PANOPTES

Panoptic Astronomical Networked Optical observatory for Transiting Exoplanets Survey
About us

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How many of you...

- know what an exoplanet is?
- know what a light curve is?
- are educators?
- are amateur astronomers?
- thinks space is neat?
Agenda

- Exoplanets
- Project goals
- Anatomy of PANOPTES
- Project Status
Exoplanets

in verse
Project PANOPTES, of course.
Interlude: Radial Velocity (RV)
51 Pegasi b
Radial Velocity (RV) / Doppler Spectroscopy
Not to Scale
Interlude: Transit Method
Detection Methods

- Transit
- Radial Velocity
- Gravitational Microlensing
- Direct Imaging
- Timing Variations

Number of detections by method:
Blue - Radial Velocity
Red / Yellow - Transit
Project PANOPTES, of course.
Project goals
Goals

- Research
- Education & outreach
- Openness
The PANOPTES approach
PANOPTES approach

● More smaller telescopes
  ○ More samples
  ○ Looking in different places
● Outreach guided design
Exoplanet Cost Compared

Kepler
$550 million

LSST
$465 million

PANOPTES
~$5000

LSST image credit - LSST Project Office
Kepler's field of view
How it works
Colors - Boooo!

Image credit - Cburnet on Wikipedia
Postage stamp
Postage stamp
Light curve
Light curve
PANOPTES anatomy
System architecture

- PANOPTES unit
- Python system software
- Google Cloud Platform
Hardware
System software
System software

- Intel NUC running Ubuntu
- Python 3
- Young developer friendly interface
- State machine
A night in the life...

- Sleeping
- Ready
- Scheduling
- Slewing
- Pointing
- Tracking
- Observing
- Analyzing
- Parking
- Housekeeping
- Parked
A night in the life...

Sleeping -> Ready
Housekeeping -> Scheduling
Parked -> Slewing
Slewing -> Pointing
Pointing -> Parking
Tracking -> Observing
Analyzing

Parking
A night in the life...

- Sleeping
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- Slewing
- Scheduling
- Parked
- Housekeeping

Diagram showing the various stages and processes involved in a night in the life, with arrows indicating the flow and transitions between stages.
A night in the life...

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A night in the life...

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- Scheduling
- Ready
- Housekeeping
- Sleeping
A night in the life...

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A night in the life...

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Scheduling
A night in the life...

Sleeping → Ready → Scheduling → Slewing → Parking

Housekeeping → Scheduling

Parked → Slewing

Tracking → Pointing → Parking

Observing → Analyzing
A night in the life...

- Sleeping
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A night in the life...

Sleeping  →  Ready  →  Tracking  →  Observing
               |       /               |
               |  Housekeeping        |
               |                    ↘  |
               |                     Parking
               |                     ↙   |
               |                    Pointing
               |          →           |
               |  Scheduling        |
               |                    ↘   |
               |                     Slewing
               |          →           |
               |  Parking           |

Analyzing
A night in the life...

Sleeping -> Ready -> Tracking -> Observing

Housekeeping -> Scheduling -> Pointing

Parked -> Slewing

Parking
A night in the life...

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- Parked
A night in the life...

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- Parked
Back end
Back end - goals

- Project flexibility
- Open at every level
- Easy reproducibility
The data

Full frame images

Postage stamps

Sensor data

{"_id": {  "$oid": "57384437ba6c190ab027af9d" },
"data": {
  "ambient_temp_C": 8.89,
  "gust_condition": "Calm",
  "internal_voltage_V": 5.8,
  "ldr_resistance_Ohm": 28587,
  "pwm_value": 9.9,
  "rain_condition": "Dry",
  "rain_frequency": 2656.0,
  "rain_sensor_temp_C": 12.2...}
Sensor data

PANOPTES units → Cloud Storage → Compute Engine → BigQuery → re: dash
Back end - Re:dash
Image data (planned)

PANOPTES unit → Cloud Storage → Dataflow → Bigtable
Image data (planned)

Bigtable → Python → Compute Engine → Science!
Project status

- 6 years of observing
- 1 unit online - more soon
- Team is growing
- v1.0 "baseline" hardware (almost)
- Time to science
Contribute

- Write code
- Be a mentor
- Build a PANOPTES unit
- Sponsor a unit
Thank you!
Help us find exoplanets!

Web: projectpanoptes.org
Code: github.com/panoptes
Email: info@projectpanoptes.org

Hi! I find exoplanets!
Wanna help?