The Potential of JWST for studies of the Magellanic Clouds and Beyond

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Collaborators: MIRI Team
photometric performance, point source, $10\sigma$ in $10^4$s

- Herschel
- ALMA
- SOFIA
- Spitzer
- Gemini
- Hubble
- JWST
JWST launches in 2018
Time is now to develop appropriate target lists...
The Mid-InfraRed Instrument (MIRI)
MIRI Inspected at Goddard

8 January 2013

AAS 2013  Meixner
Spitzer Survey of the Large Magellanic Cloud:
Surveying the Agents of a Galaxy’s Evolution (SAGE)

IRAC 3.6 µm
IRAC 8.0 µm
MIPS 24 µm

SAGE team
Meixner et al. 2006

http://sage.stsci.edu/
SAGE-SMC: Spitzer IRAC & MIPS
Imaging of Small Magellanic Cloud
http://sage.stsci.edu/
Tracing the Lifecycle of Baryonic Matter:
Intermediate mass stars
High mass stars

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credit: http://hea-www.cfa.harvard.edu/CHAMP/EDUCATION/PUBLIC/ICONS/
Sewilo et al. submitted:
- all confirmed YSOs (35)
- 99% of previously known YSO candidates that fulfill our criteria

Contamination:
- 18 evolved stars
- 10 massive stars
- 34 PNe

Spitzer SMC Wide YSO Searches: Sewilo et al. submitted
Spitzer LMC Wide YSO Searches

SAGE IRAC 8 $\mu$m

Pre-Spitzer:
~20 protostars known

Spitzer:
Whitney, Sewilo et al. (2008)
~1000 YSO candidates

Gruendl & Chu (2009)
~1200 YSO candidates

~1800 unique sources
SFR~0.1 $M_\odot$ yr$^{-1}$
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JWST NIRCam & MIRI imaging of N113 in LMC: 10.3 hrs
6 filters: 0.7, 1.77, 1.5, 3.56, 5.6 & 21 microns
Limit: 2 solar mass classical, 30 Myr T-Tauri star
JWST NIRSpec & MIRI
Integral Field Unit Spectroscopy of selected YSOs
Example: N113

Seale, Sewilo, Meixner
Example Source:
Stage I YSO in the LMC N 113

\[
M_{\text{star}} \sim 14 \ M_{\odot}
\]
\[
L_{\text{star}} \sim 1.2 \cdot 10^4 \ L_{\odot}
\]
\[
dM_{\text{env}}/dt \sim 0.01 \ M_{\odot}/\text{yr}
\]
\[
M_{\text{disk}} \sim 0.4 \ M_{\odot}
\]

Whitney, Sewilo et al. 2008
Example Source: 
Stage I YSO in the LMC N 113

Spitzer IRS spectra:
YSO spectral type: PE
PAH and Emission line spectra

Seale et al. 2009
8 January 2013

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Spitzer IRS spectra: YSO spectral type: PE

PAH and Emission line spectra

Example Source:
Stage I YSO in the LMC N 113

Spitzer IRS spectra:
YSO spectral type: PE
PAH and Emission line spectra

Seale et al. 2009
Stage I YSO in the LMC N 11 region: $14 \, M_{\text{Sun}}$ & $1.7 \times 10^4 \, L_{\text{Sun}}$

SSTISAGE1CJ045640.75-663230.4

CO$_2$ ice

Intensity [Jy]

Wavelength [\mu m]

JWST: NIRSpec & MIRI IFU spectroscopy, 3.8 hrs/source
Full spectral coverage for a massive YSO source in LMC/SMC

ISO SWS spectrum
Whittet et al. 1996
JWST: **NIRSpec** & MIRI IFU spectroscopy, 3.8 hrs/source
Full spectral coverage for a massive YSO source in LMC/SMC

ISO SWS spectrum
Whittet et al. 1996
JWST: **NIRSpec** & **MIRI** IFU spectroscopy, 3.8 hrs/source
Full spectral coverage for a massive YSO source in LMC/SMC

ISO SWS spectrum
Whittet et al. 1996
MIRI/ MRS-IFU spectroscopy of SAGE-LMC sources

~2 hrs with MIRI/MRS/IFU;
R~3000
S/N~10 on Continuum on faintest source
Pursuing SAGE like studies in nearby Galaxies
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SAGE like Studies in nearby Galaxies.

- Nearby: <1 Mpc
- Well studied by Herschel and Spitzer
- ISM gas tracers: HI, CO
- Stellar population studies with star formation histories
M31: 0.812 Mpc, ~1 pc resolution @ 7.7 micron
angular size of galaxy: 190’x60’
M31: 6 filters: 0.7, 1.77, 1.5, 3.56, 7.7 & 21 microns
strip size: 190’x2’, total time is ~80 hrs
JWST programs

• Star Formation in the LMC/SMC: 94030
  – NIRCam/MIRI imaging – T-Tauri stars
  – NIRSpec/MIRI spectroscopy – circumstellar chemistry at low metallicities

• SAGE-like Photometric survey of M31

• Science Operations Design Reference Mission for JWST