SPICA, the next generation IR Telescope (is there an Italian interest for IR?)

C. Gruppioni (OABo-INAF)

Bologna, 2016 June 16

Infrared Space Observatories


IRAS 1985


ISO 1995


Herschel 2009-2013


IRTS 1995


Akari 2006


Spitzer 2003


SPICA!


JWST 2018?

SAFARI

SRON

SPICA COLLABORATION

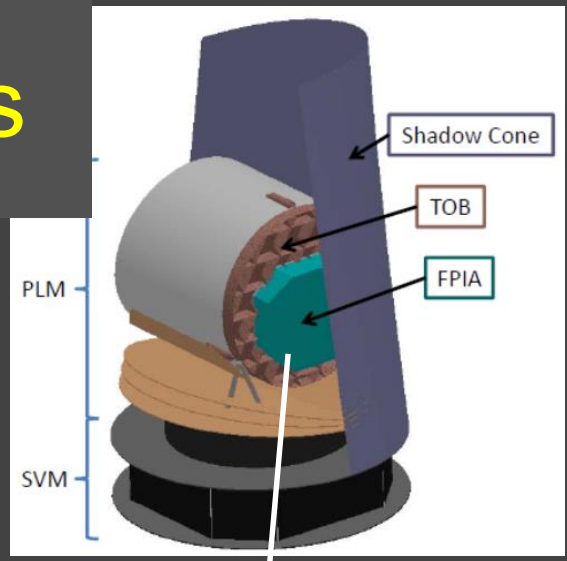
SPICA PI: T. Nakagawa (Japan)
SAFARI PI: P. Roelfsema (SRON, NL)
SAFARI Scientific Co-Is L. Spinoglio, C. Gruppioni (INAF, IT)
F. Helmick, I. Kamp, C. Dominik, P. Van der Werf (NL), J. Goicoechea, J. Martin-Pintado, I. Perez-Fournon (ES), C. Joblin, S. Madden (FR), M. Baes, L. Decin (BE), M. Audard, M. Meyer (CH), D. Rigopoulou (UK), E. Sturm (DE), F. Kenschbaum (AT), D. Naylor (Canada)

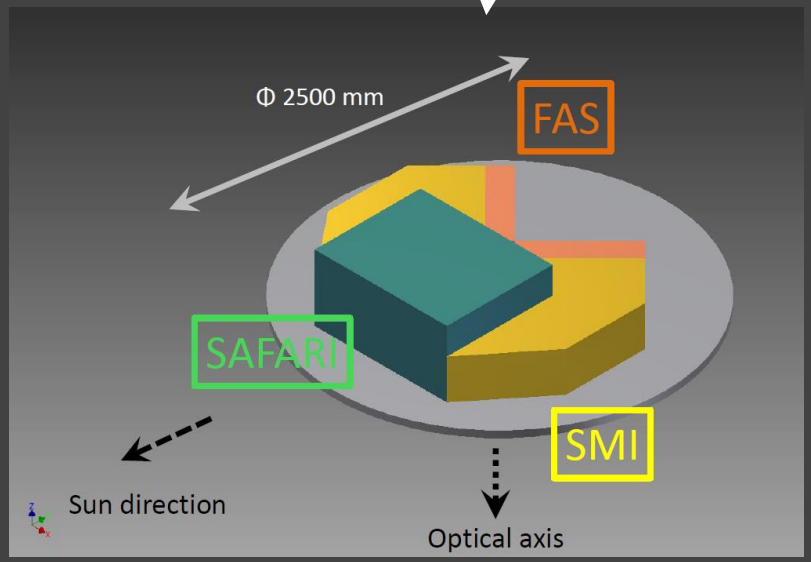
The mission concept

- Joint ESA-JAXA mission
- 'PLANCK configuration'
  - Size - Φ4.5 m x 5.3 m
  - Mass - 3450 kg (wet, with margin)
  - V-grooves
- 2.5 meter telescope, < 8K
  - Warm launch
- 12 - 230 μm spectroscopy
  - MIR imaging spectroscopy – SMI
  - FIR spectroscopy – SAFARI
- 'standard' Herschel/Planck SVM
- Japanese H3 launcher, L2 halo orbit
- 5 year goal lifetime

SPICA focal plane intruments

- Focus on spectroscopic capability
  - SAFARI 35–230 μm – R~300/3000
  - SMI 17–35 μm – R~100/1500
  - SMI 12–18 μm – R ~ 28000
- Imaging capability
  - SMI 17–35 μm camera
- Final FPIA iterations ongoing
- Options (still) under consideration
  - Extending SAFARI to 300/350 μm
  - Potential for a third instrument (BiBoP)… Photometry/polarimetry 50-110-220-350 μm





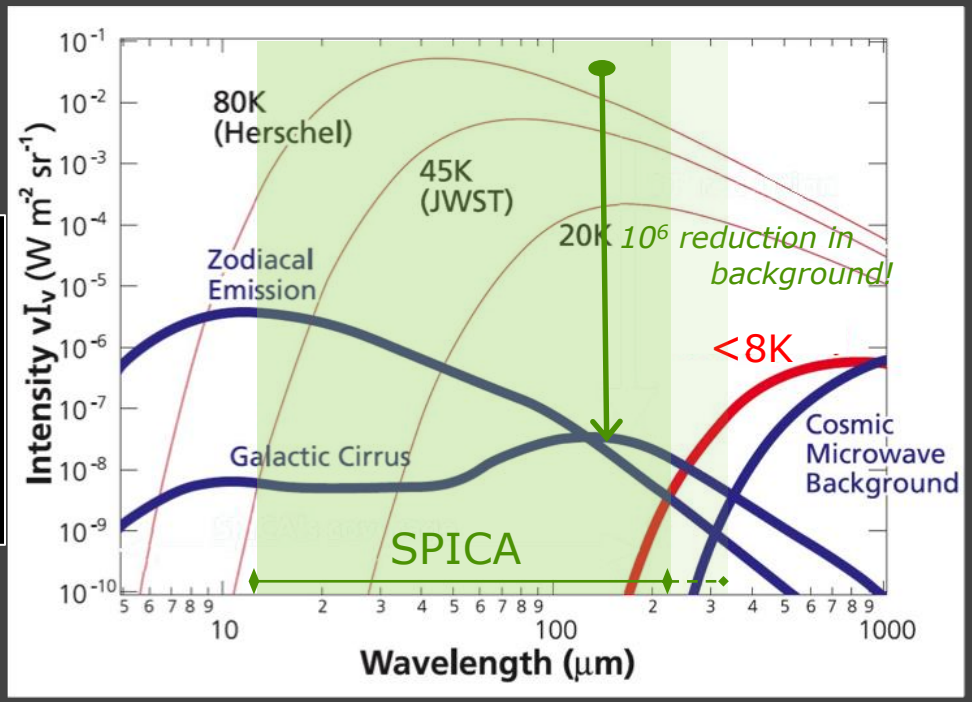
The SPICA "sweet spot" – the dusty Universe

A unique observatory

looking through the veils, enabling

transformational science

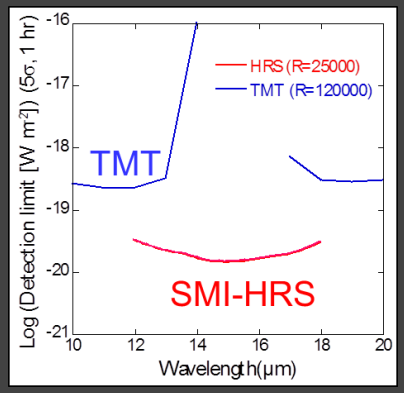
A cryogenically-cooled telescope significantly reduces the thermal emission from the telescope

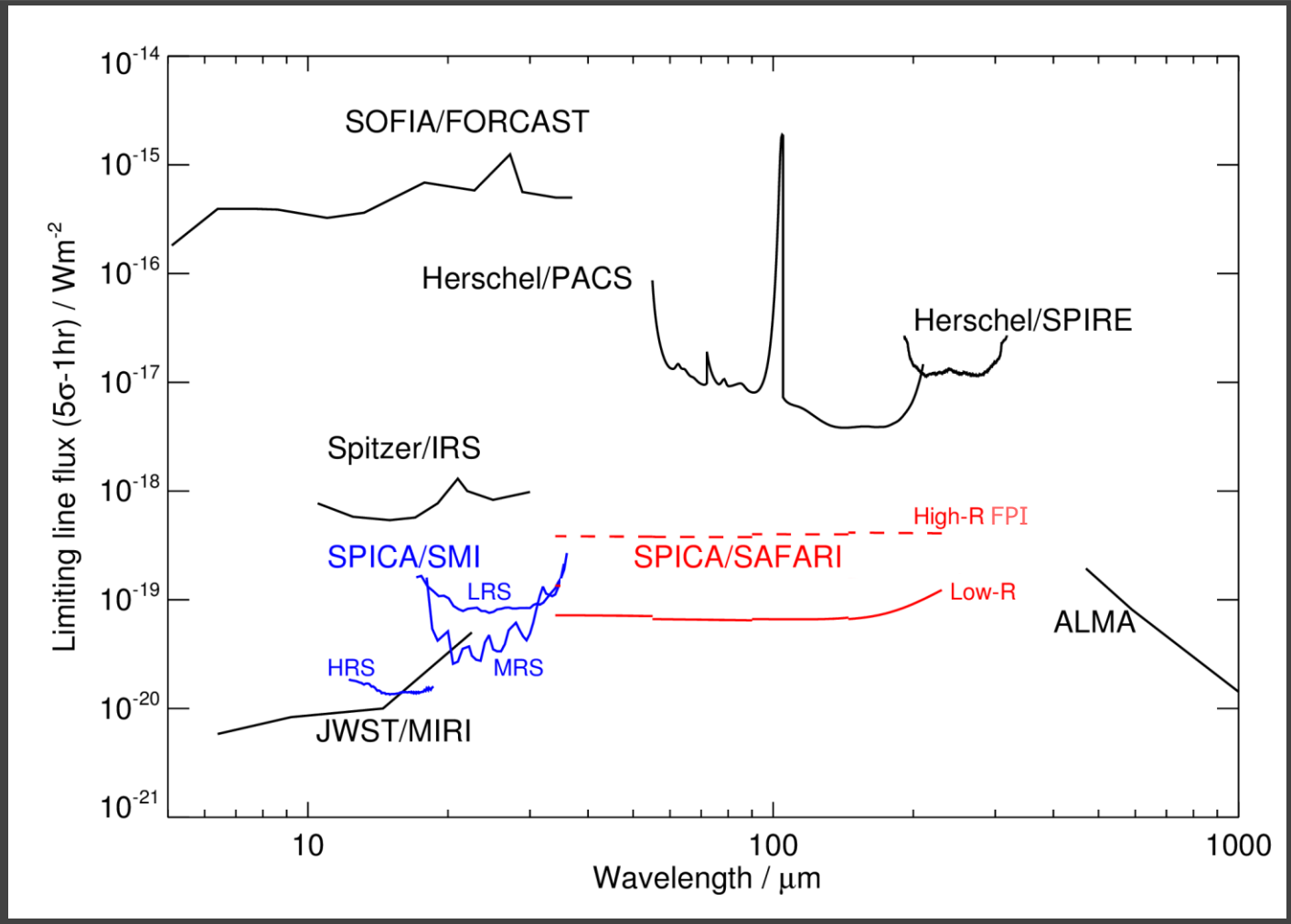


What is so unique?

- A ***COLD***, ***big*** mirror
  - → ***true background limited*** Mid/Far-IR observing
    - >2 orders of magnitude better raw sensitivity than Herschel
- ~20 to ~350 μm ***inaccessible for any observatory***
  - → the wavelength domain where ***obscured matter*** shines
    - fill the void between JWST and ALMA @ R~ few 1000

SPICA's sensitivity: making a huge leap forward

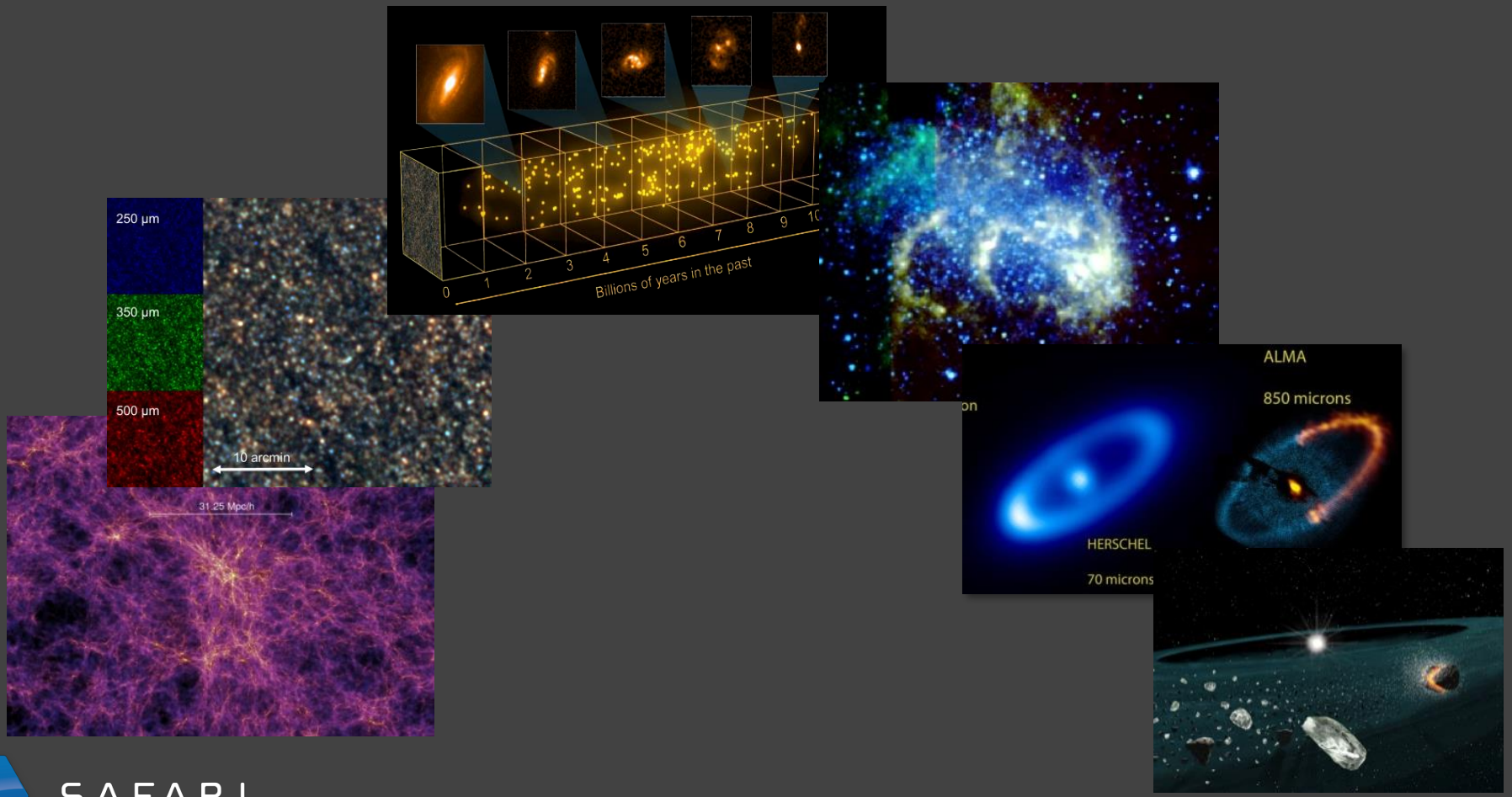




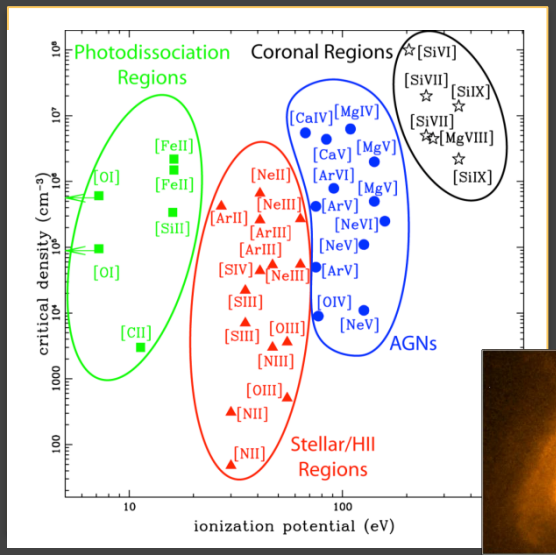
Raw sensitivity improvement **>2 orders** of magnitude
Instantaneous full spectra → huge step in efficiency

SPICA will unveil the dusty matter in the Universe

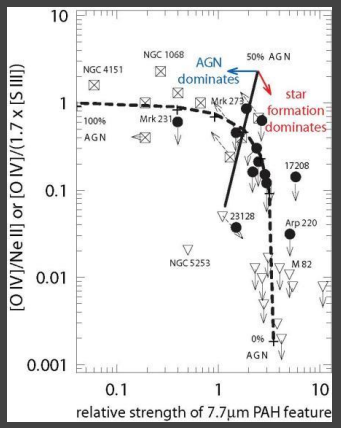
Seeing through the veils on cosmic timescales
from galaxy evolution to the formation of (proto) planetary disks

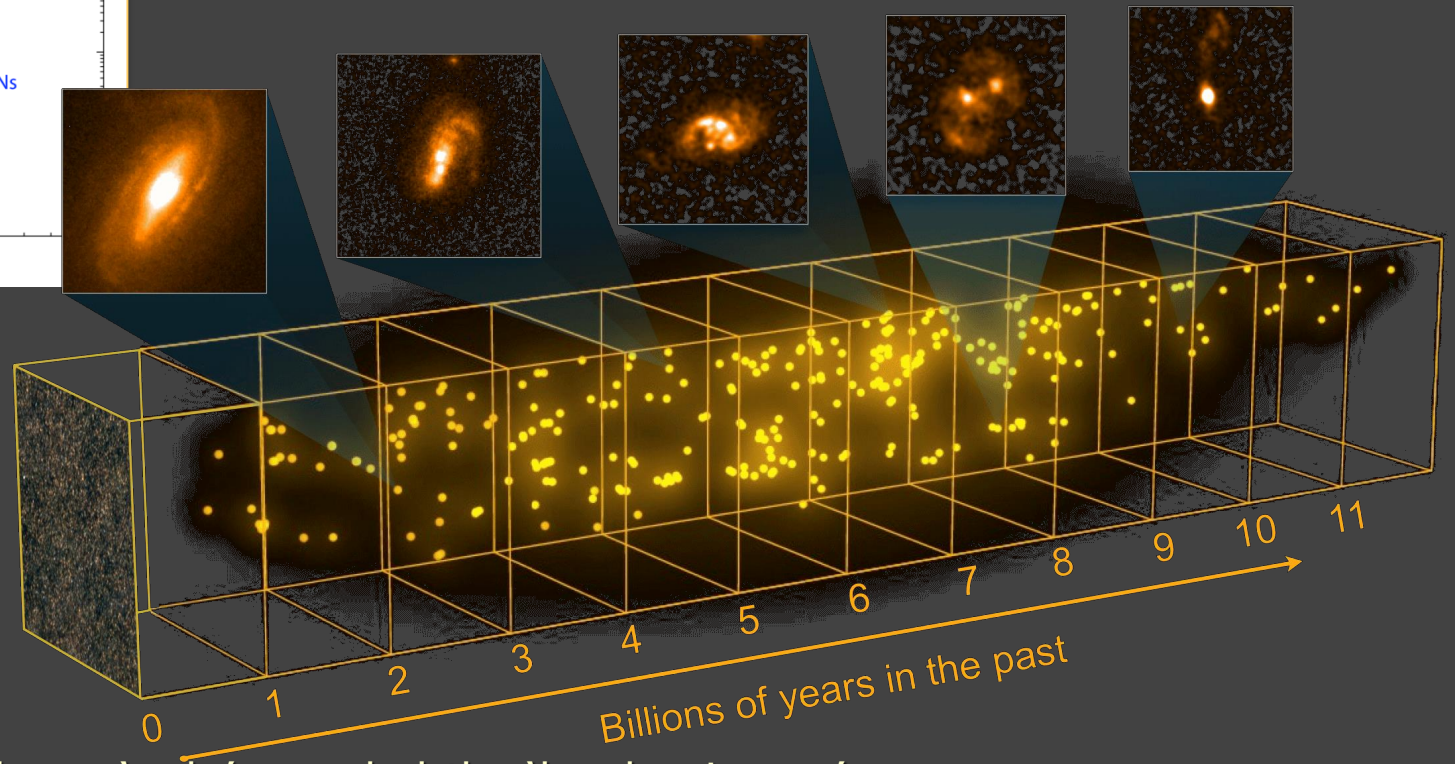


Evolution of IR-Luminous galaxies



- FAR-IR diagnostic tools
  - Line-ratios → physical state of dust and ionised gas
  - Line profiles → outflow/infall
  - Discriminate between AGN and star-formation

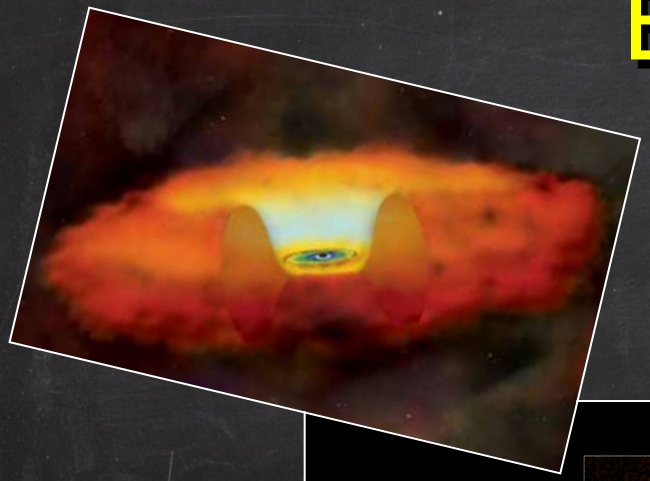


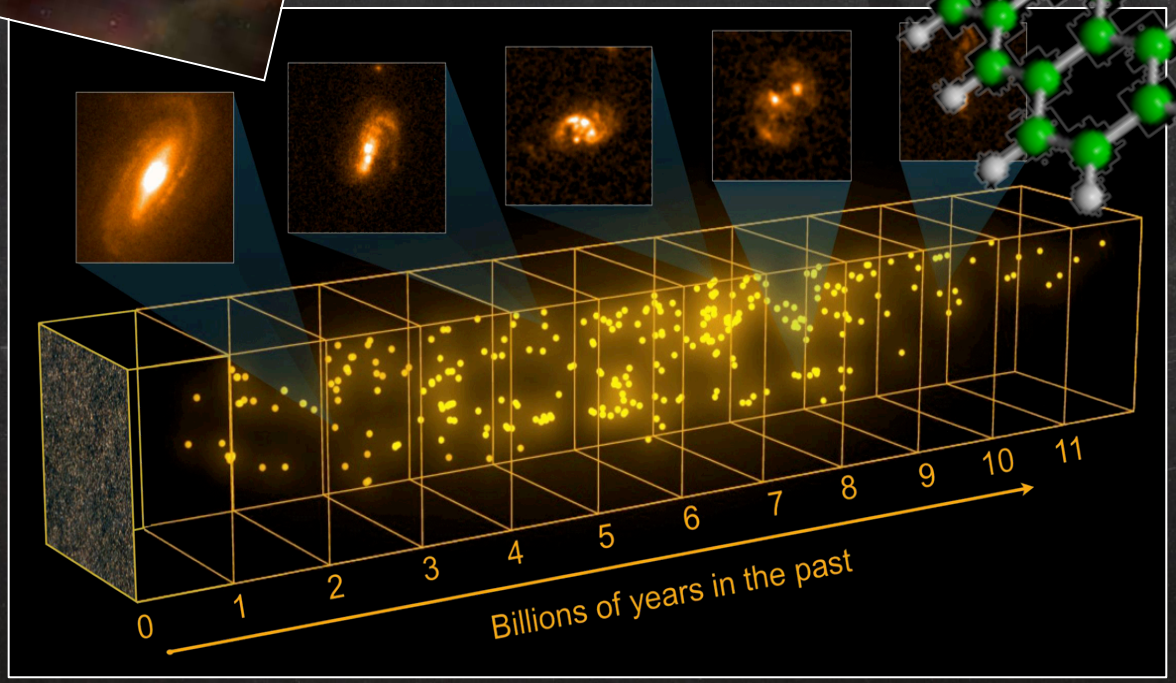


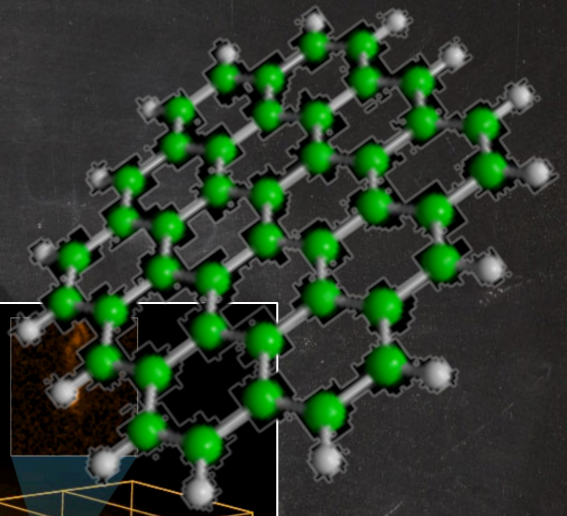
So far only we 'only' sampled the 'local universe'…

*…SPICA will **measure physical conditions** out to **z~3***

Understanding the Physical Processes that Regulate Galaxy Evolution

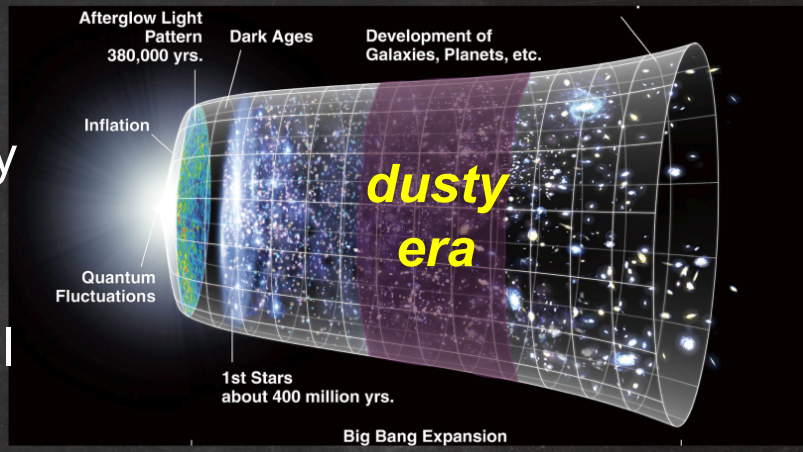




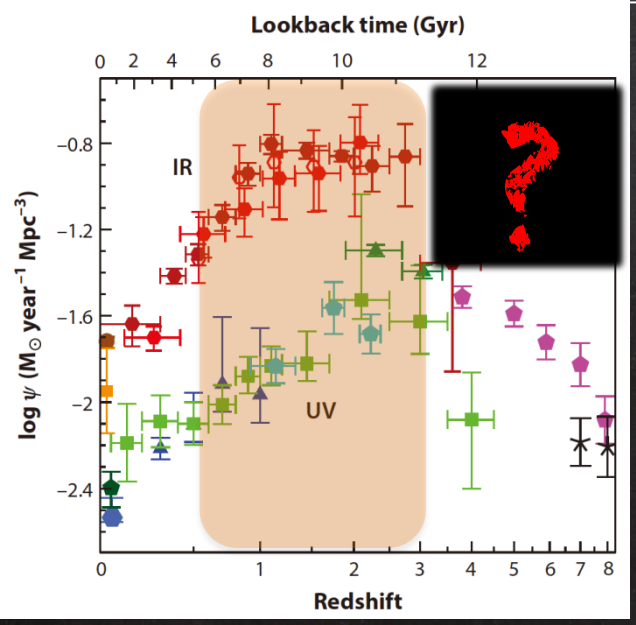


Unveiling the "dusty era" of the Universe

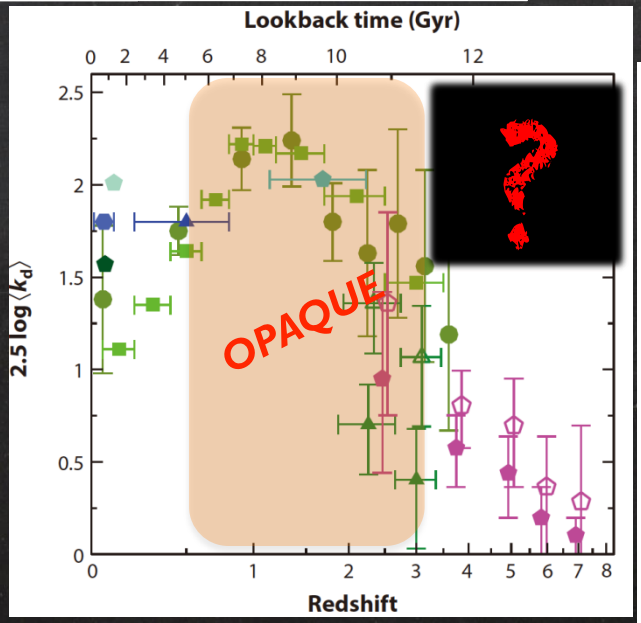
- ★ "Dusty era" (z~1-3) invisible at optical wavelengths,
- ★ Peak of the star formation and AGN activity in the Universe
- ★ most stars, massive black holes, and metal and dust are formed.



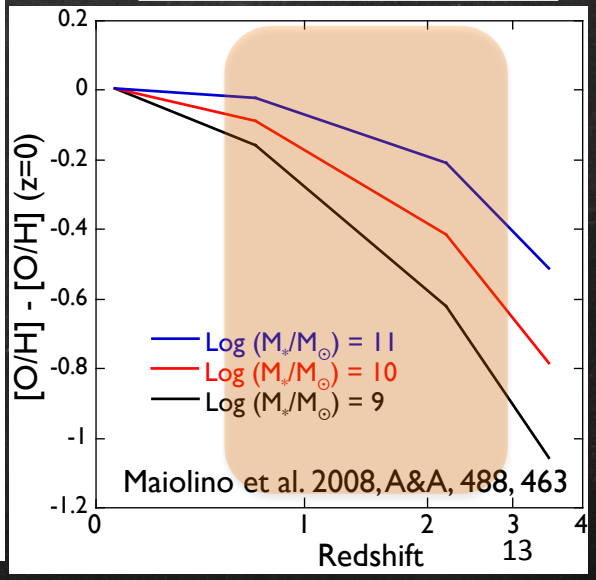
Star Formation Rate Density (SFRD)



Dust attenuation



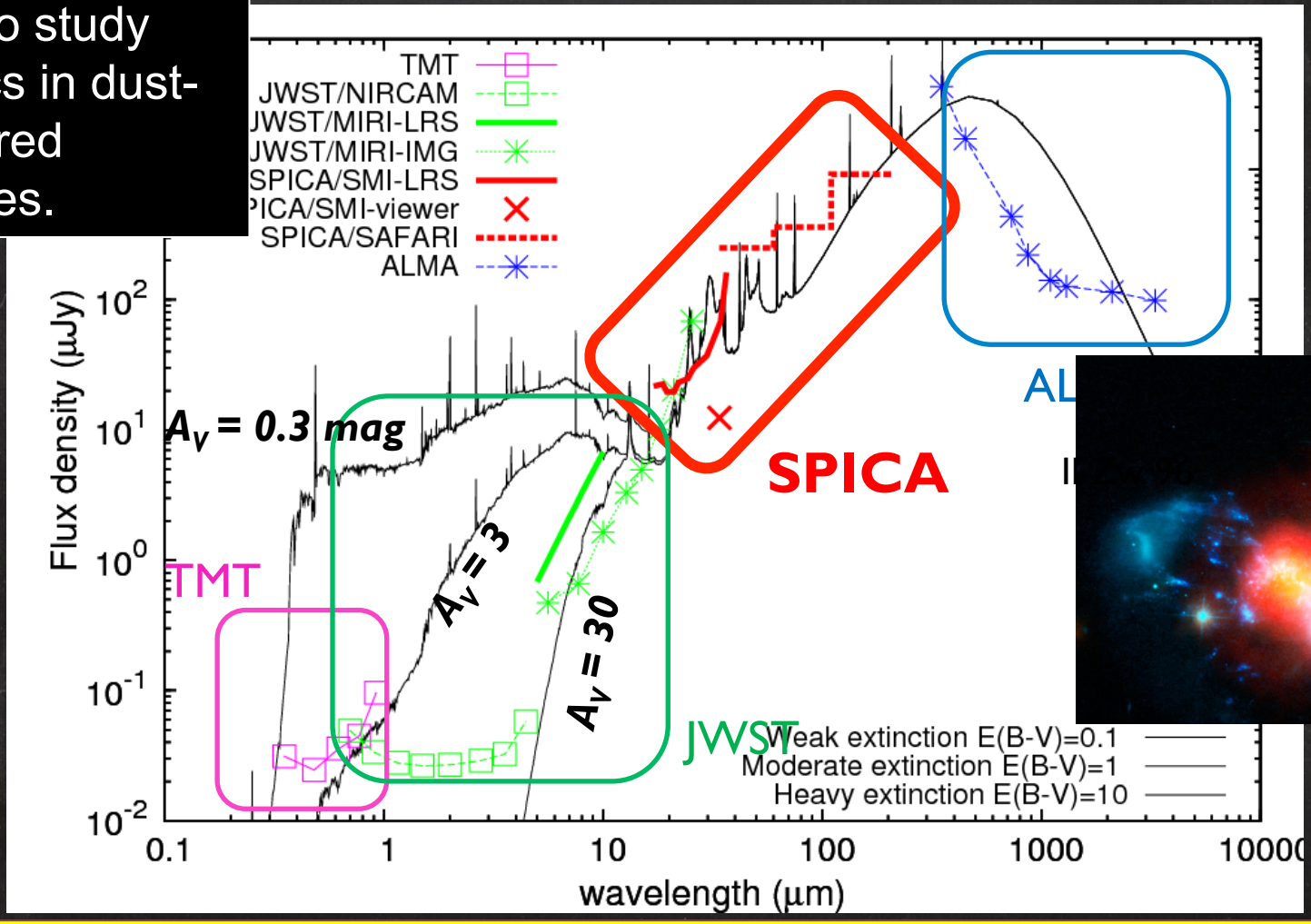
Metallicity (optical)



Madau & Dickinson 2014, ARAA, 52, 415

SPICA's uniqueness in extra-galactic astronomy

SPICA provides unique spectral tools to study physics in dust-obscured galaxies.



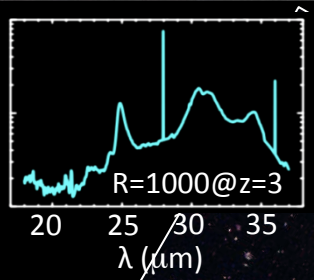
SPICA fills the spectral gap between ALMA and JWST

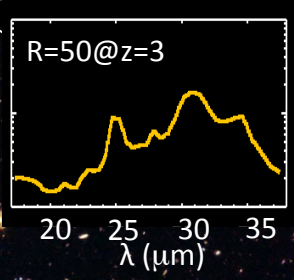
Cosmological survey with SMI-LRS

Spitzer / IRS-LL

slit size: 168”x11”

3.3′x3.3′





SPICA/SMI-LRS

R = 50–100

Multi slit
slit size: 10’x3.7”

SMI-LRS blind survey
wide (10 square deg)
&
deep (1 square deg)

3.2°x3.2°

JWST / MIRI-MRS

R = 2,000
slit size: 7.7”x7.7”

2′x2′

Follow-up by SAFARI (& SMI)

SPICA will be proposed for ESA M5 call

dead-line
5 October 2016

SPICA Italian web page: *http://safari.iaps.inaf.it/wp*
To sign in support of SPICA: *http://safari.iaps.inaf.it/wp/?page_id=272*

Conclusions

- No future far-IR mission planned: SPICA will be the only one
- SPICA: the next generation Infrared Telescope
  To be proposed for ESA M5 call (ESA+JAXA)
- It will fill the gap between JWST and ALMA
- Synergies with Athena for complete AGN census (CT AGN)
- Need to create an Italian group of interested scientists to support SPICA with INAF and ASI

(sub)mm (extragalactic) observations with ALMA under-exploited

partnerships with state-of-the art mm facilities

NOEMA, successor to Plateau de Bure Interferometer, most powerful millimeter facility in the Northern Hemisphere.

Currently 8 15-m antennas, 12 planned, 10 already funded, to be installed one per year to 2019. Baseline lengthened to 1.6 km, similar to ALMA "standard" configuration.

New receivers more sensitive than ALMA; new correlators 16 GHz bandwidth (4 x ALMA).

IRAM is soliciting partnerships, but time-critical. Now or opportunity lost !!!!

Thank You !