The GLASS-JWST Early Release Science Program.

Stage I release of NIRCam imaging and catalogs in the Abell 2744 region.

This directory contains images, catalogs and the strong lensing parametric model released as part of the GLASS-JWST Stage 1 release of the NIRCAM data in the Abell 2744 field, as obtained from 3 JWST programs: GLASS-JWST (PI: Treu, T.), UNCOVER (PIs: Bezanson, R. and Labbé, I.) and DDT-2756 (PI: Chen, W.). Please refer to Treu, T. et al 2022 for more details on the GLASS-JWST Early Release Science Program, to Paris et al. 2023, ApJ, in press for detailed information on images and catalogs and to Bergamini et al. 2023c, ApJ, in press for detailed information on the lensing model. **Please cite the papers if you use the data for your research**.

History

- 2023 June 29: added strong lensing parametric model
- 2023 April 27: data products compliant with MAST guidelines (review)
- 2023 April 18: data products compliant with MAST guidelines
- 2023 January 11: added flag list
- 2023 January 9: updated catalog files to correct a small bug affecting the WFC3 bands + release of catalogs in FITS format
- 2023 January 5: First release, announcement posted on Astro-ph

Version coding

Image version is currently v1.0. Newly processed images will be released as v1.1 and so on. Catalog version is inherited from the image version so it is uniquely associated to the parent images.
For instance, images looks like: hlsp_glass-jwst_jwst_nircam_abell2744_F444W_v1.0_sci.fits and the catalog is : hlsp_glass-jwst_jwst_nircam_abell2744_multiband_v1.0_cat.fits
Strong lensing parametric model version is currently v2.0.

Images

Images are in FITS format and have been taken in 8 bands: F090W, F115W, F150W, F200W, F277W, F356W, F410M, F444W.
Images in F090W and F410M do not cover the entire area, as they have been obtained for GLASS-JWST and UNCOVER only, respectively.
All images are in FITS format and have been flux-scaled to microJy (ZP_AB=23.9).
Images named **hlsp_glass-jwst_jwst_nircam_abell2744_F????_v1.0_sci.fits** are the science images. Images named **hlsp_glass-jwst_jwst_nircam_abell2744_F????_v1.0_rms.fits** contains the rms image in the same flux scale. F???? is the filter (F090W etc).
For more detail please refer to Paris et al. 2023, ApJ, in press

Catalog

We have built a multi-wavelength photometric catalog. We have first used SExtractor (Bertin et al. 1996) to detect sources in the F444W band. In the other bands we have PSF-

matched the images to F444W and measured colours in a set of apertures using the A-PHOT code (Merlin et al. 2019). The derived colours have been normalised to the total (Kron) F444W flux, again measured with A-PHOT.
We release the catalog as multi-extensions fits file, where each extension contains data corresponding to the aperture specified in EXTNAME keyword. Every extension contains total fluxes, estimated using colours measured on PSF-matched images in the relevant aperture: these are 2x, 3x, 8x and 16x F444W FWHM (diameter, which correspond to 0.28", 0.42", 1.12" and 2.24") and in the isophotal (segmentation) aperture. Along with all the NIRCam bands (F090W, F115W, F150W, F200W, F277W, F356W, F410M, F444W) we also computed photometry including existing images obtained with the Hubble Space Telescope (HST) in previous programs namely including the F435W, F606W, F775W and F814W bands with ACS and the F105W, F125W, F140W and F160W bands with WFC3 (images provided by Gabriel Brammer, resource here). Note that all files contain the same 24,389 objects in the same order. A summary of the 48 columns contained in the catalog is reported here:

Index	Name	Units	Description
1	ID		ID of the source
2	RA	deg	Right Ascension
3	DEC	deg	Declination
4	X	pix	X pixel coordinate
5	Y	pix	Y pixel coordinate
6	isoarea_SE		SExtractor segmented isoarea in detection band F444W
7	class_starSE	pix	SExtractor point-like probability in detection band F444W
8	flags_SE		SExtractor flags in detection band F444W
9	r50_SE	pix	SExtractor half light radius in detection band F444W
10	f_autoSE	μJy	SExtractor AUTO flux in detection band F444W
11	e_autoSE	μJy	SExtractor AUTO flux error in detection band F444W
12	a_f444w	pix	Major semi-axis in detection band F444W
13	ell_f444w		Ellipticity in detection band F444W
14	theta_f444w	deg	Position angle in detection band F444W
15	rKron_f444w	pix	Kron major semi-axis in detection band F444W
16	f_f435w	μJy	APHOT total flux in F435W band
17	f_f606w	μJy	APHOT total flux in F606W band
18	f_f775w	μJy	APHOT total flux in F775W band
19	f_f814w	μJy	APHOT total flux in F814W band
20	f_f105w	μJy	APHOT total flux in F105W band
21	f_f125w	μJy	APHOT total flux in F125W band
22	f_f140w	μJy	APHOT total flux in F140W band
23	f_f160w	μJy	APHOT total flux in F160W band
24	f_090fw	μJy	APHOT total flux in F090W band
25	f_f115w	μJy	APHOT total flux in F115W band
26	f_f150w	μJy	APHOT total flux in F150W band
27	f_f200w	μJy	APHOT total flux in F200W band
28	f_f277w	μJy	APHOT total flux in F277W band
29	f_f356w	μJy	APHOT total flux in F356W band
30	f_f410m	μJy	APHOT total flux in F410M band
31	f_f444w	μJy	APHOT total flux in F444W band
32	e_f435w	μJy	APHOT total flux error in F435W band
33	e_f435w	μJy	APHOT total flux error in F606W band
34	e_f435w	μJy	APHOT total flux error in F775W band
35	e_f435w	μJy	APHOT total flux error in F814W band
36	e_f435w	μJy	APHOT total flux error in F105W band
37	e_f435w	μJy	APHOT total flux error in F125W band
38	e_f435w	μJy	APHOT total flux error in F140W band
39	e_f435w	μJy	APHOT total flux error in F160W band
40	e_f435w	μJy	APHOT total flux error in F090W band
41	e_f435w	μJy	APHOT total flux error in F115W band
42	e_f435w	μJy	APHOT total flux error in F150W band
43	e_f435w	μJy	APHOT total flux error in F200W band
44	e_f435w	μJy	APHOT total flux error in F277W band
45	e_f435w	μJy	APHOT total flux error in F356W band
46	e_f435w	μJy	APHOT total flux error in F410M band
47	e_f435w	μJy	APHOT total flux error in F444W band

48	FLAG	FLAG (0: good object, 1: fake object)

Photometry methods are also described in Merlin et. al 2022 and they are also based on previous experience with HST (CANDELS, Galametz et. al 2013 and AstroDeep, Merlin et al. 2016, Merlin et al. 2021).
For more detail please refer to Paris et al. 2023, ApJ, in press

NOTES:

- All fluxes and errors are given in microJy (ZP_AB=23.9)
- APHOT fluxes and errors are computed in the given aperture, corresponding to the specific catalog EXTNAME
- A few objects in the catalog do not correspond to physical objects, as they are due to image defects of various sources. This is reported in the last catalog column: Flag (0: good object, 1: fake object)

Lens Model

The lens model is developed with the public software LensTool (Kneib et al 1996, Jullo et al 2007, Jullo & Kneib 2009). The mass distribution is parametrized with:

- 2 PIEMDs cluster-scale halos located close to the cluster BCG-N and BCG-S;
- 2 PIEMDs cluster-scale halos located close to the external bright galaxies G1 and G2, and G3 (external clumps);
- 5 dPIEs to describe the cluster galaxies BCG-N, BCG-S, G1, G2, and G3;
- 172 cluster galaxies modeled as circular coreless dPIEs and by using sigma-L, r_cut-L scaling relations.

The model is constrained by the point-like positions of 149 multiple images (121 spectroscopically confirmed with redshift between z=1.026 and z=9.756) from 50 background sources.
The positions of the images are determined by combining the Hubble Frontier Fields data (Lotz et al. 2017) with new JWST NIRCam observations obtained with the programs: GLASS -JWST (PI: T. Treu), UNCOVER (co-PIs: Labbé and Bezanson), DDT 2756 (PI: Chen)
The redshifts of the multiple images are largely measured with VLT/MUSE observations (GTO Program 094.A-0115, PI Richard; ESO DDT program 109.24EZ.001, co-PIs: Mason, Vanzella), including one system with JWST/NIRSpec at z~10.

The model final RMS precision in reproducing the position of the multiple images is 0.43"

For more details please see the paper Bergamini et al. 2023c, ApJ, in press

OUTPUTS:

The folder contains the following files:

- *_params-input.txt : Input LensTool parameter file
- *_arcs.txt : list of multiple images used as model constraints in LensTool format
- *_cluster-members.txt : list of cluster galaxies in LensTool format
- *_z*_magnif.fits : magnification maps computed for a redshift z
- *_gamma.fits : map of the shear modulus computed by assuming Dls/Ds=1
- *_gamma*.fits : maps of the shear components computed by assuming Dls/Ds=1
- *_kappa.fits : convergence map computed by assuming Dls/Ds=1
- *_deflect.fits : x and y components of the deflection maps (in arcsec or pixel units) computed by assuming Dls/Ds=1

The folder '/range' contains 200 shear and convergence maps (Dls/Ds=1 is assumed) created by randomly extracting parameter values from the model MCMC chains, which can be use d to compute the uncertainties on the model predicted quantities.