A Mid-Infrared Spectroscopic Study of Submillimeter Galaxies: Luminous Starbursts at High Redshift


Chelsea Sharon
Ph 689: 10/22/2009
Outline

• History

• Characterization of SMGs
  • Specifically, this paper

• The Big Picture
  • Local Analogues

SMGs = Submillimeter Galaxies
Submillimeter Galaxies: History

- FIR/submm background first resolved with SCUBA (JCMT) and MAMBO (IRAM 30m)

- Small instrument bandwidth required accurate redshifts for follow-up observations

- Expensive to obtain redshifts
  - Radio Counterpart
  - Optical Spectroscopy
  - CO line detection
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Hughes et al. 1998
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Frayer et al. 2000
Characteristics of SMGs: Morphology and Distribution

- Morphology: disturbed and compact
- Redshift distribution
  - Ranges from 2-3
  - Chapman et al. (optical) peaks at $z=2.3$
  - Valiante et al. (7.7 $\mu$m) peaks at $z=2.8$
- Spatial distribution?

SMM J14011+0252
$z=2.565$
NICMOS 1.6$\mu$m

6.6" = 54 kpc rest frame

Baker et al. (in prep)
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Characteristics of SMGs: Emission

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<th></th>
<th>X-ray</th>
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<th>Submm</th>
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<tbody>
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<td>High-frequency radio</td>
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<td>Source</td>
<td>AGN</td>
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- PAH signatures
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Thursday, October 22, 2009
Characteristics of SMGs: Emission

CO Lines!

- CO is the best tracer for molecular gas
- $M_b = 10^{11} \, M_{\odot}$
- Molecular gas fuels star formation
- Line profiles probe dynamical state of gas
- $M_{\text{dyn}} = 6 \times M_{\text{gas}}$

**Caution!**

Extreme Model Dependence

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The Big Picture

- Local Analogues = ULIRGs
- SMGs are major mergers caught in star-burst phase
- Progenitors of modern massive elliptical galaxies

ARP 220 (VIXENS Survey)

(U)LIRGs = (Ultra-) Luminous Infrared Galaxies
In Summary, SMGs are...

- Massive, infrared-luminous galaxies at $z\sim2$-3
- Dusty and gaseous
- Starburst dominated; may have AGN components
- Likely formed during major mergers
- Likely the progenitors of the most massive elliptical galaxies
- Similar to scaled-up versions of ULIRGs