Finding Peas in the Early Universe with JWST

James E. Rhoads
NASA Goddard Space Flight Center
James.E.Rhoads@nasa.gov
480-278-0192

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

Rhoads et al, ApJ Letters 942, L14, 2023 January 3 - https://doi.org/10.3847/2041-8213/acaaaf
JWST’s first deep field: the SMACS 0723 galaxy cluster
JWST’s first deep field: the SMACS 0723 galaxy cluster
Early “peas” discovered behind SMACS 0723
Spectra of early "peas" with JWST
What are Green Pea Galaxies?

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

All properties shared by early galaxies!
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.

James E. Rhoads
NASA Goddard Space Flight Center
James.E.Rhoads@nasa.gov
480-278-0192

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

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