# Visible Telescope Afterglow Candidate

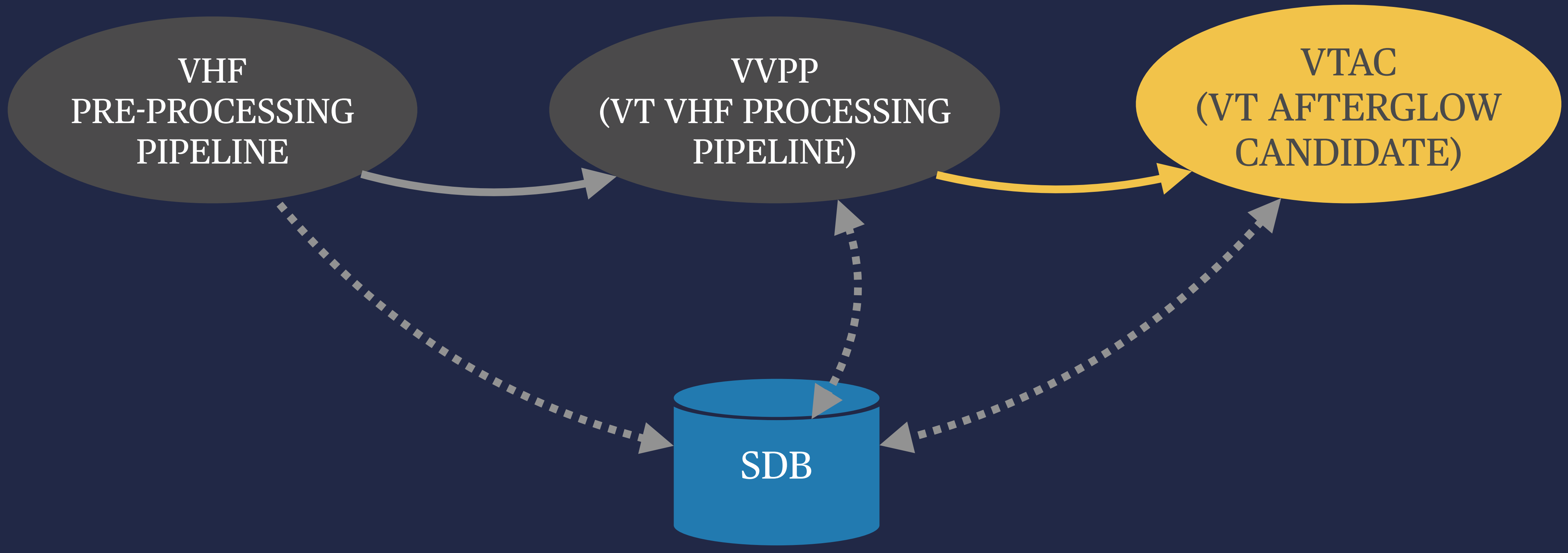
## Data analysis and feedback for COLIBRI

Jesse Palmerio - 09/11/2021 - Observatoire de Haute Provence

# Presentation

## General information about VTAC

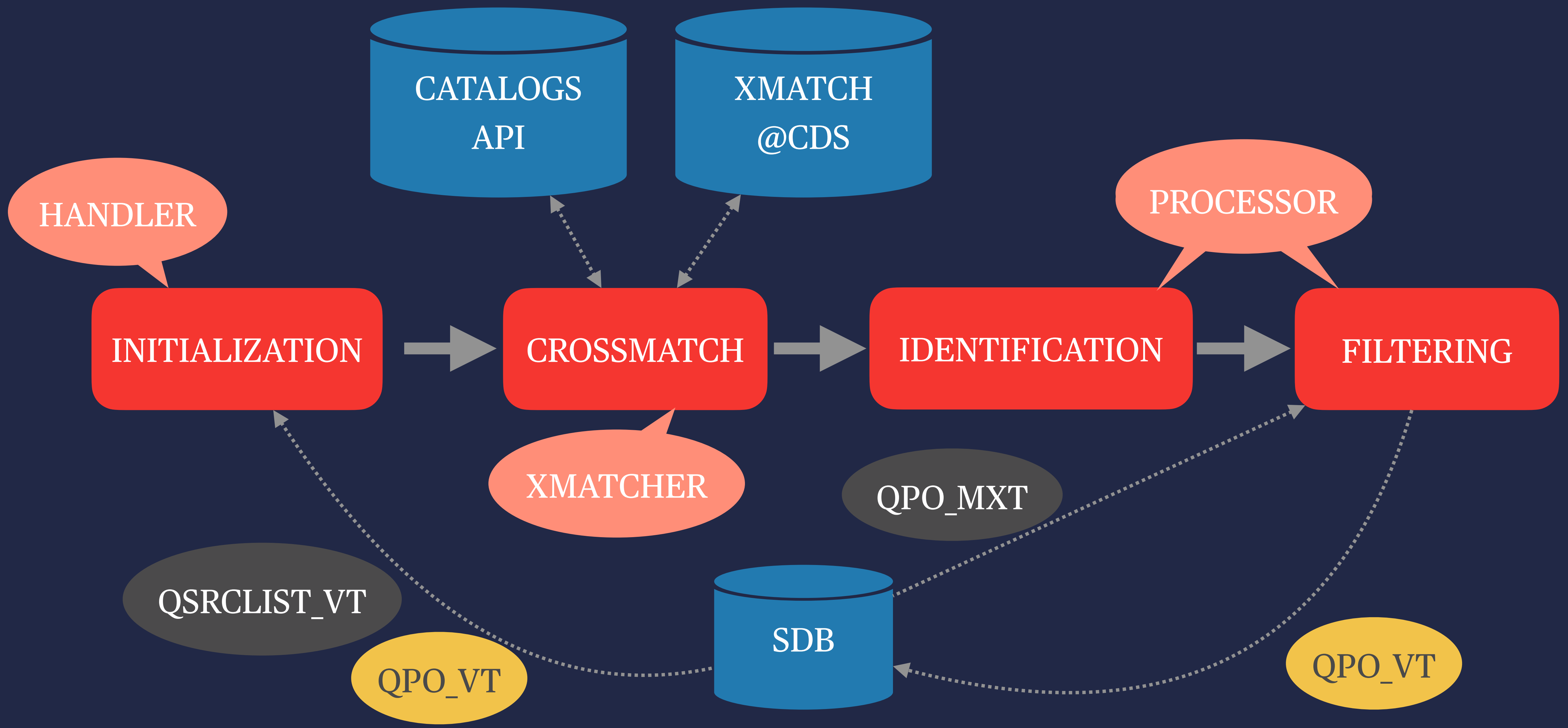
- Dockerized module deployed at French Science Center (FSC)
- Activated at the end of the VHF processing for the Visible Telescope (VT) pipeline
- Aims to identify the optical position of GRB afterglow



# Presentation

## VTAC in detail

- 4 main steps performed using 3 classes developed in Python3
- Uses XMatch service at Centre de Données de Strasbourg (CDS)



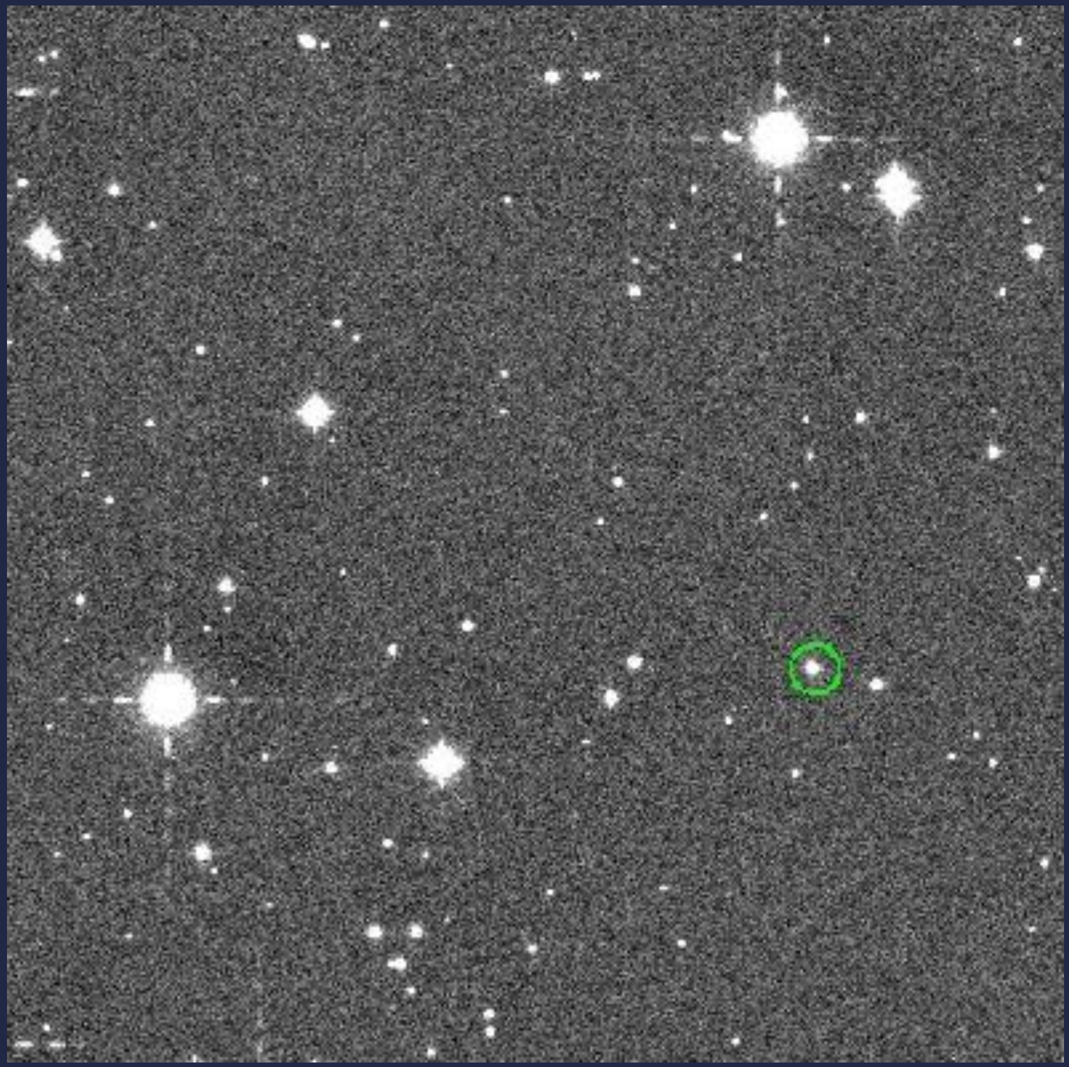
# Positional crossmatching

## Results from VT simulated fields

# Positional crossmatching

## Results from VT simulated fields

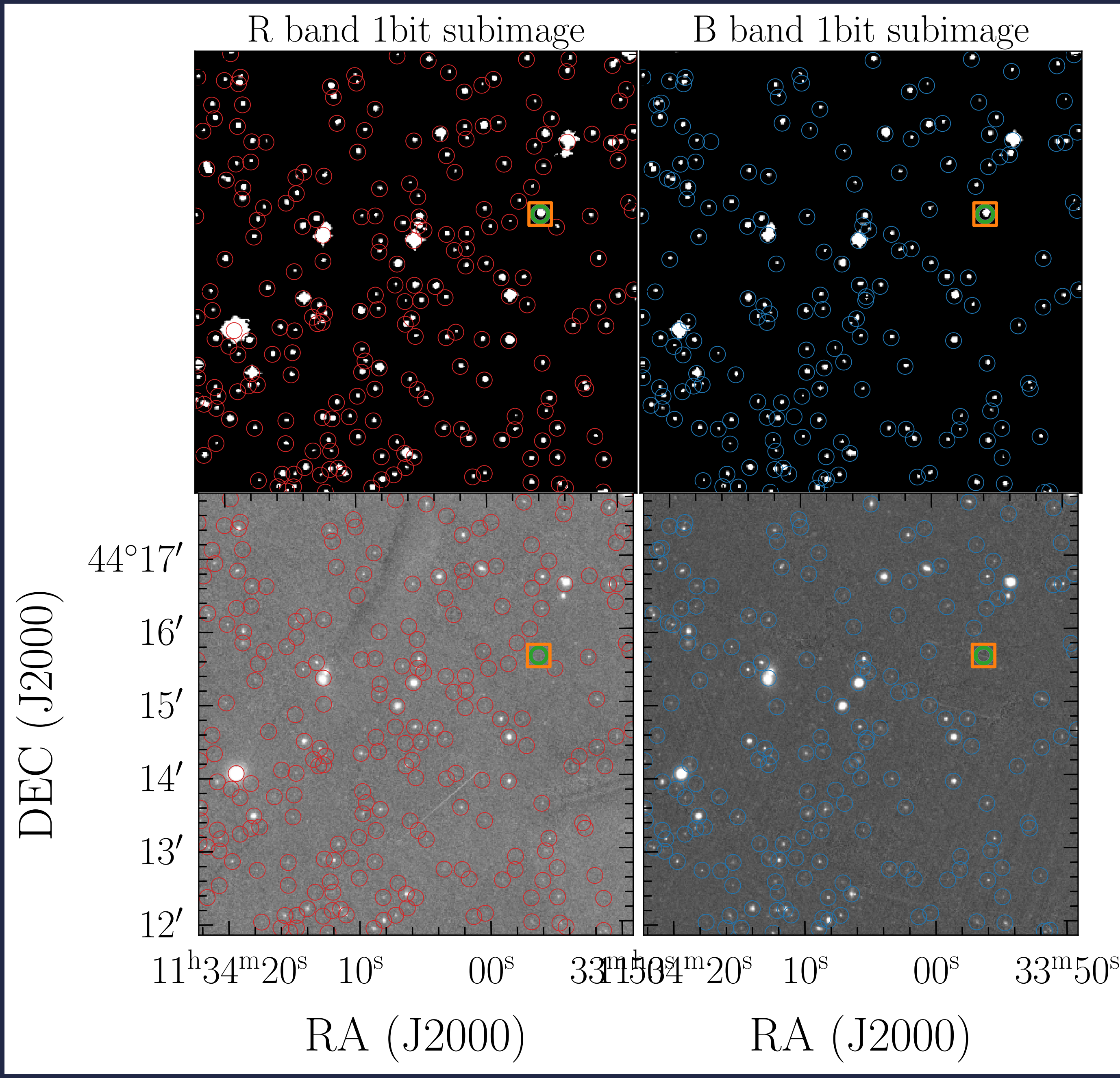
- 238 fields simulated by Yulei (bright case 1 ; extend to faint case (in progress))
- 3 catalogs: GaiaDR3, SDSSDR12, PS1DR1
- R and B bands, 1st sequence only
- In majority of cases, positional crossmatching is sufficient (probably because we are in bright case)



# Positional crossmatching

## Results from VT simulated fields

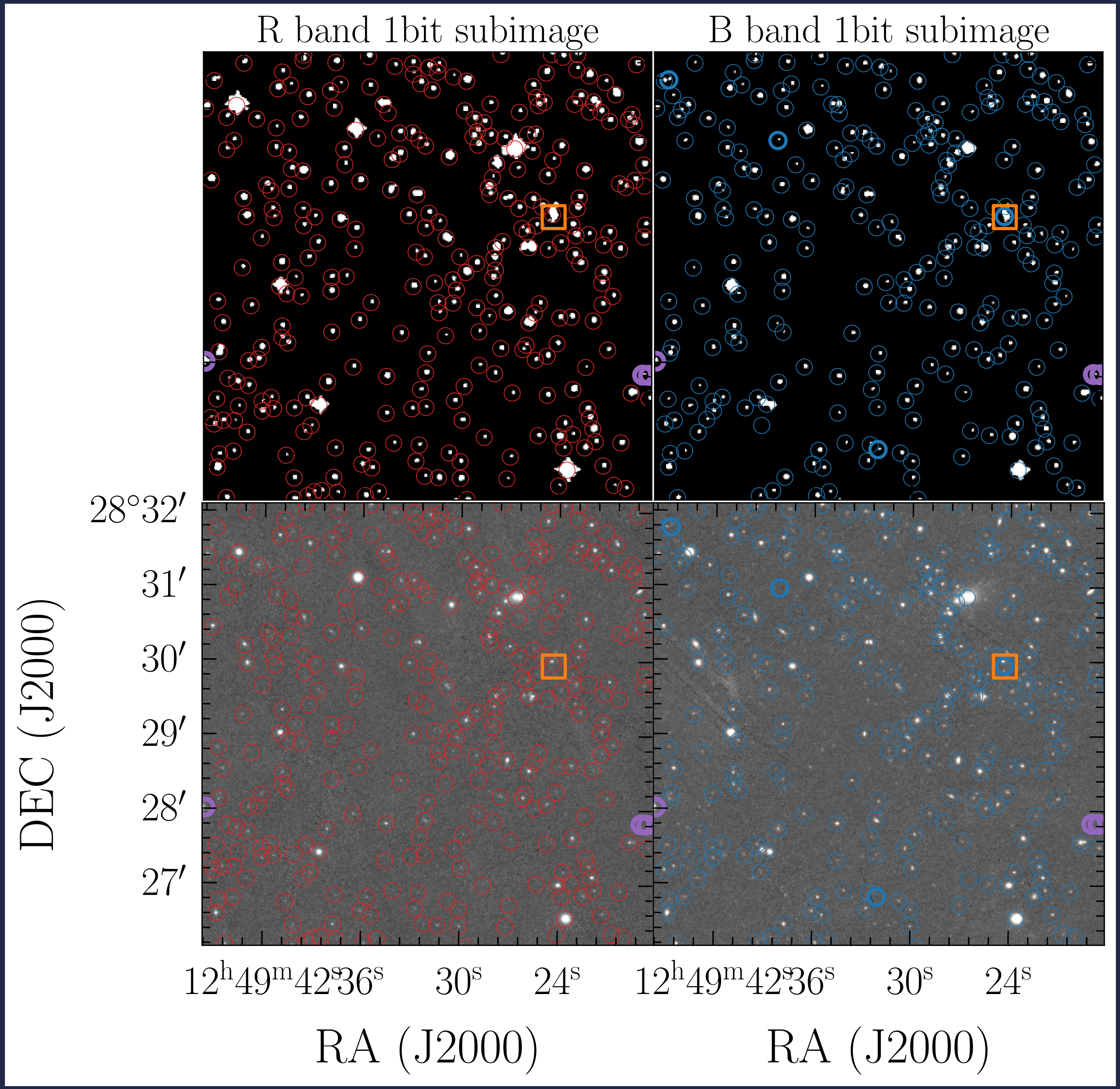
- Estimated best crossmatch radius ~ 2 arcsec
- In 90% of cases GRB afterglow is included in the candidate list using only positional crossmatching



# Positional crossmatching

## Results from VT simulated fields

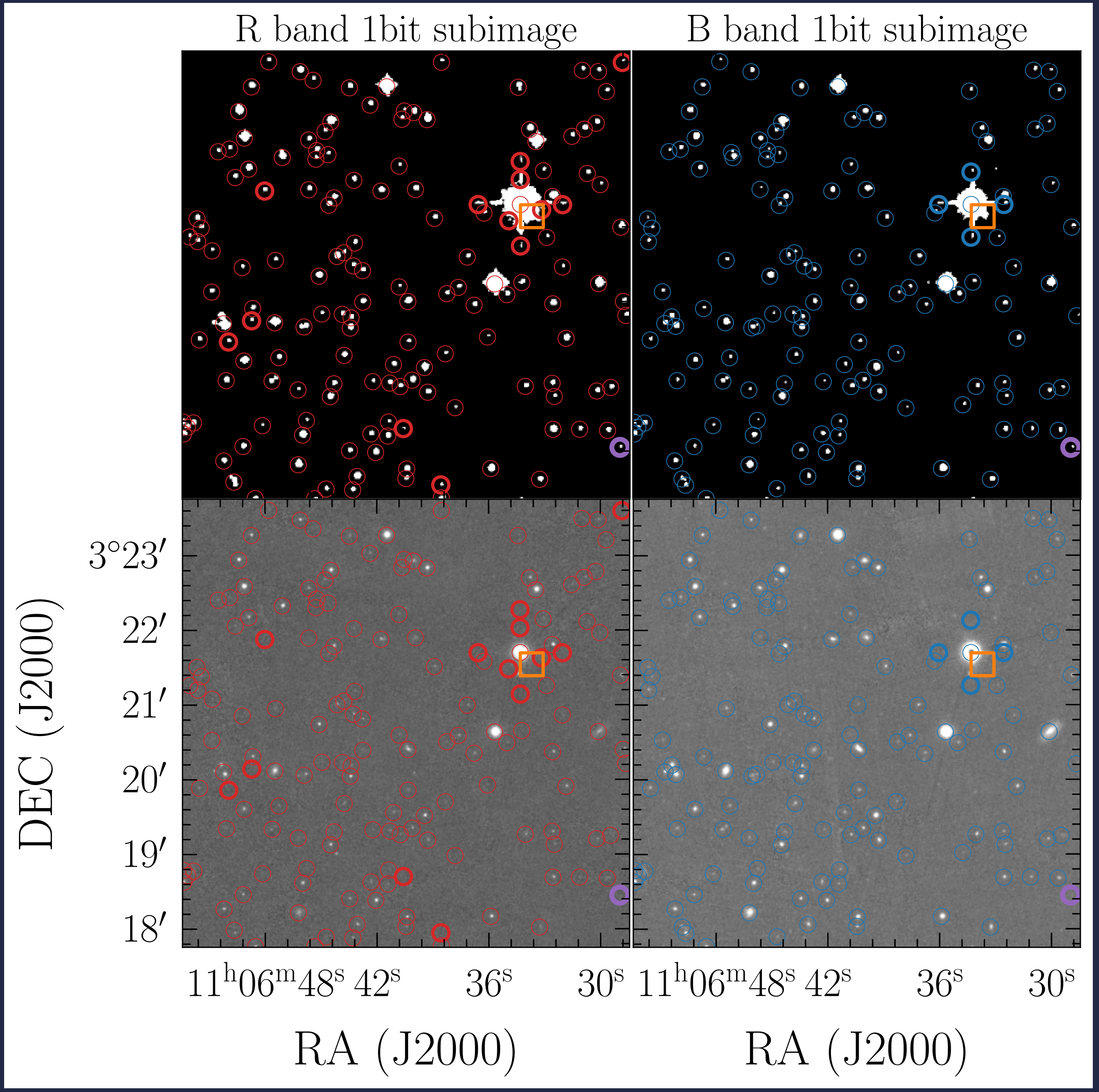
- In 3% of cases, GRB afterglow crossmatches with spurious source (but then $\Delta$mag will identify)



# Positional crossmatching

## Results from VT simulated fields

- In 7% of cases, GRB afterglow is behind a bright star
- Not much to do, bad luck



# Positional crossmatching

## Results from VT simulated fields

- Estimated best crossmatch radius ~ 2 arcsec
- In 90% of cases GRB afterglow is included in the candidate list using only positional crossmatching
- In 3% of cases, GRB afterglow crossmatches with spurious source (but then $\Delta$mag will identify)
- In 7% of cases, GRB afterglow is behind a bright star
- Extend this to faint cases
- Include other catalogs

# Estimating $\Delta$mag threshold

## VT magnitudes vs catalog magnitudes

# Estimating *Δ*mag threshold

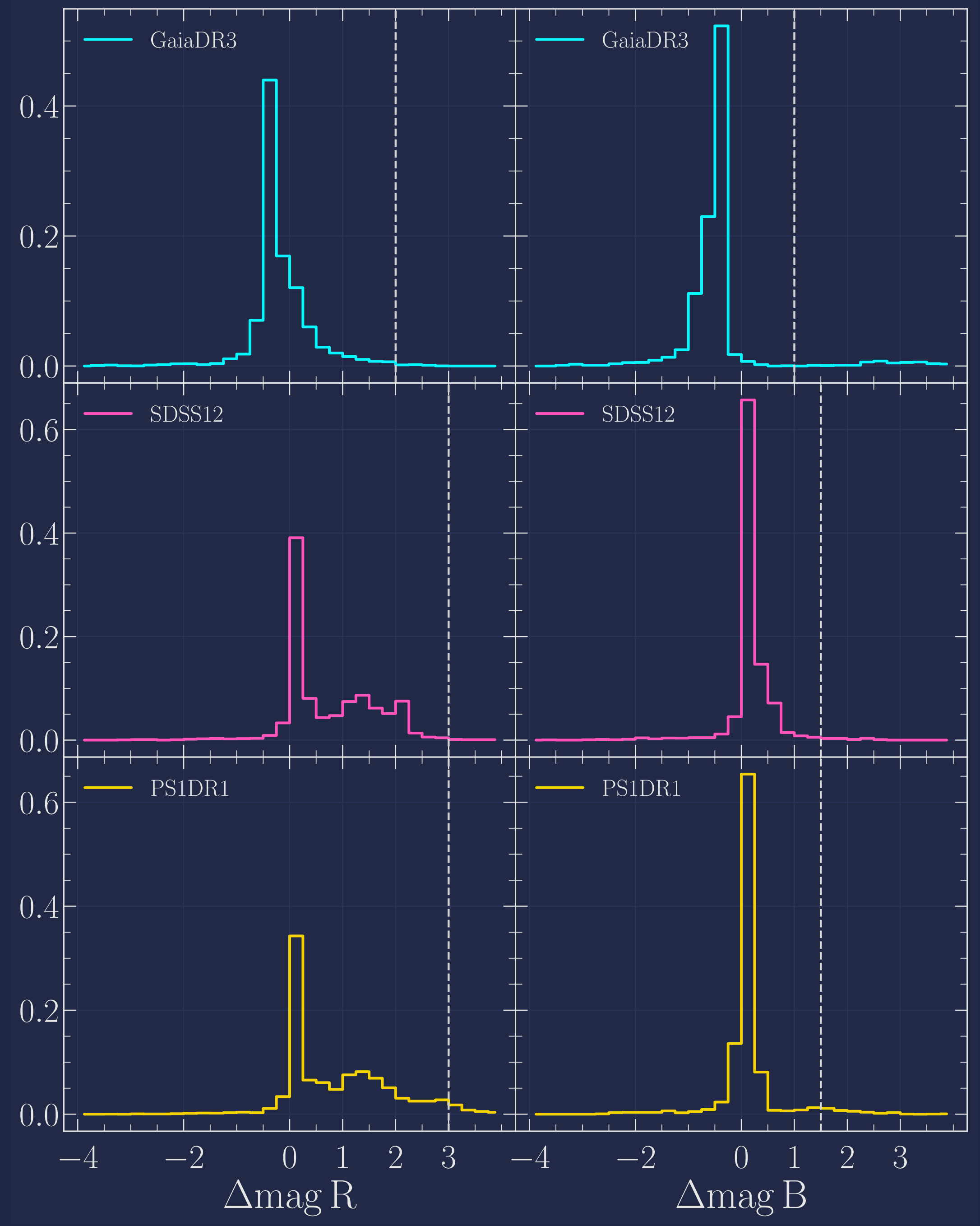
## VT magnitudes vs catalog magnitudes

- Looked at distribution of *Δ*mag for VT R and B bands compared with three catalogs: SDSS, PS1DR1, GaiaDR3
- !!! For now : *Δ*mag defined as: $mag_{cat}$ - $mag_{VT}$ (different filters)
- Used simulation from Yulei of 238 different VT fields

# Estimating $\Delta$mag threshold

## VT magnitudes vs catalog magnitudes

- Histogram summed over all simulated fields
- Shows that majority of sources have $\Delta$mag ~ 0
- Vertical lines indicate $\Delta$mag used
- Can be improved by excluding blended sources



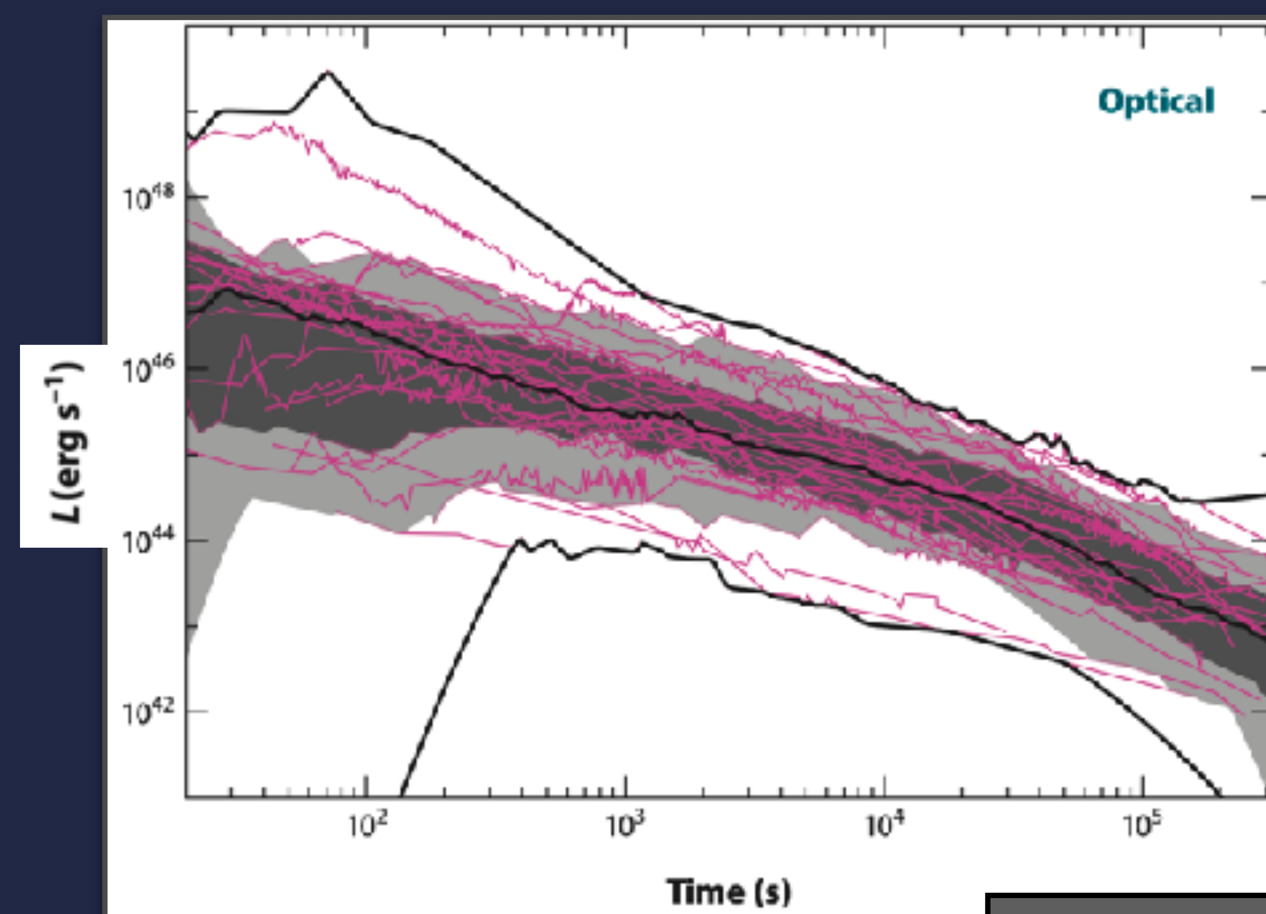
# Estimating $\Delta$mag threshold

## Simulation of magnitudes between VT sequences

# Estimating $\Delta$mag threshold

## Simulation of magnitudes between VT sequences

- Optical lightcurve (LC) parameters based on Gehrels et al. 2009
- Assume a flat spectrum (same results in R and B)
- L0 = $10^{47}$ erg/s, z = 2
- 10 min between sequences
- Early rise & power law decay
- Monte Carlo simulation

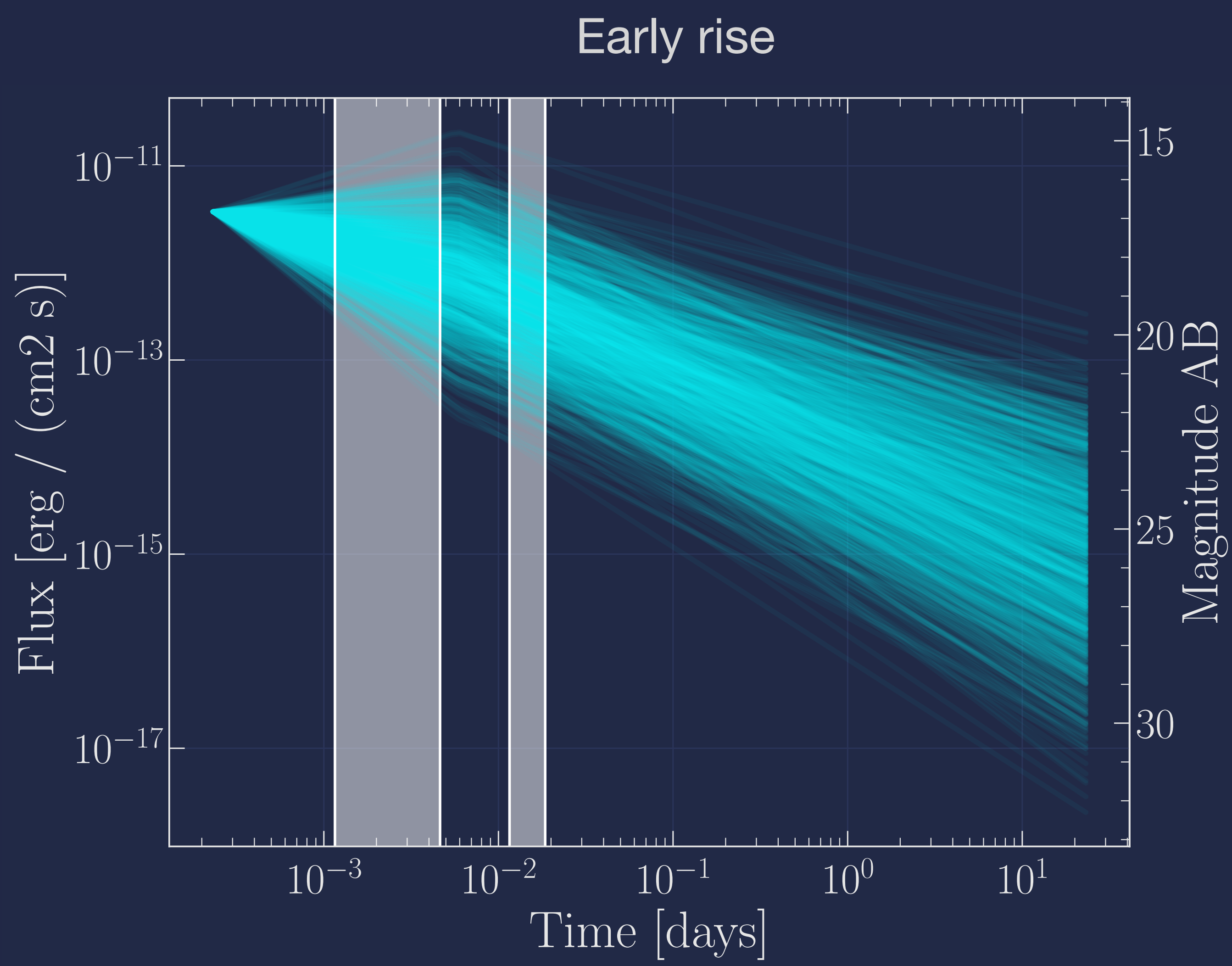


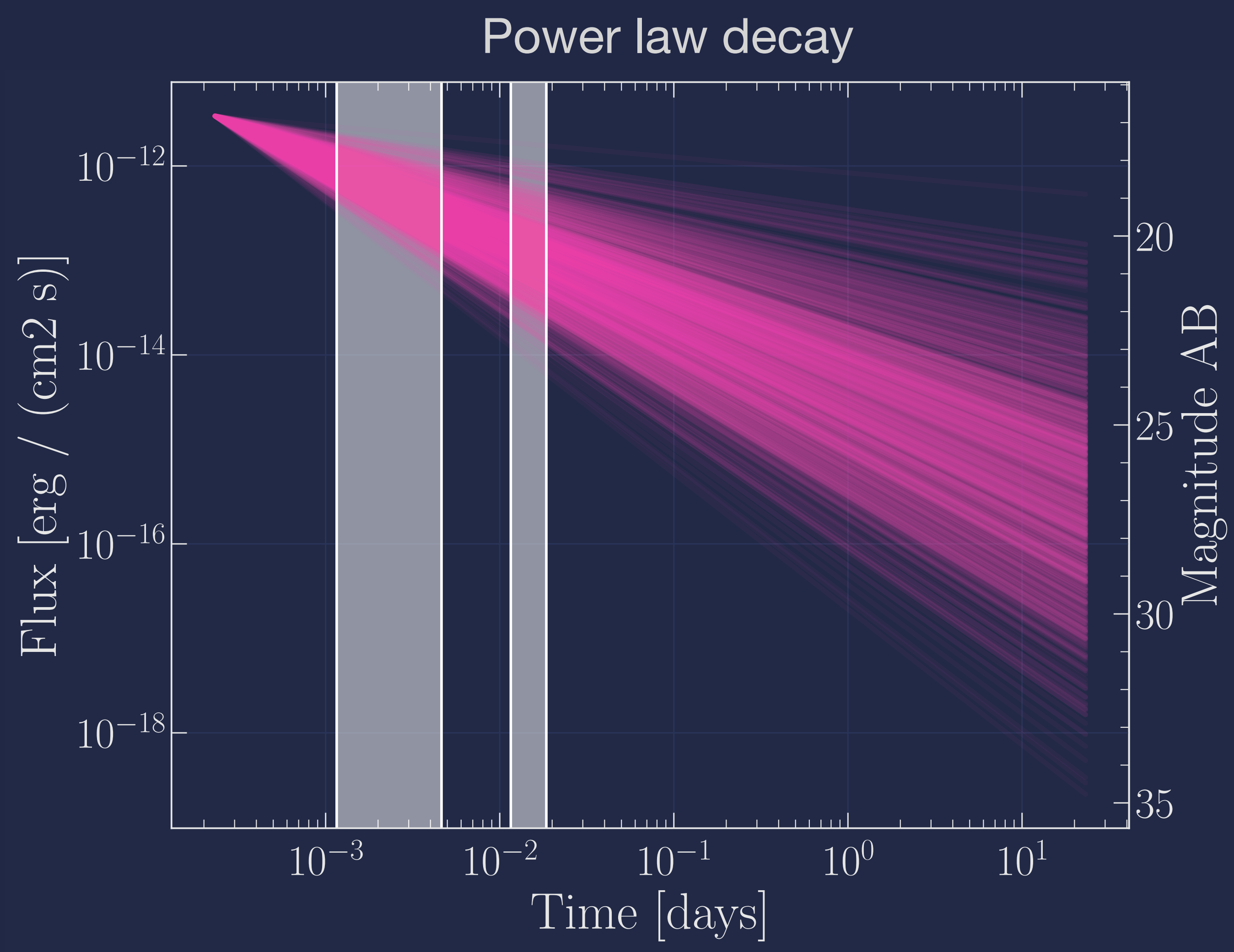

Gehrels et al. 2009

# Estimating $\Delta$mag threshold

## Simulation of magnitudes between VT sequences

- Example of LC, sequences are shown as shaded area

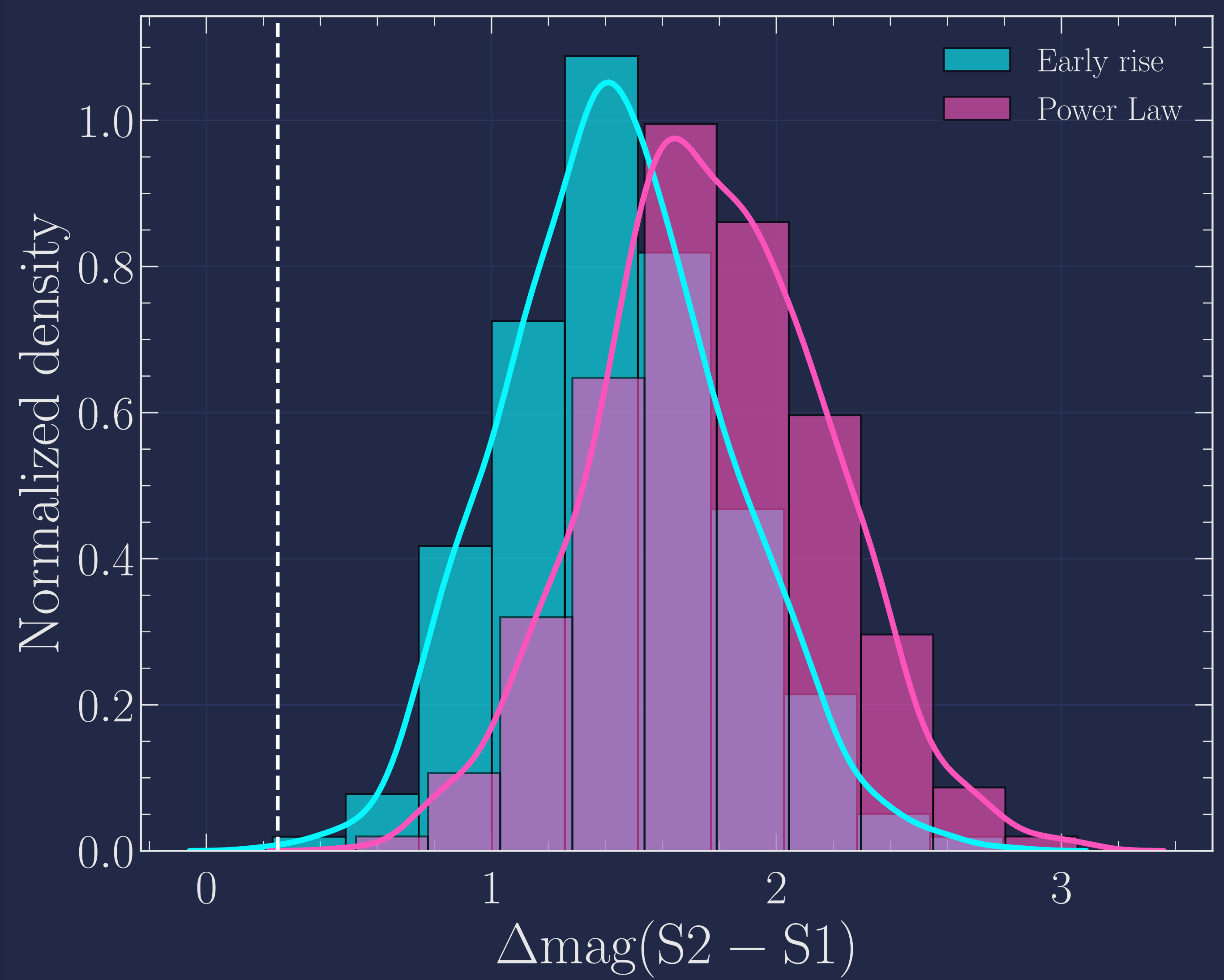


# Estimating *Δ*mag threshold

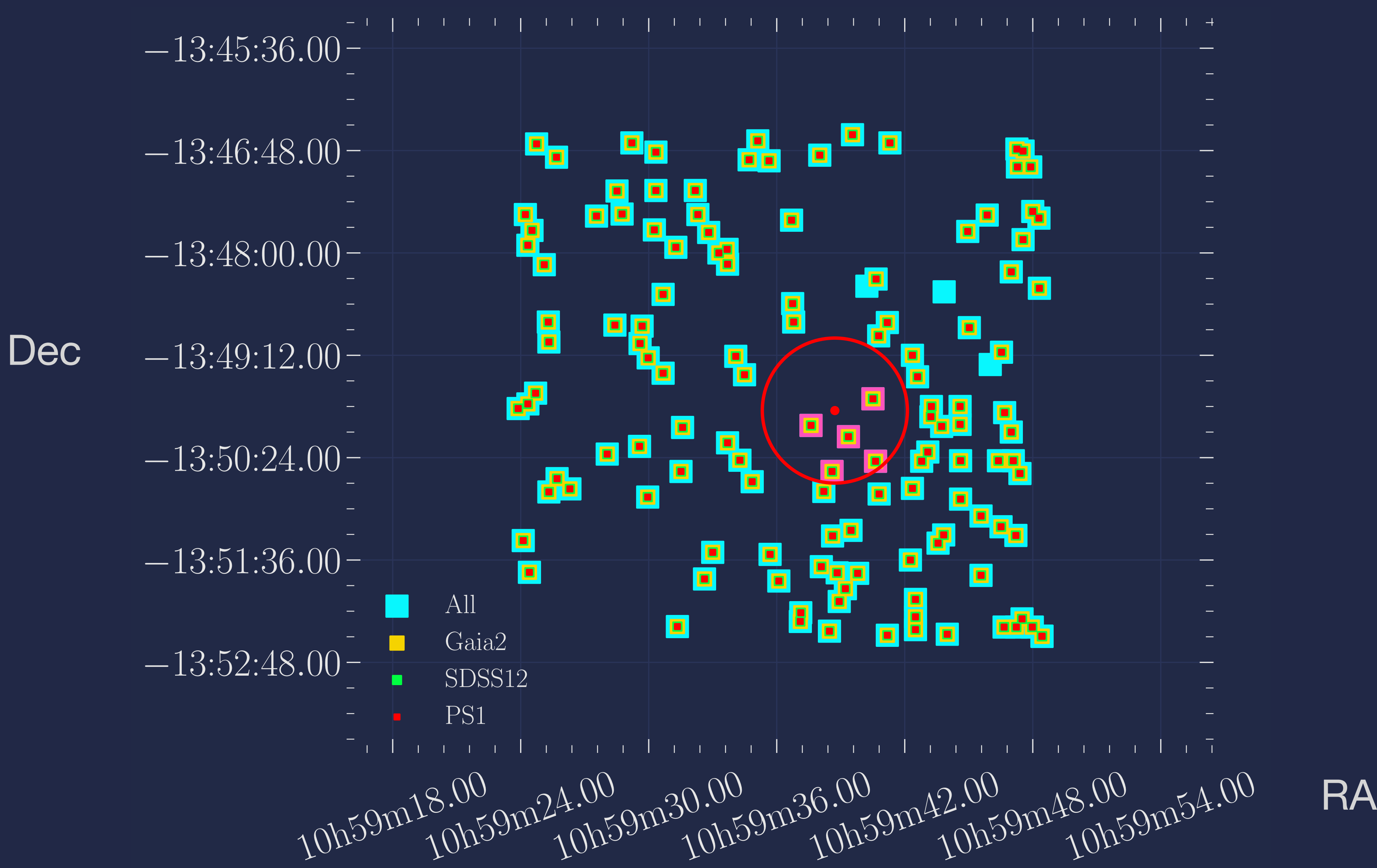
## Simulation of magnitudes between VT sequences

- Settled on *Δ*mag = 0.25 (dashed vertical line)



# Filtering by QPO_MXT

- Use 90% containment radius if available to constrain candidates



# Summary

- Candidates are sources that:
  - Did not exist before in catalogs
  - Existed before but have varied in magnitude
- Most promising candidates are contained within QPO_MXT
- Candidates detected in R but not in B are very interesting (potentially high redshift ($z > 3$-4) or highly dusty)

# VT characteristics

- Magnitude limit V : ~22.5 after 300s
- Blue channel : 4000 to 6500 Å
- Red channel : 6500 Å to 1 µm
- Field of View : ~ 26 x 26 arcmin