All the images required for these tests are in :
https://grandma-owncloud.lal.in2p3.fr/index.php/apps/files/?dir=/Candidates/GRB/Tutorial_muphoten&fileid=495691

Guided Tutorial :

We will use an image from the Liverpool Telescope (LT) - use the images called "h_e_20180619_32_1_1_1.fits"

It was acquired in the g band for the follow-up of SN2018cow (Ra = 244.00092; Dec = 22.2680094)

1- Subtract a template image with Pan-STARRS by typing:
mu_subtraction --images PATH-TO-IMAGE --telescope LT --astrometry scamp --sub ps1

It can take a few minutes for Muphoten to download the PS images.
If it takes too long you can subtract a reference image from LT itself :
mu_subtraction --images PATH-TO-IMAGE --telescope LT --astrometry scamp --sub PATH-TO-REF-IMAGE

Check that a repertory called "results" has been created. Inside there should be a repertory with the same name as the LT image. The latter contains one fits file and one png file of the sub images.

2- Create a *coord.dat* file with the coordinate of the transient and a ref star located at : Ra_{star} = 243.97494 and Dec_{star} = 22.29366
It should have the following shape:

```
# type Ra Dec
transient Ra_transient Dec_transient
star Ra_star Dec_star
```

3- Compute the magnitude of SN2018cow in that image by typing :
mu_photometry --images PATH-TO-IMAGE --coord PATH-TO-COORD --outname results.dat --telescope LT --catalog Pan-STARRS --photo iso --sub-method sub --band gmag
Check that there is a repertory "calibration" created with the results of Muphoten.

Question :

- What is the image zero point ? (Hint : Use information in the calibration repertory. Hint 2 : the information is visible in one of the plots)
- What is the transient magnitude? (Hint : look at your terminal)
- What is the transient magnitude uncertainty?
- Which of the three photometry methods of muphoten did you use?
- Which catalog did you use for calibration?

Non guided exercice :

This exercise is based on the CAHA image of GRB220514A :

This image **does not require** any template subtraction.

Exercice :

Compute the magnitude of the afterglow knowing that :

- the afterglow is located at : Ra = 147.66556; Dec = 13.1562
- the sanity star is located at : Ra = 147.6902 ; Dec = 13.1495
- there is no need for template subtraction : use the mu_photometry arguments for taking that into account. Use *mu_photometry --help* to find the relevant argument(s)

Question :

- What catalog did you use?
- Which band has been used for this image?
- What is the magnitude of the transient?
- What is the zero point of the image?
- How can this result be improved?