PRIME Wide FOV
1.8m Telescope at SAAO

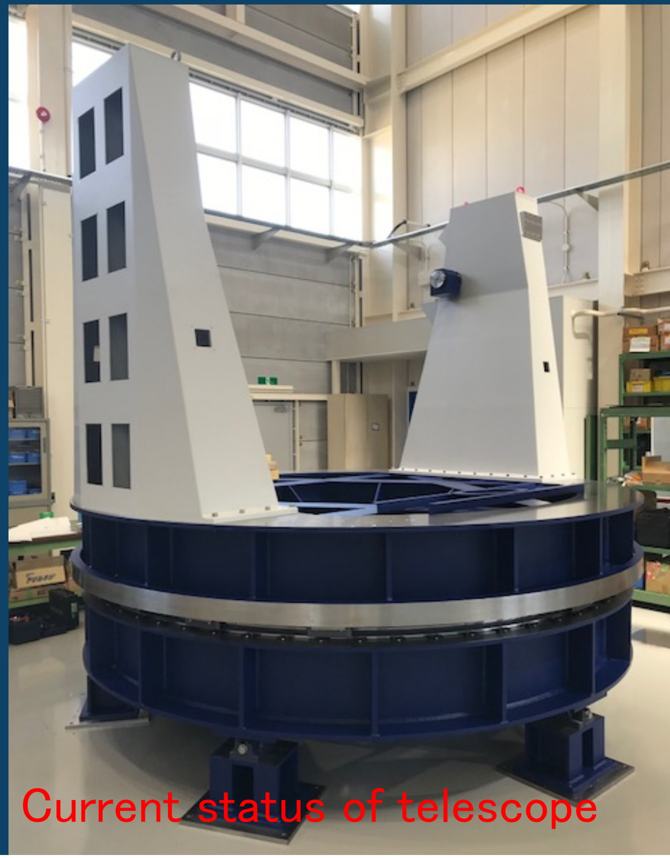
Funded by JSPS

Diameter: 1.8m, (f/2.29)

FOV:1.25deg^2=1.56deg^2(0.5"/pix)

(6xfull moon) World Largest FOV

With H-band Hi-res spectrograph



PRIME (PRime-focus Infrared Mirolensing Experiment)

Objectives:

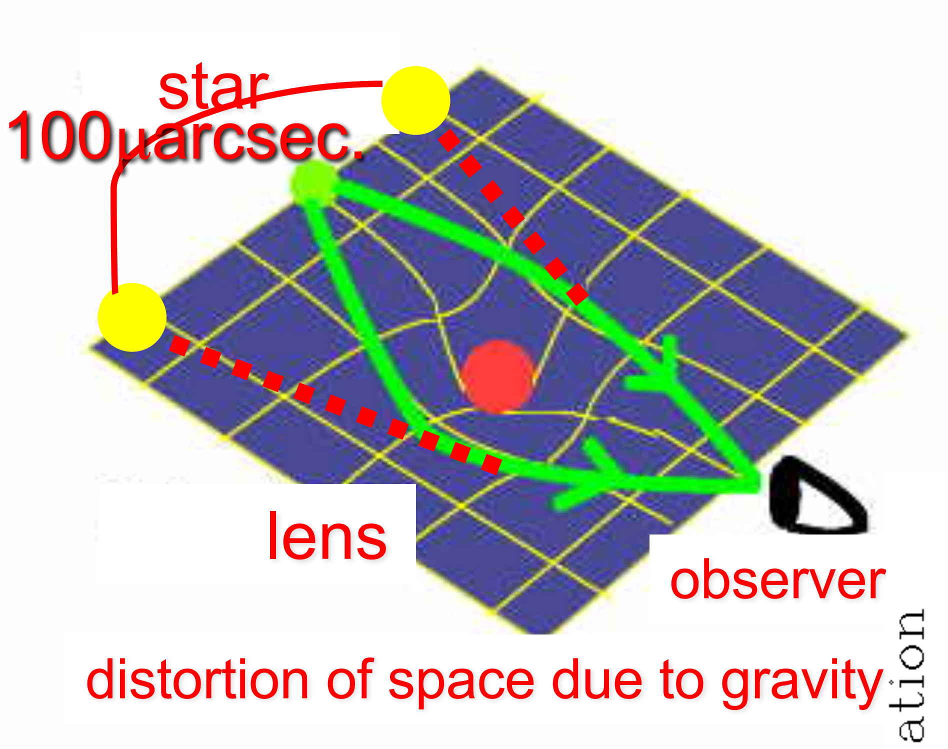
1. Microlensing Exoplanets (～50%)
   - Study low-mass planets outside of snowline
   - Plant frequency in the Galaxy Center
   - WFIRST microlensing survey field optimization
   - Concurrent observations with WFIRST
2. Other sciences （～50%）
   - IR RV survey
   - IR transit
   - Transient GW, GRB, SNe etc.

PRIME collaboration

- **Osaka Univ.:** T Sumi (PI), H. Shibai, T. Matsuo, Naoki Koshimoto Yuki Hirao , M. Nagakane
- **ABC (Astro-Biology Center):** M. Tamura (Director. & U Tokyo)
- **JAXA:** D. Suzuki
- **NASA GSFC:** D. Bennett, R. K. Barry , Alexander Kutyrev,
- **U of Maryland:** Sylvain Veilleux, Drake Deming
- **SAAO:** David Buckley, Ted Williams +

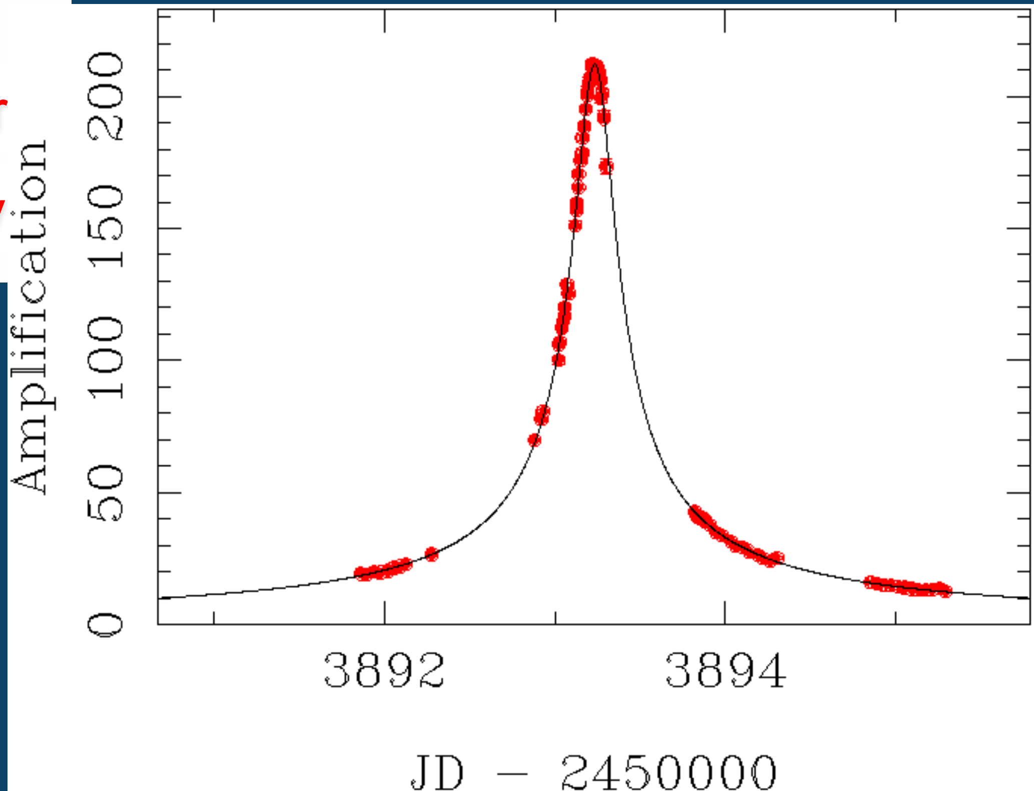
Bond(Massey U), N. Rattenbury (U Auckland), J-P. Beaulieu (IAP), A. Fukui (NAOJ), T. Nagayama (Kagoshima U), N. Matsunaga, Norio Narita (U Tokyo), Yasushi Muraki, Fumio Abe (Nagoya U), Mikio Kurita (Kyoto U), Joachim Wambsganss, Luigi Mancini (U Heidelberg), Eamonn Kerins (U Manchester), David Charbonneau（Harvard、Mearth PI、TESS CoI）、Cullen Blake (Pennsylvania、TESS CoI)

Gravitational Microlensing

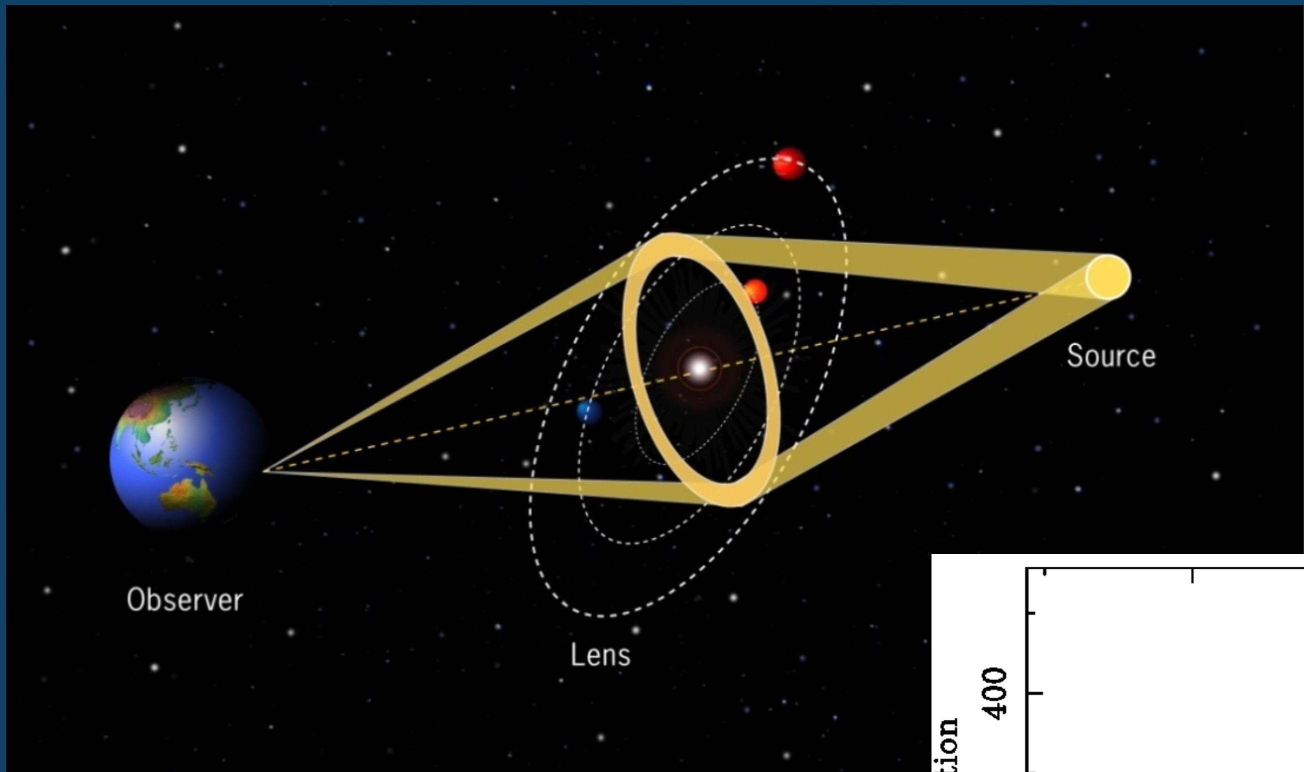


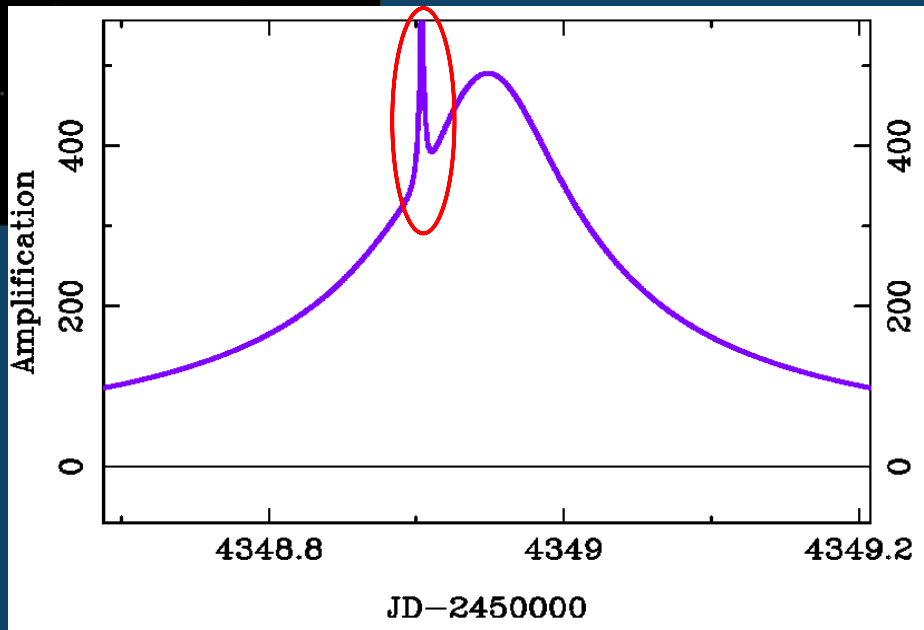
Science, 1936

- ✧If a lens is a star, elongation of images is an order of 100μarcsec.
- ✧Just see a star magnified



planetary microlensing

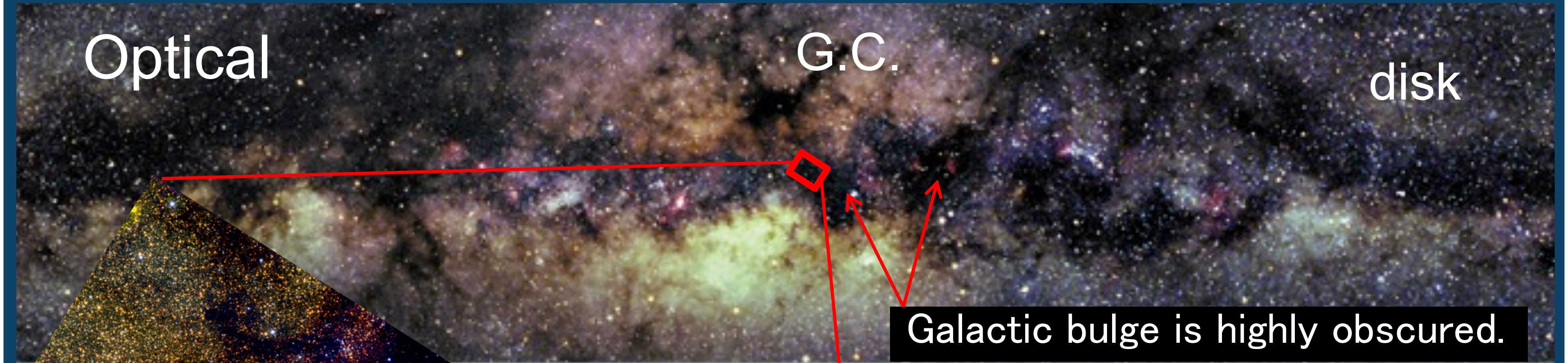


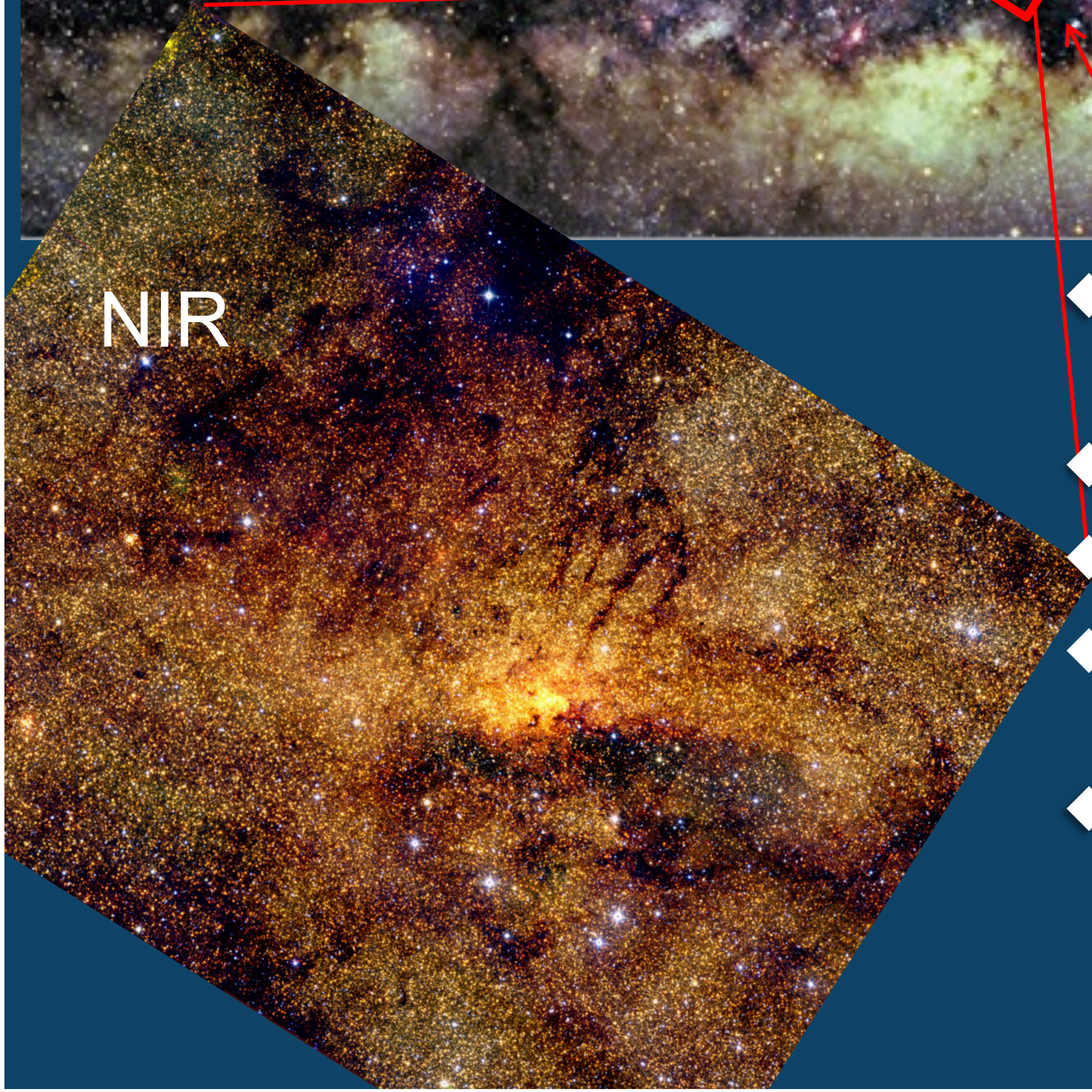


Time scale: $t_p \sim M^{1/2} \sim 1\text{day}(M_J)$
$\sim$a few hours (M_E)

Sensitive to Cold planets
outside of snowline ($\sim 3a_{snow}$)

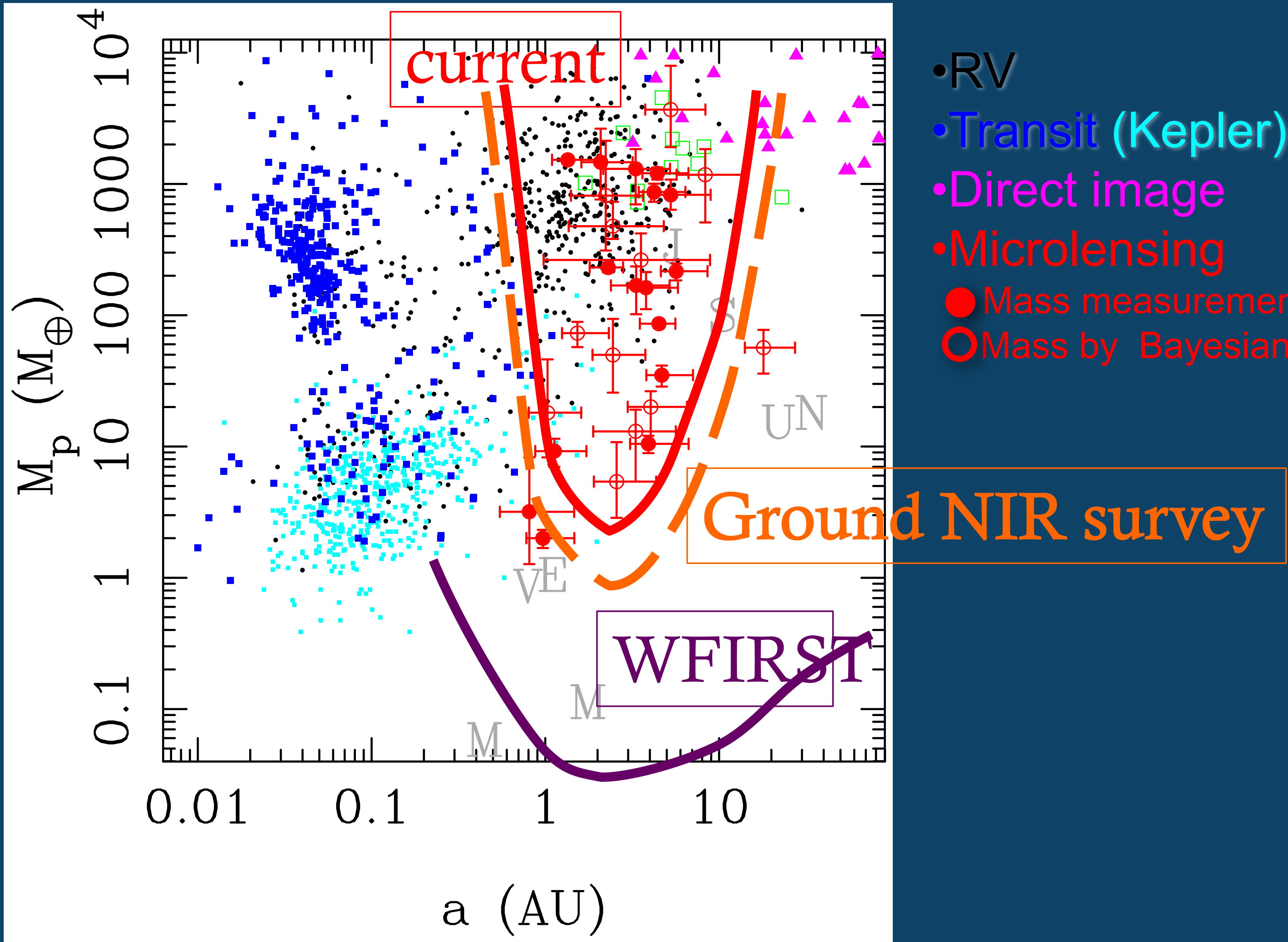
More events & planets in NIR at G.C.





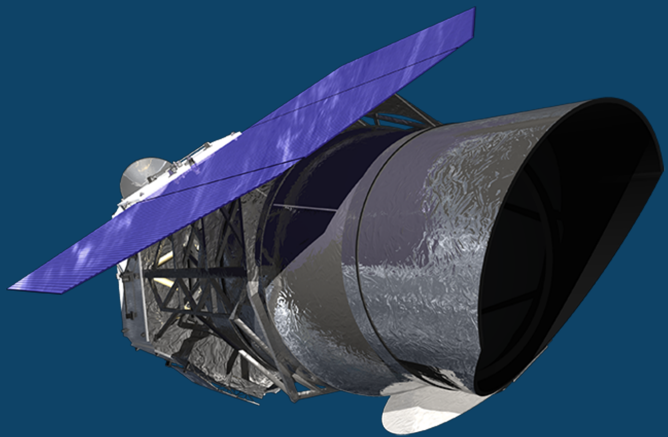
- More stars & more events at GC. (～2400events/yr, ～12planets/yr)
- Planet frequency at GC.
- Select WFIRST fields.
- Simultaneous observation with WFIRST to measure lens mass.
- Mass Function at GC (planet-Black Hole)

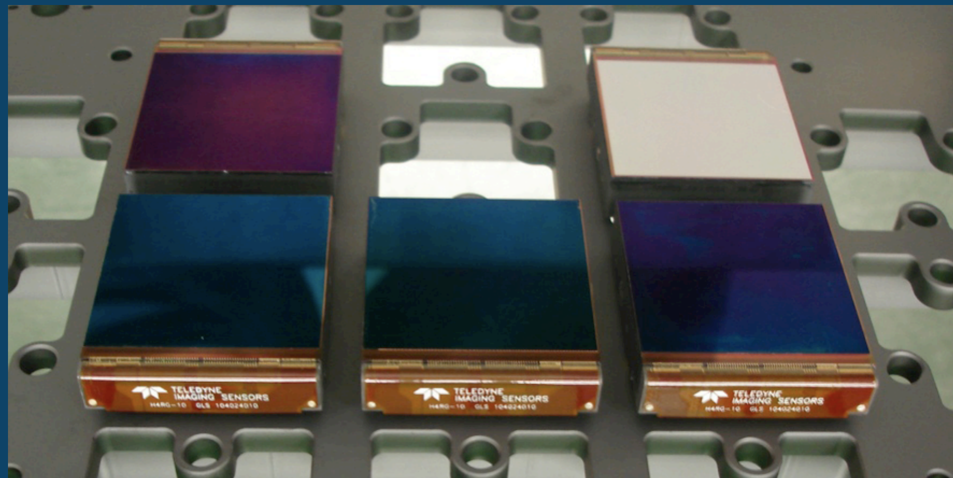
Discovered exoplanets and sensitivity



The World Widest FOV in NIR with World Largest class NIR camera

Loan Four Teledyne HgCdTe 4kx4k H4RG-10 (10μm pitch) from WFIRST team (NASA)





Four H4RG-10 which WFIRST Team owns. (1 chip is dummy)

Diameter:1.8m, f/2.29,

FOV:1.25° x1.25° =1.56deg^2

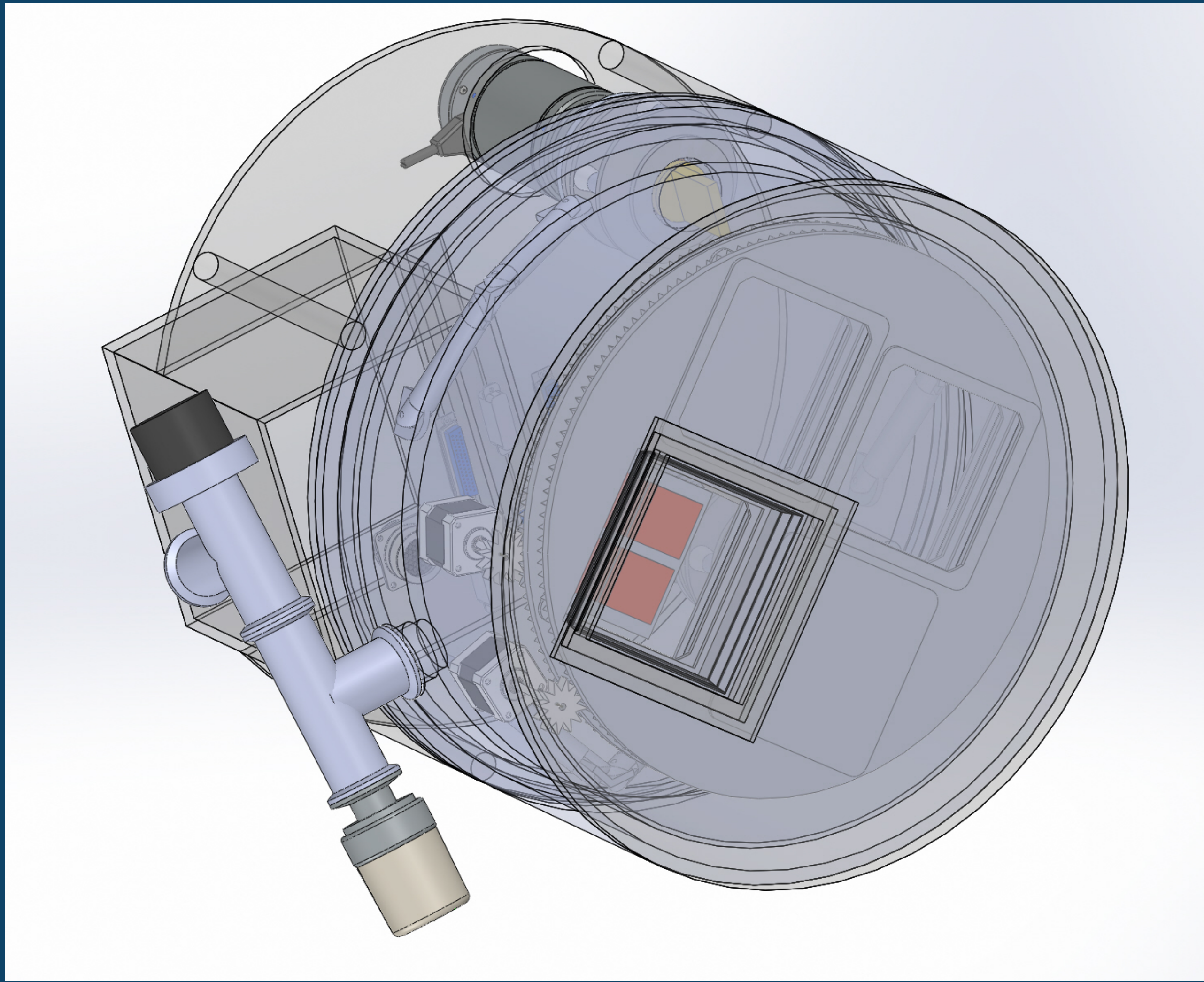
0.5arcsec/pix

Will be Manufactured by University of Meryland @GSFC

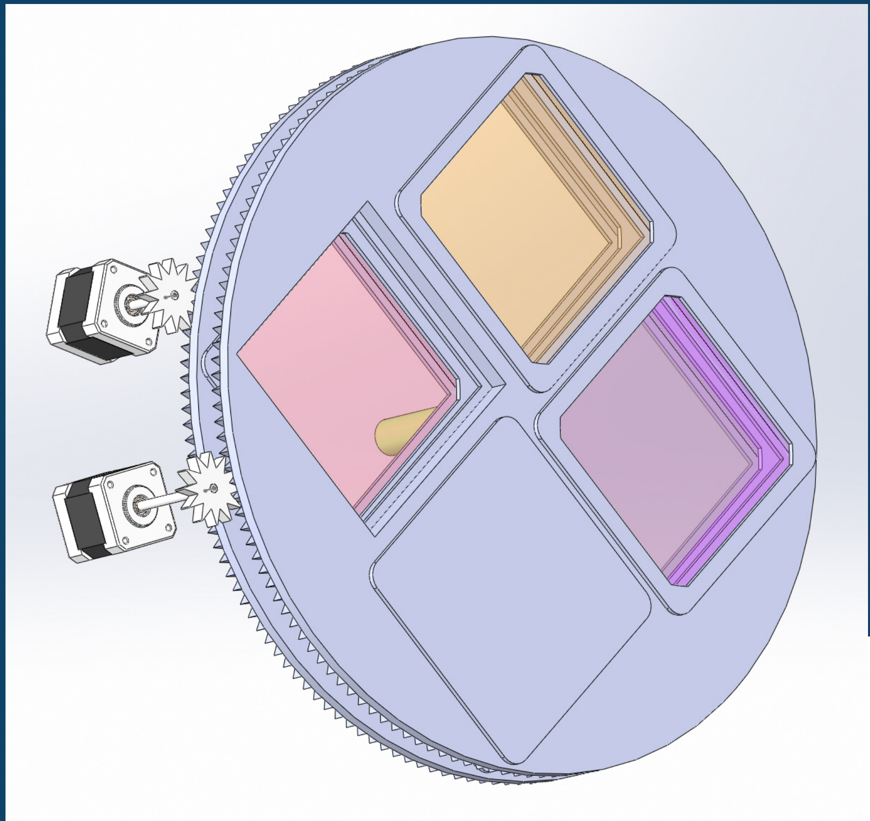
Camera

Alexander Kutyrev（NASA/GSFC,UMD）
Yuki Hirao　（Osaka U./GSFC：D2）
manufactur@GSFC

- 4 H4RG-10
- 2GTcryocooler
- 2 filter wheels

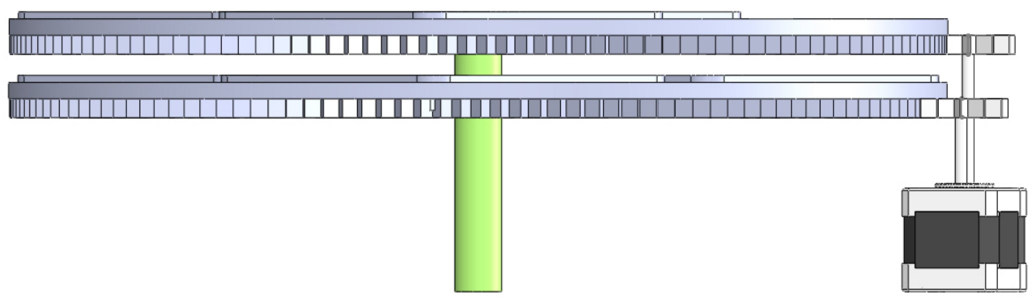


Filter wheels

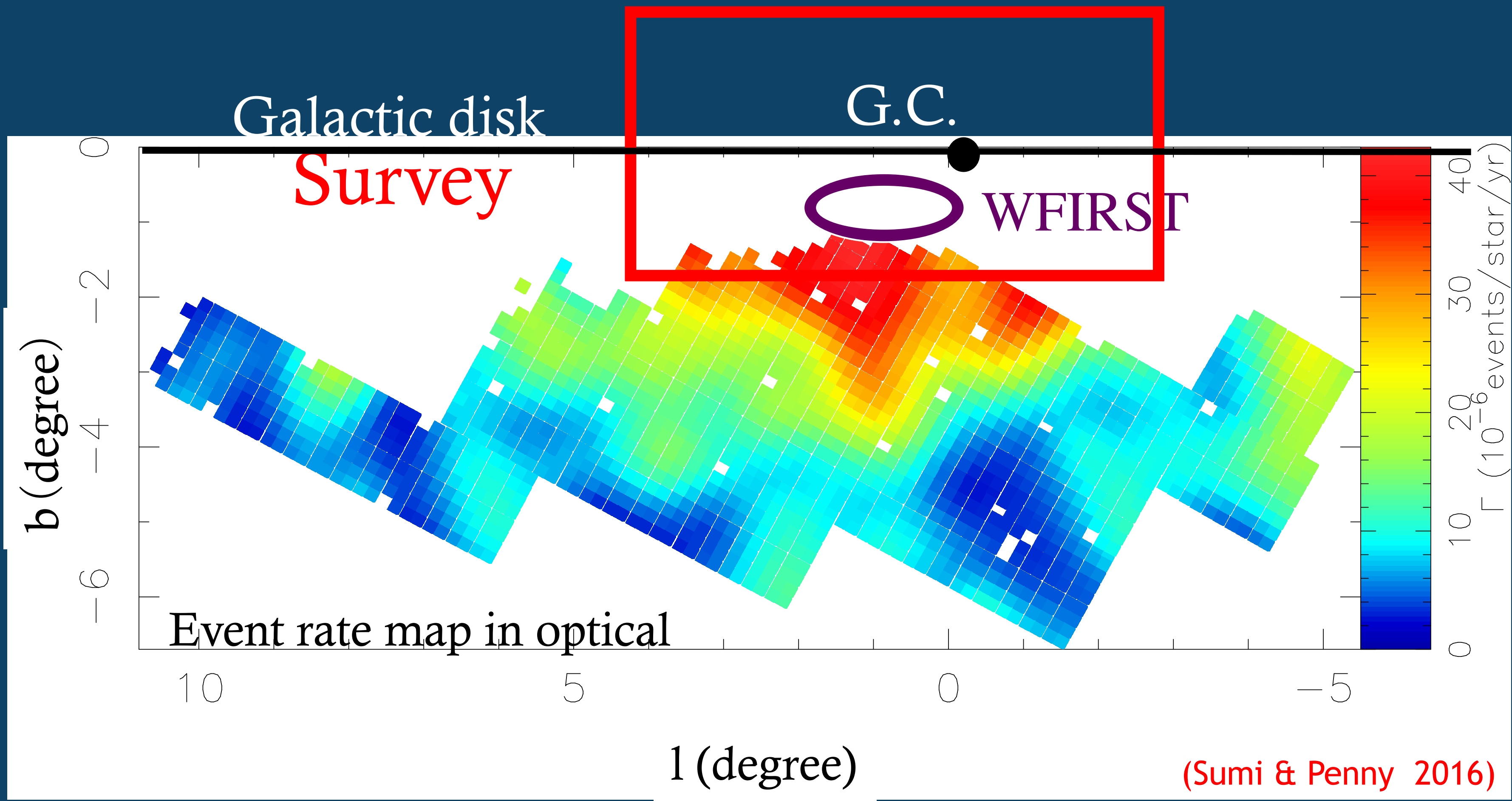


Filter size： 112mm x 112mm

5 filters: z, Y, J, H (Primary),
+Narrow band ([FeII]、Paβ、
HeI etc)

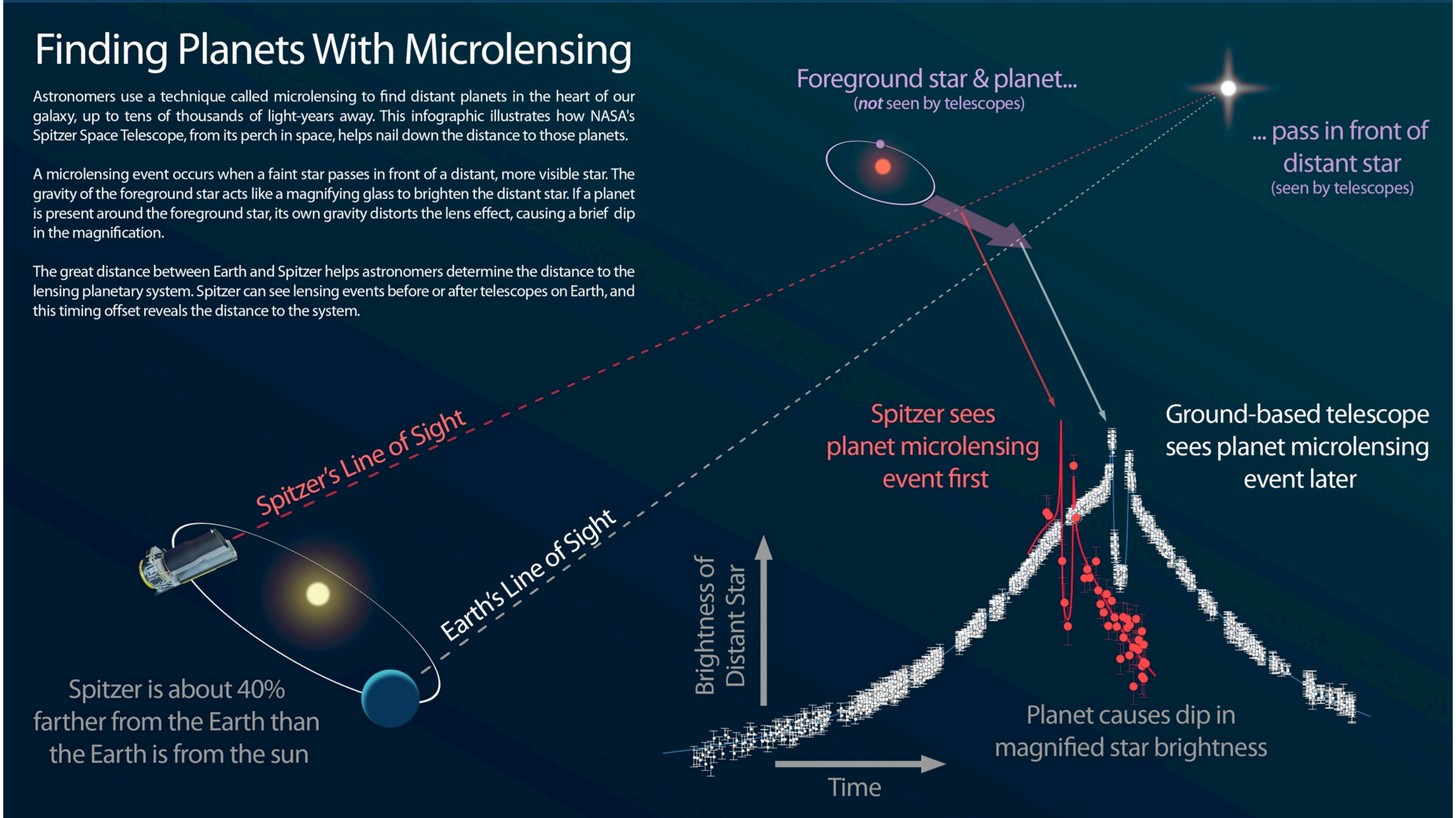


Study the galactic structure & Optimize WFIRST microlensing survey fields by mapping the event rate in NIR



Event rate vary by a factor of 2 (peak is at l=1°)

Mass Measurements via Simultaneous WFIRST-Ground obs.



Off-bulge season sciences

● Transit search for M-dwarfs:

- Search for habitable planets around M-dwarf which is bright in IR
- Follow-up transit candidates by HAT-South, Mearth projects for select real planets and measure the atmosphere.
- Systematics due to Sunspot and limb darkening is smaller in IR.
- Wide FOV enable us to observe many reference stars for high precision photometry.
- Follow-up TESS candidates. TESS is optical. Need IR for M-dwarfs. Collaborators:

  David Charbonneau（Harvard、Mearth PI、TESS CoI）、
  Cullen Blake (Pennsylvania、TESS CoI)、
  Narita（NAOJ, TESS CoI）、Fukui（Okayama）

● Search for counterparts of high-z GRB, GW etc.
→ ToO observation

● H-band spectrograph: RV for giant planets around M-dwarf.

Schedule

2016 detail design

2017 manufacture

2018 manufacture, construction

2019 install, first light.

2020 observation start

～

2023 create event rate map in the bulge

2025 WFIRST launch,

Concurrent observation start

2030 continue to the end of the WFIRST

Summary

- PRIME is first NIR microlensing exoplanet survey
- Detect ～2400 events/yr & ～12 planets/yr down to Earth-mass planet outside of the snowline
- Galactic distribution of exoplanets
- Optimize WFIRST fields
- Simultaneous observation with WFIRST to measure lens mass.
- Mass Function at GC (planet-Black Hole mass)
- Other sciences w/ bulge data
- H-band spectrograph: RV for giant planets around M-dwarf