

# The Crown Jewels of the JWST PEARLS Project

Rogier Windhorst (ASU) — Regents' Professor & JWST Interdisciplinary Scientist

+JWST PEARLS team: T. Carleton, S. Cohen, R. Jansen, P. Kamieneski, T. Acharya, H. Archer, J. Berkheimer, D. Carter, N. Foo, R. Honor, D. Kramer, T. McCabe, I. McIntyre, R. O'Brien, R. Ortiz, J. Summers, S. Tompkins, C. Conselice, J. Diego, S. Driver, J. D'Silva, B. Frye, H. Yan, D. Coe, N. Grogin, W. Keel, A. Koekemoer, M. Marshall, N. Pirzkal, A. Robotham, R. Ryan Jr., C. Willmer + 100 more scientists over 18 time-zones

## JWST North Ecliptic Pole Time Domain Field – Spoke 1 JWST NIRCam + HST ACS&WFC3

HST F275W  
HST F435W  
HST F606W  
F090W  
F115W  
F150W  
F200W  
F277W  
F356W  
F410M  
F444W



NASA / ESA / CSA, R. Jansen, J. Summers, R. O'Brien, and R. Windhorst (Arizona State University),  
A. Robotham (ICRAR/UWA), A. Koekemoer (STScI), C. Willmer (UofA), and the PEARLS team; 11-filter composite by R. Jansen (ASU);  
additional image processing by A. Pagan (STScI)

Dec 10 2022

SESE Symposium, Wednesday Aug. 16, 2023 (ASU, Tempe, AZ)

PEARLS = Prime Extragalactic Areas for Reionization and Lensing Science (Windhorst<sup>+</sup> 2023, AJ, 165, 13; astro-ph/2209.04119).



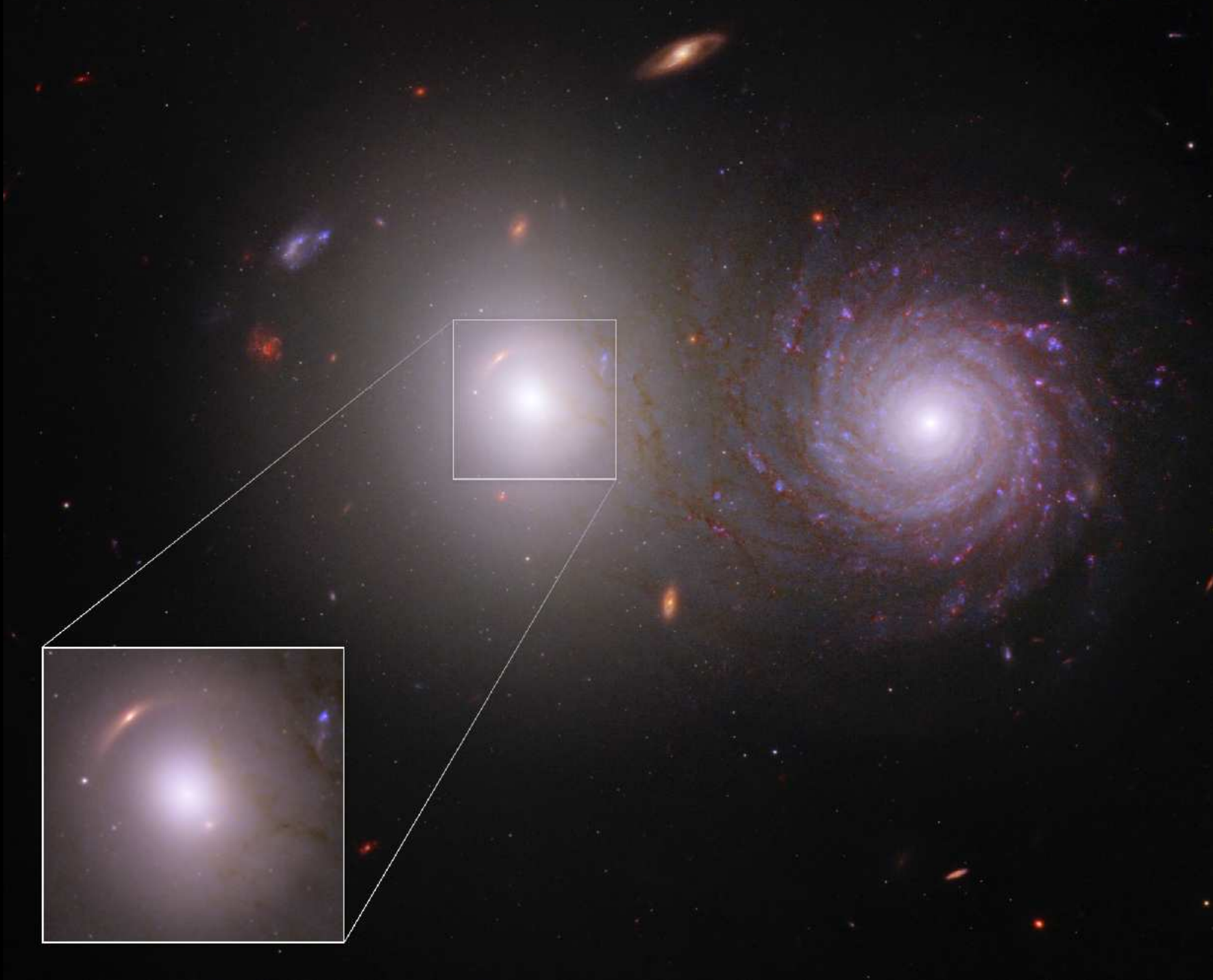
North Ecliptic Pole (NEP) Time Domain Field (TDF) from PEARLS project

— some remarkable results in PEARLS and other JWST projects:

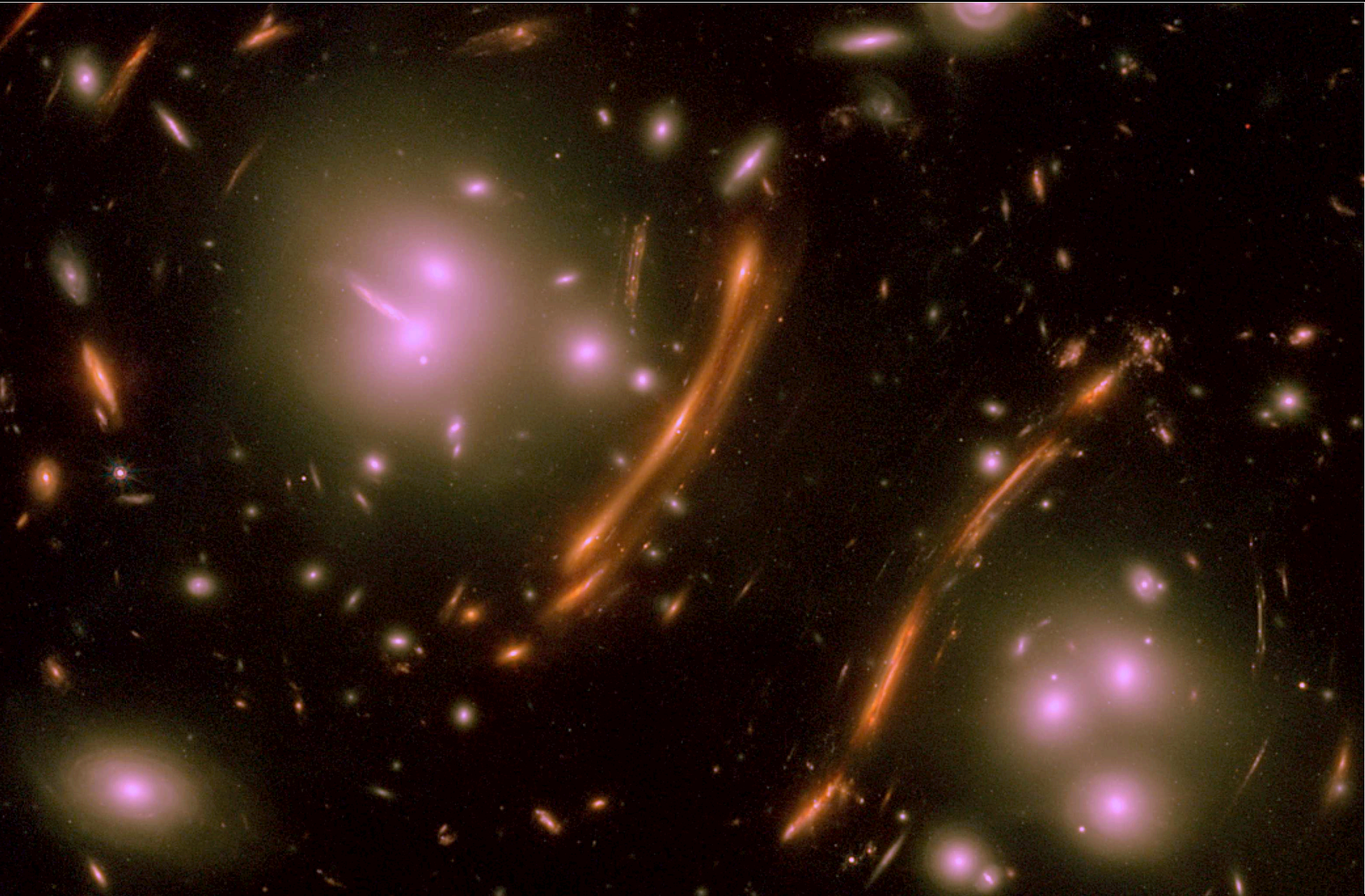
- (Old star) tidal tails everywhere (J. Summers<sup>+</sup> astro-ph/2306.13037);
- $\lesssim 1\%$  of objects variable: AGN & SNe (R. O'Brien, R. Jansen<sup>+</sup> 2023);
- Gravitational (galaxy-galaxy) lensing common (Keel<sup>+</sup> 23, AJ, 165, 166).



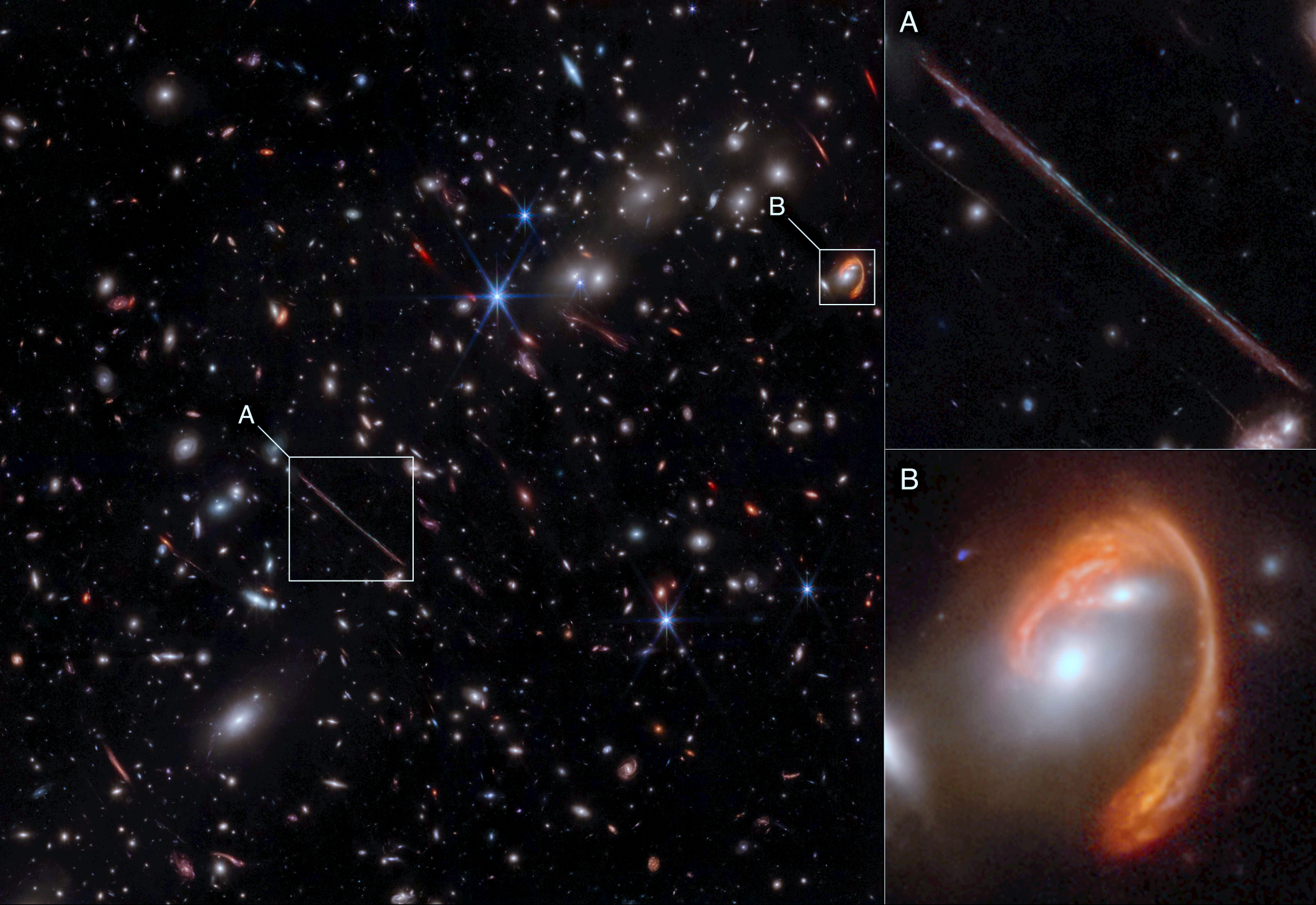
- Spiral overlapping Elliptical: Trace cosmic dust: small grains! (Keel<sup>+</sup> 2023).
- 100's of Globular Clusters in Elliptical at 0.7 Blyr (J. Berkheimer<sup>+</sup> 2023).



... and the Elliptical also lenses a galaxy seen 6 Byrs after Big Bang (Keel, et al. 2023, AJ, 165, 16)!



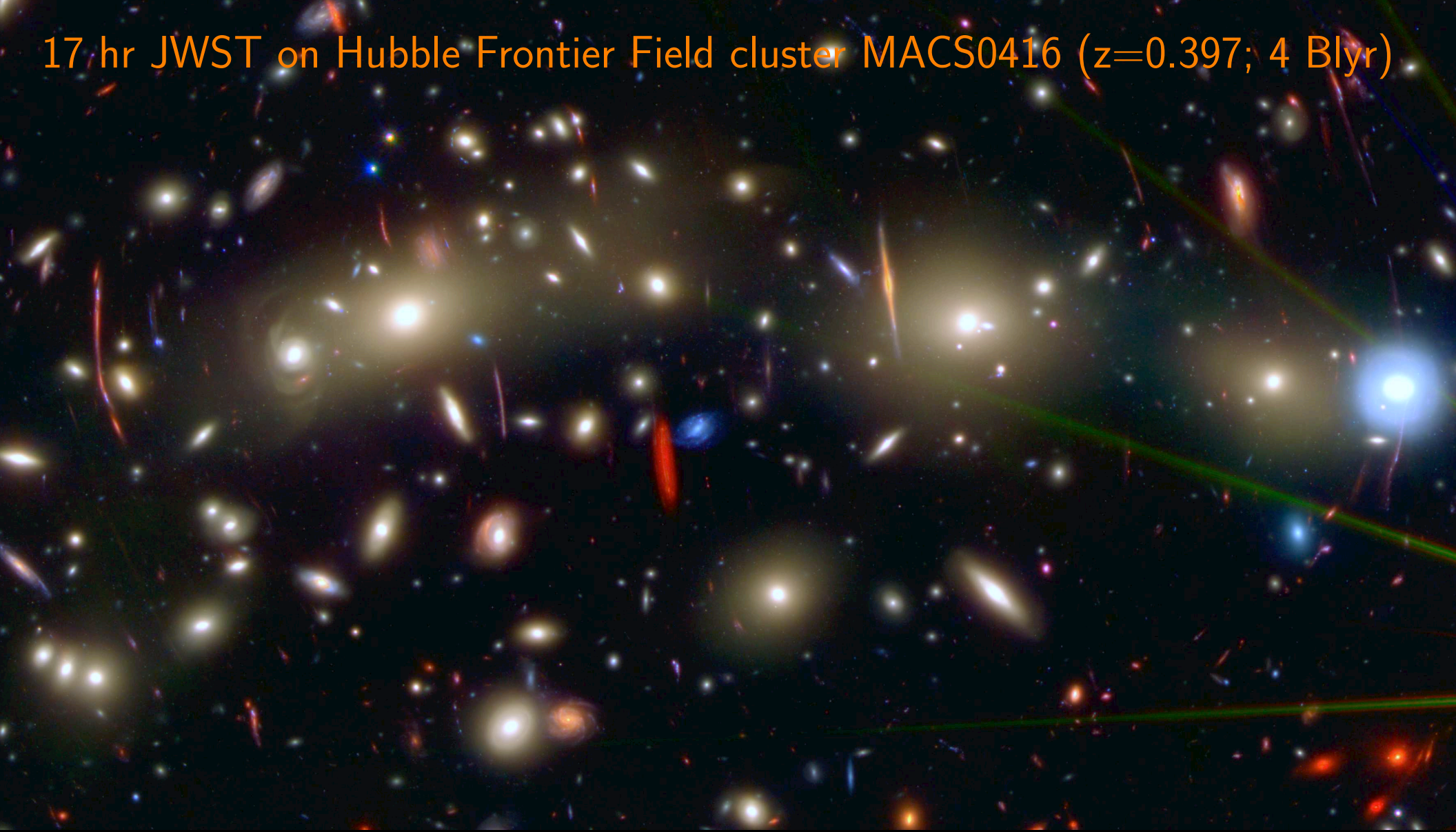
JWST image of most luminous far-IR Planck cluster G165 at  $z=0.35$  found:  
Highest- $z$  SN-Ia: 3 epochs, 9 points at  $z=1.78 \rightarrow H_0$  ? (Frye, Foo<sup>+</sup> 2023).



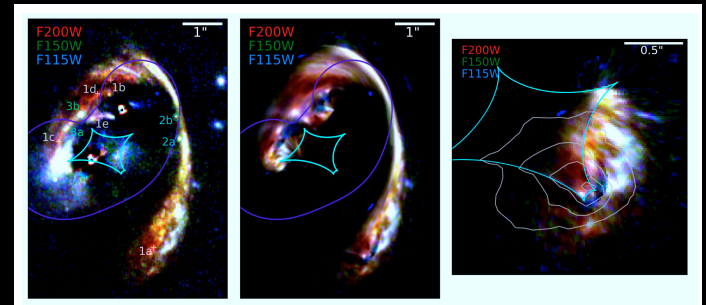
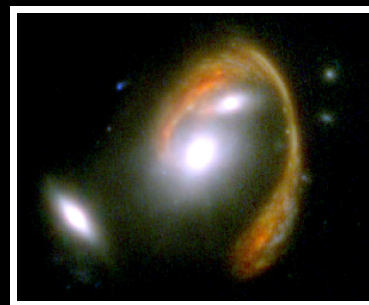
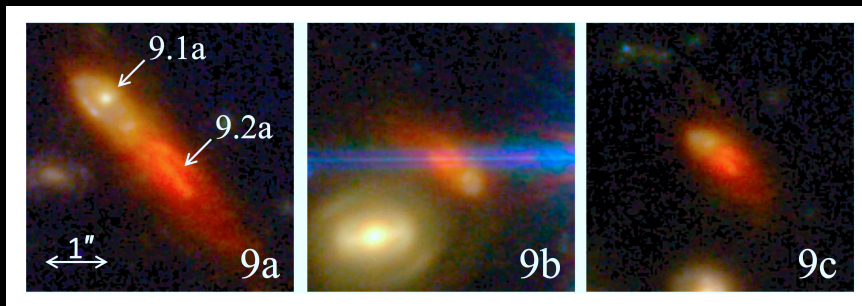
## 8-filter JWST/NIRCam of massive El Gordo cluster at redshift $z \approx 0.87$

T. Carleton<sup>+</sup> (2023, ApJ, 953, 83); P. Kamieneski<sup>+</sup> (astro-ph/2303.05054); J. Diego<sup>+</sup> (2023; A&A, 672, A3); B. Frye, N. Foo<sup>+</sup> (2023, ApJ, 952, 81).

17 hr JWST on Hubble Frontier Field cluster MACS0416 ( $z=0.397$ ; 4 Blyr)



JWST: Lensed Dusty sources behind El Gordo in first few Byrs (P. Kamieneski<sup>+</sup>; astro-ph/2303.05054):



## ● References and other sources of material

Talk: [http://www.asu.edu/clas/hst/www/jwst/sese\\_symp23.pdf](http://www.asu.edu/clas/hst/www/jwst/sese_symp23.pdf) Data: <https://sites.google.com/view/jwstpearls>

Carleton, T., Windhorst, R. A., O'Brien, R., et al. 2022, AJ, 164, 170 (astro-ph/2205.06347)

Carleton, T., Cohen, S. H., Frye, B., et al. 2023, ApJ, 953, 83 (astro-ph/2303.04726)

Cheng, C., Huang, J.-S., Smail, I., et al. 2023, ApJ, 942, L19 (astro-ph/2210.08163)

Diego, J. M., Meena, A. K., Adams, N. J., et al. 2023, A&A, 672, A3 (astro-ph/2210.06514)

Duncan, K. J., Windhorst, R. A., et al. 2023, MNRAS, 522, 4548–4564 (astro-ph/2212.09769)

Ferreira, L., Adams, N., Conselice, C. J., et al. 2022, ApJL, 938, L2 (astro-ph/2207.09428)

Frye, B. L., Pascale, M., Foo, N., et al. 2023, ApJ, 952, 81 (astro-ph/2303.03556)

Kamieneski, P. S., Frye, B. L., Pascale, M., et al. 2023, ApJ, in press (astro-ph/2303.05054)

Keel, W. C., Windhorst, R. A., Jansen, R. A., et al. 2023, AJ, 165, 166 (astro-ph/2208.14475)

Kramer, D. M., Carleton, T., Cohen, S. H., et al. 2022, ApJL, 940, L15 (astro-ph/2208.07218v2)

O'Brien, R., Carleton, T., Windhorst, R. et al. 2023, AJ, 165, 237 (astro-ph/2210.08010)

Polletta, M. del Carmen, Nonino, M., Frye, B., et al. 2023, A&AL, 675, L4 (astro-ph/2306.12385)

Summers, J., Windhorst, R. A., Cohen, S. H., et al. 2023, ApJ, resubmitted (astro-ph/2306.13037)

Windhorst, R., Timmes, F. X., Wyithe, J. S. B., et al. 2018, ApJS, 234, 41 (astro-ph/1801.03584)

Windhorst, R. A., Carleton, T., O'Brien, R., et al. 2022, AJ, 164, 141 (astro-ph/2205.06214)

Windhorst, R. A., Cohen, S. H., Jansen, R. A., et al. 2023, AJ, 165, 13 (astro-ph/2209.04119)

Yan, H., Cohen, S. H., Windhorst, R. A., et al. 2023, ApJL, 942, L8 (astro-ph/2209.04092)

<https://hubblesite.org/contents/news-releases/2022/news-2022-050>

<https://blogs.nasa.gov/webb/2022/10/05/webb-hubble-team-up-to-trace-interstellar-dust-within-a-galactic-pair/>

<https://blogs.nasa.gov/webb/2022/12/14/webb-glimpses-field-of-extragalactic-pearls-studded-with-galactic-diamonds/>

<https://esawebb.org/images/pearls1/zoomable/>

<https://webbtelescope.org/contents/news-releases/2023/news-2023-119>

<https://news.asu.edu/20230801-jwsts-gravitational-lens-reveals-distant-objects-behind-el-gordo-galaxy-cluster>