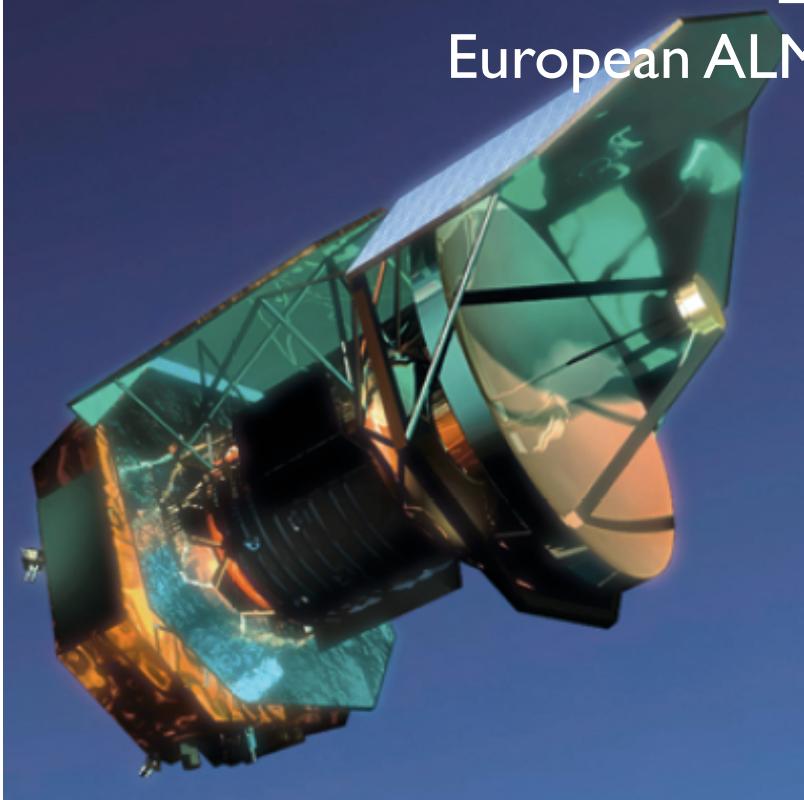


The promise of ALMA: Herschel & ALMA

Leonardo Testi
European ALMA Project Scientist (ESO)



The Herschel-ALMA workshop

- ♦ ESO workshop: “The impact of Herschel Surveys on ALMA Early Science”
- ♦ Garching, Nov. 16-19, 2010
- ♦ Co-organizers: Goeran Pilbratt and Paola Andreani
- ♦ All Herschel key science represented: talks from GT and OT Key Programs and normal programs
- ♦ Herschel Space Observatory and ALMA synergy has a long history
 - The ESA-ESO report on “The Herschel-ALMA Synergies” (T. Wilson & D. Elbaz)
 - The EC-FP6 ALMA Enhancement Project



Herschel vs. ALMA

HSO	ALMA
Wavelength coverage: 70-550 μm	Wavelength coverage: 350-7000 μm (ES 450-3000 μm)
PACS+SPIRE broad band continuum bolometers & low resolution spectroscopy HIFI high resolution spectroscopy (single pixel)	Low resolution ``continuum'' 2 pol 8GHz bandwidth High resolution spectroscopy Combination of modes
3.5m Diffraction (6"-35")	Angular resolution 1'-0.01"
3.5 yrs lifetime (last call next summer)	2011 ES; ~2013 Full Science ~30yr lifetime (development)

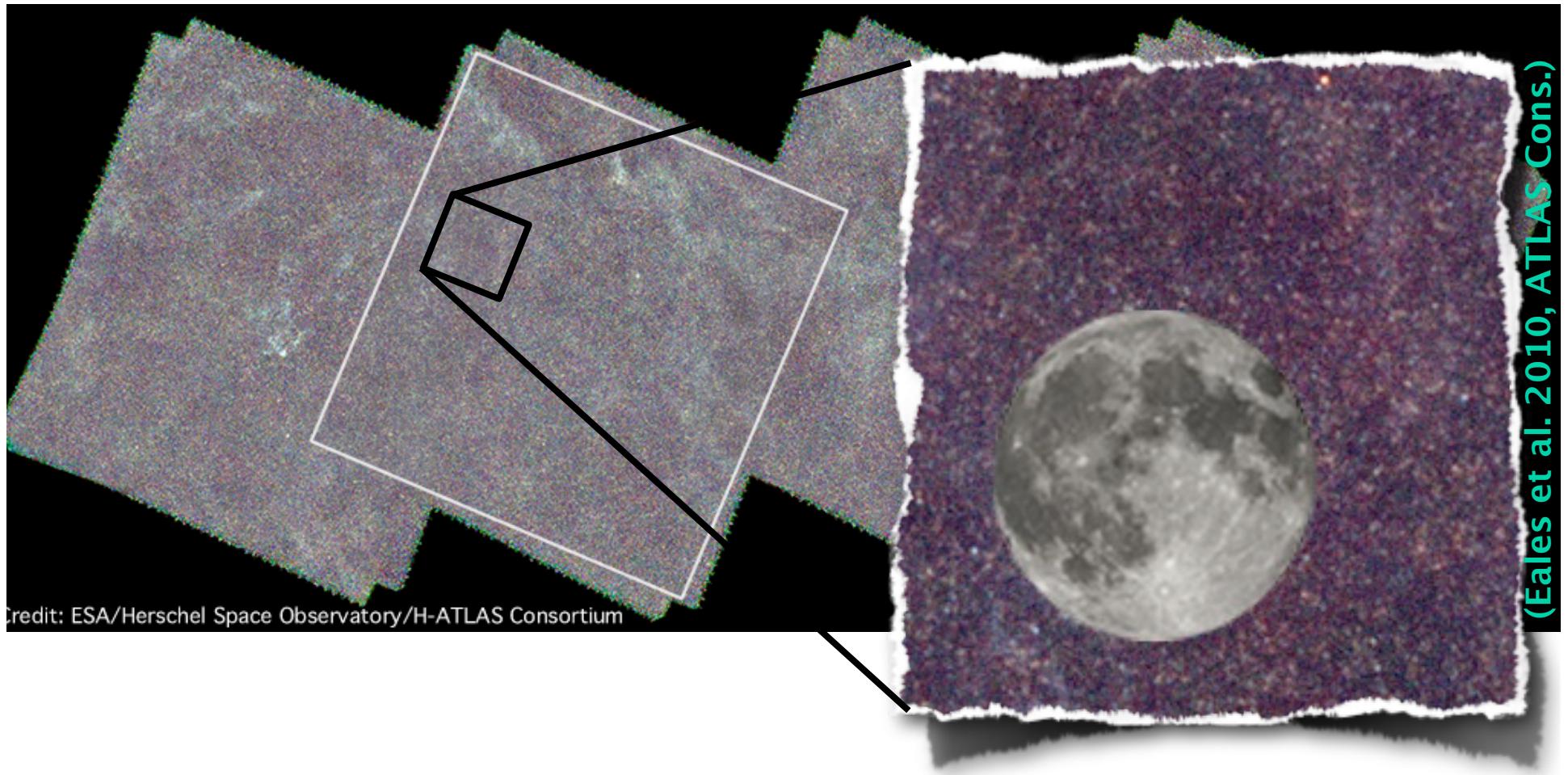


Herschel vs. ALMA

HSO	ALMA
Far infrared high spatial and spectral resolution	(Sub)millimetre high spatial and spectral resolution
Wide area continuum (and low spec res line) high sensitivity surveys	Small field of view high angular resolution very good continuum sensitivity.
Far infrared heterodyne spectroscopy (new space)	Complementary high resolution (sub)mm spectroscopy. Sensitivity will be limited for thermal spectral lines at high resolution!
Time is critical	Capabilities will evolve with time



Extragalactic high-z Surveys



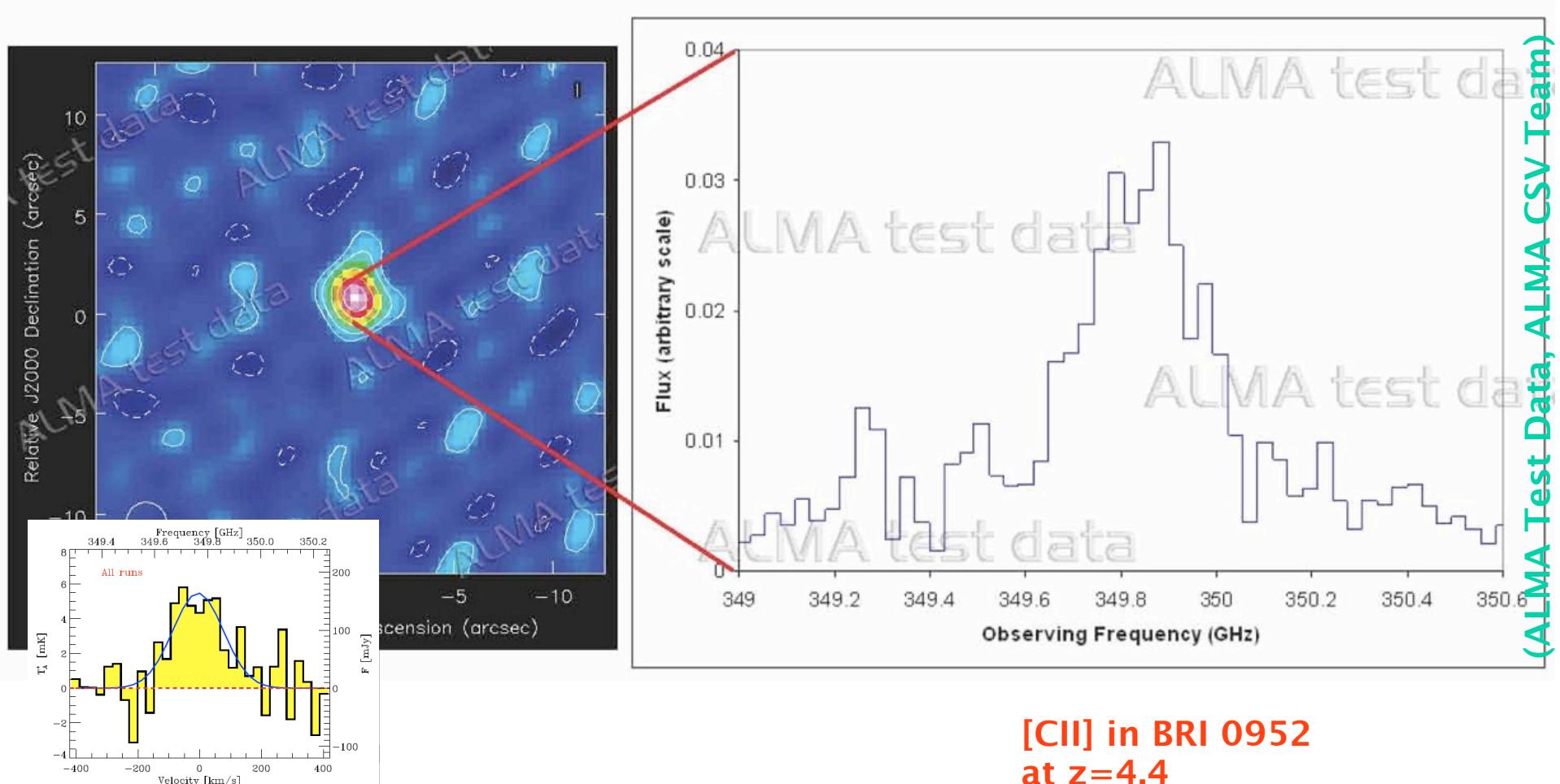
- ◆ Herschel: wide & deep area surveys, sources+statistics!
- ◆ ALMA: high resolution & spectroscopy (id+physics)



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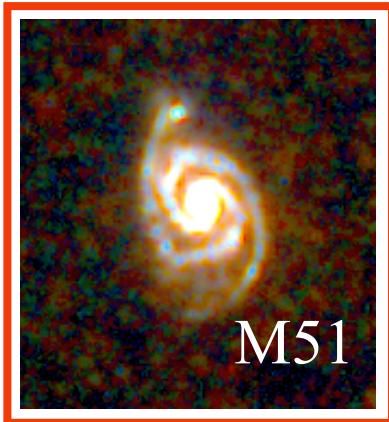
Extragalactic high-z Surveys



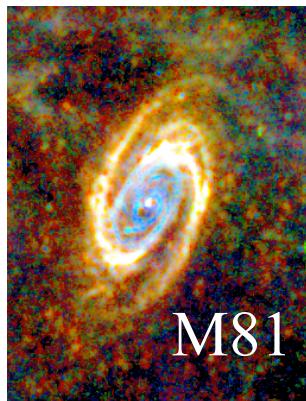
- ♦ Followup possible starting with Early Science
- ♦ Including spectroscopy (CO, CI, CII)



The Herschel Very Nearby Galaxies Survey



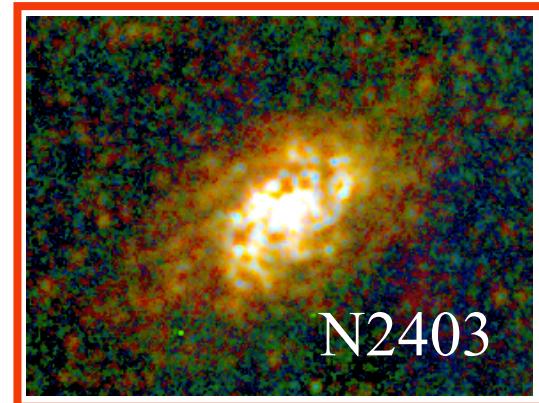
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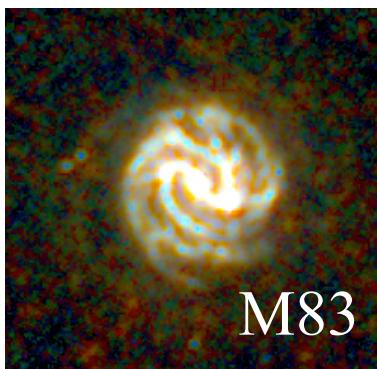
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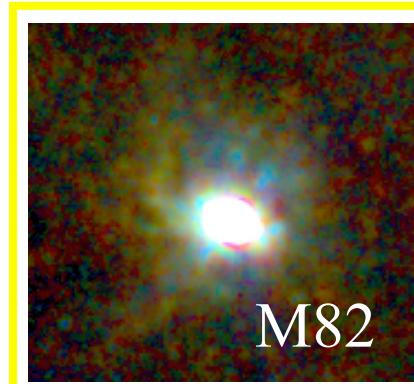
N891



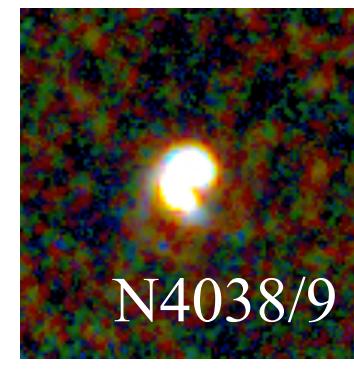
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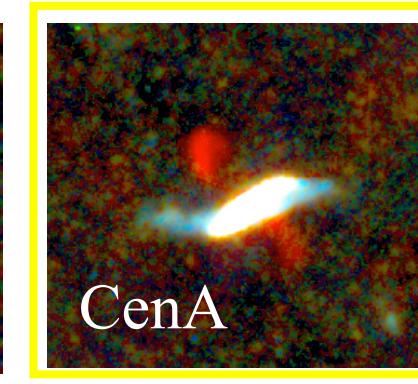
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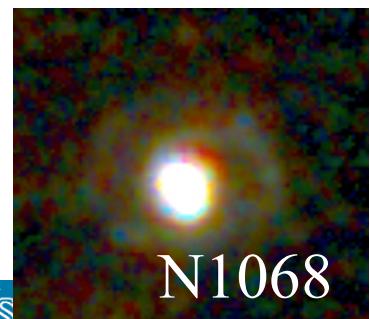
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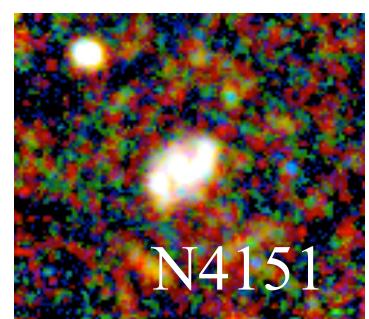
N4038/9



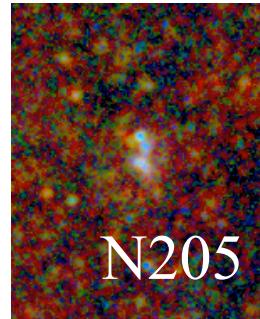
CenA



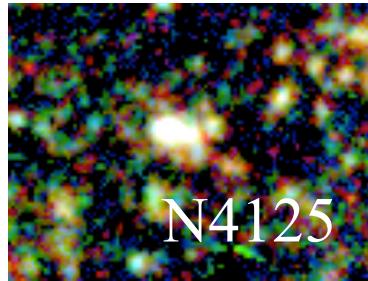
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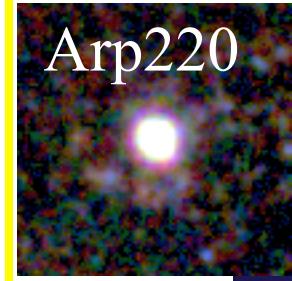
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N205



N4125



Arp220

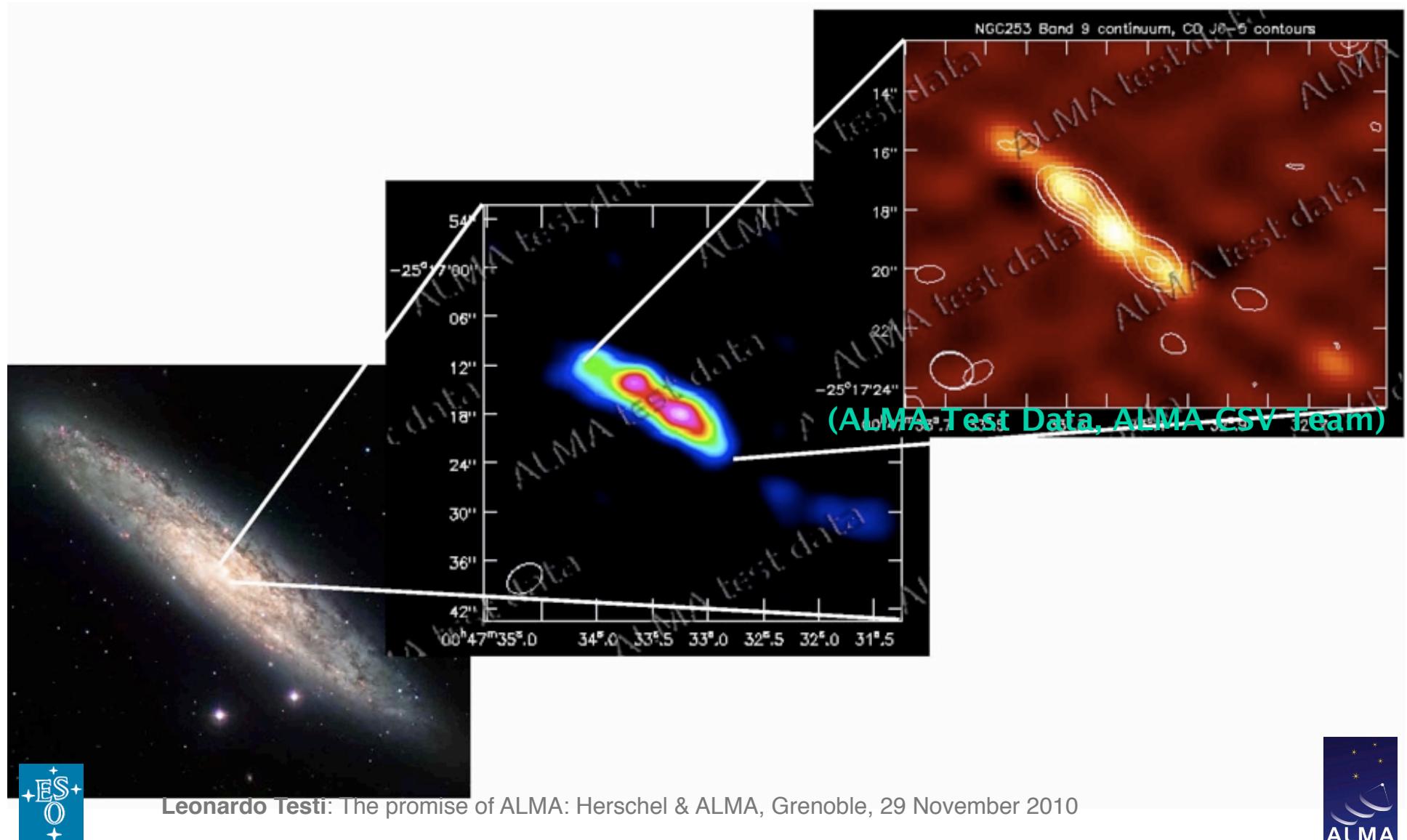


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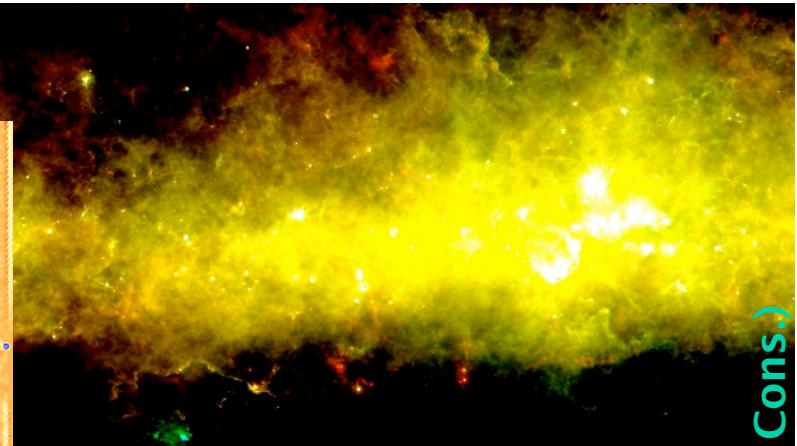
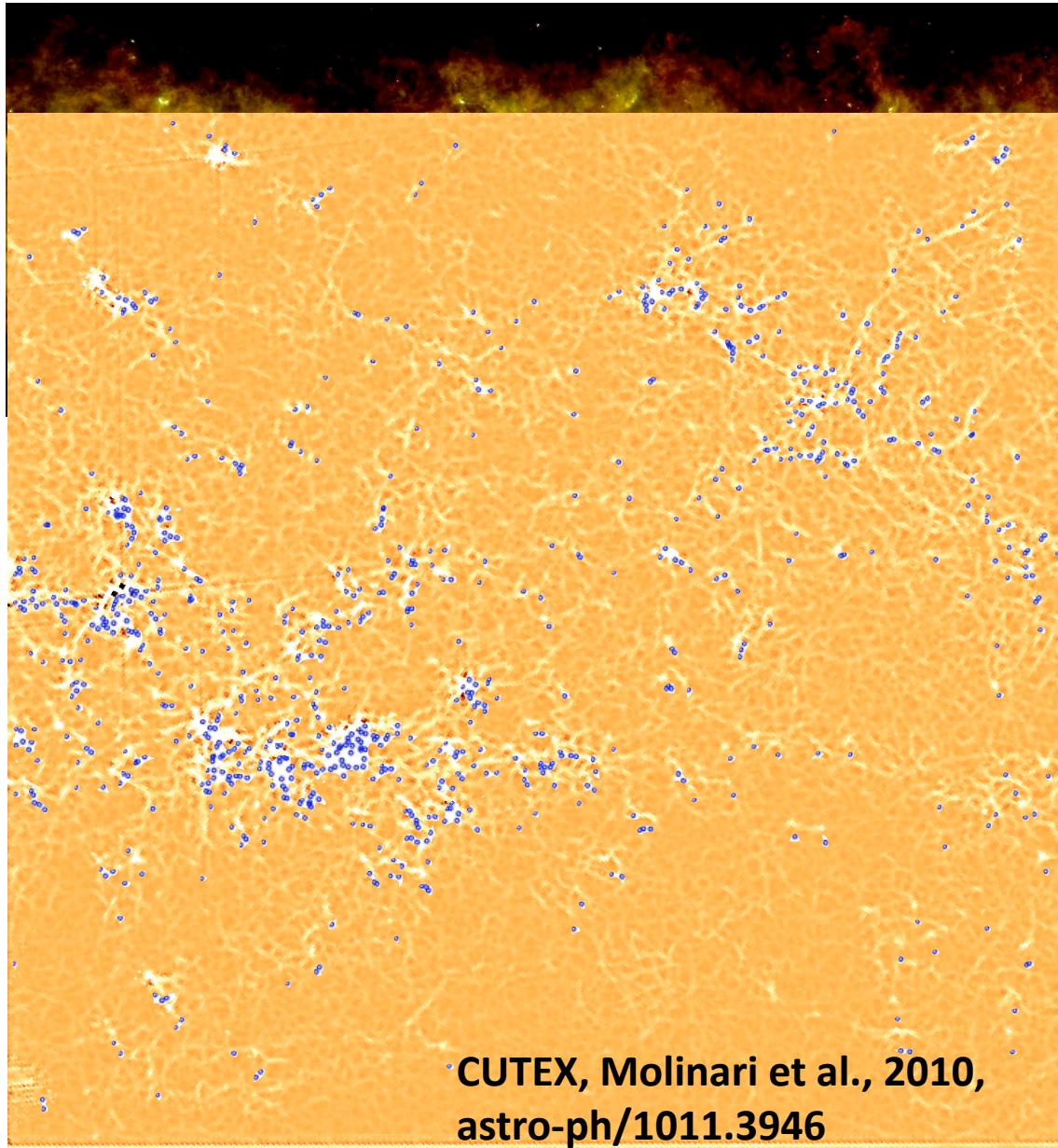
250/350/500 μm images by L. Cortese



ALMA Test Data on NGC253



The Milky Way Galaxy



(Molinari et al. 2010, HIGAL Cons.)

- ◆ Complete survey of the inner (+/-70deg) and outer Galaxy(180+/-60deg)
- ◆ Role of filaments in forming Clouds and Clumps
- ◆ Nature of compact sources?

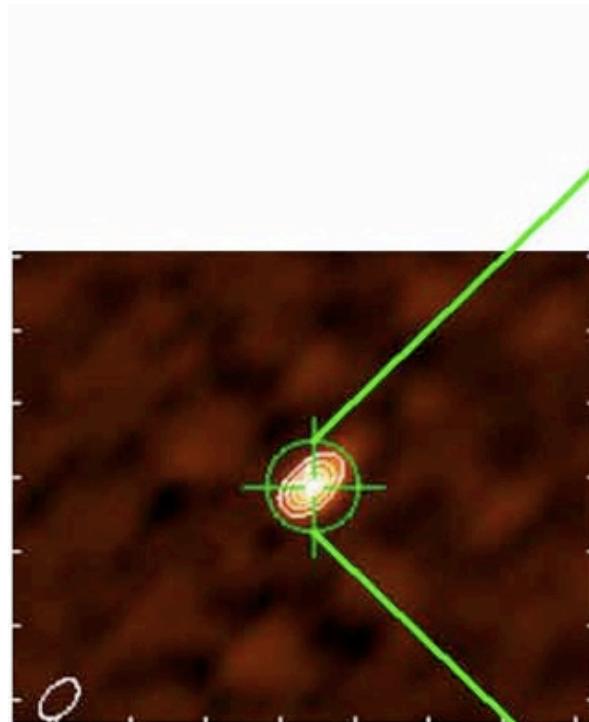
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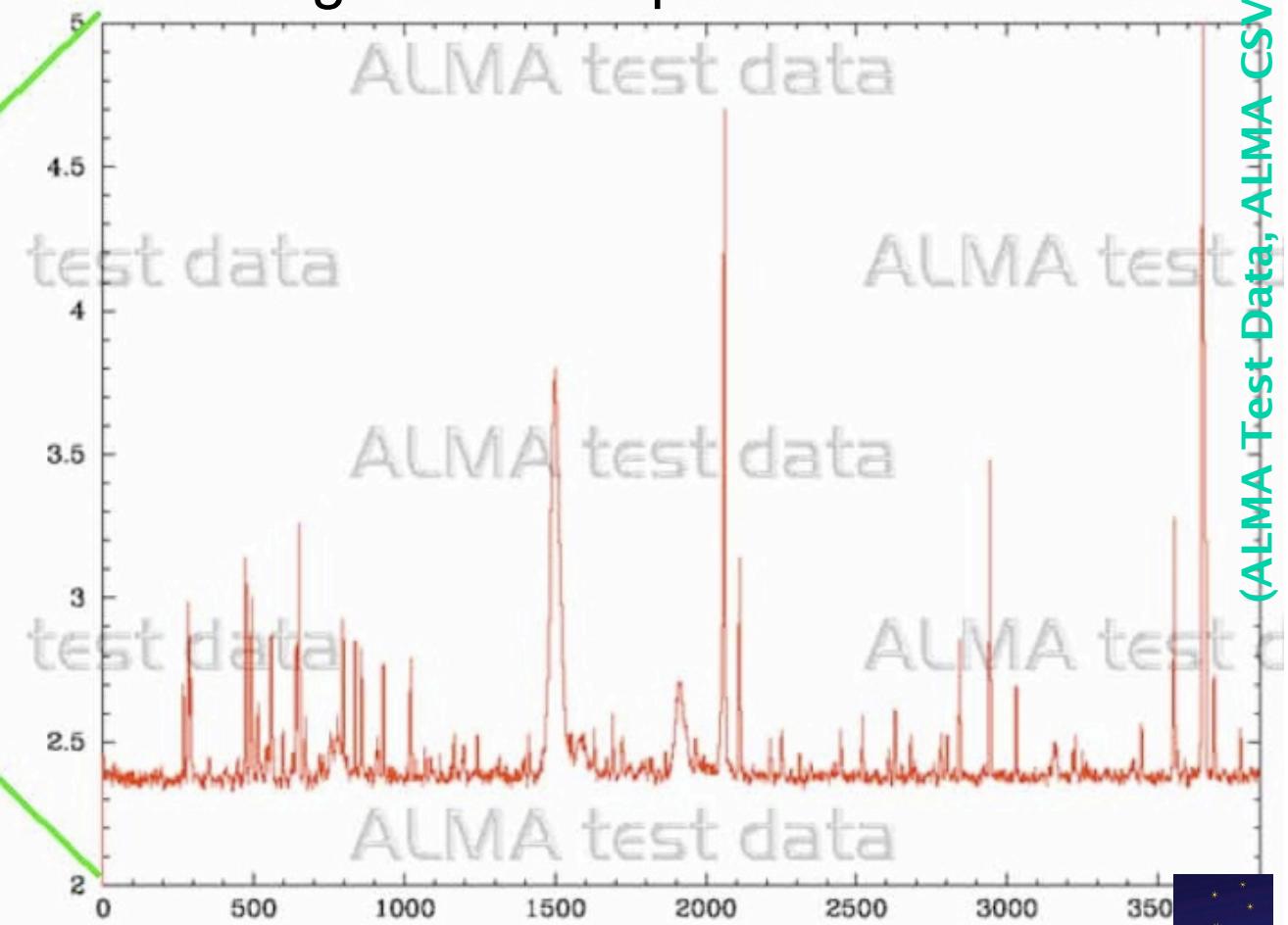


High Mass Star Formation

G34.26+0.15 Band 3



Single 2 GHz Spectral Window



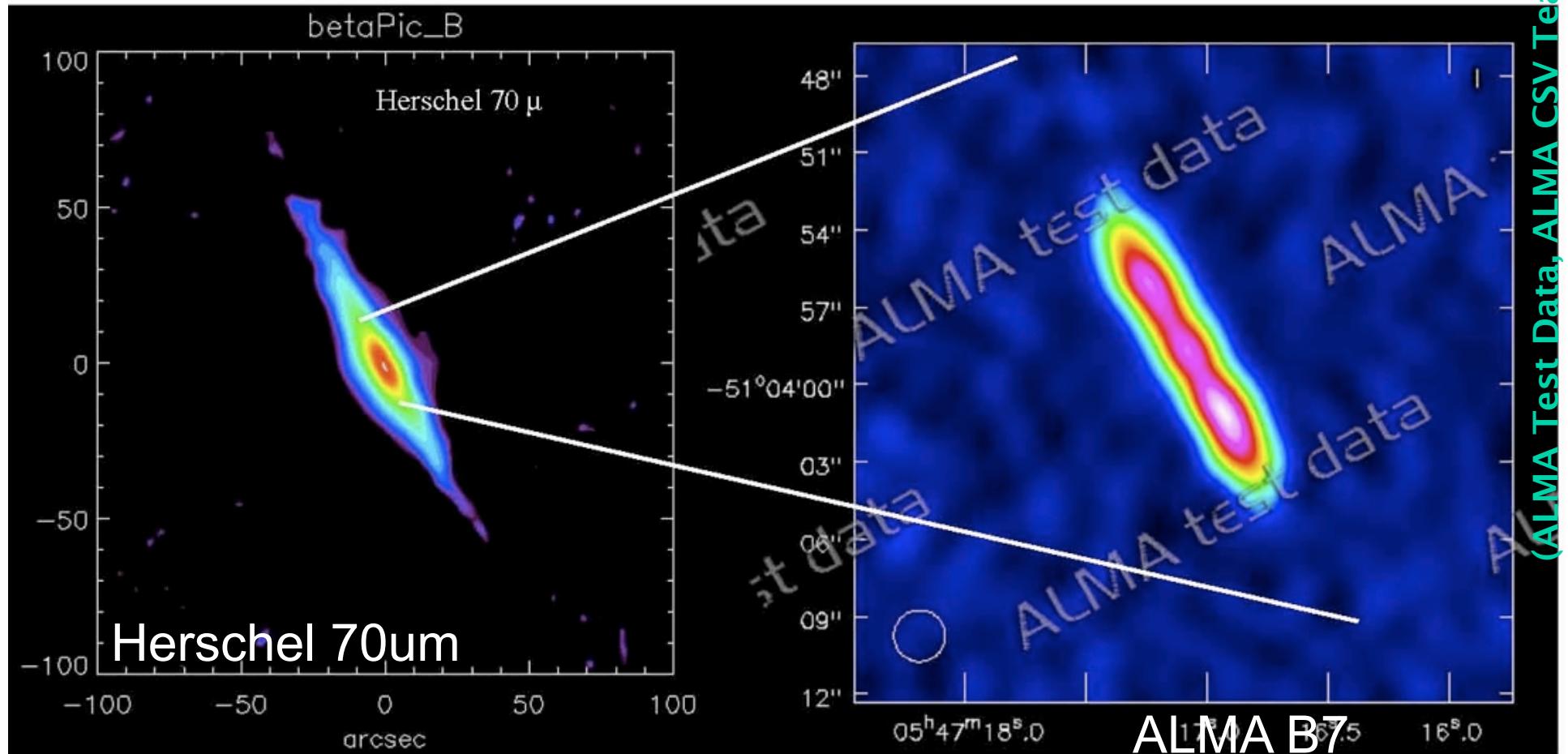
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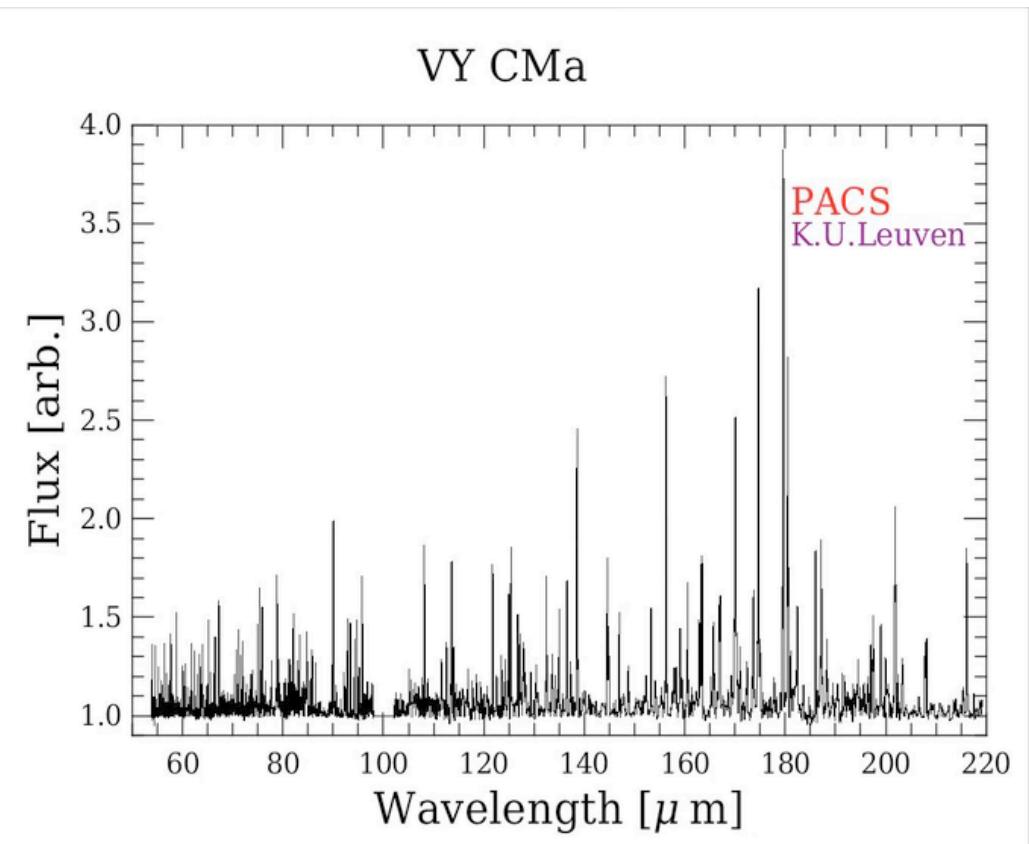
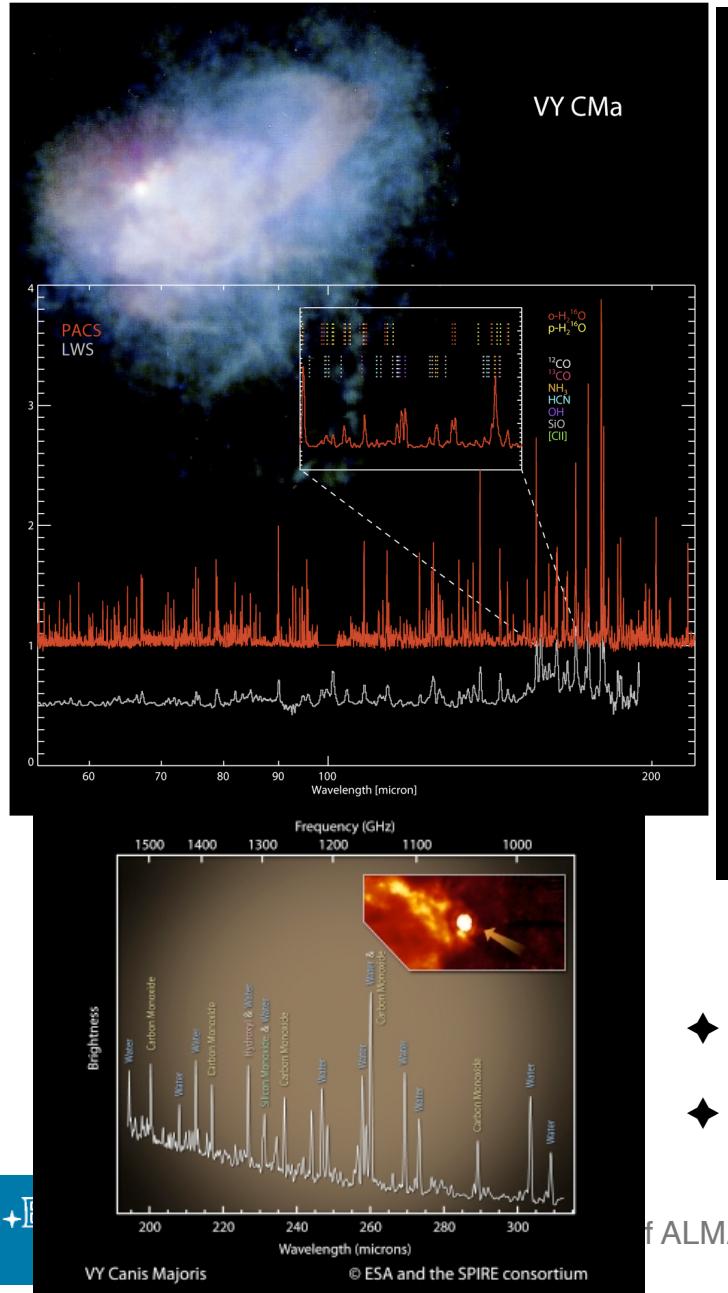


(ALMA Test Data, ALMA CSV Team)

Disk evolution



Evolved Stars Outflows



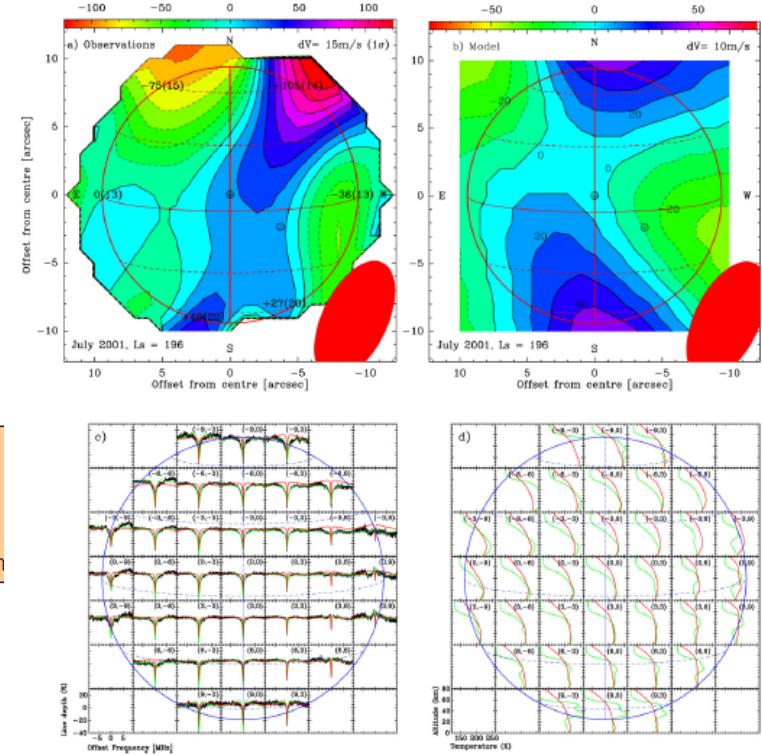
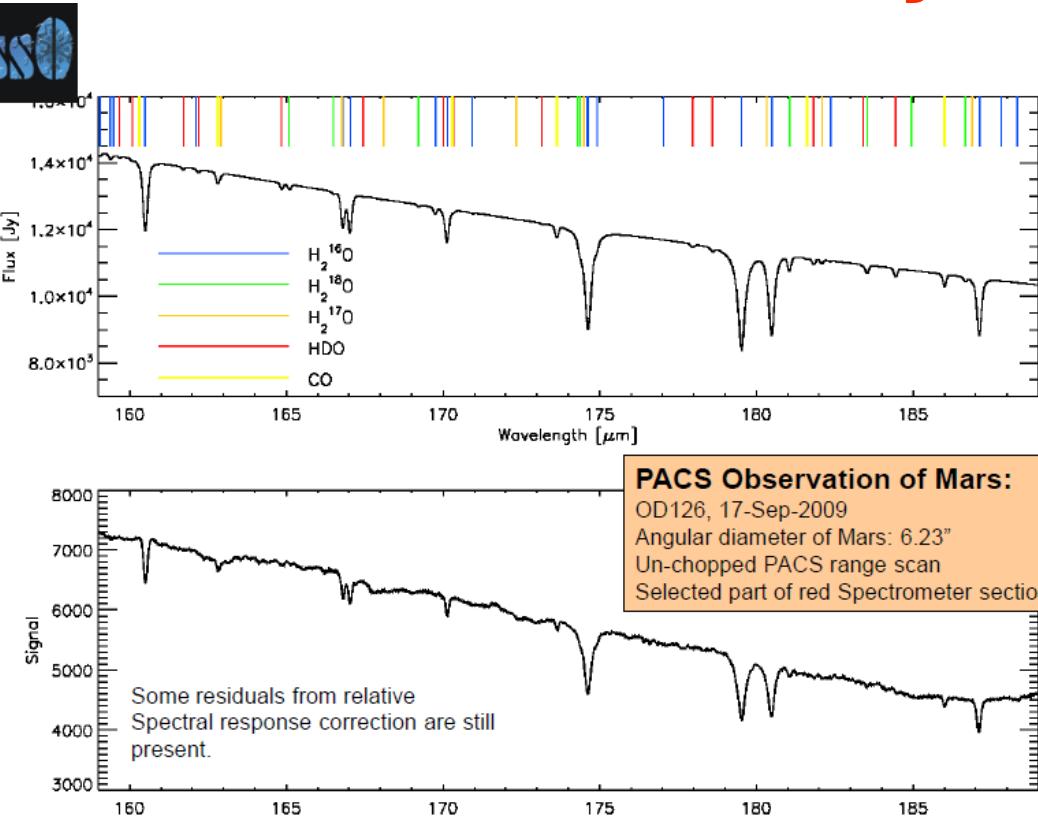
(Waelkens et al. 2010)

- ◆ Herschel+ALMA: Chemistry
 - ◆ ALMA: Angular resolution & kinematics

f ALMA: Herschel & ALMA, Grenoble, 29 November 2010

Solar System

(Mars PACS scan, HSSO Consortium)



(PdBI, Moreno et al. 2009)

- ◆ Chemistry and physics of atmospheres
- ◆ Physical structure of the surface of rocky bodies
- ◆ Calibration synergies



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Herschel and ALMA

- ♦ The perfect complement for the full development of FIR and sub-mm astrophysics
- ♦ ALMA will be mostly used for high angular resolution followup of Herschel observations (timing)
- ♦ Some ALMA science may require low redshift preparatory work with Herschel
- ♦ There may be possibilities for “simultaneous” ALMA-Herschel observations (e.g. comets?)
- ♦ EC-FP6. B5: water in the local Universe and [CII] at high-z; OTF interferometry (efficient wide field imaging); Calibration

