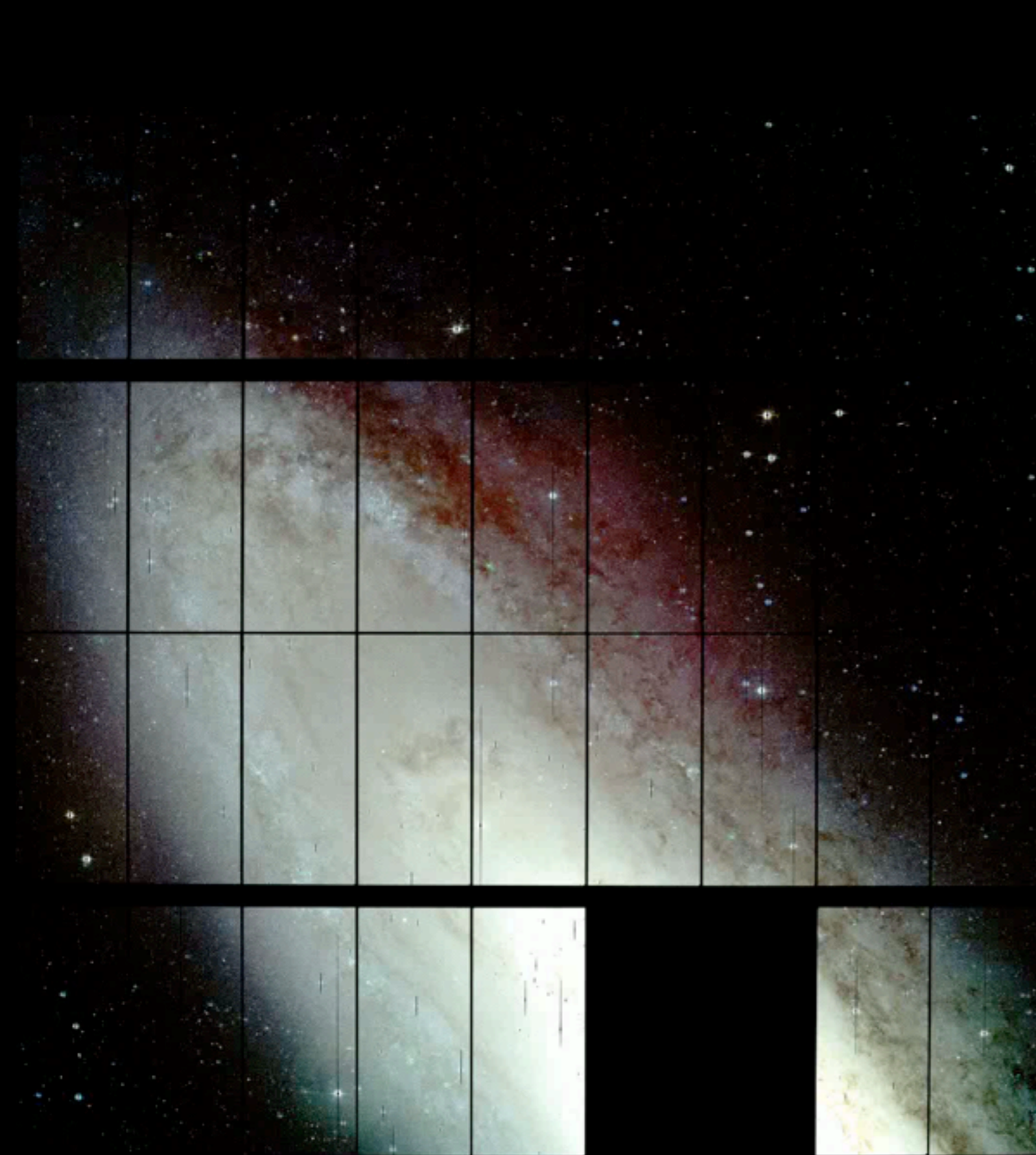


POMME

Pixel Observations of M31 with MEGacam

David Valls-Gabaud (LERMA)
Renaud Savalle (DIO/VOPDC)

Forum du Paris Data Center/OV Paris
7 juillet 2014



Filters

r' g' i'

Seeing

0.6"-1.2"

Nightly

over

5 months

Colour-
magnitude
diagrams

Time-domain

cepheids

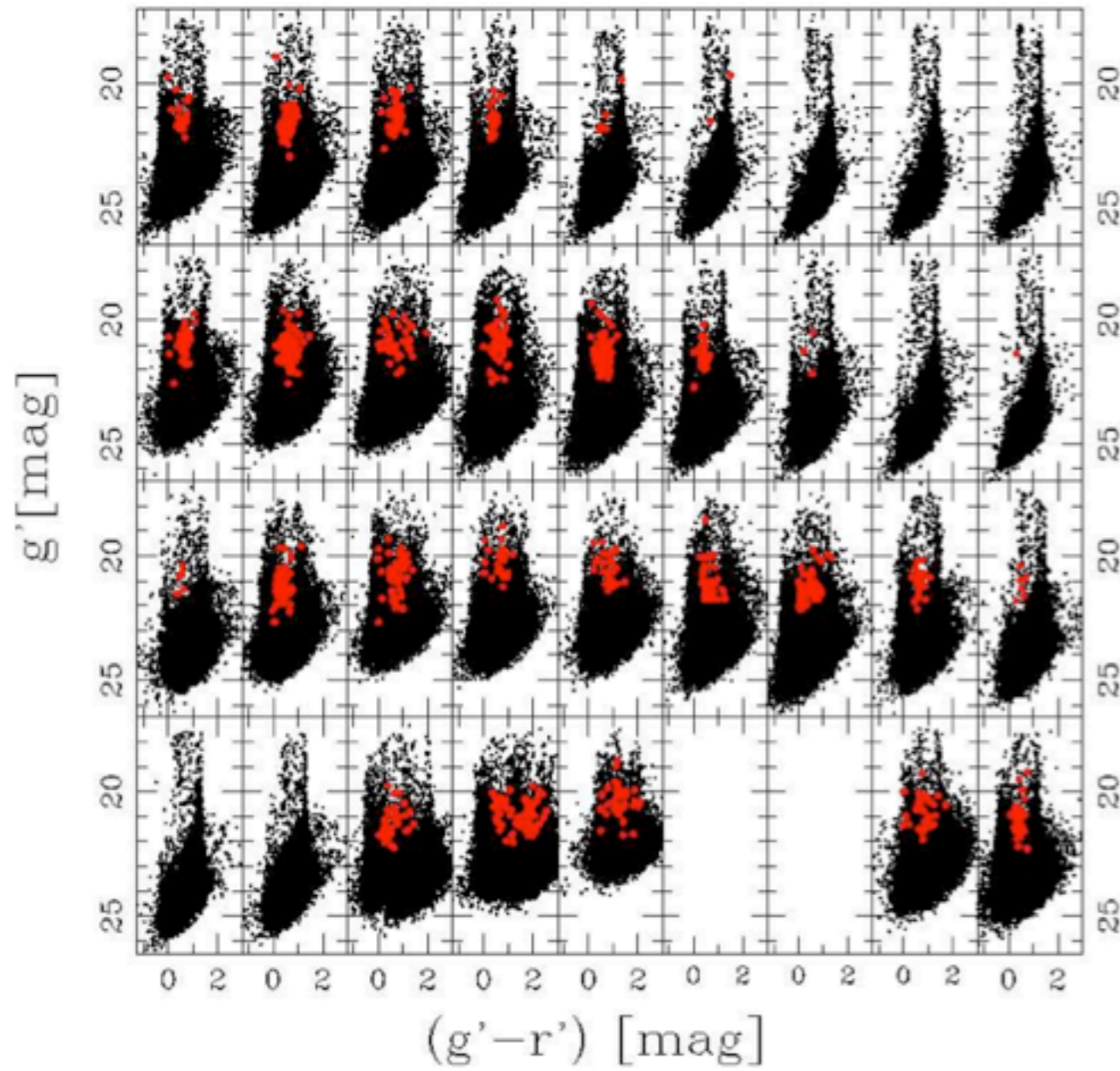
eclipsing binaries

novae

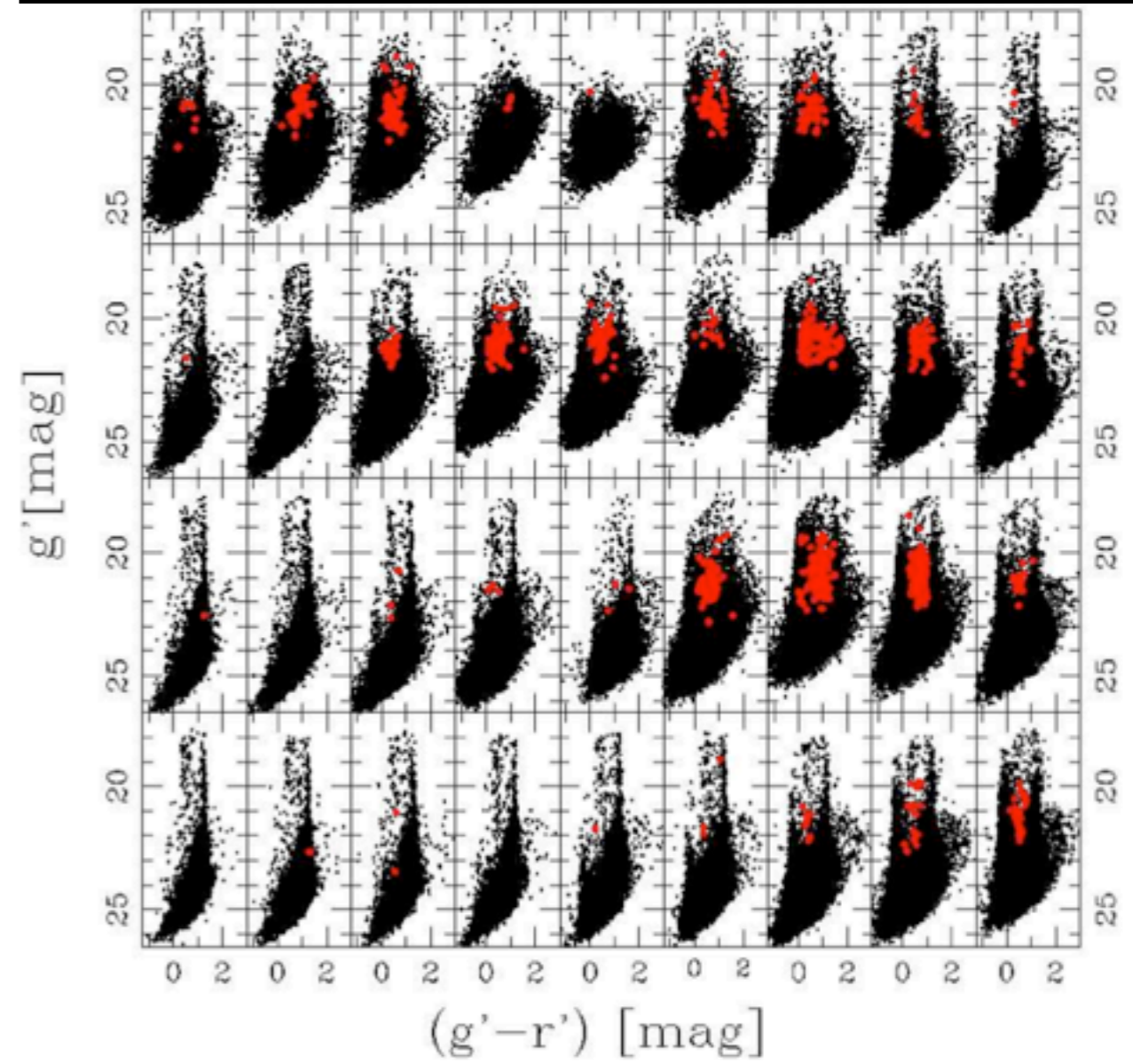
microlensing

POMME Pixel Observations of M31 with MEGacam (CFHT)

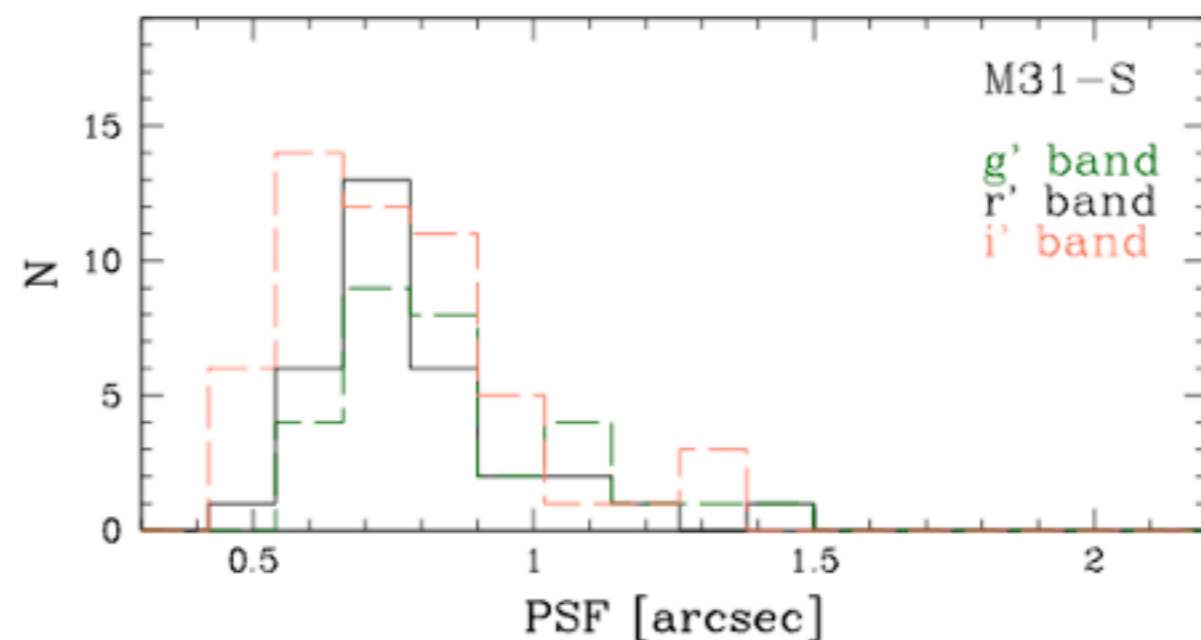
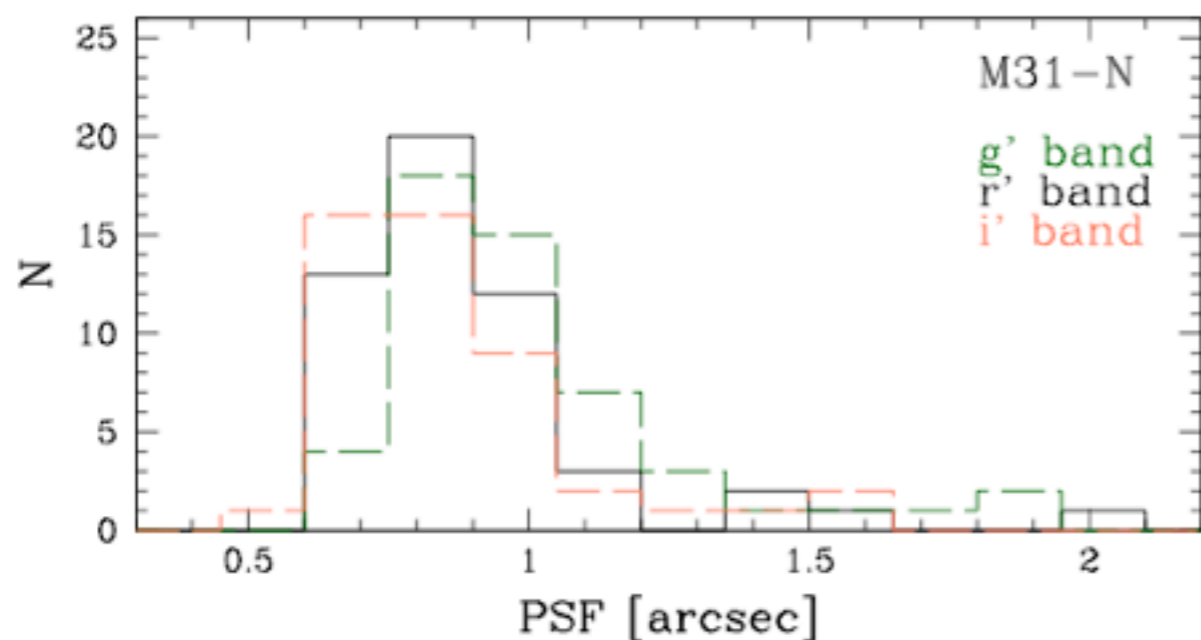
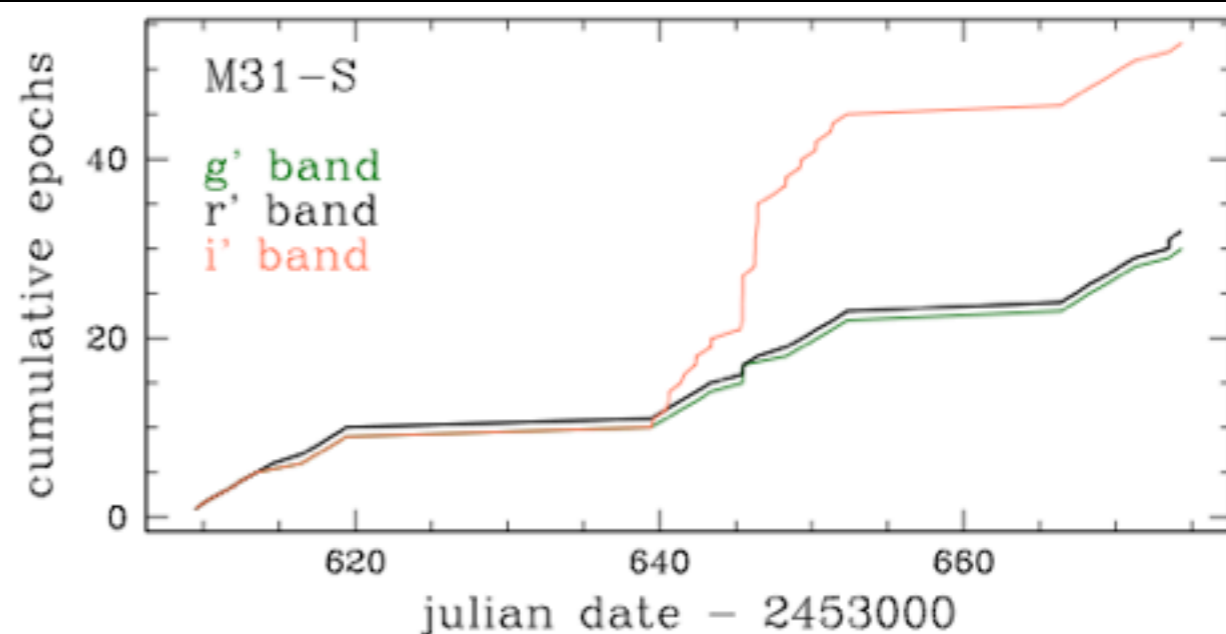
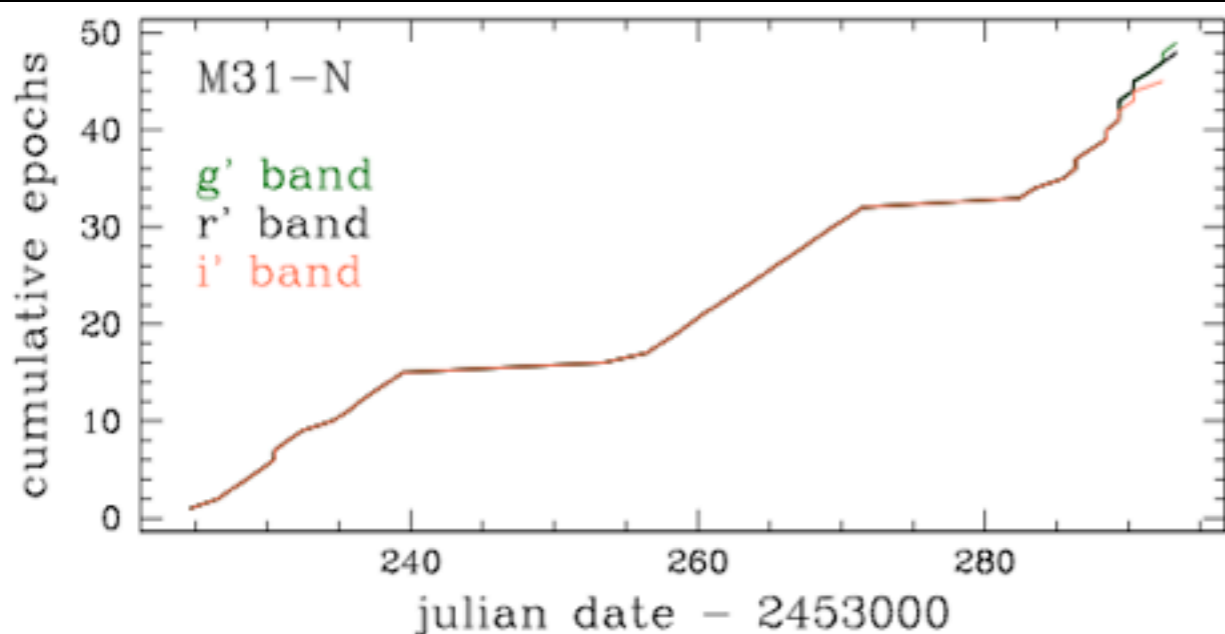
Colour-magnitude
diagrammes
across the full disc of M3 I
in $r' g' i'$



Fliri & Valls-Gabaud (2012)



The time-domain POMME database



Challenge: to detect all types of intrinsic variability

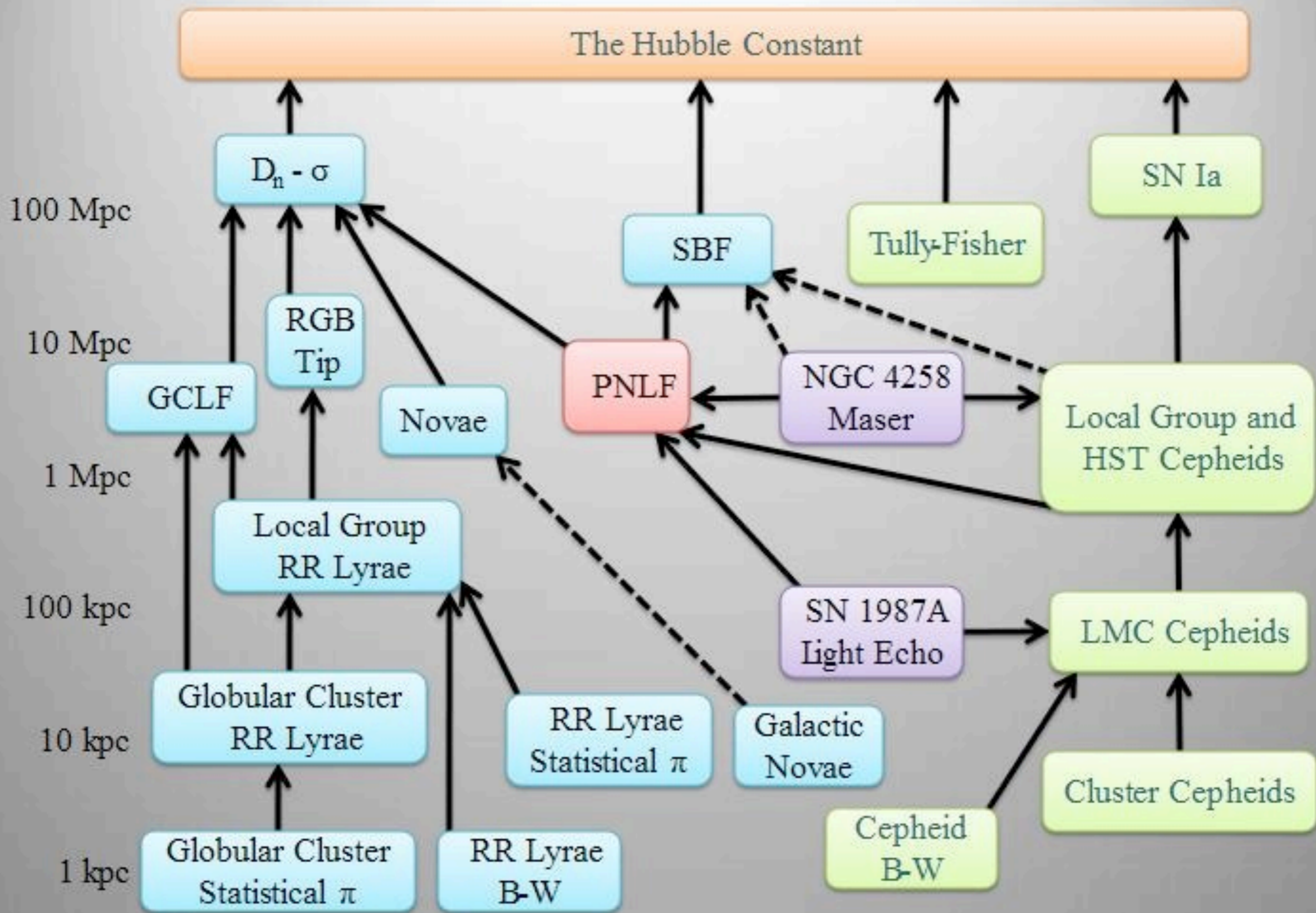
cepheids

eclipsing binaries

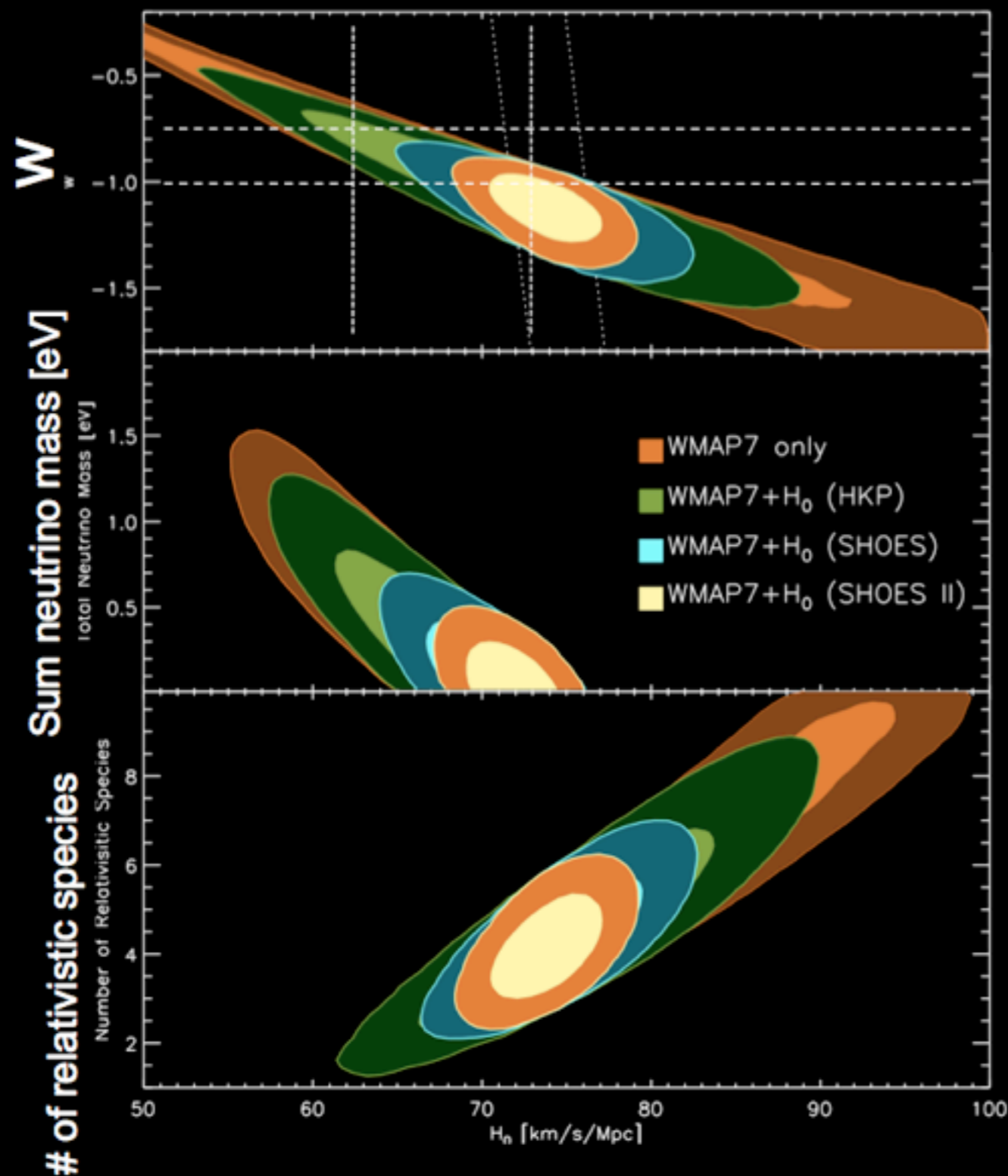
novae

microlensing events

Extragalactic Distance Ladder



The Hubble Tension

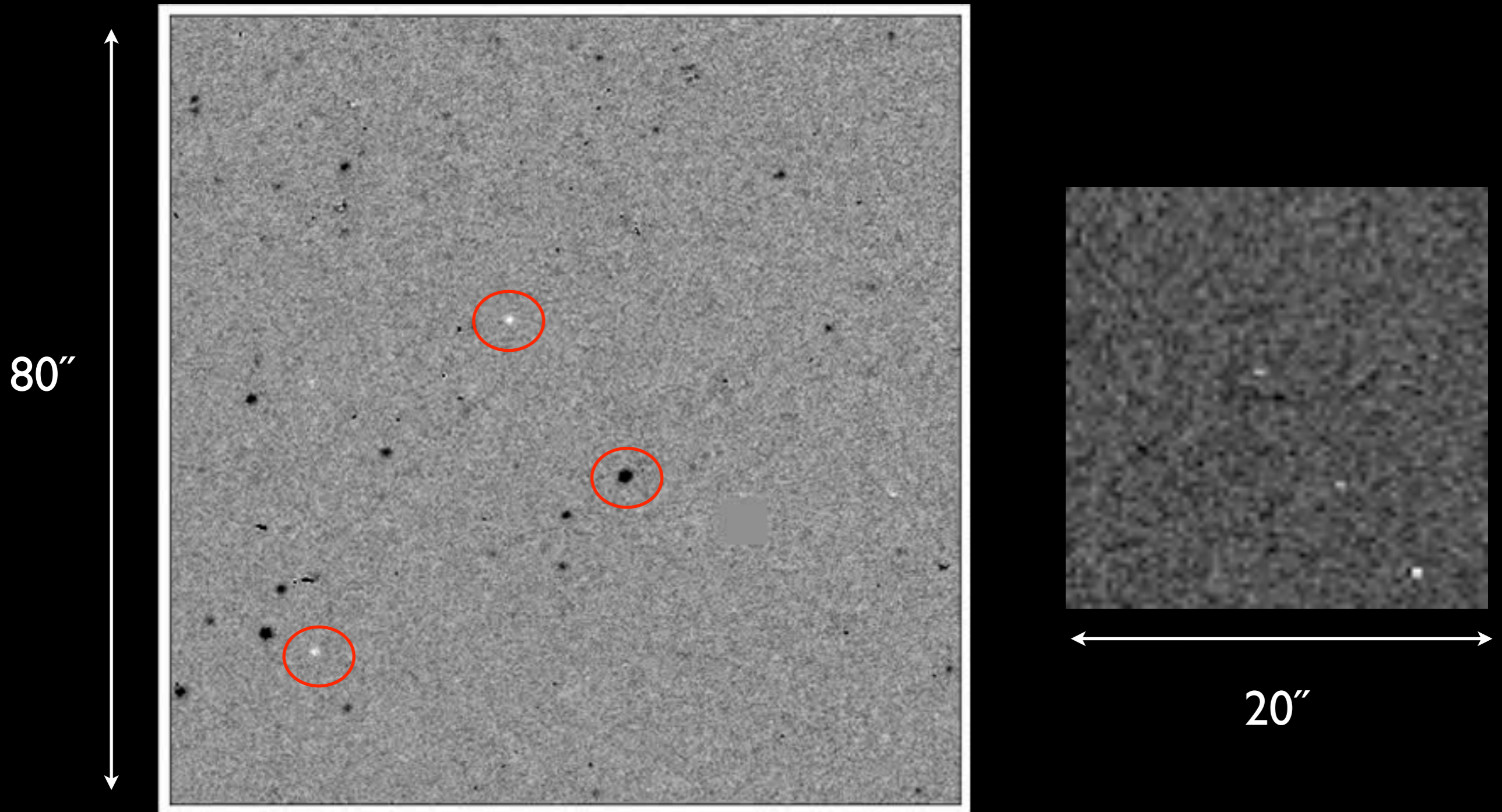


Local vs CMB values
of H_0 disagree ($\sim 2\sigma$)

Measures of H_0 to 1%
constrain
the equation of state
parameter w
of dark energy

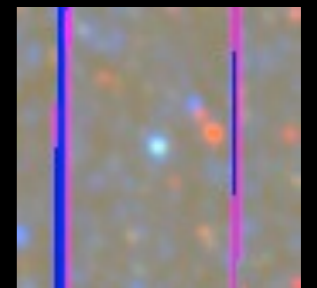
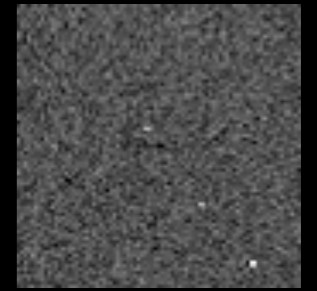
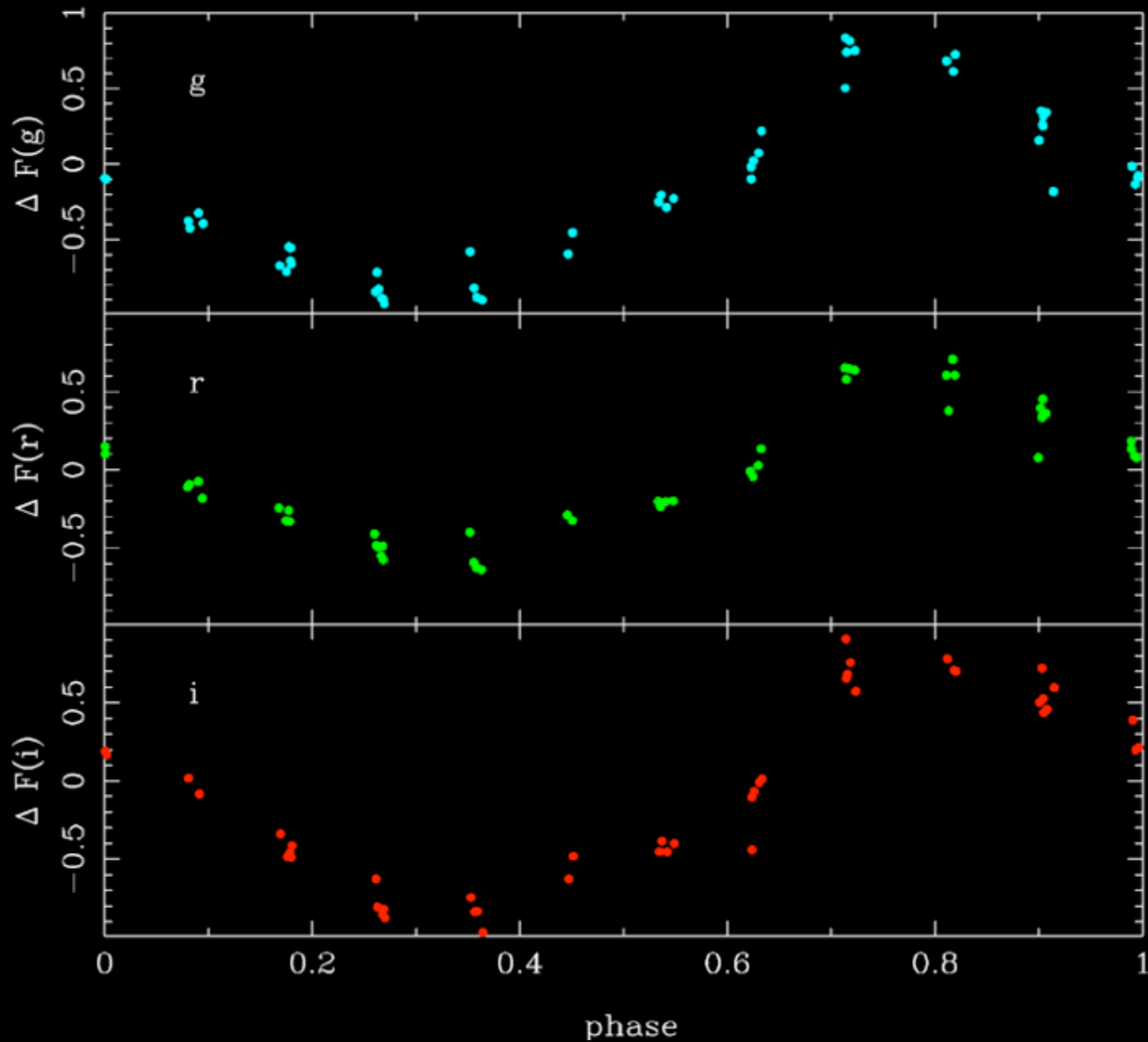
Role of systematics?
Use different tracers:
cepheids vs eclipsing SB2 binaries

Difference Image Analysis

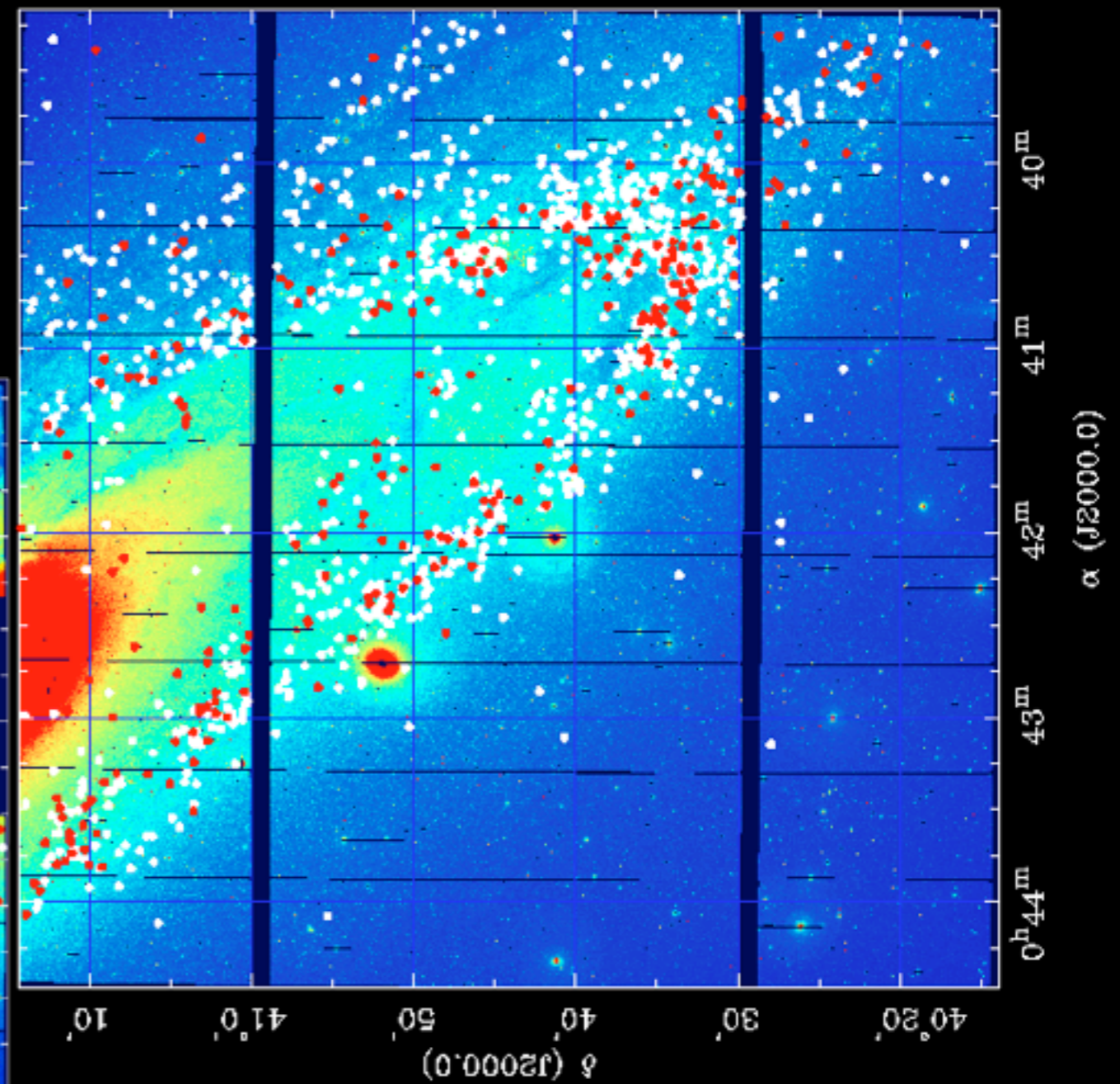
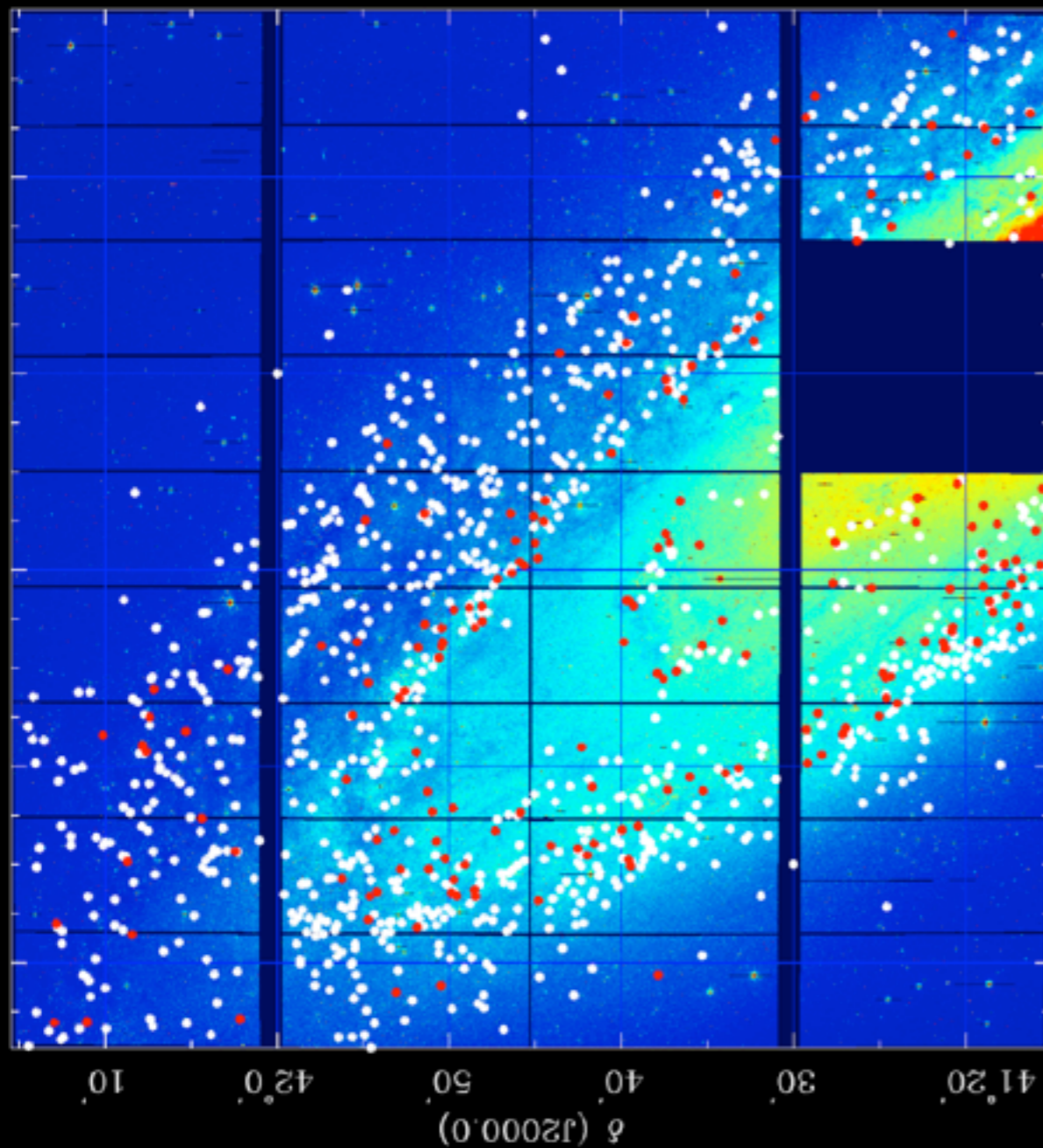


$$Var(x,y,t) = Image(x,y,t) - Reference(x,y) \otimes PSF(x,y,t)$$

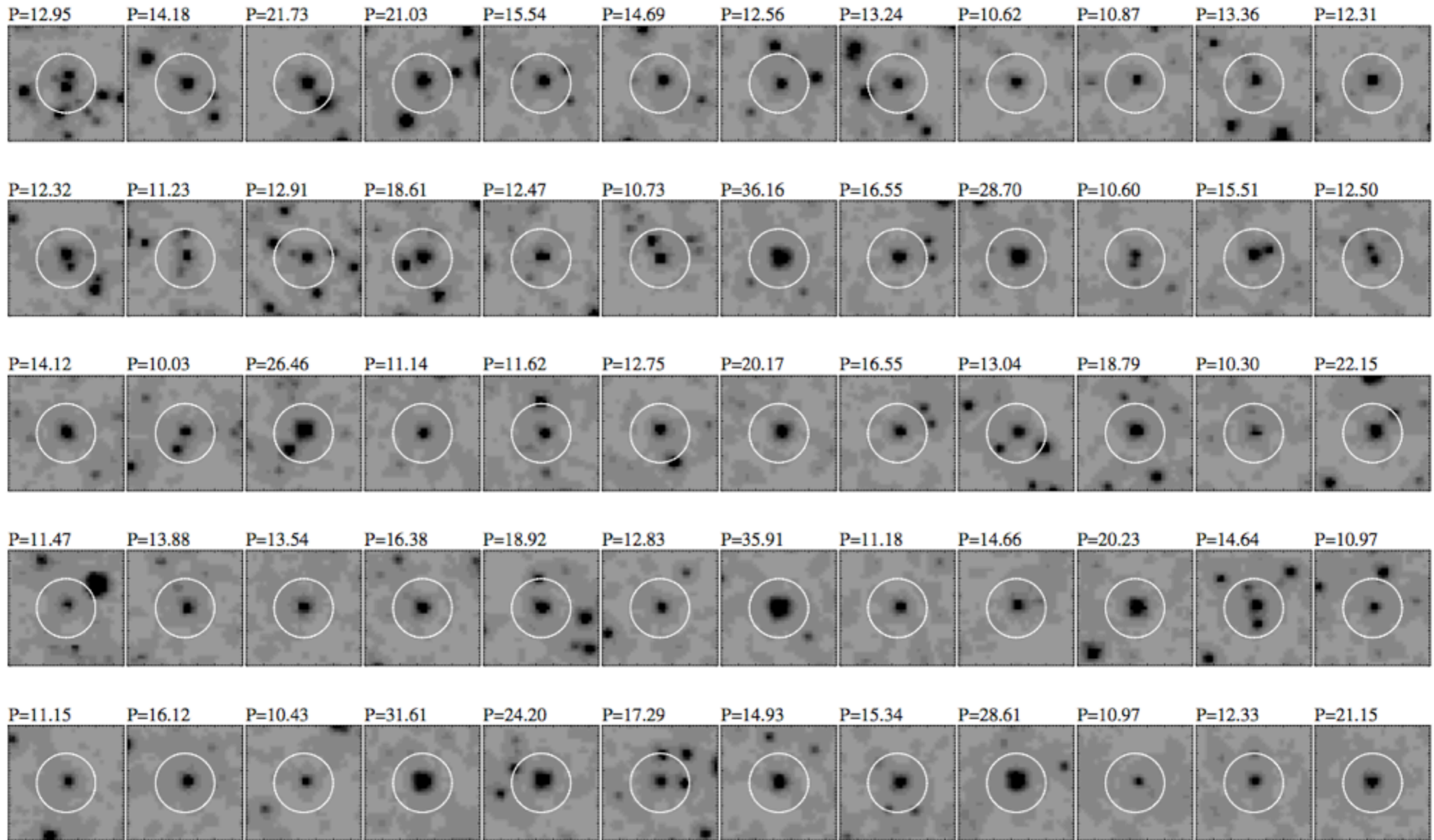
The POMME cepheids



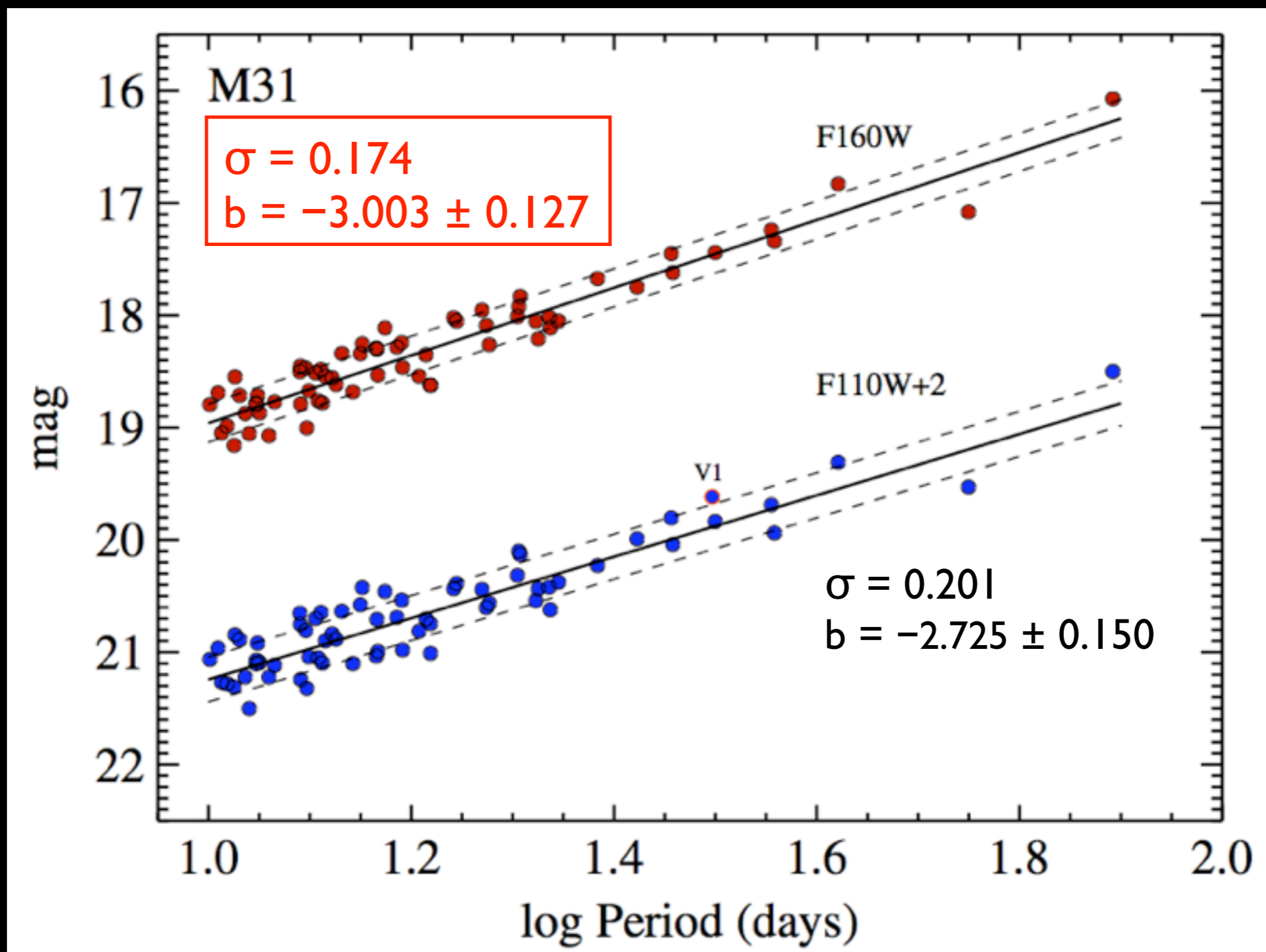
Spatial distribution
of 2460 cepheids
across the disc of M3 I



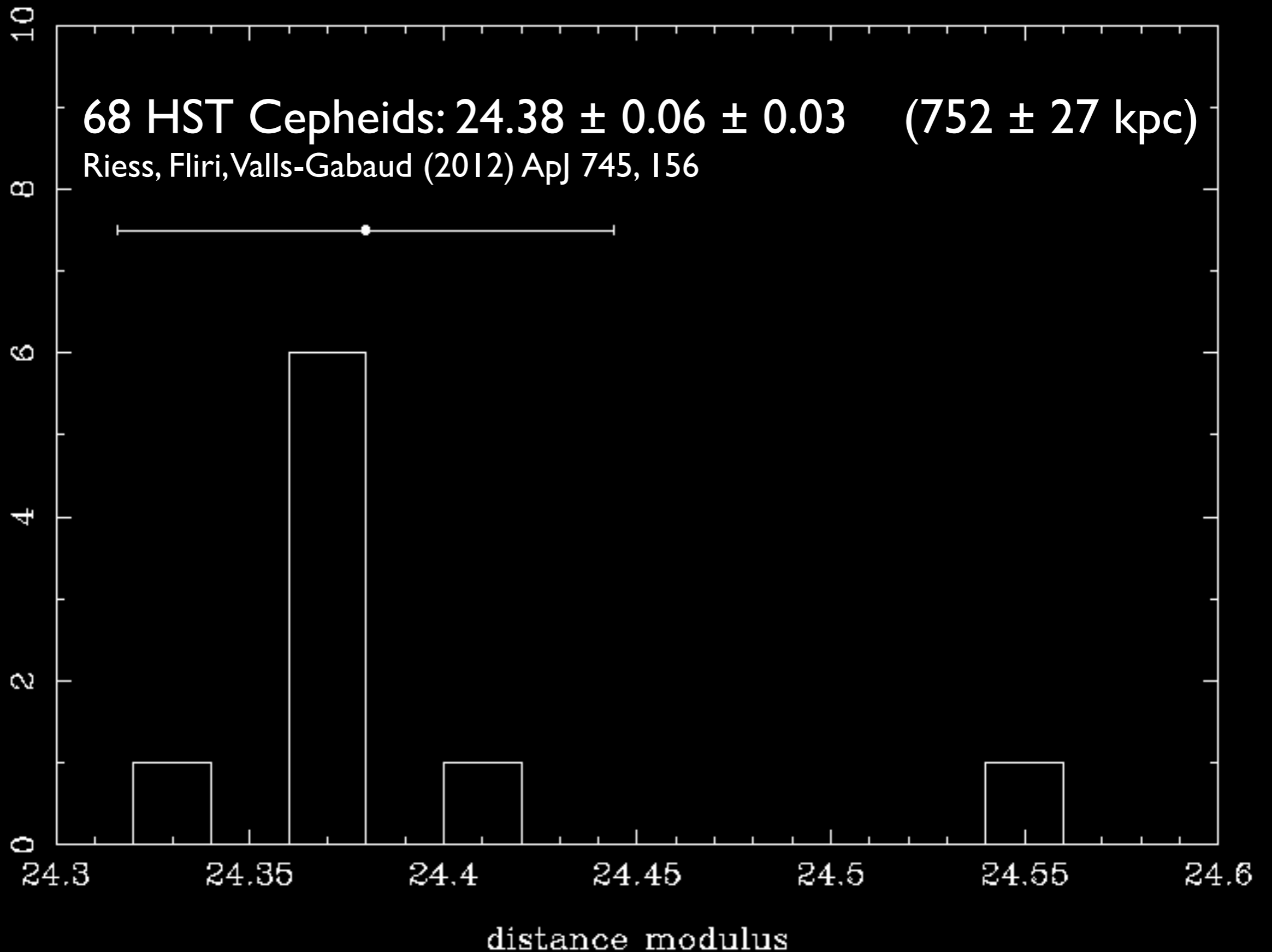
WFC3/HST images of POMME cepheids



Tightest Period-Luminosity-Colour (Leawitt) relation ever measured



The distance to M31 measured to 3% precision



The POMME Data Base demonstrator

- Analysis, display and value-added database
- First light curve database via ObsTAP @VOP

Demo

- A *HEALPIX* image of M31 is displayed with *AladinLite*
- Select a catalog to display (e.g. crossmatches with known sources)
- Select a source to display its lightcurve in 3 bands and its folded light curve (when the period is known)
- The light-curves are generated on-the-fly in *JS* with *Dygraph*

Re-usable technologies

- The data (8 10^6 sources, 65 10^4 variables, and their lightcurves) is stored into a *PostgreSQL RDBMS*
- The data is exposed via the TAP Server *DaCHS* and queryable via *ADQL*
- A Java servlet hosted by *Tomcat* stands between the TAP server and the web client, creates *VOTables* and CSV files from *TAP queries*, and computes folded light curves on the fly.
- A web client written in *JavaScript* renders the data.
- (Manual) cross-matches with *Vizier* via CDS *xmatch API*

The POMME Data Base Demonstrator

The screenshot displays the POMME Data Base Demonstrator interface. The main window is divided into several sections:

- Top Left:** A header bar showing the J2000 epoch and coordinates: "J2000 : 00 47 29.084 +40 39 3.85". Below this are icons for a list, a search, and a zoom function.
- Main View:** A large astronomical image of a star field with a grid of red lines. A pink crosshair is centered on a bright star. A blue box in the bottom left corner indicates "FoV: 2.5°".
- Right Panel (POMME):**
 - POMME** header.
 - Select data to send to AladinLite:** A section with a dropdown menu labeled "Select query below..." and a "Display selected data" button.
 - Info on selected source:** A section with a "+" and "-" button for expanding/collapsing information.
- Far Right (SIMBAD):** A section labeled "SIMBAD" which is currently empty.

National and international collaborations

LERMA

D. Valls-Gabaud

A. Tavant (stage X, gravitational microlensing)

G. Thomas (PhD thesis Sep 2014+)

DIO/VOP

R. Savalle (database and demonstrator)

IRAP - Toulouse

J.F. Leborne (periodic variables)

Milano Brera

E. Poretti (periodic variables)

IAC Canarias

J. Fliri (periodic variables)

Obs. Athens / CfA Harvard

A. Bonanos + M. Kournioutis (eclipsing binaries)

IfA Hawaii

E. Magnier (spectroscopic follow-up at Keck+Gemini)

STScI / JHU

A.G. Riess (HST follow-up)

Publications

Master theses

- M. Kourniotis (MSc, Athens, 2013)
- A. Tavant (stage X, gravitational microlensing, 2014)

PhD Theses

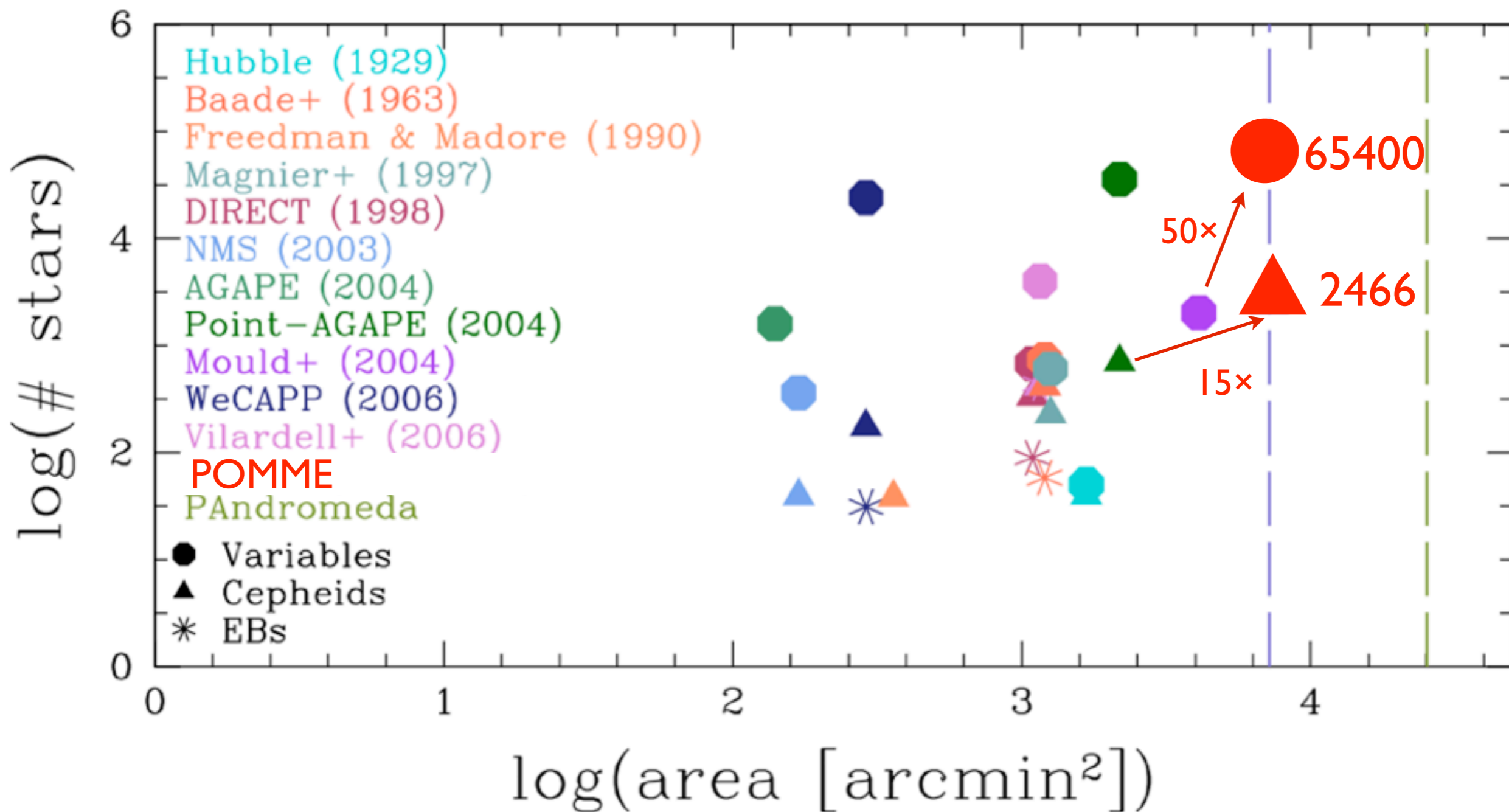
- M. Kourniotis (Athens, eclipsing binaries, 2013+)
- G. Thomas (Paris, SFR, EB, microlensing, 2014+)

Publications

- A.G. Riess, J. Fliri & D.Valls-Gabaud (2012) *Cepheid Period-Luminosity Relations in the Near-infrared and the Distance to M31 from the Hubble Space Telescope Wide Field Camera 3*, *Astrophys. J.*, 745, 156
- J. Fliri & D.Valls-Gabaud (2012) *First results from the POMME survey of M31*, *Astrophys. Space Sci.* 341, 57
- D.Valls-Gabaud (2013) *The distance to M31 in the era of precision cosmology*, IAU Symposium 289 *Advancing the physics of cosmic distances*, Beijing,
- T. Davidge, McConnachie, A. W.; Fardal, M. A.; Fliri, J.; Valls-Gabaud, D.; Chapman, S. C.; Lewis, G. F.; Rich, R. (2012) *The Recent Stellar Archeology of M31—The Nearest Red Disk Galaxy*, *Astrophys. J.*, 751, 74
- J. Fliri, D.Valls-Gabaud, E. Magnier, R. Savalle (2014) *The POMME Survey I. Classical and first overtone cepheids*, in prep.

POMME

The largest and deepest time-domain survey of M3 I



Pan-Andromeda Archaeological Survey

