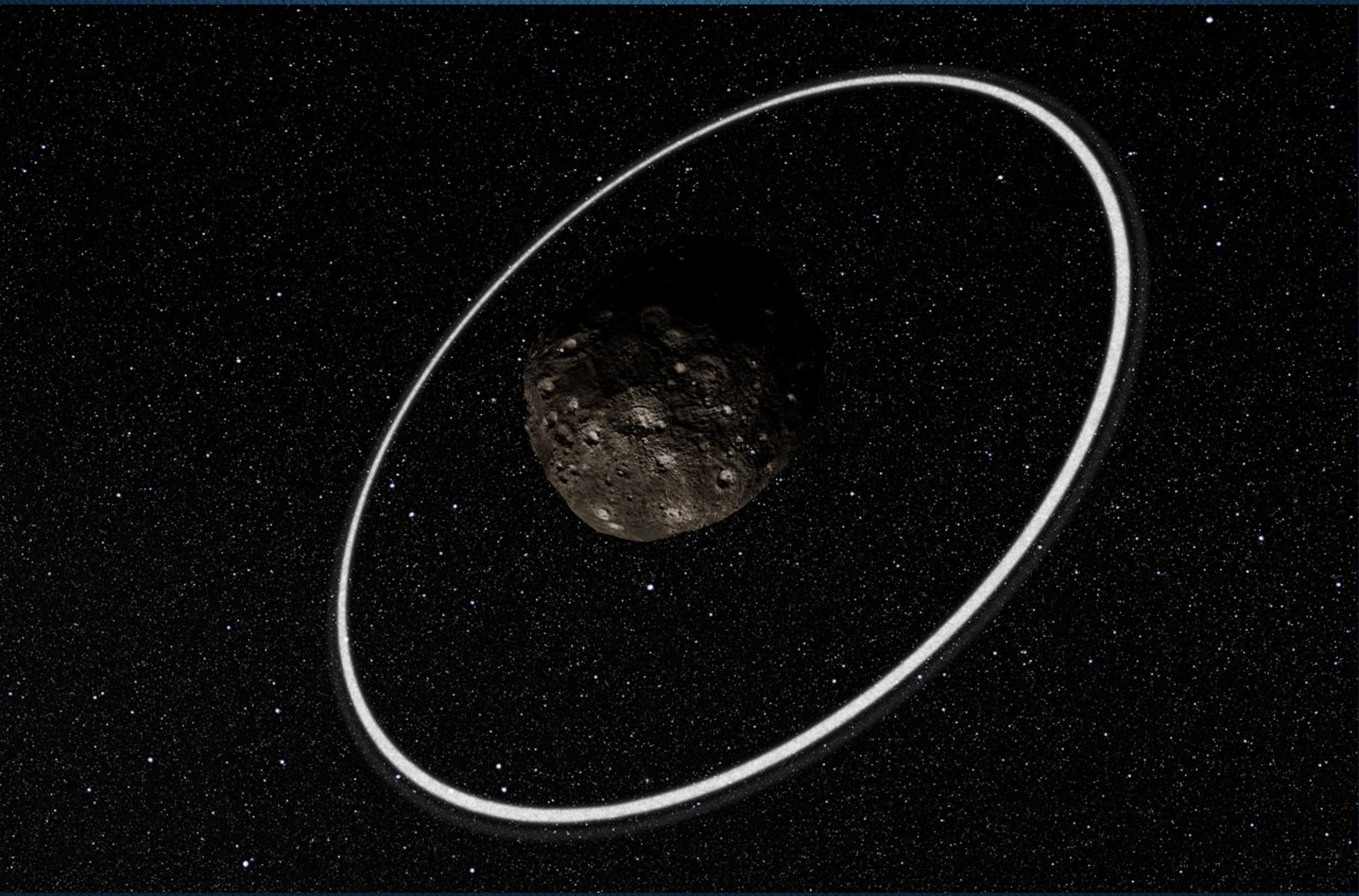
Ring passage at 19:57:18 & 19:57:51 (mid-occultation: 19:57:34.5), marked with red arrows (1, 4).
Main body from 19:57:27 to 19:57:42 (mid-occultation: 19:57:34.5)
Modified Disappearance (2) ~ 19:57:27.5, Reappearance (3) ~ 19:57:41.3

http://www.iota-es.de/JOA/JOA2012_2.pdf

OBS	OCC	Date	Star	Asteroid/Planet	SUC	Meth.	Instr.	CC	Observer	UT1	UT4	Dur. [s]
8214	2714	2011-06-07	HIP 48340	(173) Ino	O+	VID	M250	PL	P. Maksym et al	21:00:00	21:10:00	4.96
8385	2796	2011-03-08	TYC 1879-00114-1	(554) Peraga	O-	VID	M250	PL	P. Maksym et al	20:57:00	21:08:00	
8406	2800	2011-03-02	3UC225-098375	(4234) Evtushenko	O-	VID	M250	PL	Pawel Maksym	22:00:00	22:15:00	
7471	2401	2010-07-08	HIP 79593	(472) Roma	O-	VID	L100	DE	Pawel Maksym	21:50:00	22:06:00	
6610	2084	2009-09-08	HIP 25965	(10247) Amphiaraos	O-	VID	M250	PL	Pawel Maksym	00:50:00	01:05:00	
6627	2089	2009-08-24	TYC 2934-00106-1	(71) Niobe	O+	VID	M250	PL	P. Maksym et al	23:50:00	01:10:00	0.48
5947	1837	2008-09-04	TYC 0727-01424-1	(1144) Oda	O-	VID	M200	PL	Pawel Maksym	01:23:00	01:31:00	
5165	1541	2007-09-21	2UCAC 38215341	(663) Gerlinde	O+	VID	M200	PL	Pawel Maksym	01:42:00	01:47:00	4.28
5708	1726	2007-01-14	HIP 29196	(840) Zenobia	O-	VIS	M200	PL	Pawel Maksym	16:20:00	16:33:00	
4853	1377	2006-04-21	TYC 0406-02150-1	(15457) 1998 YN6	O-	VIS	M200	PL	Pawel Maksym	00:50:00	01:03:00	
3999	1012	2005-07-28	2UCAC 26766082	(2397) Lappajarvi	O-	VIS	M200	PL	Pawel Maksym	00:23:00	00:27:00	
4206	1081	2005-03-19	HIP 43206	(-) 1999 CO153	O-	VIS	L70	PL	Pawel Maksym	22:00:00	23:10:00	
4279	1110	2005-02-08	TYC 0207-00824-1	(1936) Lugano	O-	VIS	M200	PL	Pawel Maksym	23:12:00	23:18:30	
4300	1118	2005-02-06	TYC 1344-02003-1	(1306) Scythia	O-	VIS	M200	PL	Pawel Maksym	02:48:00	02:52:30	
3358	791	2004-09-06	HIP 84012	(287) Nephthys	O-	VIS	M200	PL	Pawel Maksym	15:21:00	15:27:00	
3394	805	2004-07-31	TYC 1688-01854-1	(849) Ara	O-	VIS	M200	PL	Pawel Maksym	00:40:00	00:50:00	
2879	652	2003-08-26	TYC 5757-00353-1	(420) Bertholda	O-	VIS	M110	PL	Pawel Maksym	21:30:00	22:00:00	
2969	676	2003-04-17	TYC 1368-01752-1	(407) Arachne	O-	VIS	M120	PL	Pawel Maksym	21:14:00	21:25:00	
2234	544	2002-09-17	HIP 19388	(345) Tercidina	O-	VIS	M90	IT	Pawel Maksym	00:41:00	01:01:00	
2294	547	2002-08-29	HIP 26351	(1567) Alikoski	O-	VIS	M150	PL	Pawel Maksym	23:45:00	00:08:00	
2342	565	2002-05-12	TYC 6747-01271-1	(280) Philia	O-	VIS	M150	PL	Pawel Maksym	22:27:00	22:48:00	
2436	585	2002-02-15	TYC 2847-00852-1	(36) Atalante	O-	VIS	M150	PL	Pawel Maksym	17:50:00	18:15:00	
2477	590	2002-02-02	TYC 4742-00609-1	(1051) Merope	O-	VIS	M170	PL	Pawel Maksym	20:24:00	20:49:00	

www.iota-es.de/JOA/JOA2013_2.pdf

Artistic vision of Chariklo and its rings



Wikipedia.org

The largest asteroid from the group of centaurs, orbiting the Sun for 62.87 years at an average distance of 15.81 au. Discovered on February 15, 1997. The asteroid is the fifth - after four giant planets - the solar system object known to us that has rings. The rings were noticed by chance during the observation of the star's cover by Chariklo.

THE ASTROPHYSICAL JOURNAL LETTERS, 837:L13 (7pp), 2017 March 1 https://doi.org/10.3847/2041-8213/aa6256

CrossMark

Simulating the Smallest Ring World of Chariklo

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[1] Center for Computational Sciences, University of Tsukuba, Tsukuba, Ibaraki 305-8577, Japan; michikos@ccs.tsukuba.ac.jp
[2] Division of Theoretical Astronomy, National Astronomical Observatory of Japan, Osawa, Mitaka, Tokyo 181-8588, Japan; kokubo@th.nao.ac.jp
Received 2016 December 14; revised 2017 February 17; accepted 2017 February 21; published 2017 March 3

Abstract

A ring system consisting of two dense narrow rings has been discovered around Centaur Chariklo. The existence of these rings around a small object poses various questions about their origin, stability, and lifetime. In order to understand the nature of Chariklo's rings, we perform global *N*-body simulations of the self-gravitating collisional particle rings for the first time. We find that Chariklo should be denser than the ring material in order to avoid the rapid diffusion of the rings. If Chariklo is denser than the ring material, fine spiral structures called self-gravity wakes occur in the inner ring. These wakes accelerate the viscous spreading of the ring significantly and typically occur on timescales of about 100 years for m-sized ring particles, which is considerably shorter than the timescales suggested in previous studies. The existence of these narrow rings implies smaller ring particles or the existence of shepherding satellites.

Key words: methods: numerical – minor planets, asteroids: general – minor planets, asteroids: individual (10199 Chariklo) – planets and satellites: rings

iopscience.iop.org/article/10.3847/2041-8213/aa6256/pdf

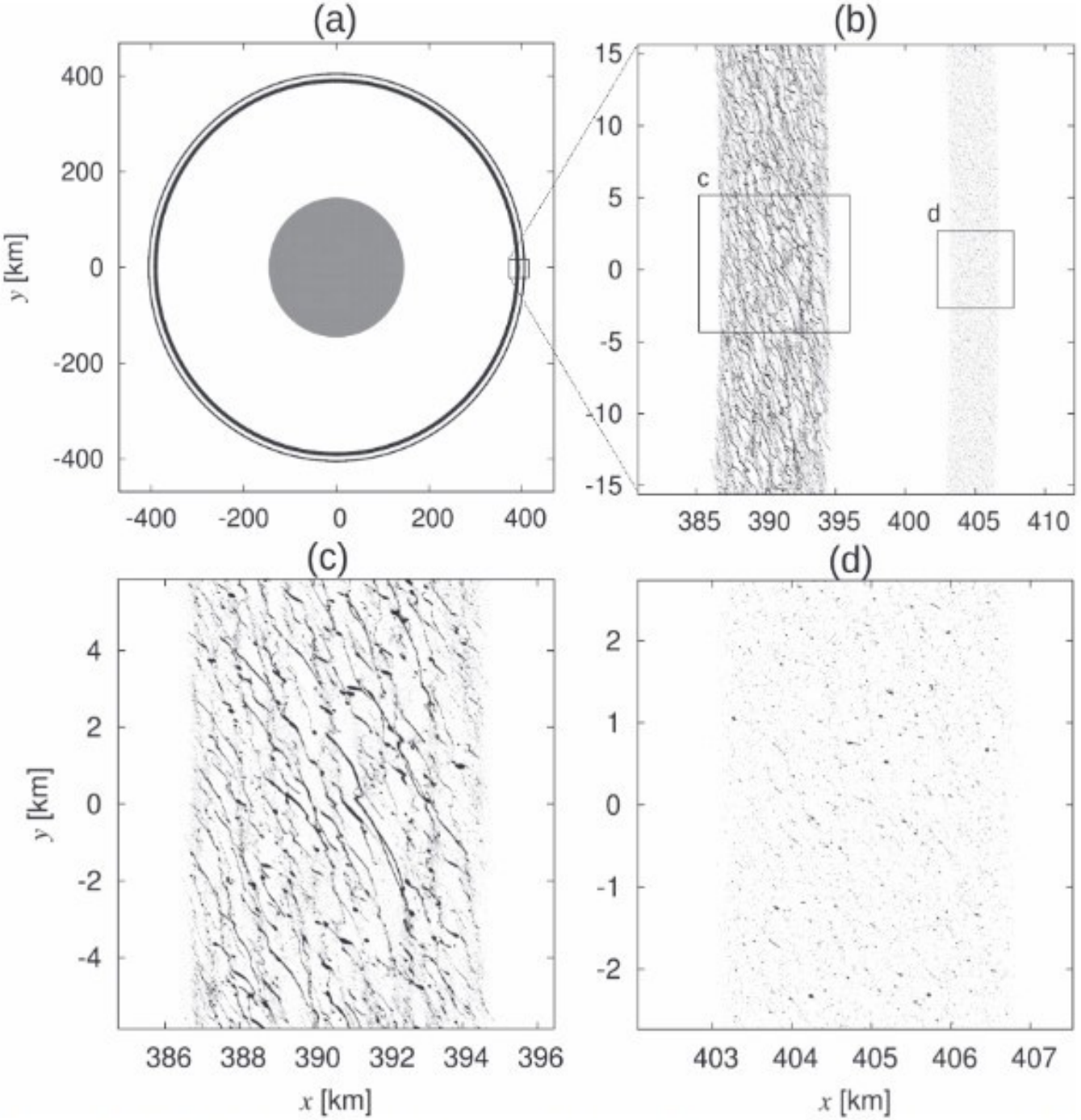
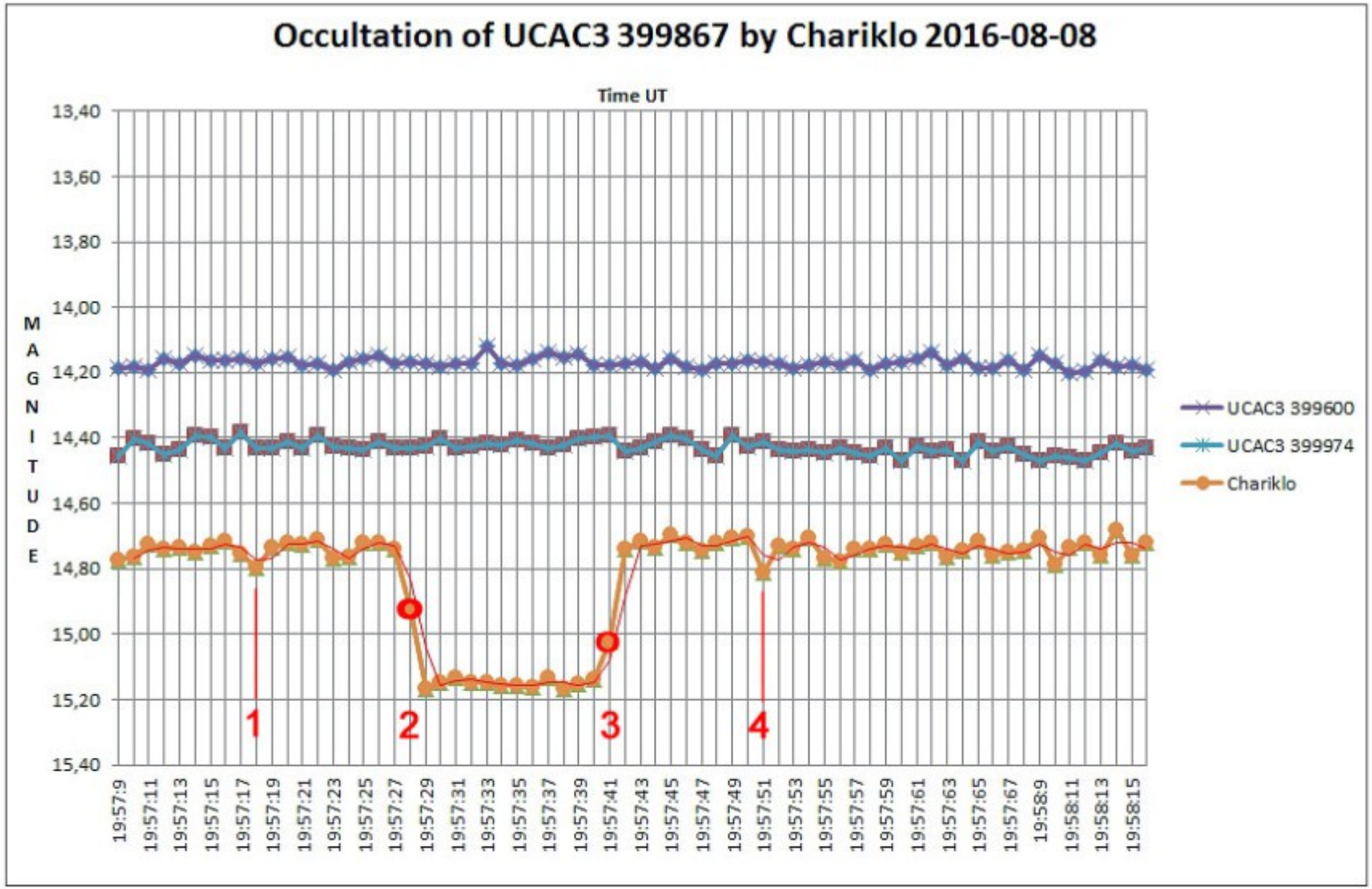


Figure 1. Snapshots of the simulated ring in the x–y plane at $t = 10t_K$, where the particle density and radius are $\rho_p/\rho_C = 0.5$ and $r_p = 5$ m, respectively. The left panel (a) shows the overall structure of the ring, while the panels (b), (c), (d) show enlarged views of ring sections.

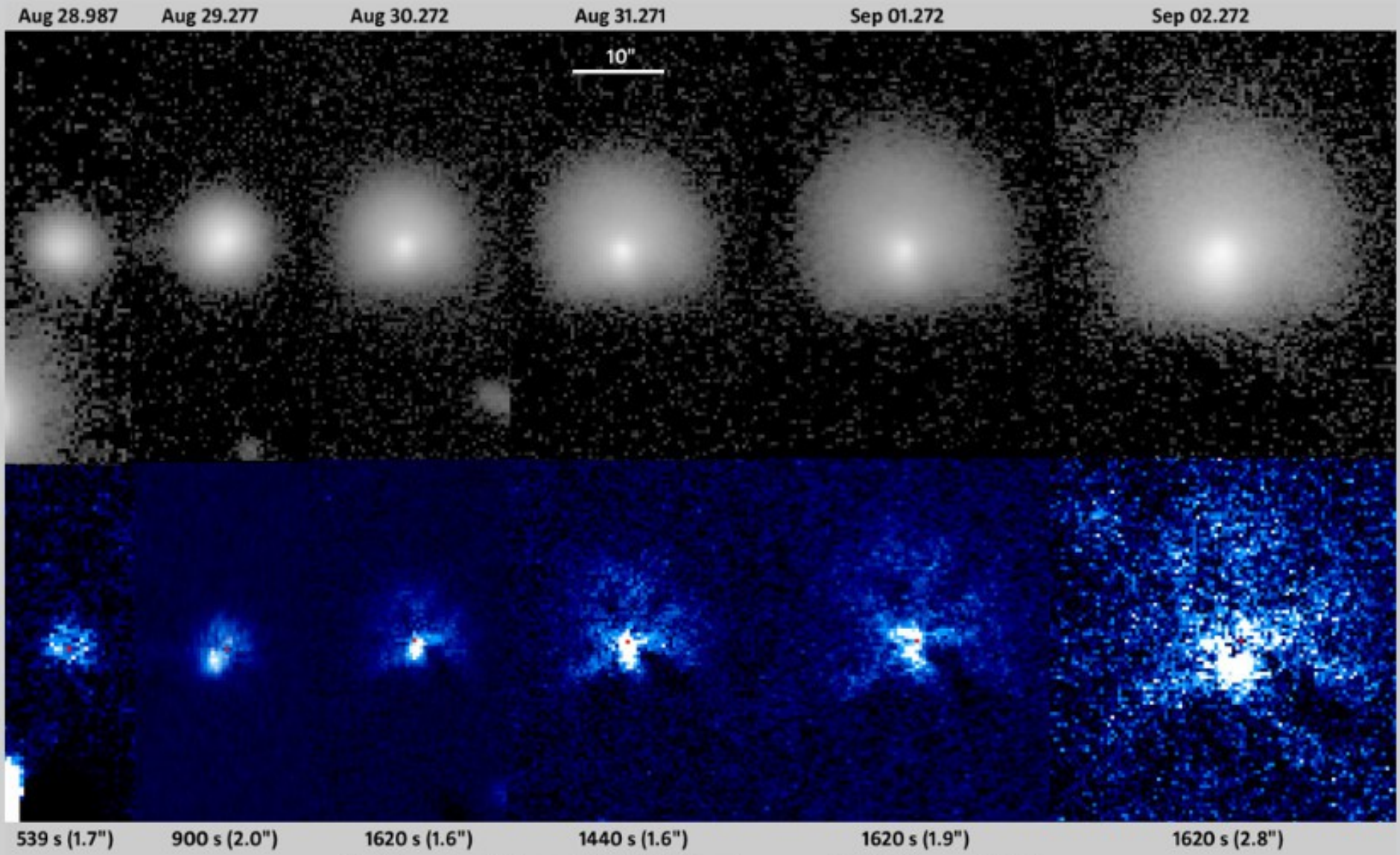
iopscience.iop.org/article/10.3847/2041-8213/aa6256/pdf

Chariklo and water?



Ring passage at 19:57:18 & 19:57:51 (mid-occultation: 19:57:34.5), marked with red arrows (1, 4).
Main body from 19:57:27 to 19:57:42 (mid-occultation: 19:57:34.5)
Modified Disappearance (2) ~ 19:57:27.5, Reappearance (3) ~ 19:57:41.3

www.iota-es.de/JOA/JOA2017_1.pdf



Outburst of Comet 174P/Echelcus on 2016 August 28

1.0-m LCOGT telescopes at Sutherland, S. Africa, and Cerro Tololo, Chile, R filter, North up, total exposure time and fwhm seeing as quoted above

Lower images: processed using a 20° rotational gradient filter with *IRIS* software.

Expansion rate of leading edge of coma = 95 ± 4 m/s (2.0 "/d). Some evidence of a denser condensation moving in direction p.a. 180°

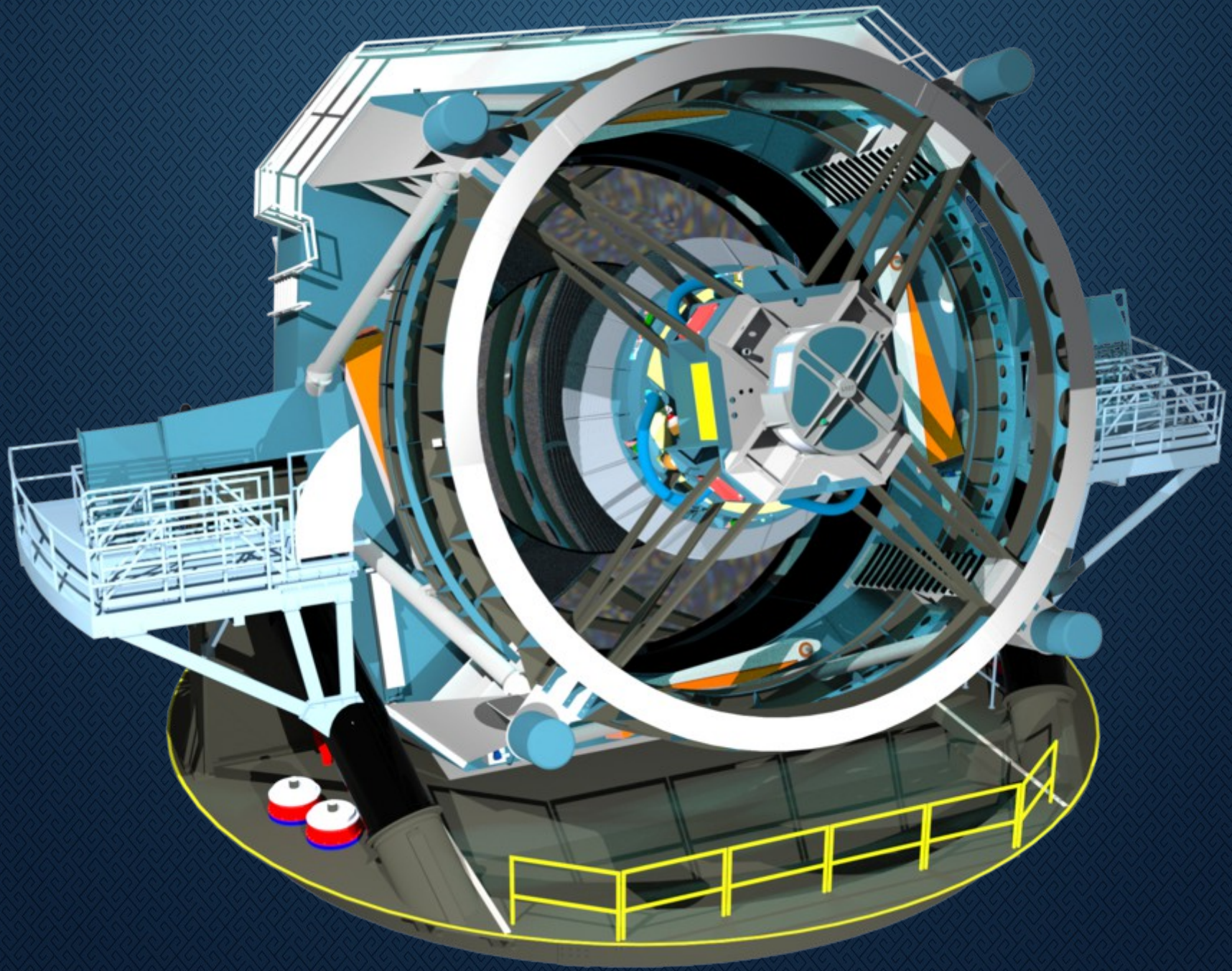
Time of outburst = 2016 August 28.56 ± 0.07

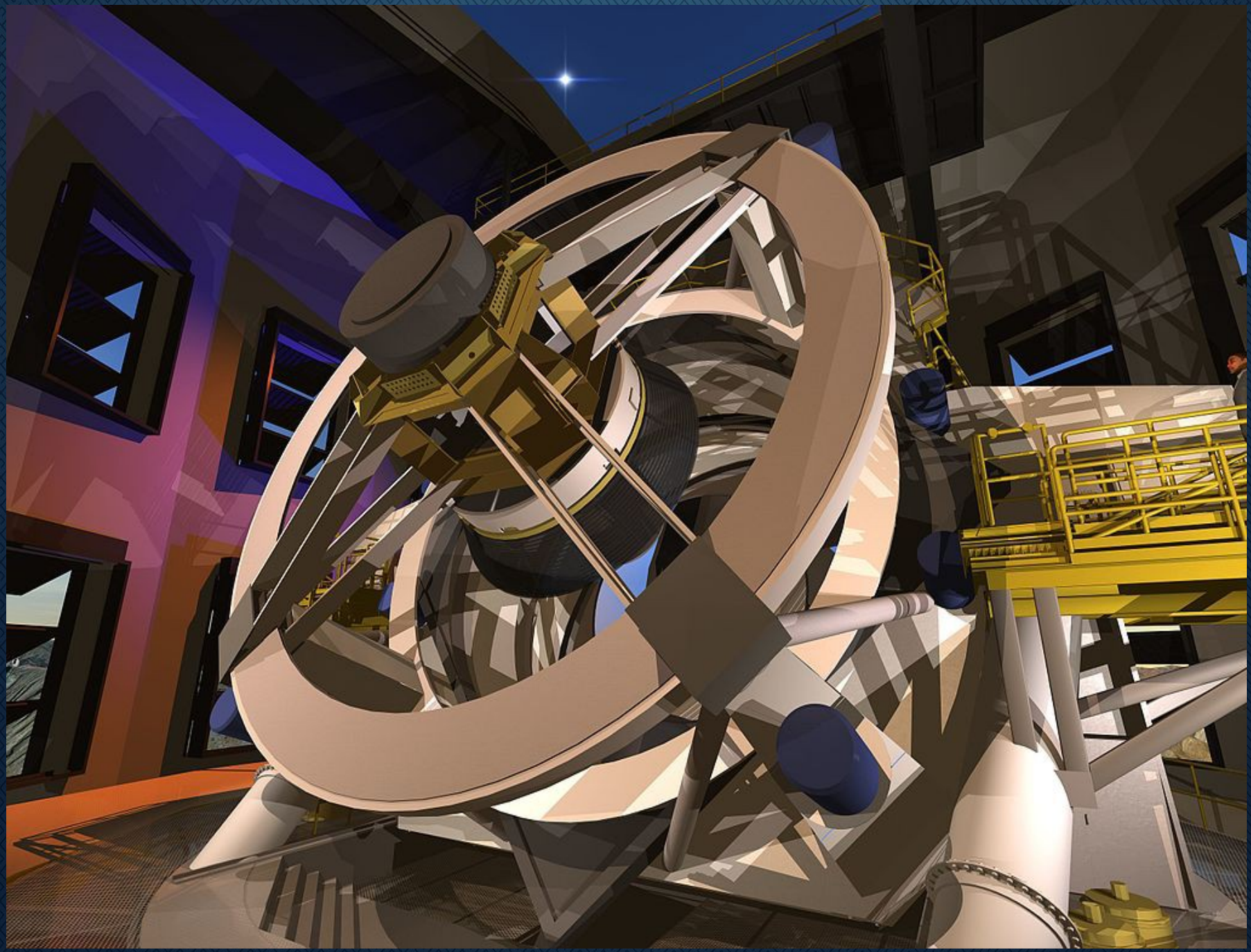
R. Miles / A. Watkins , BAA

www.iota-es.de/JOA/JOA2017_4.pdf

Large Synoptic Survey Telescope (LSST)

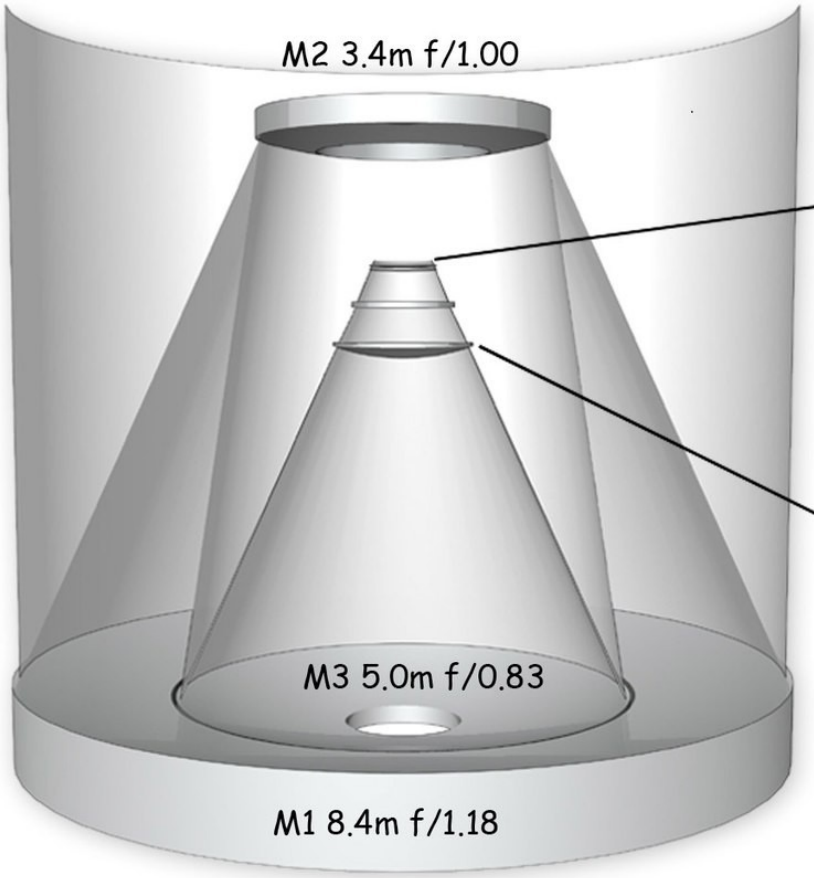
UNIWERSYTET JAGIELLOŃSKI
W KRAKOWIE

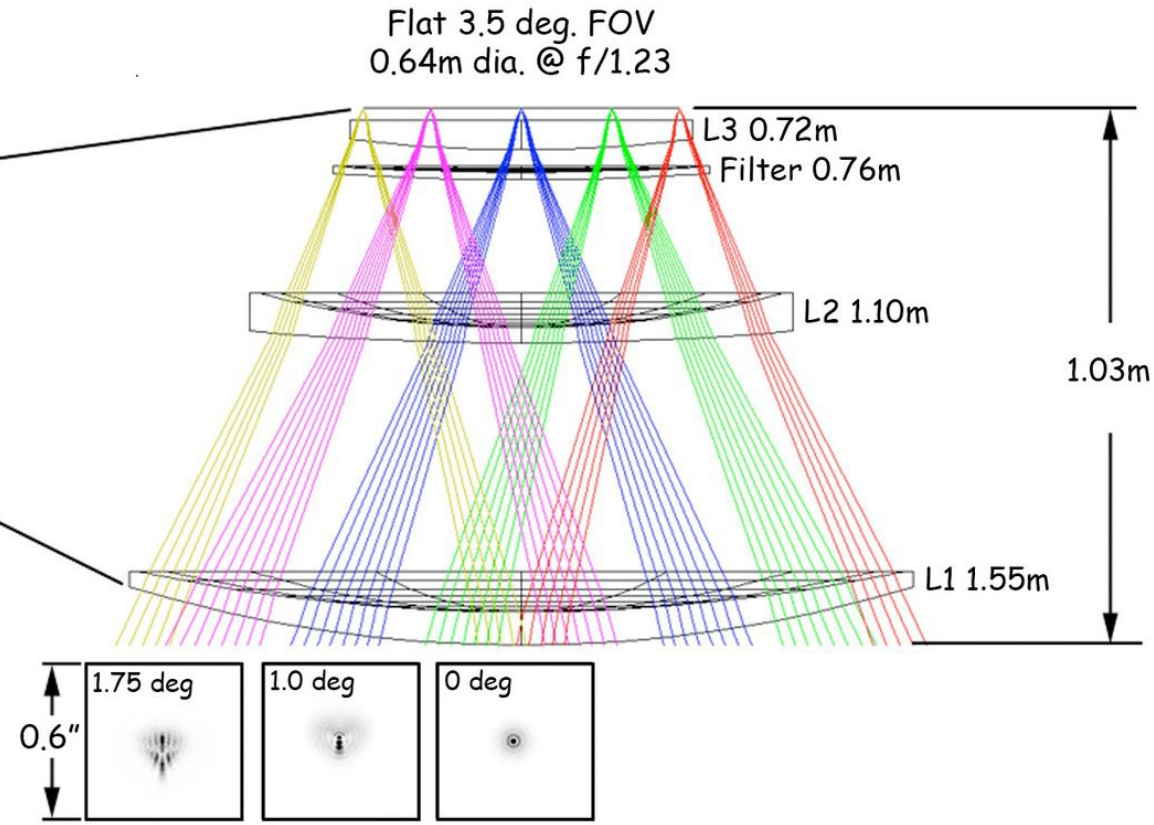




Artist's conception of the LSST inside its dome.
The LSST will carry out a deep, ten-year imaging survey in six broad optical bands over the main survey area of 18,000 square degrees.

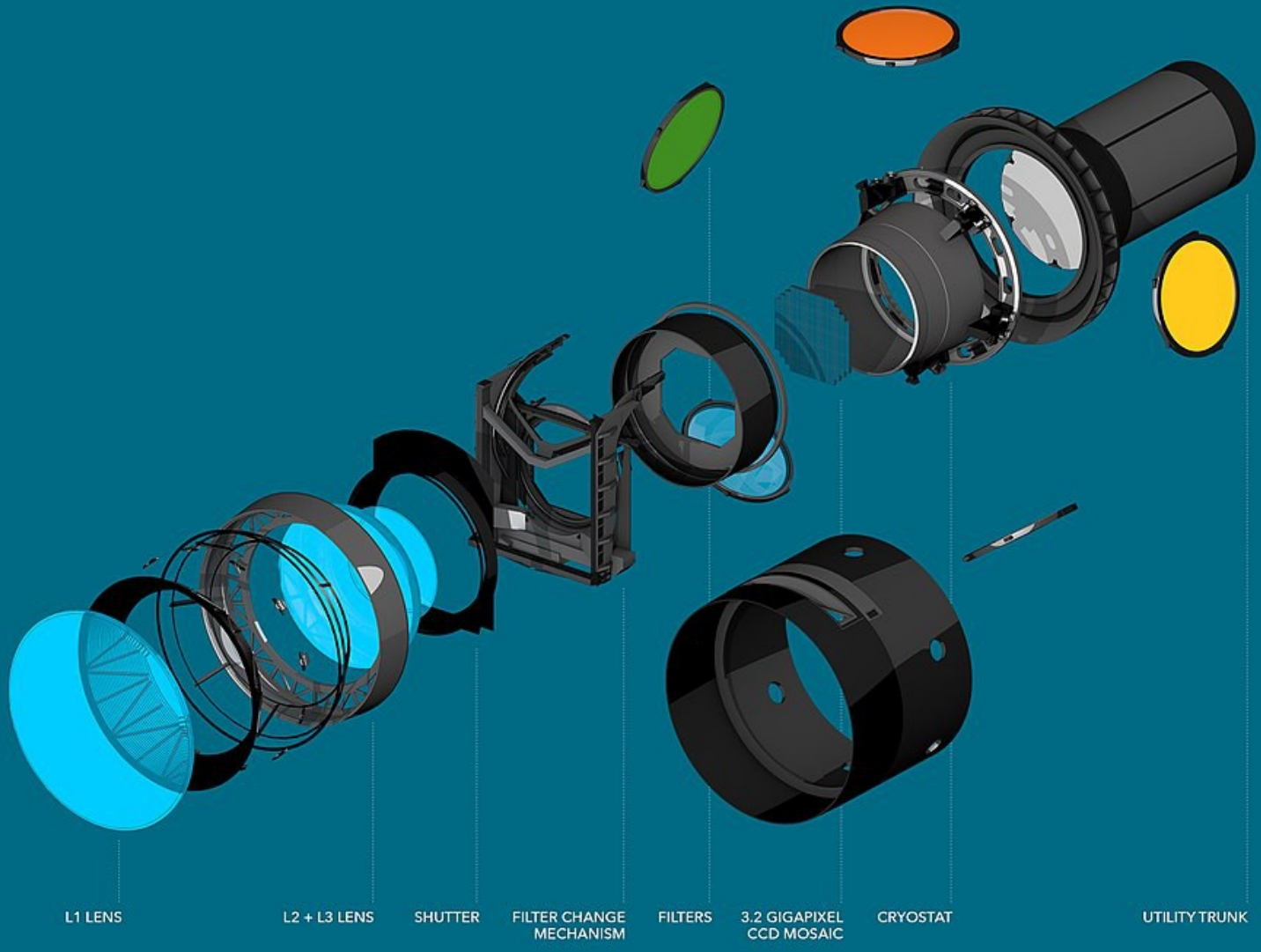
Optics of the LSST Telescope



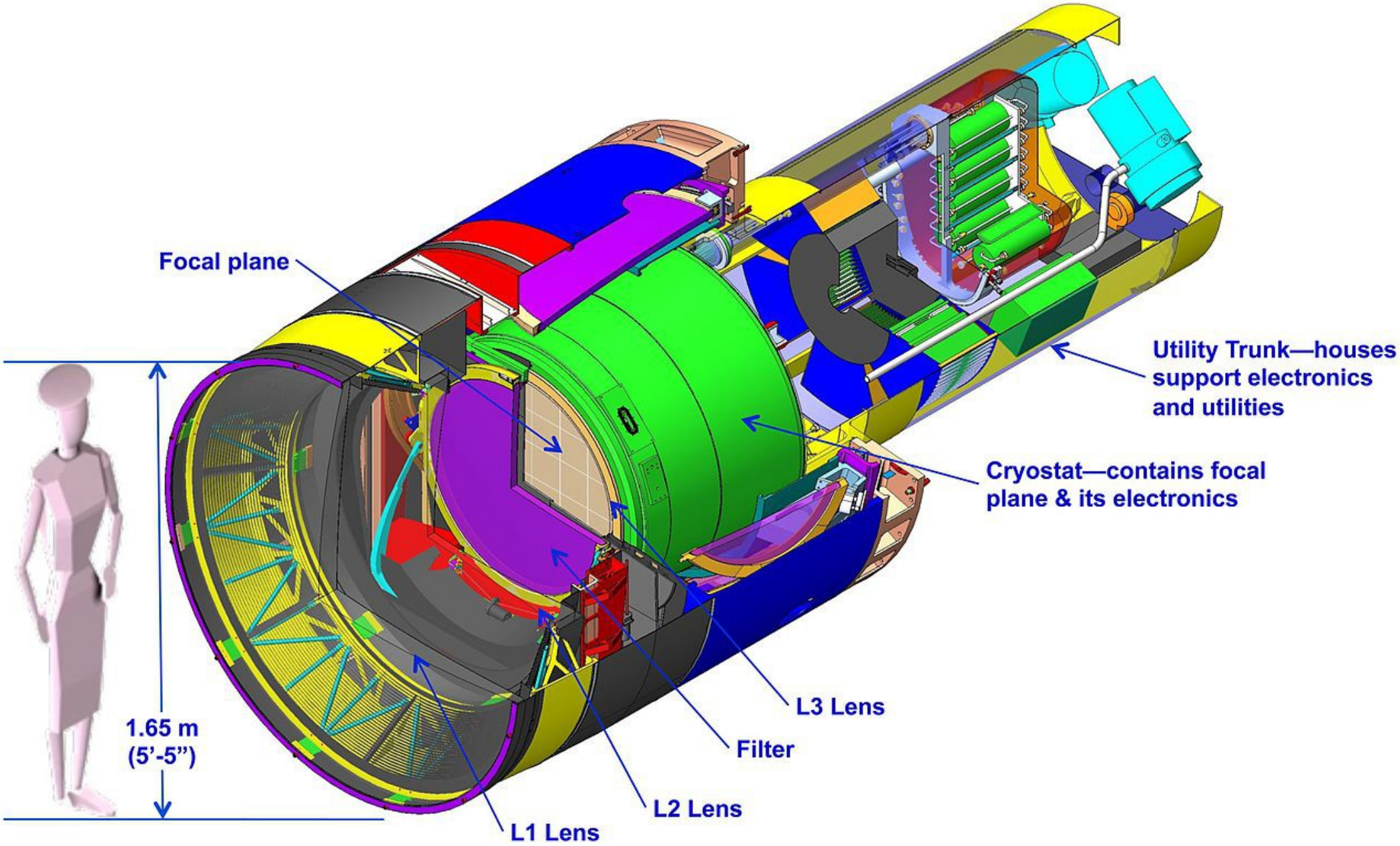


www.lsst.org/sites/default/files/photogallery/FPA-full.jpg

Exploded view of the optical components of the LSST camera



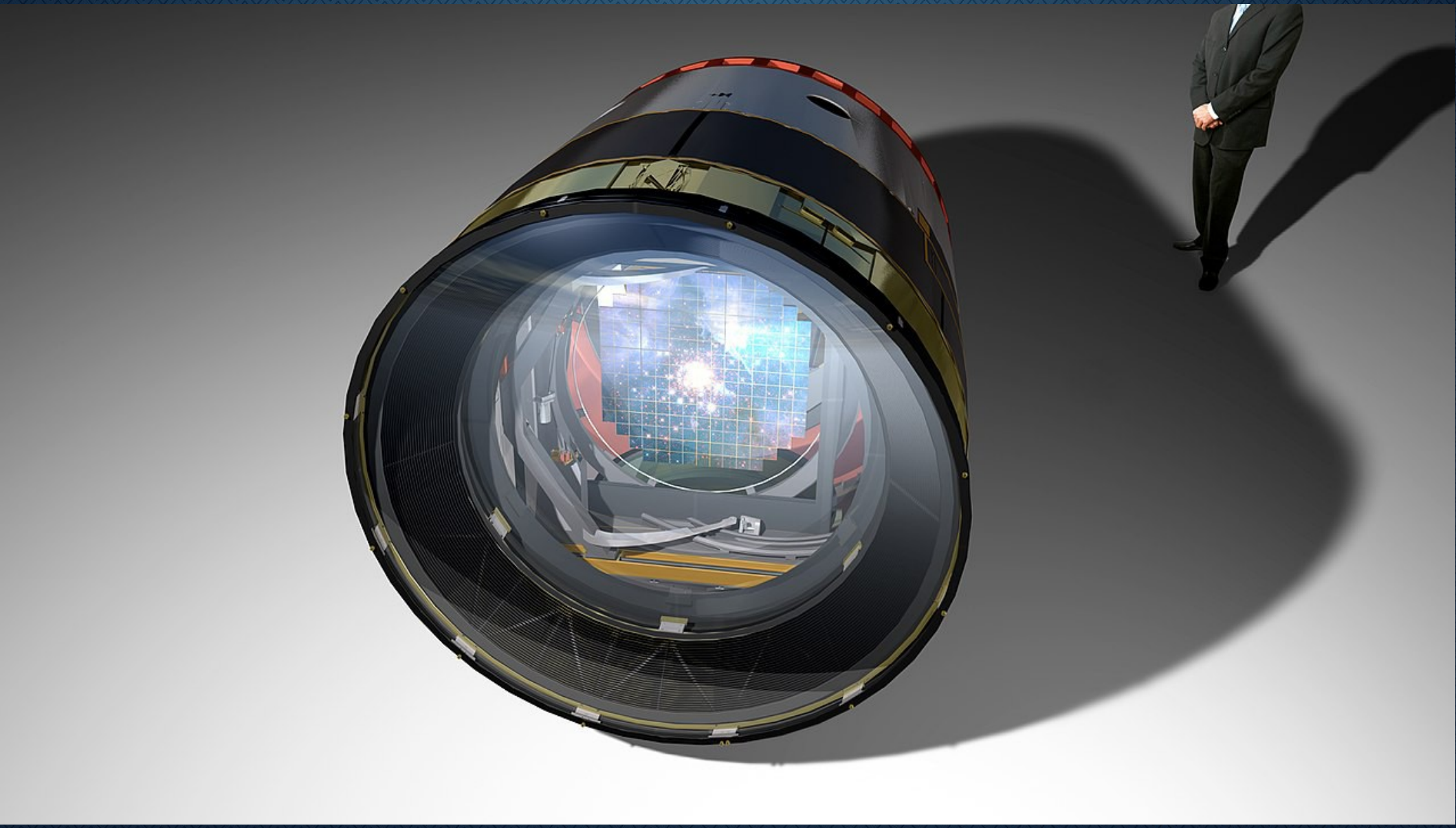
lsst.org/sites/default/files/LSSTexploded-lg.jpg



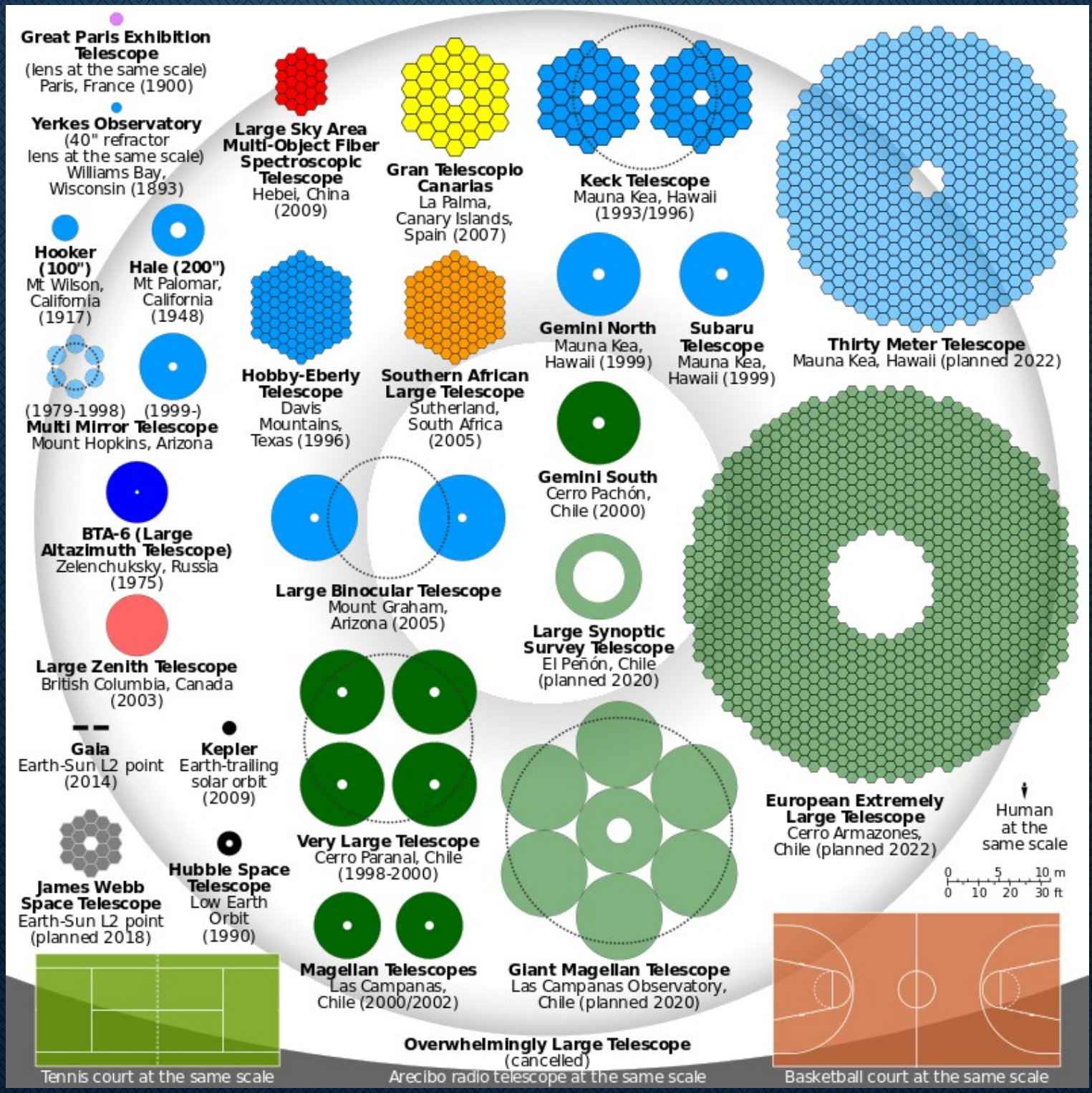
Camera ¾ Section

lsst.org/sites/default/files/LSSTexploded-lg.jpg

Rendering of the LSST camera



lsst.org/sites/default/files/LSSTexploded-lg.jpg


Great Paris Exhibition Telescope
(lens at the same scale)
Paris, France (1900)
Yerkes Observatory
(40" refractor
lens at the same scale)
Williams Bay,
Wisconsin (1893)
Hooker (100")
Mt Wilson,
California
(1917)
Hale (200")
Mt Palomar,
California
(1948)
(1979-1998)
(1999-)
Multi Mirror Telescope
Mount Hopkins, Arizona
BTA-6 (Large Altazimuth Telescope)
Zelenchuksky, Russia
(1975)
Large Zenith Telescope
British Columbia, Canada
(2003)
Gaia
Earth-Sun L2 point
(2014)
Kepler
Earth-trailing
solar orbit
(2009)
James Webb Space Telescope
Earth-Sun L2 point
(planned 2018)
Hubble Space Telescope
Low Earth
Orbit
(1990)
Tennis court at the same scale
Large Sky Area Multi-Object Fiber Spectroscopic Telescope
Hebei, China
(2009)
Gran Telescopio Canarias
La Palma,
Canary Islands,
Spain (2007)
Keck Telescope
Mauna Kea, Hawaii
(1993/1996)
Hobby-Eberly Telescope
Davis
Mountains,
Texas (1996)
Southern African Large Telescope
Sutherland,
South Africa
(2005)
Gemini North
Mauna Kea,
Hawaii (1999)
Subaru Telescope
Mauna Kea,
Hawaii (1999)
Thirty Meter Telescope
Mauna Kea, Hawaii (planned 2022)
Large Binocular Telescope
Mount Graham,
Arizona (2005)
Gemini South
Cerro Pachón,
Chile (2000)
Large Synoptic Survey Telescope
El Peñón, Chile
(planned 2020)
Very Large Telescope
Cerro Paranal, Chile
(1998-2000)
Magellan Telescopes
Las Campanas,
Chile (2000/2002)
Giant Magellan Telescope
Las Campanas Observatory,
Chile (planned 2020)
European Extremely Large Telescope
Cerro Armazones,
Chile (planned 2022)
Human at the same scale
0 5 10 m
0 10 20 30 ft
Overwhelmingly Large Telescope
(cancelled)
Arecibo radio telescope at the same scale
Basketball court at the same scale

Summary and conclusions

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[8] https://iopscience.iop.org/article/10.3847/2041-8213/aa6256/pdf - Dostęp: [21.04.2019 r, godz. 16.00 CEST]
[9] https://iopscience.iop.org/article/10.3847/2041-8213/aa6256/pdf- Dostęp: [21.04.2019 r, godz. 16.40 CEST]
[10] http://www.iota-es.de/JOA/JOA2017_4.pdf
[11] Artist's conception of the LSST inside its dome. The LSST will carry out a deep, ten-year imaging survey in six broad optical bands over the main survey area of 18,000 square degrees.
[12] lsst.org/sites/default/files/LSSTexploded-lg.jpg
[13] NASA, ESA, ESO, LSST
[14] lsst.org/sites/default/files/LSSTexploded-lg.jpg
[15] http://cok.wis.pk.edu.pl/obserwacje/21p.gif

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Thank you for your attention!

Ruch gwiazd po sferze niebieskiej nad Ożarowem, podczas pracy kamerki ASI ZWO 178 MM-C (28.04.2018 r.) Fot. Adam Tużnik