Multi-Epoch Surveys with the NASA K2 Mission

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K2 Science:
Exoplanets, Young Stars,
Star Clusters, Active Galaxies,
Supernovae, Variable Stars,
Solar System
K2 Mission

HYADES
Nearest Open Star Cluster

M67
Nearest Old Open Star Cluster

PLEIADES
Nearby Open Star Cluster (Seven Sisters)

M44
Nearby Open Star Cluster (Beehive Cluster)

COMA BERENICES
Galaxy Cluster

RUPRECHT 147
Oldest Nearby Star Cluster

QATAR-2b
Transiting Exoplanets

PLUTO
Largest Dwarf Planet
Revisiting K2 Targets
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- Longer time baseline:
  - increases sensitivity to planet detection as well as eclipsing binaries
  - provides constraints on orbital periods and transit/eclipse times
  - explores aperiodicity in variable stars or pulsation timing
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• Repeating targets allows for characterization of noise properties*
Single Transits from K2

Vanderburg et al. 2016
Single Transits from K2

HIP 41378 b
$P = 15.57 \text{ d}$
$R_p = 2.90 \text{ Re}$

HIP 41378 c
$P = 31.70 \text{ d}$
$R_p = 2.56 \text{ Re}$

HIP 41378 d
$P \approx 156 \text{ d}$
$R_p = 3.96 \text{ Re}$

HIP 41378 e
$P \approx 131 \text{ d}$
$R_p = 5.51 \text{ Re}$

HIP 41378 f
$P \approx 324 \text{ d}$
$R_p = 10.2 \text{ Re}$

Vanderburg et al. 2016
Campaign 10  (Jul-Sep 2016)

Virgo; high galactic latitude (+60°)

> 28,000 targets, including 3C273, NGC4593, PG1159
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78 targets in overlap region
Revisiting Variable Stars: C1 + C10

EPIC 201230010, Kp = 9.635, List = GO1059_LC
Campaign 11 (Sep-Dec 2016)

Ophiuchus; low galactic latitude (+5°)

> 14,000 targets, including M9, M19, NGC 6293, NGC 6355, Terzan 5 (globular clusters), Titan, Enceladus
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294 targets in overlap regions

(254 from C2)
(40 from C9)
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294 targets in overlap regions

(254 from C2)
(40 from C9)
Revisiting Planet Hosts: C2 + C11
Campaign 12 (Dec-Mar 2017)

Aquarius / Pisces; high galactic latitude (-60°)

Targets include TRAPPIST-1, comet Chiron
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Campaign 12 (Dec-Mar 2017)

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>234 targets in overlap region
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Aquarius / Pisces; high galactic latitude (-60°)

Targets include TRAPPIST-1, comet Chiron

>234 targets in overlap region
Revisiting Planet Hosts: EF + C12

- a single-transit 5.5 Re planet candidate around an M1 dwarf
- transit duration implies 20-60 day orbital period
Campaign 13 (Mar-May 2017)

Taurus; low galactic latitude (-15°)

Targets include members of the Hyades and the Taurus star-forming region
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Targets include members of the Hyades and the Taurus star-forming region

DDT proposals currently being accepted until Nov 10
Mission Status

- Kepler was discovered in Emergency Mode on April 7 (a fuel intensive, low operational mode)
- Science operations resumed April 22
- Module failure during Campaign 10
- Current estimates suggest fuel will deplete sometime in 2018
K2 Campaign Fields

- Completed Campaigns (2014-16)
- Future Campaigns (2016-18)

Legend:
- Pisces
- Aries
- Taurus
- Cancer
- Leo
- Virgo
- Libra
- Scorpio
- Sagittarius
- Ophiuchus
- Capricorn

Map showing campaign fields with numbers indicating campaign numbers.
K2 GO Cycle 5

- Proposals for Campaigns 14-15-16 are currently being solicited
- K2 observes targets with $Kp = 3 - 23$ in a broad optical bandpass
- Mission is entirely community driven, with no proprietary period
- Small programs (< 1,000 targets) eligible for funding up to $50k
- Large programs ($\geq 1,000$ targets) eligible for up to $150k$

- Deadlines: **Nov 3** (Step 1) & **Dec 15** (Step 2)
SIMBAD’s View of Campaigns 14-15-16

19,208 Galaxies;
6,993 Quasars;
1,904 M-type Stars;
868 High Proper-Motion Stars;
820 Active Galactic Nuclei;
533 Planetary Nebulae;
515 White Dwarfs;
511 RR Lyr Variables;

296 Symbiotic Stars;
131 Brown Dwarfs;
75 Blue Stragglers;
64 Cepheids;
28 T Tauri Stars;
22 Cataclysmic Variables;
16 Mira Variables;
3 O-type Stars.
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+ exoplanet hosts and Solar System objects
Campaign 14  (May-Aug 2017)

Leo / Sextans; moderate galactic latitude (+50°)

Notable targets:

**Wolf 359**
(nearby late-M dwarf at 2.4pc)

**WASP 104**
(bright G dwarf w/ transiting hot Jupiter)

**Leo I Group**
(M95, M96, M105)
Campaign 15 (Aug-Nov 2017)

Libra; moderate galactic latitude (+30°)

- Small overlap with Campaign 2
- Notable targets:
  - Upper Sco
  - HIP 78530 (B star w/ directly imaged low-mass companion)
  - HD 134439 / HD 134440 (metal-poor proper motion pair)
  - Asteroid Ryugu (to be visited by the Hayabusa 2 sample-return mission in 2018)
Campaign 16 (Dec-Feb 2018)

Cancer; moderate galactic latitude (+35°)

- 30% overlap with Campaign 5

- Notable targets:
  - M44 = Praesepe = Beehive
    (600 Myr-old open cluster)
  - M67
    (4 Gyr-old open cluster)
  - Arkushanangarushashutu
Campaign 16 (and 17): Forward-Facing

View from above on 15 May 2016
K2 Supernova Cosmology Experiment
Type II Supernova:
- Progenitor Radius
- Shock Breakout

Garnavich et al. 2016
Supernova Science from Kepler

Type II Supernova:
- Progenitor Radius
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Garnavich et al. 2016

K2 has observed > 12 SN in the first few campaigns
- Aim to monitor >10,000 low-z galaxies to capture >20 Type Ia SNe in each campaign and characterize them via simultaneous ground-based observations

- Campaign 16: Dec 2017 to Feb 2018

- Campaign 17: Feb 2018 to Apr 2018

- **Field 17 is not finalized - we welcome advocated targets from the community!**
Science goals include:
- getting a detailed view of lightcurve variations;
- improving the use of SNe as standard candles;
- improving constraints on supernova frequencies;
- probing circumstellar environments of progenitors;
- searching for optical counterparts of fast radio bursts.
A workshop will be held at NASA Ames Research Center from Feb 14-16, 2017 to organize the K2 program and the simultaneous ground-based observing efforts. Registration is now open!

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For More Information

- Up to date information on K2, data products, how to propose for targets, and the SNe workshop is available at the Science Center website

[keplerscience.arc.nasa.gov]
KEPLER & K2
SciCon IV:
LEGACY & SCION

JUNE 19-23 2017

NASA Ames Research Center
Moffett Field, CA
Extra Slides
TESS Fields
Single Transits from Kepler

Foreman-Mackey et al. 2016
Disintegrating Planets

- WD 1145+017 - disintegrating planets or planetesimals in orbit around a white dwarf star