ZTF DR2 host-galaxy photometry with HostPhot: summary and challenges

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HostPhot

Tool for downloading, masking and calculating global and local photometry of galaxies hosting transients (uses SExtractor)

Please, cite the paper: Müller-Bravo & Galbany JOSS, 7, 4508 (2022)

Docs: https://hostphot.readthedocs.io

Available Surveys

survey	filters	zp	pixel_scale	mag_sys	mag_sys_conv
DES	grizY	30	0.263	AB	0.0
PS1	grizy	25	0.25	AB	0.0
SDSS	ugriz	22.5	0.396	AB	0.0
GALEX	FUV,NUV	18.82,20.08	1.5	AB	0.0
2MASS	J,H,Ks	header	1.0	Vega	0.91,1.39,1.85
WISE	W1,W2,W3,W4	header	1.375	Vega	2.699,3.339,5.174,6.620
unWISE	W1,W2,W3,W4	22.5	2.75	Vega	2.699,3.339,5.174,6.620
LegacySurvey	grz	22.5	0.262	AB	0.0
Spitzer	IRAC.1,IRAC.2,IRAC.3,IRAC.4,MIPS.1	header	0.6,2.45	AB	0.0
Vista	Z,Y,J,H,Ks	header	0.339	Vega	0.502,0.600,0.916,1.366,1.827
HST	WFC3/UVIS,WFC3/IR	header	0.04,0.13	AB	0.0
SkyMapper	uvgriz	header	0.5	AB	0.0
SPLUS	u,F378,F395,F410,F430,g,F515,r,F660,i,F861,z	header	0.55	AB	0.0
UKIDSS	ZYJHK	header	0.4	Vega	0.528,0.634,0.938,1.379,1.900
JWST	NIRCam_F090W,NIRCam_F150W,NIRCam_F277W	header	0.031,0.031,0.063	AB	0.0

Image Cutouts

Images for different surveys+filters can be easily downloaded
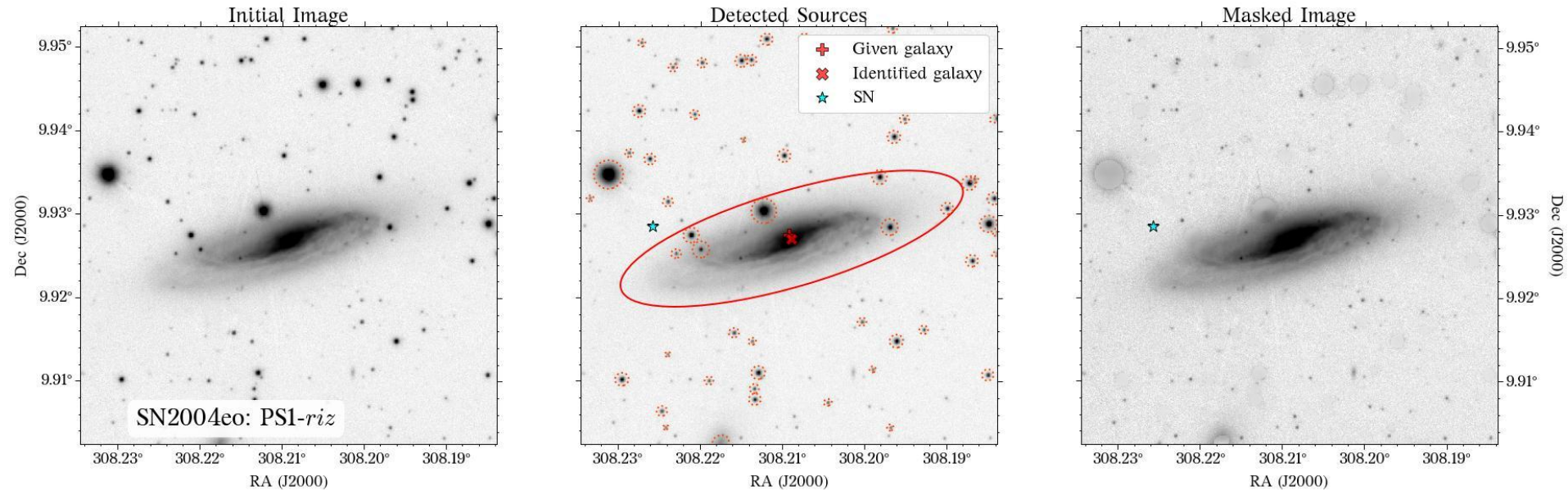
Inputs:

- Name
- Coordinates
- Survey
- Filters
- Size

PS1 g
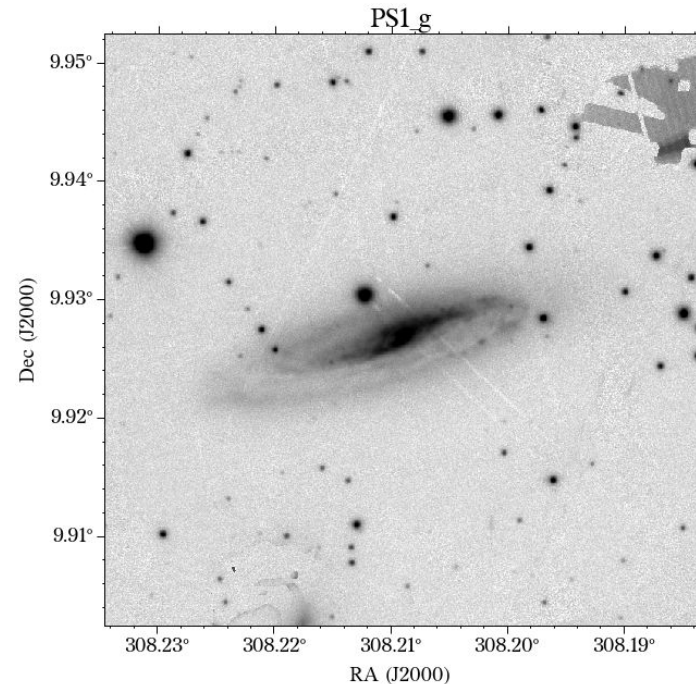
Coadds & Masking

Images from different filters can be coadded together (e.g. *g+r+i*)
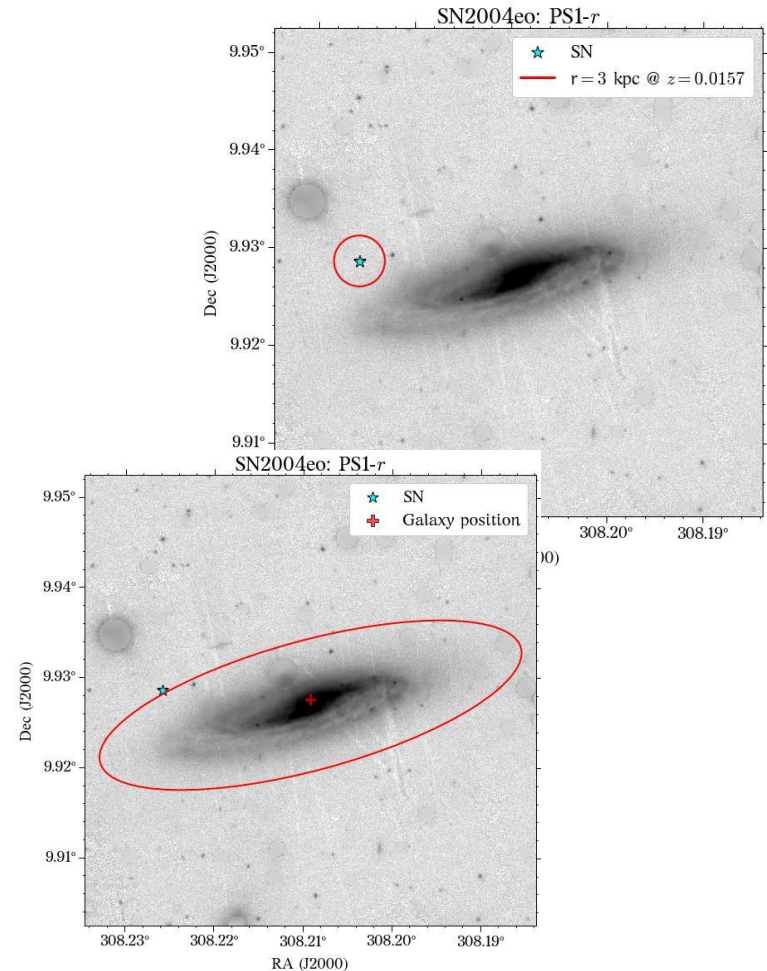
Sources of contamination can be masked out
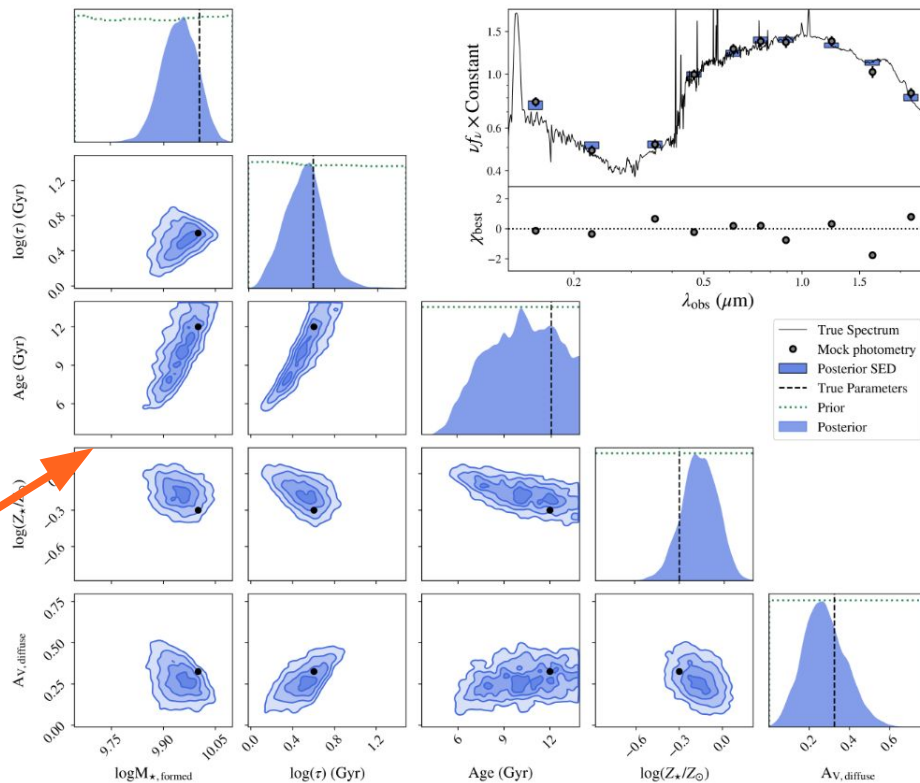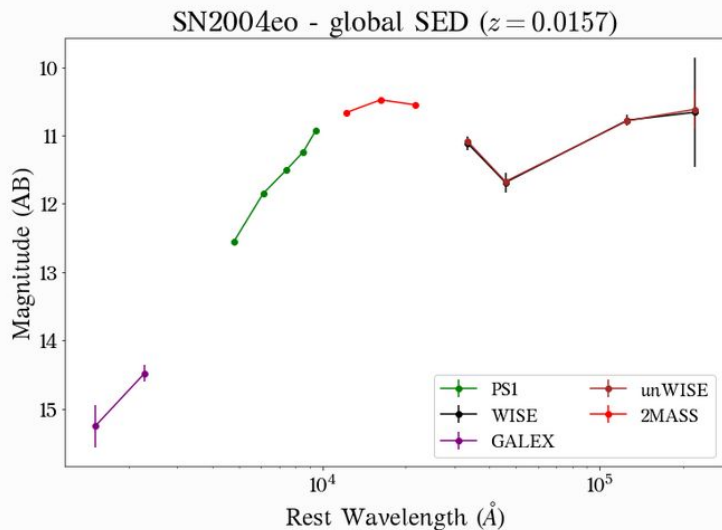
Local and Global Photometry

Local photometry is calculated for a physical radius (e.g. 3 kpc), assuming a cosmology

Global photometry can be "optimised", i.e. the aperture size is increased until there is no change in flux

Host SED + Properties

Once the photometry is ready, it is used as input for obtaining host properties!

SN2004eo - global SED ($z = 0.0157$)

Looks easy, yeah?

It is NOT!

There are many challenges, specially when dealing with large samples!

Host Photometry Challenges

- Selecting hosts or possible candidates
- Changes in the sample (hosts, coordinates, etc.)
- Surveys coverage (e.g. PS1, DES, LS)
- Image size
- **Masking sources of contamination**
- Obtaining global aperture

Other challenges?

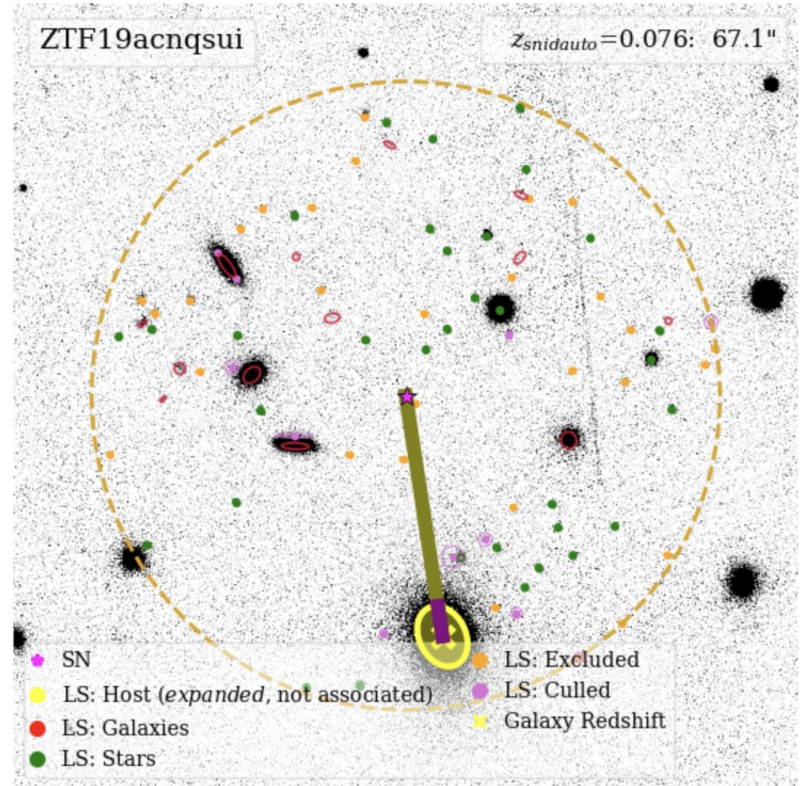Future challenges (DR2.5 & DR3)

- Calibration across wavelengths (e.g. PS1 + 2MASS)
- Use optical surveys as reference for the others?
- Visual inspection of (hundreds of) flagged hosts

Selecting Hosts + Changes in the Sample
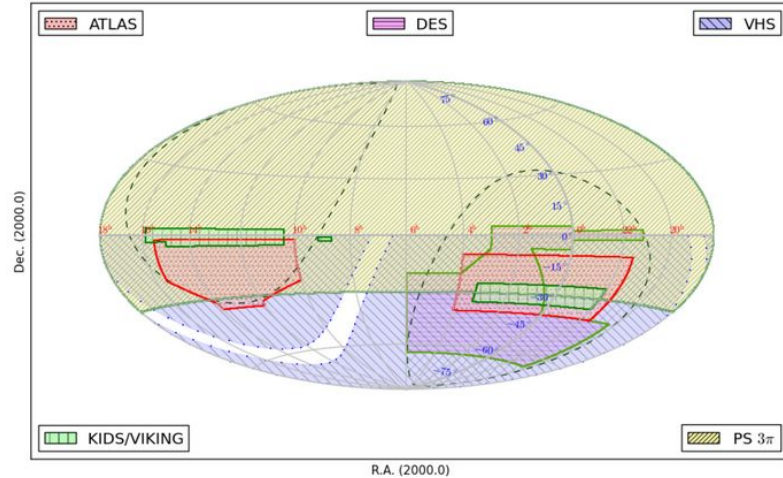
Selecting hosts is not trivial (DLR?)

Should we include candidates?

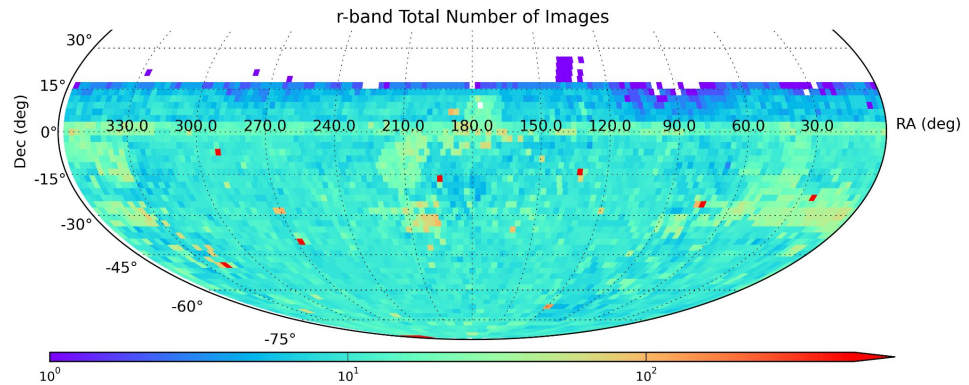If the sample is redefined, the photometry needs to be redone

Surveys Coverage

Selecting surveys is not always trivial, e.g. sky coverage, filters used, overlap with ZTF SNe (e.g. Legacy Survey)
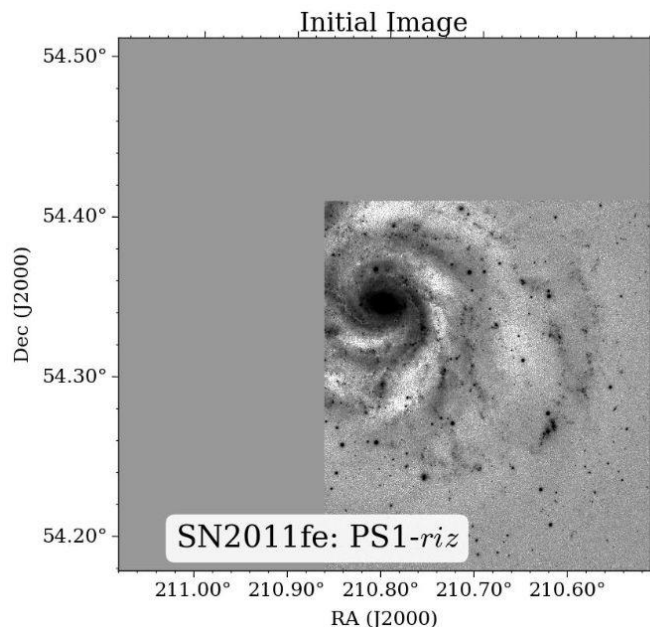

PanSTARRS

SkyMapper

Image size

Some galaxies are too big and some are too small

Physical size (e.g. 200 kpc) can be used to obtain the best image size

Masking Sources of Contamination

Masking is the main **bottleneck** of the entire process and affects particularly **low-z** SNe

- Foreground stars close to galaxy nuclei (masking too much!)
- Bright and faint sources (mask one or the other)
- Mergers (hard to mask - are we getting the right host?)
- Deciding when the masking looks good (human factor)
- HostPhot is not perfect!

Too many images to inspect by eye, so maybe a redshift cut can help reducing the sample size

Masking Sources of Contamination

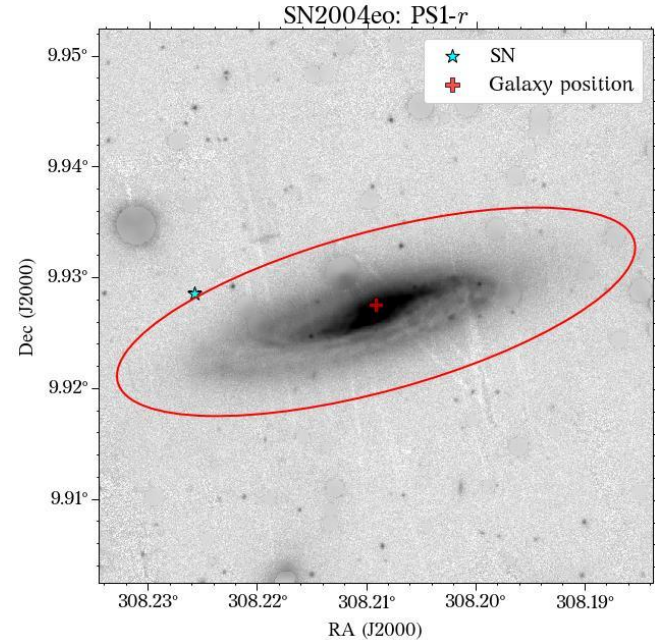Masking is the main **bottleneck** of the entire process and affects particularly **low-z** SNe
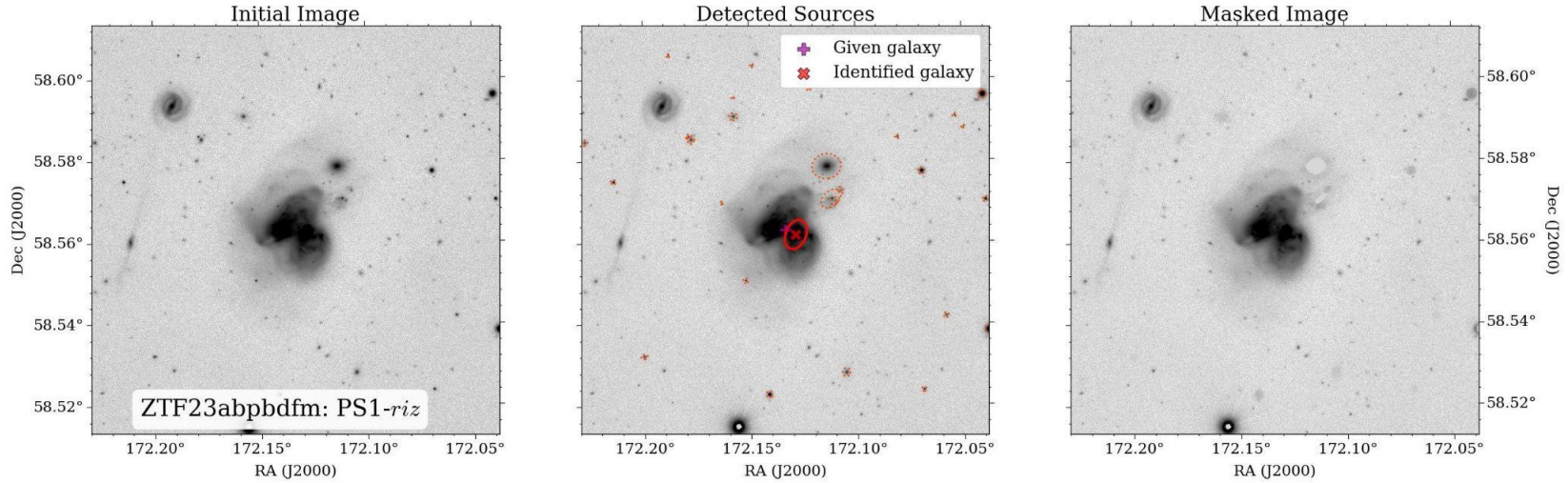
Obtaining Global Aperture

Coadds are used for this, but the filters depend on the survey

Should we "optimise" the aperture?

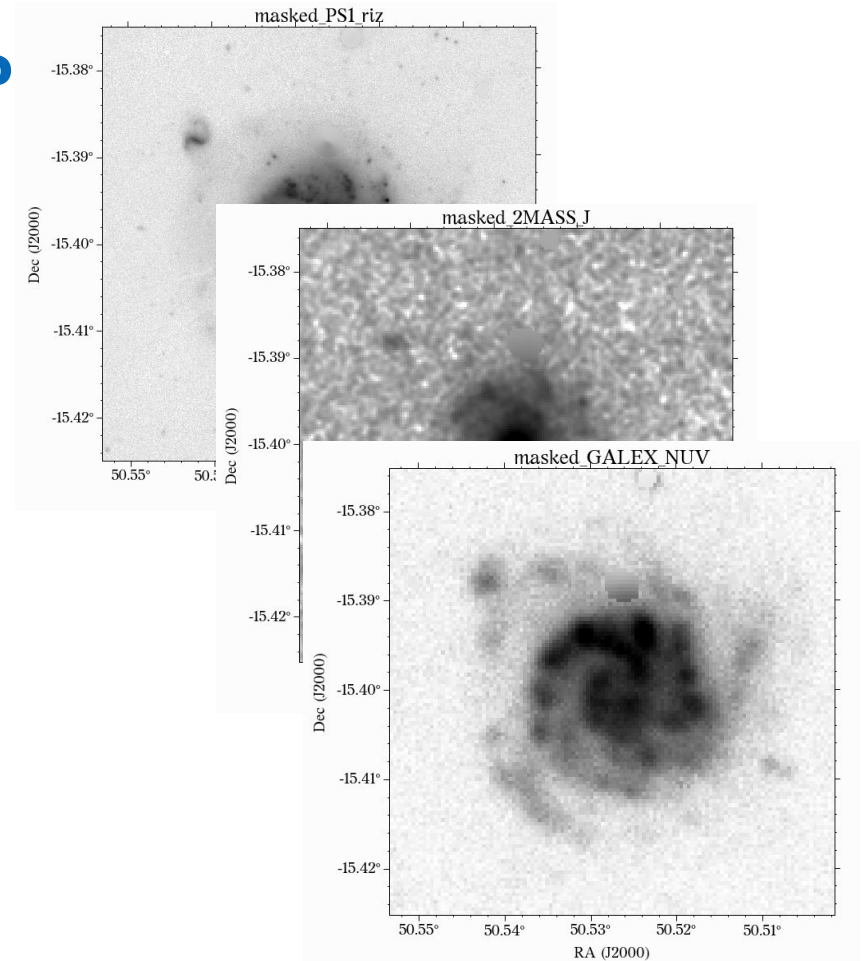This step is also a (minor) bottleneck and requires some inspection by eye

Optical Survey as Reference?
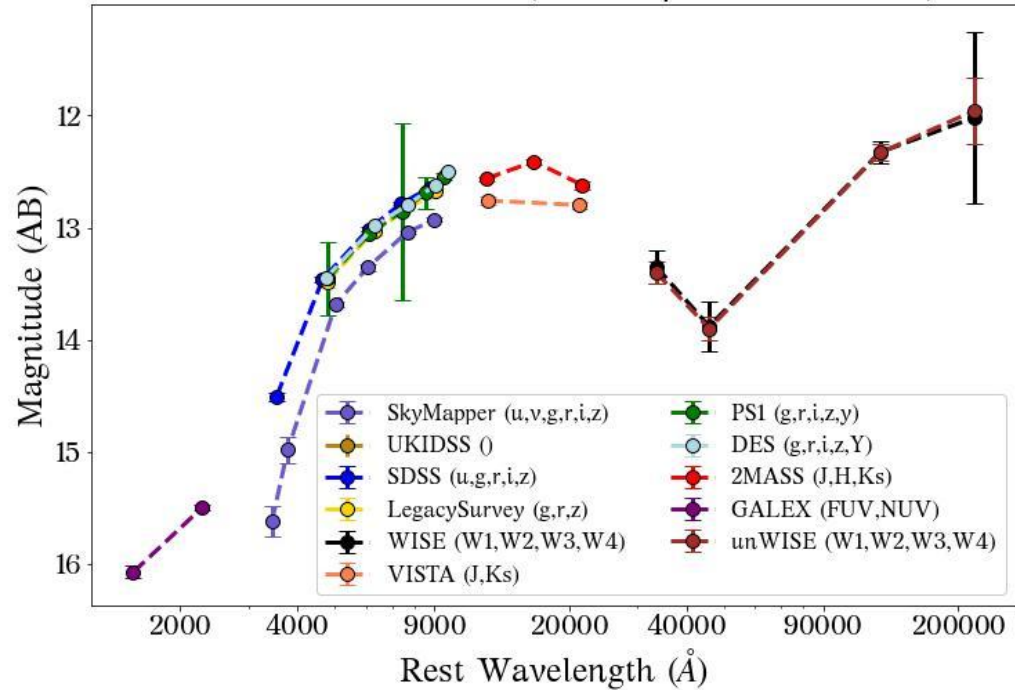
Image quality varies from survey to survey

Optical surveys are usually the best and can be used as *reference* for other surveys

However, the size of the sources changes with wavelengths as well

Calibration across wavelengths

2002fk - local SED ($r = 2$ kpc @ $z = 0.0157$)

Visual Inspection of Images

- Do we want to inspect every image by eye?
- Are there simple ways of flagging objects with issues?
- What is a god redshift to assume that no masking is needed?
- Who should inspect the images ("experts")?
- How should we inspect them?

Feedback from you!

- Host-galaxy photometry is not an easy task and cannot be fully automated

- Comparison to Blast measurements can be a good approach to detecting issues with the photometry

- Eye-inspection is needed for a relatively large fraction of the sample (20-30%? → hundreds to thousands of images)

- Could a Typing-app-like/Blast-like website be useful for inspecting images?