Illuminating Star Formation in the Warped, Dusty Galaxy "*El Anzuelo*" with JWST

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Image credit: Patrick Kamieneski, Rogier Windhorst, Anton Koekemoer, Jake Summers, Jordan D'Silva, Aaron Robotham, Alyssa Pagan

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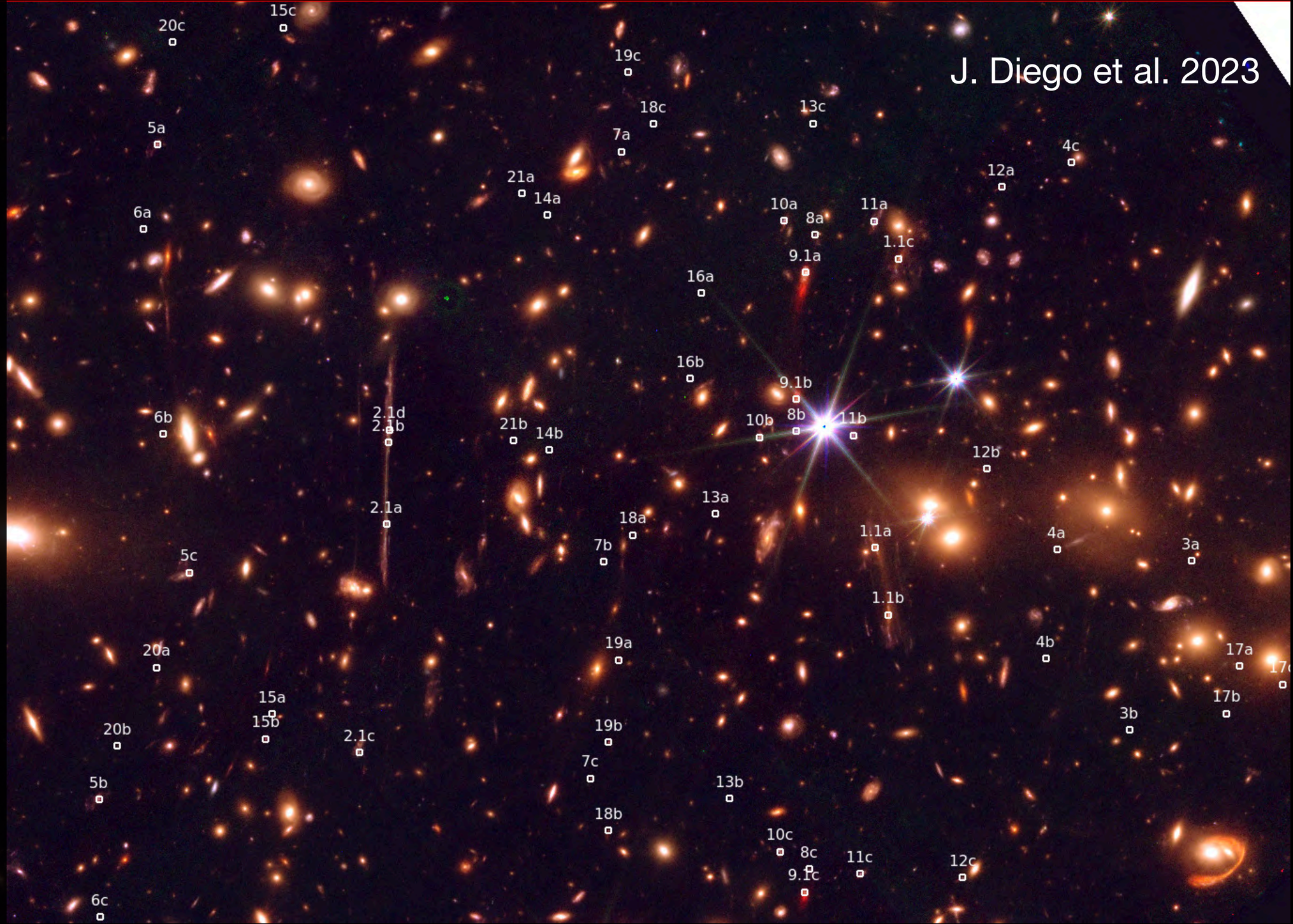
El Gordo (“The Big One”)

- Ultra-massive galaxy cluster (10^{15} solar masses), the most massive known cluster of its time (6.3 billion years after Big Bang)
- z=0.87, 7.2 billion years ago



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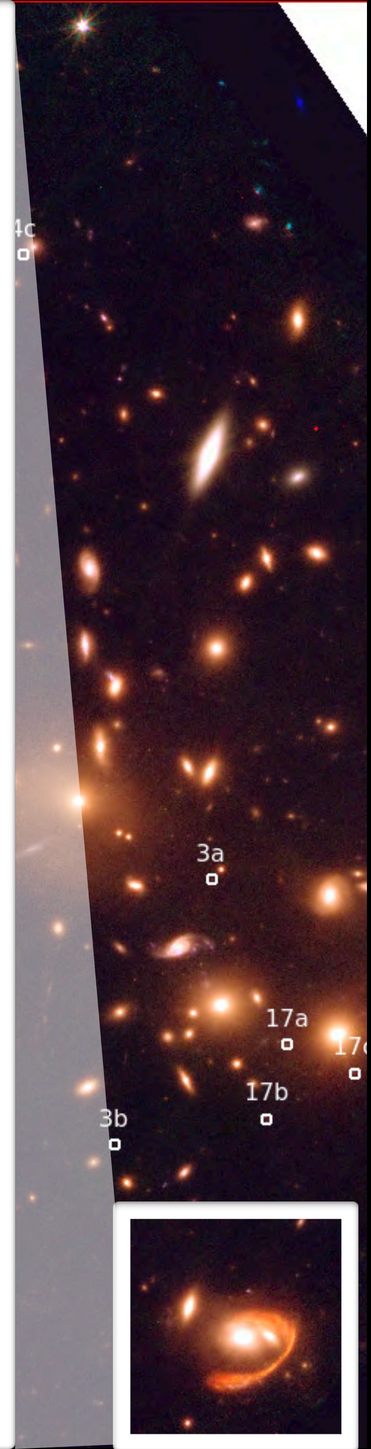
El Anzuelo, or “The Fish Hook”



The Dusty *El Anzuelo* Galaxy

Gravitational lensing warps and magnifies the galaxy to offer us an intimate view of star formation in the distant Universe

A profile of *El Anzuelo*:

- Forming stars 80x faster than the Milky Way
- Stellar mass of 50 billion Suns (very close to that of the Milky Way!)
- About 6 kiloparsec (20,000 lightyears) in diameter, similar to Milky Way
- Magnified by a factor 7x in area by lensing
- Redshift z=2.3 (~11 billion years in the past, ~3 billion years since the Big Bang)

Image credit: Patrick Kamieneski, Rogier Windhorst, Anton Koekemoer, Jake Summers, Jordan D'Silva, Aaron Robotham, Alyssa Pagan

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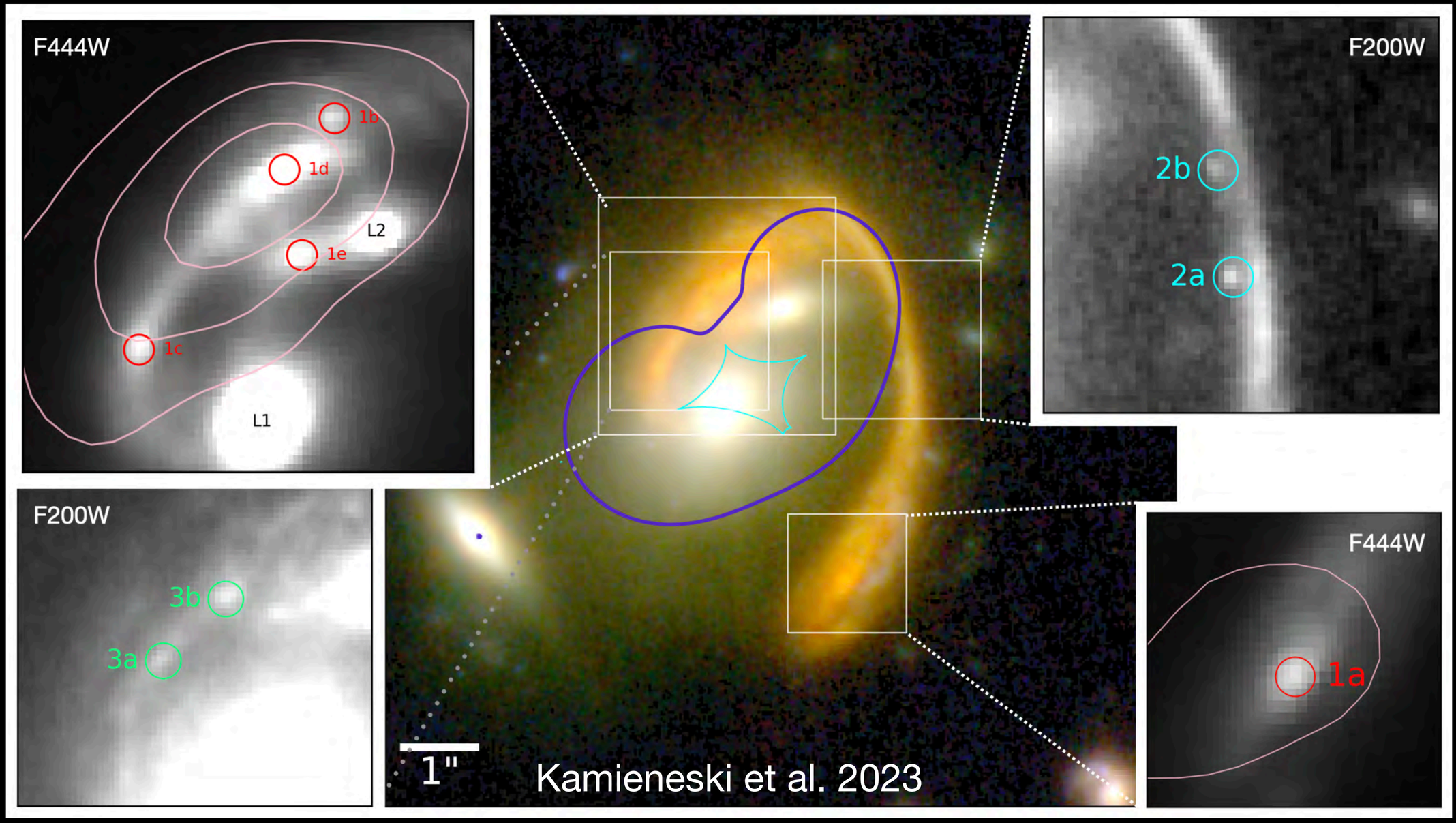
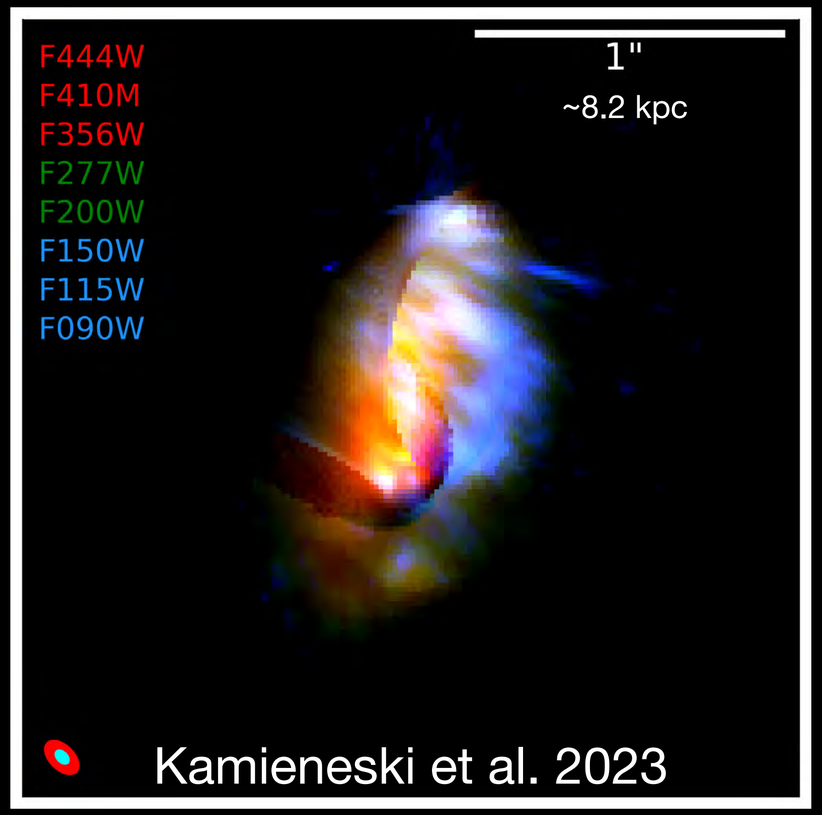


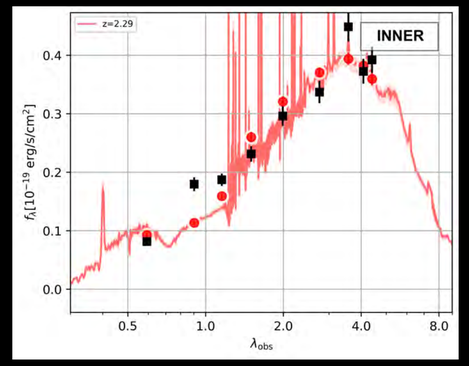
Carefully identifying features of the galaxy that are “multiply imaged” lets us model the distribution of foreground mass

Unraveling the lensing distortion to recover what the galaxy actually looks like…

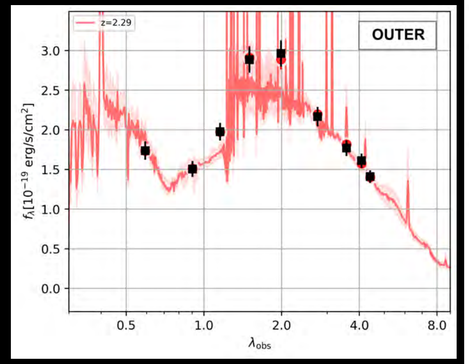


El Anzuelo shows signs of "inside-out" quenching

- By analyzing the extent of the galaxy in 17 different *Hubble* and *JWST* filters…
- …and the shape of the spectrum for the inner vs. outer regions…
- We find evidence that the concentration of dust is amplified in the center, but star formation is also suppressed or "quenched" in the core

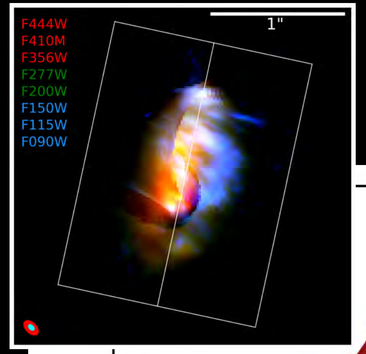


inner vs. outer



Fitting the *spectral energy distribution* reveals the galaxy's properties

Figures from Kamieneski et al. 2023



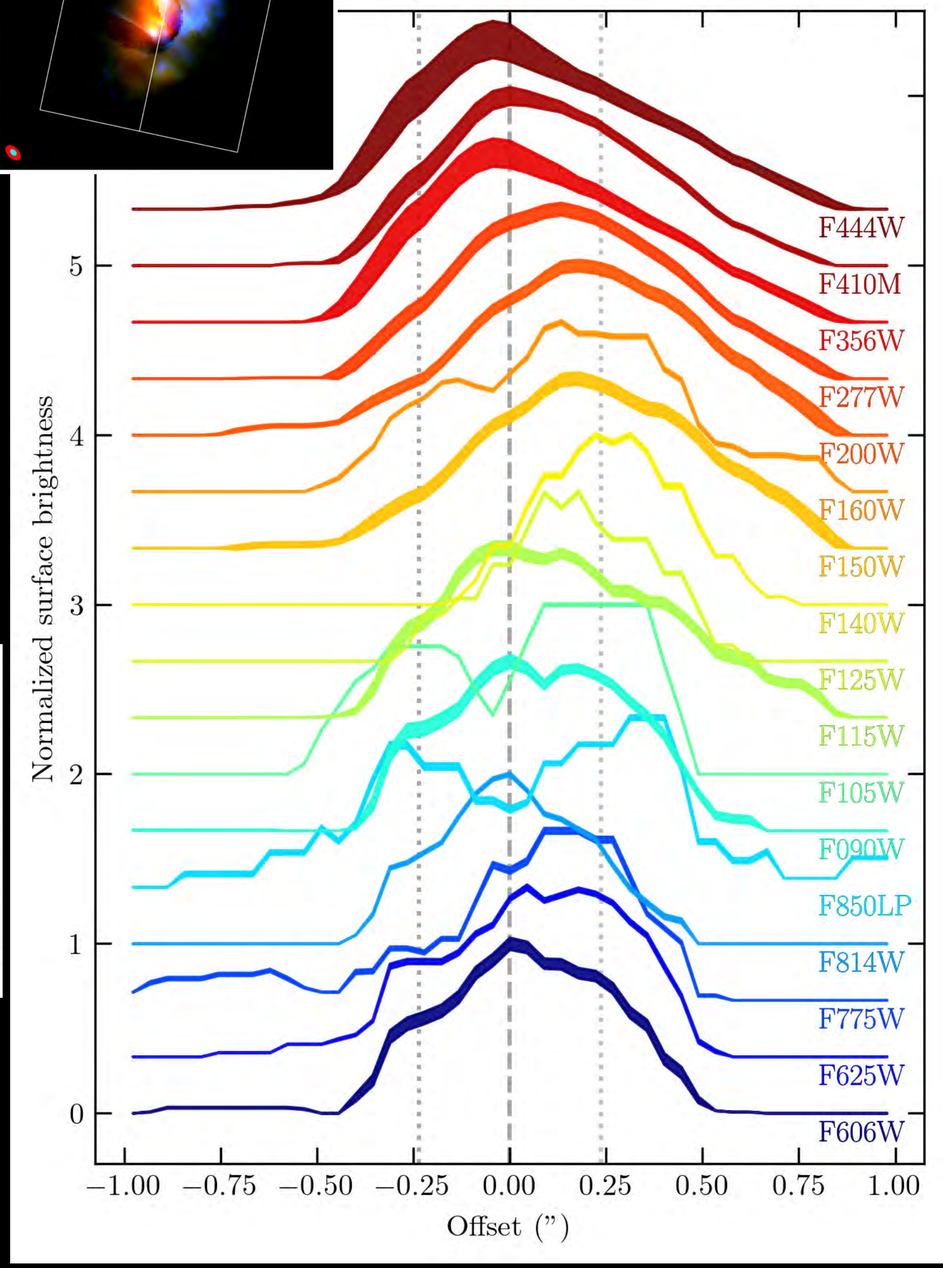



Image credit: Patrick Kamieneski, Rogier Windhorst, Anton Koekemoer,
Jake Summers, Jordan D’Silva, Aaron Robotham, Alyssa Pagan
Comparing the view
from *Hubble* vs. *JWST*…

Press release on JWST studies of the full *El Gordo* galaxy cluster, coming later this month!

All materials on *El Anzuelo* available now at:

this link

Video credit:
Stephen Filmer (ASU)

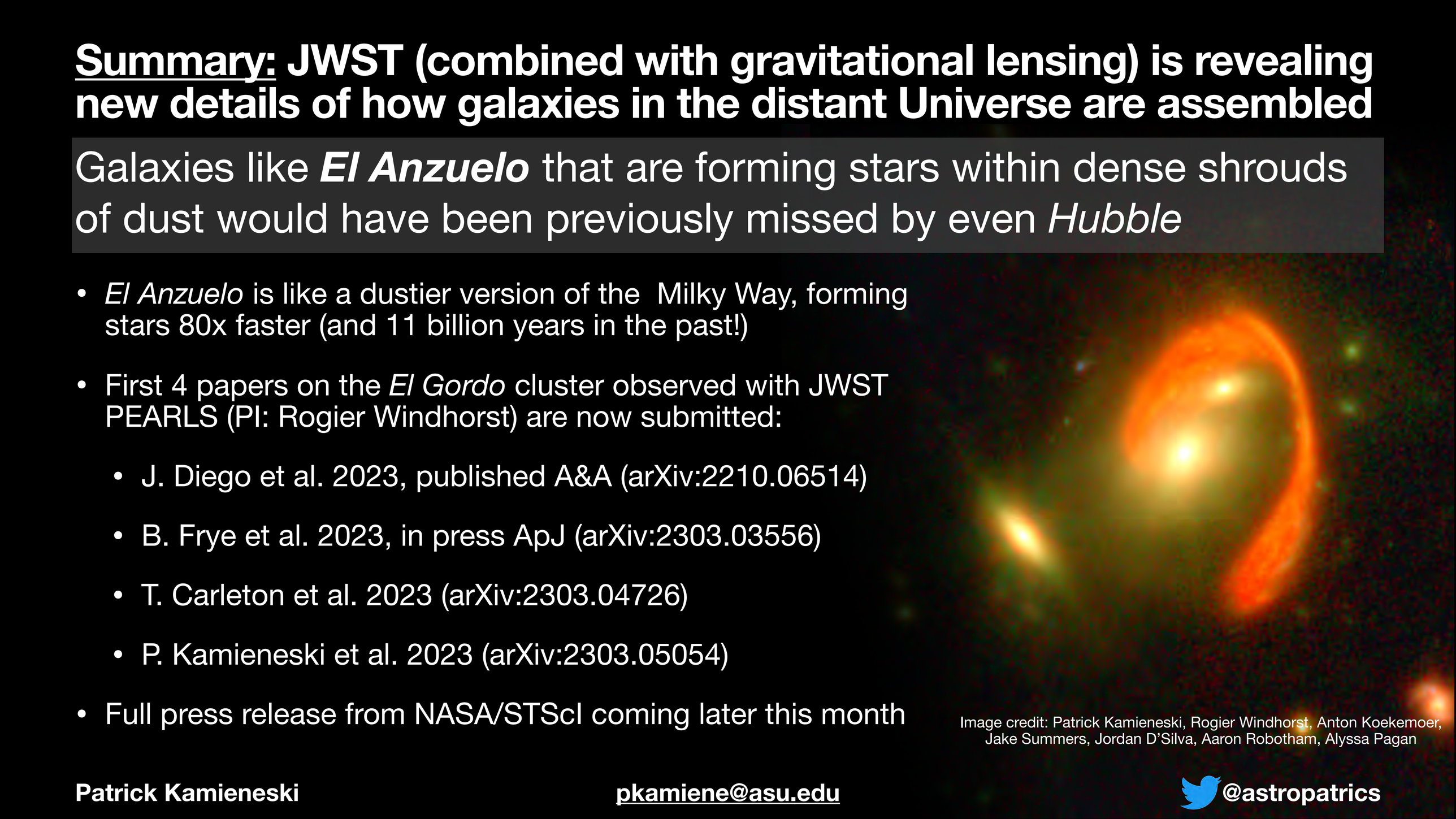
Full video describing *El Anzuelo* available now at:

https://www.dropbox.com/s/javfuay3n2vhiub/EL_ANZUELO_V4_press.mp4

<u>Summary:</u> JWST (combined with gravitational lensing) is revealing new details of how galaxies in the distant Universe are assembled

Galaxies like ***El Anzuelo*** that are forming stars within dense shrouds of dust would have been previously missed by even *Hubble*

- *El Anzuelo* is like a dustier version of the Milky Way, forming stars 80x faster (and 11 billion years in the past!)
- First 4 papers on the *El Gordo* cluster observed with JWST PEARLS (PI: Rogier Windhorst) are now submitted:
  - J. Diego et al. 2023, published A&A (arXiv:2210.06514)
  - B. Frye et al. 2023, in press ApJ (arXiv:2303.03556)
  - T. Carleton et al. 2023 (arXiv:2303.04726)
  - P. Kamieneski et al. 2023 (arXiv:2303.05054)
- Full press release from NASA/STScI coming later this month



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