



Nearby Universe: Rapporteur

Margaret Meixner (STScI)

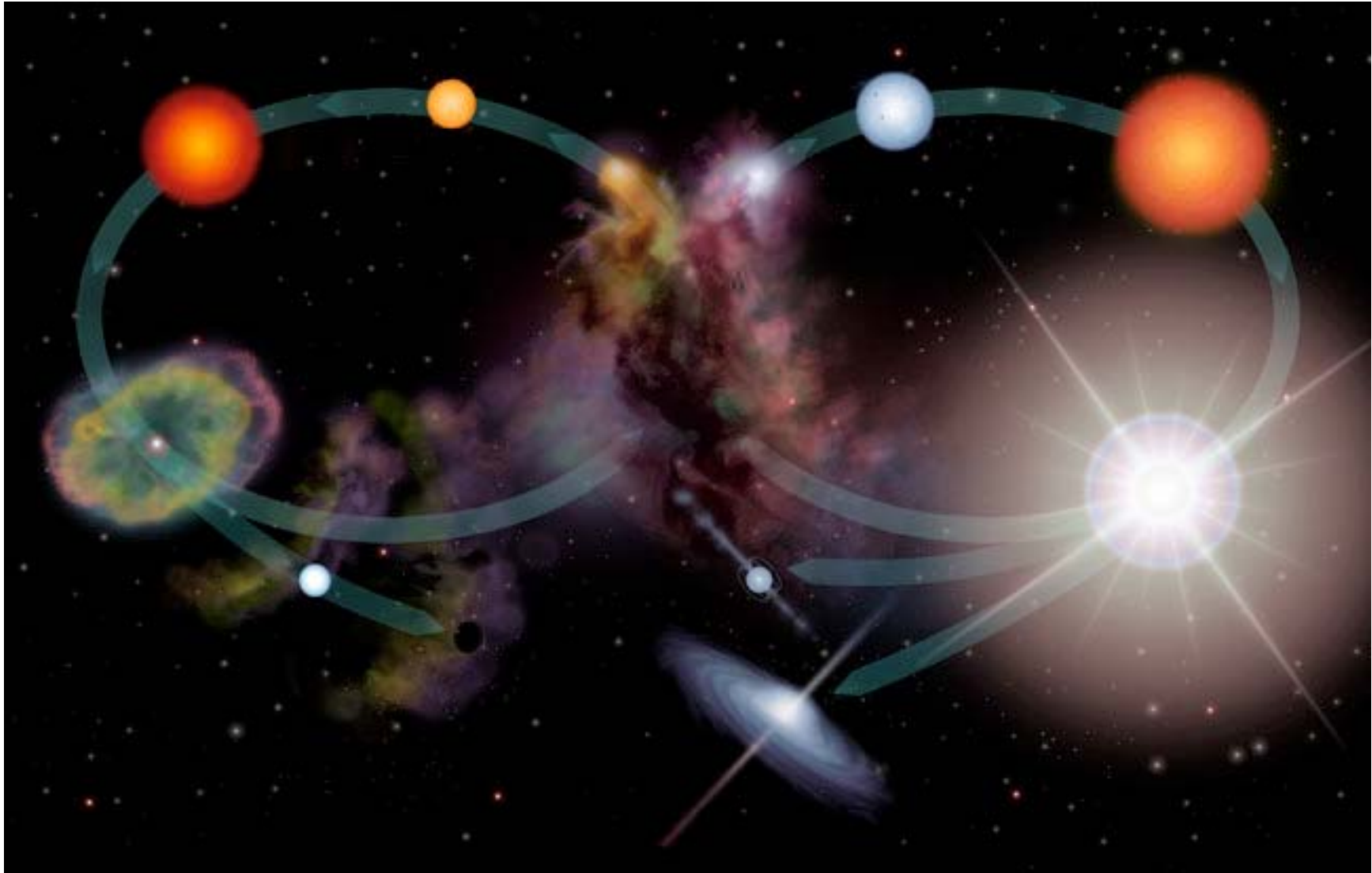
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SAGE: Tracing the Lifecycle of Baryonic Matter:

Intermediate mass stars

High mass stars



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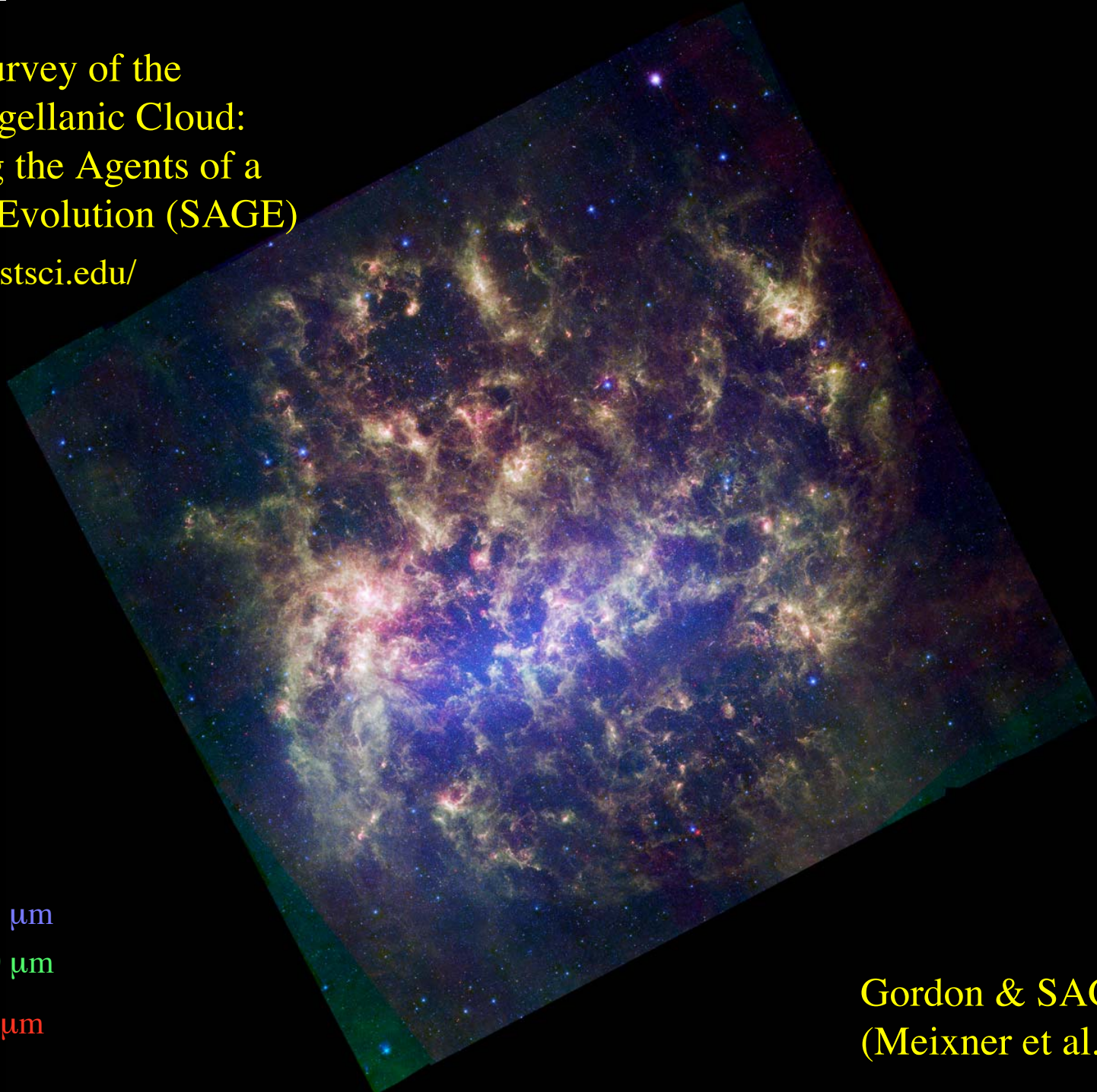
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credit: <http://hea-www.cfa.harvard.edu/CHAMP/EDUCATION/PUBLIC/ICONS/>

Spitzer Survey of the
Large Magellanic Cloud:
Surveying the Agents of a
Galaxy's Evolution (SAGE)

<http://sage.stsci.edu/>



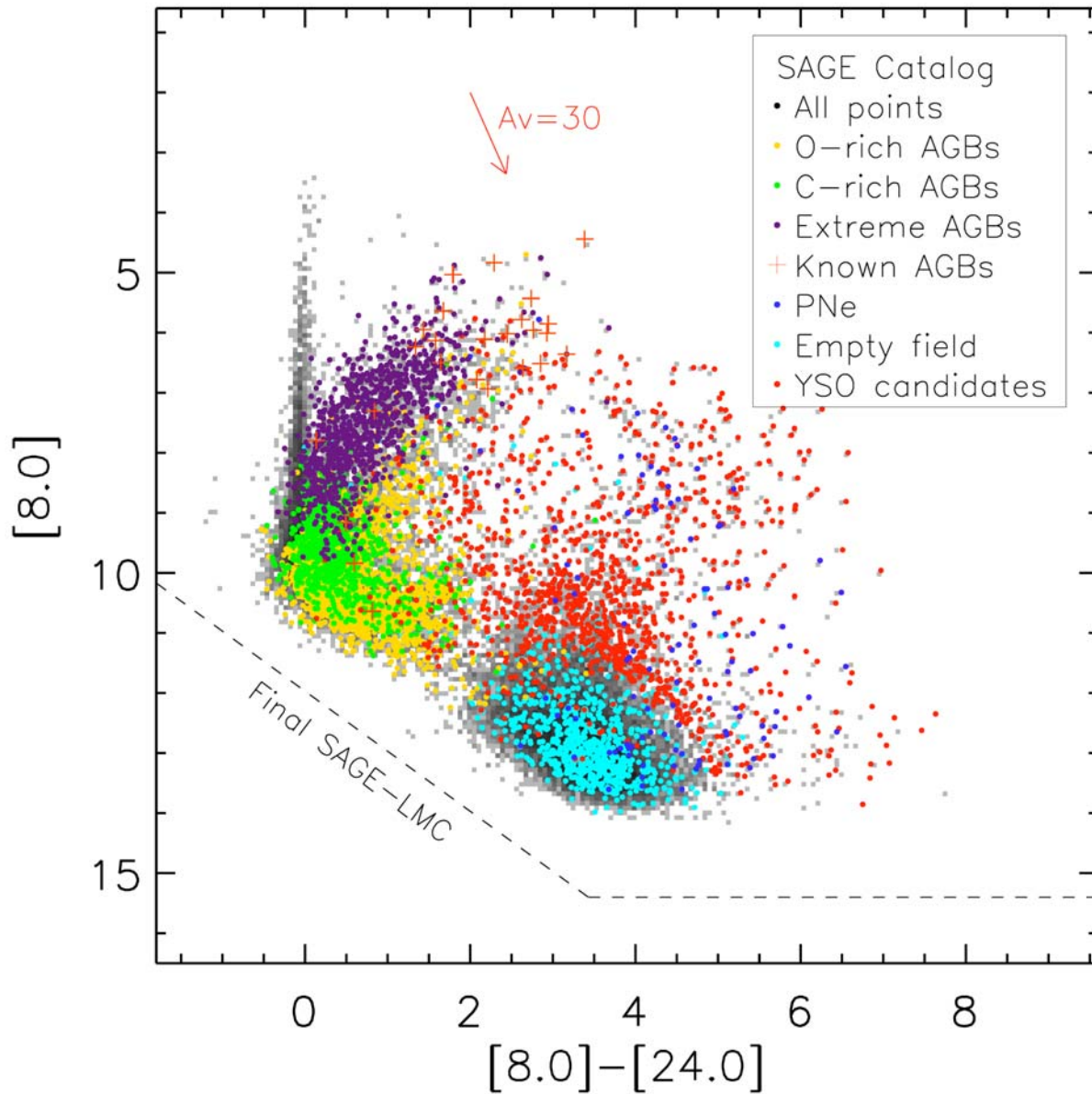
IRAC 3.6 μm

IRAC 8.0 μm

MIPS 24 μm

Gordon & SAGE team
(Meixner et al. 2006)

SAGE – LMC



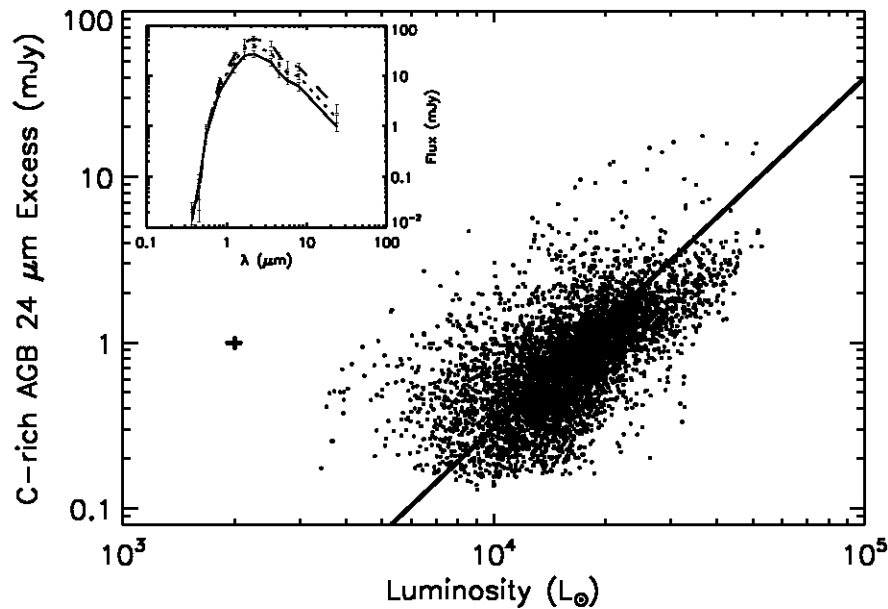
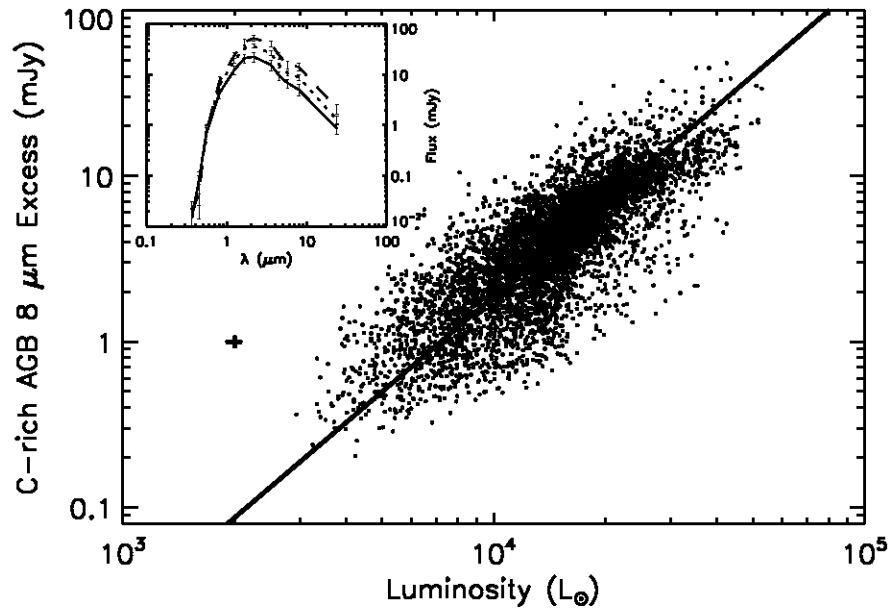
SAGE Point Source Populations:

- AGB stars: Blum et al. (2006)
- YSO candidates: Whitney et al.
- PNe: Hora et al. (in prep.)
- Empty field = background galaxies: Whitney, Sewilo et al.

Sewilo & SAGE Team (2006)

Empirical Shell Properties

- C-rich AGB stars

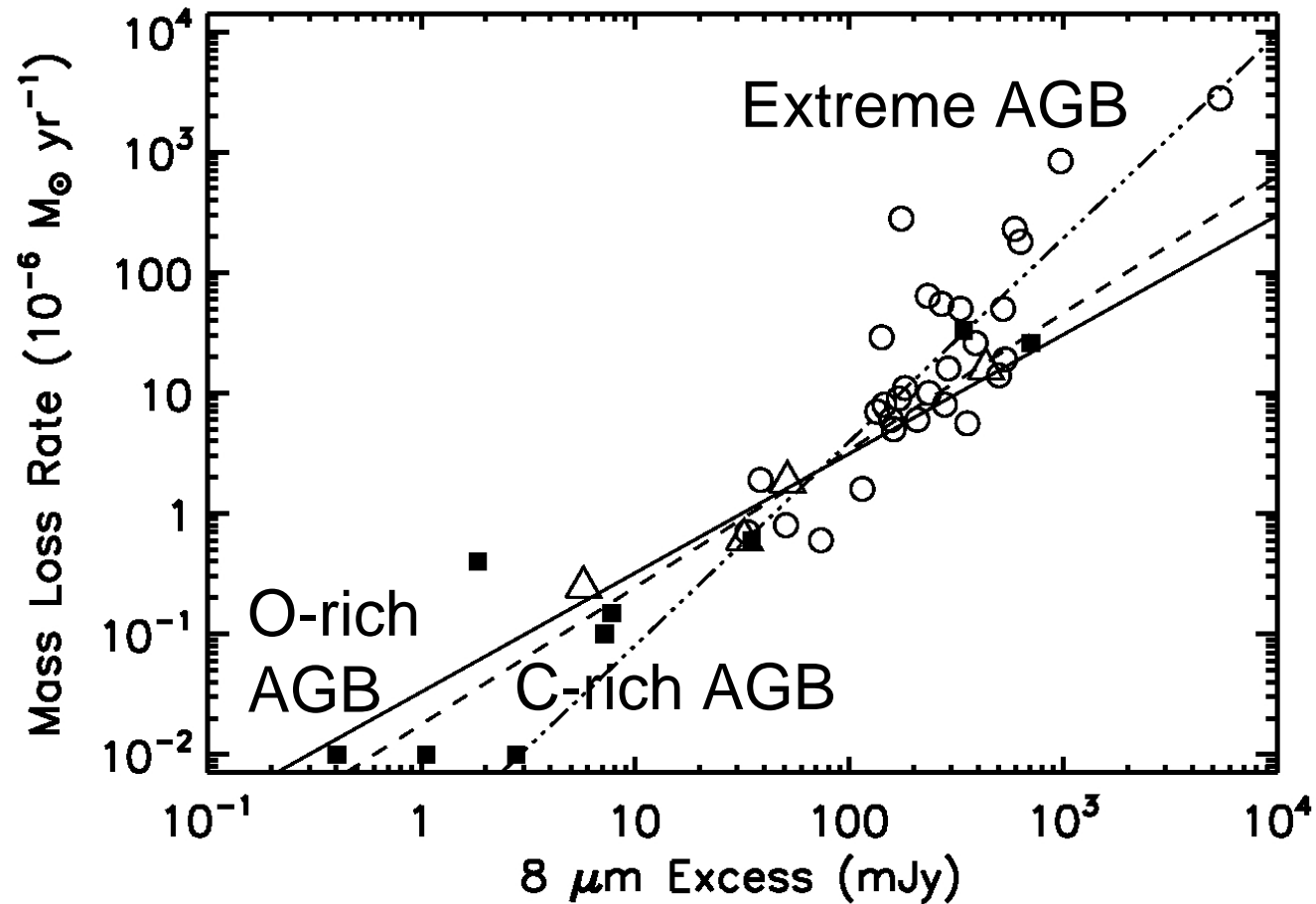


Srinivasan et al. in prep

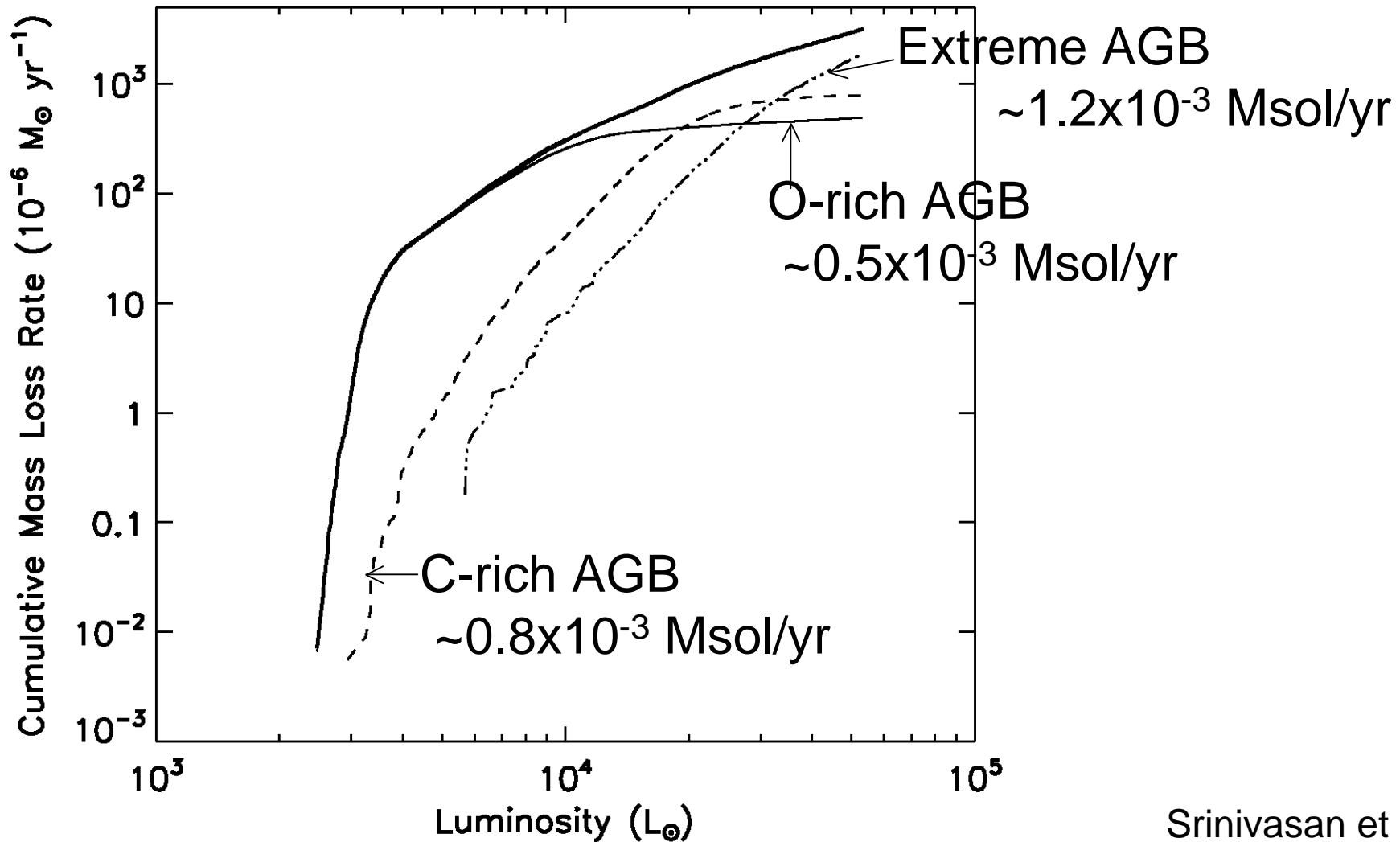
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Mass Loss Rate vs. 8 μm excess

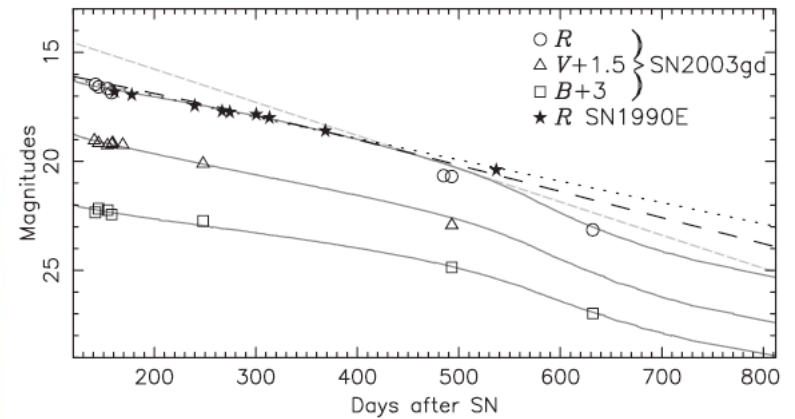
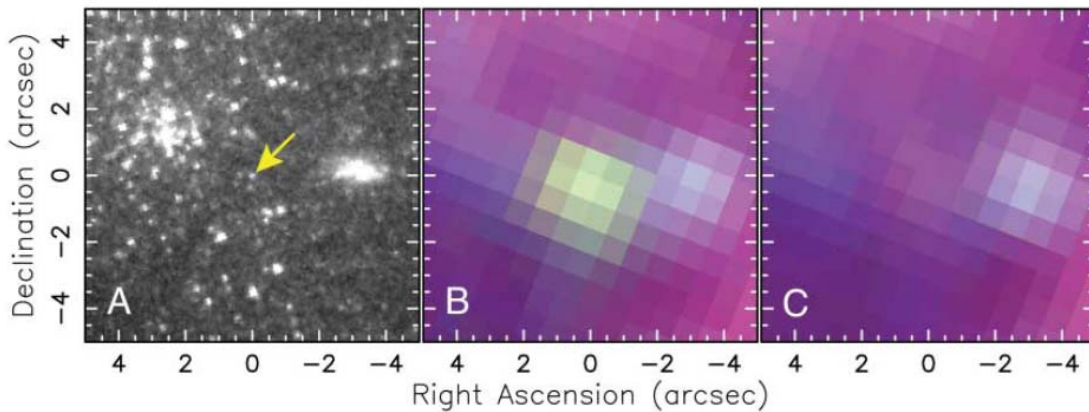
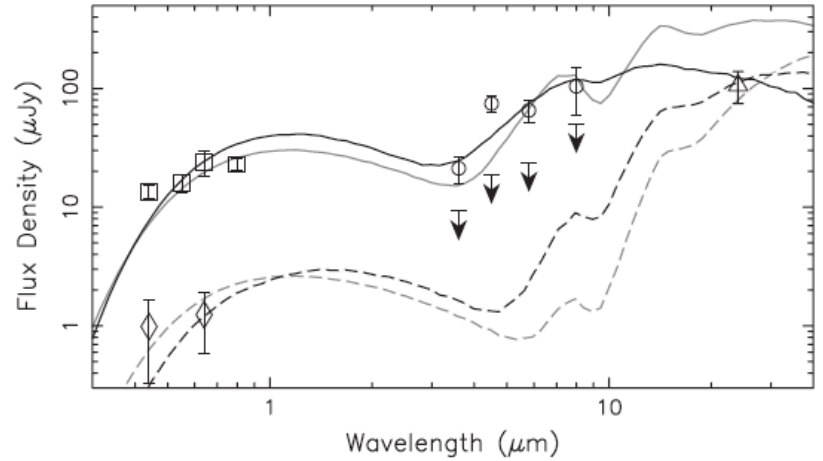
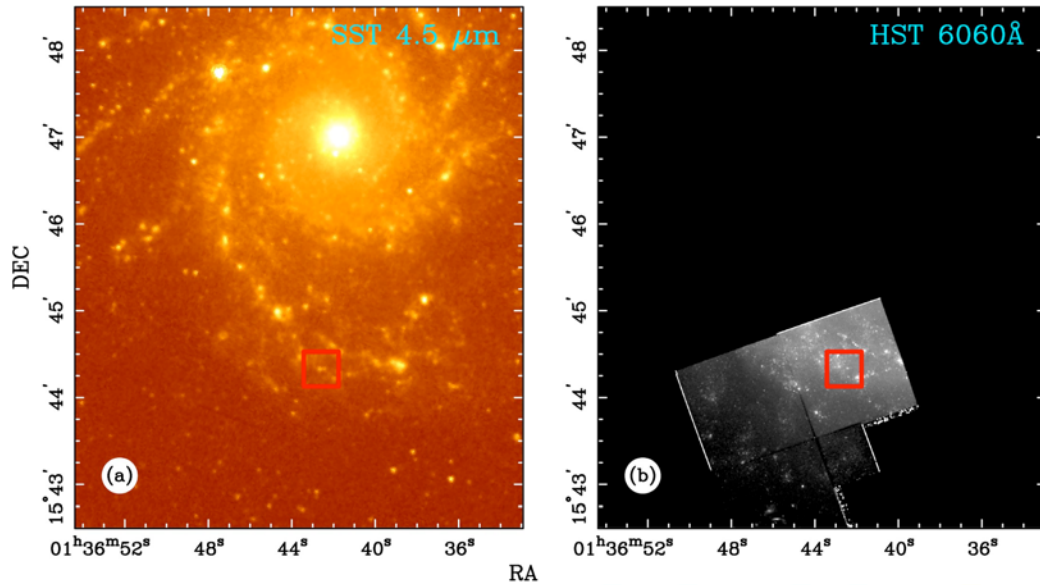


AGB star mass loss return: $2.5 \times 10^{-3} \text{ Msol/yr}$



Srinivasan et al.

SEEDS: SN 2003 gd detected in NGC 628, Sugerman & SEEDS team (Science 2006)



$2 \times 10^{-2} M_{\odot}$ dust produced starting
493 days after outburst

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Nearby Universe: Questions Emerging from current studies

- How much dust is generated and produced by the evolved star population and supernovae?
- How does this metal/dust rich material mix with the ISM?
- How far out does the dust emission from galaxies extend? Can we use this as a tracer of metal enrichment of the intergalactic medium?

Nearby Universe: Questions Emerging from current studies

- Morten & Rho: What is dust enrichment rate? Supernova Remnants, dust content, $0.002 M_{\text{sun}}$
- Armus: What are the physical conditions in ISM of nearby galaxies? Diagnostic Emission lines: [CII], [OI], [OIII]
- Carey: How do massive stars form? Competitive accretion? Fragmentation?
- Faustini: What are the ages and evolution of forming stars? star formation in context of infrared stellar populations

Nearby Universe: Questions Emerging from current studies

- Bergin: ISM
 - How do molecular clouds form?
 - How do planets get water?
 - What is the full extent of interstellar chemistry?
 - What is the Deuterium abundance?
- Yorke: Star Formation
 - How do massive stars form, and how does galaxy/ISM environment change the process?

Nearby Universe: Questions Emerging from current studies

- Calzetti: Nearby galaxies
 - How do stars, gas, dust cycle in galaxies?
 - How does the star formation rate change from the global galaxy view we have down to the size of a YSO (10 pc) and how does it vary in different galaxy environments?
 - FIR - radio correlation, what causes it?
 - How does cycling occur at the interface between galaxies and the intergalactic medium?
- Martin: BLAST Submm: What is the nature of all these cold submm sources?

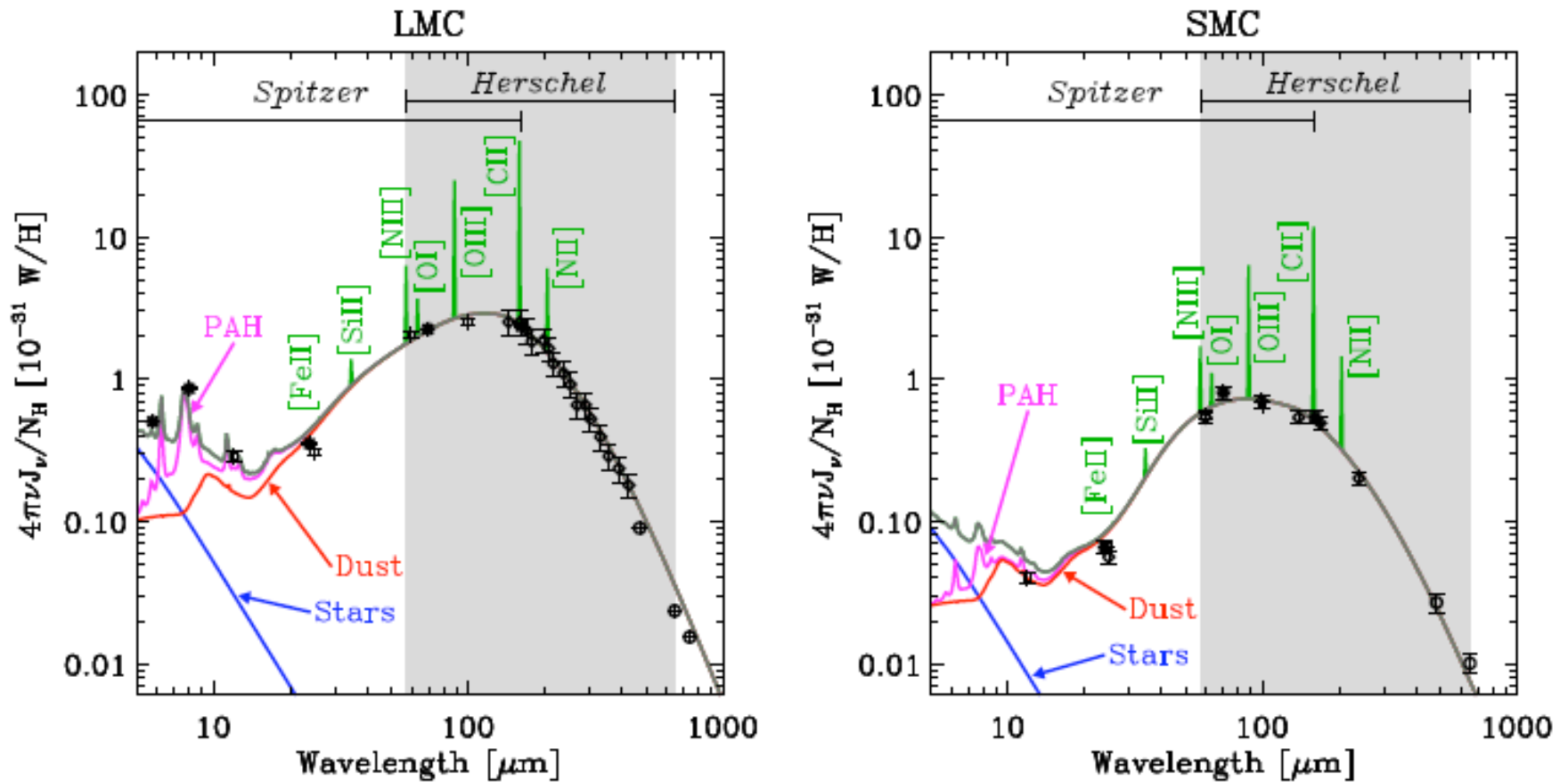
Nearby Universe: Questions Emerging from current studies

- Molinari: Hi-Gal
 - What is the time scale for high mass star formation?
 - What is the inventory of dust/ISM in the galaxy?
- Onaka: Akari
 - What are the sources found with Akari?
 - Why wide fields are important
- Dowell: Magnetic fields
 - How important are magnetic fields in molecular cloud and star formation?

Nearby Universe: Missions

- Current: Spitzer & Akari
- Missions Happening in next Decade:
 - Herschel, SOFIA, JWST, ALMA
 - important to capitalize on these to maintain and improve upon the scientific case for future missions

HERschel Inventory of The Agents of Galaxy Evolution: HERITAGE

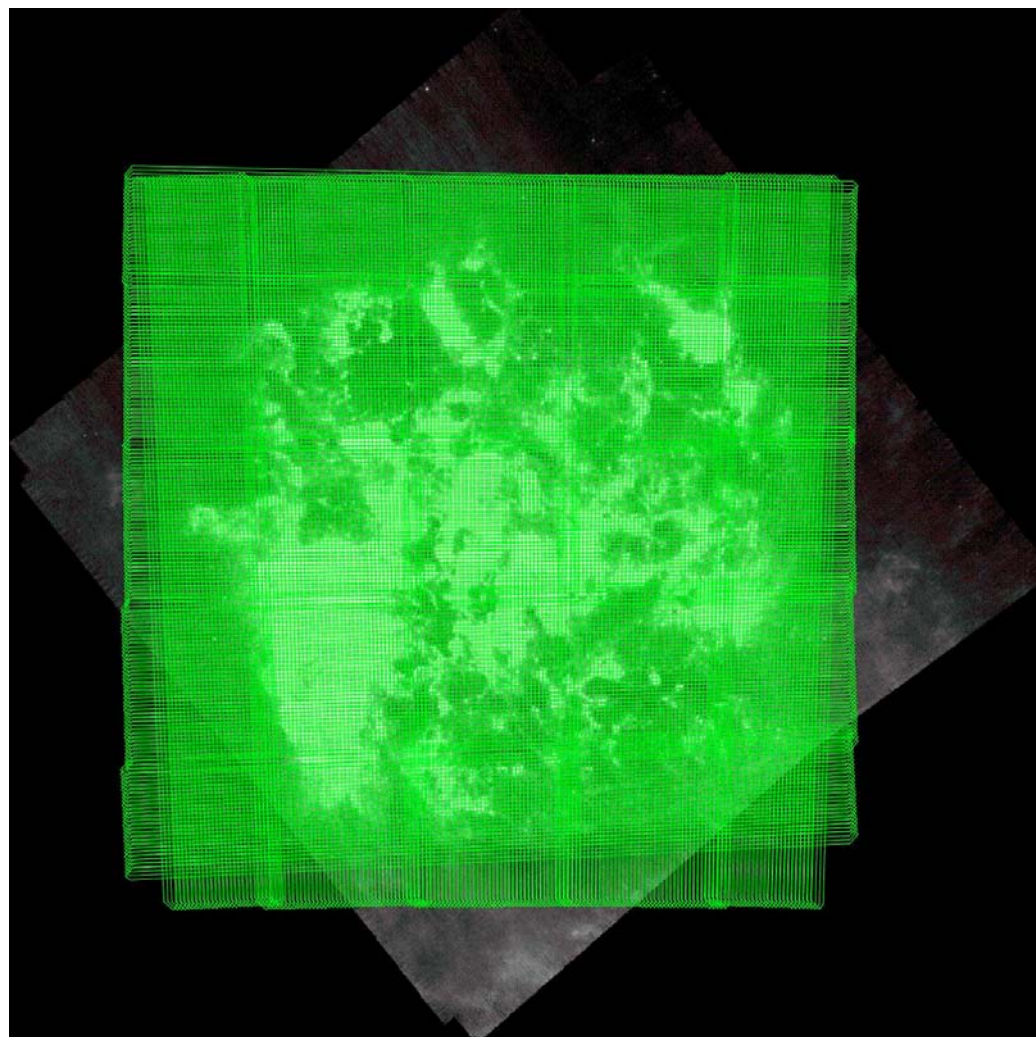


Meixner & HERITAGE team

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SPIRE coverage on SAGE-LMC 160 micron image

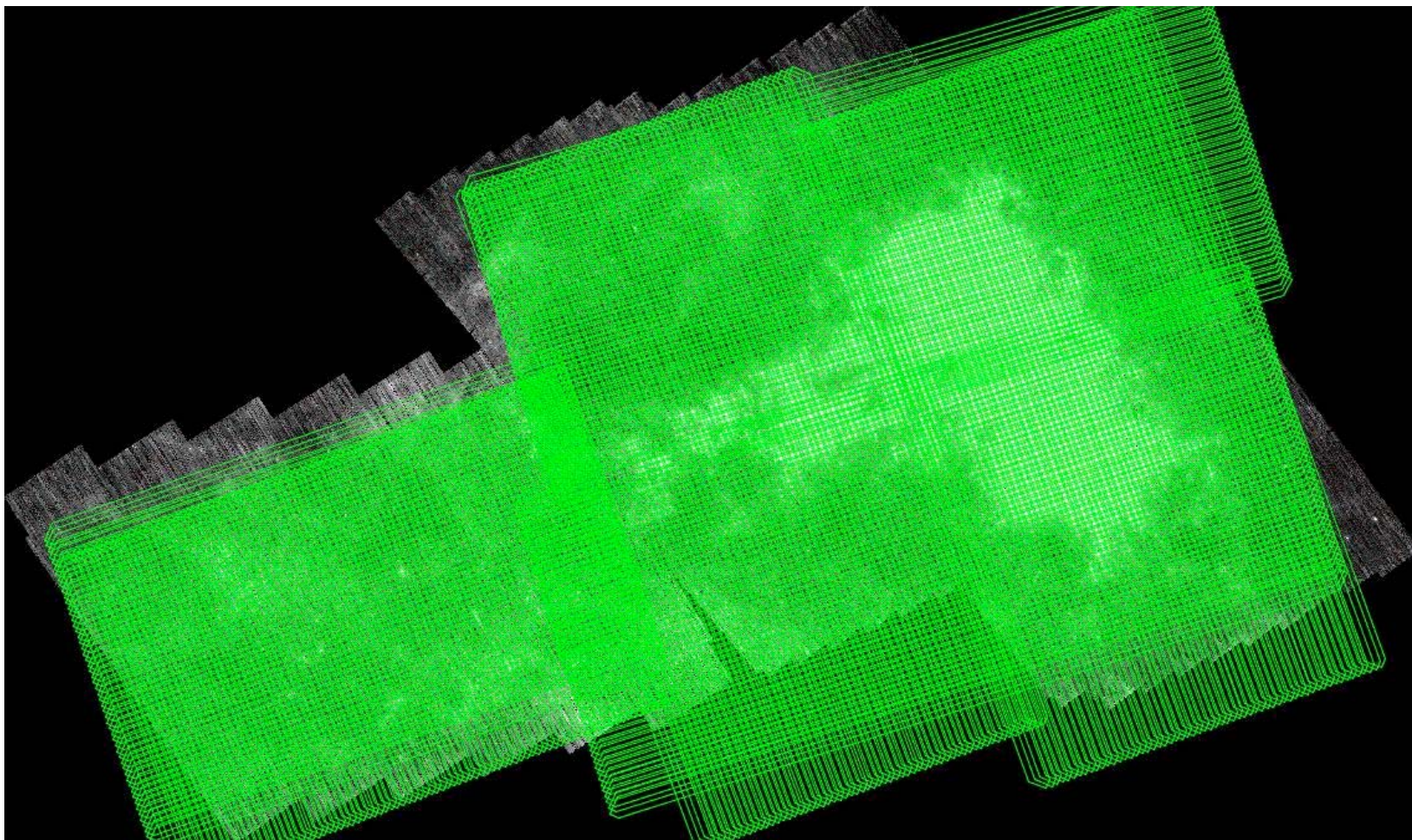


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SPIRE coverage on SAGE-SMC 160 micron image

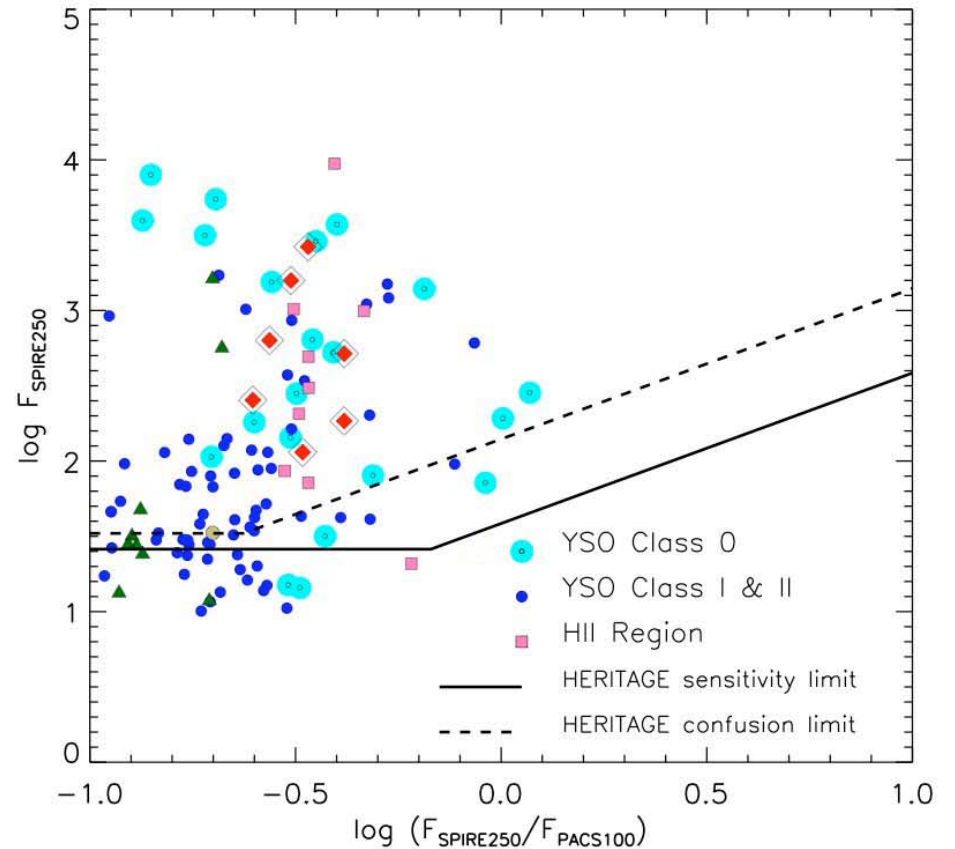
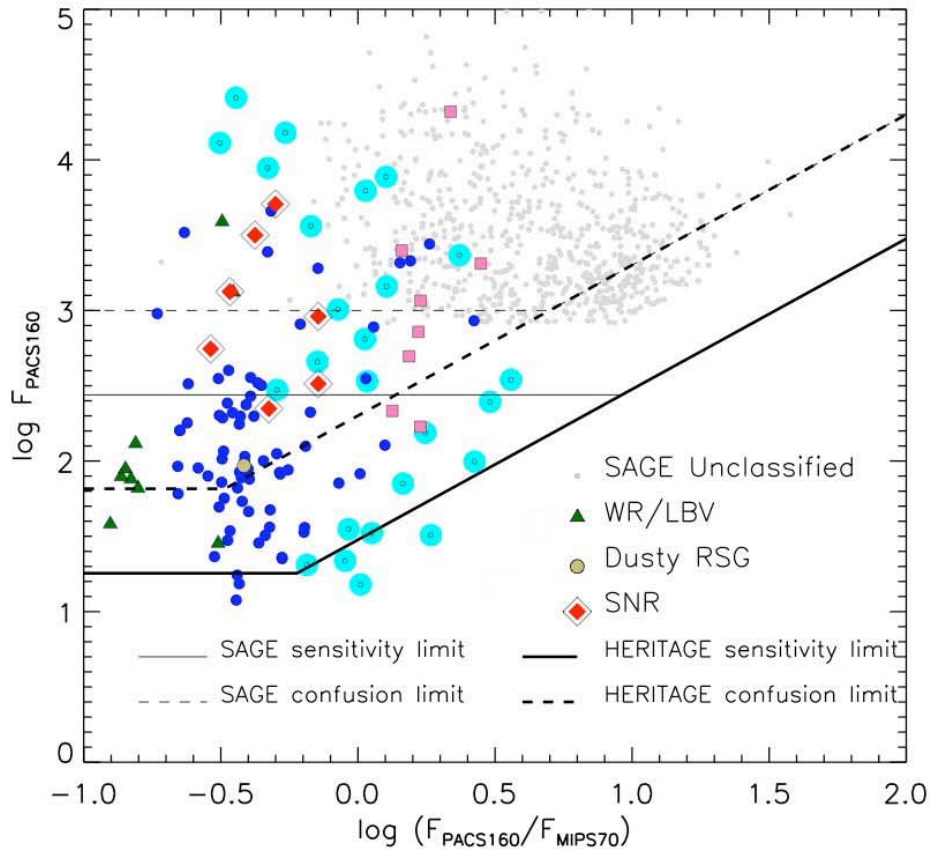


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HERITAGE will detect the circumstellar dust from the most massive stars at all stages of their evolution.

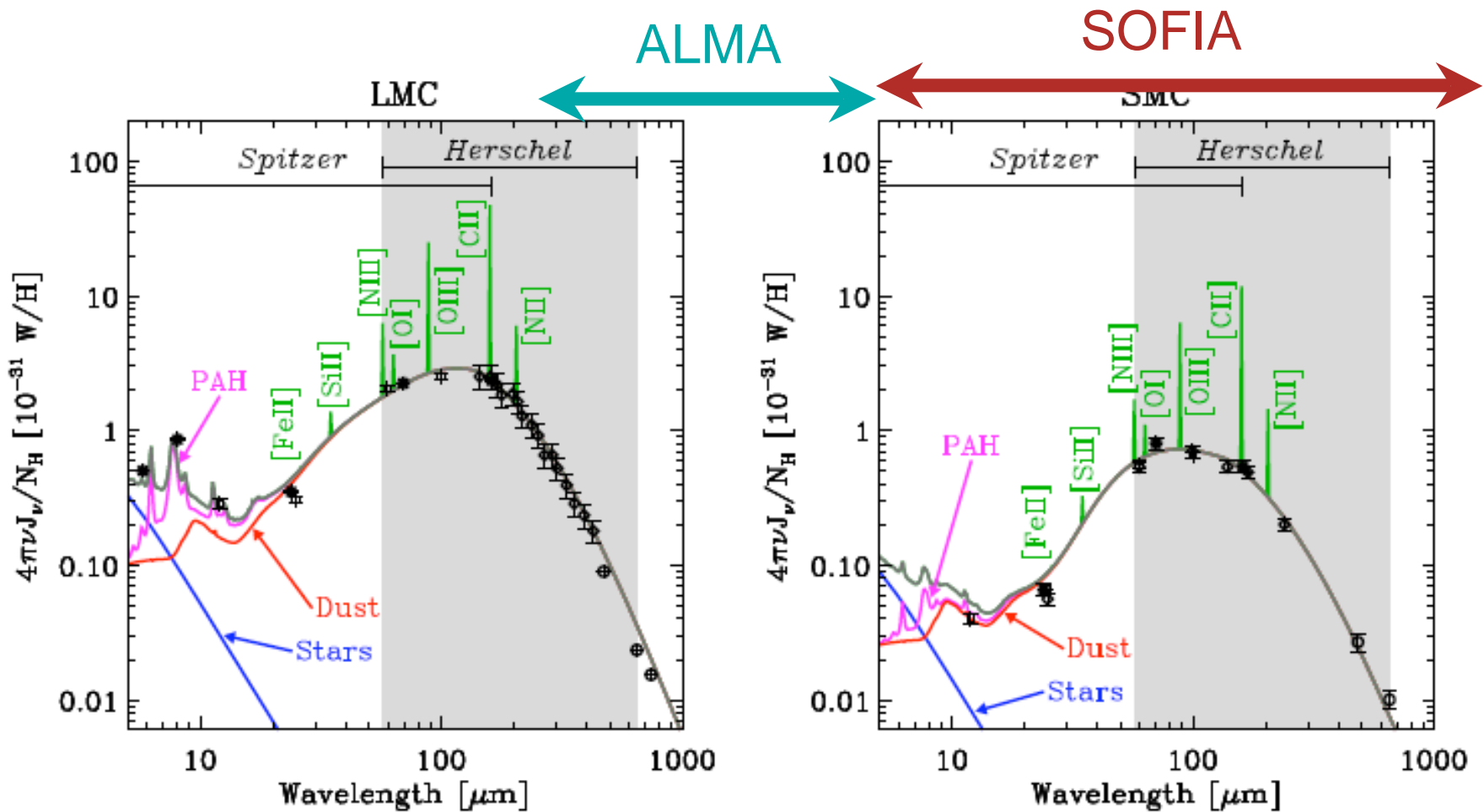


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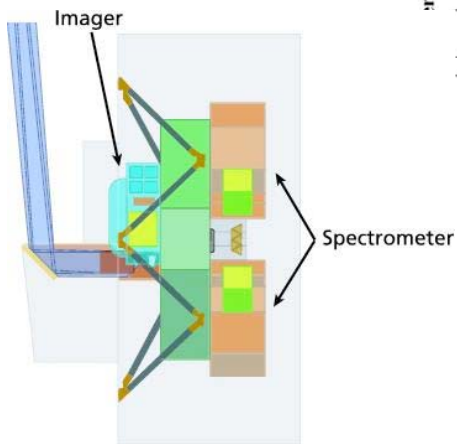
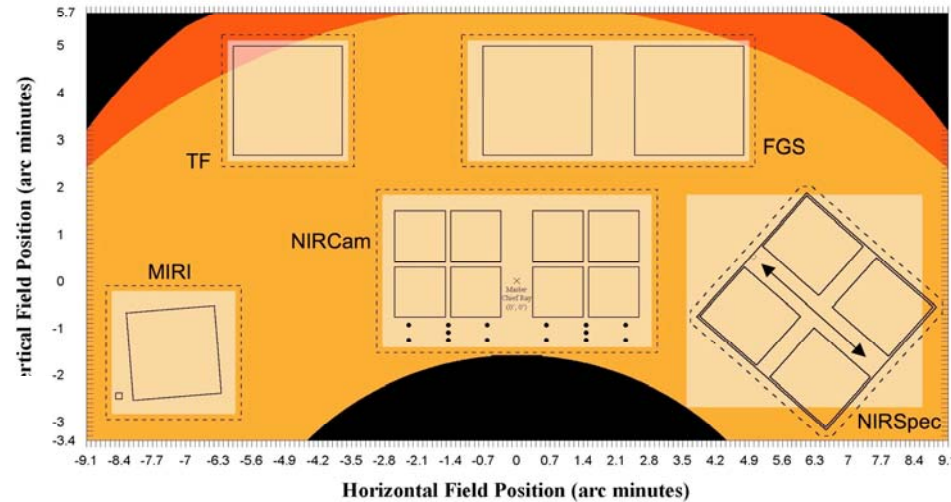
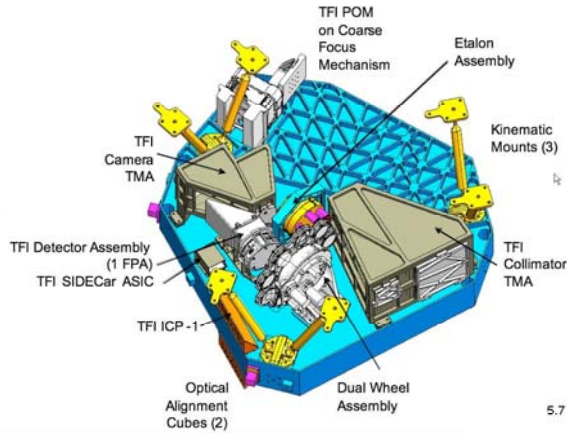
Followup on SAGE and HERITAGE with SOFIA and ALMA: Spectroscopy, spectroscopy, spectroscopy



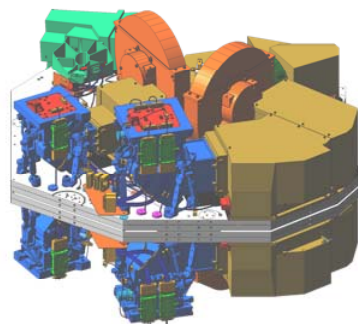
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James Webb Space Telescope: Webb >2013



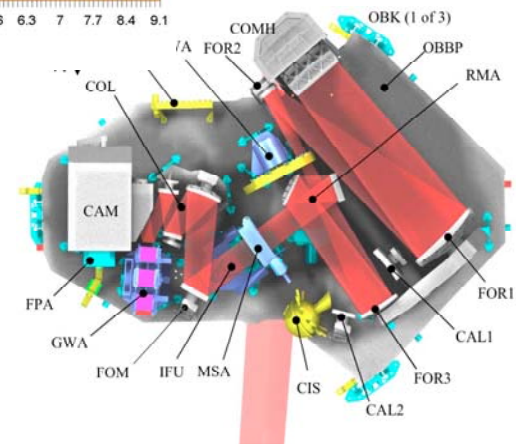
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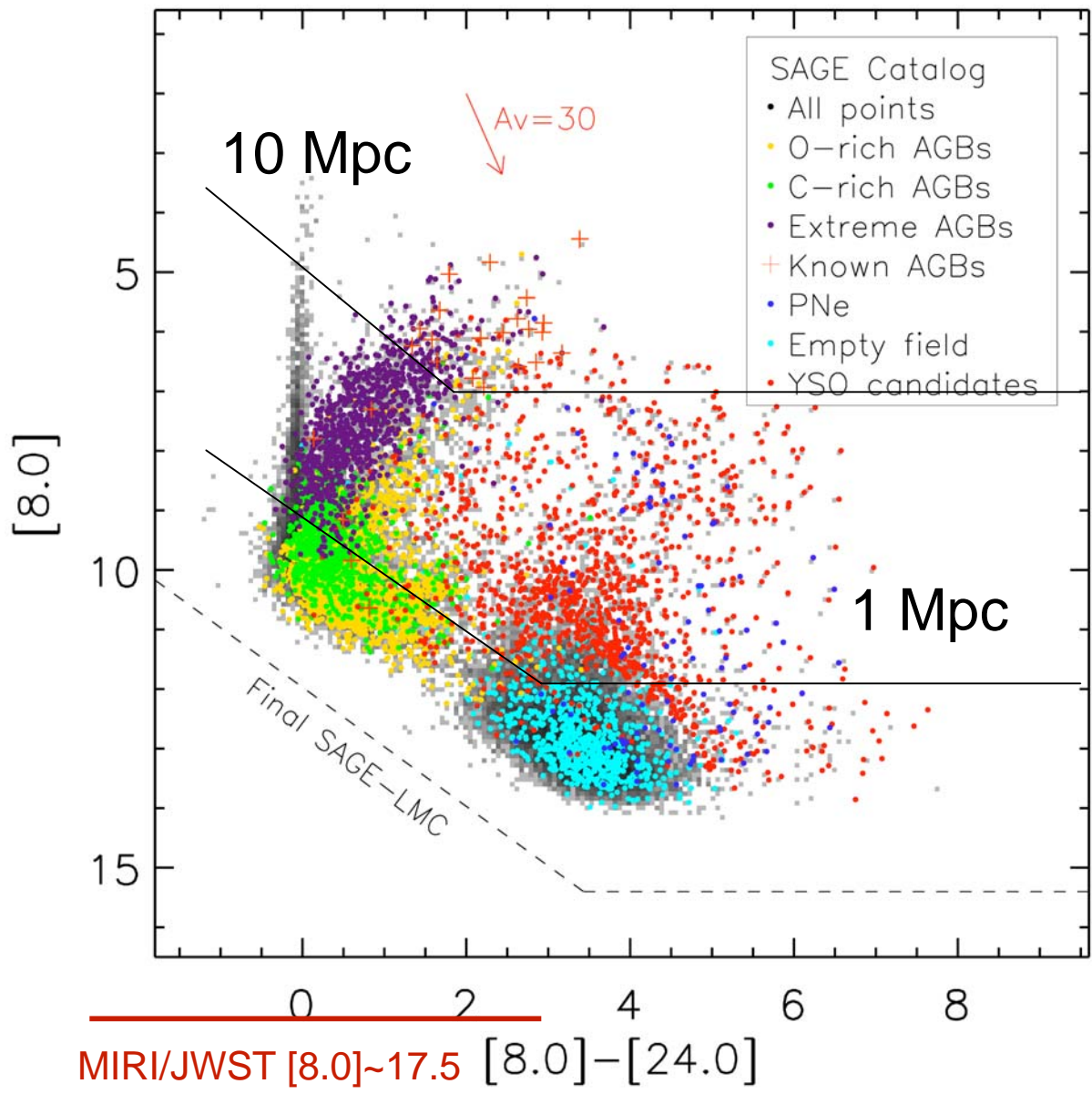
M. Mei

Two back-to-back modules

Space



SAGE – LMC



Local Volume of
Galaxies &
SAGE Point
Source Populations:

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Nearby Universe: Missions, Farther Future

- How many of us plan to be using a FIR Space mission in 2020 to 2030?
- What are the interesting science questions that require 1 or 2 orders of magnitude improvement in
 - Angular resolution
 - Sensitivity: point source and extended source
 - Spectral resolution
 - Timing resolution
 - Photometric accuracy/stability
- What type of mission is needed:
 - High enough angular resolution to distinguish evolved stars and surrounding ISM
 - Timing resolution to probe dynamic phenomena: supernovae
 - High enough spectral resolution
 - to detect the main cooling lines
 - to measure kinematics of stellar outflows

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