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

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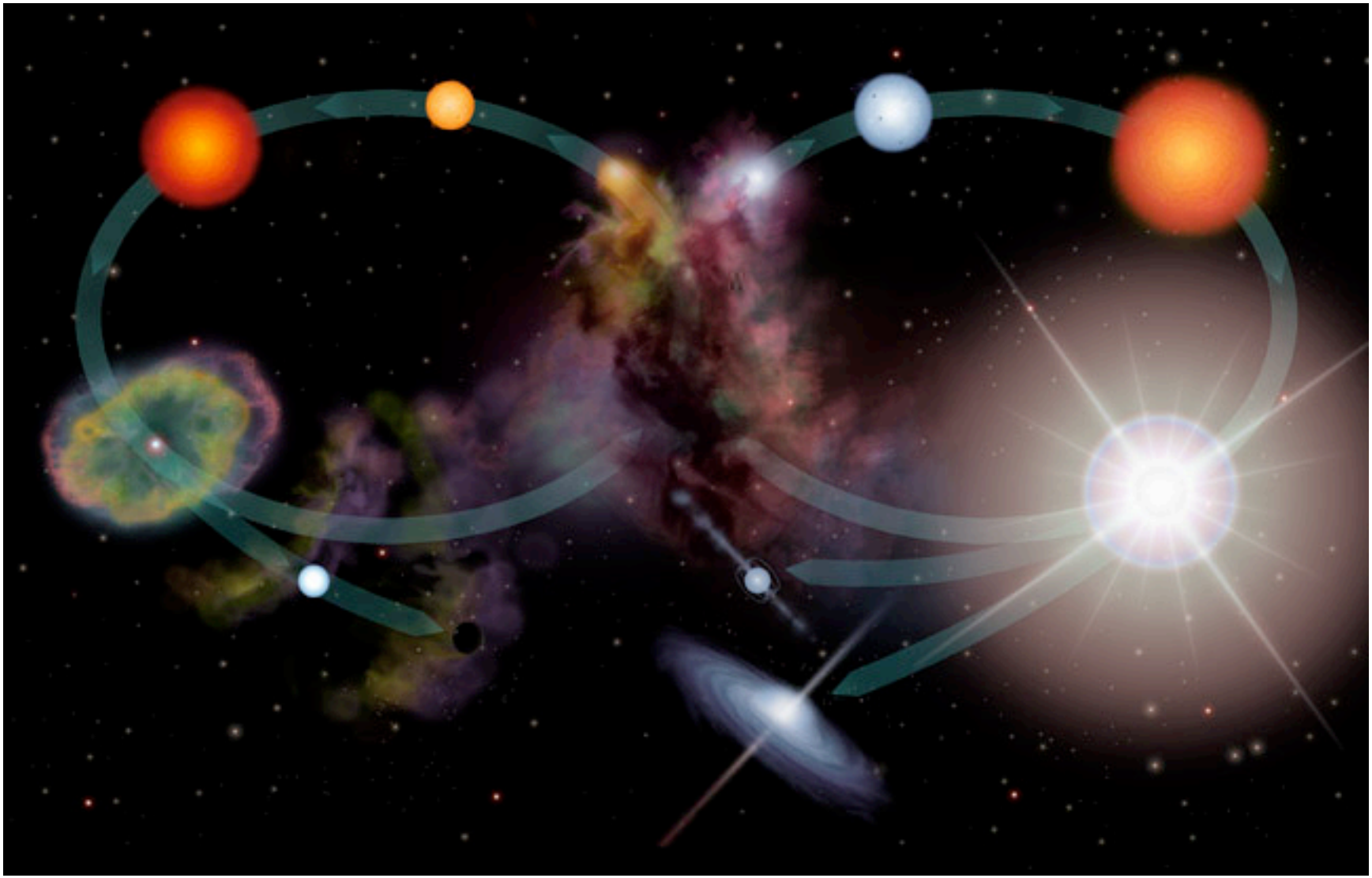
Collaborators: SAGE Team

http://sage.stsci.edu/

SAGE: Tracing the Lifecycle of Baryonic Matter:

Intermediate mass stars High mass stars



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

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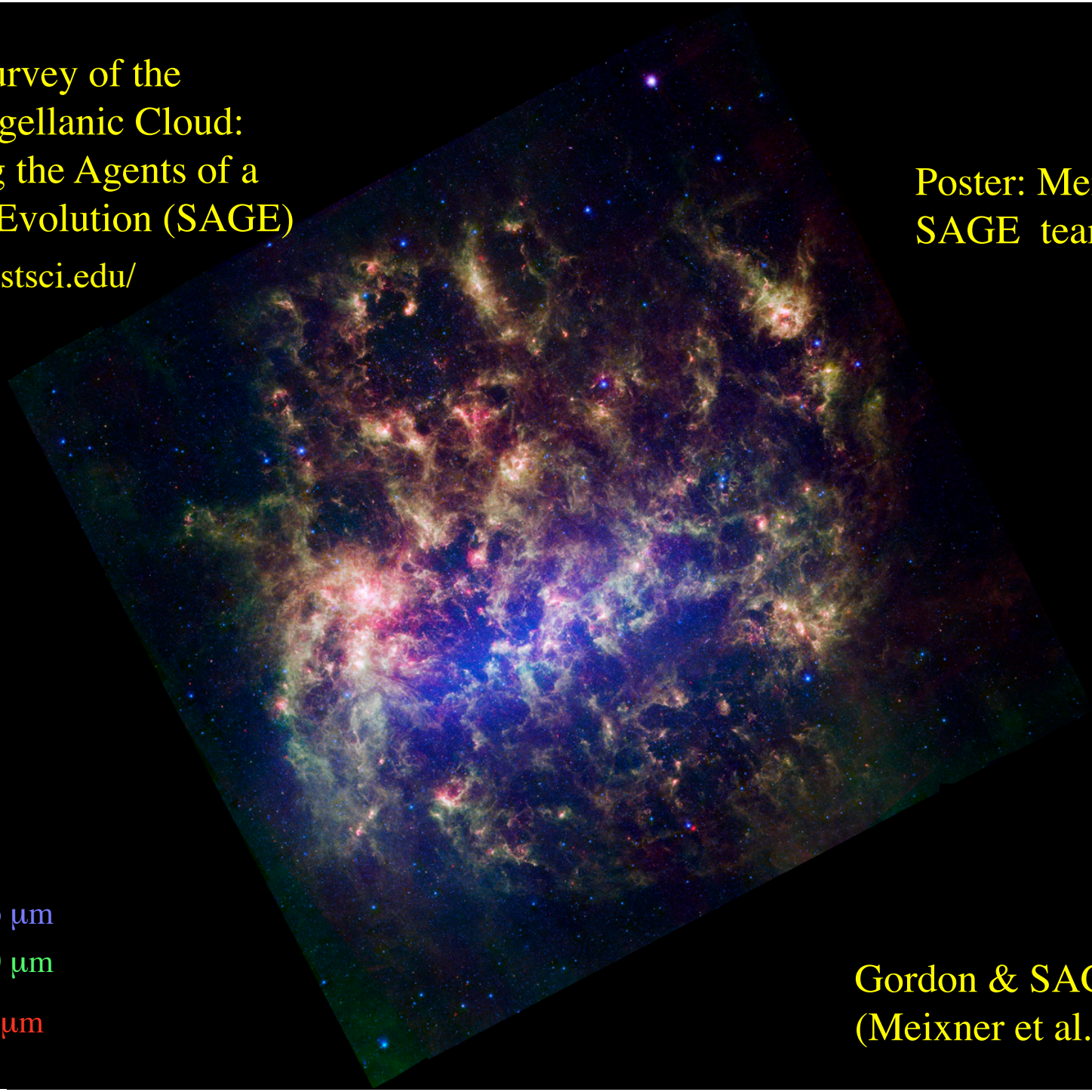


Poster: Meixner & SAGE team

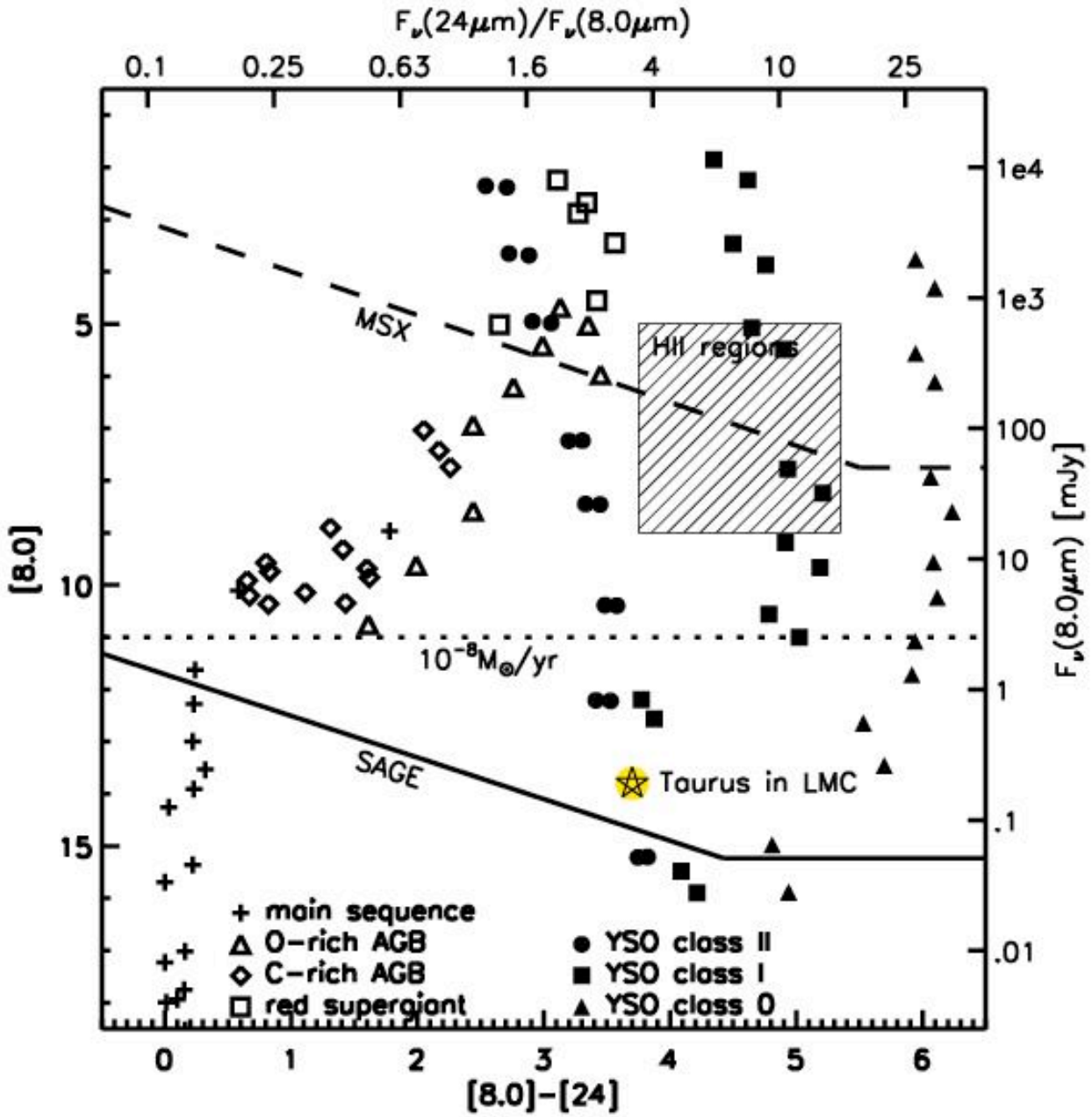
IRAC 3.6 μm

IRAC 8.0 μm

MIPS 24 μm

Gordon & SAGE team (Meixner et al. 2006)

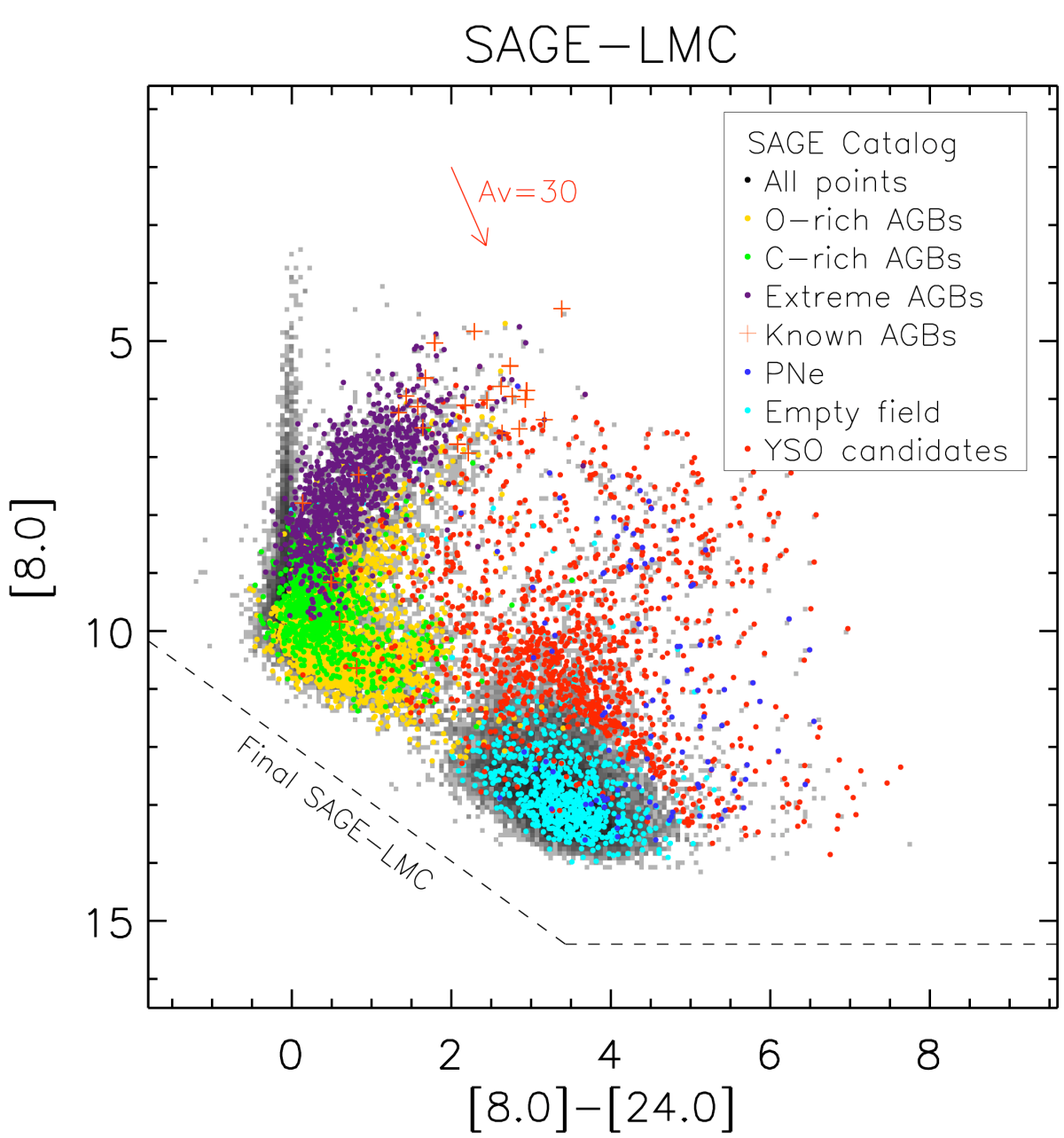
SAGE-LMC sensitivity limits and discovery space



SAGE Deep Catalog,
Source Counts:
~6.3 million point sources
>650,000 red giant stars
>45,000 dusty evolved stars
>1200 Young Stellar Objects

Diffuse ISM limit
$> 1.2 \times 10^{21}$ H/cm^2
($A_V = 0.2$ mag)

Indebetouw &
SAGE Team
Meixner et al. (2006)

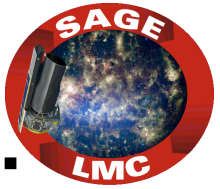


SAGE Point Source Populations:

AGB stars: Blum et al. (2006)
YSO candidates: Whitney et al. (2008)
PNe: Hora et al. (2008)
Empty field = background galaxies: Whitney, Sewilo et al.

Sewilo & SAGE Team (2006)

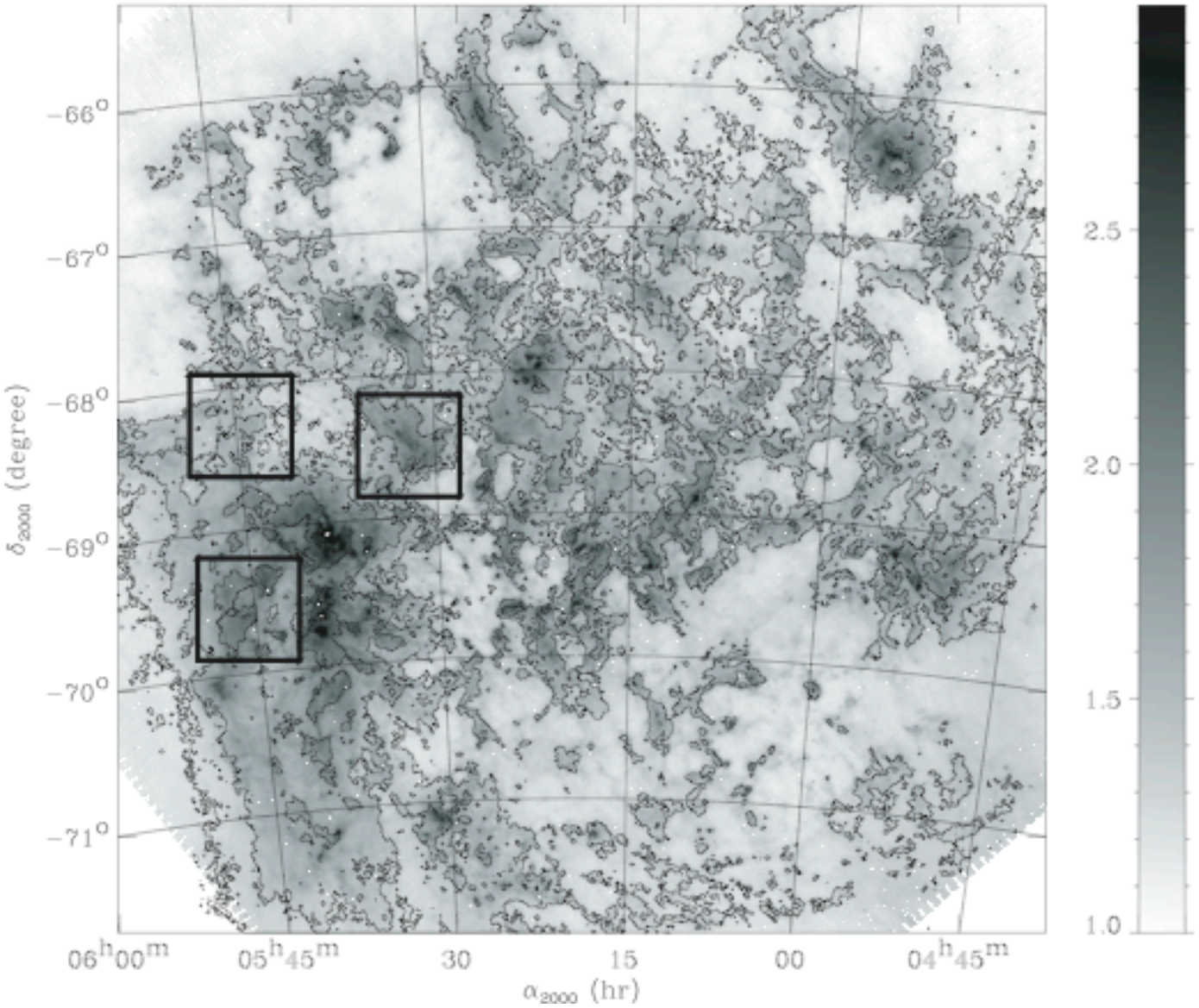
SAGE-LMC the Mass budget:



- How much mass is currently in the ISM?
- What is the galaxy-wide star formation rate of the LMC?
- What is the mass budget of material injected into the ISM by evolved stellar winds?

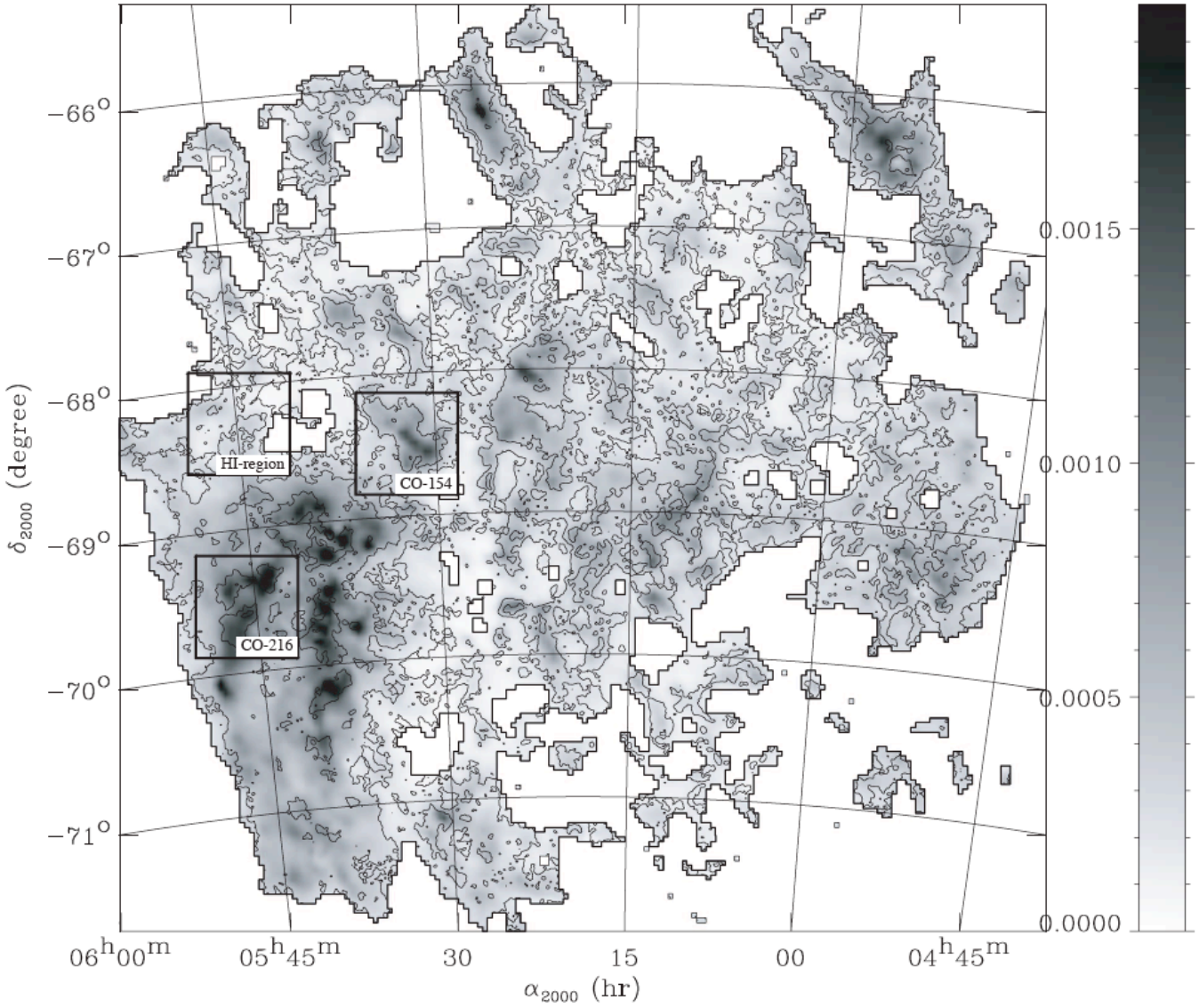
Meixner & SAGE Team
http://sage.stsci.edu/

160 um and the HI contours



Bernard, Reach, Paradis et al. 2008, AJ, 136, 919

Dust Optical Depth at 160 um, HI gas

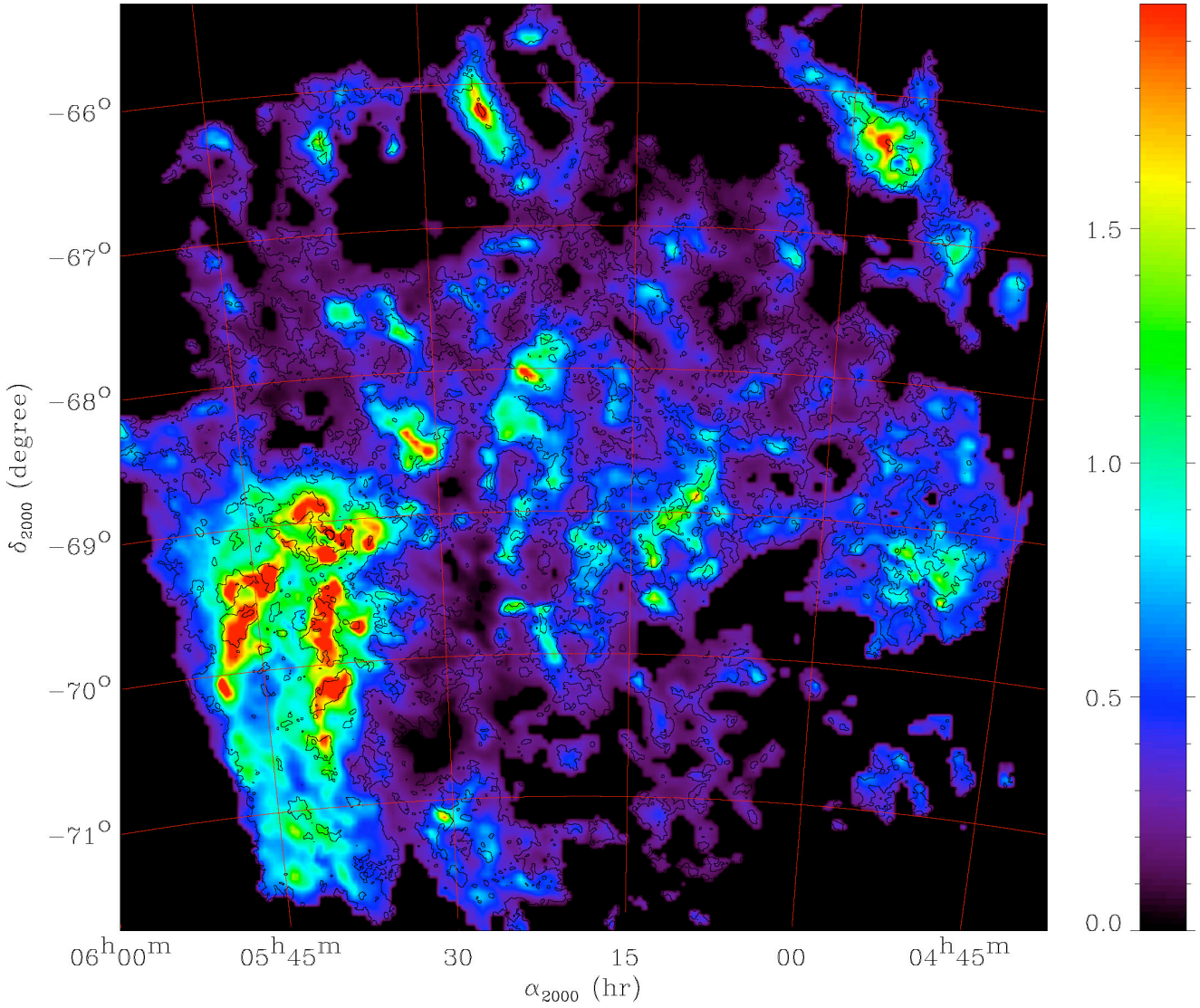


SAGE/MIPS 160 um Dust Temp. Map

$$\tau_{160} = \frac{I_\nu^{160}}{B_\nu^{160}(T_d)}$$

Bernard, Reach, Paradis et al. 2008, AJ, 136, 919

LMC FIR excess map & ISM mass



Color:N_H^x

Units: 10^{22} H/cm^2

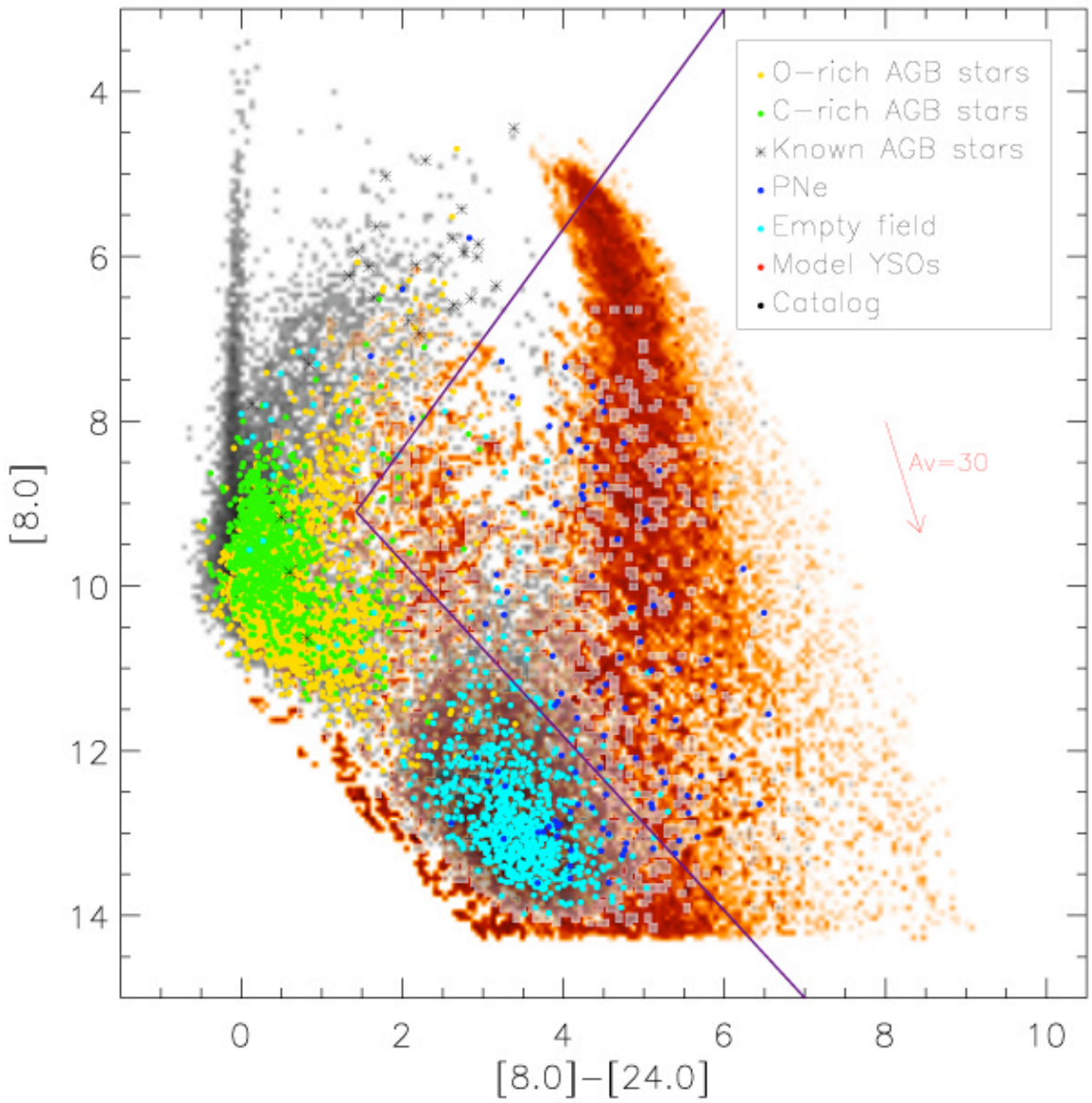
Contours H_I

Total mass of excess component = HI mass = 5.6x10^8 Msun

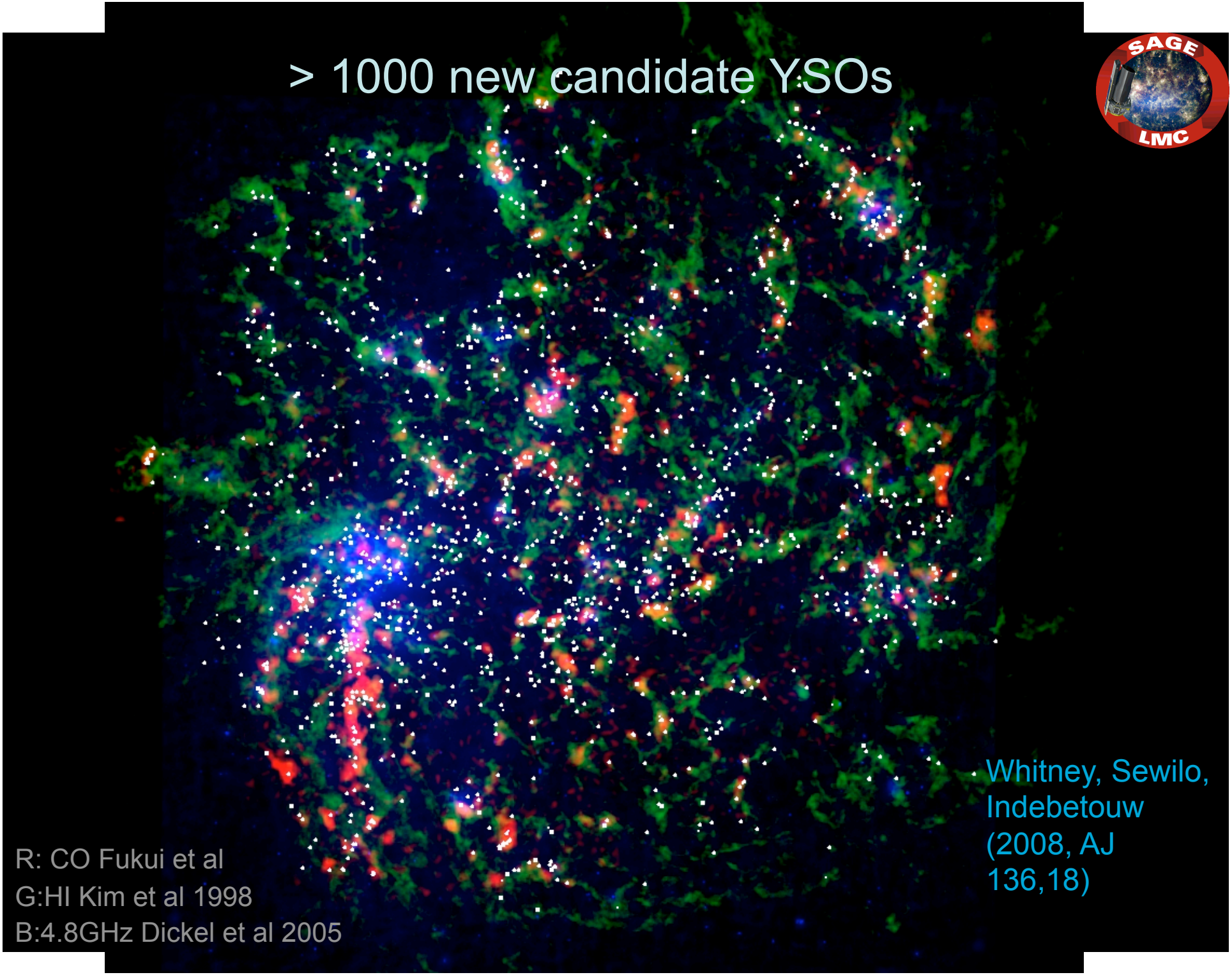
Total mass of ISM (MIPS 160 um): ~10^9 Msun

Bernard, Reach, Paradis et al. 2008, AJ, 136, 919

☆ point sources ~ candidate YSOs/protoclusters

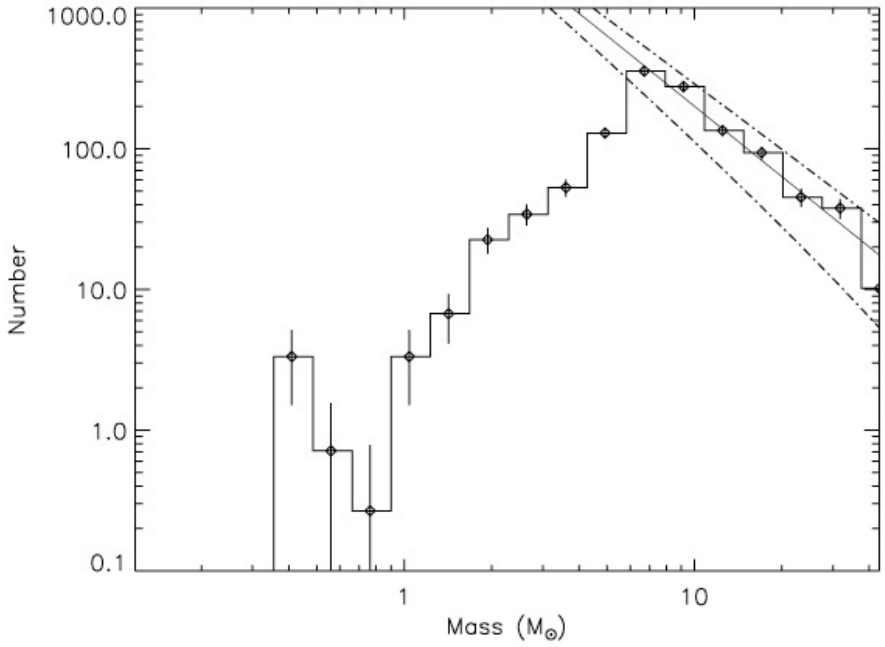


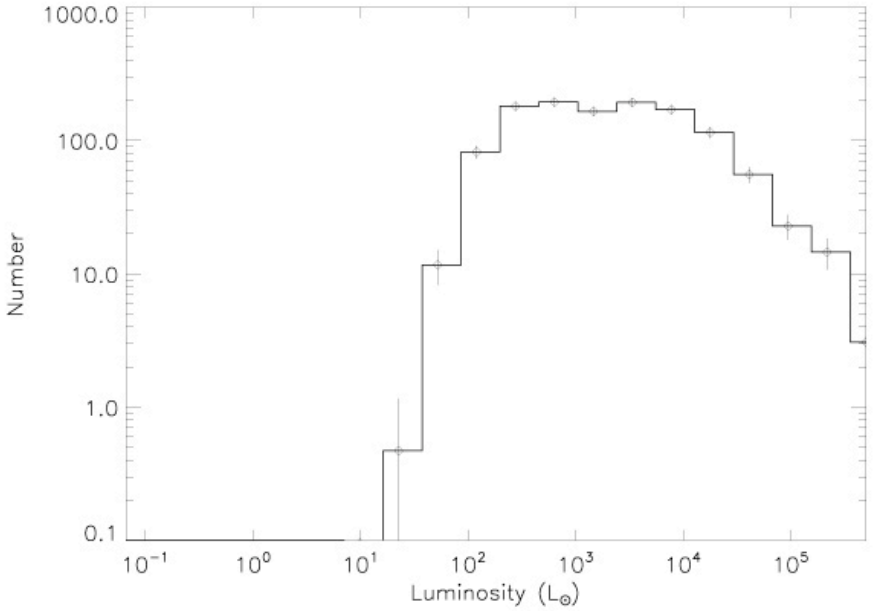
Whitney, Sewilo, Indebetouw, et al. 2008, AJ, 136, 18


> 1000 new candidate YSOs
SAGE
LMC
Whitney, Sewilo, Indebetouw (2008, AJ 136,18)
R: CO Fukui et al
G:HI Kim et al 1998
B:4.8GHz Dickel et al 2005

YSO population properties

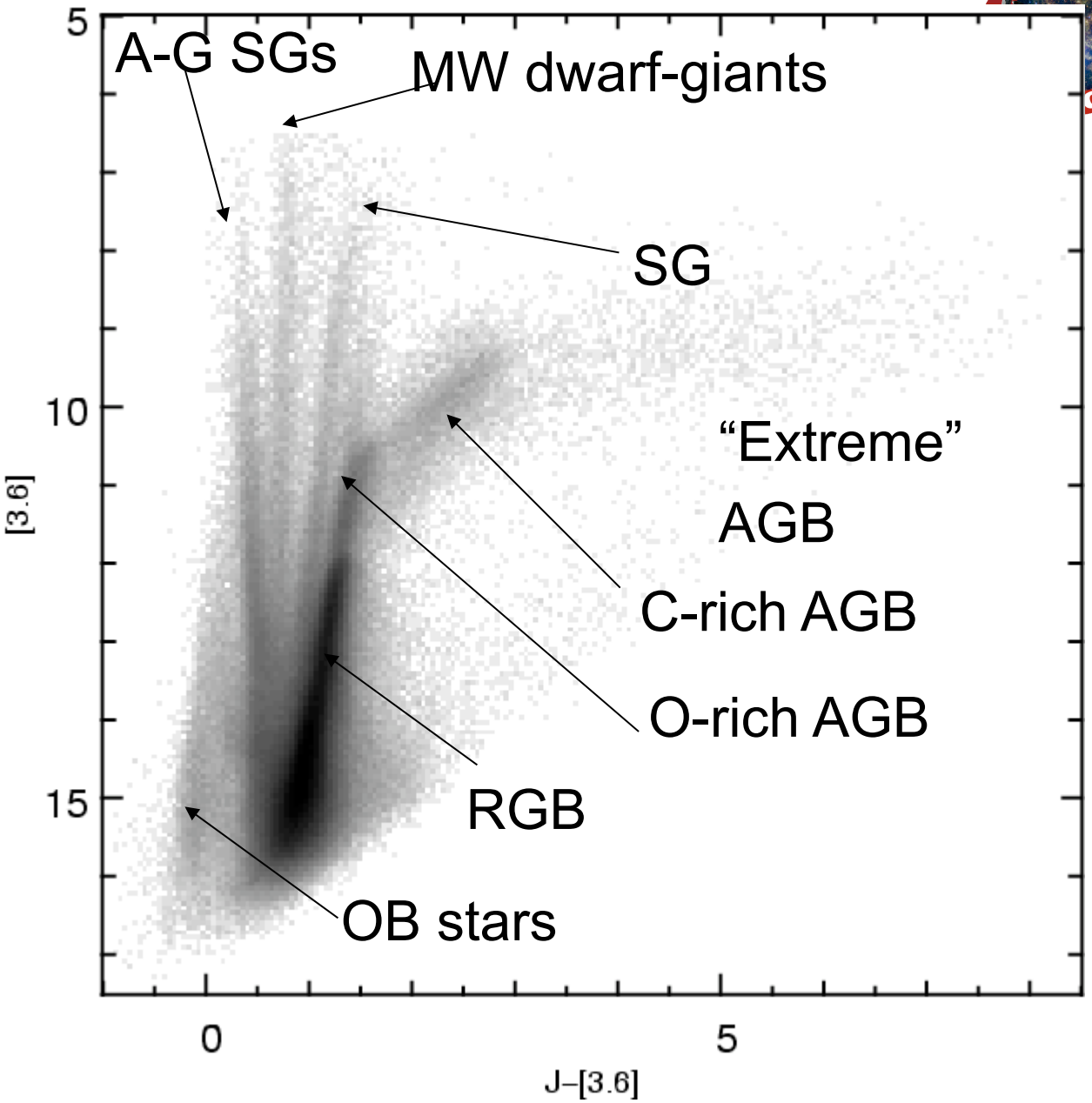
Star Formation Rate: >0.1 M_{sol} /yr





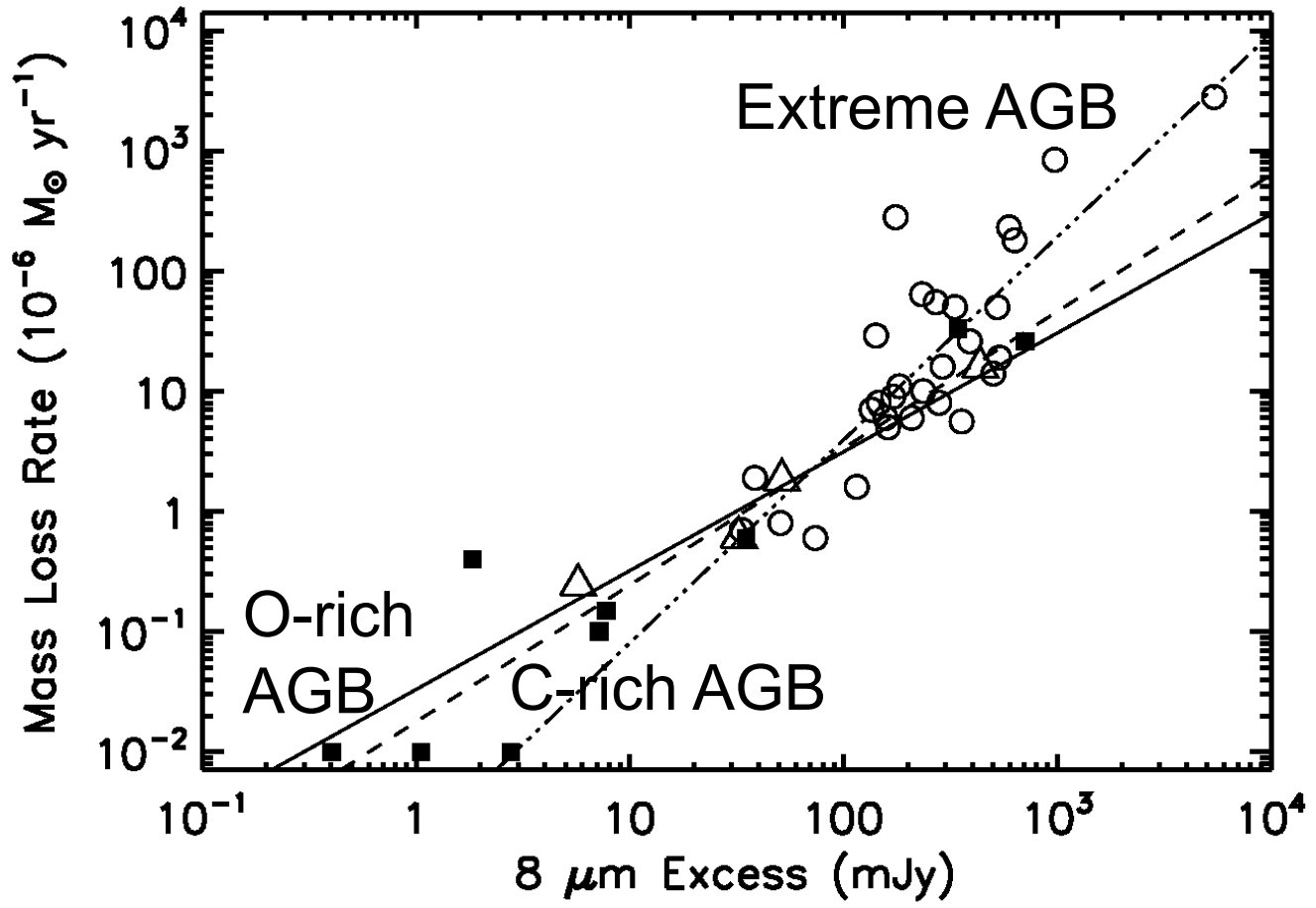
Whitney, Sewilo, Indebetouw, et al. 2008, AJ, 136, 18

- Identification of Infrared Stellar Populations
- Asymptotic Giant Branch (AGB) stars: O-rich become C-stars during dredge up
- Lower Z, easier to get C/O > 1
- Extreme AGB stars identified in 3.6, 8.0 IRAC bands



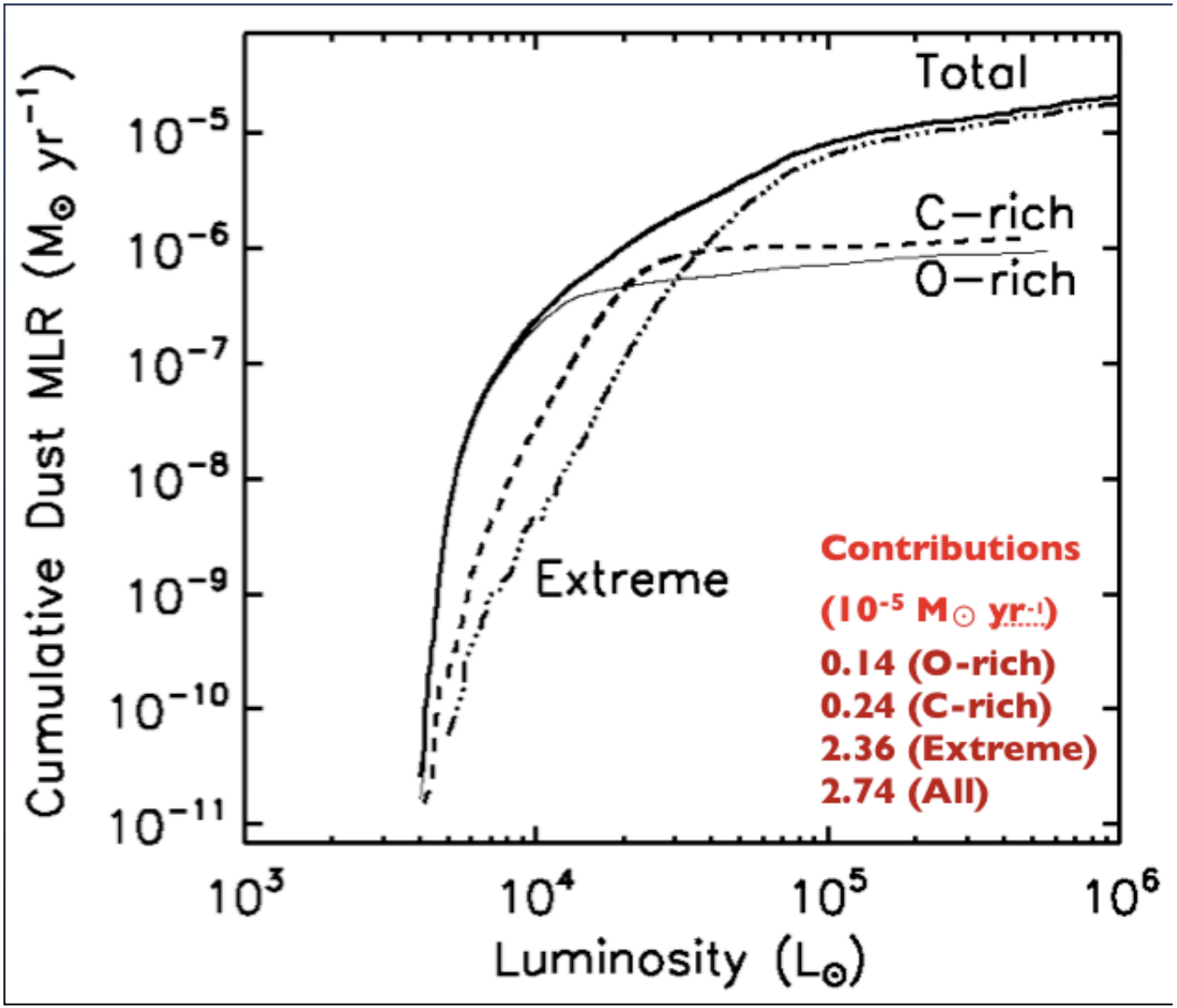
Blum et al. (2006)

Mass Loss Rate vs. 8 um excess



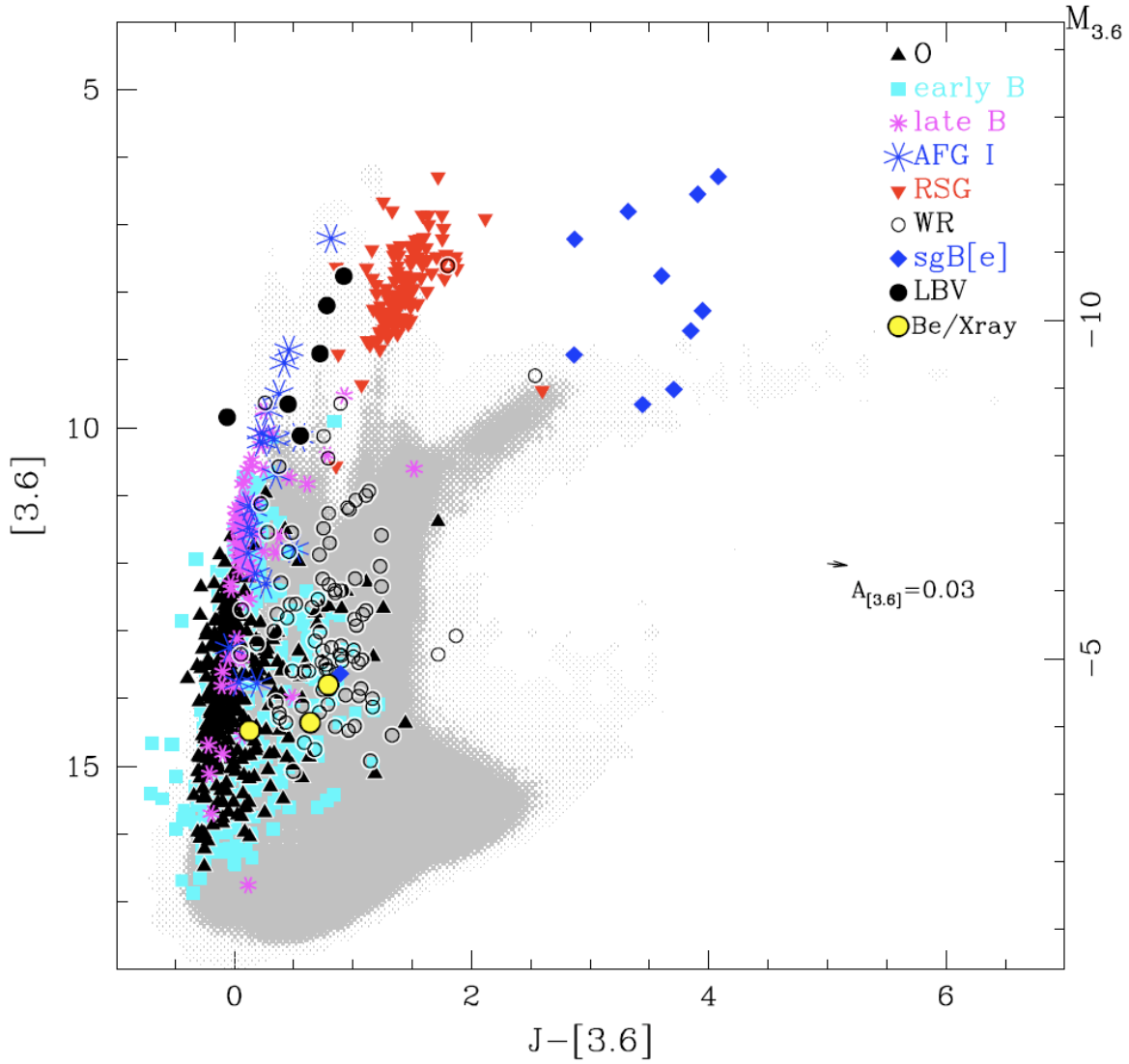
Srinivasan et al. 2009
AJ, 137, 4810

AGB star dust mass loss return:



Srinivasan et al. 2009
AJ, 137, 4810

Identification of Massive stars in SAGE

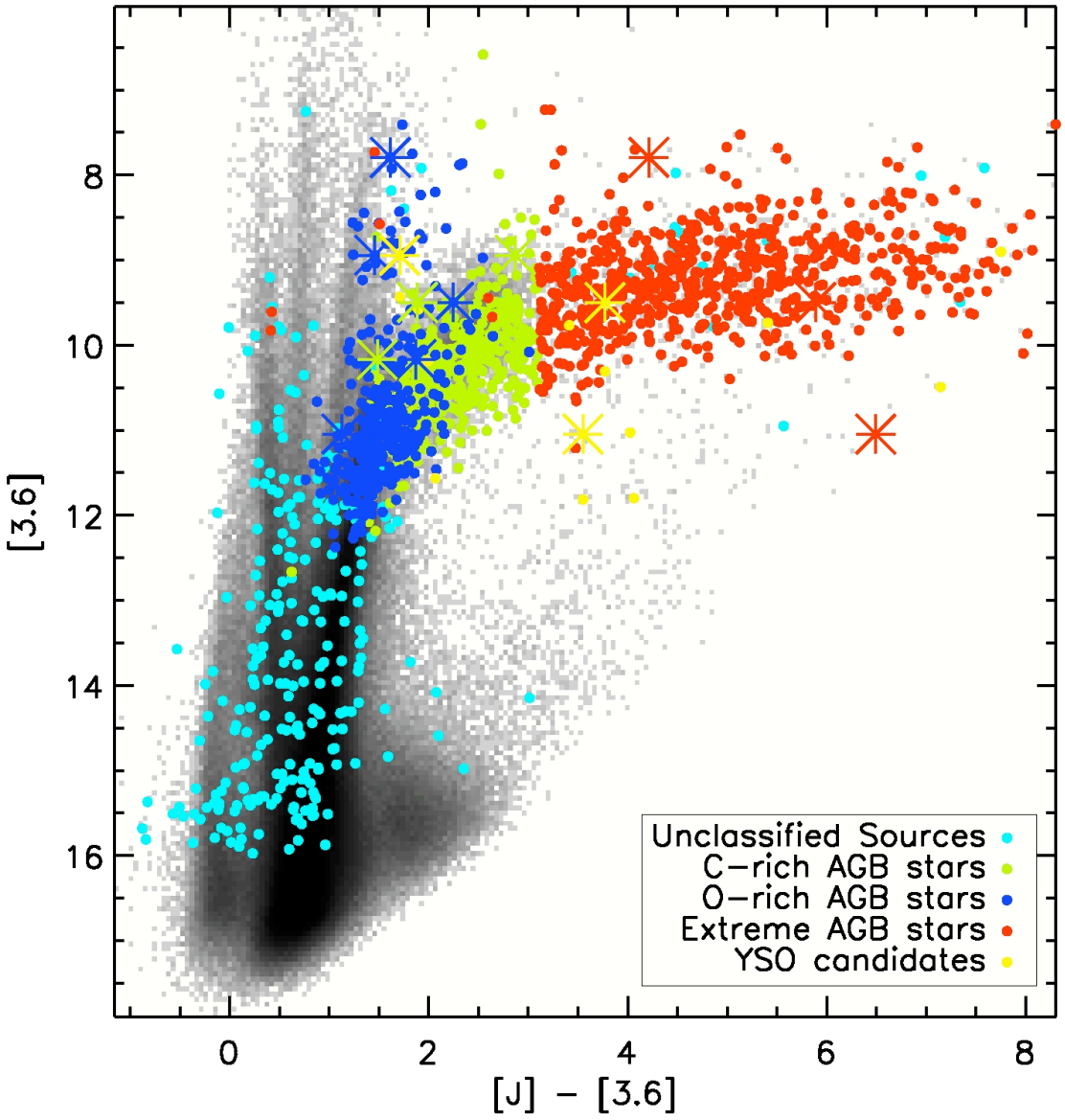


Bonanos et al. 2009 AJ, submitted

SAGE-LMC inventory in context

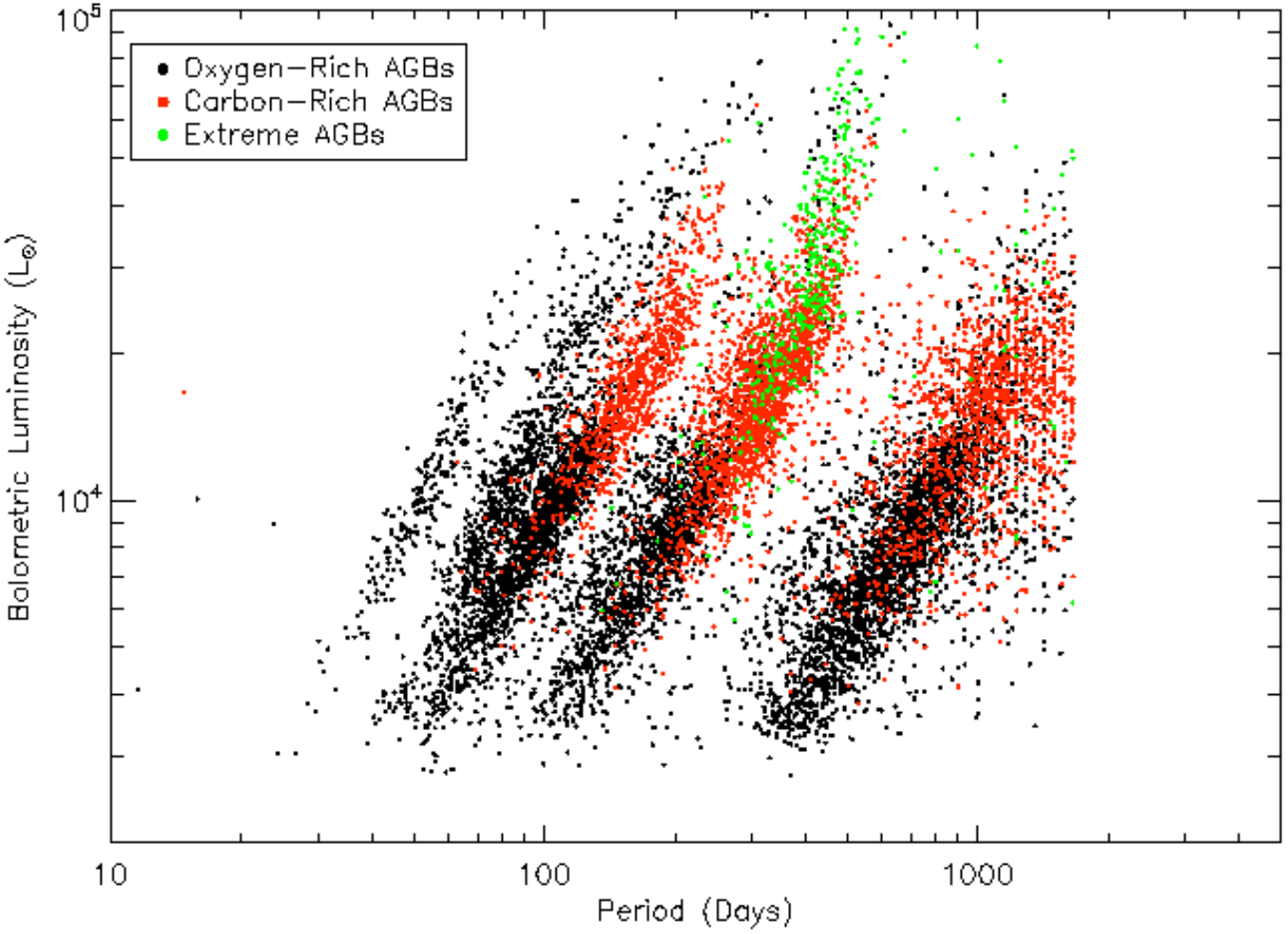
Item	Value
Total mass of dark halo	~1 - 3 x 10^{10} M⊙
Stellar Mass	3 x 10^{9} M⊙
ISM mass, 160 um, SAGE	10^{9} M⊙
Star formation rate	>0.1 M⊙ yr^{-1}
AGB Mass Loss return	6-13 x 10^{-3} M⊙ yr^{-1}
Planetary nebulae Massive stars: Red supergiants, LBV, SNs	??
Infall, ouflow into the IGM Tidal stripping	??

Variable Stars ~2000



Vijh et al. 2009
AJ, 137, 3139

Comparing SAGE & MACHO data: Period-luminosity relations for AGB stars



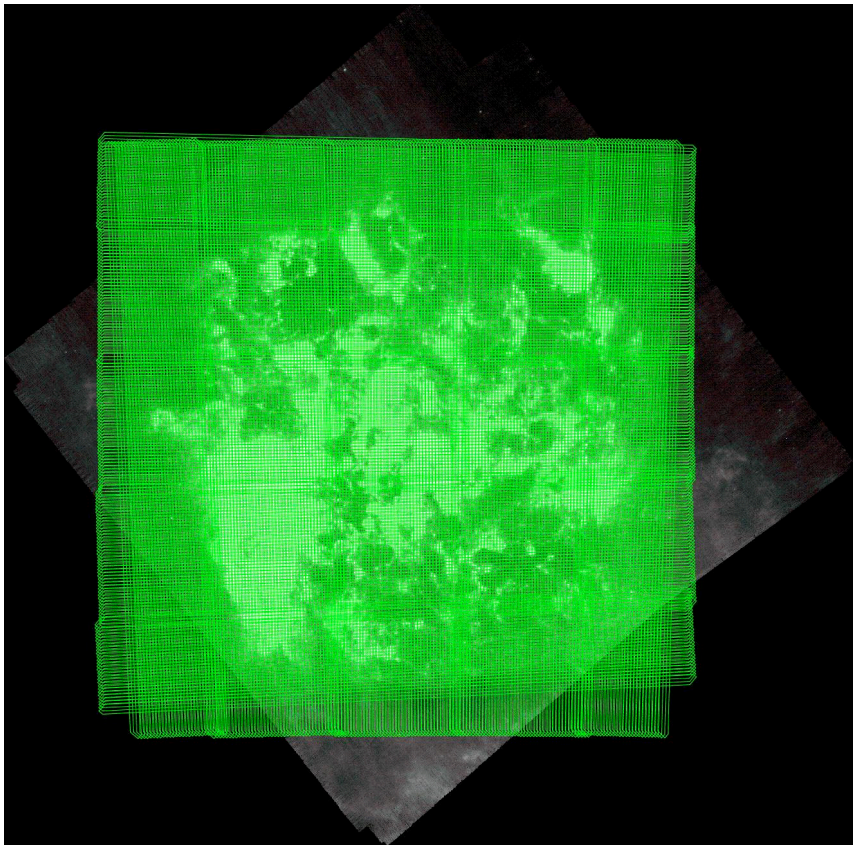
Riebel et al. in prep

The Mega-SAGE Team:

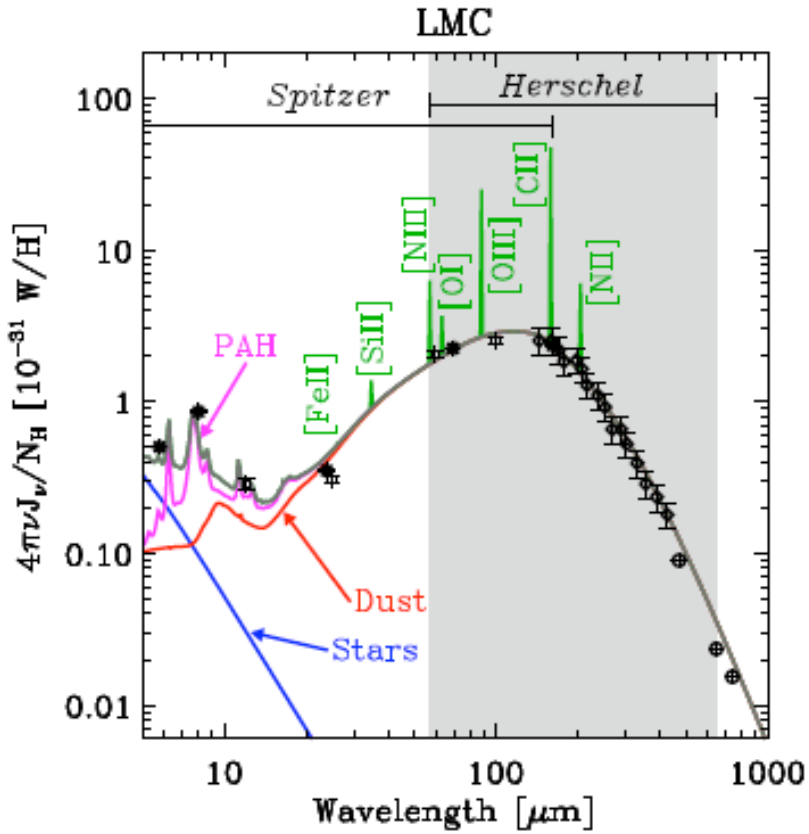
http://sage.stsci.edu/

For more Info and delivered source lists and images

HERschel Inventory of The Agents of Galaxy Evolution (HERITAGE) in the Magellanic Clouds:



SPIRE coverage on Spitzer Legacy SAGE-LMC image. Both the LMC and SMC will be mapped with PACS and SPIRE on Herschel.



HERITAGE will be sensitive to the long wavelength dust emission from the ISM and detect circumstellar dust from massive stars.

PI: Meixner, HERITAGE team

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