



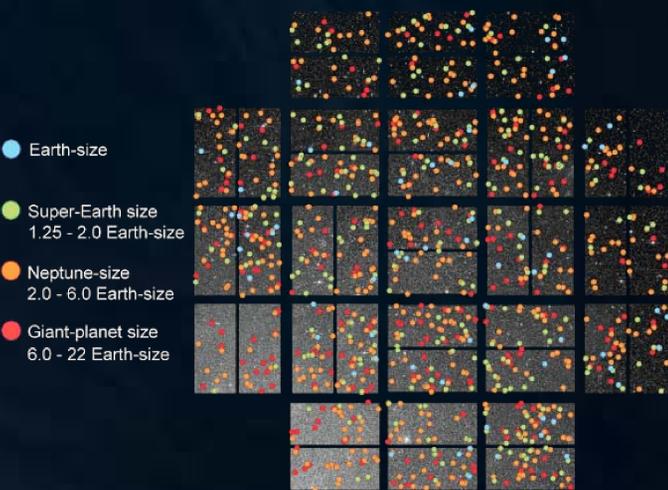
# Characterization of Kepler's Planetary Candidates within the Habitable Zone

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## Kepler Facts



Launch : May 2009  
Mission length baseline : 3.5 years  
Field of View : 105 deg<sup>2</sup>  
CDD : 42 x 1024 x 2200  
Res. : 3.98 arcsec/pixel  
Mag. range : 7 to 17  
170,000 Stars observed  
more than 1300 candidates  
more than 60 habitable zone candidates  
dozen of confirmed planets

## Abstract

The Kepler space telescope was launched in 2009 and is now monitoring permanently 150,000 stars in a fixed field of view. In February 2011, a list of 1235 planetary candidates was published for these stars, all of various types. Most of them are pending validation, waiting for further analysis or observations to be done. Only 16 have been confirmed as planets. Among this increasing number of planetary candidates are more than 60 candidates within the habitable zone. Knowledge of characteristics of the stars and candidate planets enables the Science Team to generate a first set of planet characteristics. To confirm these candidates it is first needed to rank them. Only the most interesting KOI (Kepler Object of Interest) will be investigated this summer. The Kepler Team can use a variety of measurements to ultimately confirm and characterize a planet. I will keep a track and merge this diverse information to develop a comprehensive data set of characteristics of the very first extrasolar planets within habitable zone ever discovered.

## Validation Process

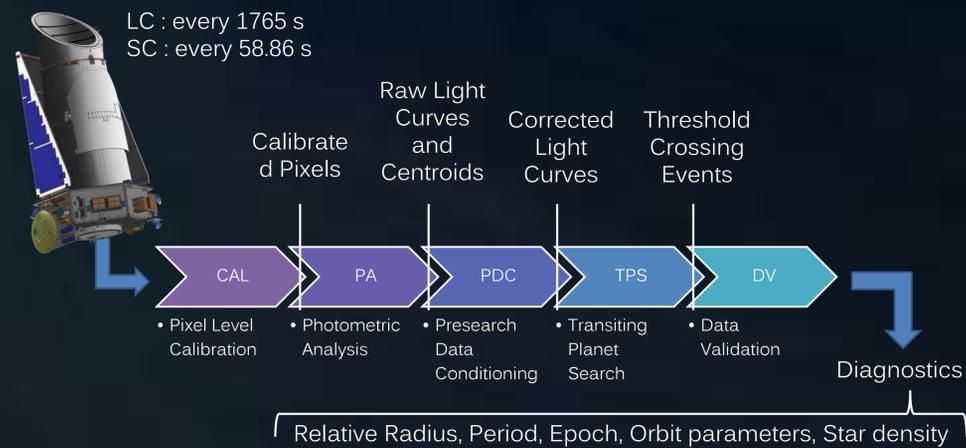


**Multiple transit** - One transit is not enough to evaluate the Period of the candidate, it is needed to wait for secondary transit.  
**Centroid** - In this analysis the motion of the object is photometrically measured. For example, a motion during transit may indicate a false positive.  
**Adaptive Optics & Speckle** - Imaging technique used to first check the presence of other objects in the neighborhood and then to evaluate probability of false positive due to objects hidden by central blot of the KOI.

## Habitable Zone Candidates

When the equilibrium temperature of the planet is calculated to be above 240K and below 372K, it is believed that liquid water may exist on the surface. The actual temperature of the planet cannot be known, but the habitable zone concept rely on local effects such as atmospheric or geologic that may let the surface be habitable within this zone.

## Data Processing Pipeline

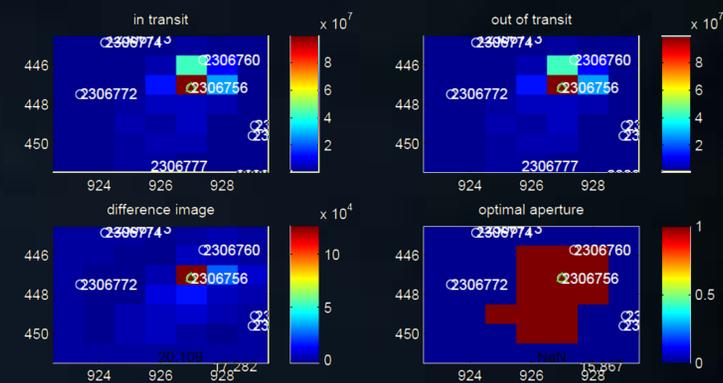


KOI	Kp mag	Planet					Star				Transit	
		P	R <sub>p</sub>	M <sub>p</sub>	ρ <sub>p</sub>	T <sub>eq</sub>	T <sub>eff</sub>	M*	R*	b	h	
87.01	11.7	289.9	2.1	3.3	2	262	5510	0.94	0.98	0.02	7.5	
113.01	12.4	386.6	8.3	104.0	1	269	5362	1.04	1.15	1.02	4.7	
119.02	12.7	190.3	3.8	20.6	2	289	5380	1.02	1.00			
372.01	12.4	125.6	8.5	110.3	1	344	5638	1.05	0.95	0.17	9.2	
1463.01	12.3	253.0	16.3	790.1	1	311	6020	1.05	1.09	0.22	12.0	
139.01	13.5	224.8	5.7	66.2	2	288	5921	1.07	0.90	0.67	10.7	
1478.01	12.5	76.1	3.7	19.1	2	341	5441	0.97	0.70	0.00	8.1	
682.01	13.9	163.7	4.8	41.5	2	307	5504	1.03	0.95	0.00	9.9	
1375.01	13.7	321.2	17.9	1048.5	1	300	6169	1.14	1.17	1.14	4.8	
351.02	13.8	210.5	6.0	39.7	1	310	6103	1.09	0.94	0.00	12.0	
683.01	13.7	278.1	4.1	26.0	2	239	5624	1.02	0.78	0.80	4.5	
51.01	13.8	10.4	4.8	40.1	2	315	3240	0.21	0.27	0.56	3.4	
351.01	13.8	331.6	8.5	111.9	1	266	6103	1.09	0.94	0.01	14.4	

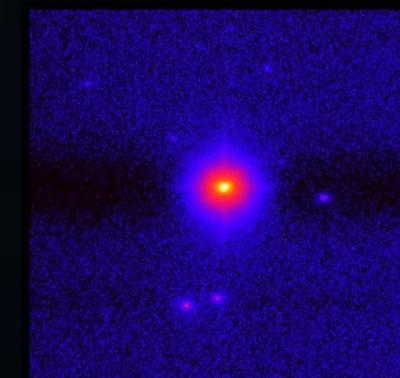
Kp mag	multi transit	AO	Speckle	Centroid	Pred. amp	Done/ Value	RV	
							N/ Who	Next Obs date/ Pred. RV/Who
11.7	Y	D	D		0.33			2/LH
12.4	Y	D			9.7			Aug15/-4.3/K
12.7	Y				2.2			Jul26/-2.2/K
12.4	Y	D	D	G	14			Jul8/-13.1/K
12.3	Y	D	D		77			Jul8/-28.8/K
13.5	Y				6.7			Aug15/4.5/K
12.5	Y				2.9			July26/2.7/K
13.9	Y				4.8			
13.7	Y				90			
13.8	Y				4.0			
13.7	Y				2.5			
13.8	Y				33			
13.8	Y				9.8			

KOI list — Planetary candidate and star parameters (Kepler Object of Interest)

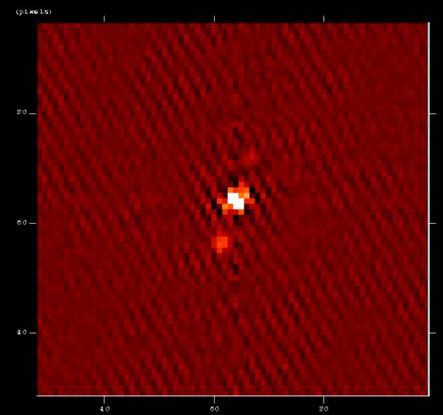
State of study table – include FOP info (Following Observation Program)



KOI 113 centroid motion analysis in and out of transit images, with difference and opt ap image



KOI 113 J-band Approx 20x20 arcsec N up; E left



KOI 113 WIYN speckle image at 692nm

## Acknowledgements

Kepler Science Team,  
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www.nasa.gov