Finding Peas in the Early Universe with JWST

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Based on work in collaboration with Isak G. B. Wold, Santosh Harish, Keunho J. Kim, John Pharo, Sangeeta Malhotra, Austen Gabrielpillai, Tianxing Jiang, and Huan Yang

JWST’s first deep field: the SMACS 0723 galaxy cluster
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Early “peas” discovered behind SMACS 0723
Spectra of early "peas" with JWST
Spectra of modern & early "peas"
What are Green Pea Galaxies?

Unique properties
- Light from glowing gas
- Small
- Young stars
- Relatively pristine composition

All properties shared by early galaxies!

Image credit: Sloan Digital Sky Survey / Keunho Kim, 2022
What we learn from the spectra

Gas is **HOT**
Very little oxygen!
In particular, the most distant JWST galaxy has only about 2% of what is “normal” today. Possibly the lowest oxygen abundance yet.
Similar Appearance

Small galaxies with intense star formation. Young in every sense!

SDSS Green Pea
Redshift 0.012, light travel time 170 million years

JWST Green Pea
Redshift 8.5, light travel time 13.1 billion years
Summary

We have found what may be the most chemically primitive galaxy yet ... among the first three “Cosmic Dawn” spectra from JWST. Green Pea galaxies are comparable objects in our own backyard, but are very rare in the modern universe. We can use the modern “peas” to better understand their distant counterparts.

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For more on Green Peas and their relationship to early galaxies, see Sangeeta Malhotra’s plenary talk on “Tiny Mighty Galaxies”, session 436.01, Thursday, January 12, 2023, 11:40 AM PT - 12:30 PM PT