To detect the counterparts with GWAC system

Liping Xin (NAOC)

on behalf of the GWAC team and GRANDMA team

Outlines

1. GWAC system and observations

2. Blind search for optical transients

3. galaxy targeting search

GWAC and its follow-up system

Search with
small FoV telescopes (60cm)

Search with
Large FoV instruments (GWAC)

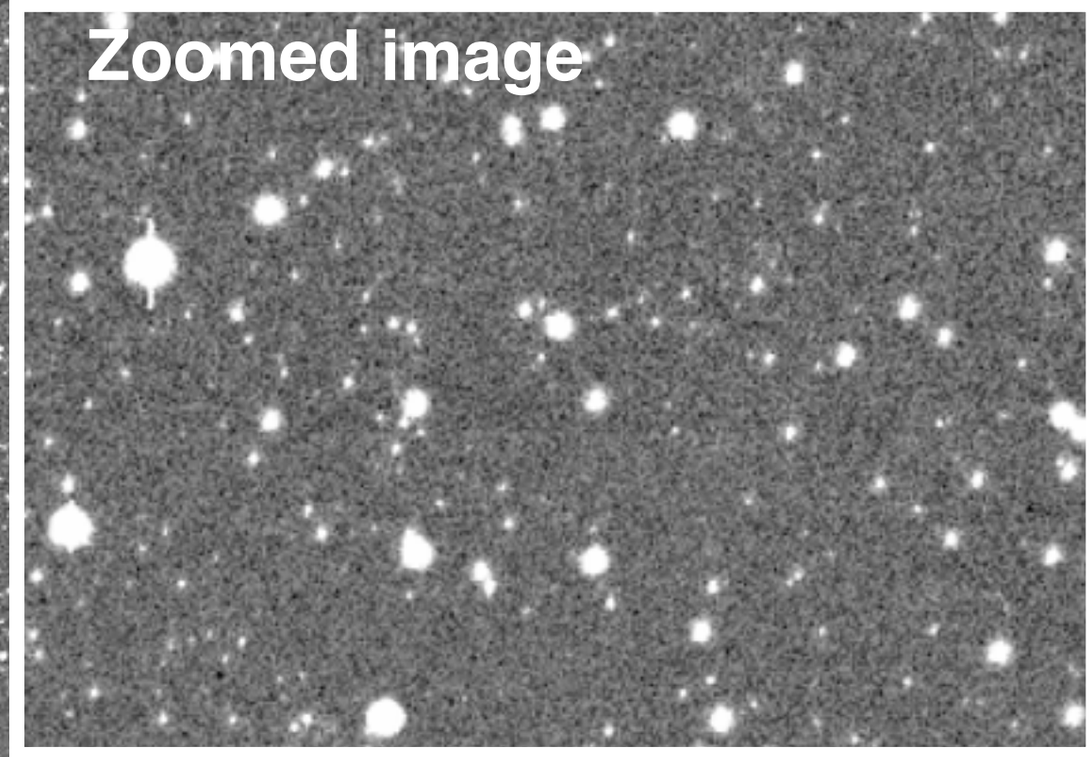
1. To detect the counterparts by GWAC system

2. To follow up the candidates found by external groups

Typical image for GWAC

~10+5s (exposure+readout)

Zoomed image



12.4 * 12.4 deg

Monitor the sky with high cadence (15s)

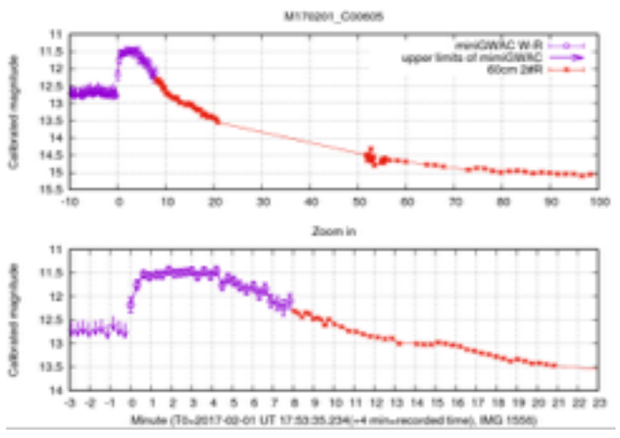
Time

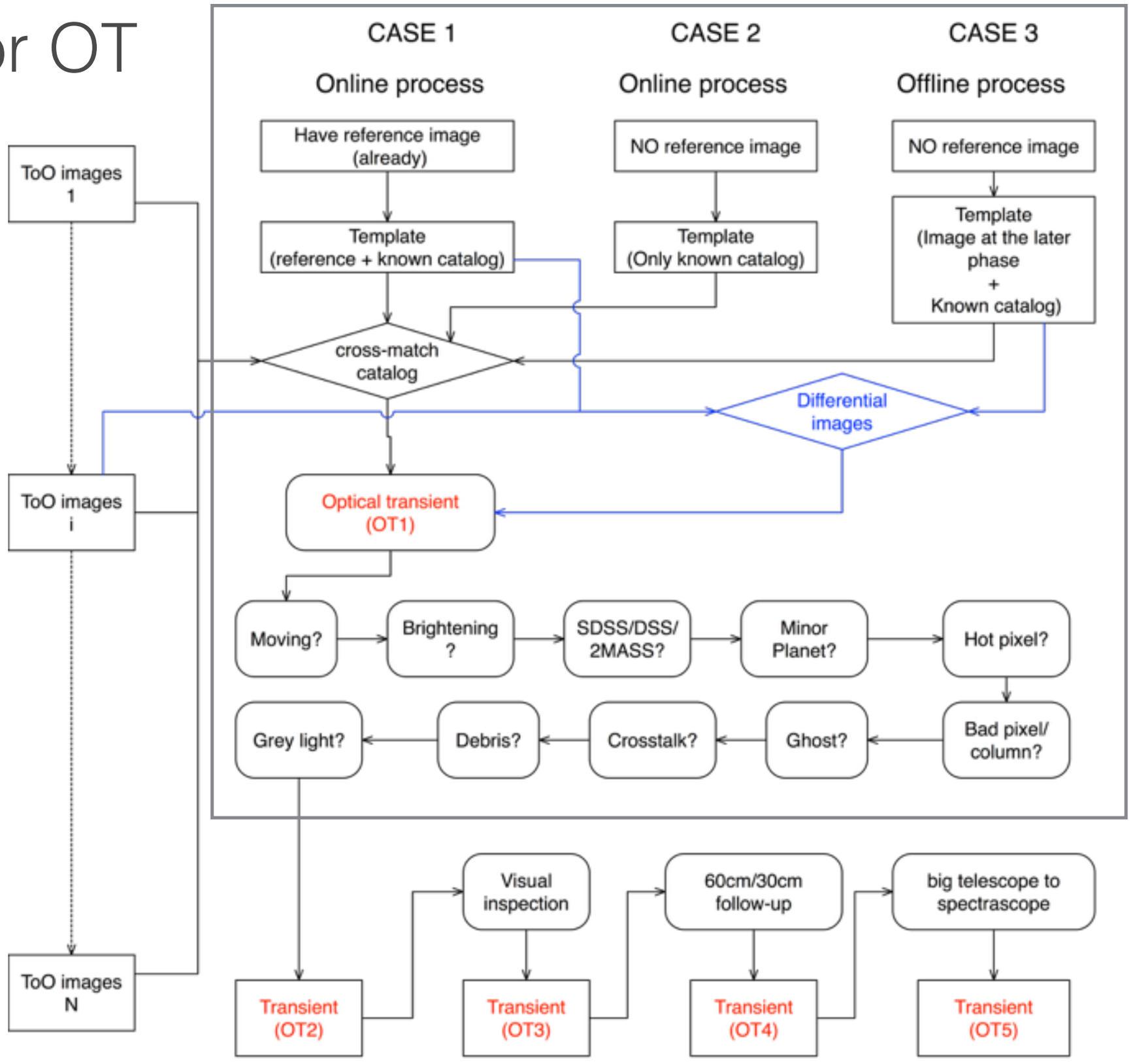
12.4 * 12.4 deg

Blind search for OT

Single images
Single images
Single images

15sec cadence

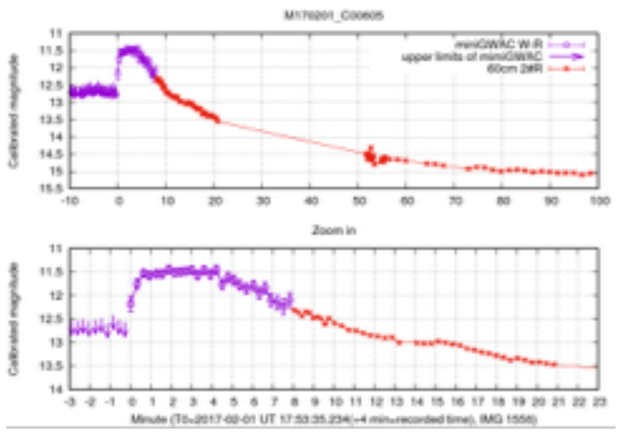


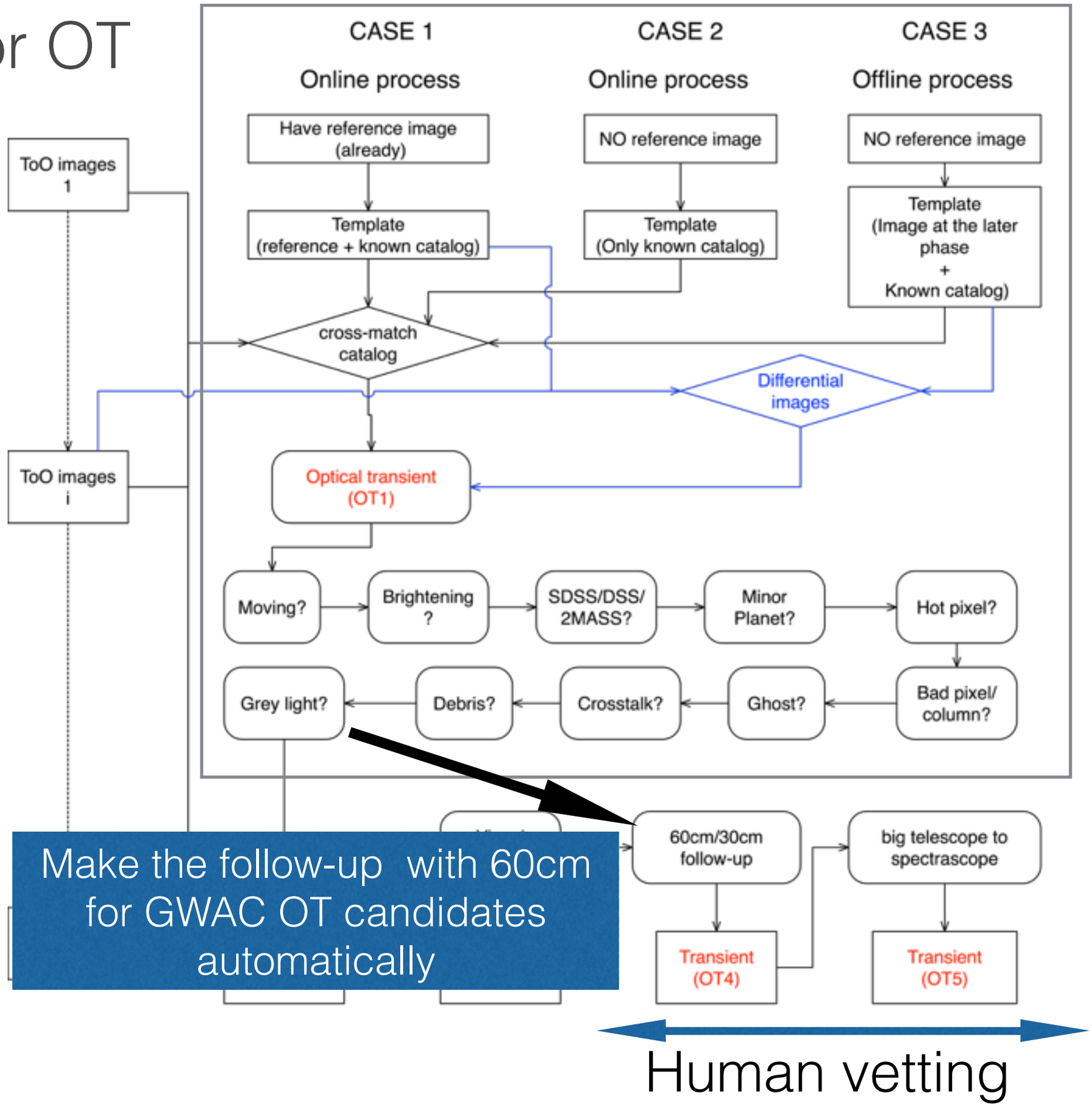


Blind search for OT

Single images
Single images
Single images

15sec cadence

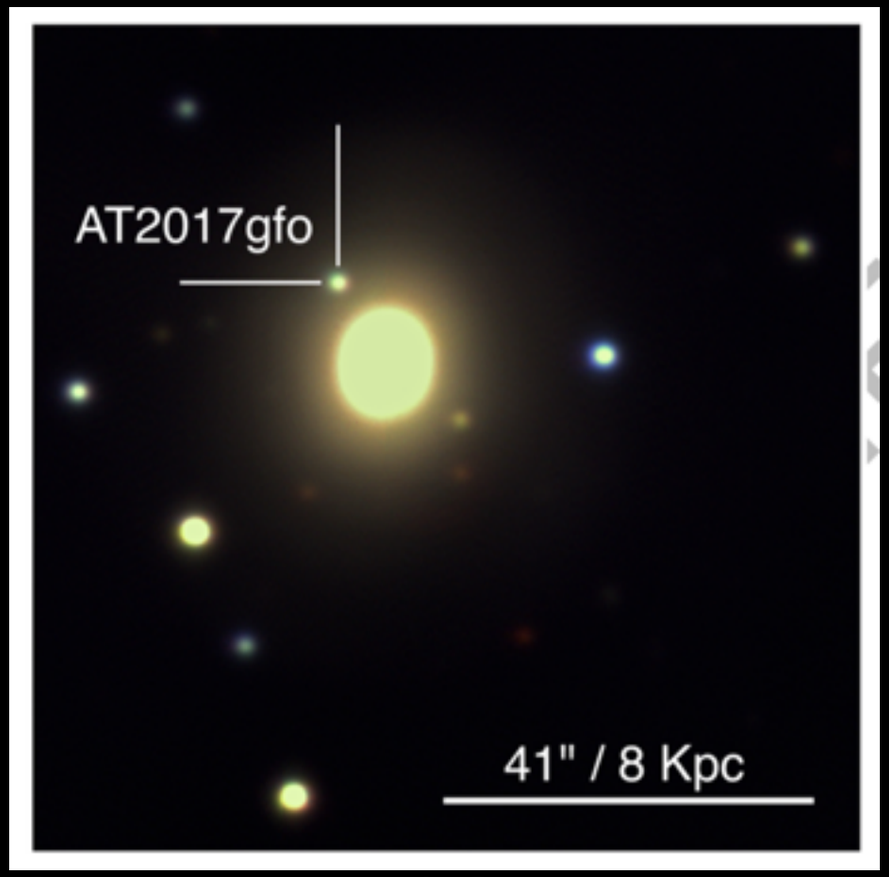




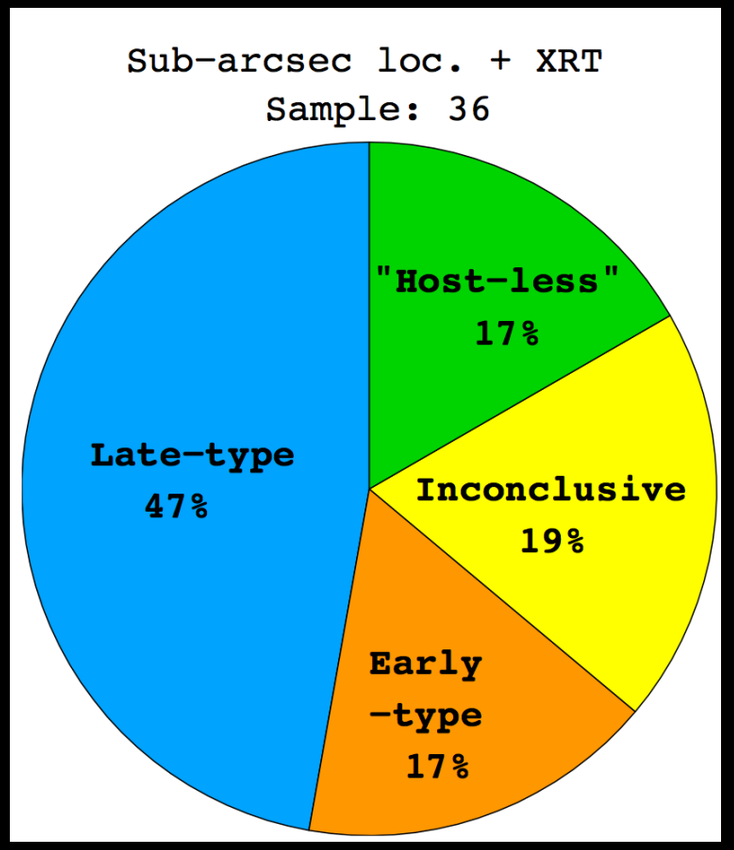
Make the follow-up with 60cm for GWAC OT candidates automatically

Human vetting

The hosts of SGRB and KN



GW170817 / GRB 170817



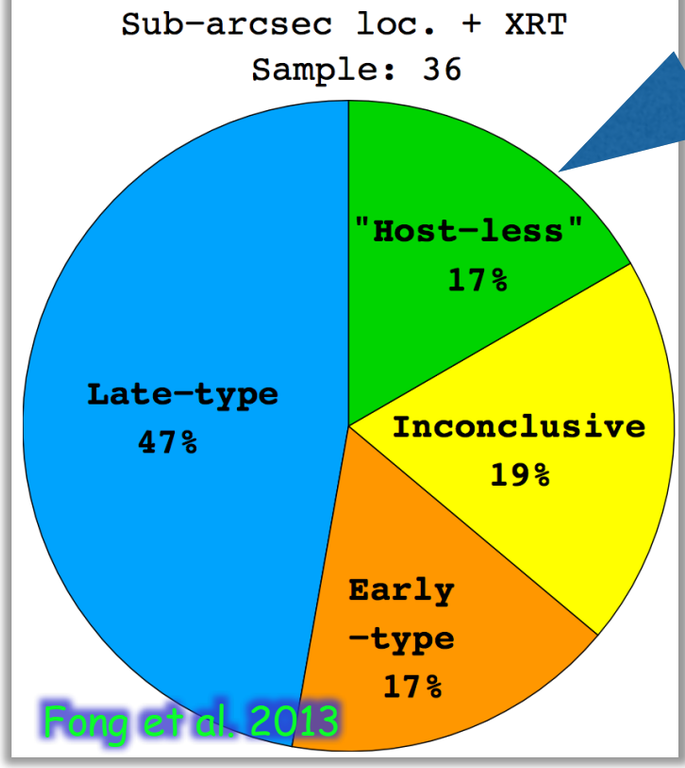
Adapted from Tanvir' talk

It is efficient to search the KN by galaxy targeting, but some kilonovae would be missed since some SGRBs are host-less

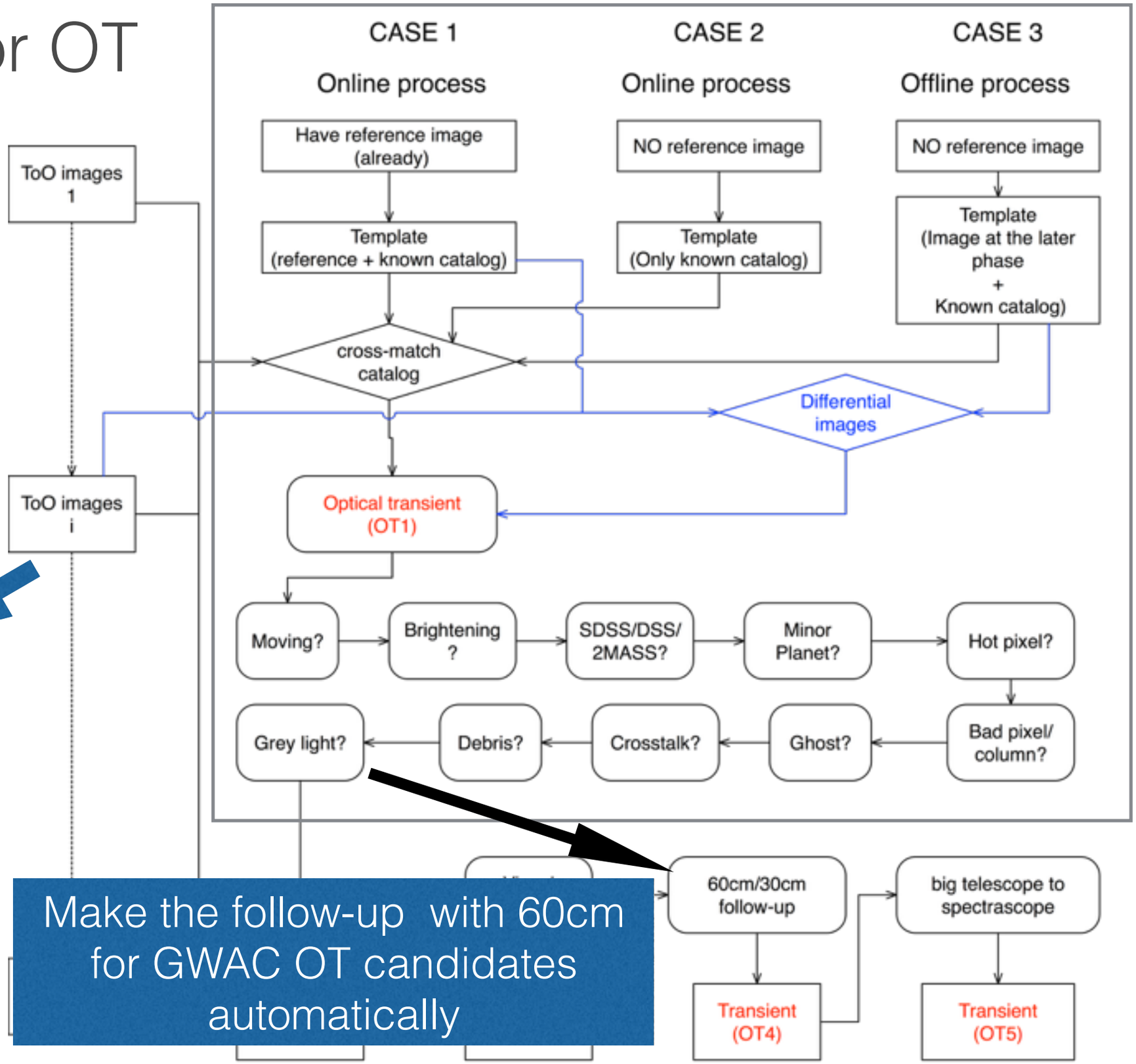
Blind search for OT

Single images
Single images
Single images

15sec cadence



See Tanvir' talk

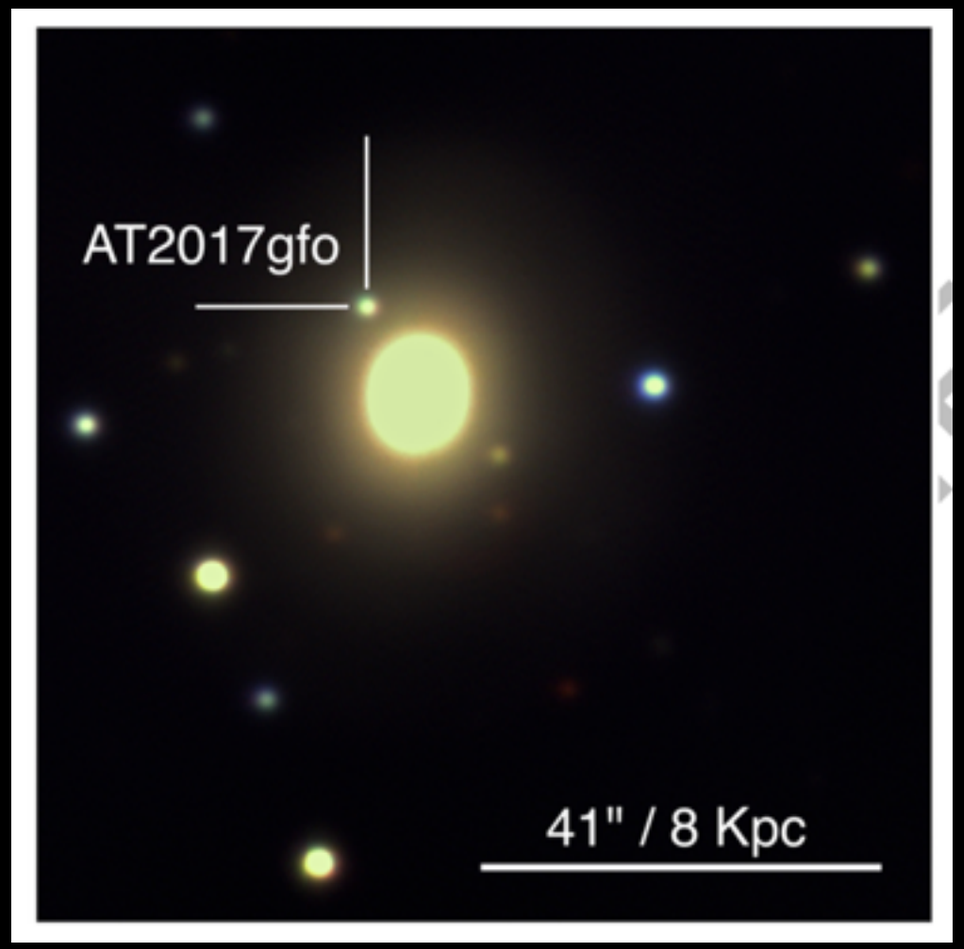


Make the follow-up with 60cm for GWAC OT candidates automatically

Human vetting

Fading slope of the brightness of the kilonovae associated with GW170817-like cases

~1 mag per day in R/r band



GW170817 / GRB 170817

Smartt et al., 2017, Nature

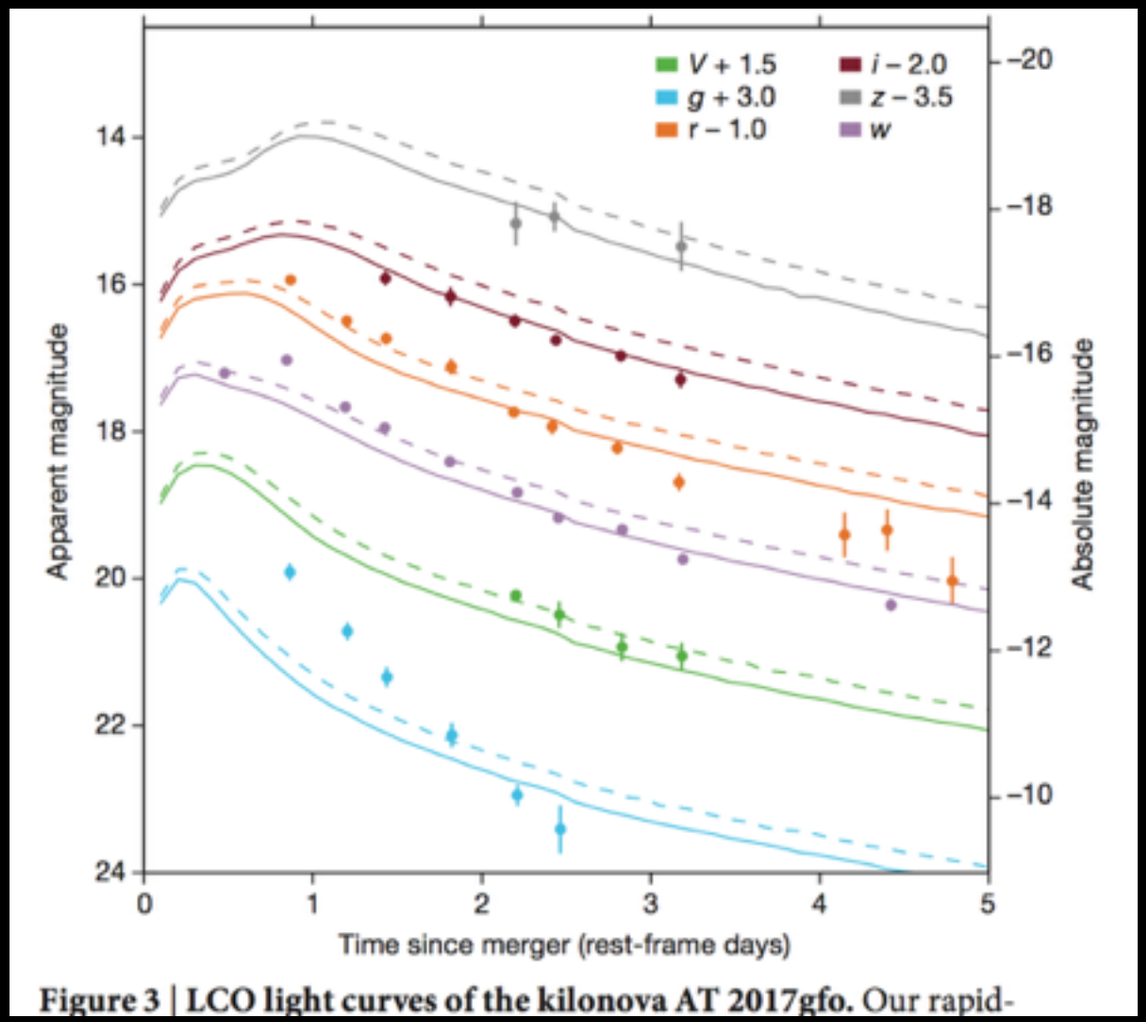
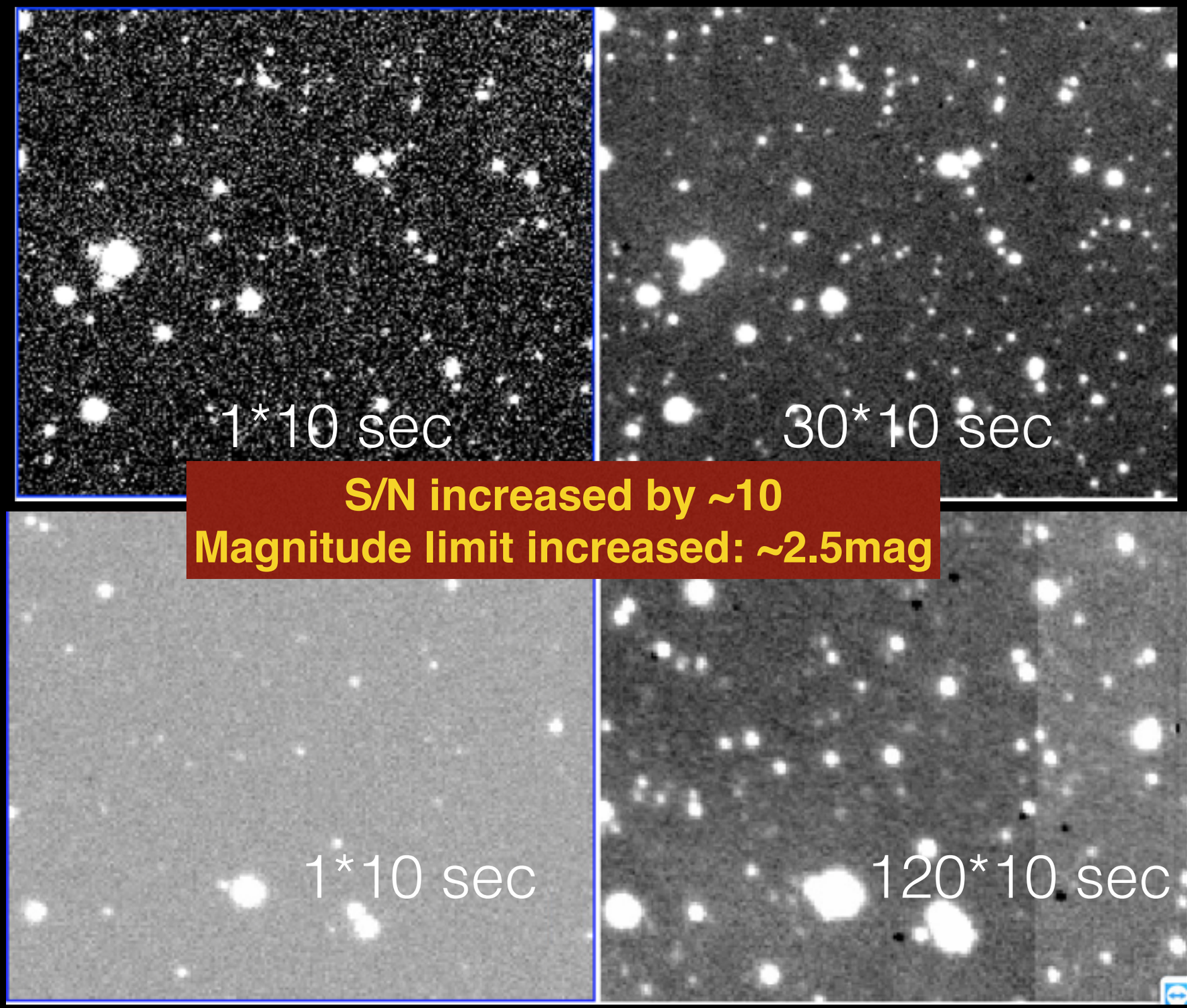


Figure 3 | LCO light curves of the kilonova AT 2017gfo. Our rapid-

Arcavi et al., 2017, Nature

Make a deep detection by stacking GWAC images

sensitive to the density of the field and the number of stacking

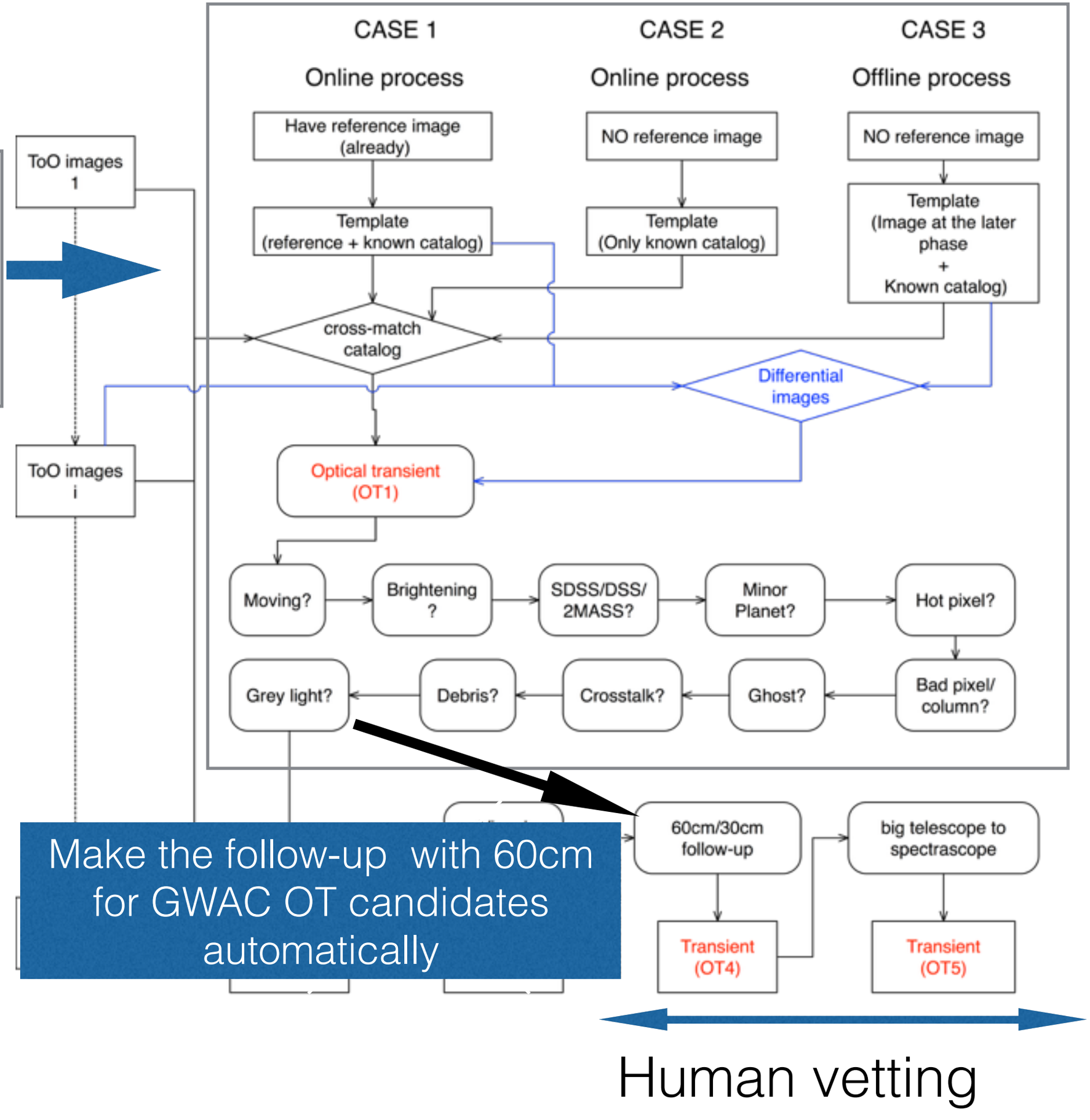


Code by H.B. Cai

Blind search

Single images
Single images
Single images

15sec cadence



Make the follow-up with 60cm for GWAC OT candidates automatically

Human vetting

Blind search

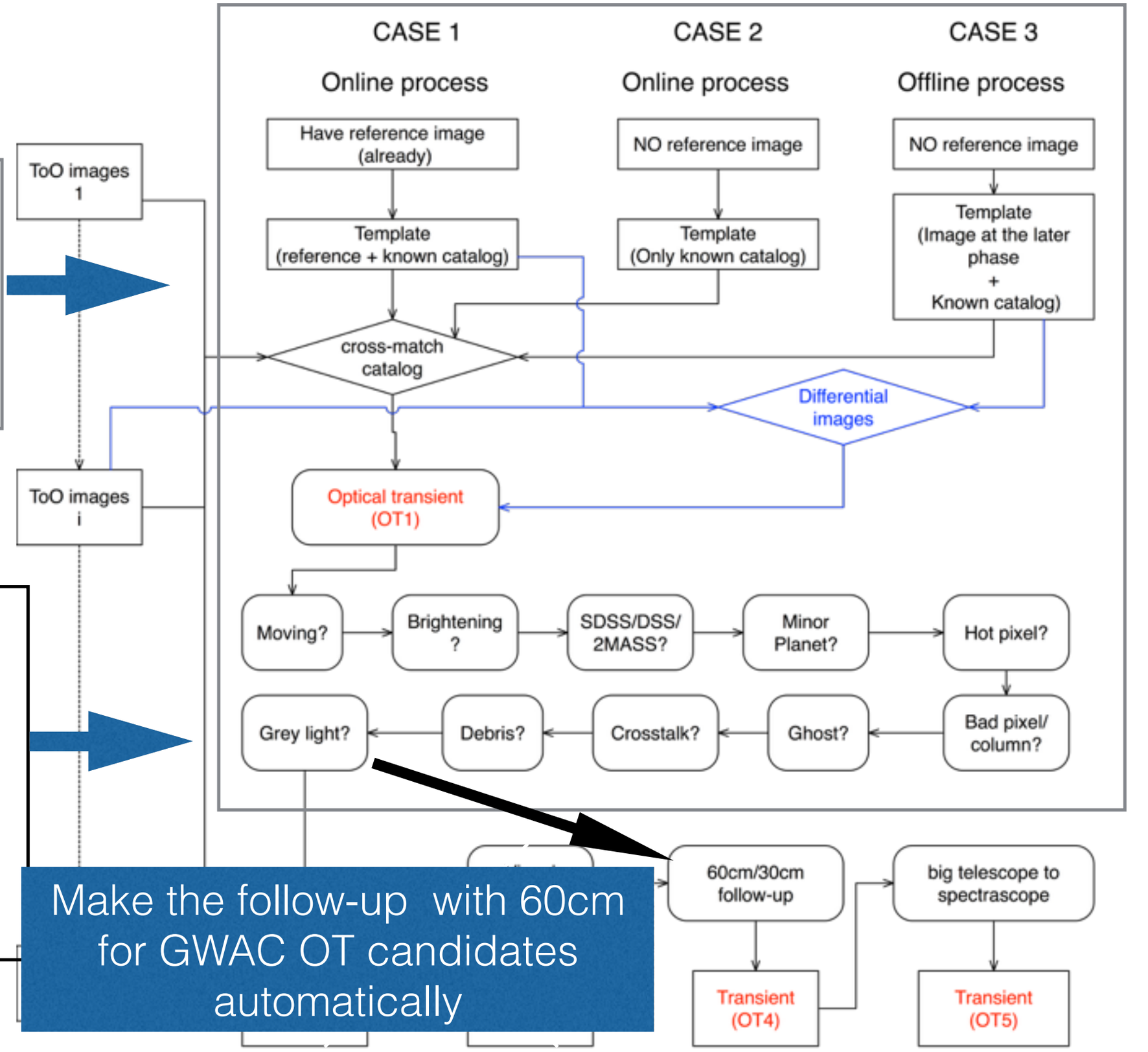
Single images
Single images
Single images

15sec cadence

Stacked images
Stacked images
Stacked images

15 min cadence?

Increase the detection capability



Make the follow-up with 60cm for GWAC OT candidates automatically

Human vetting

To search for the kilonovae by galaxy targeting in GWAC images

Galaxies in GWAC image

The sub sample of GLADE catalog

DEC>0 && dis<50Mpc

Test a GWAC image observed at 16th Apr. 2018

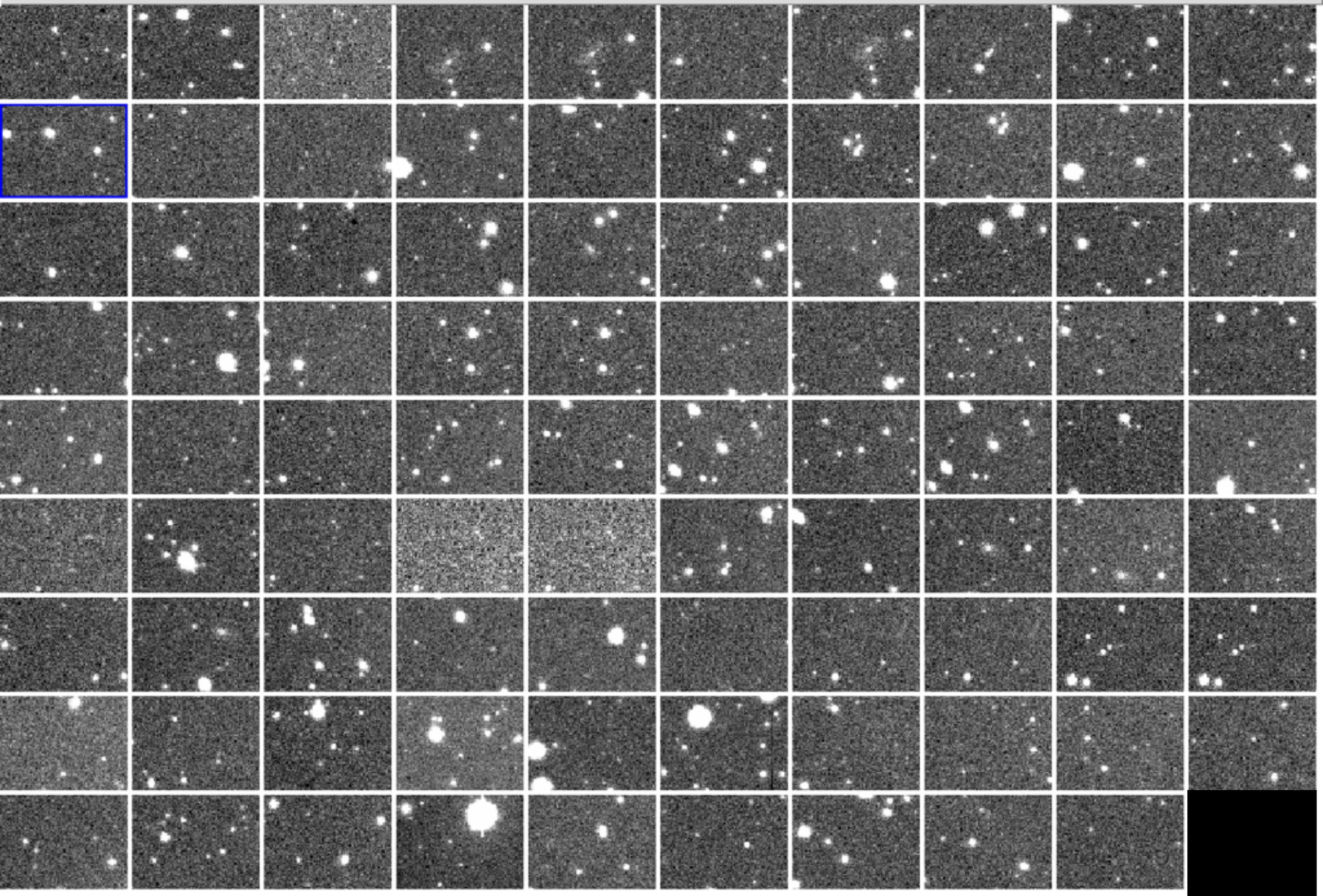
There are 98 galaxies.

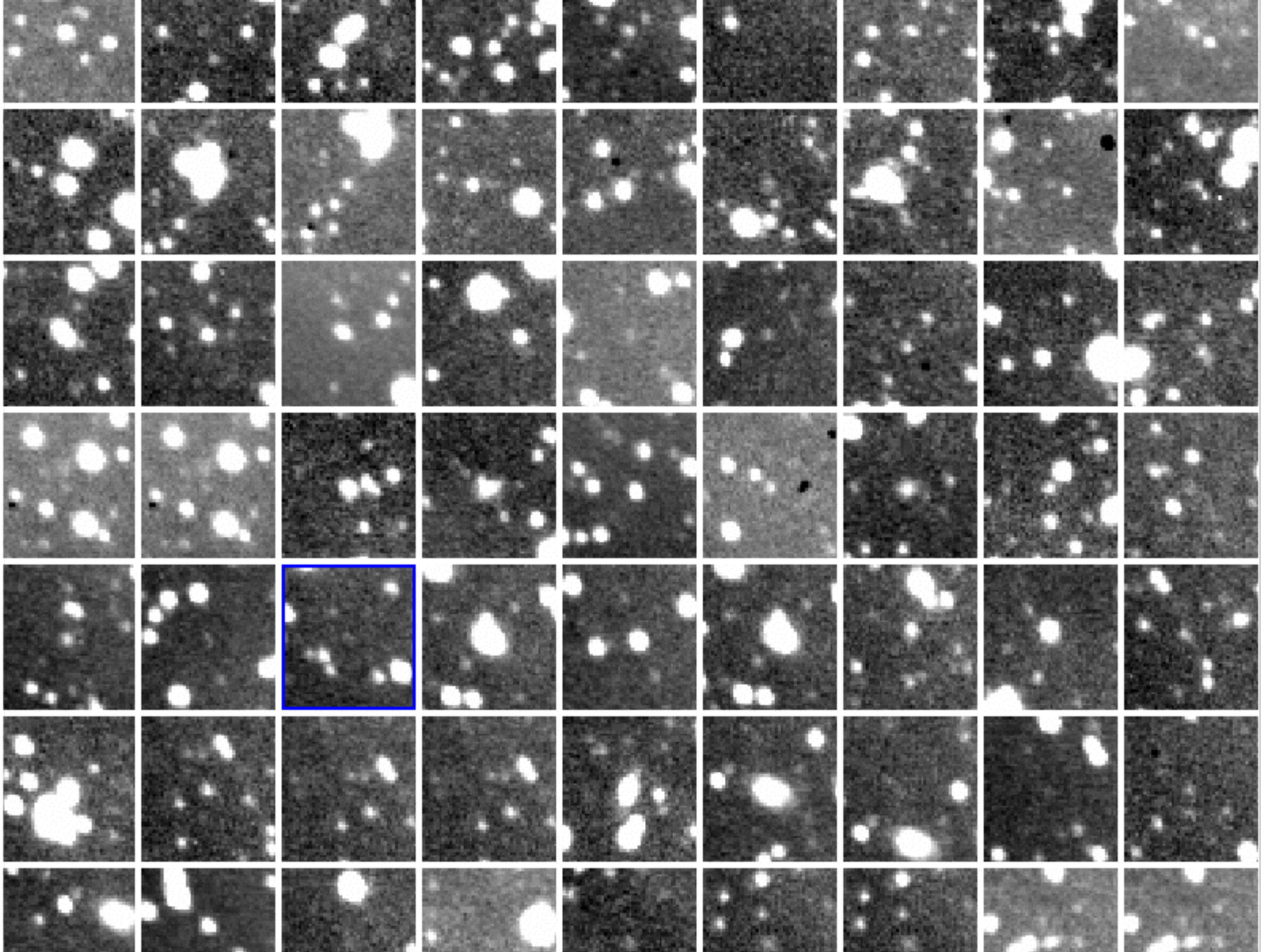
There are ~1600 galaxies covered for a single exposure
if four GWAC units are operated

Activities Ds9 Sat 15:45 zh gwac

SAOImage ds9

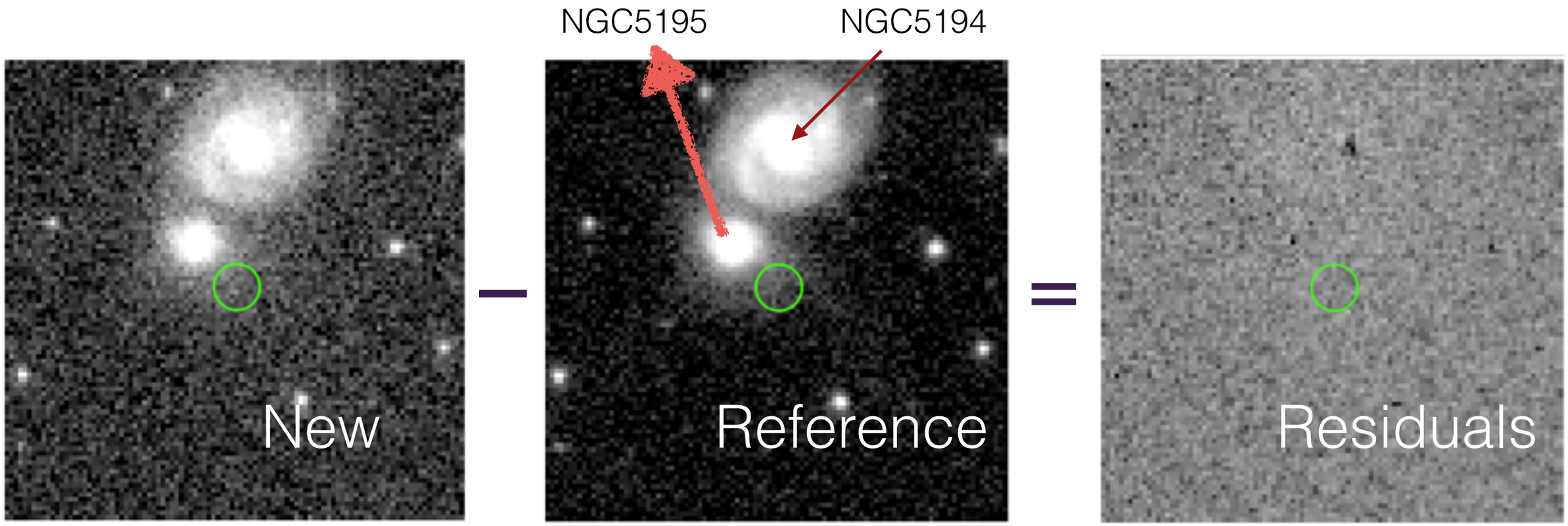
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help





One example of the differential galaxy in the sub images of GWAC

M51(NGC5194)

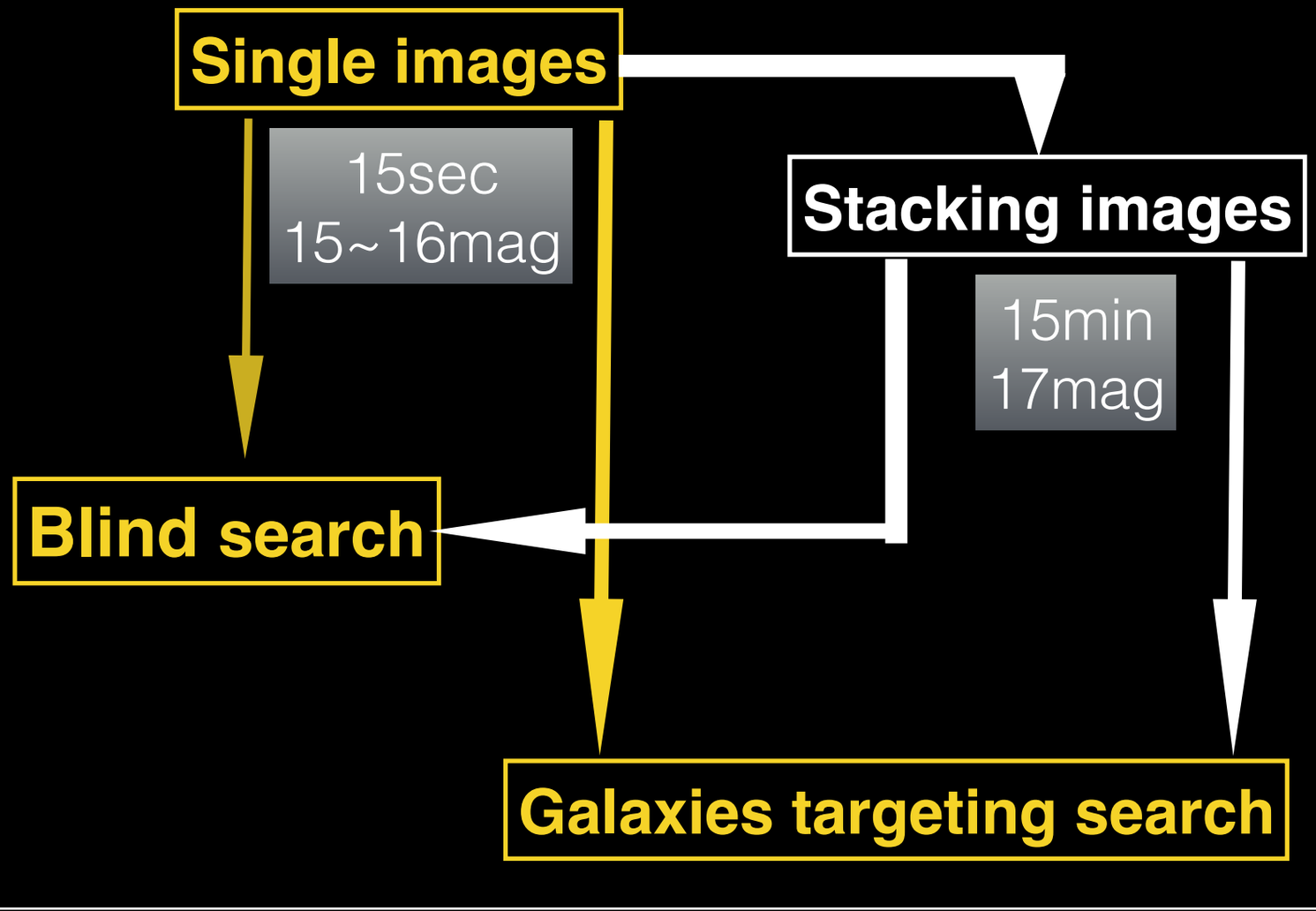


Data are observed at Mar. 18th, 2018

Summary

For O3:

- FoV: ~2500 sq^2
- ~1600 galaxies could be monitored simultaneously



- **For GWAC:**
  - **Online/offline data processing:**
    - **Blind search** in the whole images by catalogue crossmatch
    - **Sub-image subtraction** around the galaxies in the GWAC images
  - **Cadence:**
    - Search for **short-**duration counterparts —-single images one by one(15 sec candace)
    - Search for **long-**duration counterparts —- stacking images (60 images, 15 min candace)