Planetary Defense Capabilities of the 4.3-m Lowell Discovery Telescope (LDT)

Nicholas Moskovitz *(Lowell)*
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Annika Gustafsson *(NAU)*

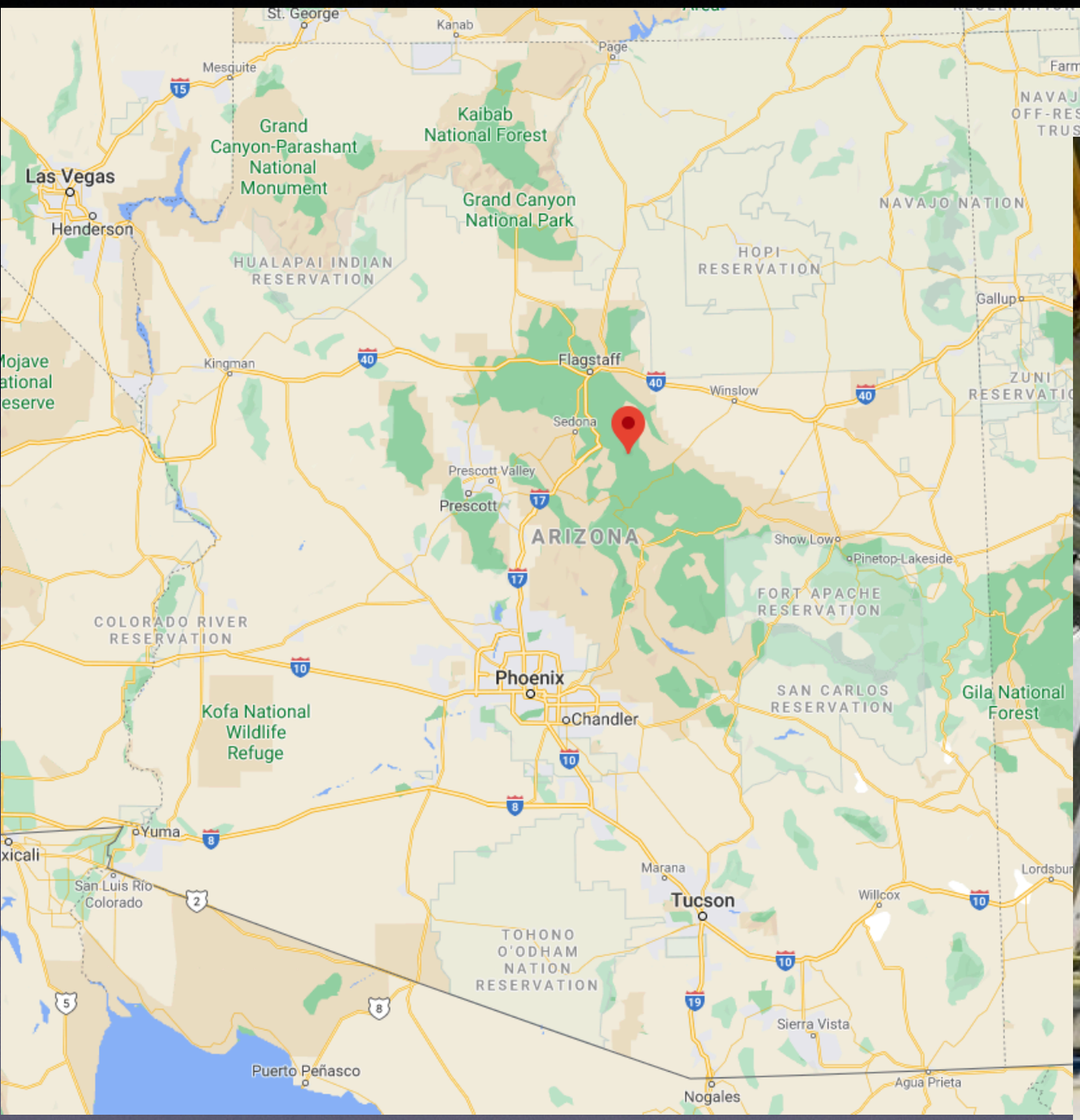
LOWELL OBSERVATORY
125 YEARS | 1894 - 2019

NORTHERN ARIZONA UNIVERSITY

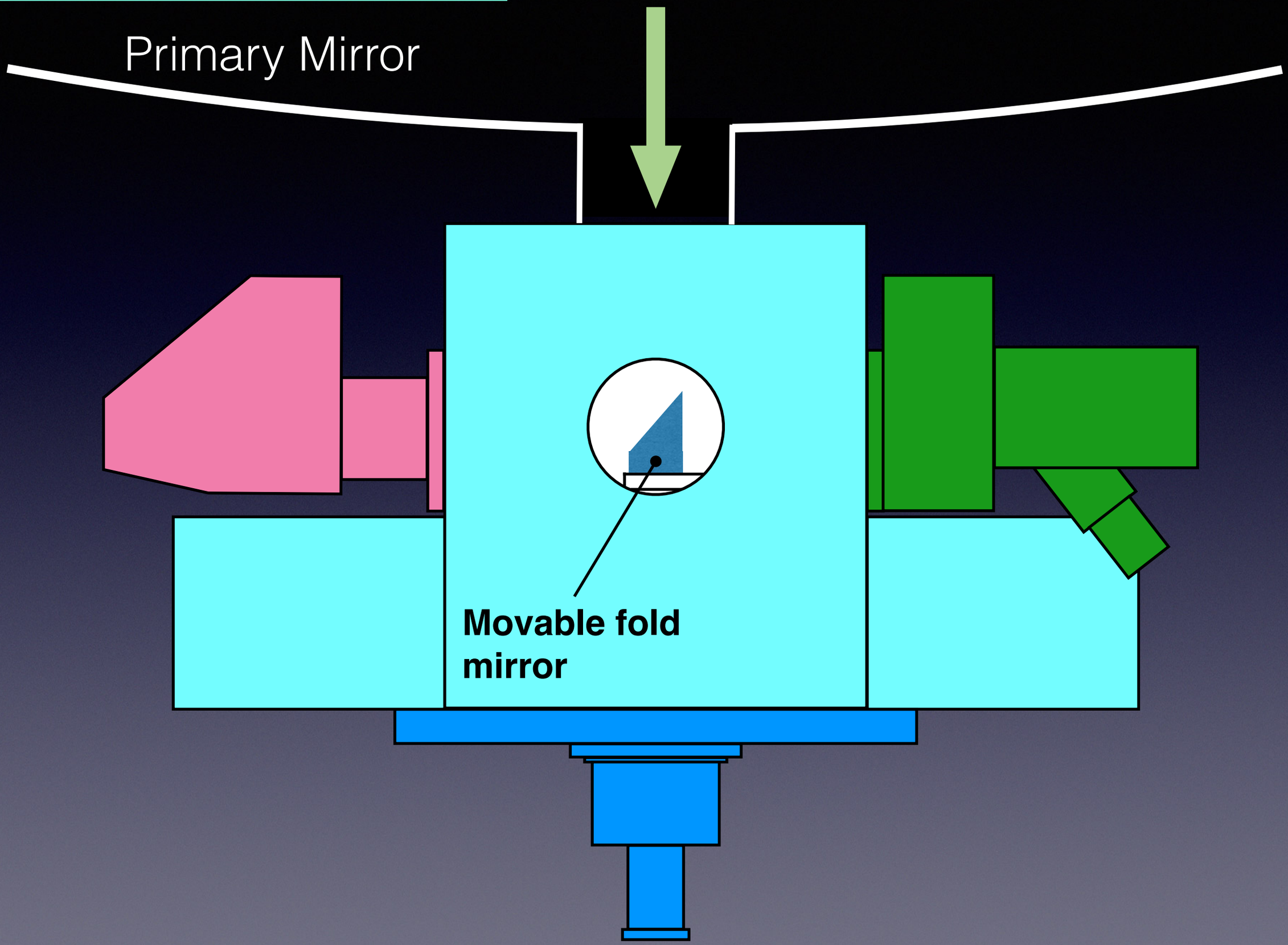
ARECIBO OBSERVATORY
PUERTO RICO
UCF • YEI • UMET

IAA Planetary Defense Conference | 27 April 2021

Lowell Discovery Telescope (LDT)



LDT Instrument Cube



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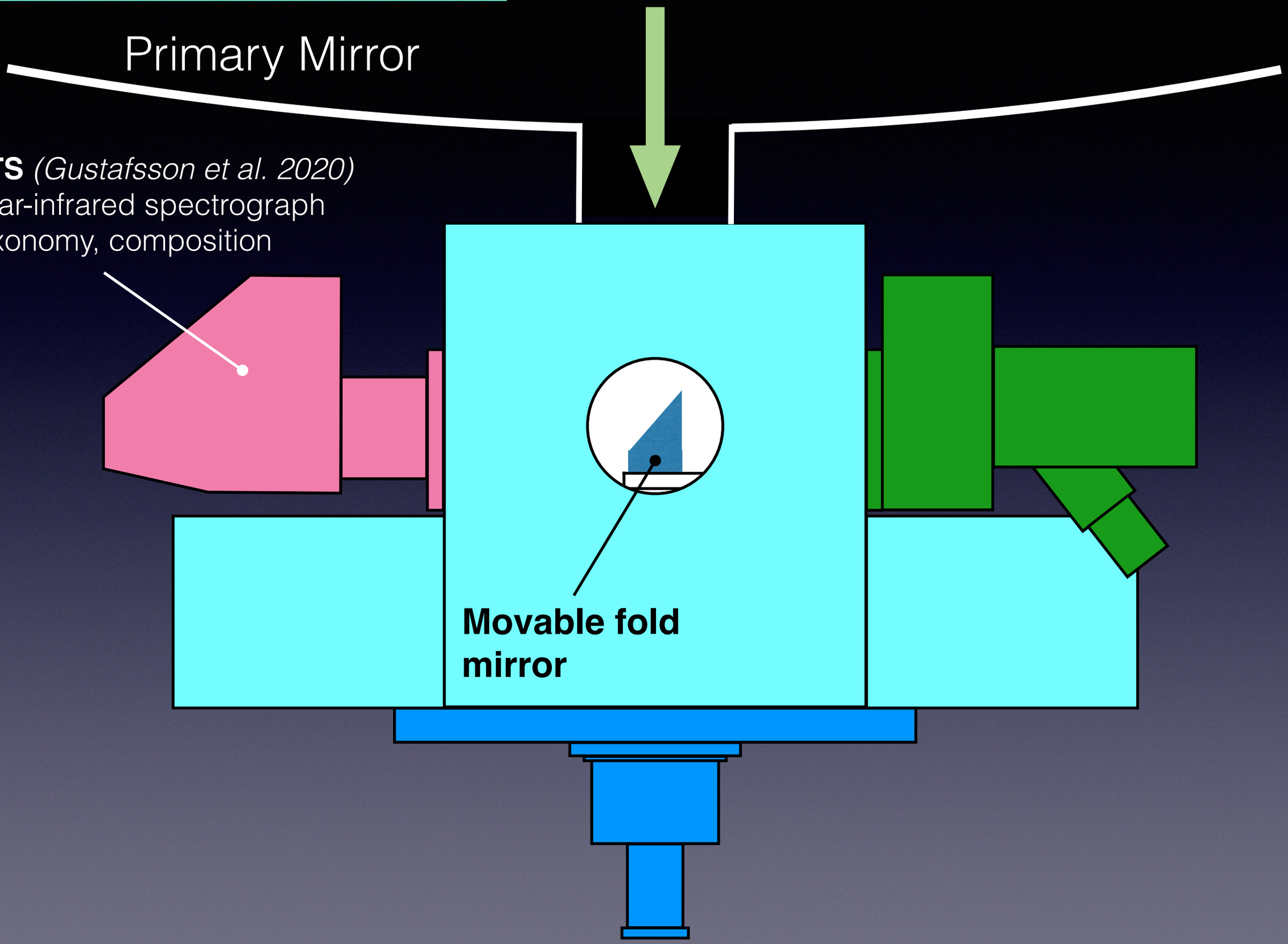
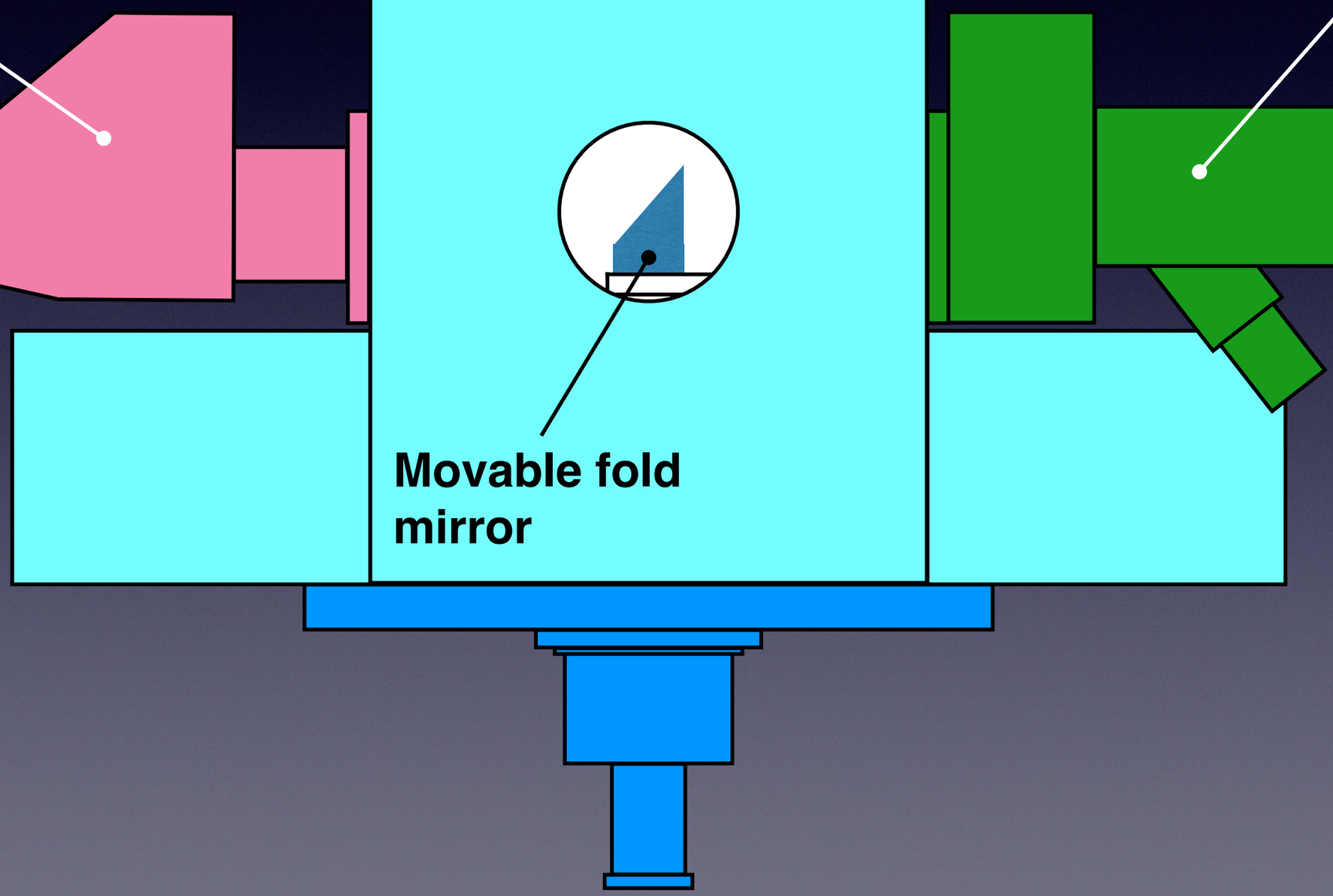


LDT Instrument Cube

Primary Mirror

NIHTS *(Gustafsson et al. 2020)*
- Near-infrared spectrograph
- Taxonomy, composition

DeVeny *(Bida et al. 2014)*
- Visible spectrograph
- Taxonomy, composition



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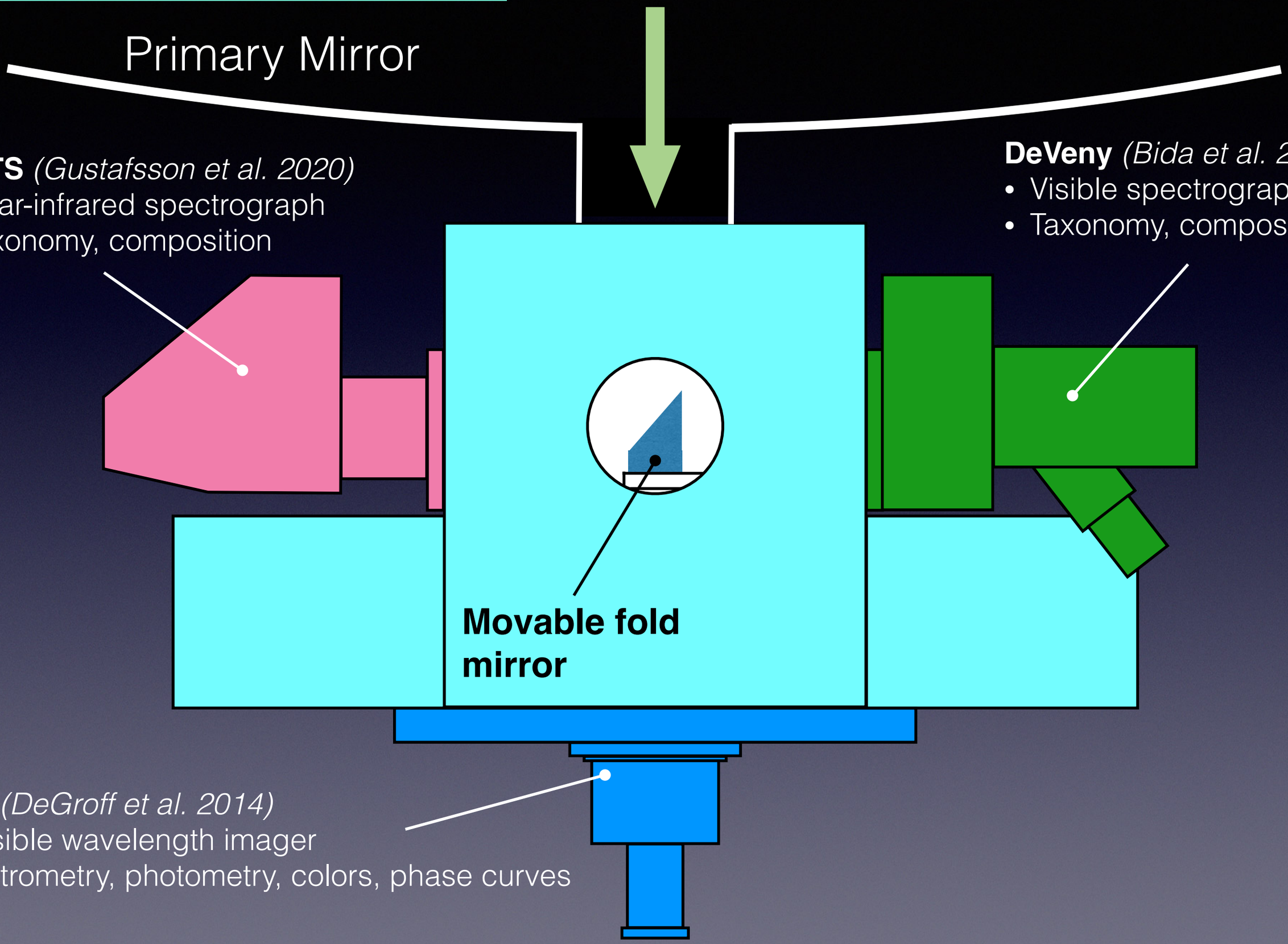


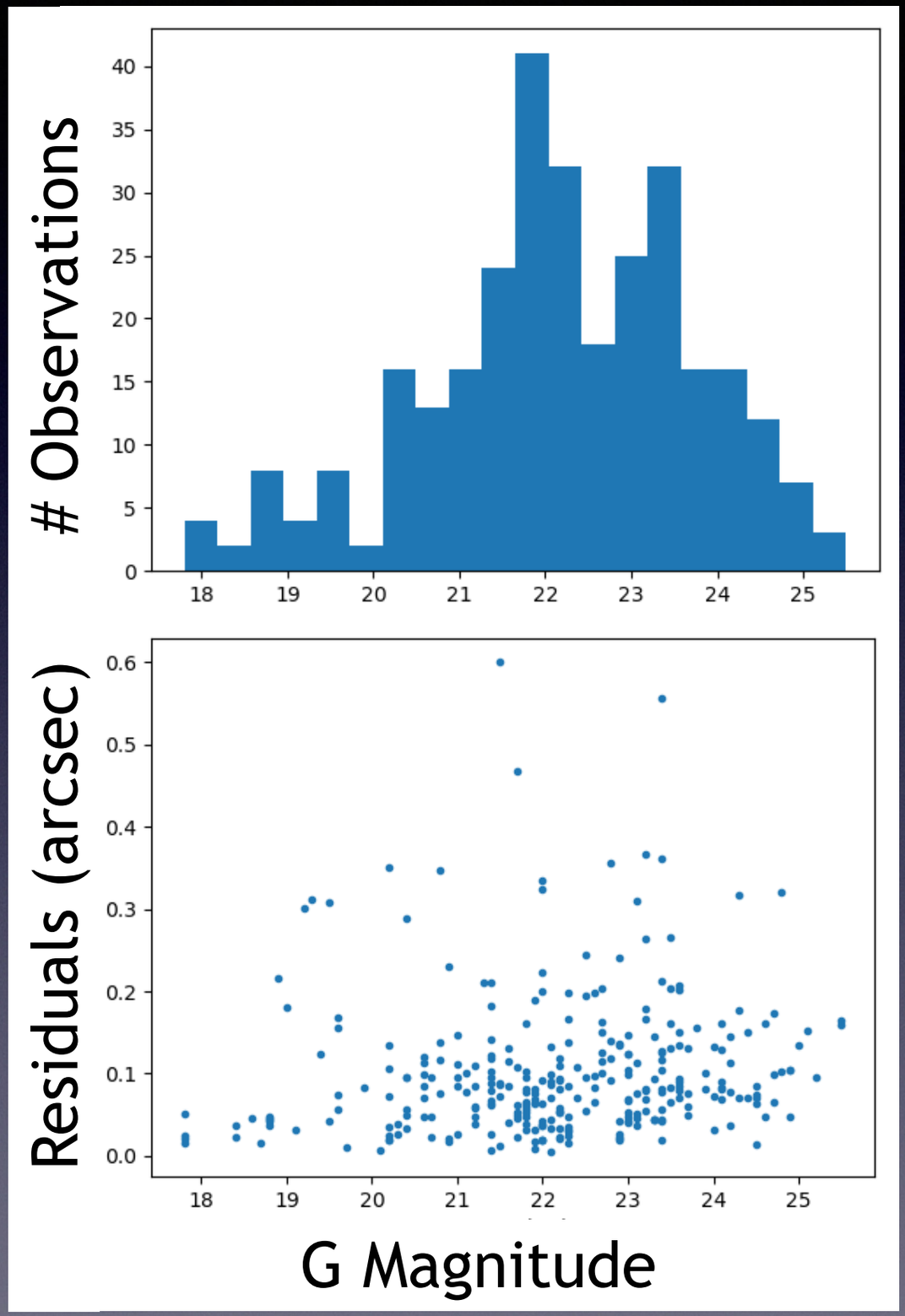
NIHTS *(Gustafsson et al. 2020)*
- Near-infrared spectrograph
- Taxonomy, composition

DeVeny *(Bida et al. 2014)*
- Visible spectrograph
- Taxonomy, composition

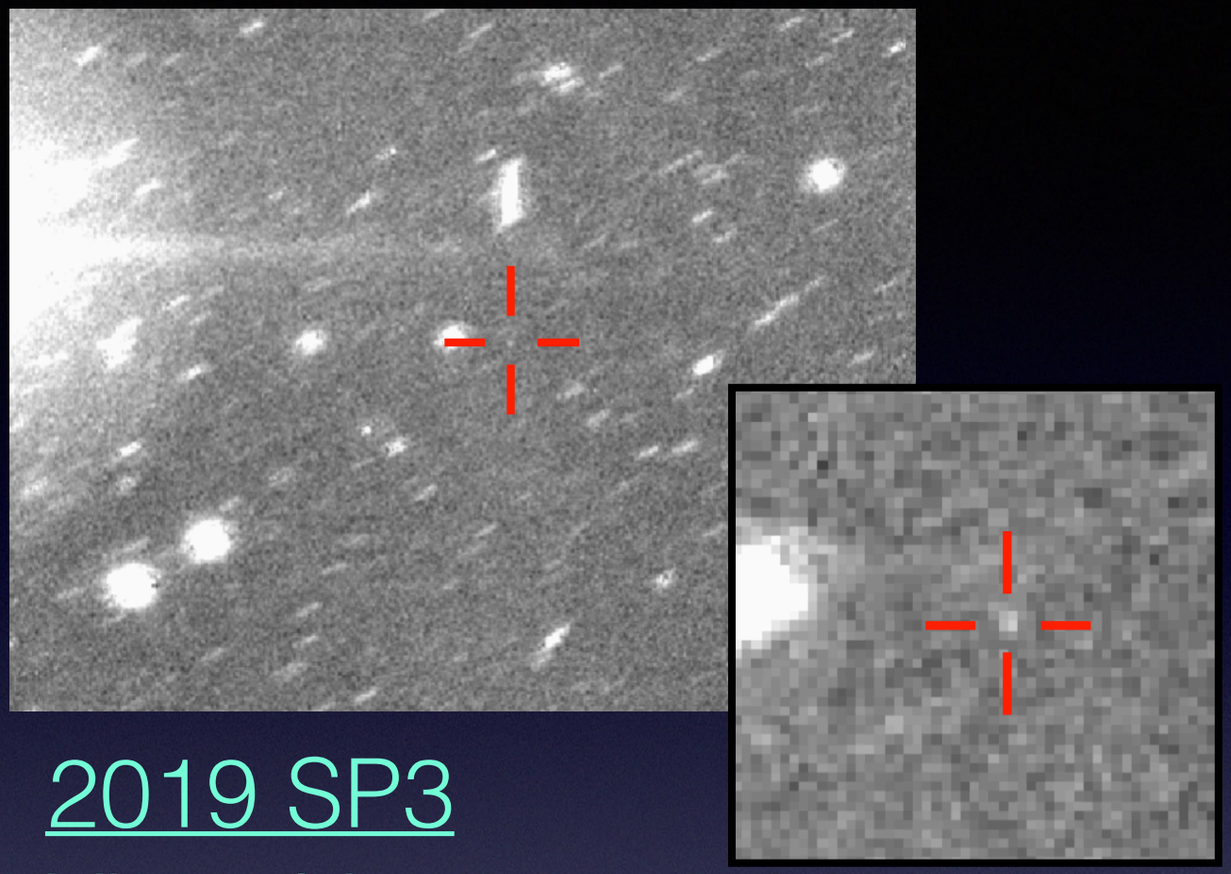
LMI *(DeGroff et al. 2014)*
- Visible wavelength imager
- Astrometry, photometry, colors, phase curves

Astrometry

NASA-funded NEO followup at LDT
(PI Devogèle, 2019-2022)



Astrometry



2019 SP3

Virtual impactor

5 x 300s exposures

V=25.5

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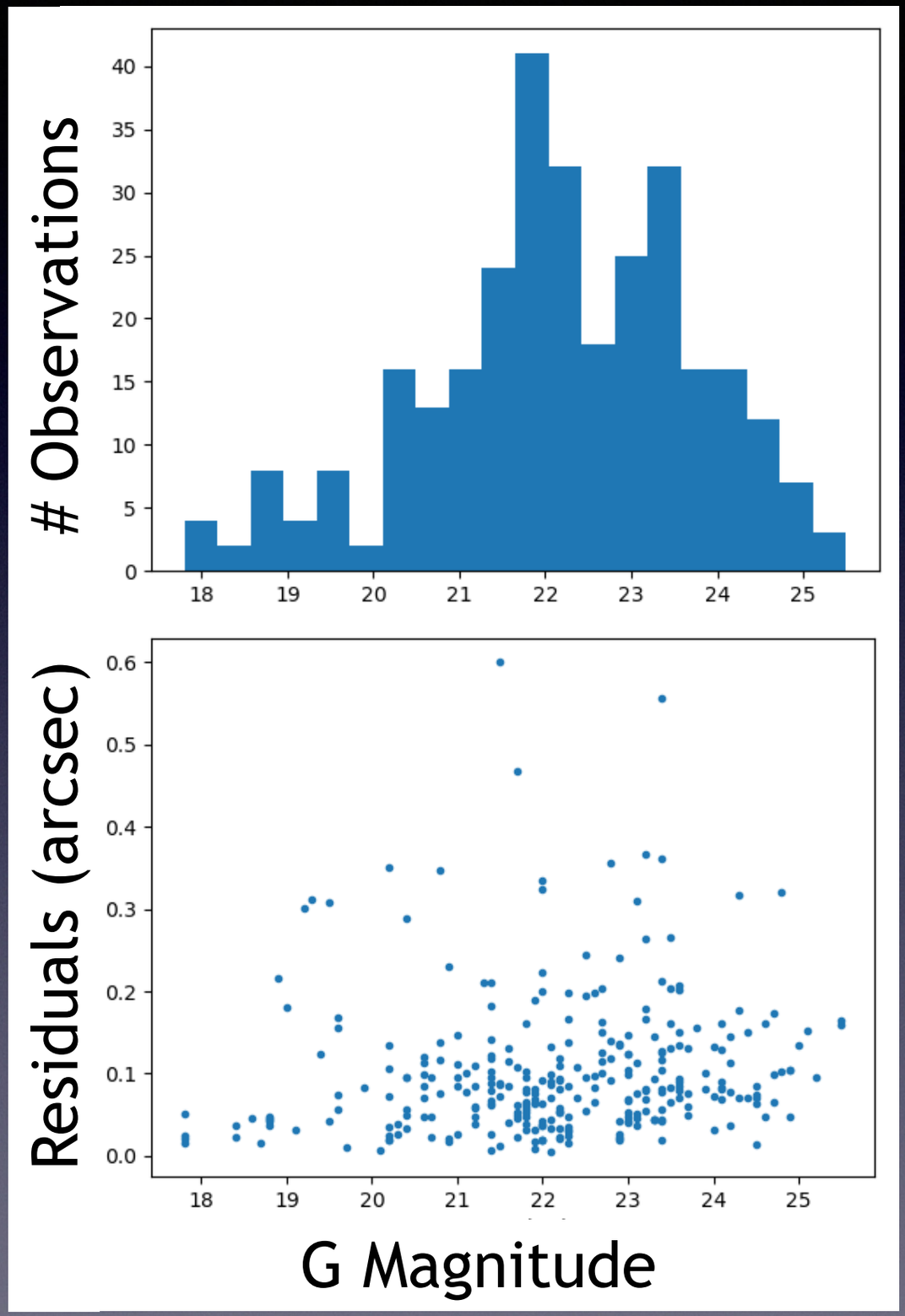

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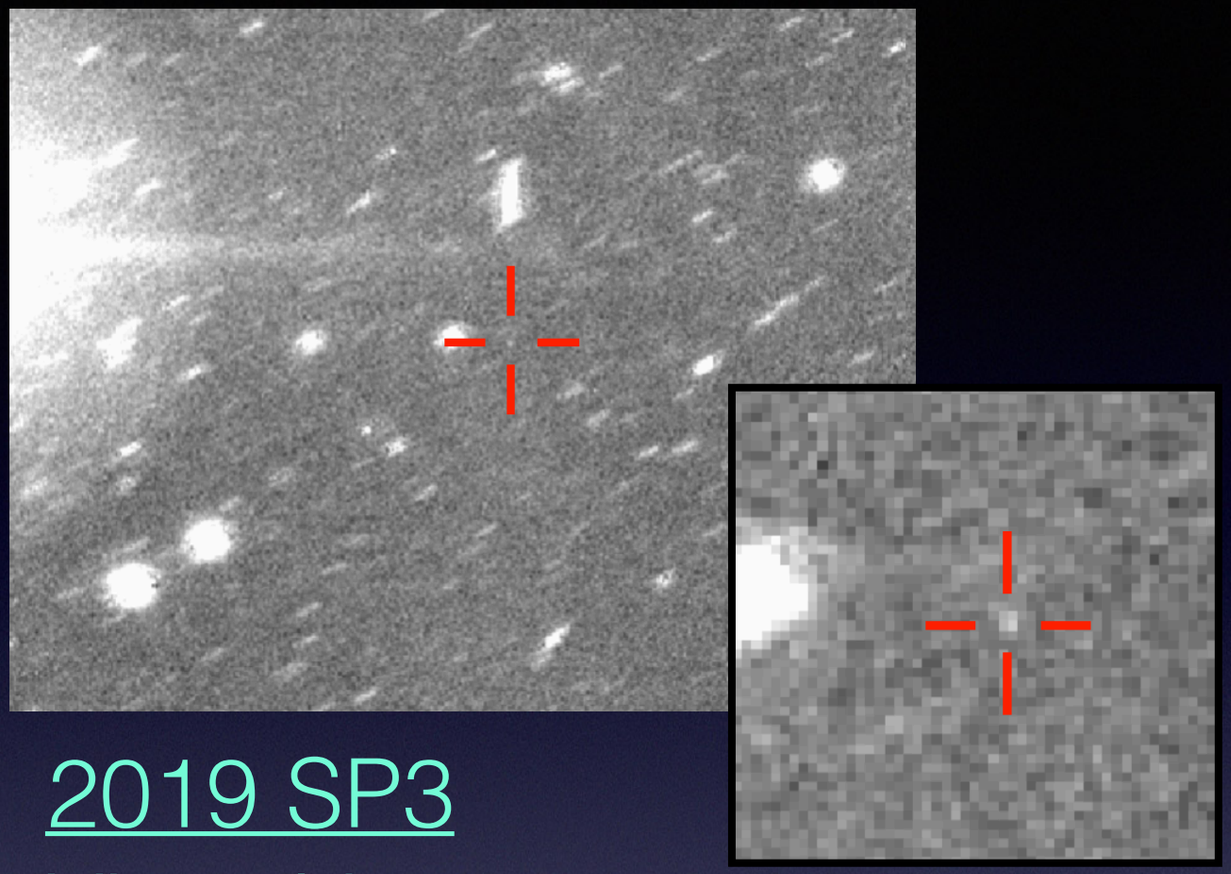

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High quality astrometry at V>25

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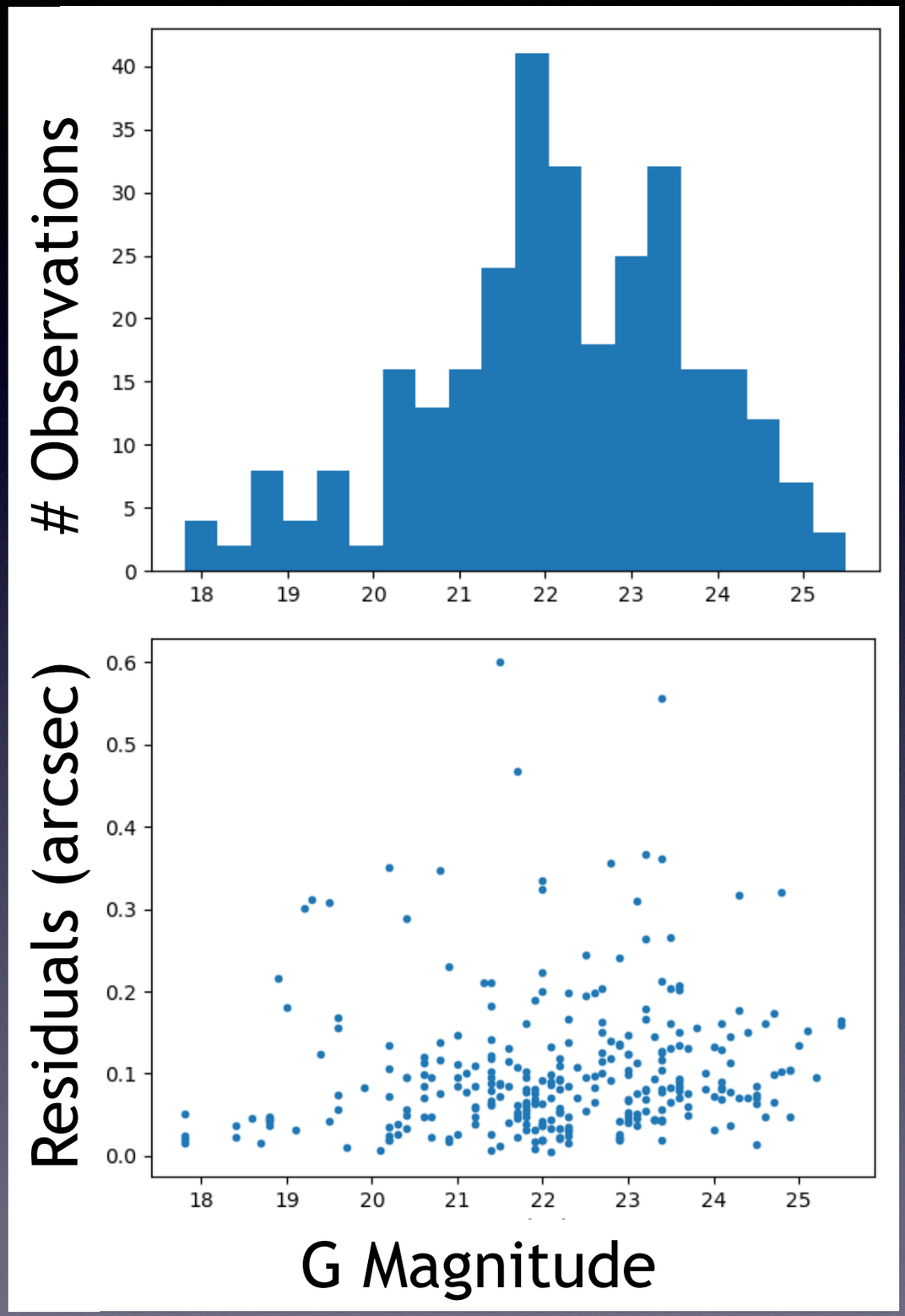
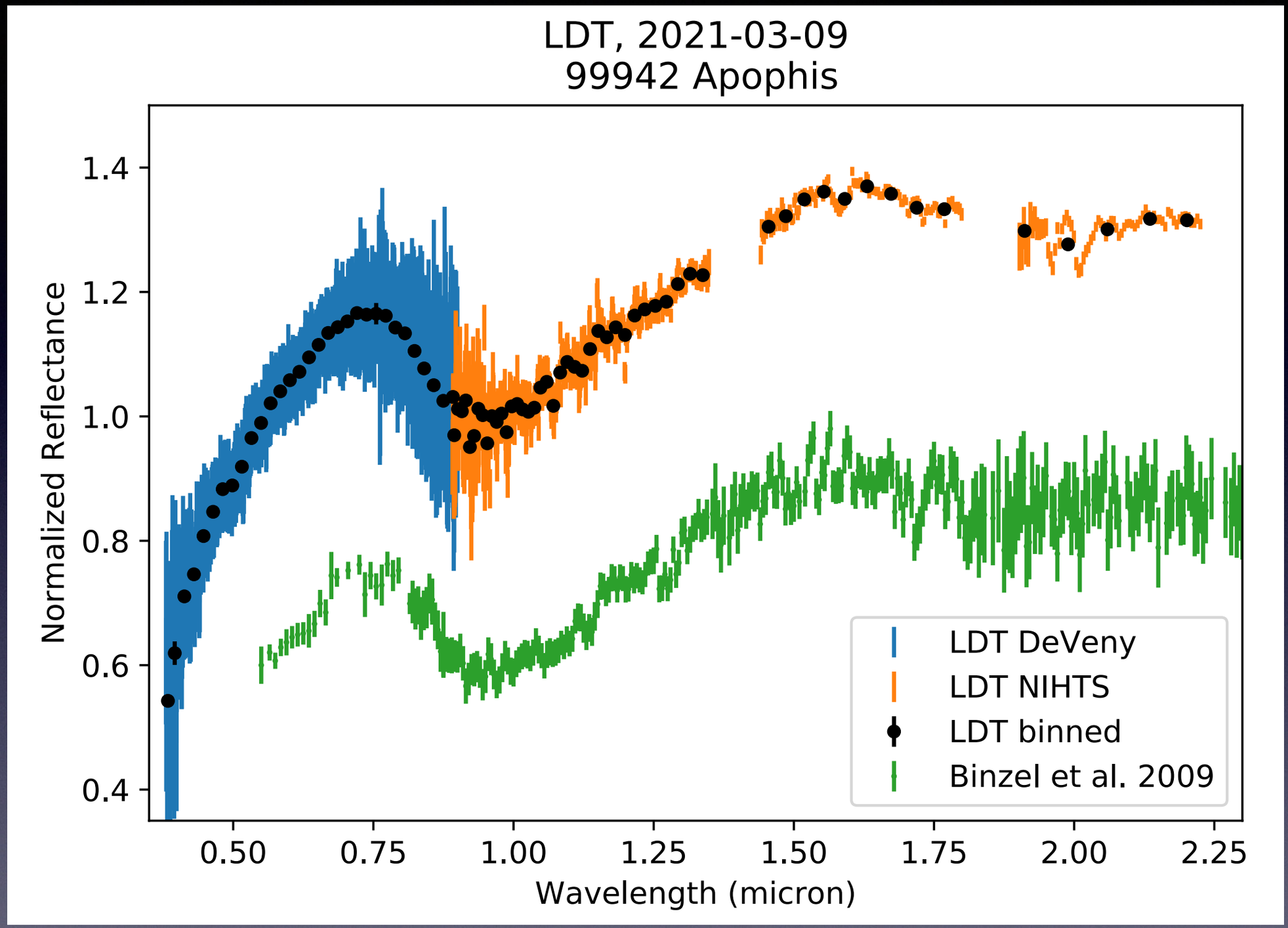


Spectroscopy



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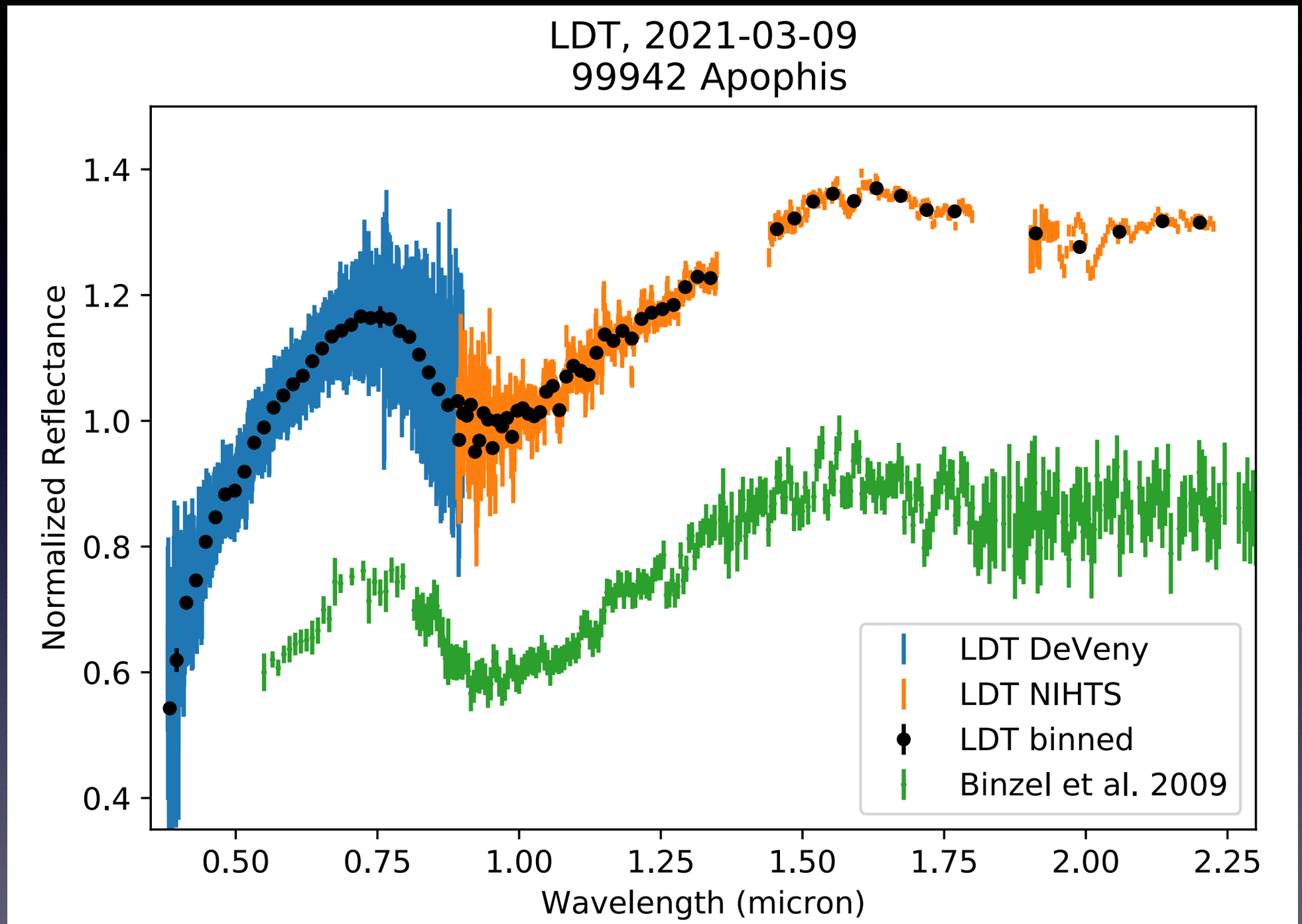
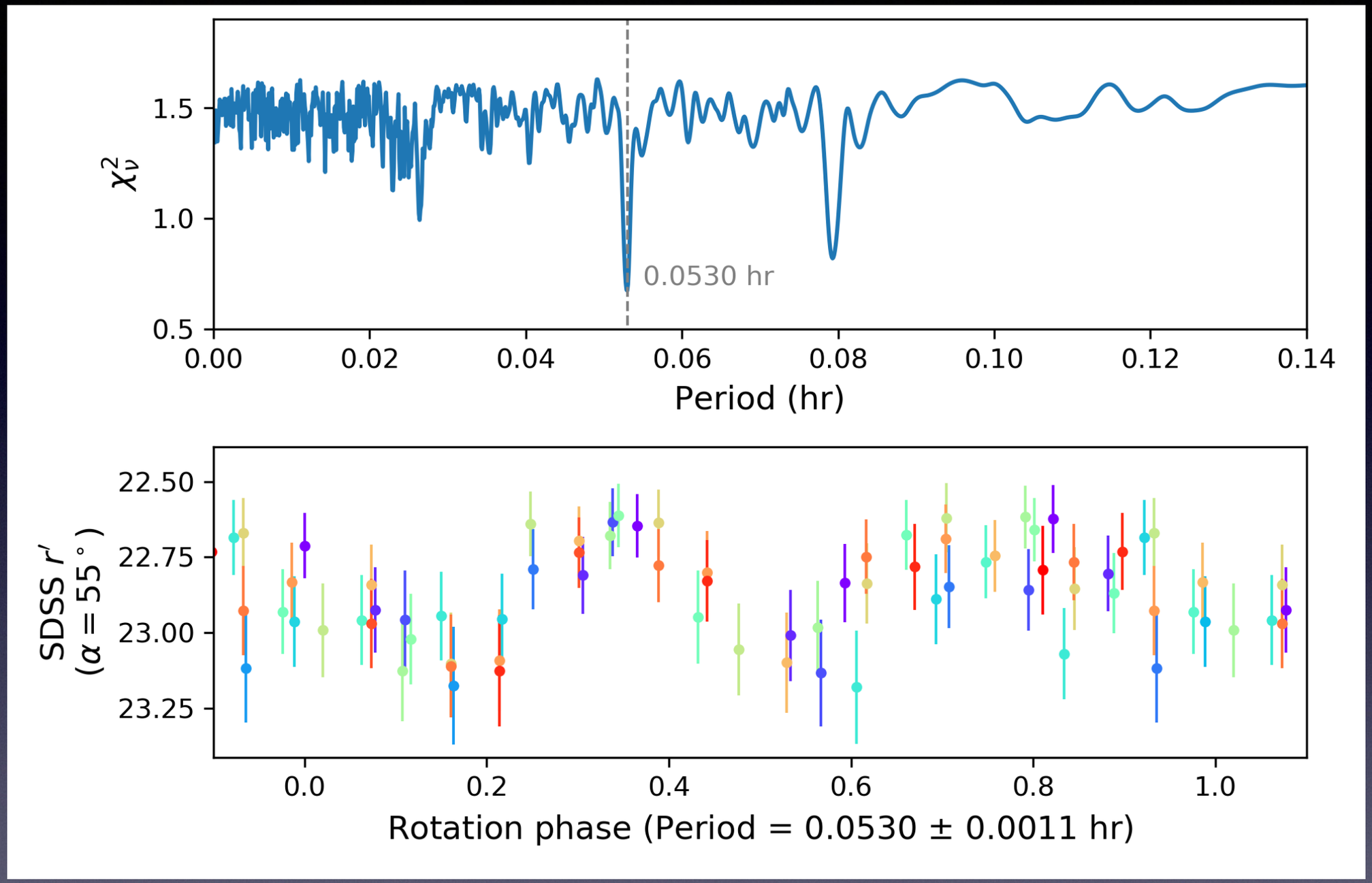


Efficient collection of visible+near-IR spectra

Photometry: Mini-moon 2020 CD3



Fedorets et al. 2020

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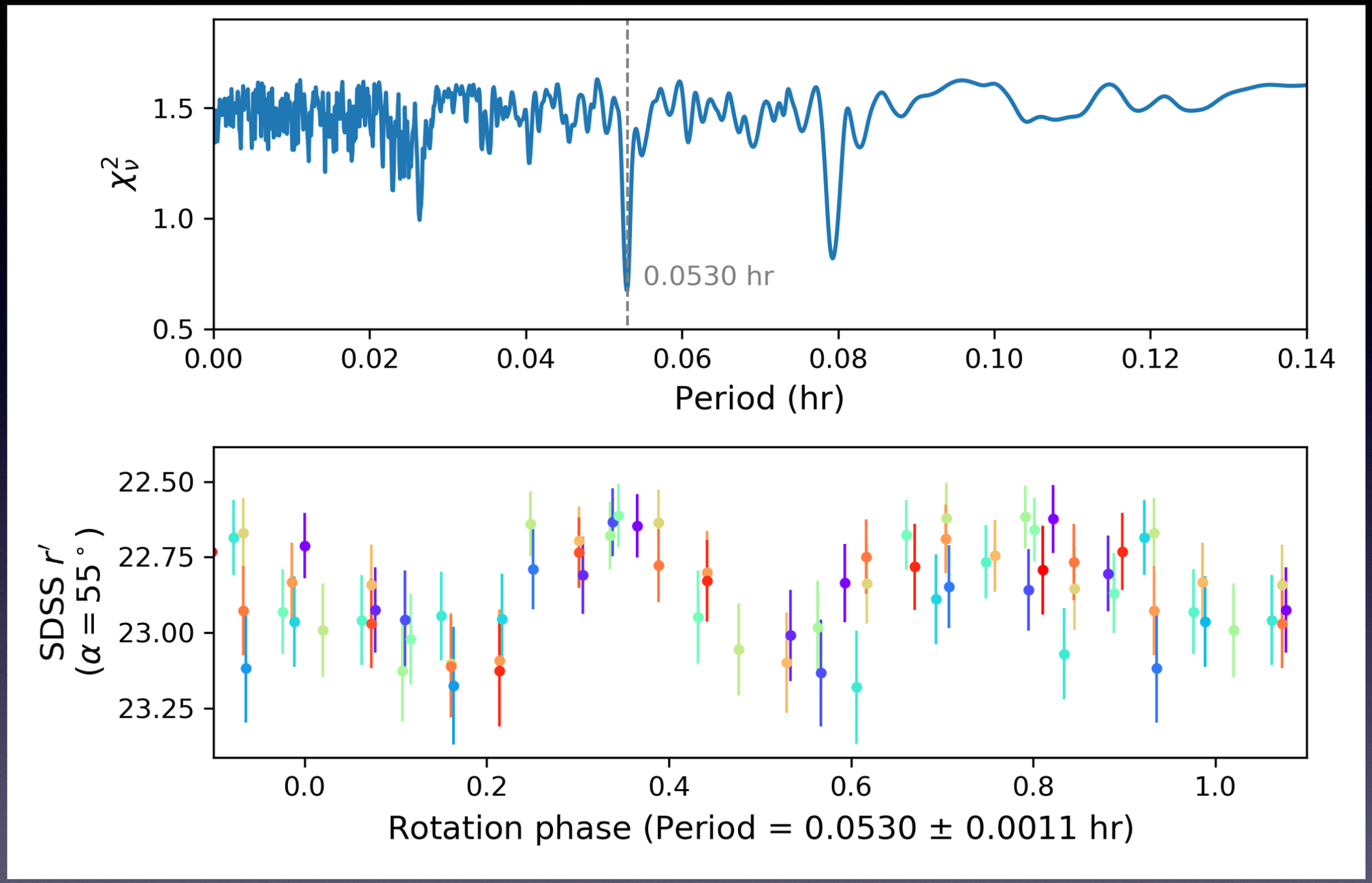
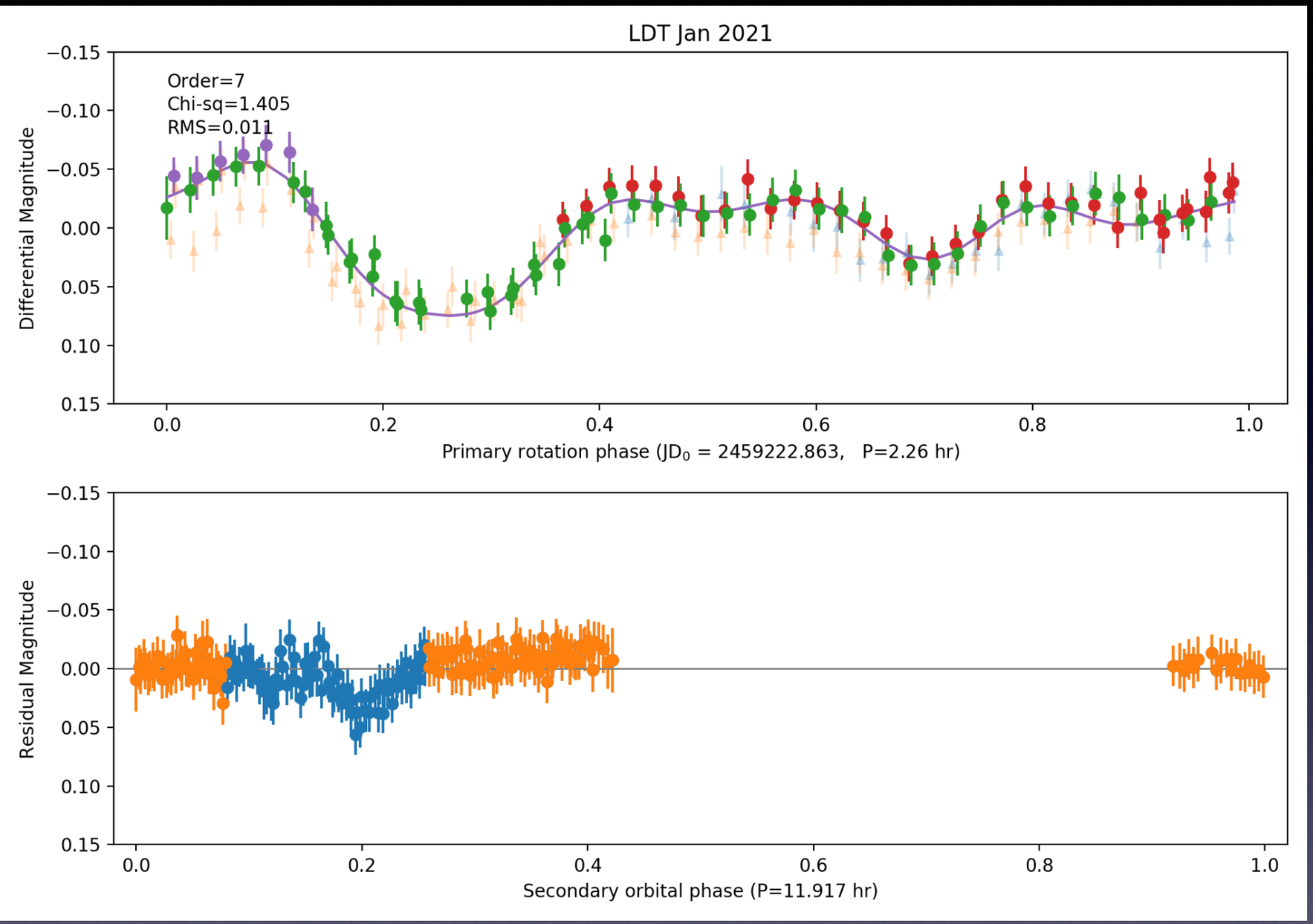


Fedorets et al. 2020

Rapid response lightcurves down to V~23

Photometry: Didymos



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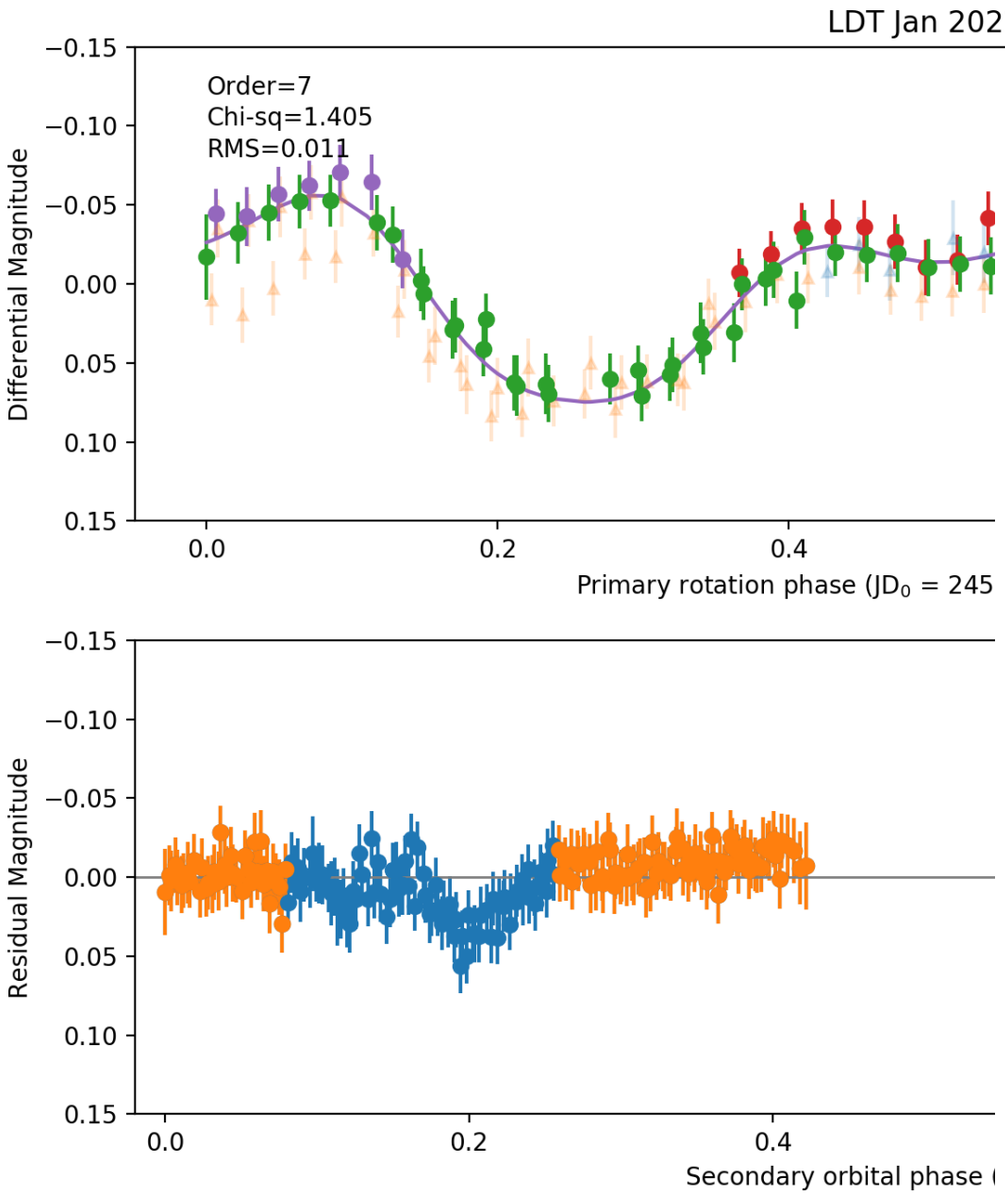

LDT Contribution to Dimorphos Orbit Solution

Calendar date (UTC)	Julian date	Contact	Occulted/Eclipsed object	Event type	1σ Uncertainty (days)
2015 Apr 13 04:54:20	2457125.7044	3.5	Primary	Occultation	0.007
2015 Apr 14 09:25:37	2457126.8928	1.5	Secondary	Eclipse	0.004
2017 Feb 25 03:50:06	2457809.6598	1.5	Primary	Occultation	0.006
2017 Feb 25 05:45:10	2457809.7397	3.5	Primary	Eclipse	0.007
2017 Apr 18 07:46:16	2457861.8238	1.5	Primary	Eclipse	0.003
2017 May 04 06:49:32	2457877.7844	3.5	Primary	Occultation	0.005
2019 Jan 31 08:39:24	2458514.8607	3.5	Secondary	Eclipse	0.007
2019 Jan 31 13:03:21	2458515.0440	1.5	Primary	Occultation	0.005
2019 Mar 09 01:42:31	2458551.5712	1.5	Secondary	Occultation	0.007
2019 Mar 09 02:35:13	2458551.6078	3.5	Secondary	Eclipse	0.005
2019 Mar 10 02:15:47	2458552.5943	3.5	Secondary	Eclipse	0.006
2019 Mar 11 02:15:30	2458553.5941	3.5	Secondary	Eclipse	0.005
2020 Dec 17 08:50:38	2459200.8685	1.5	Secondary	Eclipse	0.006
2020 Dec 17 09:36:43	2459200.9005	3.5	Secondary	Eclipse	0.007
2020 Dec 23 08:32:55	2459206.8562	3.5	Secondary	Eclipse	0.007
2020 Dec 23 12:35:42	2459207.0248	1.5	Primary	Occultation	0.006
2020 Dec 23 13:04:47	2459207.0450	3.5	Primary	Occultation	0.007
2021 Jan 08 10:57:12	2459222.9564	1.5	Primary	Eclipse	0.005
2021 Jan 08 11:35:39	2459222.9831	3.5	Primary	Eclipse	0.006
2021 Jan 09 10:50:26	2459223.9517	1.5	Primary	Eclipse	0.010
2021 Jan 09 11:21:15	2459223.9731	3.5	Primary	Eclipse	0.010
2021 Jan 10 11:11:02	2459224.9660	3.5	Primary	Eclipse	0.007
2021 Jan 14 09:56:44	2459228.9144	1.5	Primary	Eclipse	0.005
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Naidu et al. 2021

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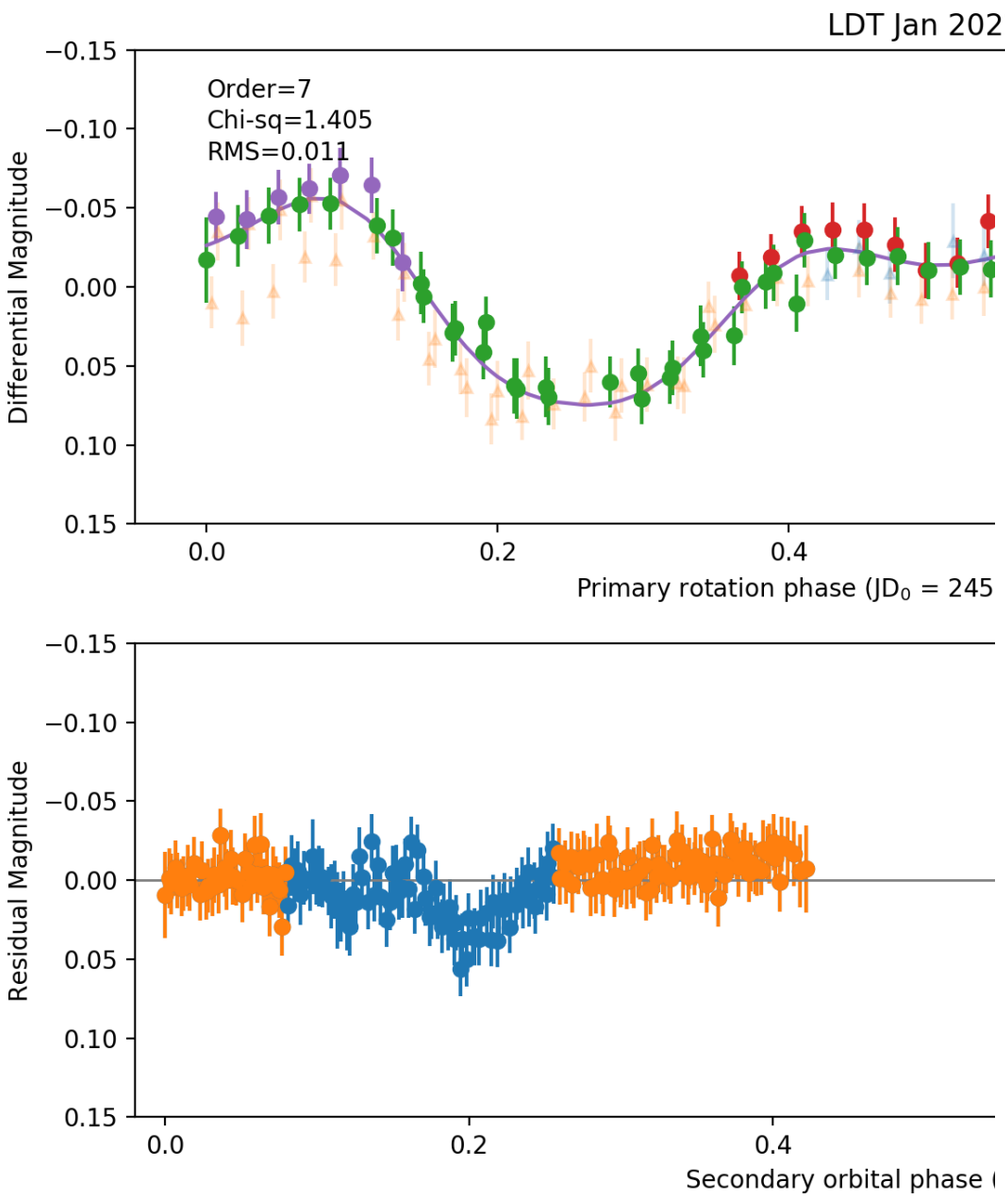

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Naidu et al. 2021

High precision ($\sigma < 0.01$ mag) photometry

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Date(s)	Action	Result
25 Apr	5% impact probability	Get serious

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From discovery through impact LDT can constrain wide range of physical properties