

Large Area Surveys of the Near-Infrared Sky with MIRIS

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Members of MIRIS Team

Development Team

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Science Advisers (SOC)

박수종 (경희대), 박창범 (KIAS), 선광일 (천문연), 안경진 (조선대), 윤태석 (경북대), 이재우 (세종대), 이형목, 임명신 (이상 서울대), 조정연 (충남대), T. Matsumoto (ASIAA, ISAS/JAXA)

Collaborating Institutions

ISAS/JAXA

Main Science Targets

- **Cosmic Infrared Background (CIB)**

: Remnant of the first stars (Pop. III stars)

- Absolute brightness
- Fluctuation

← Survey of the north ecliptic pole (NEP) at I & H bands
↳ Seasonal variation of the zodiacal light

- **Pa α Diffuse Emission of the Galaxy**

- Study of the warm ionized medium (WIM)
- Comparison with H α and far-IR maps

← Survey of the Galactic plane (GP) with narrow-band Pa α filter

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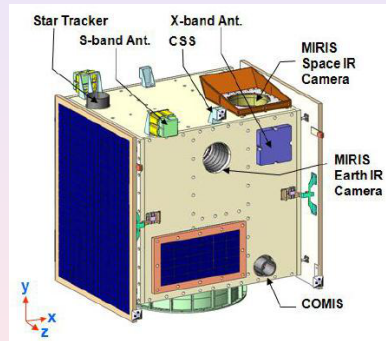
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Instrument » Satellite

- MIRIS = Multipurpose InfraRed Imaging System
- Main payload of STSAT-3
- **SOC** + EOC
- Orbit [TBD]
 - Altitude ~ 620 km
 - Eccentricity 0.002
 - Inclination $97^{\circ}.8$
 - LTAN 22 o'clock



Instrument » Space Observation Camera (SOC)

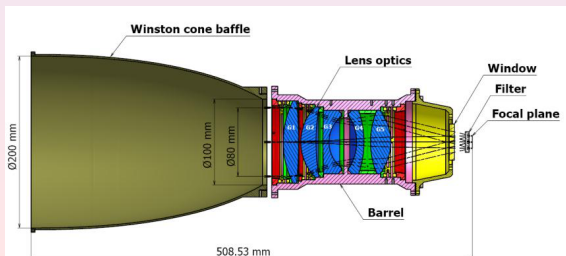
Aperture 80 mm

Pixel scale $51''.6 \times 51''.6$

Field of view $3^\circ.67 \times 3^\circ.67$

Temperature 180–200 K (telescope, passive cooling),
100 K (sensor, cryo. motor)

- Filters**
- Wide: I ($1.05 \mu\text{m}$), H ($1.6 \mu\text{m}$)
 - Narrow: Pa α line ($1.876 \mu\text{m}$), Pa α cont.
 - Blank



Instrument » Space Observation Camera (SOC)

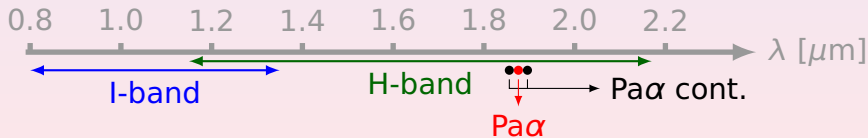
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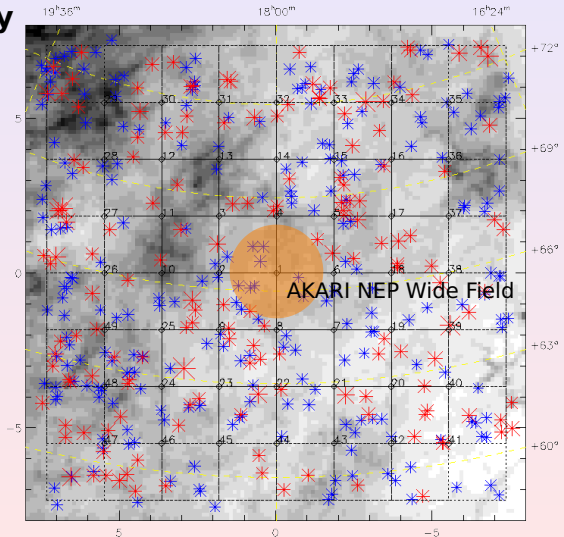
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NEP Survey with Wide Band Filters

Observation Strategy

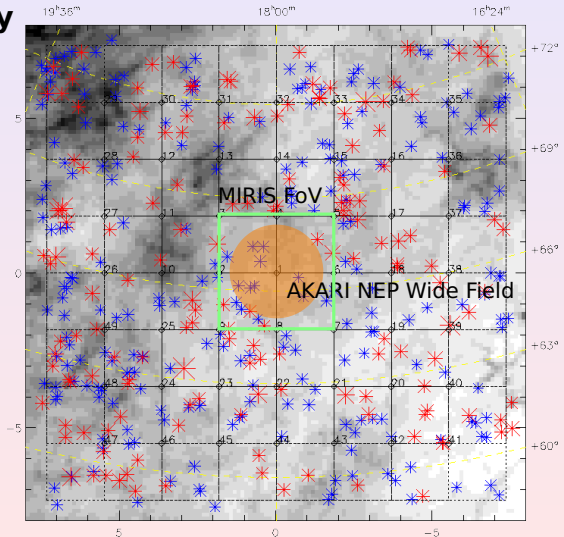
- Filters: I & H bands
- 1 month (dedicated phase) + 2 months
- $10^\circ \times 10^\circ$ area centered at NEP
- 7×7 fields w/ 50% overlap
- ~ 10 min. exposure / field



NEP Survey with Wide Band Filters

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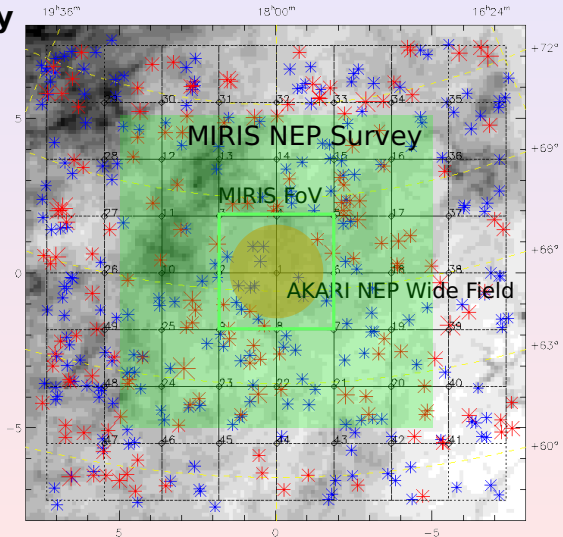
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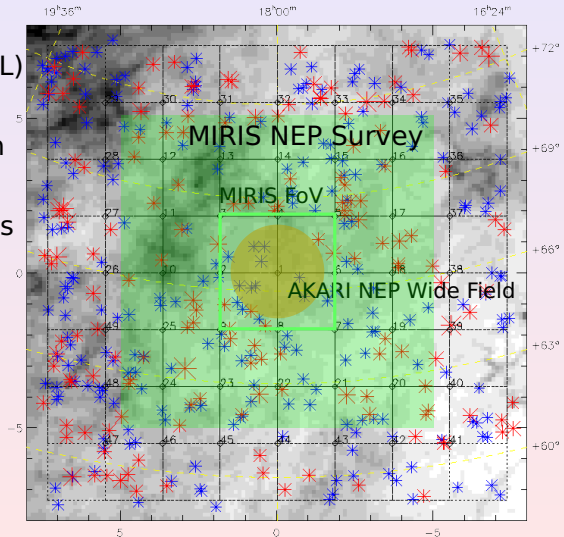
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NEP Survey with Wide Band Filters

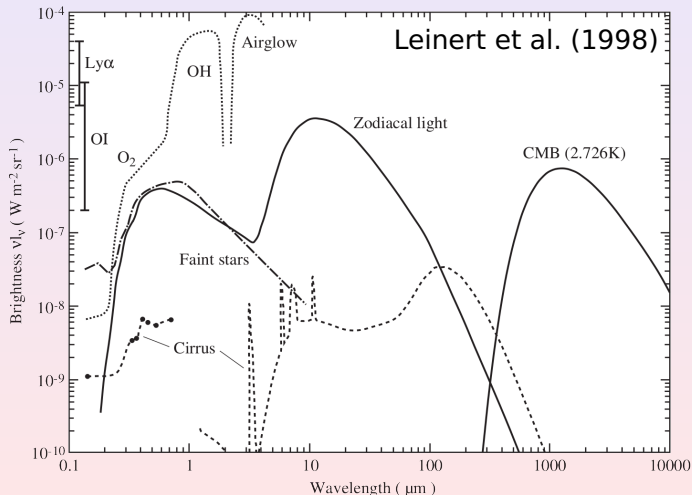
Why NEP?

- Low zodiacal light (ZL) brightness
- Frequent observation opportunities
- Previous observations (AKARI, Herschel, CIBER, ...)



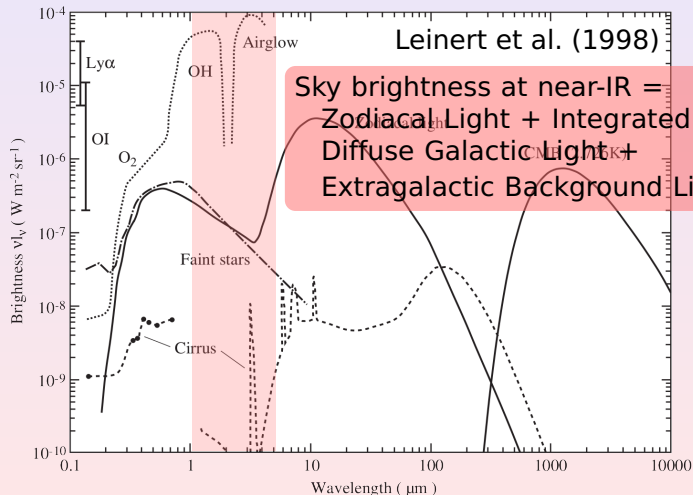
NEP Survey with Wide Band Filters

Sciences—Cosmic Infrared Background (CIB)



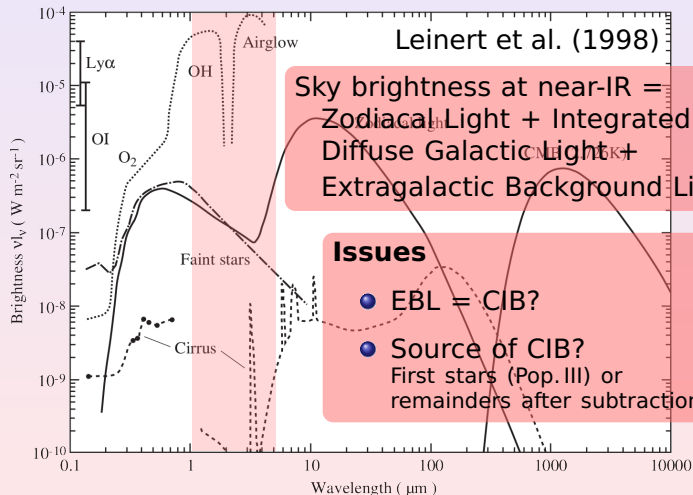
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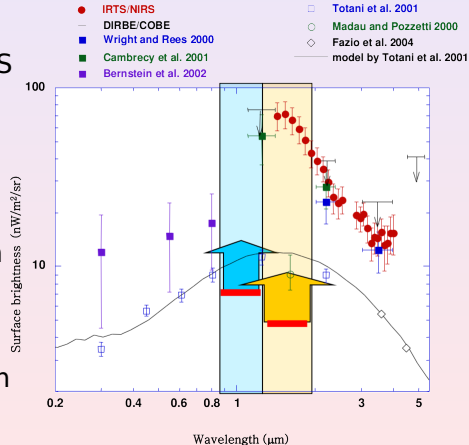
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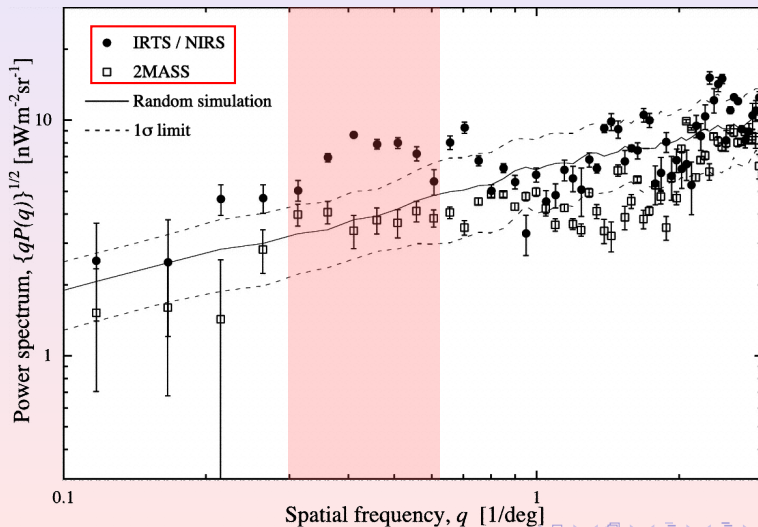
Sciences—Absolute Brightness of CIB

- Key to study the origin of CIB
- Expected sensitivities of MIRIS observations (3σ , instrumental noise)
 - I-band: 18.1 AB mag.
 - H-band: 19.0 AB mag.
- Confusion-limited observation
 - Confusion limit: 15.1 mag.
- Find the peak of CIB spectrum



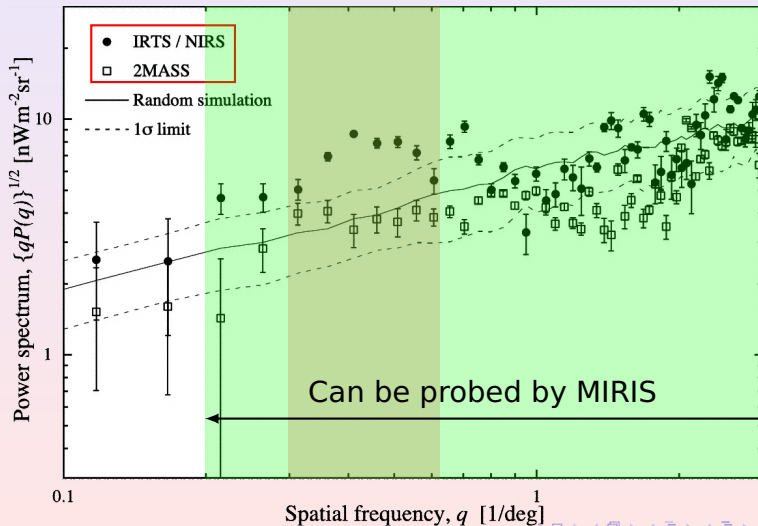
NEP Survey with Wide Band Filters

Sciences—Large-Scale Fluctuation of CIB



NEP Survey with Wide Band Filters

Sciences—Large-Scale Fluctuation of CIB

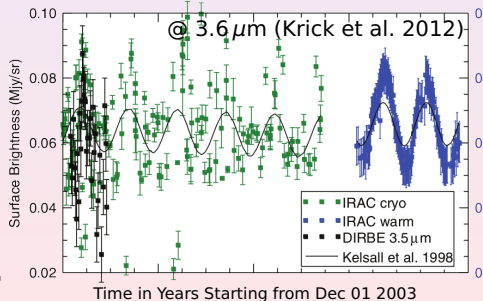
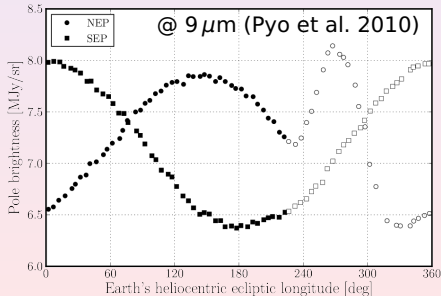


NEP Survey with Wide Band Filters

Auxiliary Observations

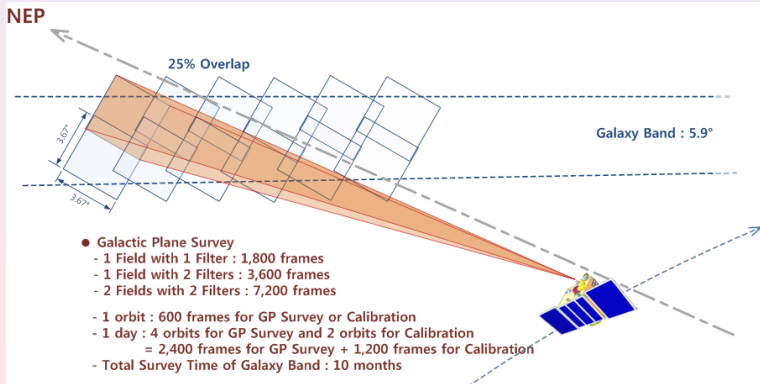
: Observe the north and south ecliptic poles once a day

- Monitoring and calibration of the detector condition
- Seasonal variation of background brightness due to ZL
→ Useful for ZL study, but no good data in near-IR so far



GP Survey with Narrow Band Filters

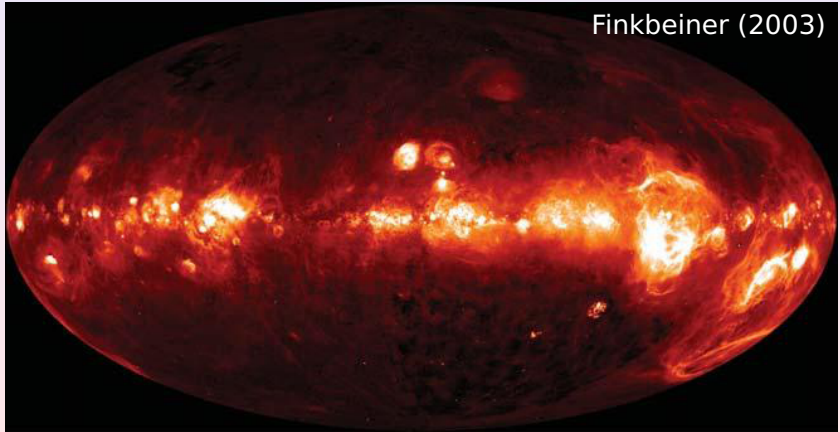
- Cover 360° along longitude and within $\pm 3^\circ$ in latitude w/ 25% overlap
- Observe each field with two narrow band filters: Pa α and Pa α cont.
- Exposure = 30 min. per filter per field



GP Survey with Narrow Band Filters

Sciences—Warm Ionized Medium (WIM)

- WIM occupies $> 20\text{--}50\%$ of the ISM volume.



Finkbeiner (2003)

Composite H α map

GP Survey with Narrow Band Filters

Sciences—Warm Ionized Medium (WIM)

- Too much $H\alpha$ emission compared to the model expectation



Possible solutions:

- Three-component model for diffuse emission (Dong & Draine 2011)
- Dust-scattered $H\alpha$ emission from H II regions + underlying $H\alpha$ absorption in background continuum (Seon & Witt 2012)

GP Survey with Narrow Band Filters

Sciences—Warm Ionized Medium (WIM)

Advantages of Pa α over H α :

- Less suffered from dust scattering
- No underlying Pa α absorption

Interesting targets in the MIRIS GP survey:

- Bright and faint H II regions
- Diffuse WIM sources (chimneys, filaments, etc.)
- Dust clouds scattering the H α background radiation (Mattila et al. 2007)

Development Status and Schedule

- Delivered to KARI; waiting for delivery to launch site
- Developing the data reduction pipeline (S0Cdr)
 - Python powered
 - Done by late March
- “Nominal” launch date: Late June
 - Launch site: Yasny, Russia
 - Launch vehicle: Dnepr LV (Yuzhnoye SDO, Ukraine)
- After launch
 - PV: 3 months
 - Dedicated observations for NEP: 1 month
 - GP survey: 5 months
 - NEP survey: 2 months
 - GP survey: 5 months