The Synoptic All Sky InfraRed Survey (SASIR) and Implication to the eROSITA Science

Takamitsu Miyaji
Instituto de Astronomía sede Ensenada
Universidad Nacional Autónoma de México

on behalf of the SASIR collaboration
(Special Thanks to the PIs: J. Bloom and W. Lee)

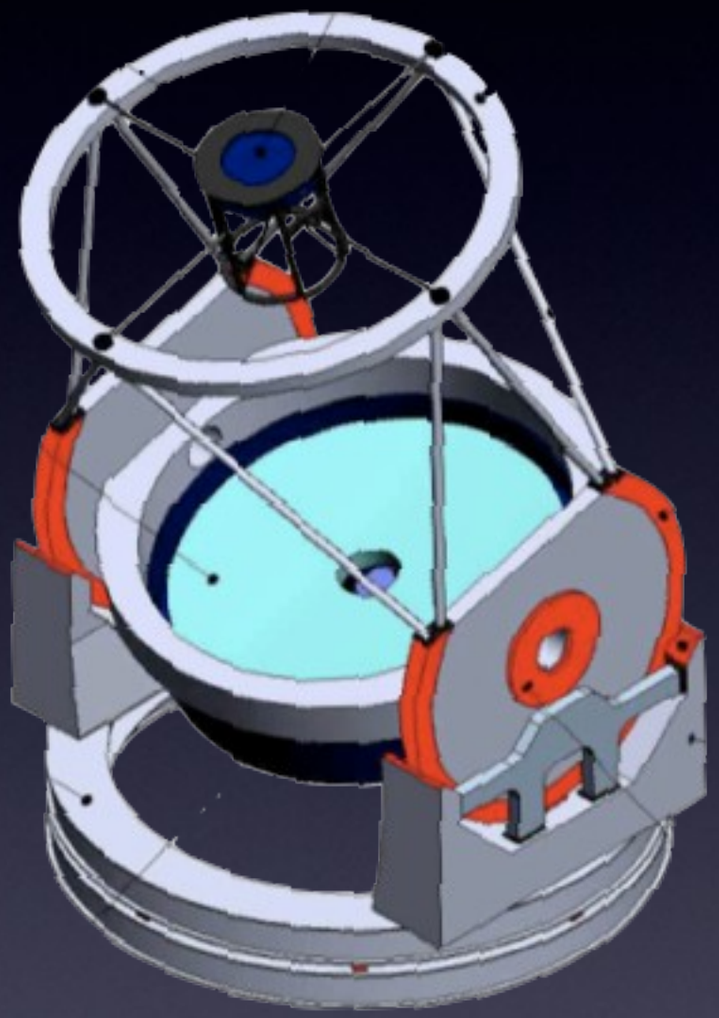
For more information, see
http://sasir.org/

The Synoptic All Sky InfraRed Survey (SASIR)

- A Mexico-US Collaboration
  - Mexico:
    - Universidad Nacional Autónoma de México (UNAM)
    - Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE)
  - US:
    - University of California (Bekeley,Santa Cruz,...)
    - University of Arizona

- PI-US: Joshua Bloom (UC. Berkeley)
- PI-Mexico: William Lee (IA-UNAM)

SASIR in a nutshell



- 6.5m telescope
- Magellan inspired design
- Simultaneous YJHK imaging
- Detectors: 124 2k x 2k IR arrays
- 0.5Gpx camera
- 1 deg. FoV
- Site: San Pedro Mártir, B.C., lat=+31°
- Survey of all observable sky from site
- Repeated sky coverage every ~3months
- Full survey in 4 years
- Various science dependent sub-surveys
- ~1TB/night in data
- Target First Light ~2017-2018
  - (cf. EUCLID-2019)

The Site of OAN-SPM

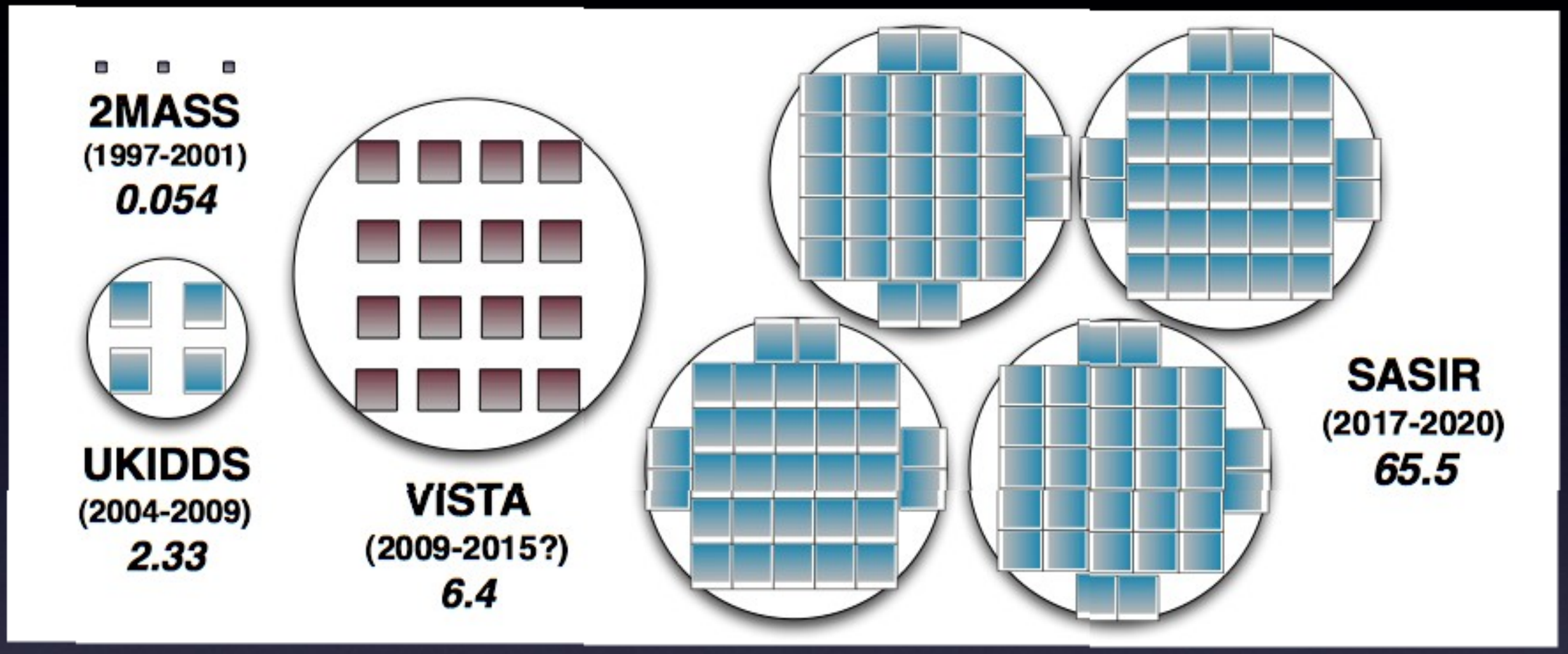
Observatorio Astronómico Nacional

San Pedro Mártir

Longitude=115° 27´49" W
Latitude=31° 02´39" N
Altitude=2,830 m

- **One of the top 4 sites for optical/IR astronomy** (with Canary Islands, Hawaii, Chile).
  - Photometric night ~60%, Spectroscopic night ~80%
  - Median seeing ~0.6”
  - Dark sky protection law “El ley del cielo”
- **Currently 3 telescopes are operated (2.1m, 1.5m, & 84cm)**

Etendue-couleur



Bands x aperture x field of view
[m^2 deg^2 bands]

Limiting magnitudes

Point Source Sensitivity

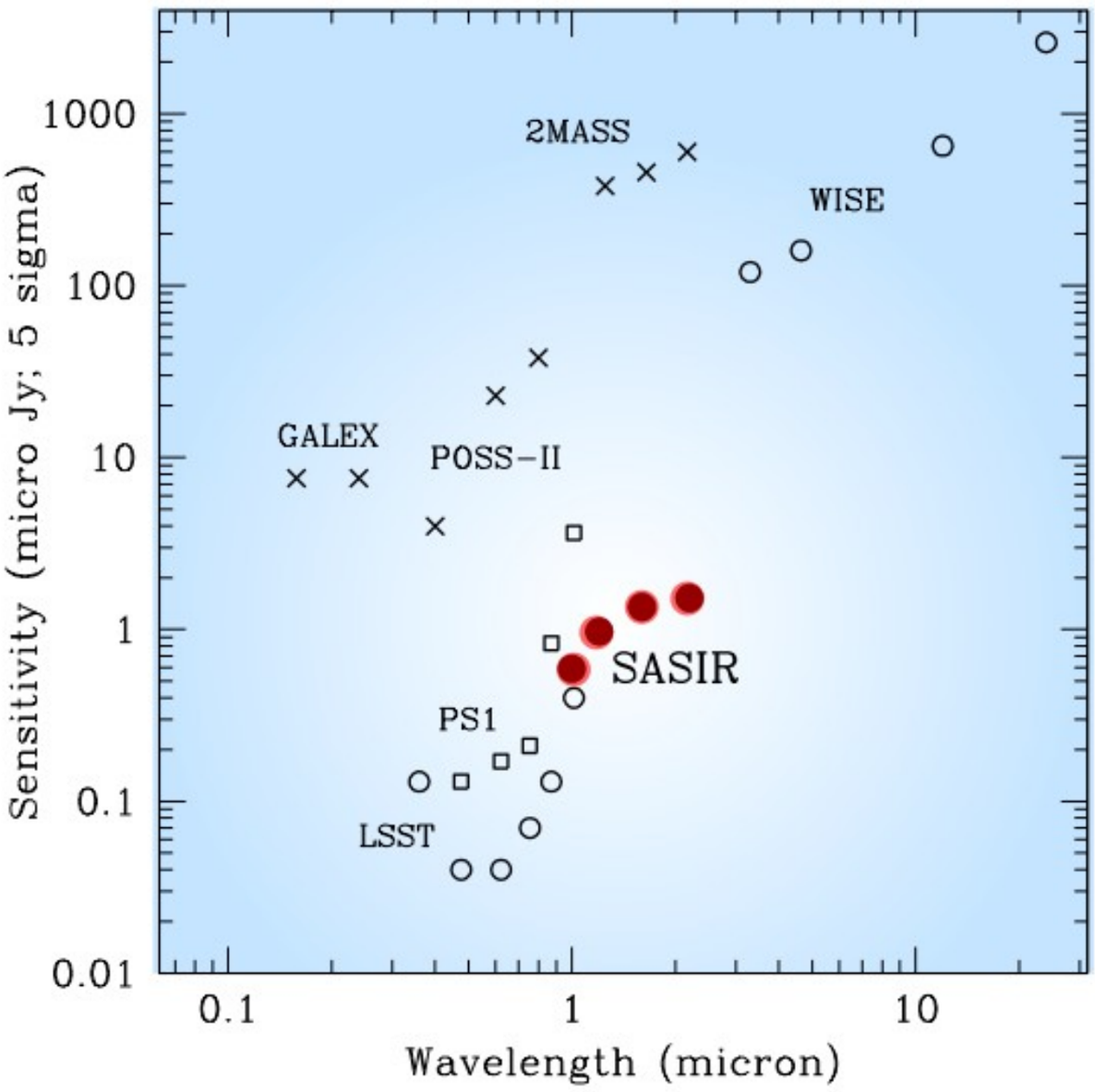
Filter	2MASS 5 sigma limiting mag [AB]	2MASS flux density μJy	SASIR/single epoch 5 sigma limiting mag [AB]	SASIR/single epoch flux density μJy	SASIR/shallow 5 sigma limiting mag [AB]	SASIR/shallow flux density μJy
J	18.13	202	22.54	3.5	23.89	1.0
H	17.63	320	22.04	5.5	23.39	1.6
Ks	17.55	346	21.95	6.0	23.30	1.7

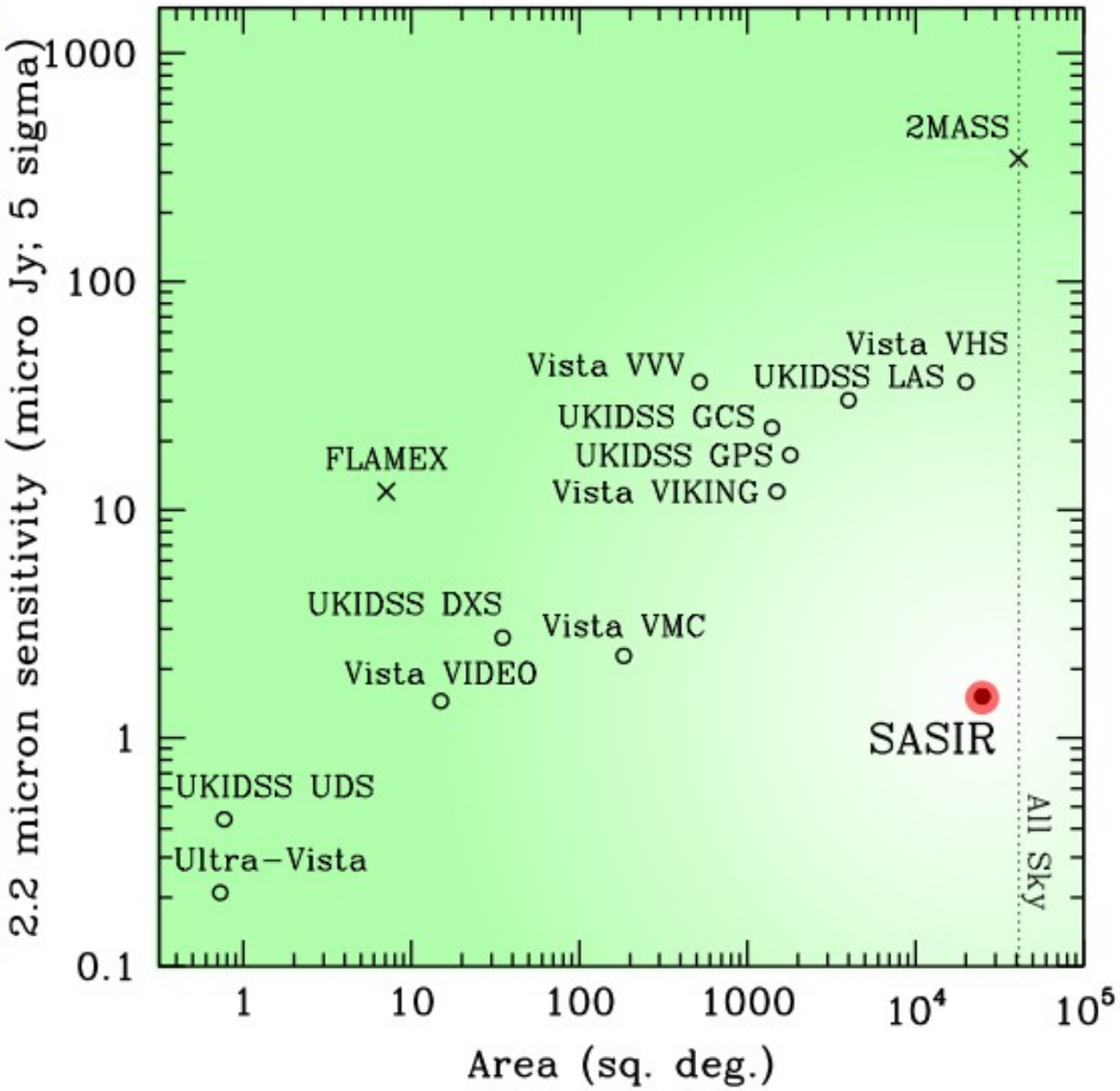
cf. Euclid: 20,000 deg^2 (YJH, H_{AB}~24)

Extended Source Sensitivity ("shallow")

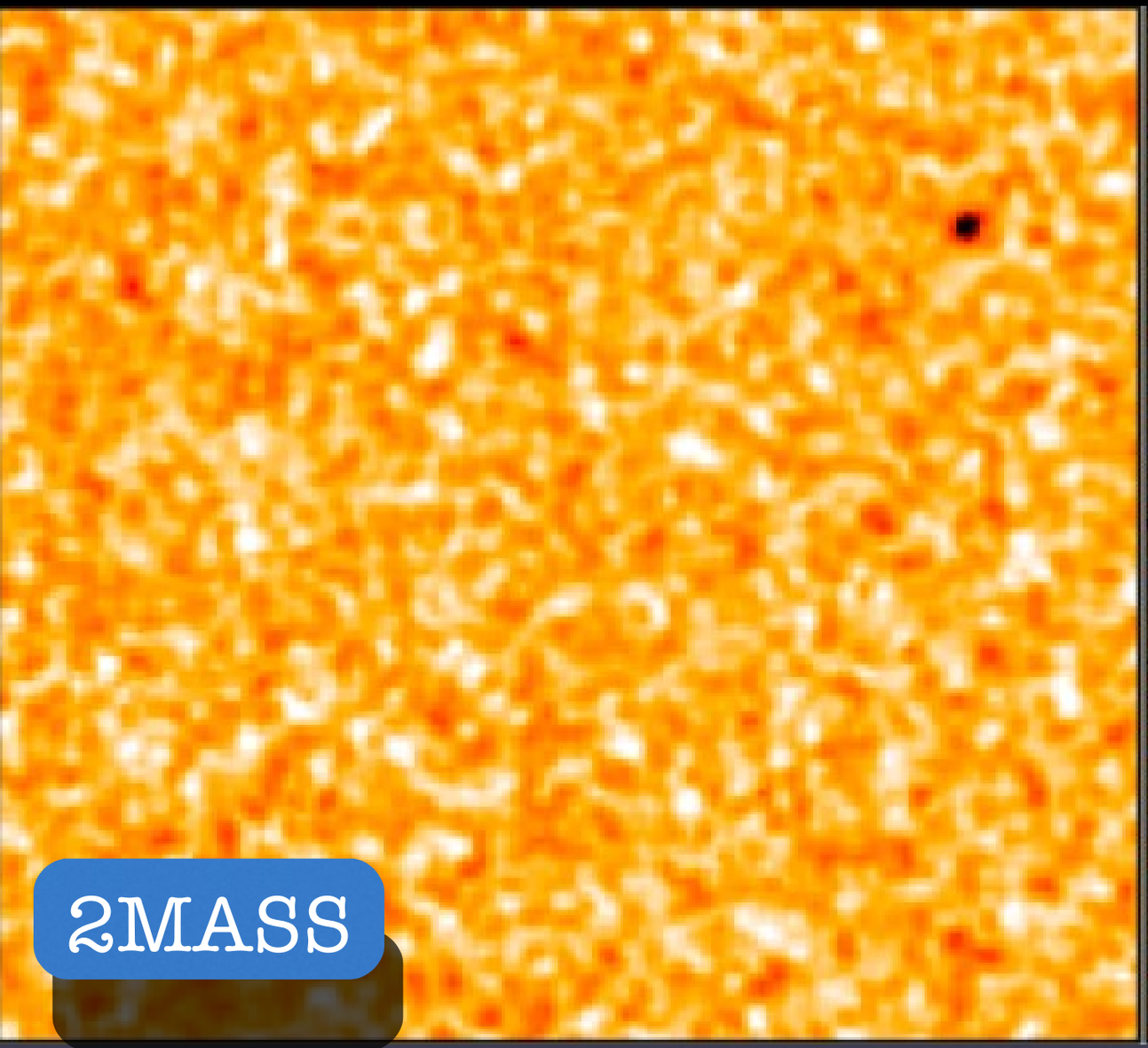
Filter	5 sigma limiting mag [AB arcsec^{-2}]	flux density μJy arcsec^{-2}
Y	23.32	1.7
J	22.78	2.8
H	22.42	3.8
Ks	22.29	4.4

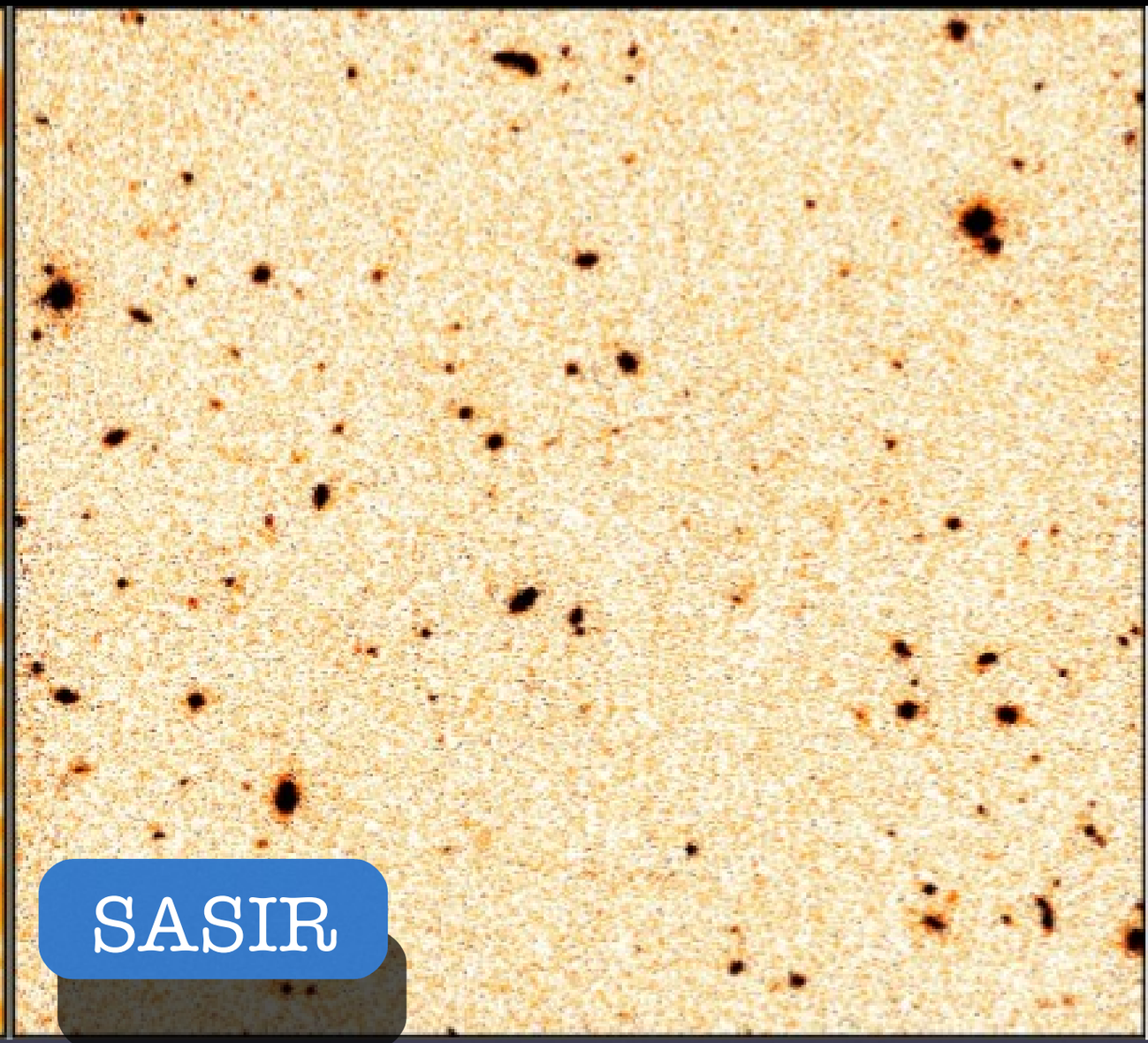
Sensitivity



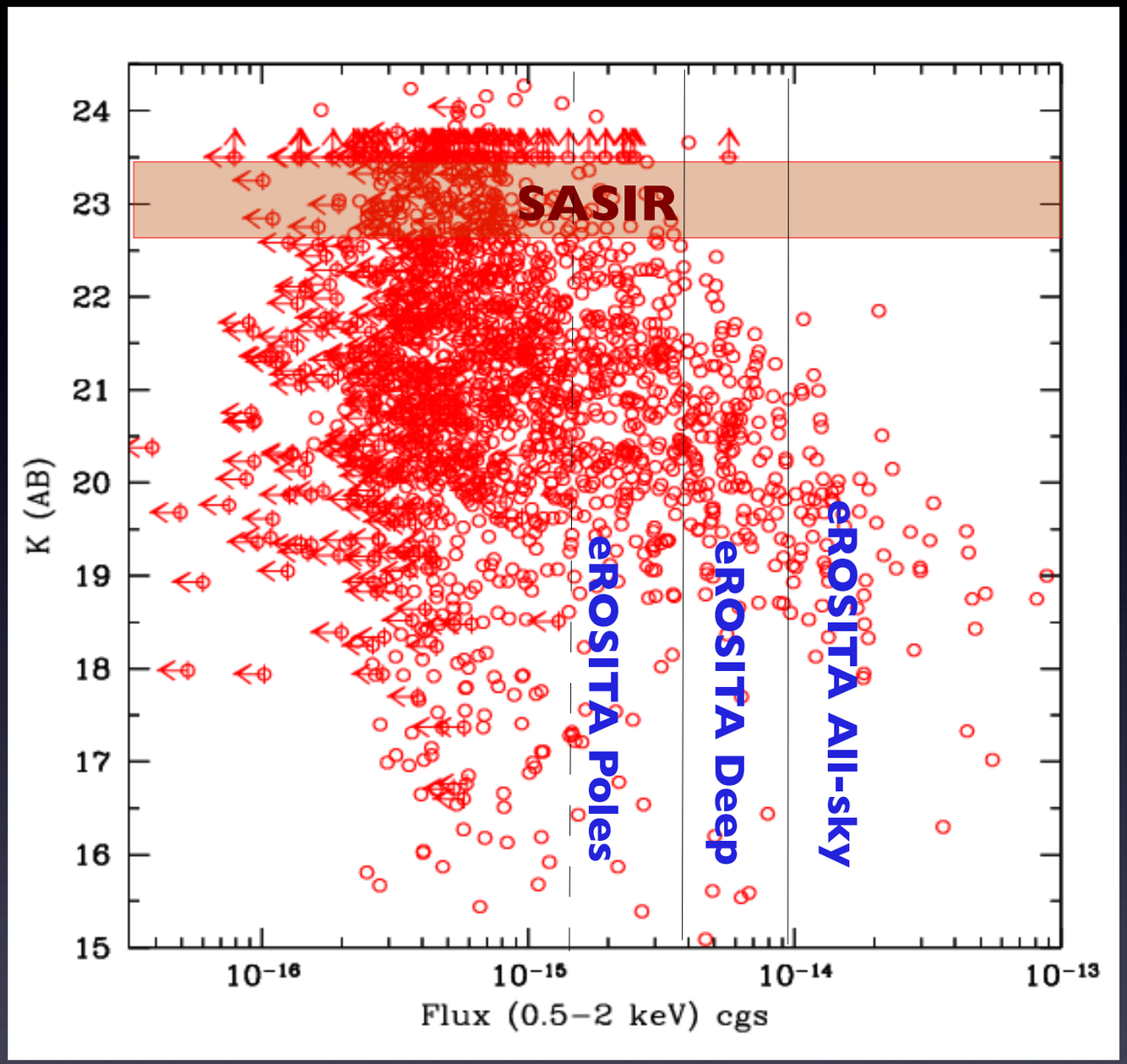


K-band imaging





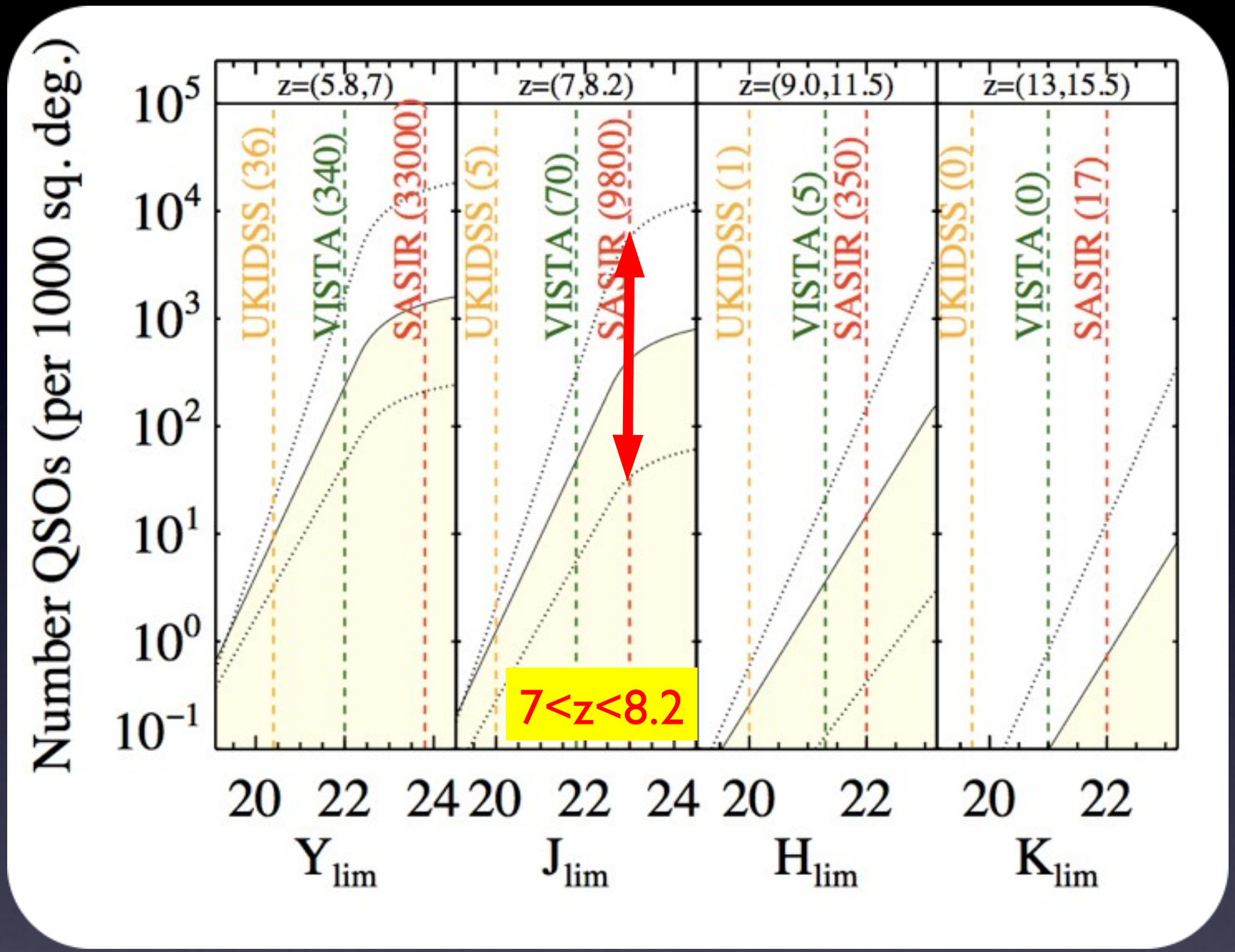
X-ray vs K-band



SASIR will detect almost all X-ray point sources detected by eROSITA All-Sky/Deep surveys at the K-band.

X-ray flux vs K_{AB} from C-COSMOS
Courtesy of F. Civano/C-COSMOS Team.

Most Distant QSOs



Repeated Surveys are essential to exclude major contamiations from nearby cool stars by proper motion.

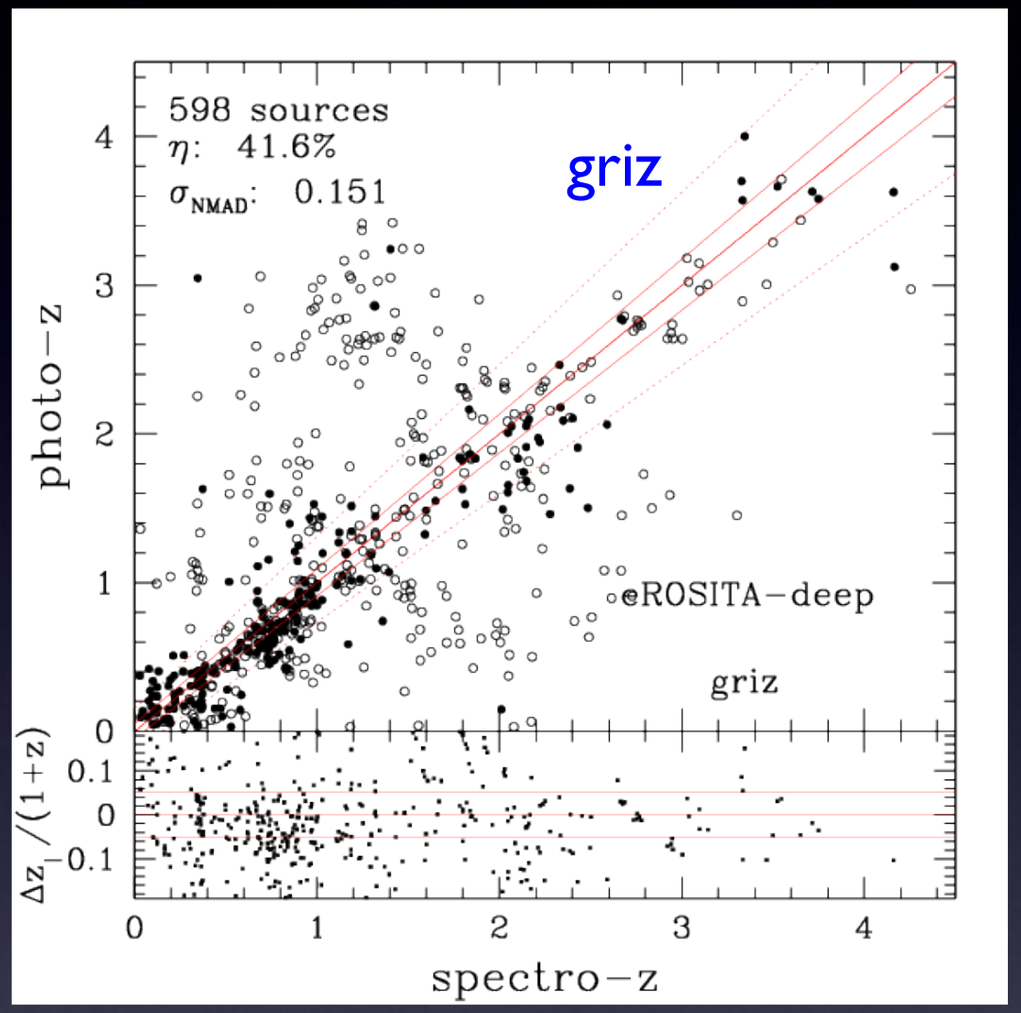
J.X. Prochaska

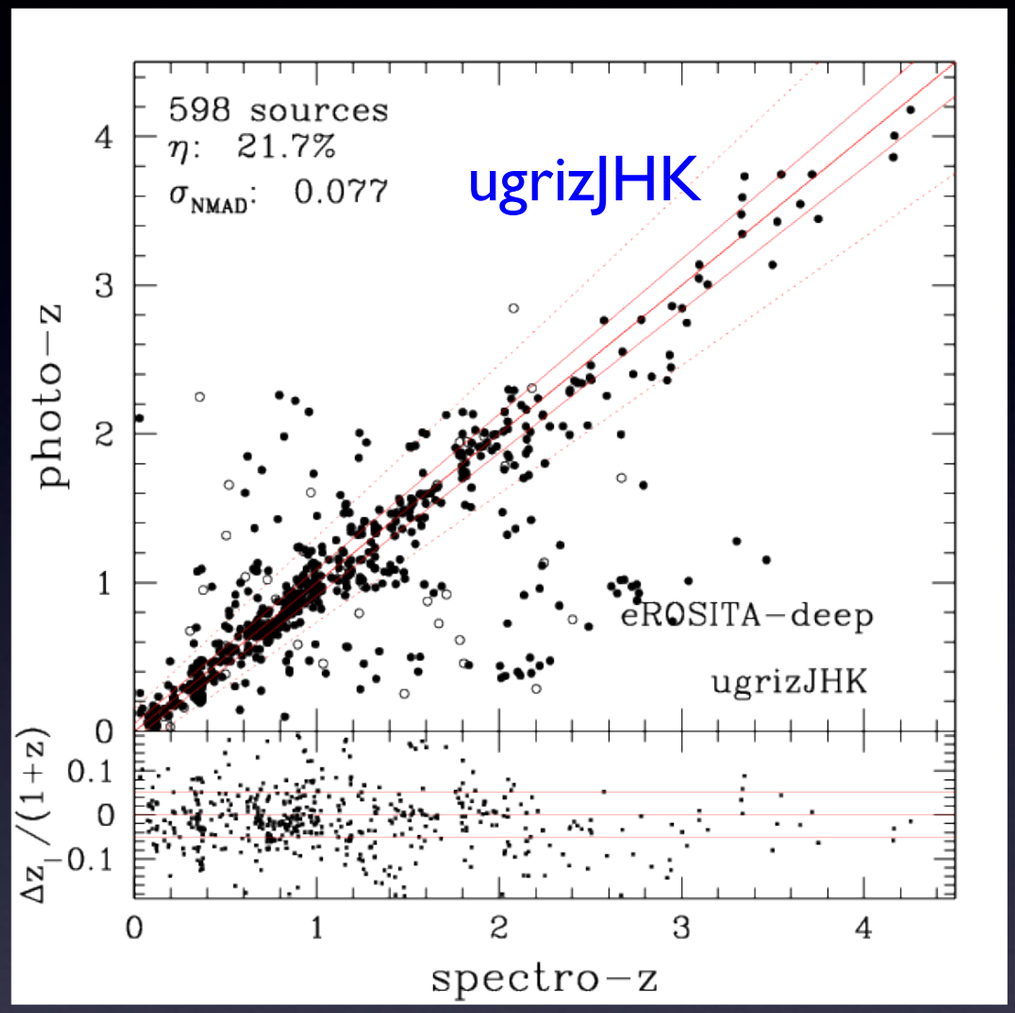
Most Distant QSOs

- SASIR J-band: 300-50,000 QSOs/10,000 deg^2 at $7<z<8.2$.
- eROSITA (All-Sky): 2-150 QSOs/10,000deg^2 in the same redshift range (based on Hasinger, Miyaji, Schmidt 2005 with and without exponential cutoff at z>3)
  - →eROSITA detects brightest of SASIR high-z QSOs.
- eROSITA: Photon-limited point source detection
  - →Stacking analysis of eROSITA data at positions of SASIR high-z QSO candidates.
- X-ray to UV index α_{ox} (detected sources and stacking)
  - Infer $<L/L_{edd}>$ (or $<M_{BH}>$) in high-z radio-quiet QSOs (Kelly et al. 2008)

Photometric redshifts of eROSITA AGNs

Sources@eROSITA Deep Flux Limit



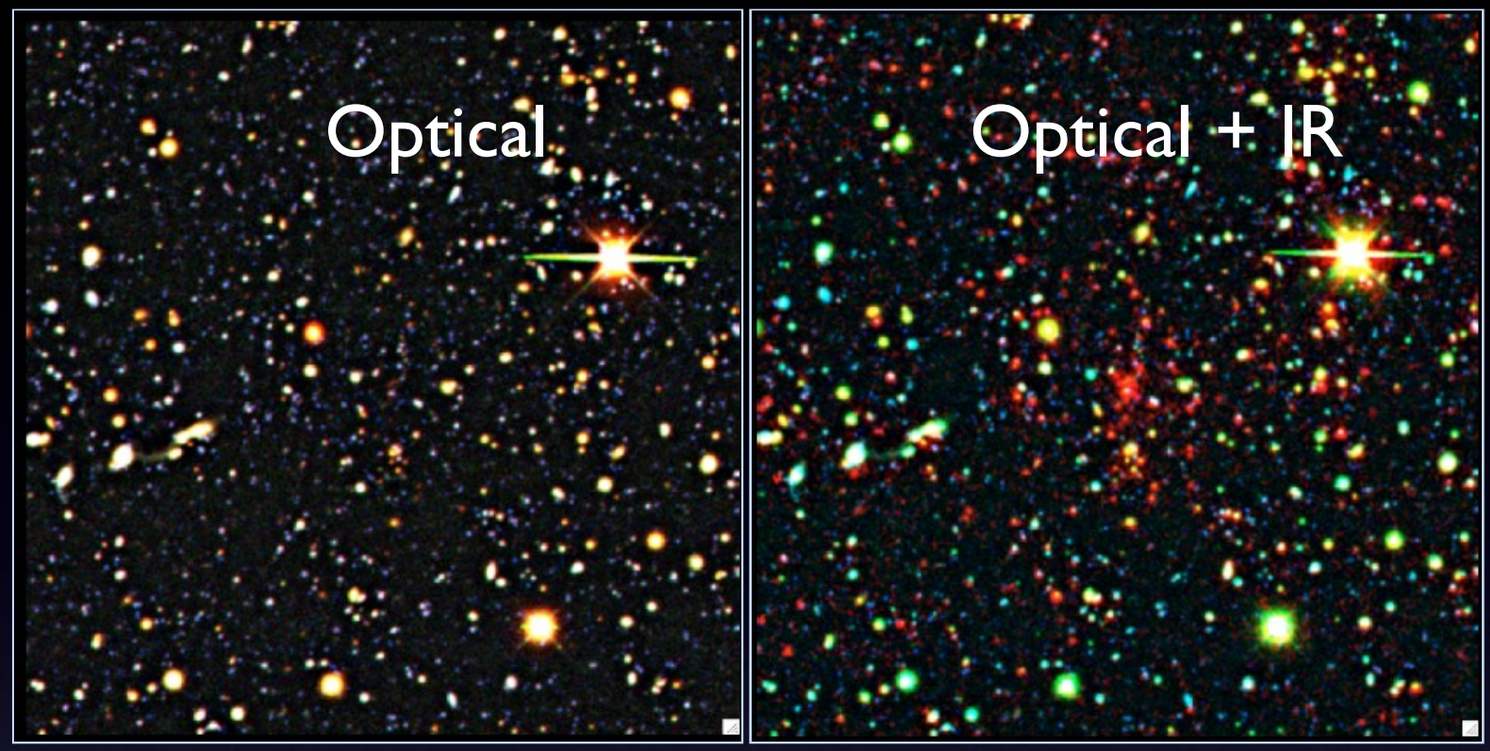


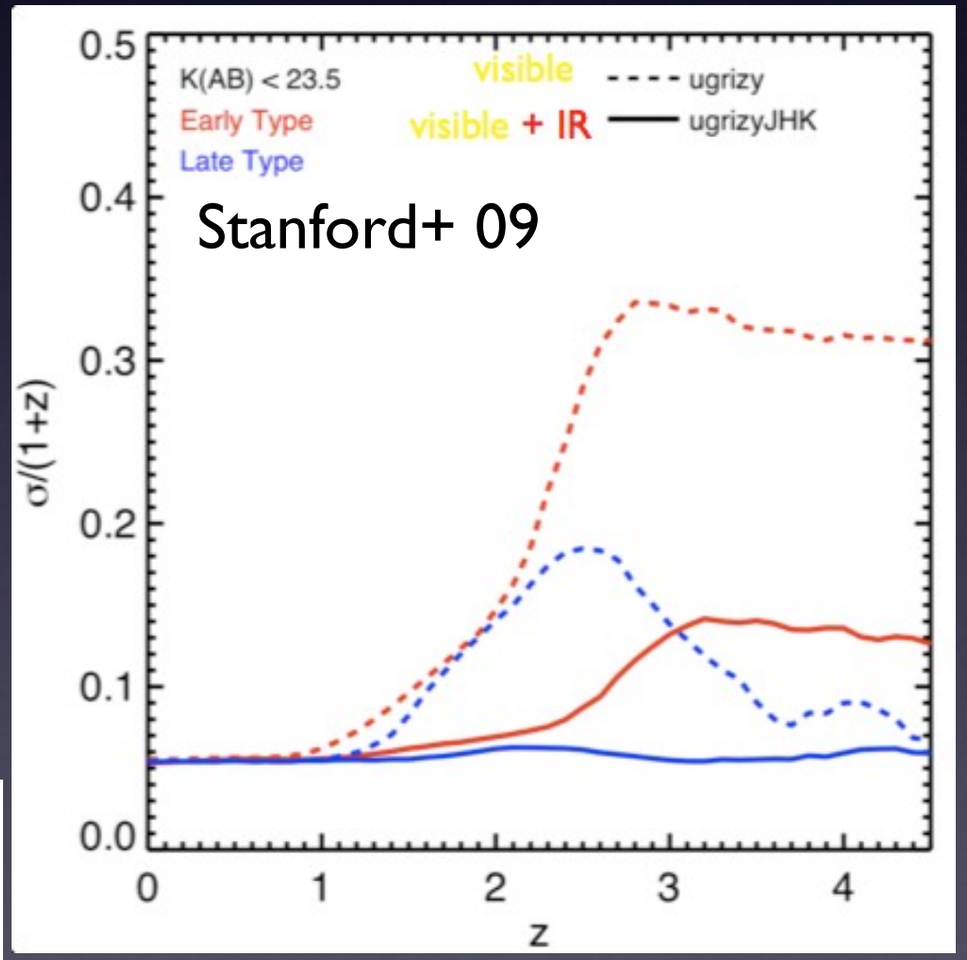
Data from XMM-COSMOS/C-COSMOS (Salvato+11; Poster)

*The IR photometry from SASIR can substantially improve determination of photometric redshifts of eROSITA AGNs.

*Repeated survey of every 3-4 months enables "variability correction" of photometry.

Galaxy Clusters





- SASIR data improves of photo-z of cluster members at high z (cf. talk by R. Fassbender)
- High-z clusters cores (z>~1) near eROSITA detection threshold may be discriminated from AGNs with the SASIR data.

Project Status

- Funding for scientific case and requirement studies awarded by CONACyT (Mexico) in 2009. Funding for academic exchange between UC and Mexico awarded (UC-MEXUS Program).
- Primary mirror is fully funded (INAOE/UA).
- The 6.5 m mirror has been casted and out of oven. Waiting for figuring and polishing at UA Steward Mirror Lab. →To be completed in 2013.
- SPM 1.5m robotization and the installation of the RATIR camera (precursor to the SASIR) close to completion.
- SPM infrastructure improvements in progress (network, power)
- Program Office, in charge of plannining, management, legal, environmental and partner issues, opened in Sept. 2009 (Mexico City)
- Optical design improvements being made.
- Applying for private and governmental funding (both from US and Mexico) for building instruments/construction/operation etc.

Open for participation!

Mirror removed from oven.

Summary

- SASIR is a planned 6.5 m telescope for nearly all-sky repeated IR surveys in the YJHK band, with a final limiting magnitude of K_{AB}~23.3.
- Data available from SASIR is expected to give substantial contribution to sciences with eROSITA.
  - The IR data improves the photometric redshifts of eROSITA AGNs and Clusters. Repeated Surveys will enable variability correction, which will further improve the photo-z of AGNs.
  - High-z QSOs selected from SASIR can be identified with eROSITA sources or used for X-ray stackings to explore X-ray properties of the first QSOs in the universe.