

The K2 Campaign 9 Microlensing Experiment

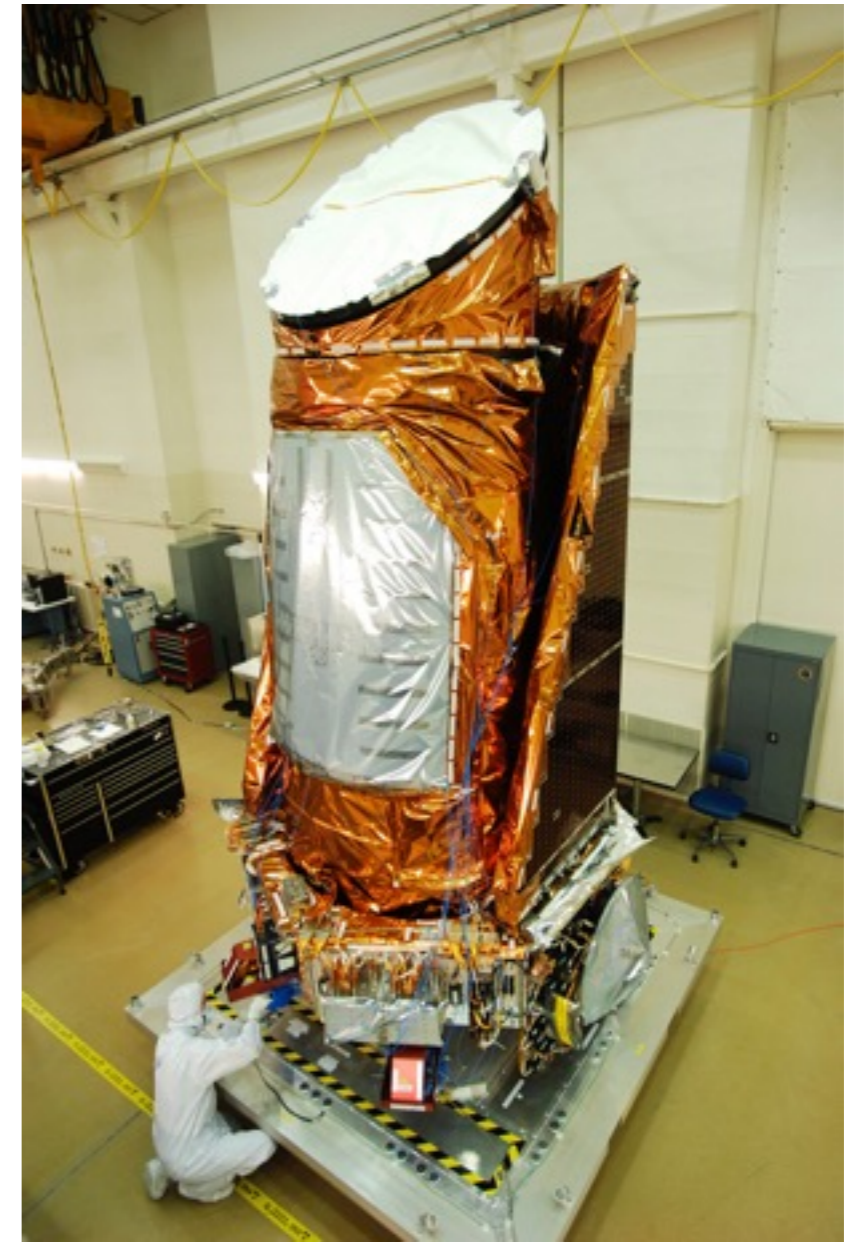
*A talk by **Geert Barentsen** for the 21st Microlensing
conference in Pasadena on 3 Feb 2017.*

*K2 Guest Observer Office
<http://keplerscience.arc.nasa.gov>*

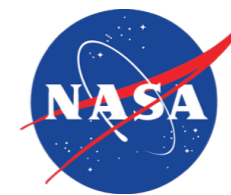
Kepler was launched on 6 March 2009



100 Mpixel array (100 deg^2)
4 arcsec pixels
1 or 30 min cadence
wide passband (V+R+I)

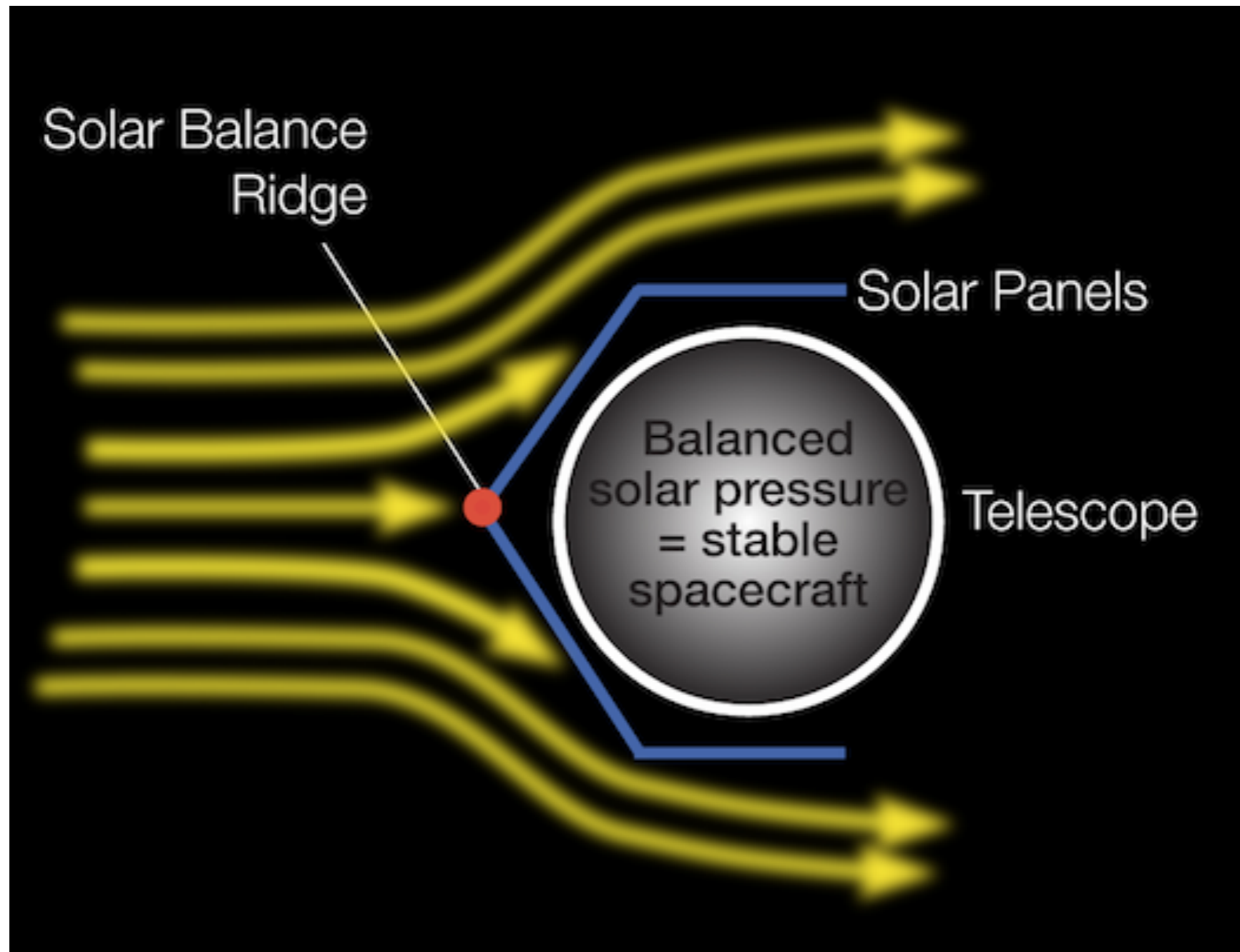


0.95-m Schmidt



Due to the loss of two reaction wheels, Kepler is now kept stable by balancing solar radiation on its solar panels

=> **K2 Mission**



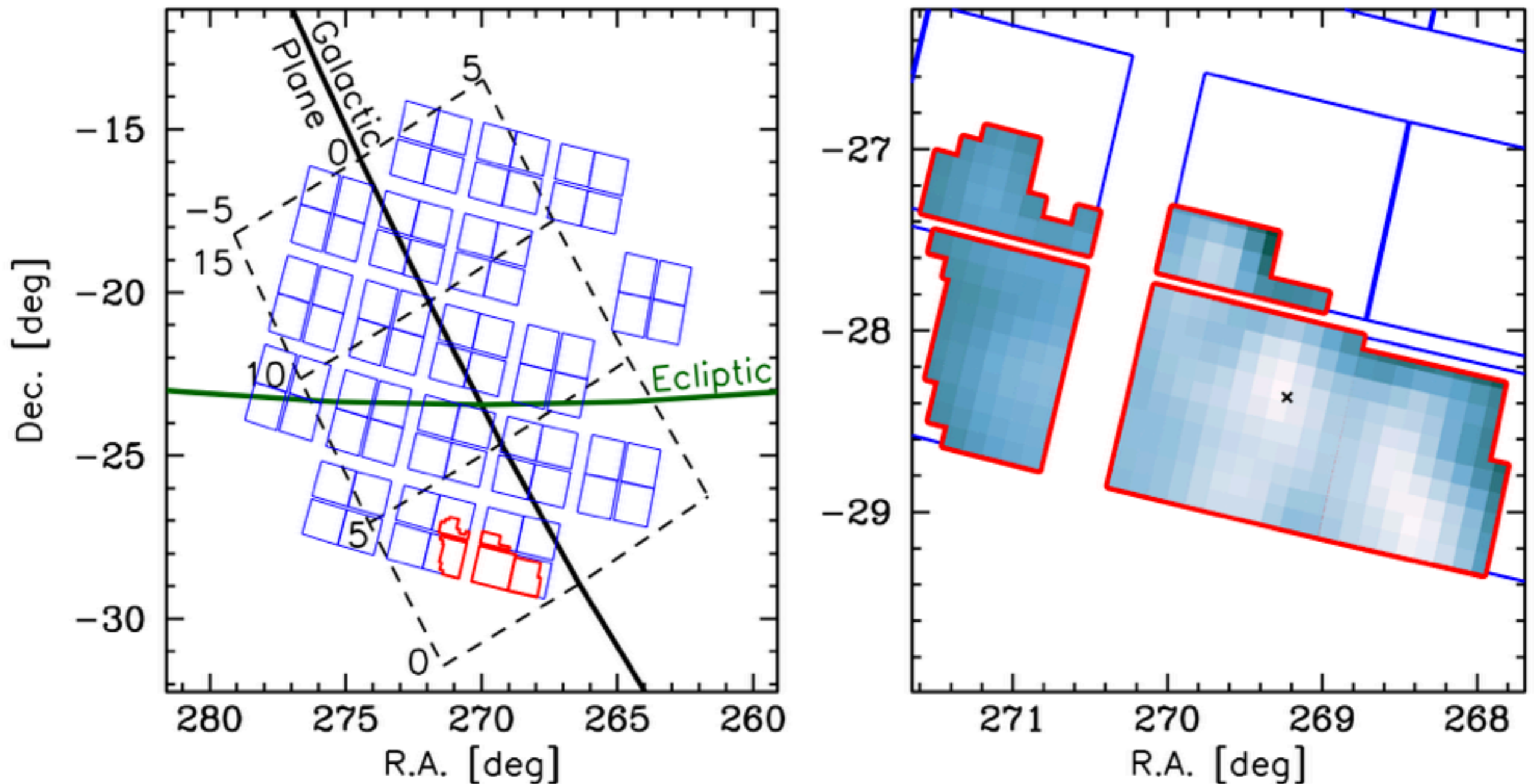
K2 Campaign 9 monitored the Bulge

9

Apr-Jul
2016



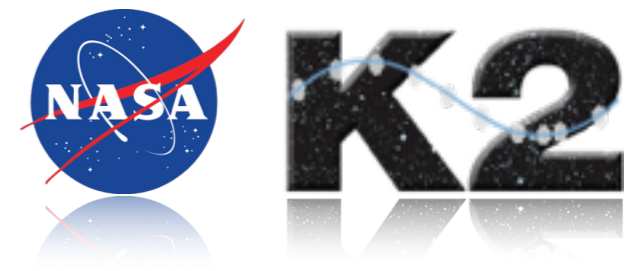
K2 C9 monitored 3.7 deg² of the Bulge for ~70 days using 30-min cadence



Henderson et al (2016); survey area selected following Poleski (2016).

Why care about K2 C9?

- First large, automated, space-based ulens survey
 - Satellite parallaxes for short-lived events; free-floating planets?
 - Galactic distribution of exoplanets
- A data set that is fully public
- Synergy with Spitzer
 - ~25+ targets shared with K2C9, ~33 with K2C11
- Excellent practice for WFIRST
 - Length of observing season (~72 d)
 - Coordination of ground and space



Orbital motion

7/Apr

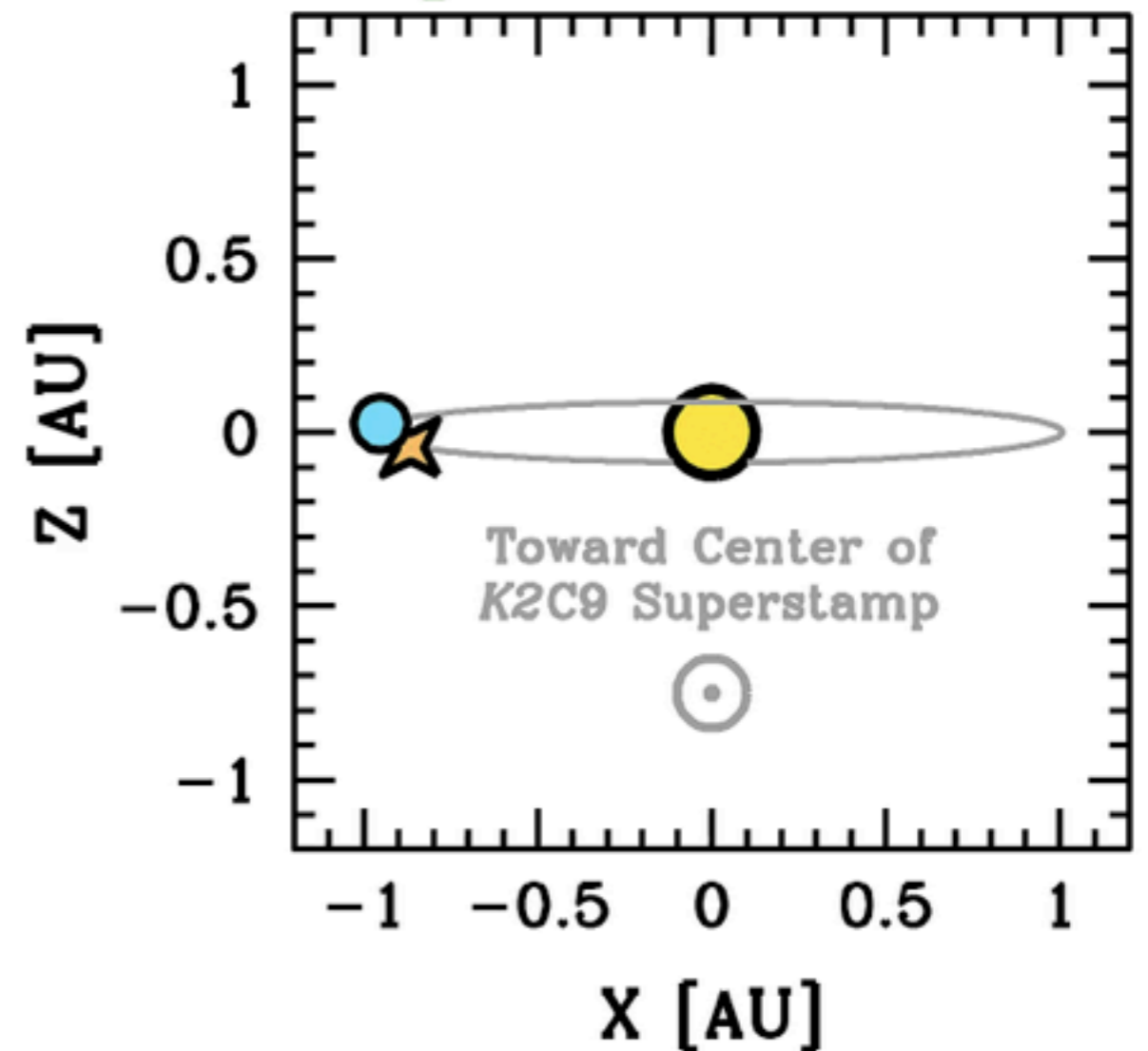
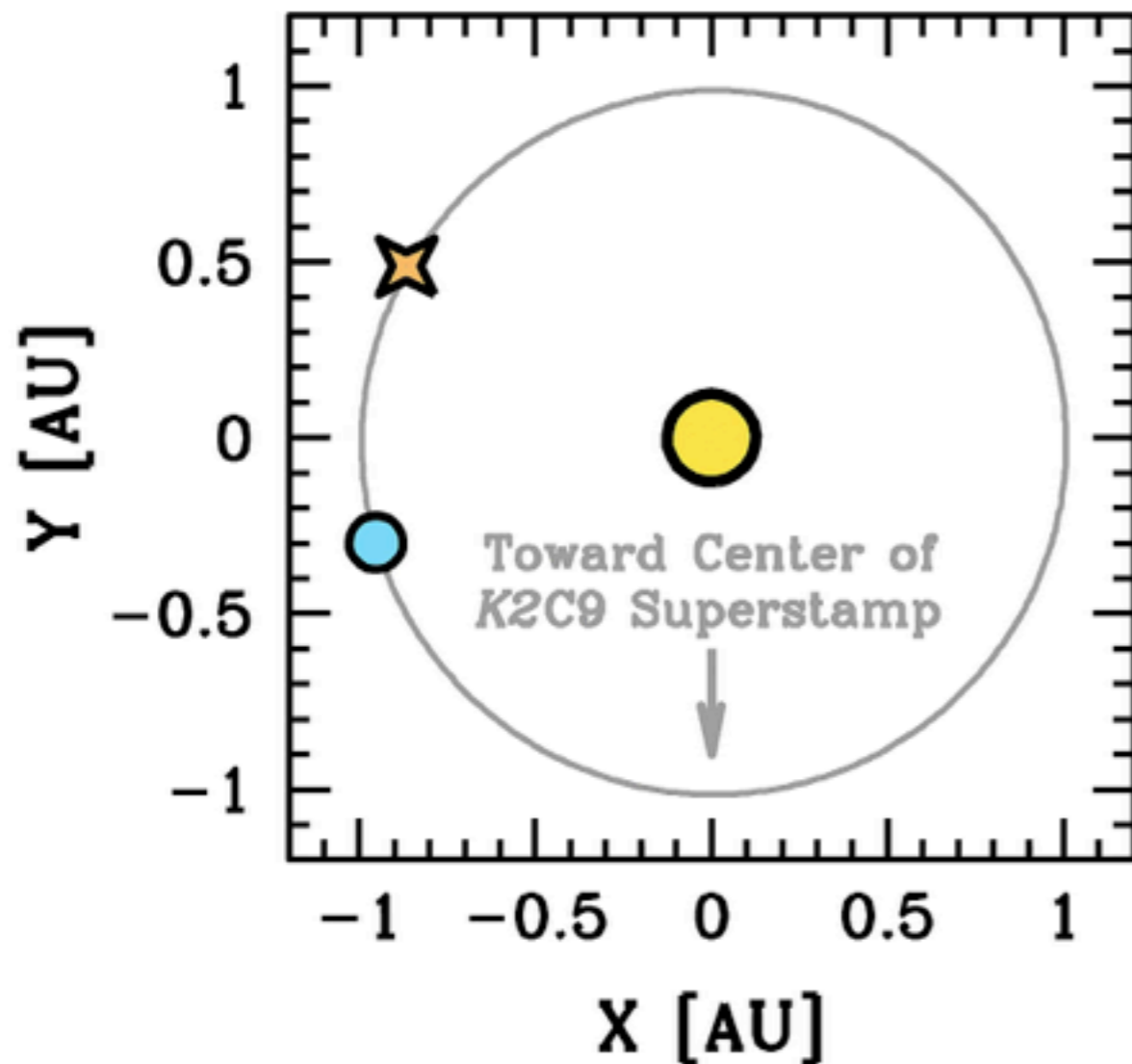
Earth-K2 Projected Separation

0.11 AU

Sun

Earth

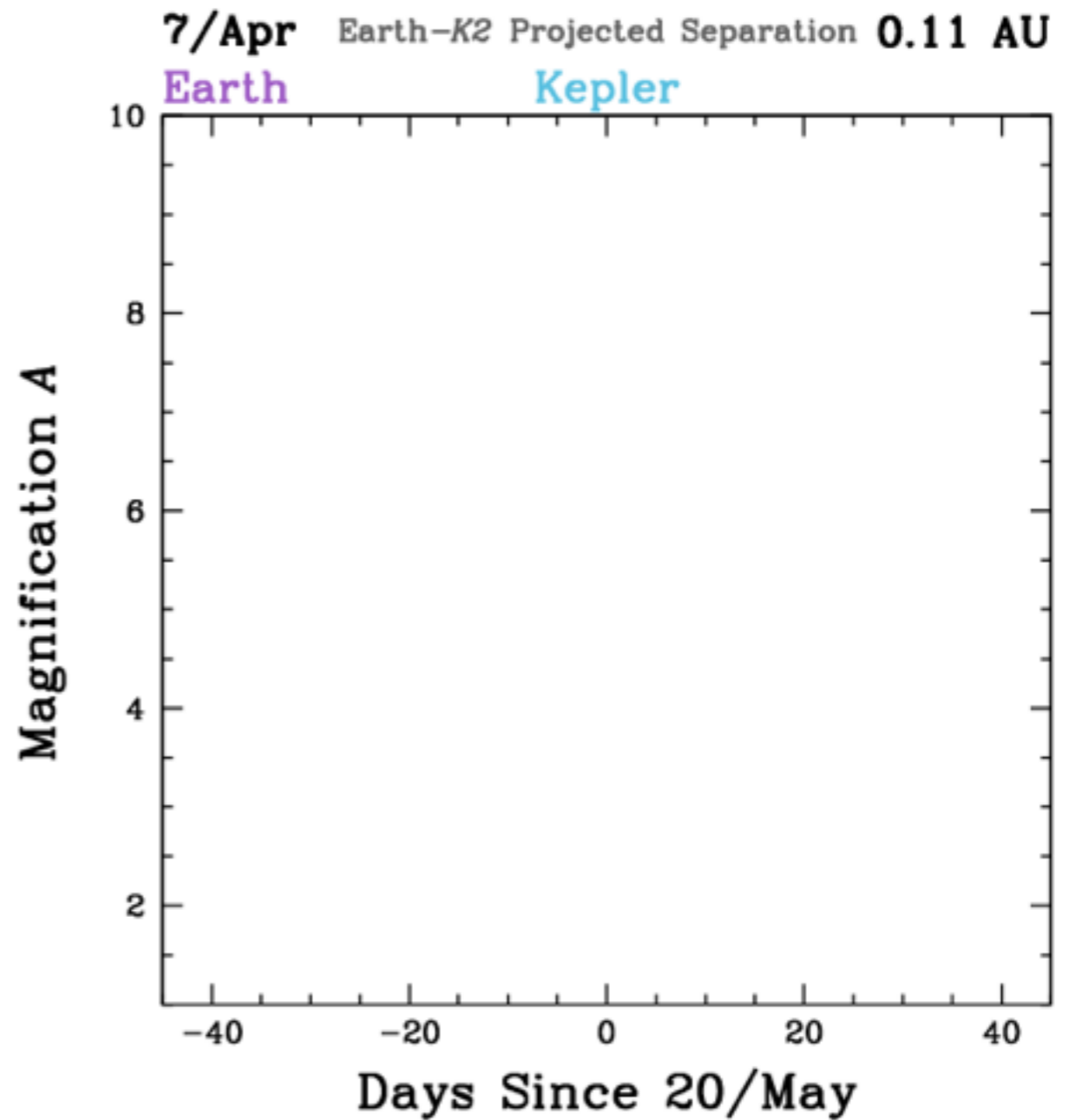
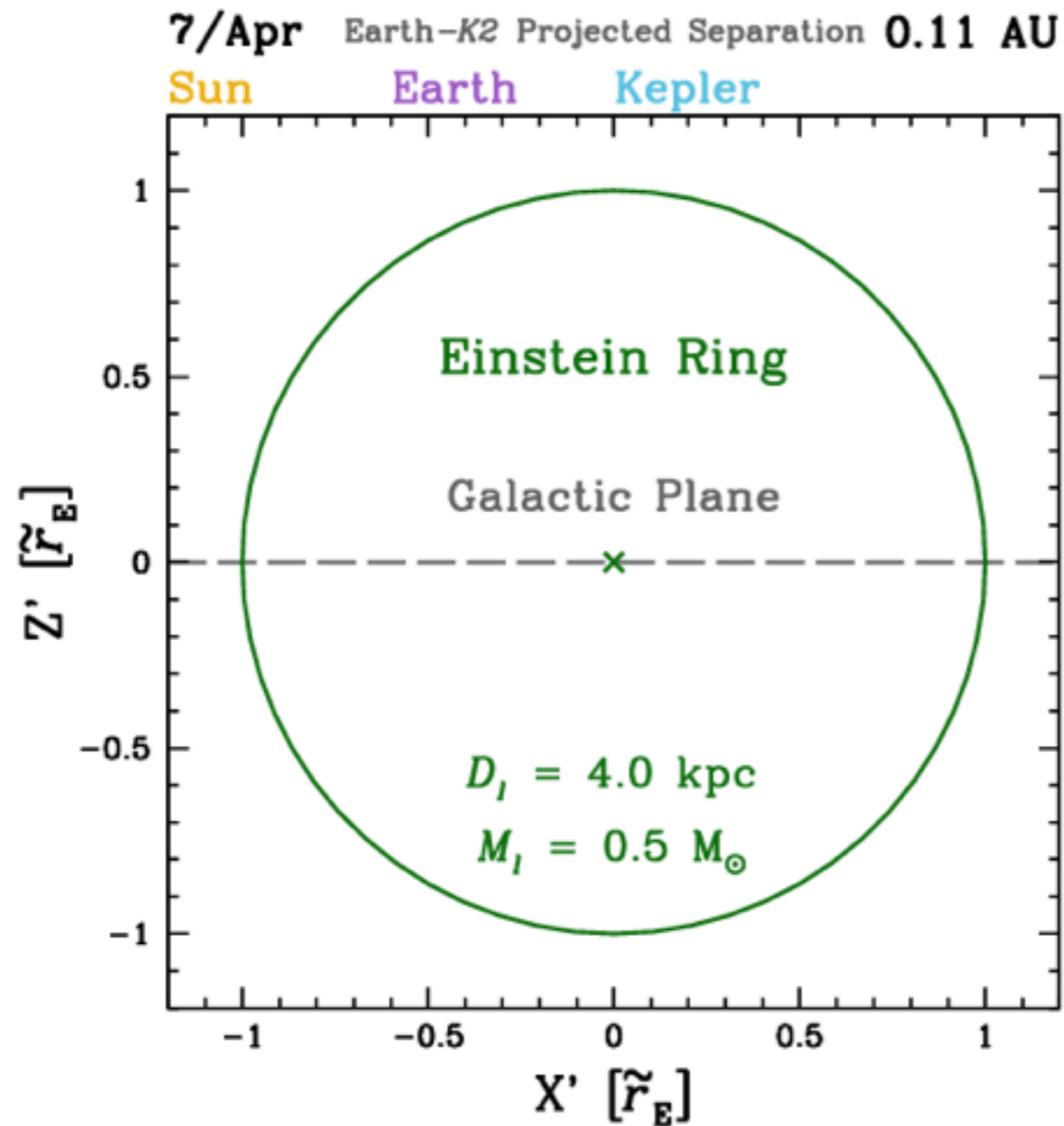
Kepler



Credit: Calen Henderson

(http://www.astronomy.ohio-state.edu/~henderson/k2c9_parallax_animations)

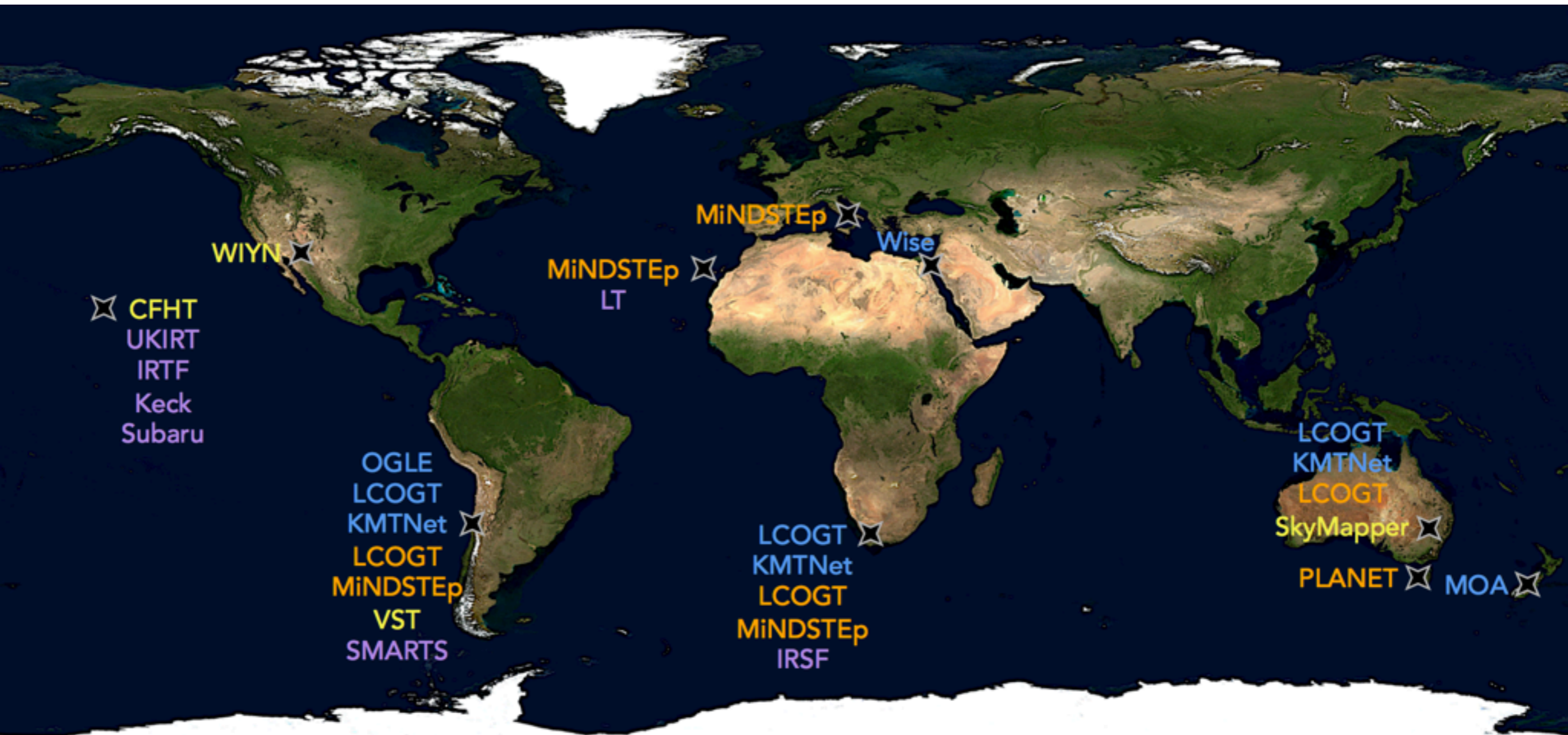
Simulated event



Credit: Calen Henderson

(http://www.astronomy.ohio-state.edu/~henderson/k2c9_parallax_animations)

Many ground-based facilities monitored the K2 C9 field — thank you!

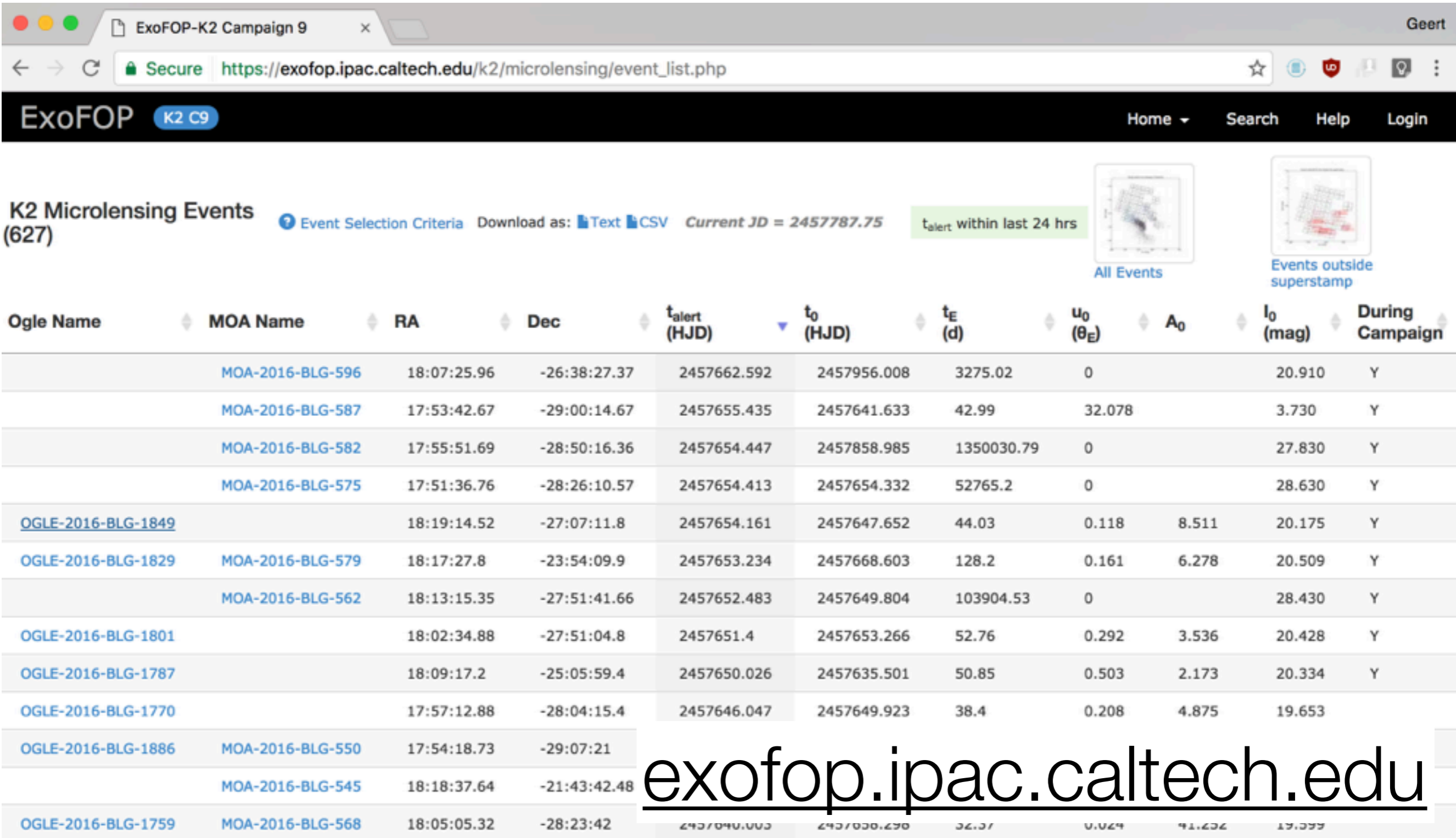


Henderson et al (2016)



Coordination via K2 C9 ExoFOP (NExSci)

=> See poster by Rachel Akeson!



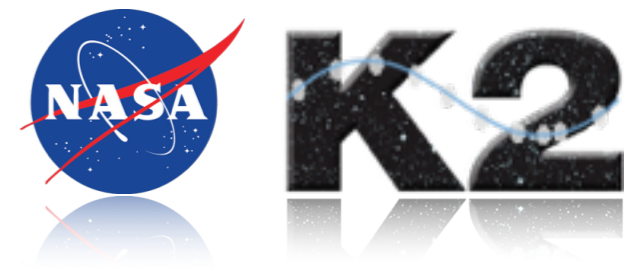
The screenshot shows a web browser window with the URL https://exofop.ipac.caltech.edu/k2/microlensing/event_list.php. The page title is "K2 Microlensing Events (627)". It includes navigation links for "Home", "Search", "Help", and "Login". There are two small thumbnail images: "All Events" and "Events outside superstamp". A green box indicates "t_{alert} within last 24 hrs". Below the navigation is a table of microlensing events with columns for Ogle Name, MOA Name, RA, Dec, t_{alert} (HJD), t₀ (HJD), t_E (d), u₀ (θ_E), A₀, I₀ (mag), and During Campaign.

Ogle Name	MOA Name	RA	Dec	t _{alert} (HJD)	t ₀ (HJD)	t _E (d)	u ₀ (θ _E)	A ₀	I ₀ (mag)	During Campaign
	MOA-2016-BLG-596	18:07:25.96	-26:38:27.37	2457662.592	2457956.008	3275.02	0		20.910	Y
	MOA-2016-BLG-587	17:53:42.67	-29:00:14.67	2457655.435	2457641.633	42.99	32.078		3.730	Y
	MOA-2016-BLG-582	17:55:51.69	-28:50:16.36	2457654.447	2457858.985	1350030.79	0		27.830	Y
	MOA-2016-BLG-575	17:51:36.76	-28:26:10.57	2457654.413	2457654.332	52765.2	0		28.630	Y
OGLE-2016-BLG-1849		18:19:14.52	-27:07:11.8	2457654.161	2457647.652	44.03	0.118	8.511	20.175	Y
OGLE-2016-BLG-1829	MOA-2016-BLG-579	18:17:27.8	-23:54:09.9	2457653.234	2457668.603	128.2	0.161	6.278	20.509	Y
	MOA-2016-BLG-562	18:13:15.35	-27:51:41.66	2457652.483	2457649.804	103904.53	0		28.430	Y
OGLE-2016-BLG-1801		18:02:34.88	-27:51:04.8	2457651.4	2457653.266	52.76	0.292	3.536	20.428	Y
OGLE-2016-BLG-1787		18:09:17.2	-25:05:59.4	2457650.026	2457635.501	50.85	0.503	2.173	20.334	Y
OGLE-2016-BLG-1770		17:57:12.88	-28:04:15.4	2457646.047	2457649.923	38.4	0.208	4.875	19.653	
OGLE-2016-BLG-1886	MOA-2016-BLG-550	17:54:18.73	-29:07:21							
	MOA-2016-BLG-545	18:18:37.64	-21:43:42.48							
OGLE-2016-BLG-1759	MOA-2016-BLG-568	18:05:05.32	-28:23:42	2457640.003	2457636.296	32.37	0.024	41.232	19.599	
OGLE-2016-BLG-1762		18:16:49.44	-27:35:58.2	2457640.003	2457636.296	168.7	0.01	100.2	20.103	Y

exofop.ipac.caltech.edu

K2 C9 Science Team

- To maximize the scientific return, NASA funded a K2 C9 Microlensing Science Team.
- PIs: Bennett, Henderson, Hogg, Penny, Street + Poleski (C11).
- The team was recruited to ...
 - help plan the K2 observations; ✓
 - facilitate coordinated ground-based observations; ✓
 - detect and characterize the events observed by K2. *ongoing*
- Value-added products are expected to become public.



So what does the data look like?

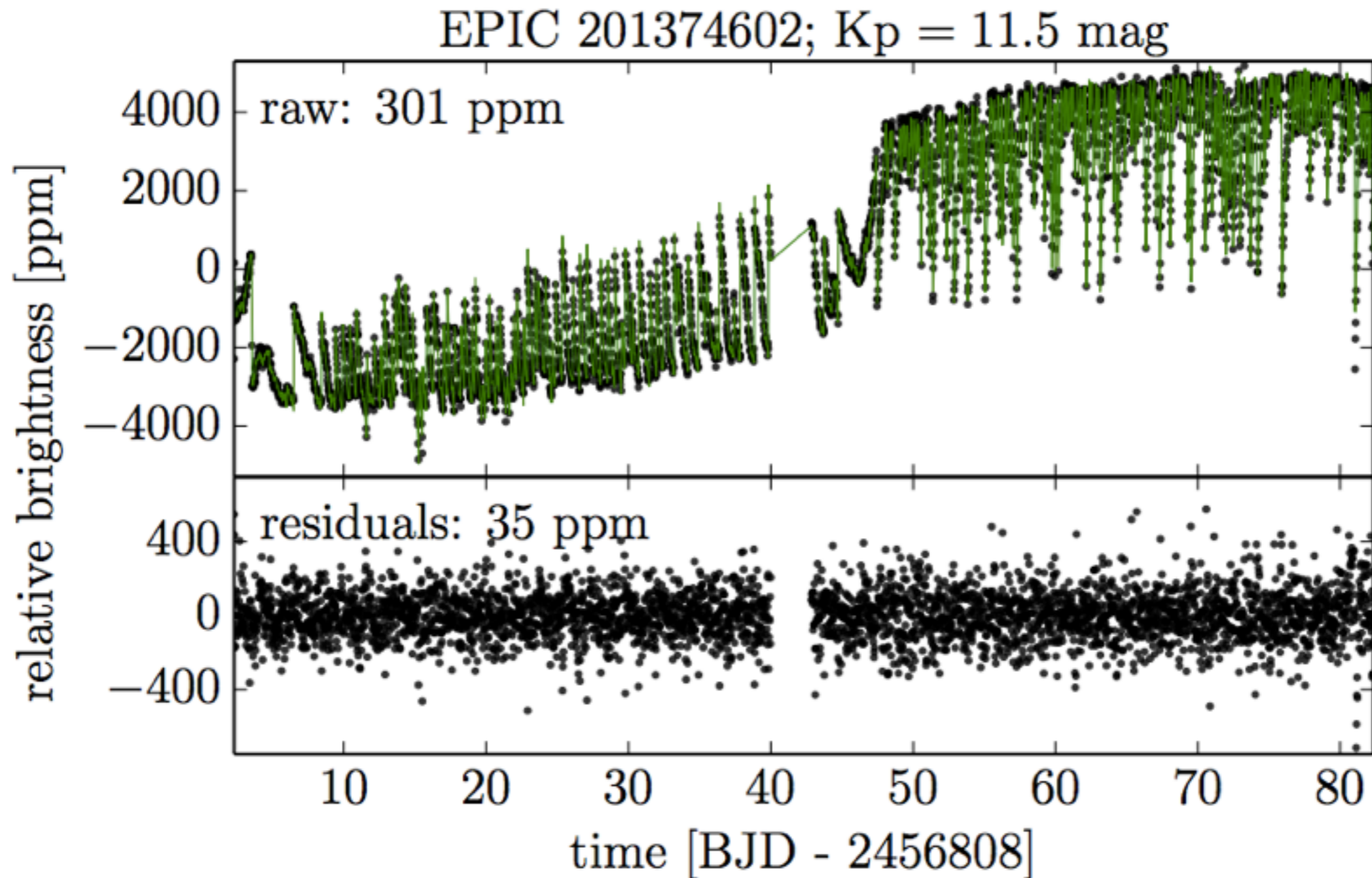


Challenge: under-sampled crowded field photometry

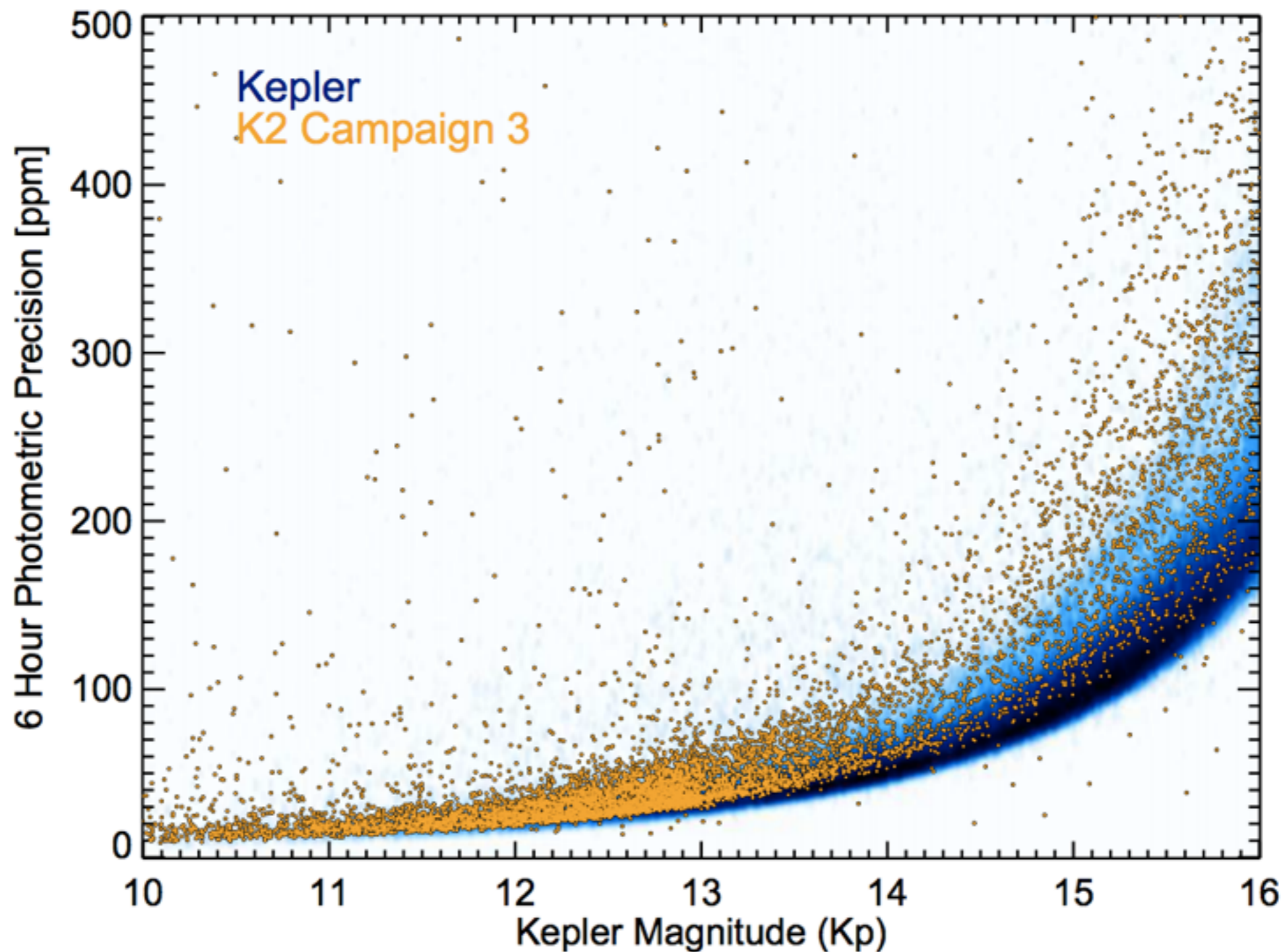
EPIC 200069862

2016-05-07 03:00:28

K2's roll motion introduces millimag-level systematics, which can be removed by modeling the noise.

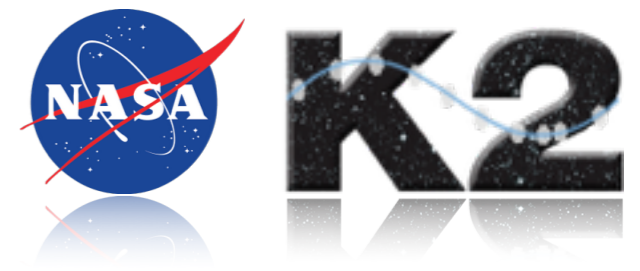
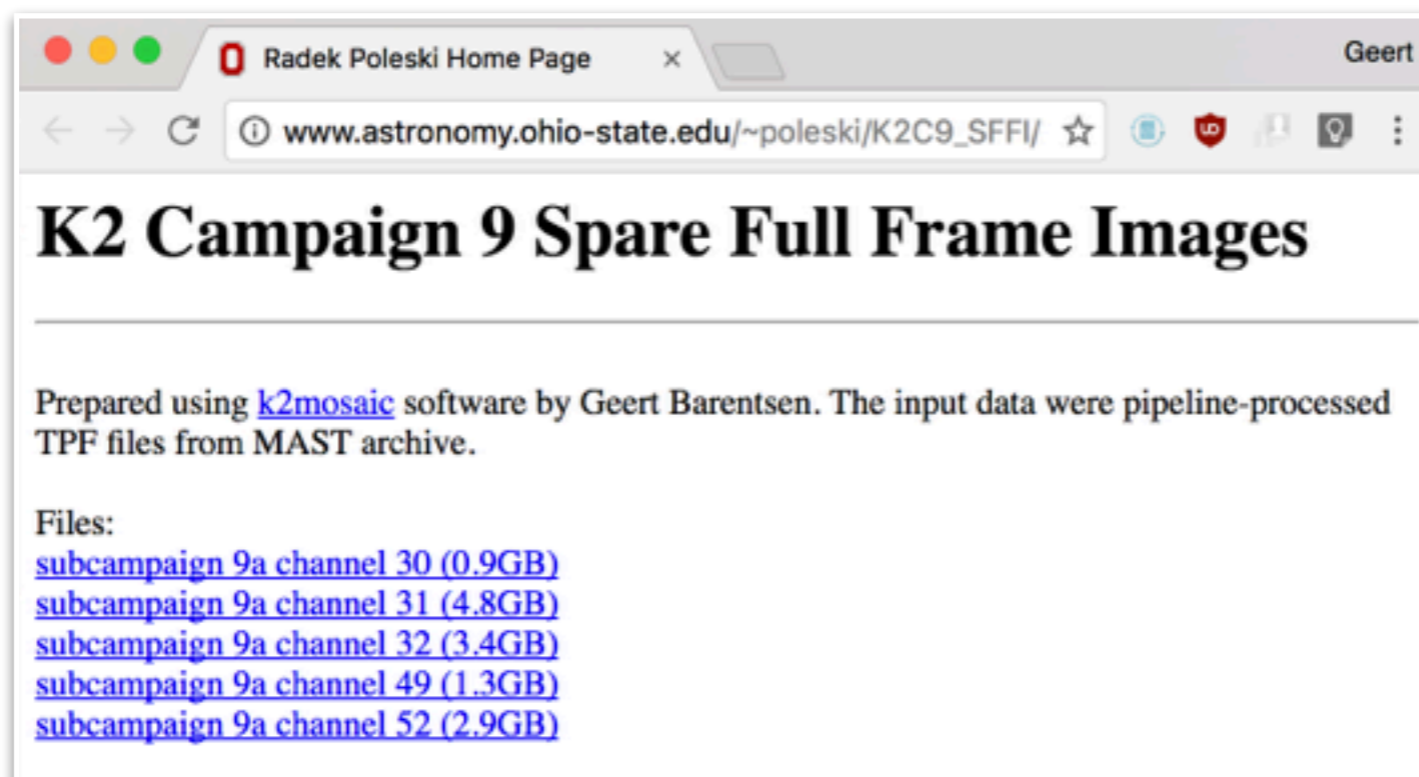


After systematics removal, the photometric performance of K2 is in family with Kepler



Data products

- All K2C9 data are now publicly available at MAST
 - <http://archive.stsci.edu/k2>
- “Target Pixel Files” provide time series for ~1000 pixels at a time
- User-friendly FITS images are being created by Radek Poleski
 - http://www.astronomy.ohio-state.edu/~poleski/K2C9_SFFI/



How to get involved?

Join the mailing list:

k2-microlensing@lco.global (Rachel Street)

Visit ExoFOP:

<https://exofop.ipac.caltech.edu/k2/microlensing>

Talk to Rachel, Radek, Calen, Dun, Matt, Dave++

Apply for ADAP funding to work on K2C9!

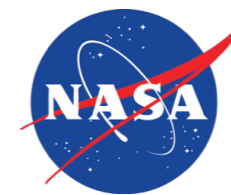
(US-based institutions only)



K2 C9 offers an opportunity to put microlensing even more on the radar



Please keep us informed of interesting results in the pipeline!



Kepler

K2



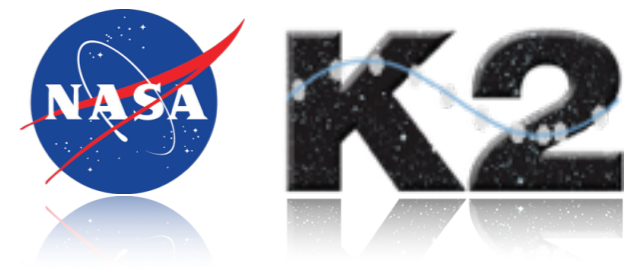
KEPLER&K2
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NASA Ames Research Center
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