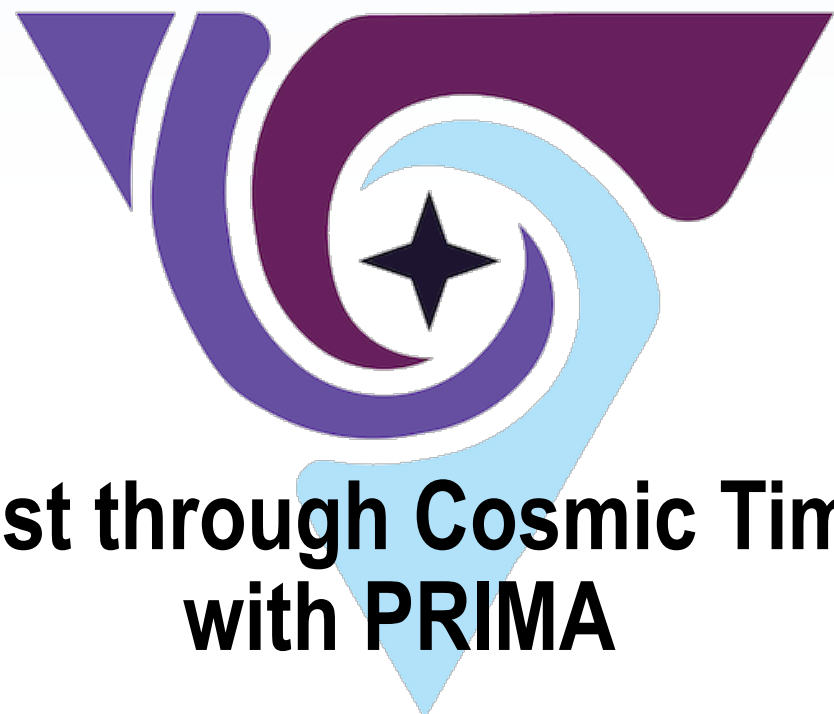


PRIMA



Dust through Cosmic Time with PRIMA

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<https://prima.ipac.caltech.edu/>

The Dusty, High-z Universe

- JWST is revealing a surprisingly dusty high-redshift Universe
- Detection of 2175Å hydrocarbon extinction feature at $z = 6.7$! (right)
- When did the first dust form? What are the formation pathways? Are there local analogues?
- Need FIR coverage to answer these questions!

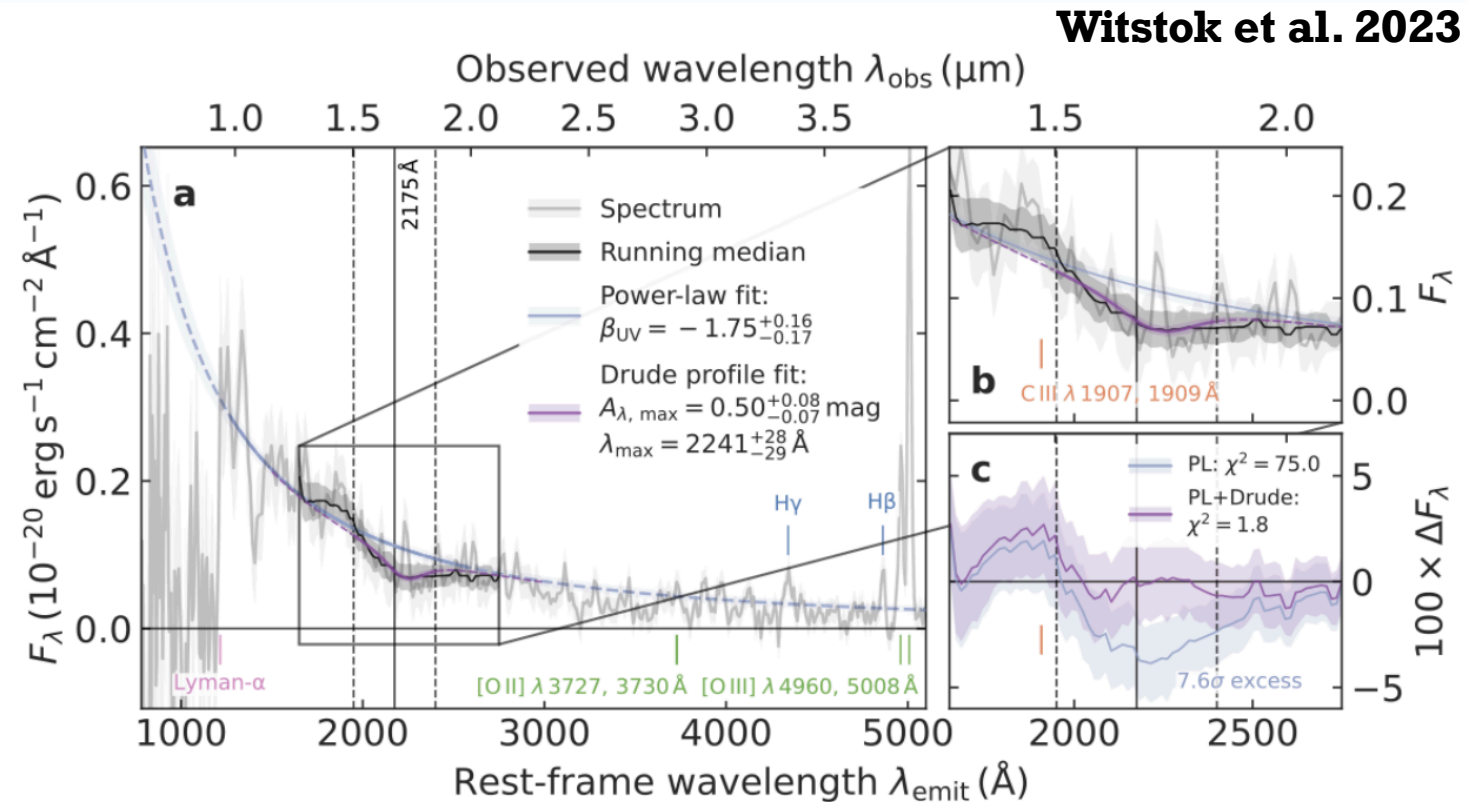


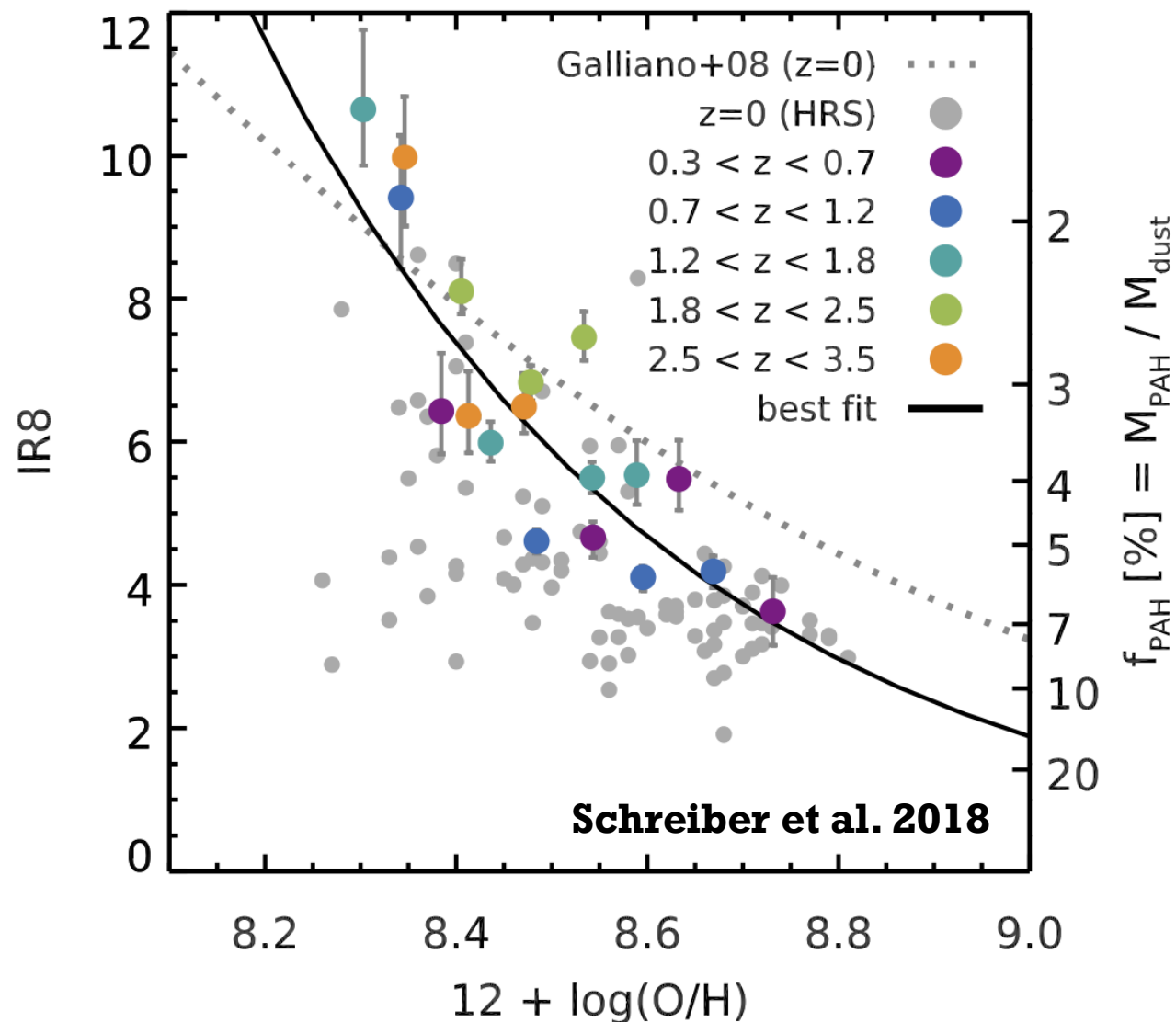
Fig. 1 | Spectrum taken by *JWST*/NIRSpec of JADES-GS-z6-0 at redshift $z = 6.71$. a,

Motivation

- When and where do the first small grains appear in the Universe?
- How does dust evolve in the interstellar medium of nearby extragalactic environments?
- PRIMA is poised to answer these questions with its far-infrared imaging and polarization capabilities

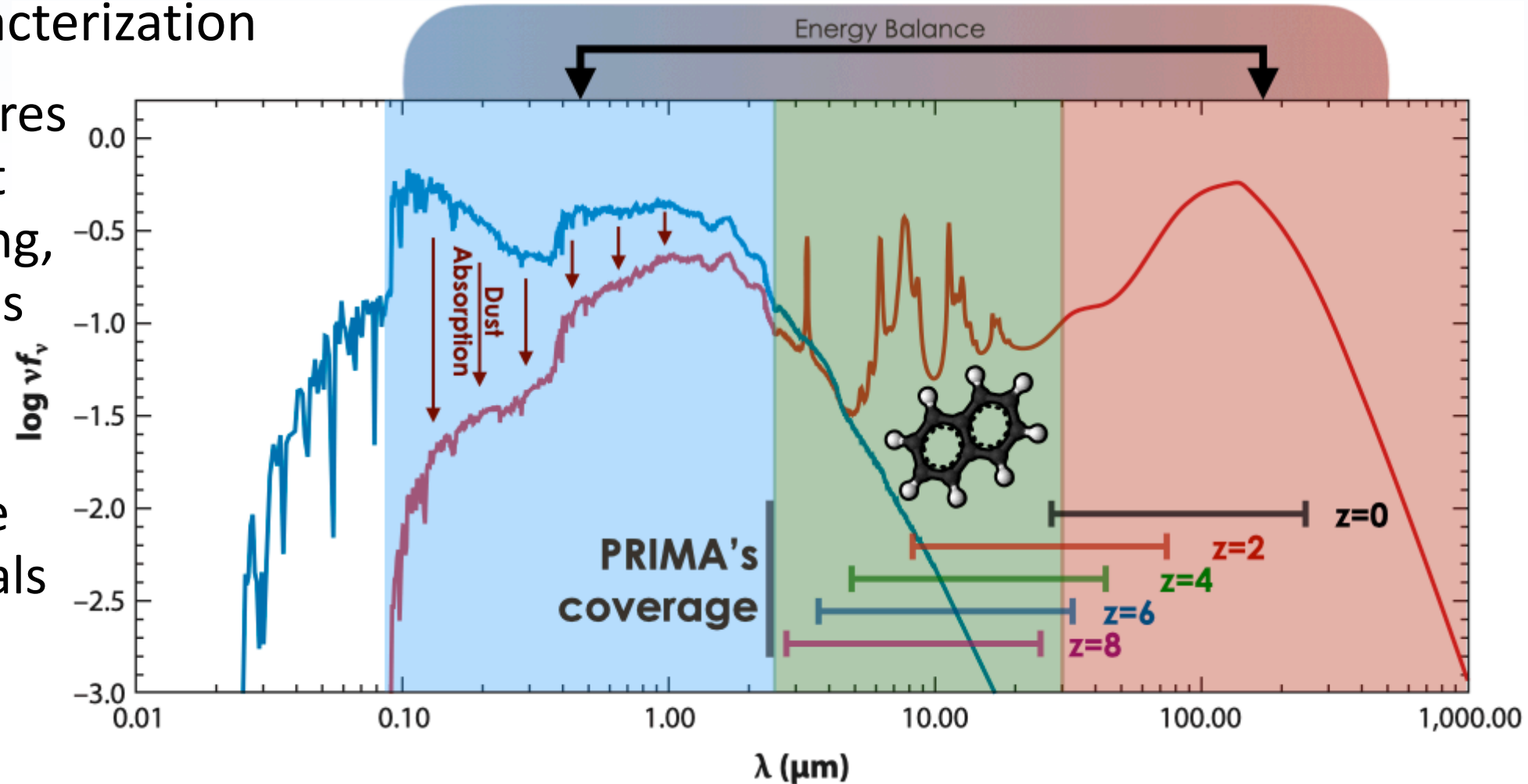
PAHs and Galaxy Properties

- PAH emission is typically $\sim 10\%$ of the total FIR luminosity of the galaxy and outshines all emission from gas lines *combined*
- Intimately tied to metallicity and star formation, though physics as yet unclear
- Goal: harness the diagnostic power of the PAH emission spectrum by measuring it across cosmic time in a large sample of galaxies



The Rise of PAHs

- PRIMA will identify high-z star-forming galaxies through their PAH emission
- Full SED characterization
- Use PAH features to extract dust masses, heating, dust properties (e.g., size, charge)
- Please join the Dust and Metals session to discuss ideas!



Dust in the Local Universe

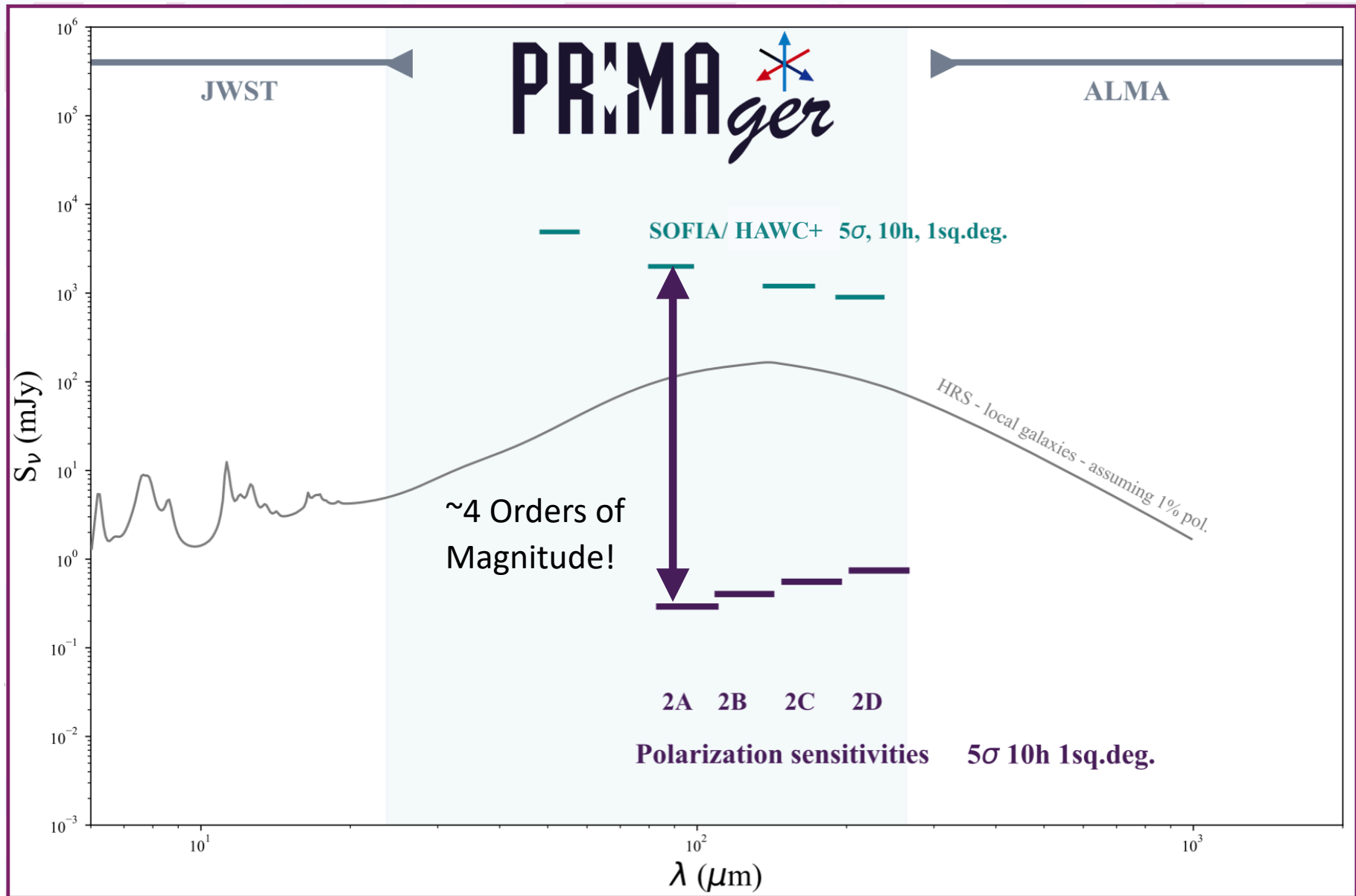
- JWST is laying the foundations of how we will interpret PAH emission at high redshift... but what about the FIR continuum?
- Polarization has been key to unraveling the properties of dust, but understanding mostly limited to large angular scale submm/mm measurements in the Galaxy (e.g., Planck) and very small, very bright regions (e.g., SOFIA/HAWC+, BLASTPol)



Dust Polarimetry with PRIMA

- Key advantages
 - Sensitivity: If Herschel could measure an SED, PRIMA can measure a polarized SED
 - Wavelength Coverage: Unique to PRIMA and not accessible from the ground. Complements ongoing and upcoming work in the submm/mm from CCAT-prime, TolTEC, JCMT...
 - Mapping Speed: Can image large areas (up to tens of square degrees)
- PRIMA polarization measurements are *not possible with any other existing or planned facility*

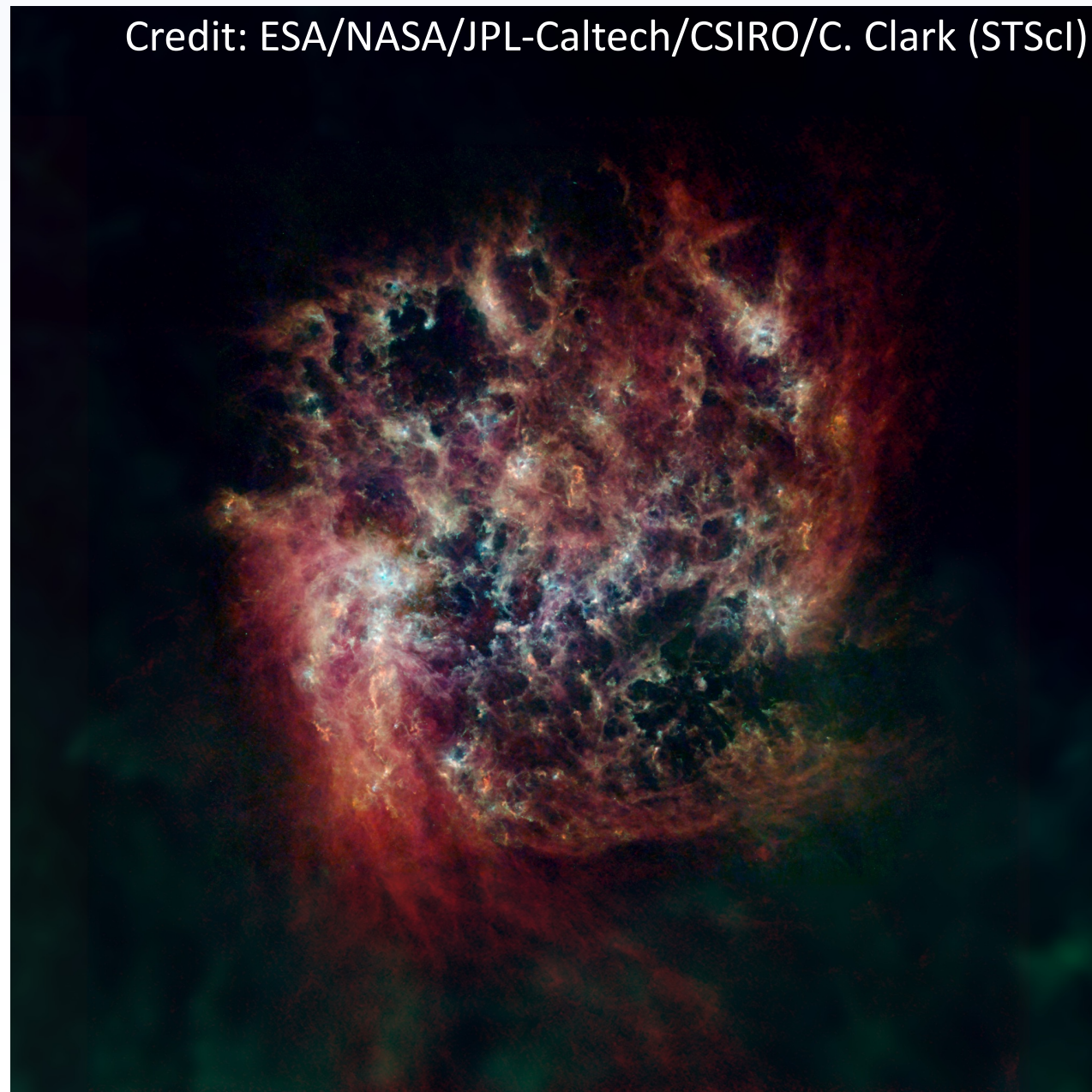
Dust Polarimetry with PRIMA



Tracing Dust Evolution

- Polarized SED uniquely sensitive to grain composition
- How do changes in the dust polarization spectrum correlate with metallicity, gas phase depletions, other aspects of the local environment?
- Aspiration: complete survey of LMC in polarized intensity in the four PRIMA polarization bands

Credit: ESA/NASA/JPL-Caltech/CSIRO/C. Clark (STScI)



Other Polarimetry Science with PRIMA

- Much more to do with polarimetry, eager to hear ideas in the Cosmic Magnetism session!
 - B-fields in external galaxies
 - B-fields and star/GMC formation
 - ISM MHD turbulence
 - Synergies with 3D starlight extinction and polarization maps
 - Dust polarization in the Galactic Center
- What would *you* do with PRIMA polarimetry?

Summary

- PRIMA will fill the gap between JWST and ALMA, providing access to PAH emission at high redshifts
- Will tell the story of how dust arises in the Universe and provide a rich set of diagnostics of galaxy properties
- PRIMA will furnish a survey of the polarized Local Universe at comparable sensitivity to Herschel's view of the unpolarized dust emission
- Will tell the story of how dust evolves in the Local Universe, laying foundations for interpreting high-z data
- And so much more! Eager to hear ideas in the "Rise of Metals and Dust" and "Cosmic Magnetism" breakout sessions!