Transient detection in the HSC data
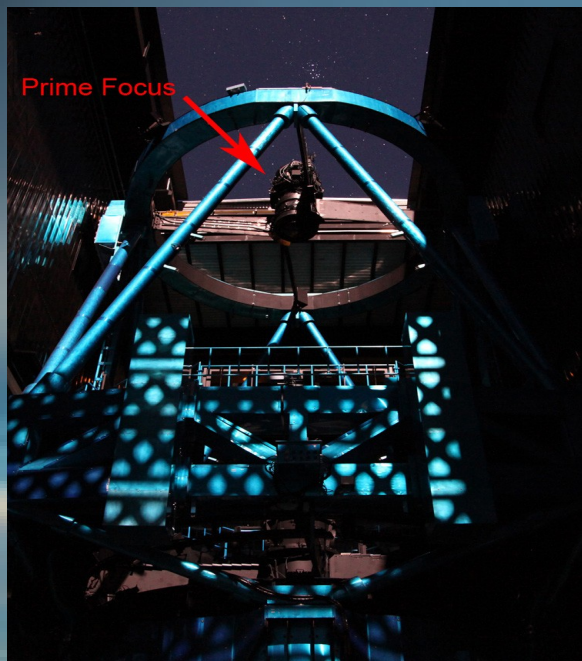
Manal Yassine, D. Fouchez, B. Racine (CPPM, Marseille)
N. Regnault, P. Astier, P.F. leget (LPNHE, Paris)
C. Saunders (Princeton univ.), P. Gris (LPC)

Nov 5, 2020

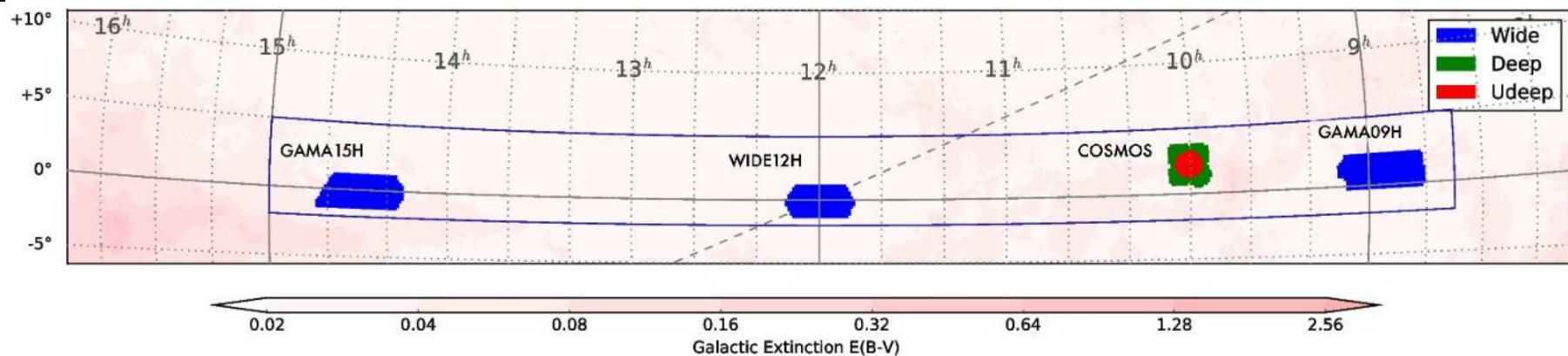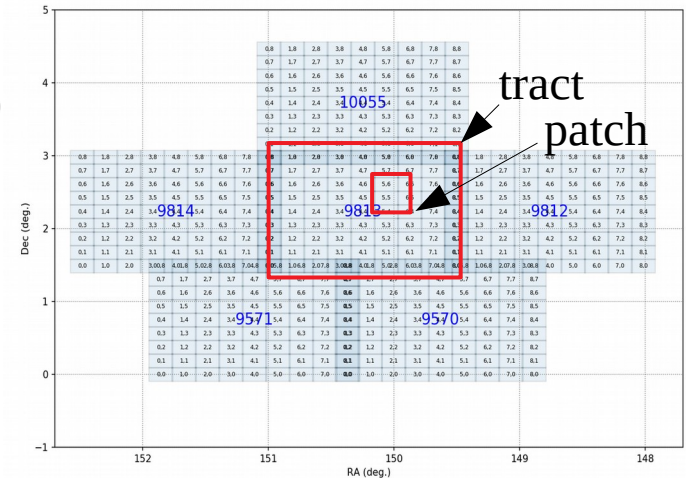Prime Focus

Subaru telescope

Hyper Suprime-Cam

mauna kea

HSC characteristics

Fast, Wide & Deep

300 nights over 5-6 years (started in March 2014)

- grizY+4 narrow bands
- Wide FoV: ~1.5° diameter
- Excellent Image quality: ~0.6" seeing
- 3 layers: - Wide (1400deg² , r~26)
  - Deep (27deg² , r~27)
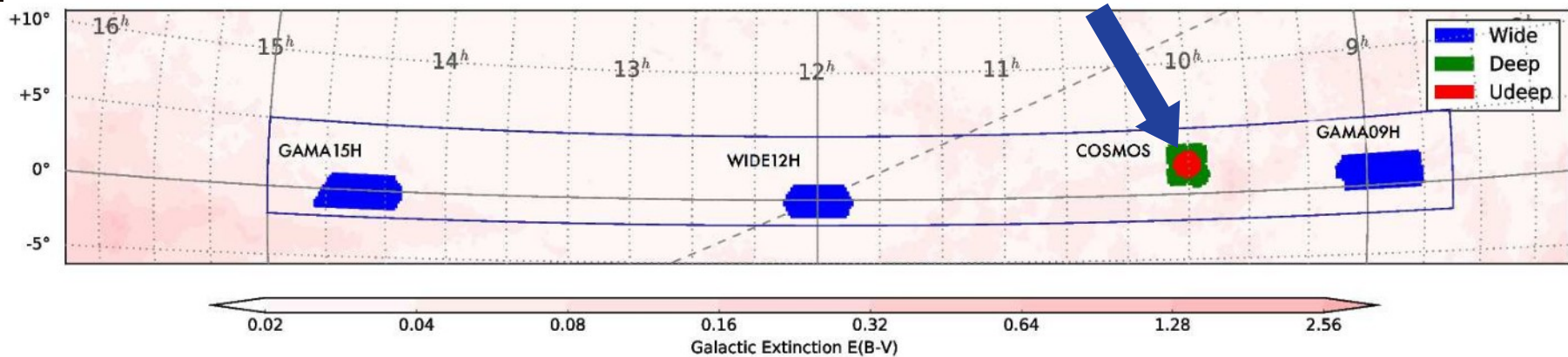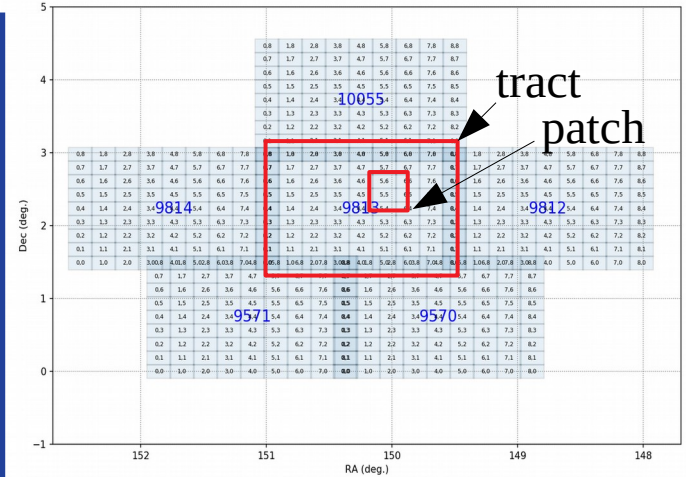 - Ultradeep (3-3.5deg² , r~27.7)

tract

patch

HSC characteristics

COSMOS: Cosmic Evolution Survey

- Astronomical survey designed to probe

the formation and evolution of galaxies

as a function of redshift

- It covers a 2 deg^2 equatorial field

**- ~ over 2 million galaxies are detected**

Ongoing work

Goal: evaluate the performance of the difference imaging pipeline

- Use the fake injection technique:

- Inject fakes onto science images (in calexps)

- Subtract images from a templates of stacked exposures (coadd)

- Check whether these fakes are detected from the difference image: detection efficiency
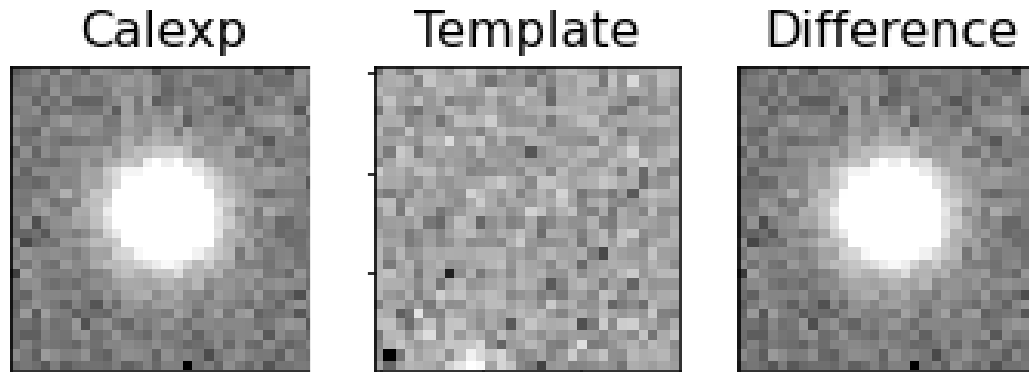
Used data & pipeline

- from 2 nights, PDR1 UDEEP COSMOS field

  - Filter: Z filter
  - Process exposures for 2 nights (2014-03-28, 2015-01-16)
  - Coaddition over 1 night (2015-01-16) → produce template
 - Add fakes on 3 visits (night 2014-03-28, visits: 1166, 1168, 1170)
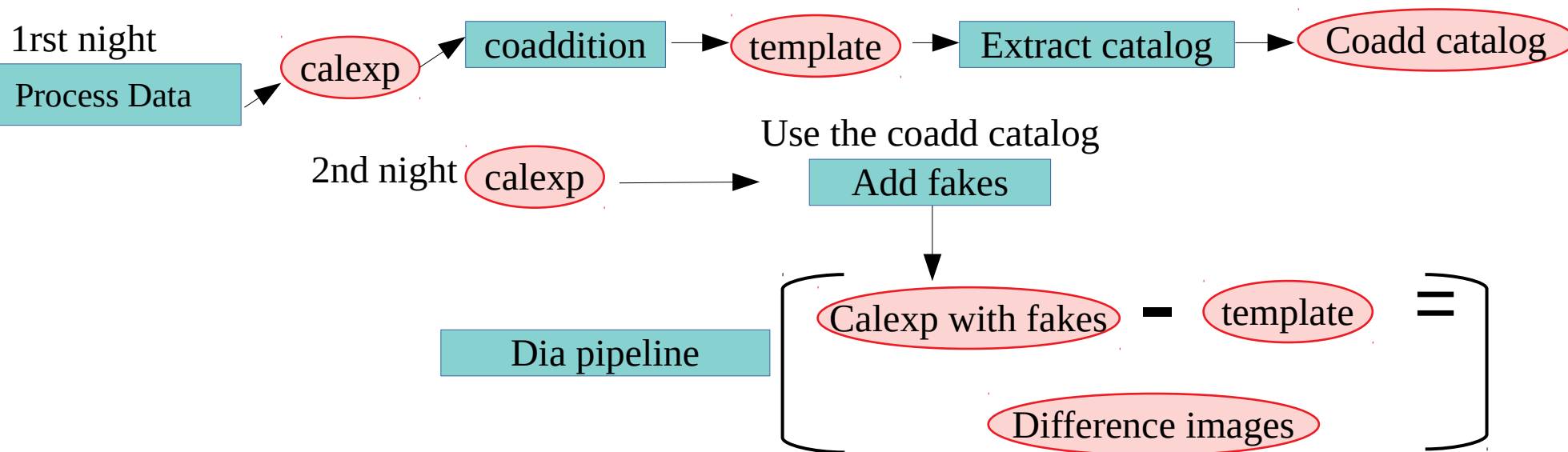
Fake injection

- Among the coadd catalog of patch 5,5, tract 9813

  - Select galaxies (without deblending)
  - Excluded flaged sources ('base_PixelFlags_flag', 'base_PsfFlux_flag')

- Generate fakes associated to a galaxy (on 10% of randomly chosen galaxies)
- Gaussian distribution to choose random position according to galaxy radius
- Flat distribution to choose mag ([galaxy mag -1, 27])
- Generate 2% fakes with random positions (witout galaxy association)
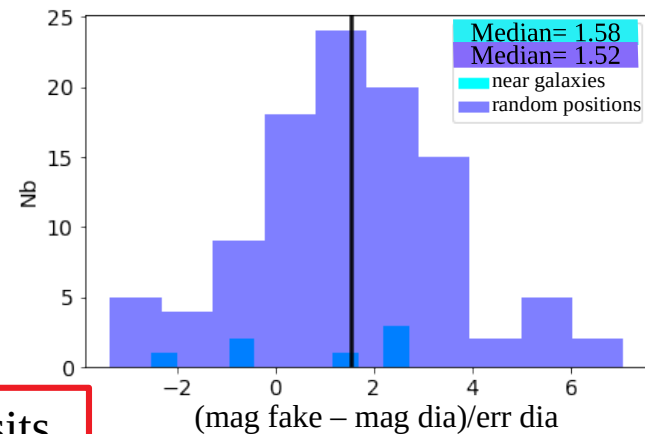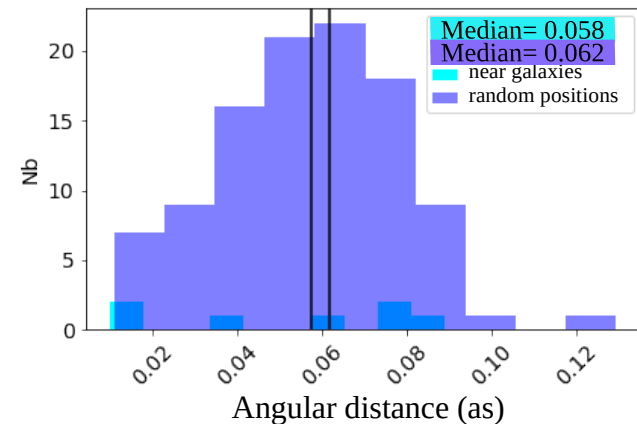- Check the detection within magnitude intervals

Mag of real galaxies

Mag of host galaxies

near galaxies
random positions

Fake mag
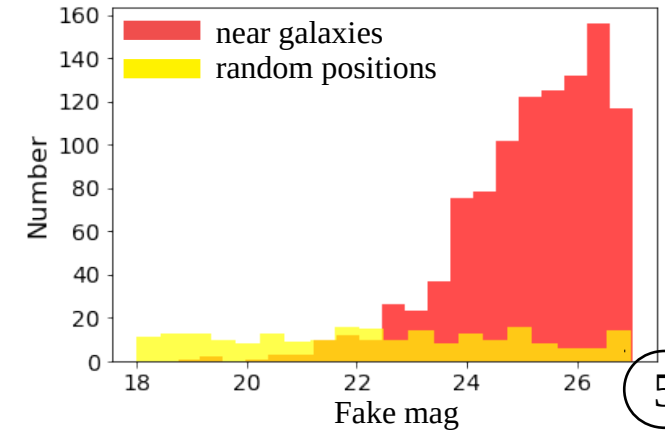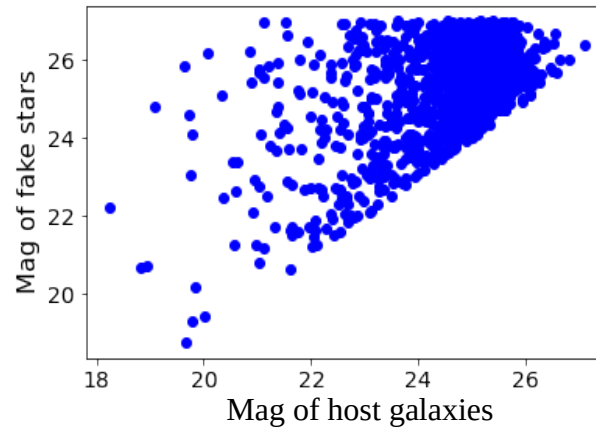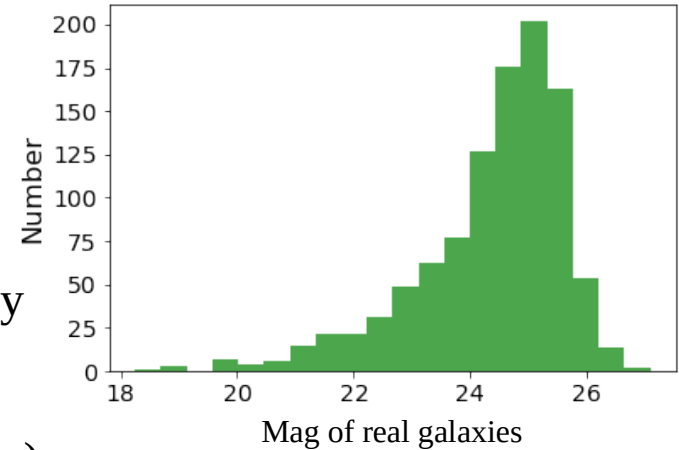
Bright fakes [18 - 20]

- Input 52 fakes with 18< mag < 20

- 46 among 52 are retrieved with angular distance < 0.12 as

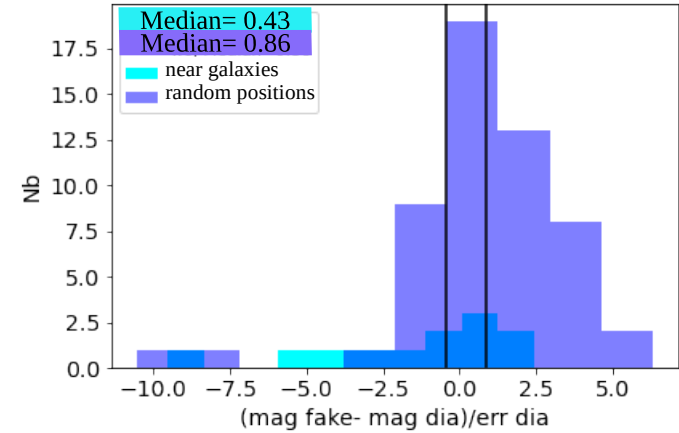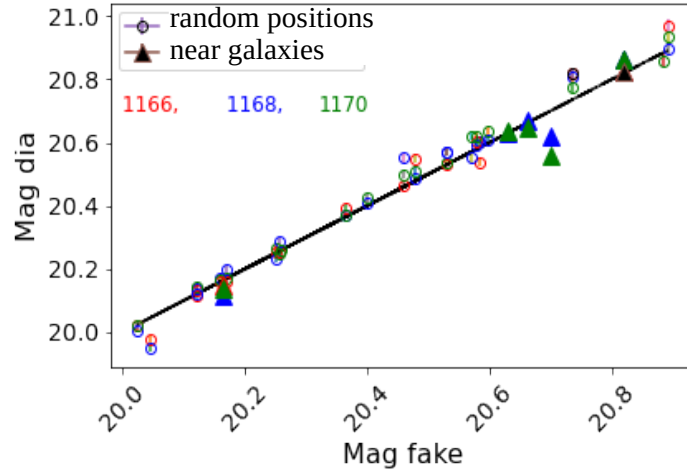- Only 3 fakes are associated with galaxies (and brighter than hosts)
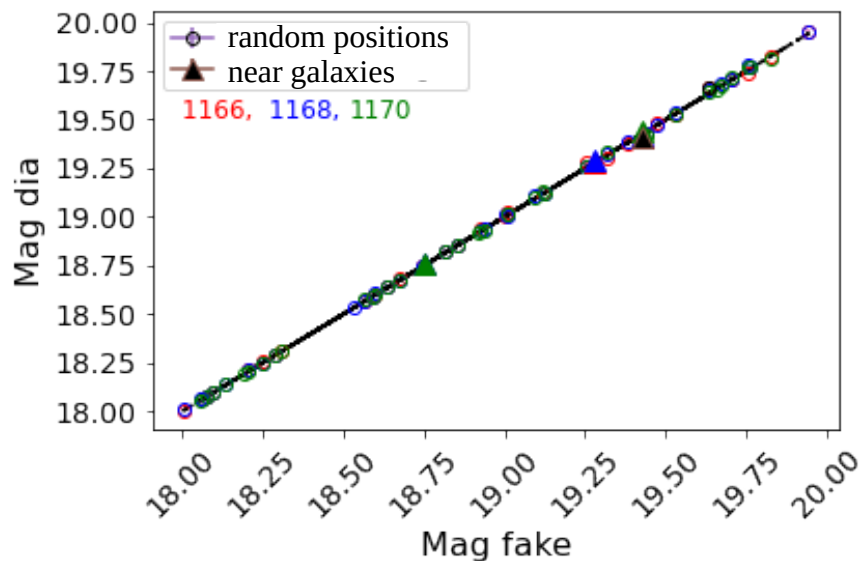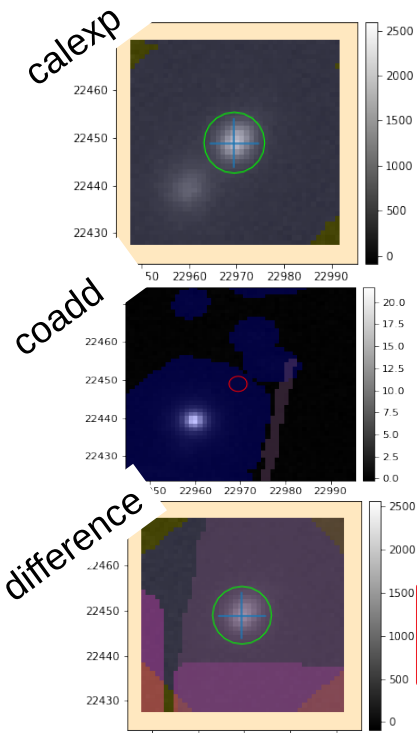
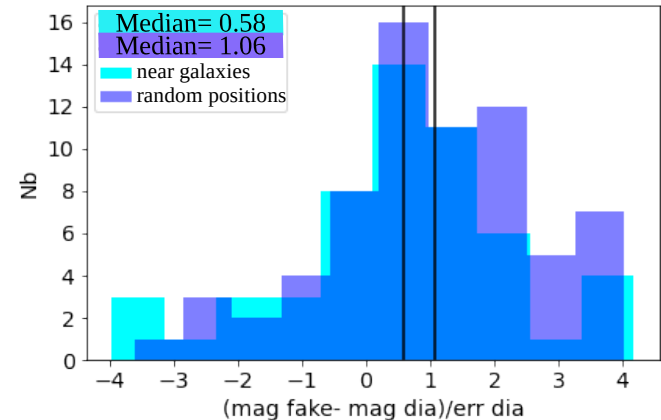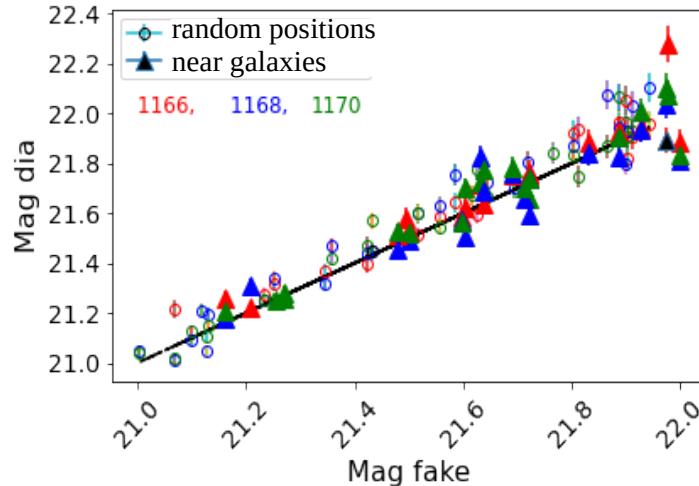Well retrieved magnitudes for all fakes in the 3 visits

Bright fakes [20 - 22]
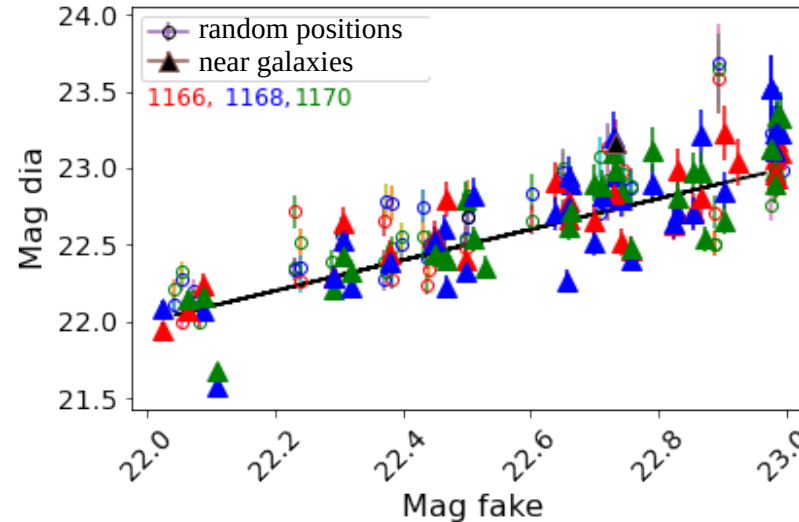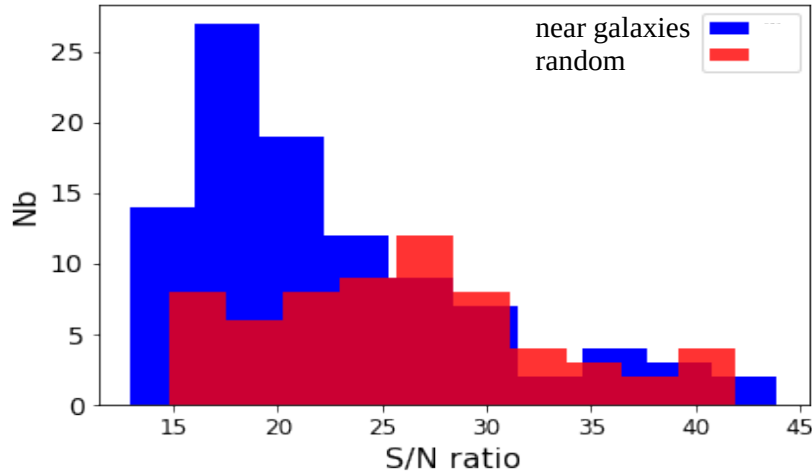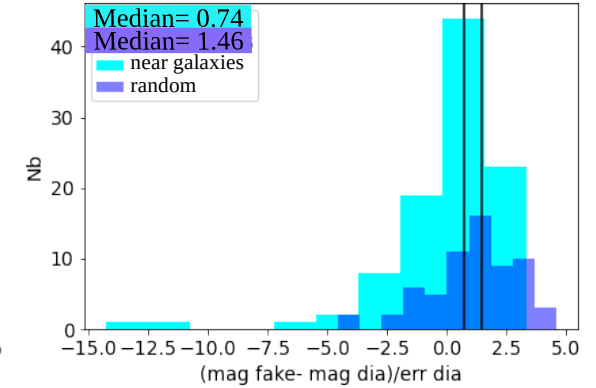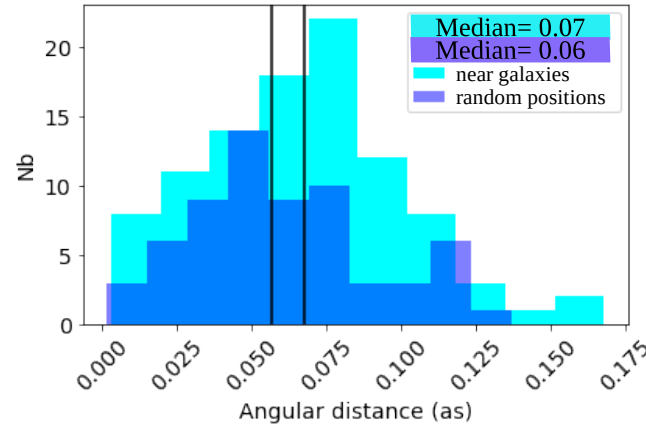
Mag [20 – 21]

26/27 retrieved with angular distance < 0.12 as

Mag [21 – 22]

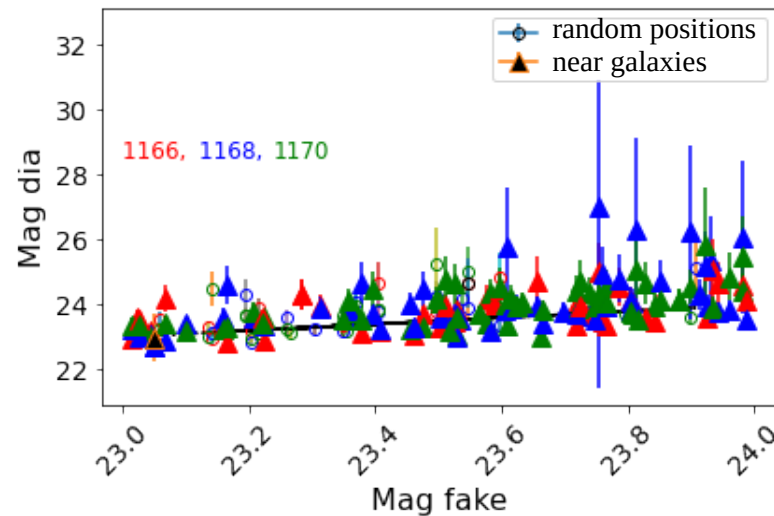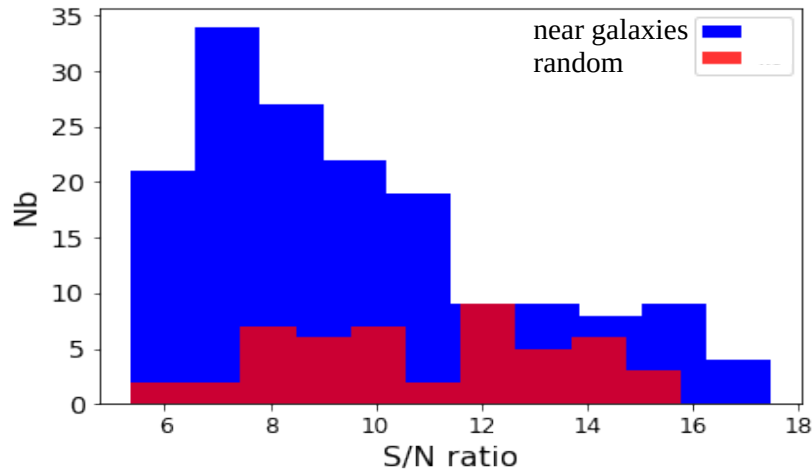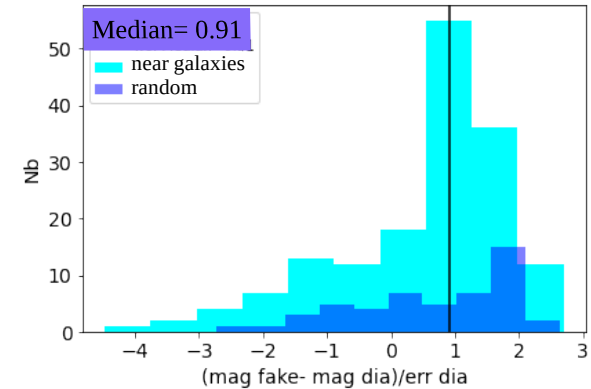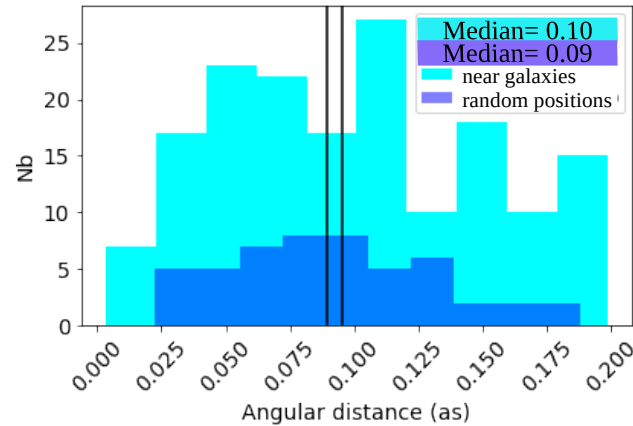53/53 retrieved with angular distance < 0.12 as

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Fakes [22 - 23]

- S/N: PSF flux/PSF flux error

  - 67/74 were retrieved
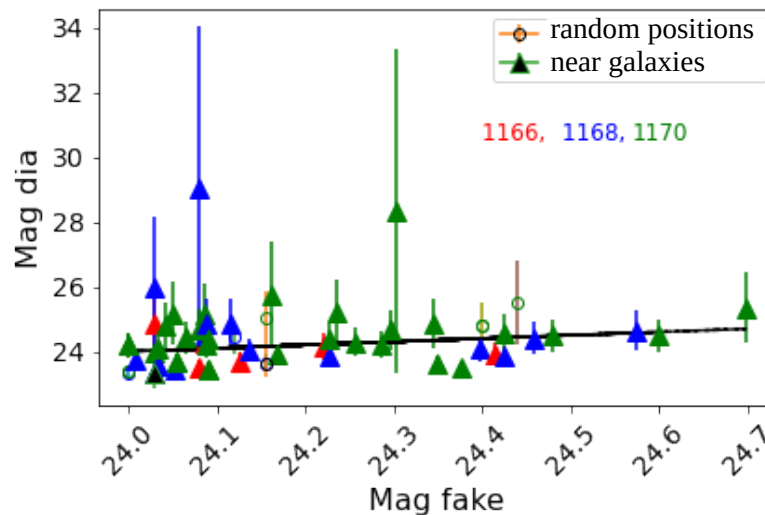   angular distance < 0.18 as
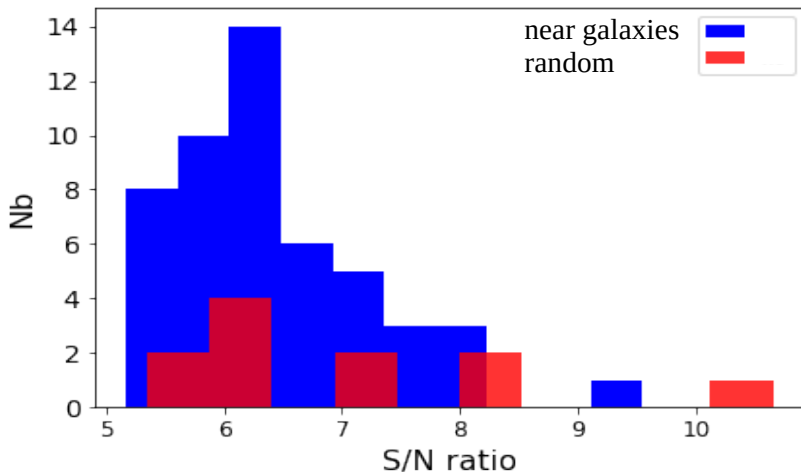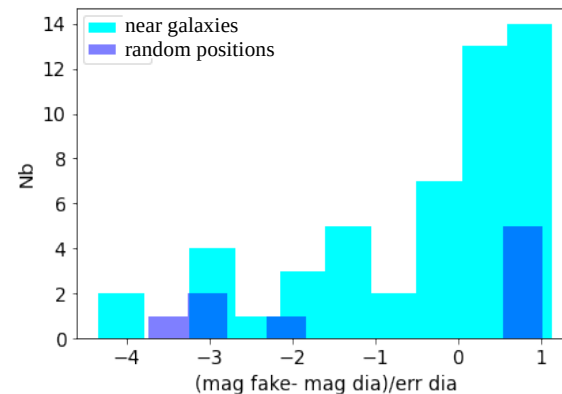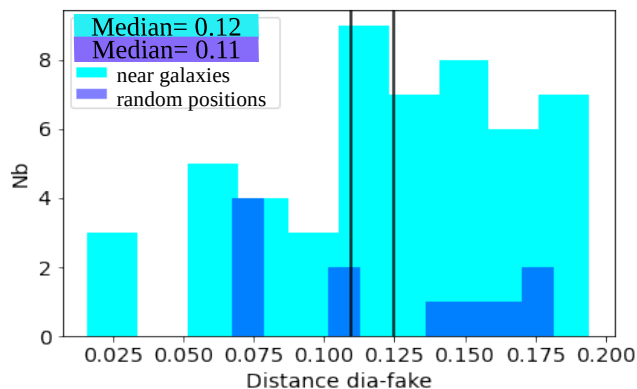
Fakes [23 - 24]

- 102/121 were retrieved angular distance < 0.2 as

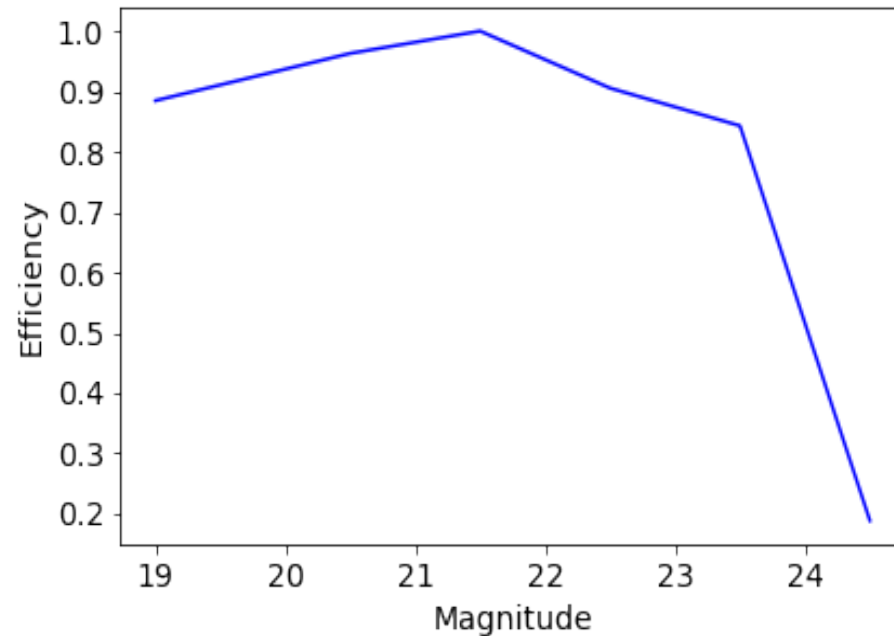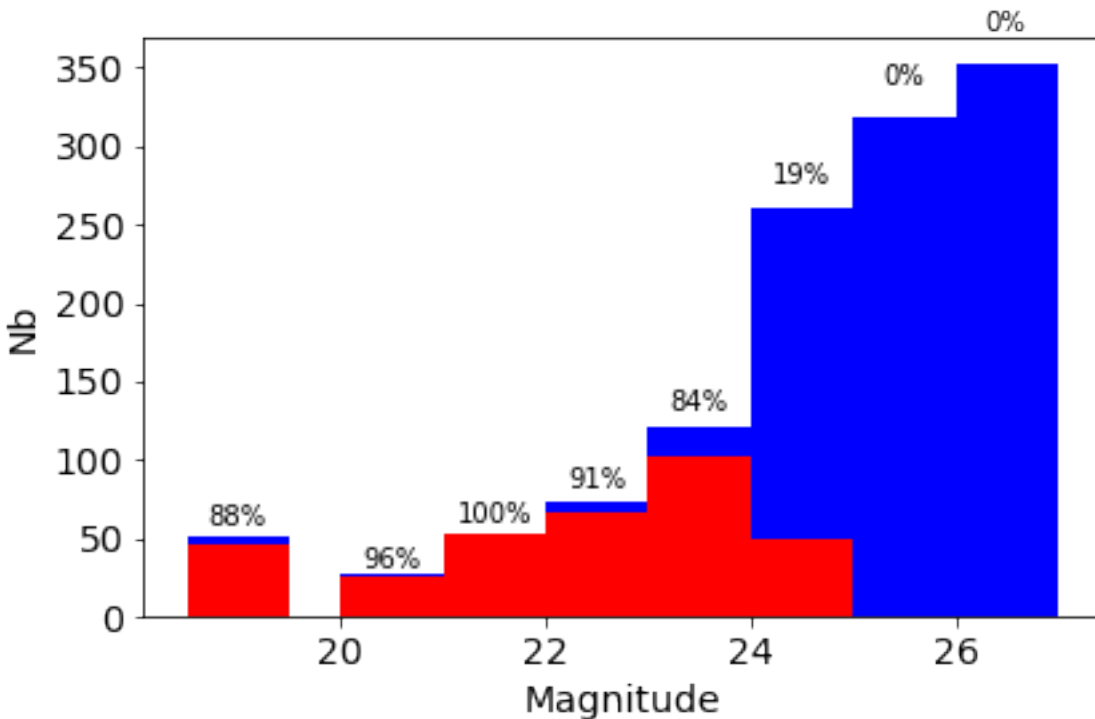- Large magnitude errors for fakes with mag > 23.5

Faint fakes [24 - 25]

- Retrieved only 49/260 fakes with angular distance < 0.2 as
- Large magnitude errors in the difference images
- S/N close to the detection threshold in the difference image (5.5)

Detection efficiency

➡ Check the positions of the missing bright fakes (masks?)
➡ Increase the detection threshold to detect fakes with mag > 24

Perspectives

- Optimize the detection threshold

- Consider flags, masked regions in the images

- Generate fakes on the whole focal plane

- Use data from the full PDR2 UDEEP COSMOS broad bands (642 visits)
- Study of false transient detection rates (artefacts)

Thank you