Challenge N: Crossmatching

Dr Paul Hancock

ADACS

Curtin University

MURCHISON WIDEFIELD ARRAY

ICRAR

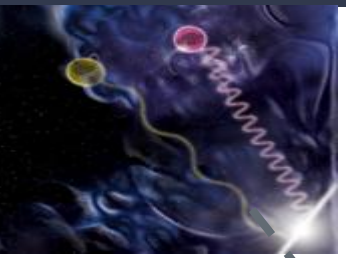
International Centre for Radio Astronomy Research

CAASTRO

ALL-SKY ASTROPHYSICS

Our view into the universe

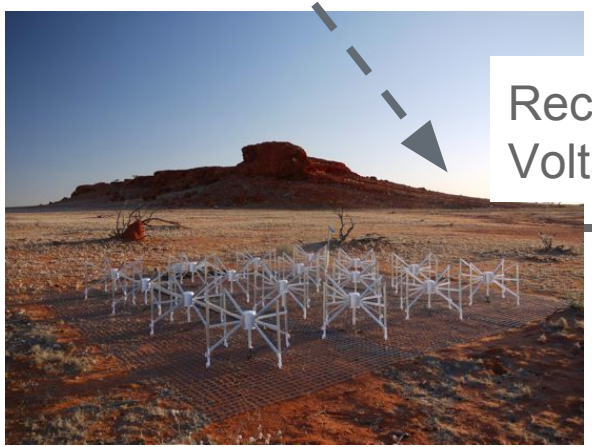
Radio Imaging: A supercomputer for a lense



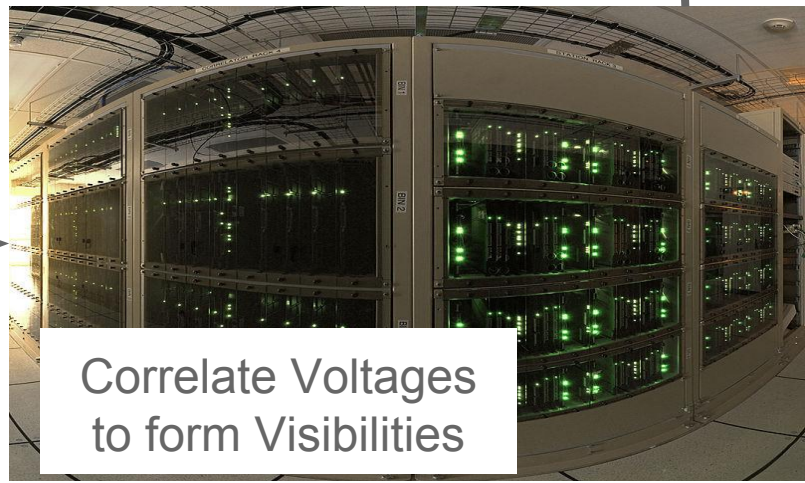
Interesting Event

$$I_\nu(l,m) = \int\int \frac{V_\nu(u,v)}{\sqrt{1-l^2-m^2}} e^{-2i\pi(ul+vm)} dl\,dm$$

Transform Visibilities into Images



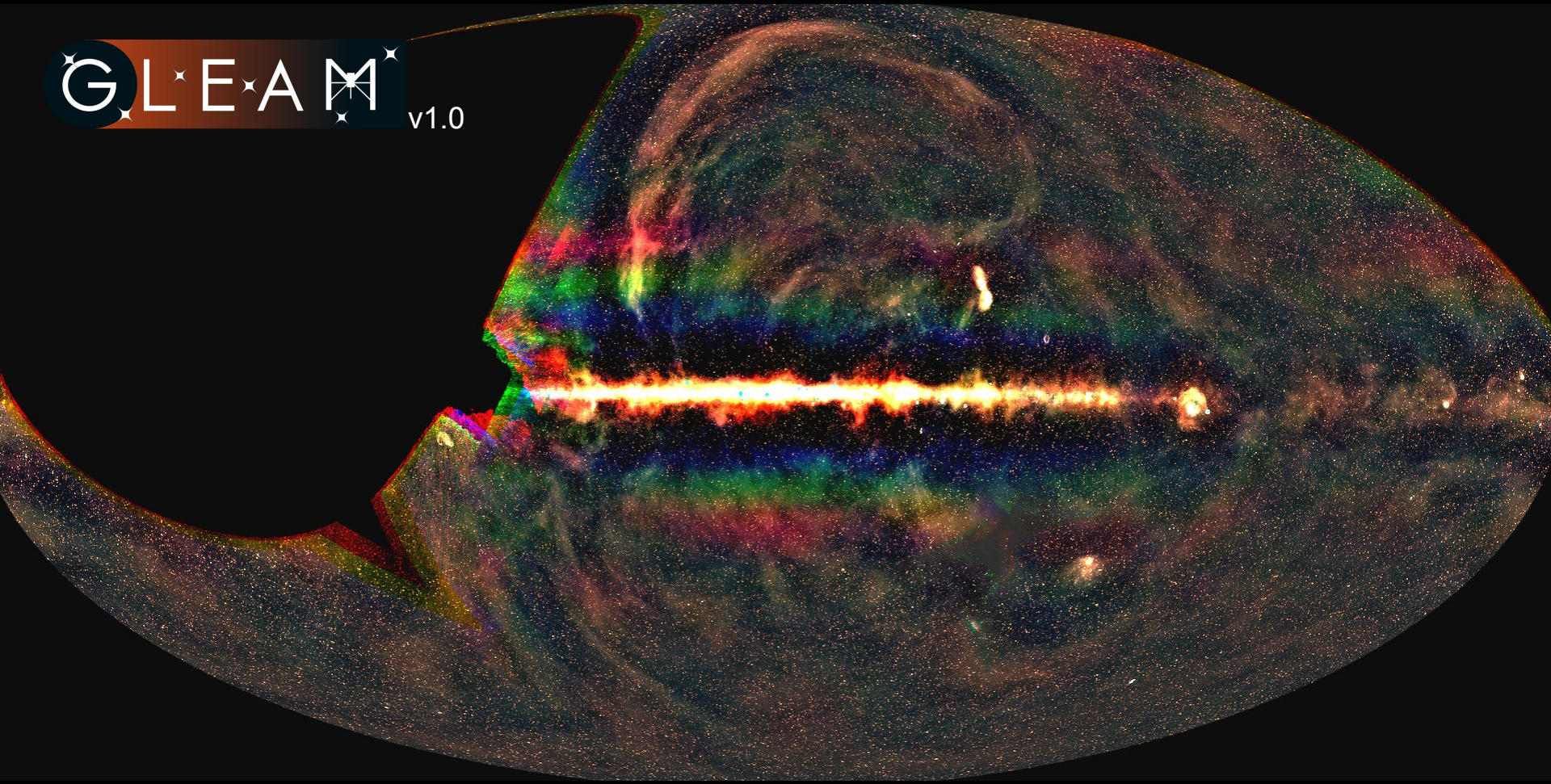
Record Voltages



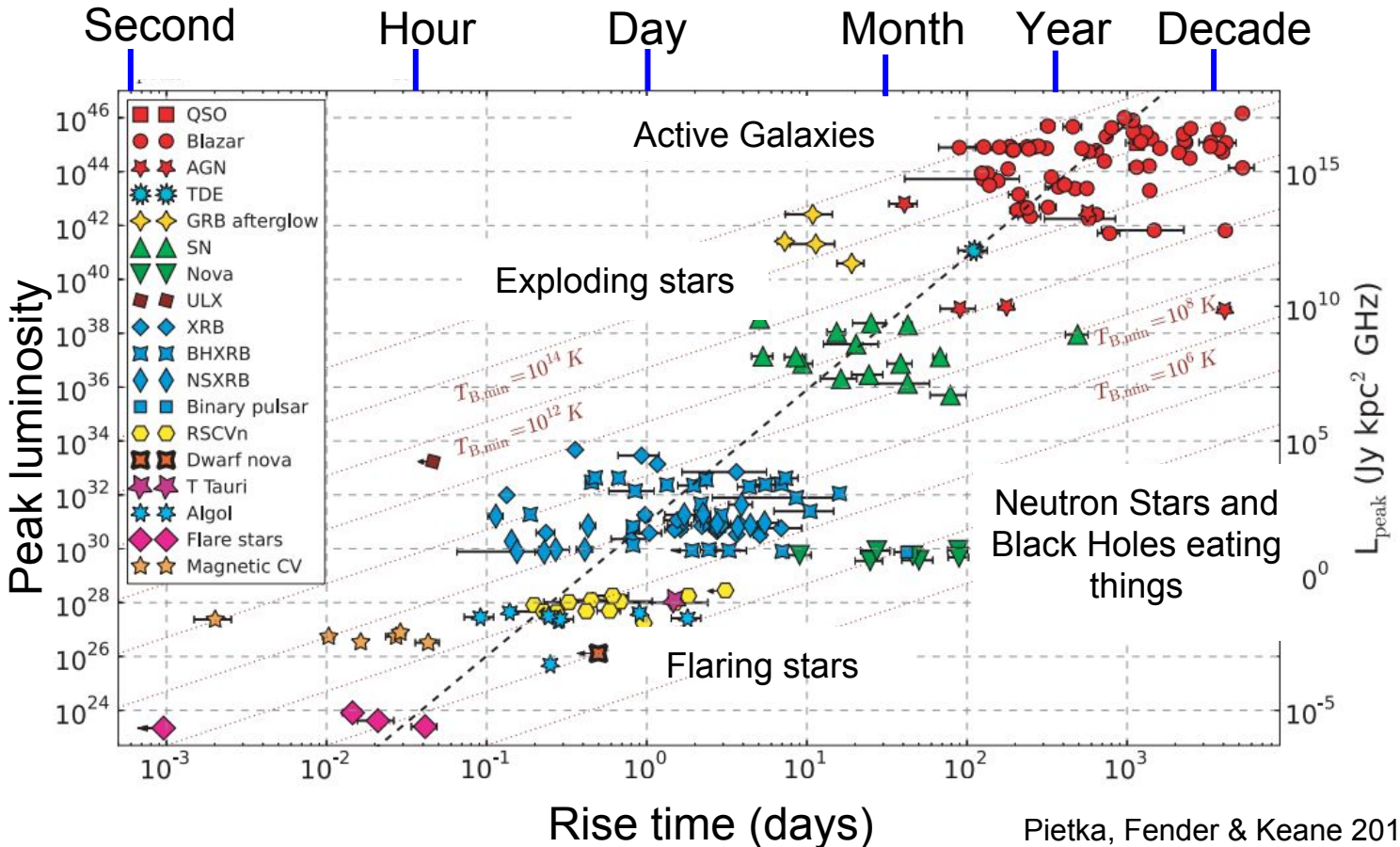
Correlate Voltages to form Visibilities

MWA - Natasha Hurley-Walker

Wikipedia

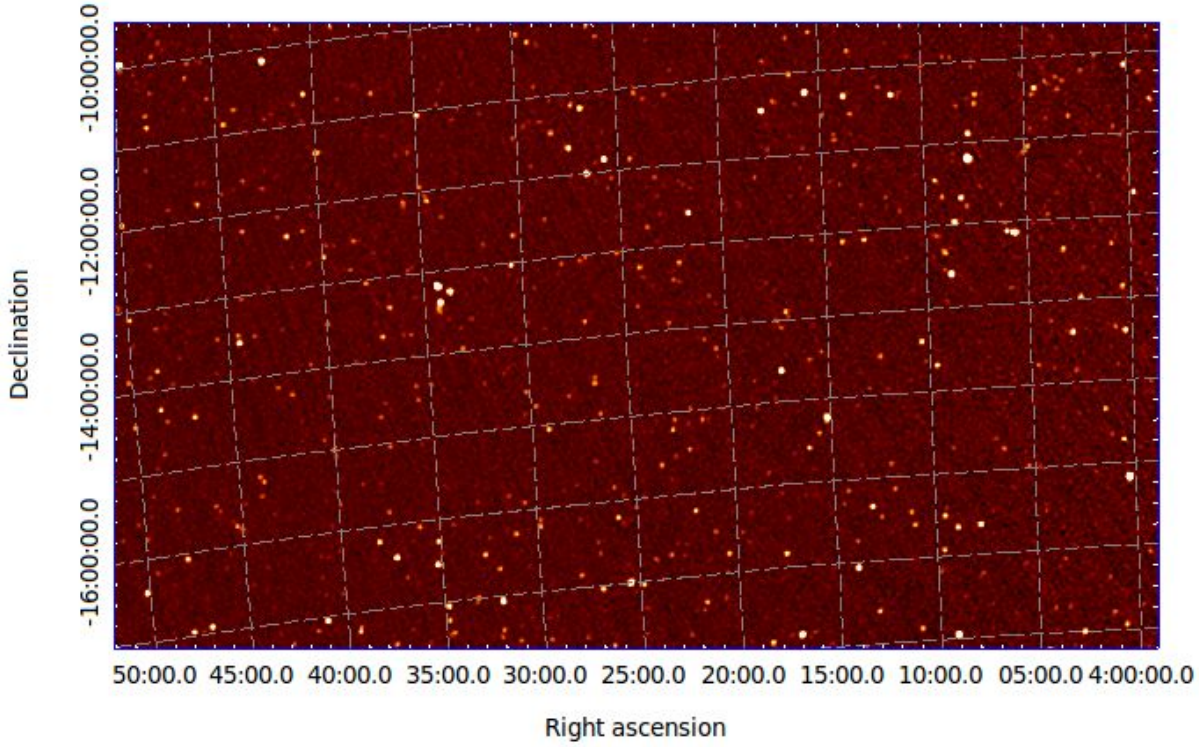

GLEAM
v1.0

What changes in the sky?



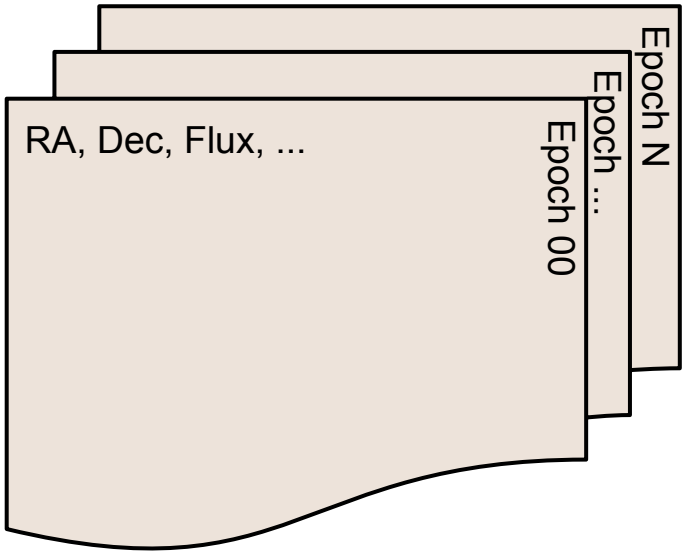
Pietka, Fender & Keane 2015MNRAS.446.3687P

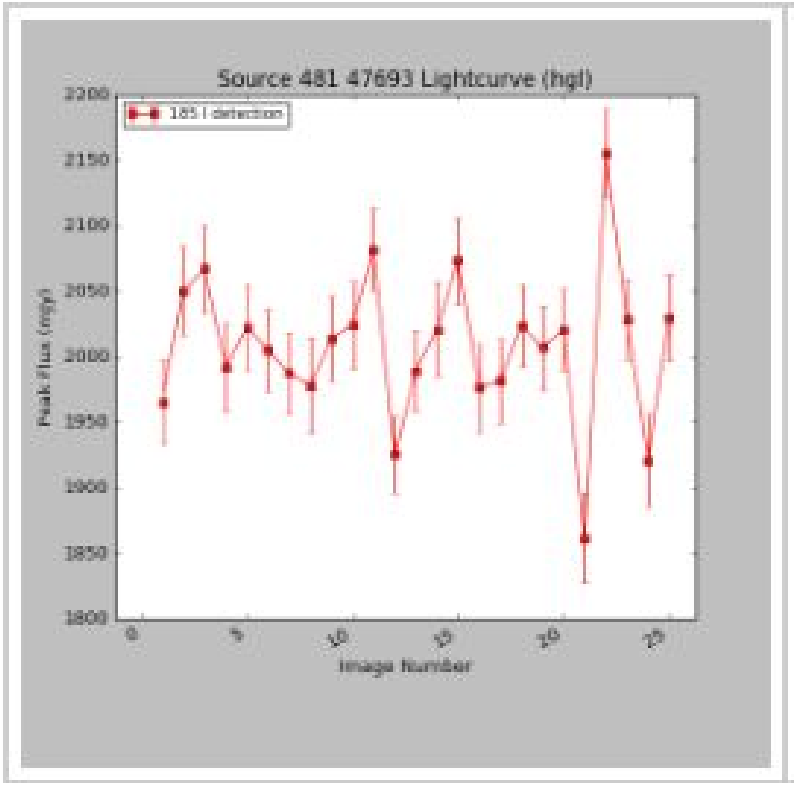
Making catalogues



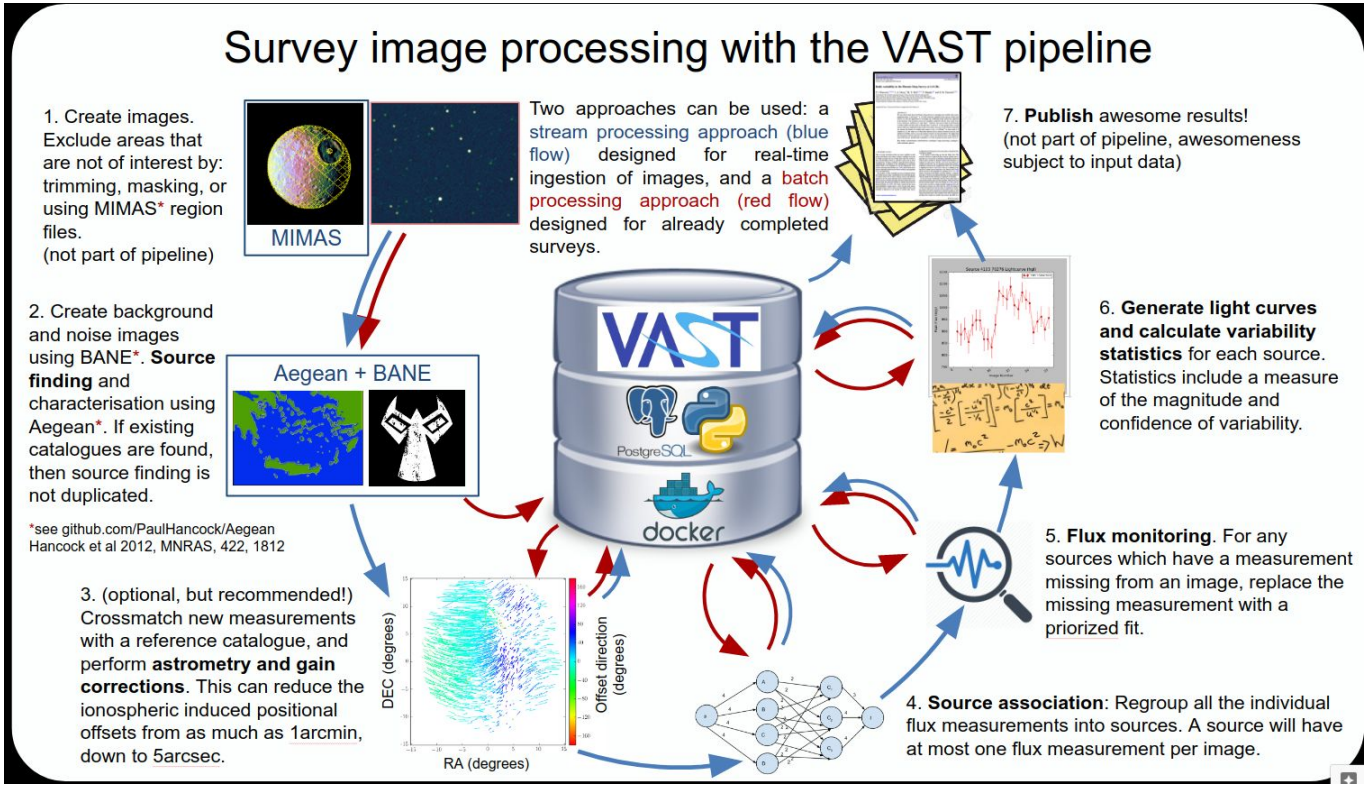
RA, Dec, Flux, ...

Making light curves = crossmatching

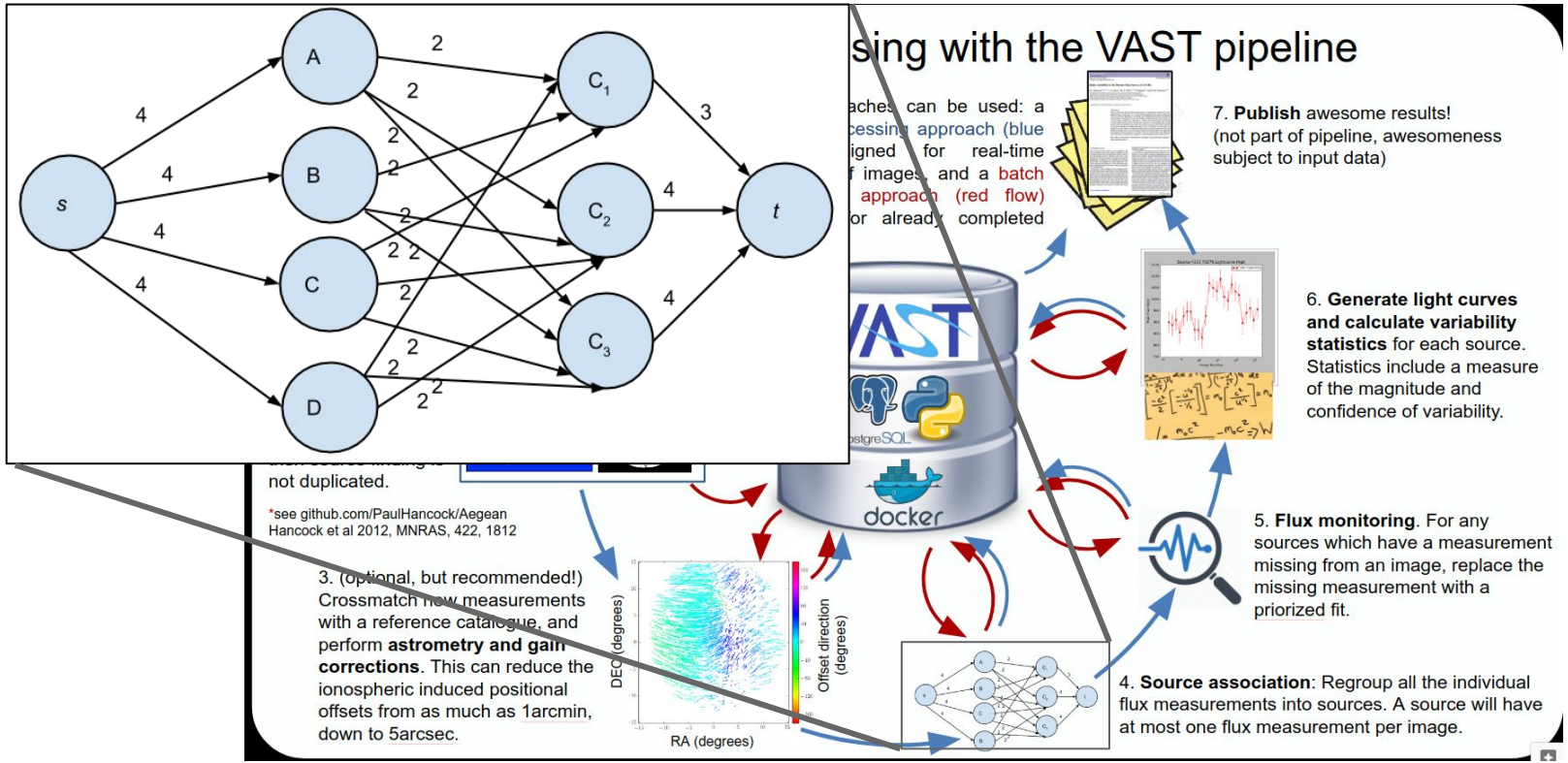




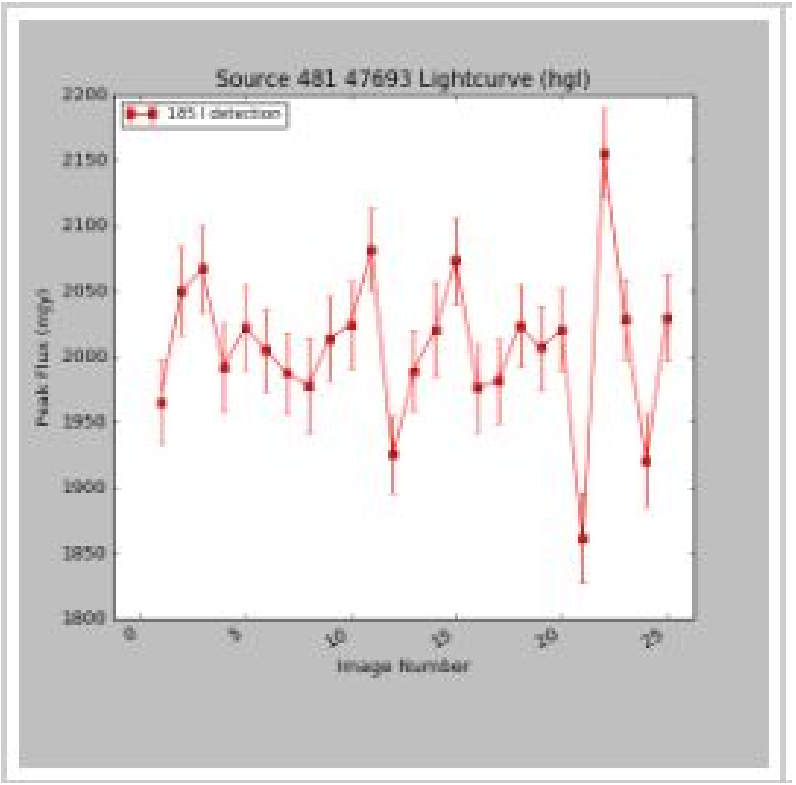
Our workflow

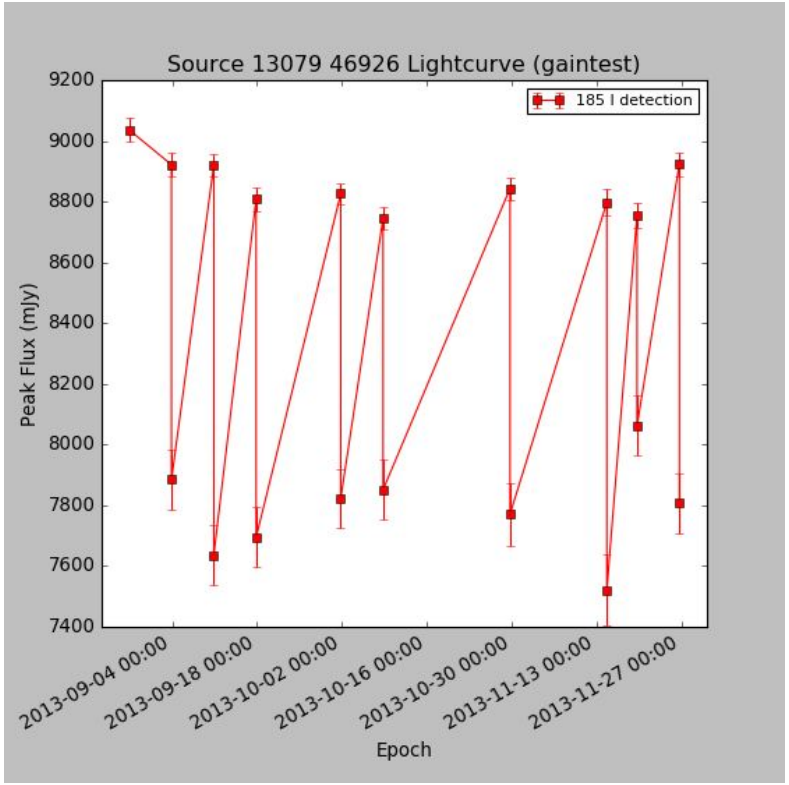


The bottleneck



Good vs Bad


Source 481 47693 Lightcurve (hgl)
185 I detection
Peak Flux (mJy)
Image Number


Source 13079 46926 Lightcurve (gaintest)
185 I detection
Peak Flux (mJy)
9200
9000
8800
8600
8400
8200
8000
7800
7600
7400
2013-09-04 00:00
2013-09-18 00:00
2013-10-02 00:00
2013-10-16 00:00
2013-10-30 00:00
2013-11-13 00:00
2013-11-27 00:00
Epoch

Good vs Bad

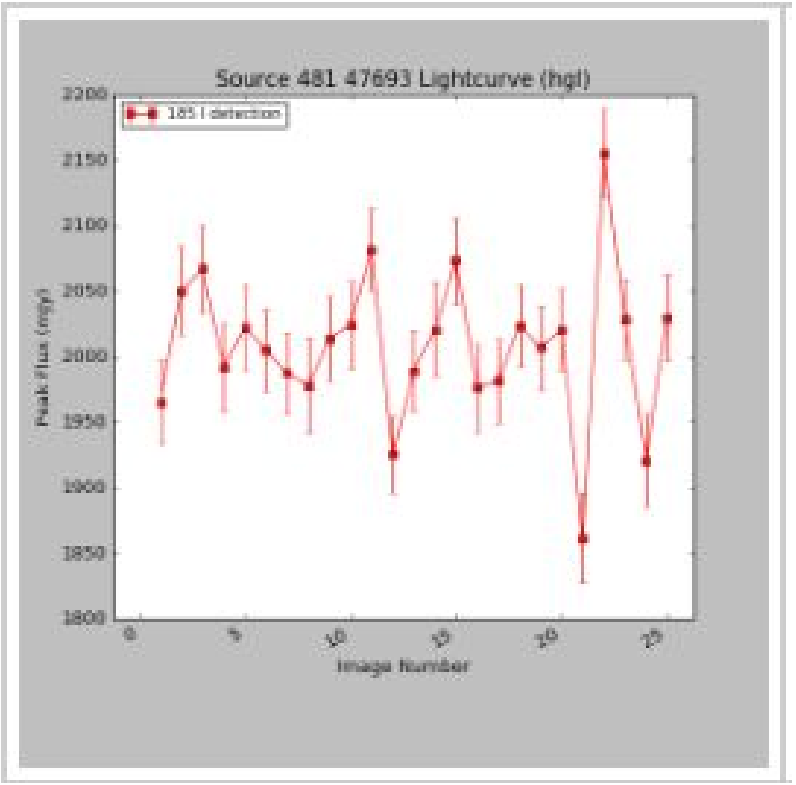

Source 481 47693 Lightcurve (hgl)
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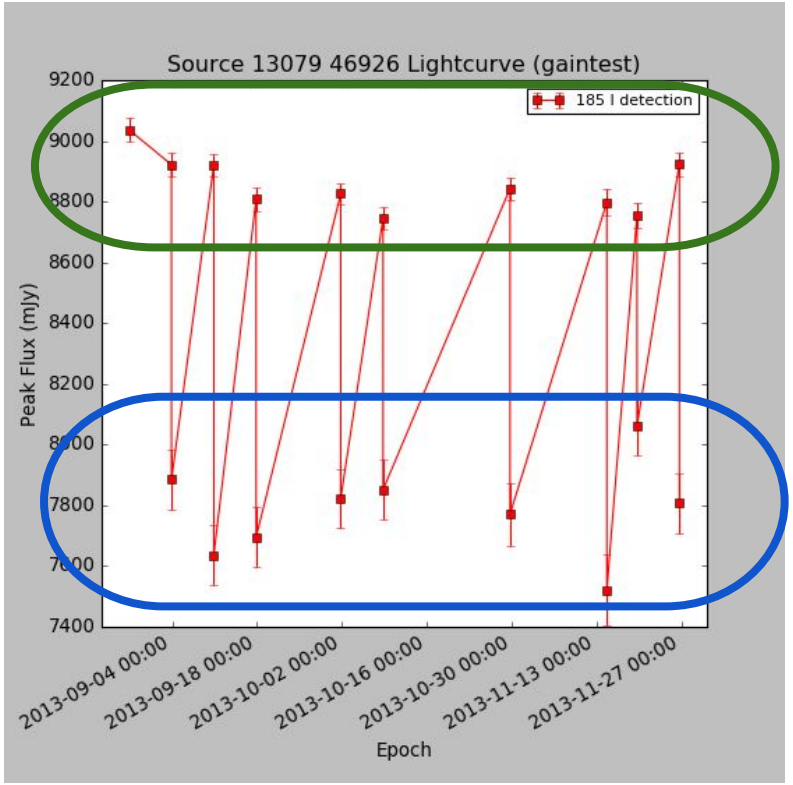
Image Number


Source 13079 46926 Lightcurve (gaintest)
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Peak Flux (mJy)
9200
9000
8800
8600
8400
8200
8000
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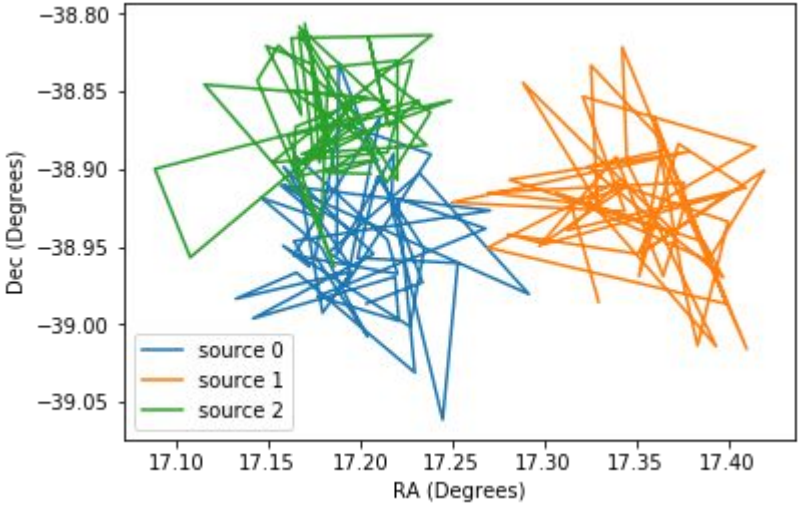
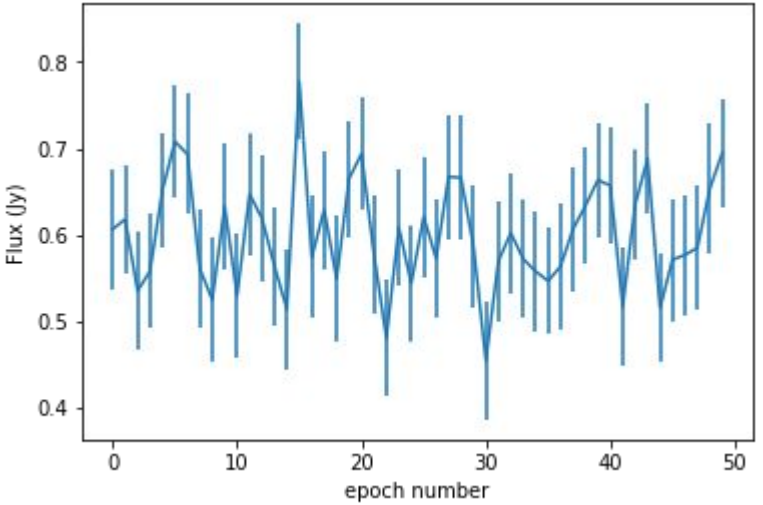
2013-09-18 00:00
2013-10-02 00:00
2013-10-16 00:00
2013-10-30 00:00
2013-11-13 00:00
2013-11-27 00:00
Epoch

Residual effects: position/flux ‘jitters’

Position shifts can confuse nearby sources



A real light curve is not always flat

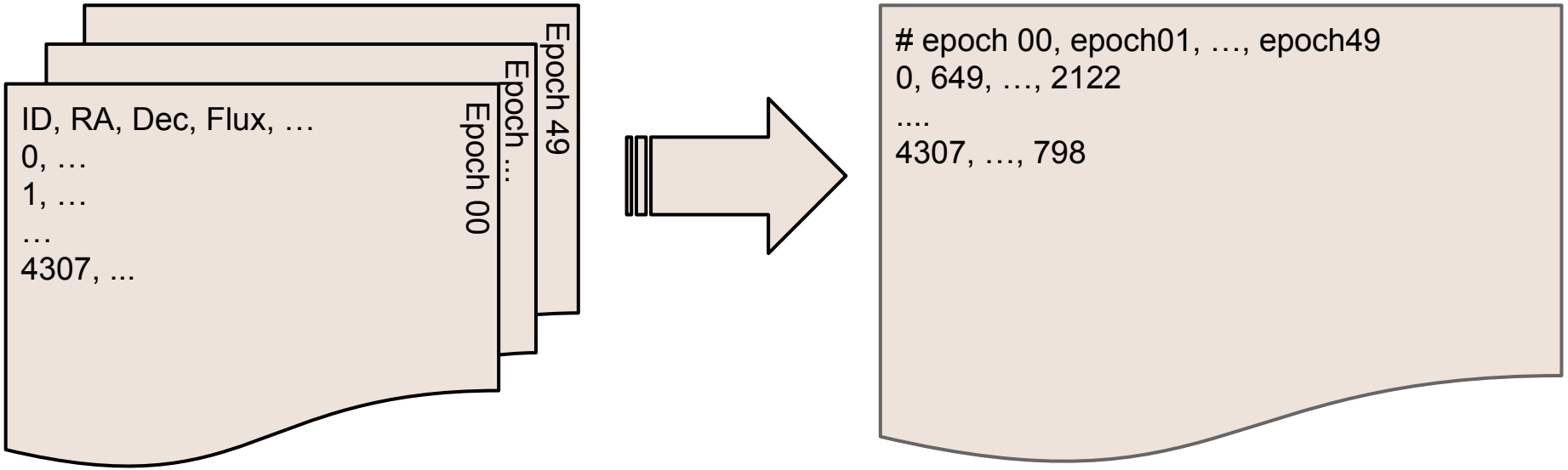


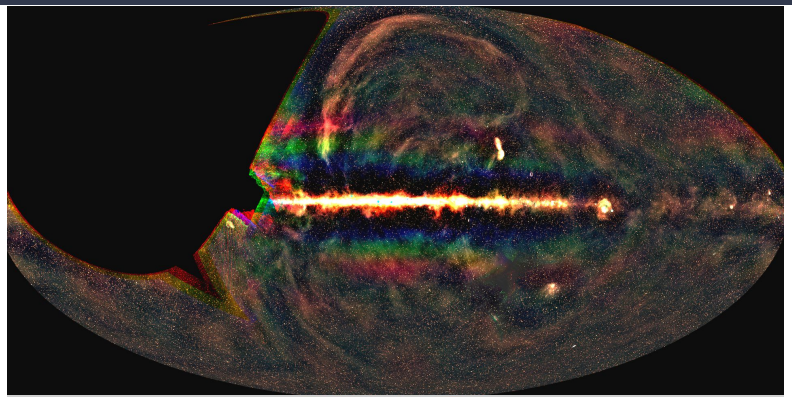
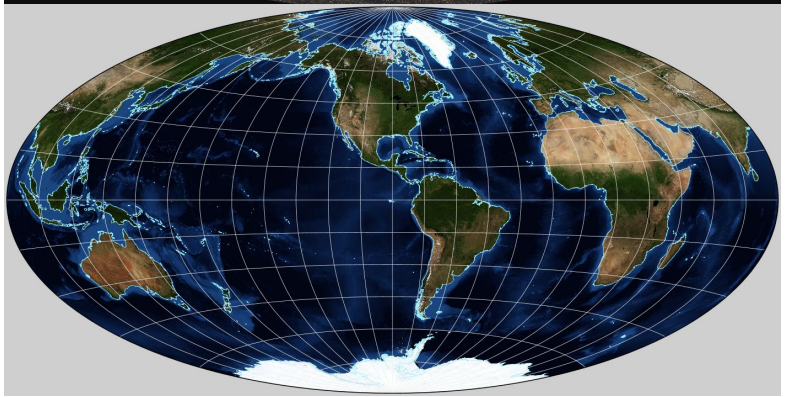
Your task:

Take the 50 catalogues

- crossmatch them and create light curves with a unique measurement in each epoch,
- report back the row ID for each source in each epoch,
- sort your answer key by epoch00 row ID

Save as a .csv



Celestial Coordinates and distances

- RA/Dec = Lat/Long
  - projected onto the sky
- RA/Dec are in degrees:
  - Dec in degrees of arc
  - RA in degrees of “time”
    - arcdeg(RA) = RA*15*cos(dec)
- Distances are Great Circle Distances
  - en.wikipedia.org/wiki/Great-circle_distance
  - en.wikipedia.org/wiki/Haversine_formula