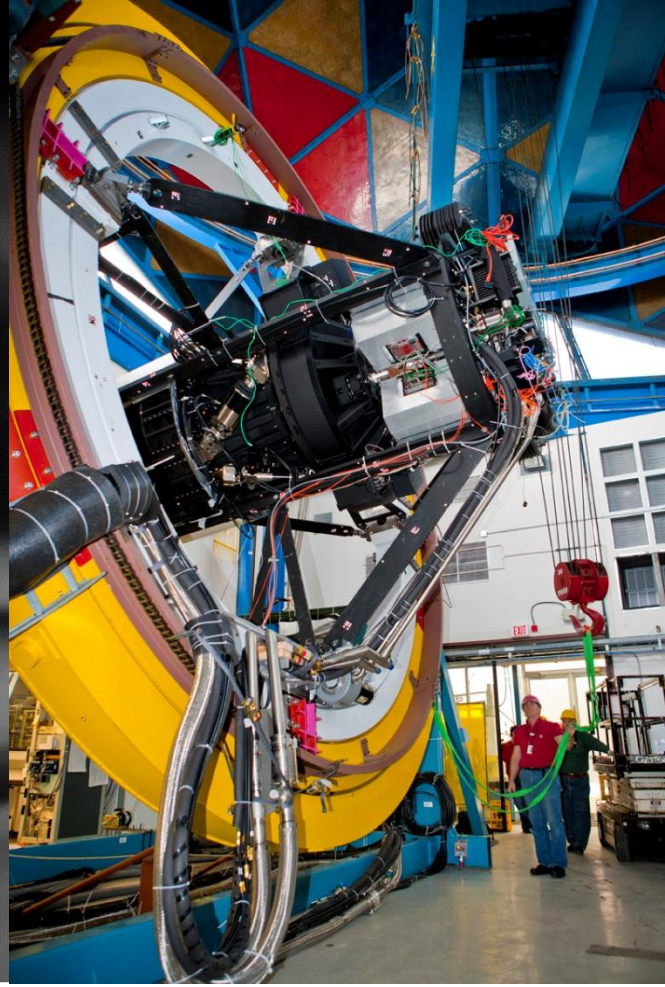
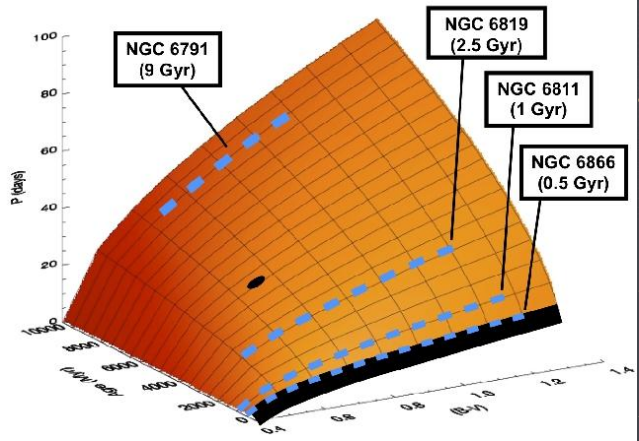
Gyrochronology in the Era of Wide-field, High-cadence, Synoptic Photometric Surveys

Establishing the Membership and Ages of Galactic Open Clusters.



http://www.quantumdiaries.org/wp-content/uploads/2011/02/11-0035-08D1.jpg



Courtesy: Søren Meibom (Priv. Comm)

NOAO DECam Community Workshop

Tucson [Az], August 2011

David James

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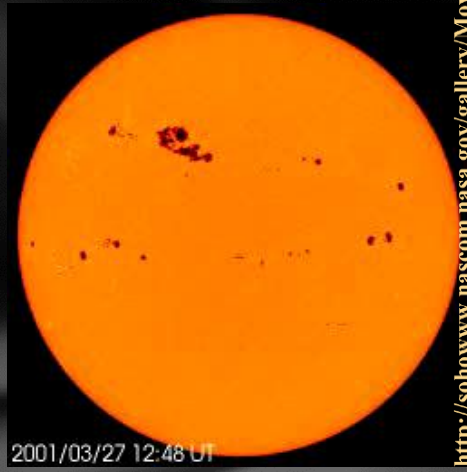
Measuring Photometric Rotation Periods:
The Galilean Way



http://sohowww.nascom.nasa.gov/gallery/Movies/sunspots.html

The Early Years

- Single Objects
- 10-14 night cadence
- Photoelectric photometers, single filter
- Narrow Field (arcsecond-arcminute)

Modern Era

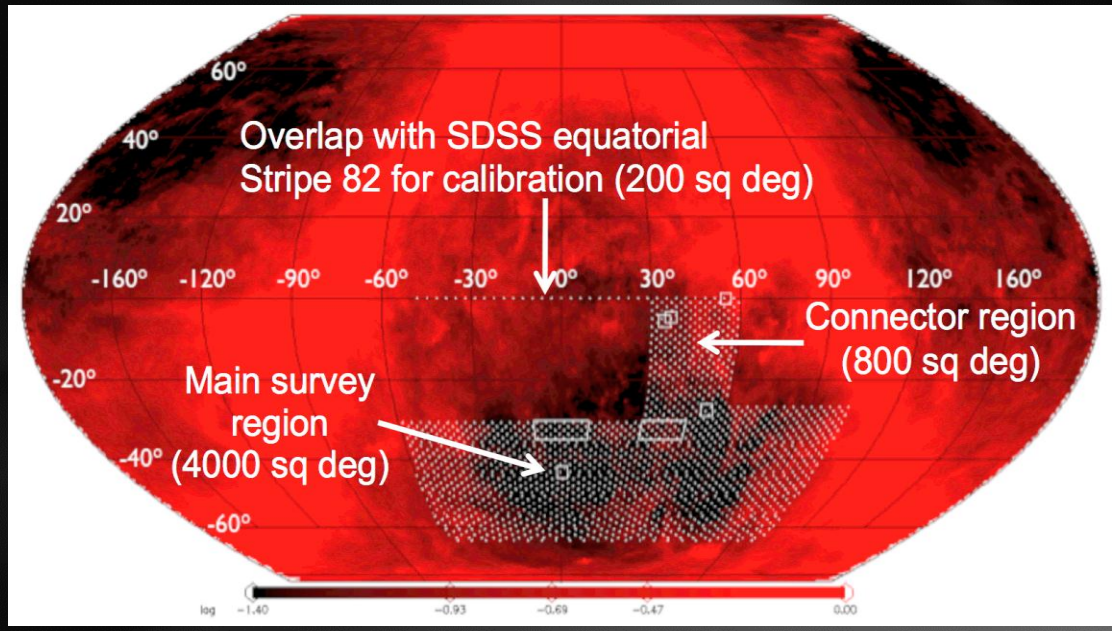
- Multi-object (10s-100s objects)
- 4-6 weeks cadence
- Some mosaic CCD cameras, multi-filter
- Generally, wide-field (10-60 arcminutes)
- Small-aperture ESP transit cameras can provide VERY wide-field, high cadence, multi-year observations.

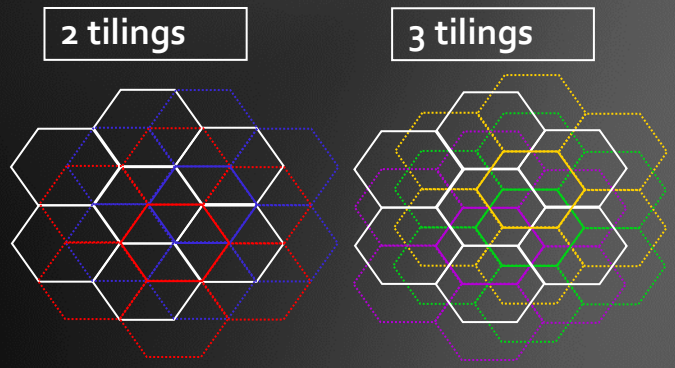
New/Next Generation

- Entire populations (10^5-10^8 stars)
- Multi-year cadence
- Giga-pixel CCD mosaic imagers
- Very wide field (2~5 degrees)
- DECam → deep, wide, low-masses

The Dark Energy Survey: Observing Strategy – bad news for gyrochronology ?

- Sept-Feb observing seasons
- 80-100 sec exposures
- 2 filters per pointing (typically)
  - *gr* in dark time
  - *izy* in bright/grey time
- Photometric calibration: overlap tilings, standard stars, spectrophotometric calibration system, preCAM
- 2 survey tilings/filter/year
- *Interleave 5-10 SN fields in griz if non-photometric or bad seeing or time gap (aim for ~5 day cadence)*
- DES is ***probably*** not going to enable substantial rotation period studies of *young* star clusters on its own. However, adding in NOAO community time will allow for period-finding to be achieved.





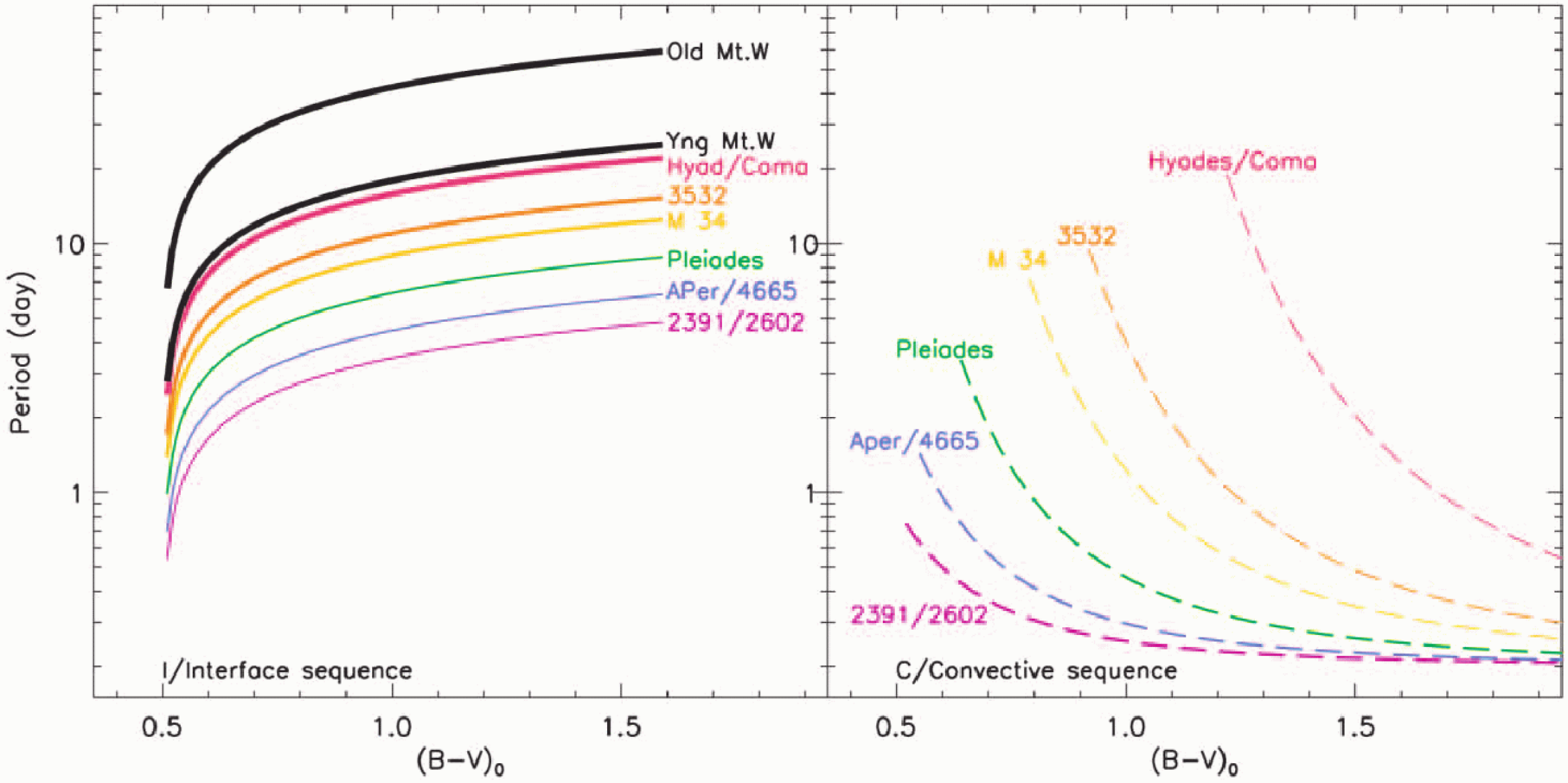
The Future of Gyrochronology: Synoptic Surveys:

What is gyrochronology ?

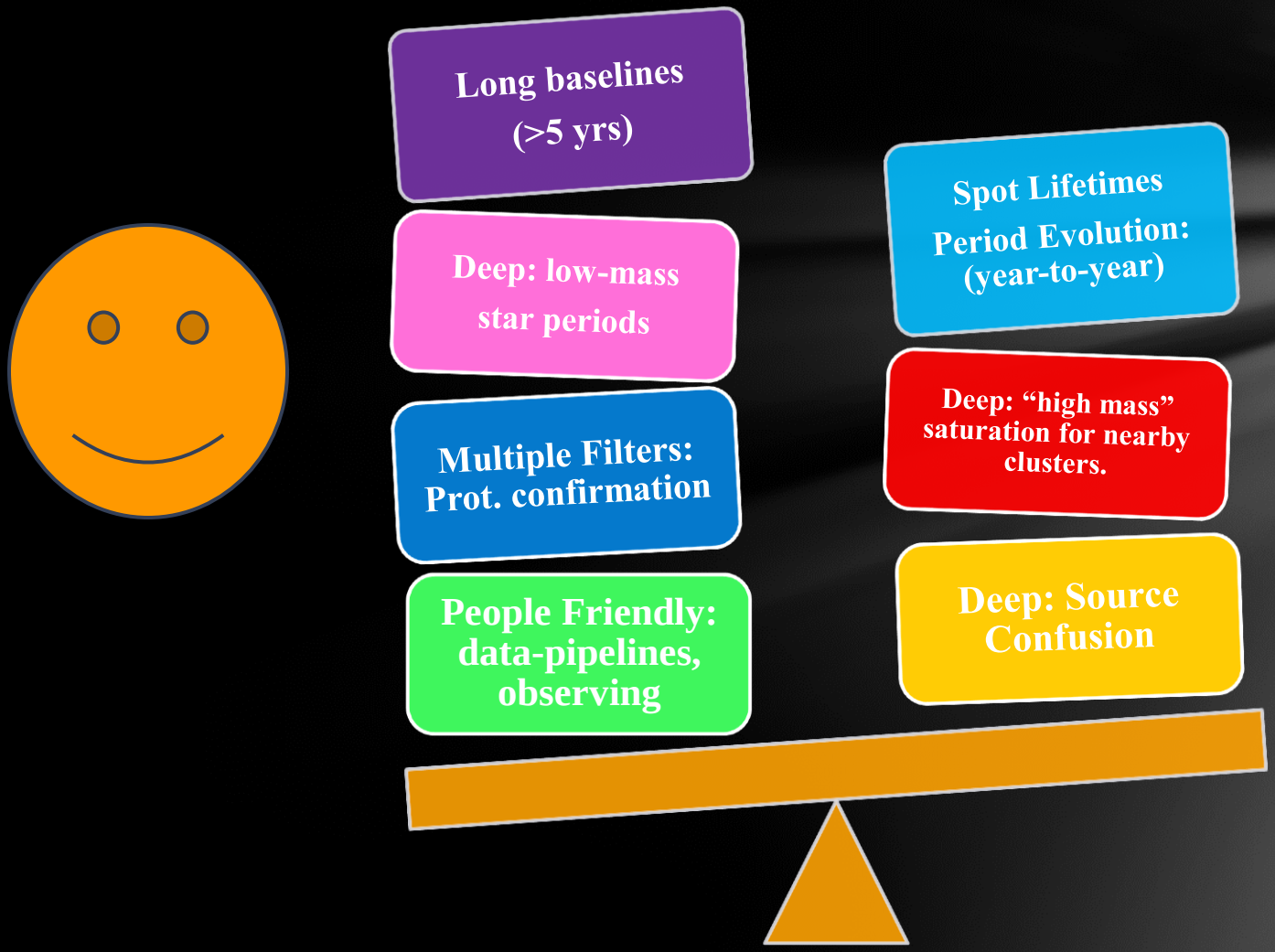
- Using rotation periods to determine the age of a star.
- Distance independent method: advantage over traditional isochrone-fitting method and modern lithium depletion boundary method.
- Identification of stars in a period-colour diagram yields internal structure.
- Works especially well in open clusters:
  - comparison with isochrones and LDB results can provide a statistically robust, distance-independent test of MS-models
- *Caveat emptor*: binarity and differential rotation can cause problems.

The Future of Gyrochronology: Synoptic Surveys:

What is gyrochronology ?



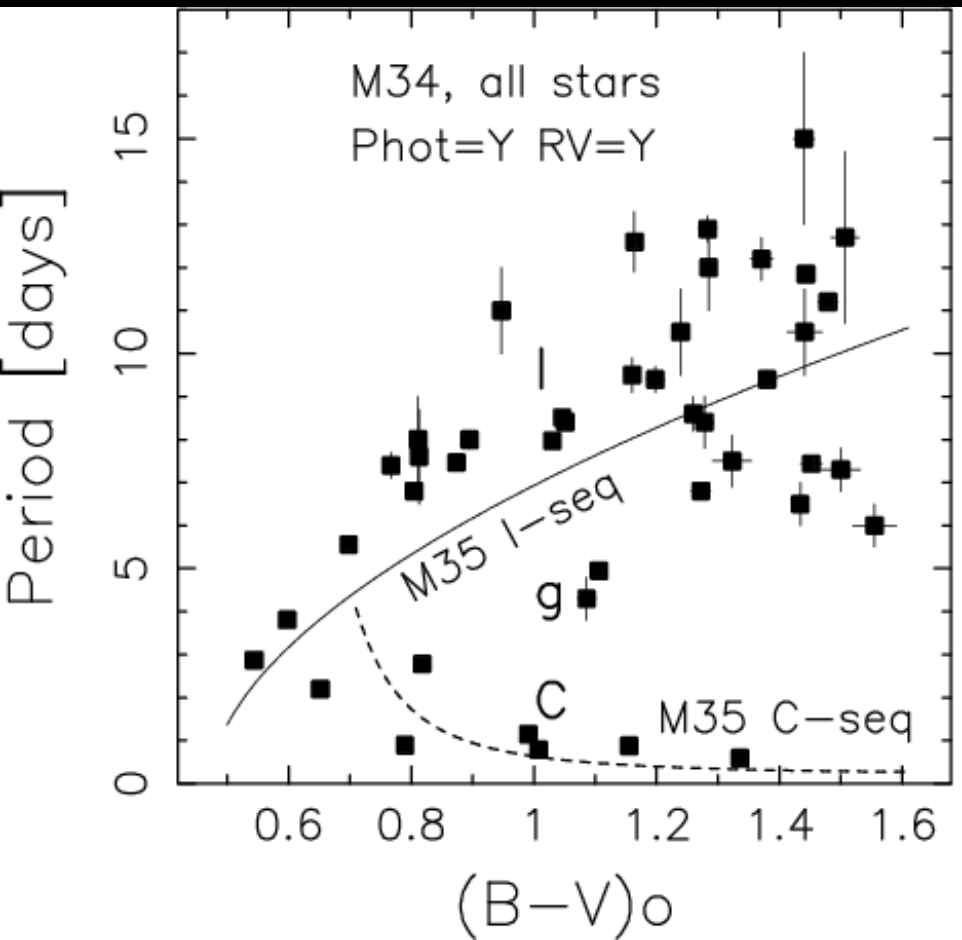
Synoptic Surveys:
Pros and Cons for Gyrochronology using DECam

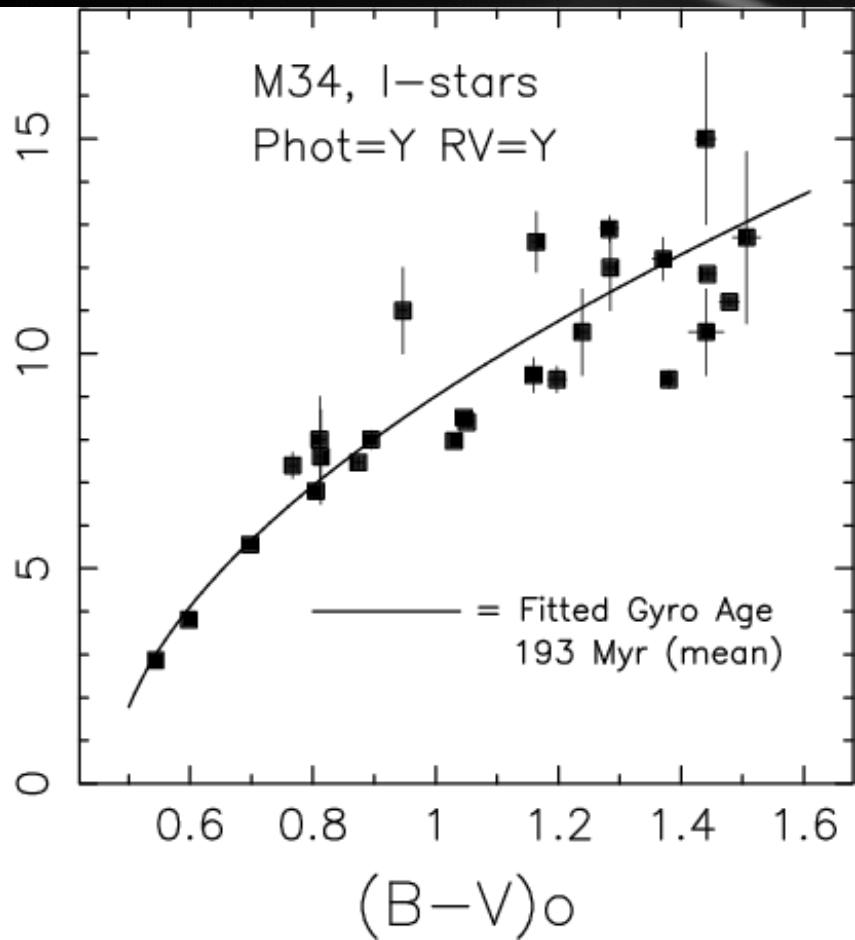


NOAO

DECam Gyrochronology Studies:
Photometric Variables and Cluster Membership

James, D.,et al. 2010, A&A, 515, 100





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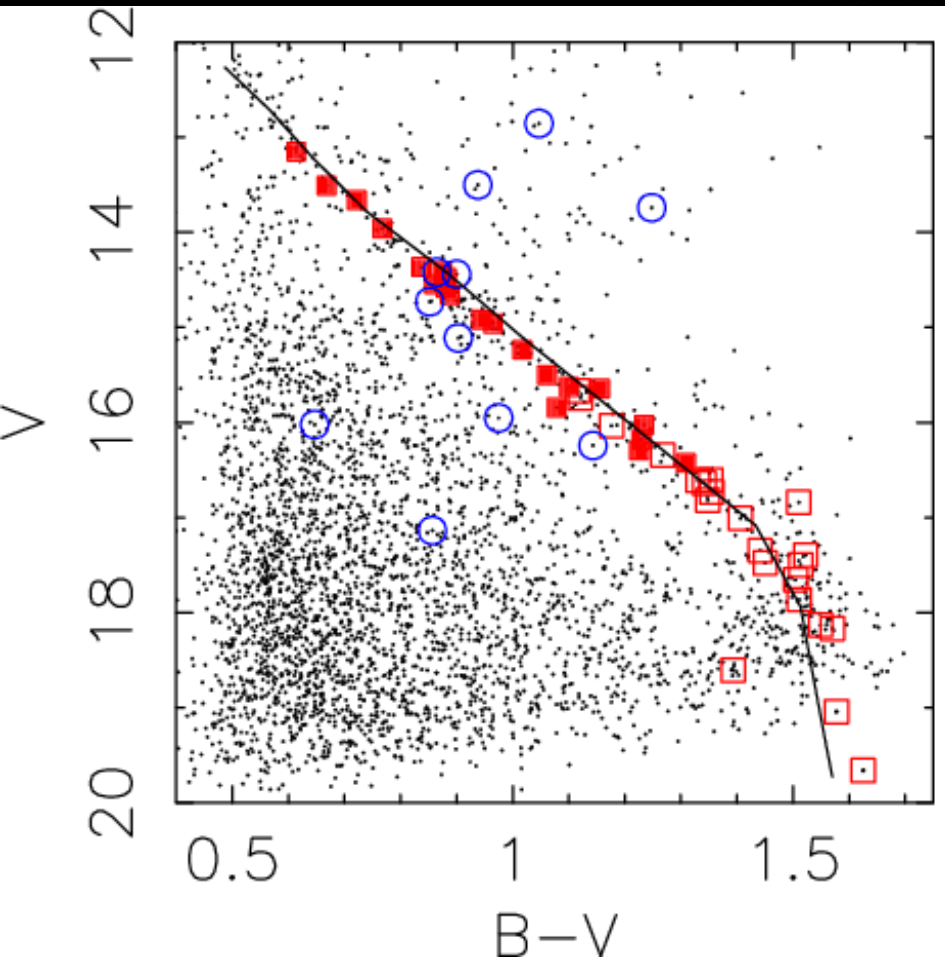
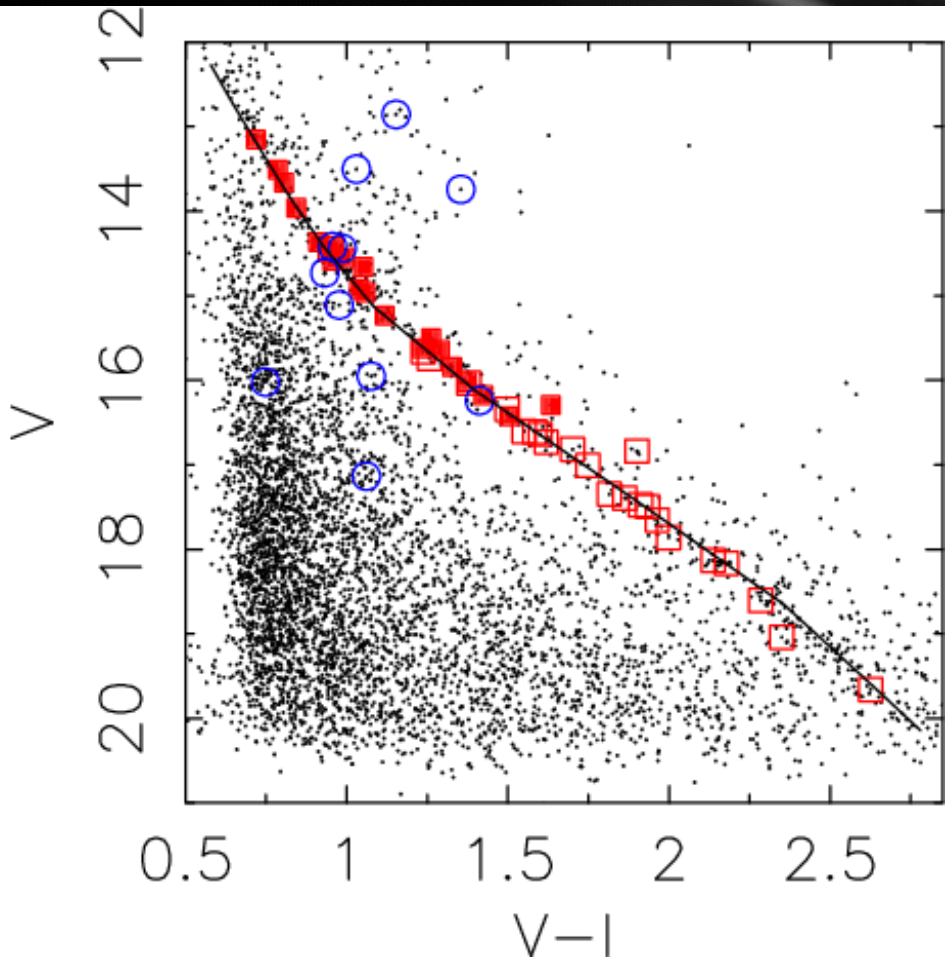


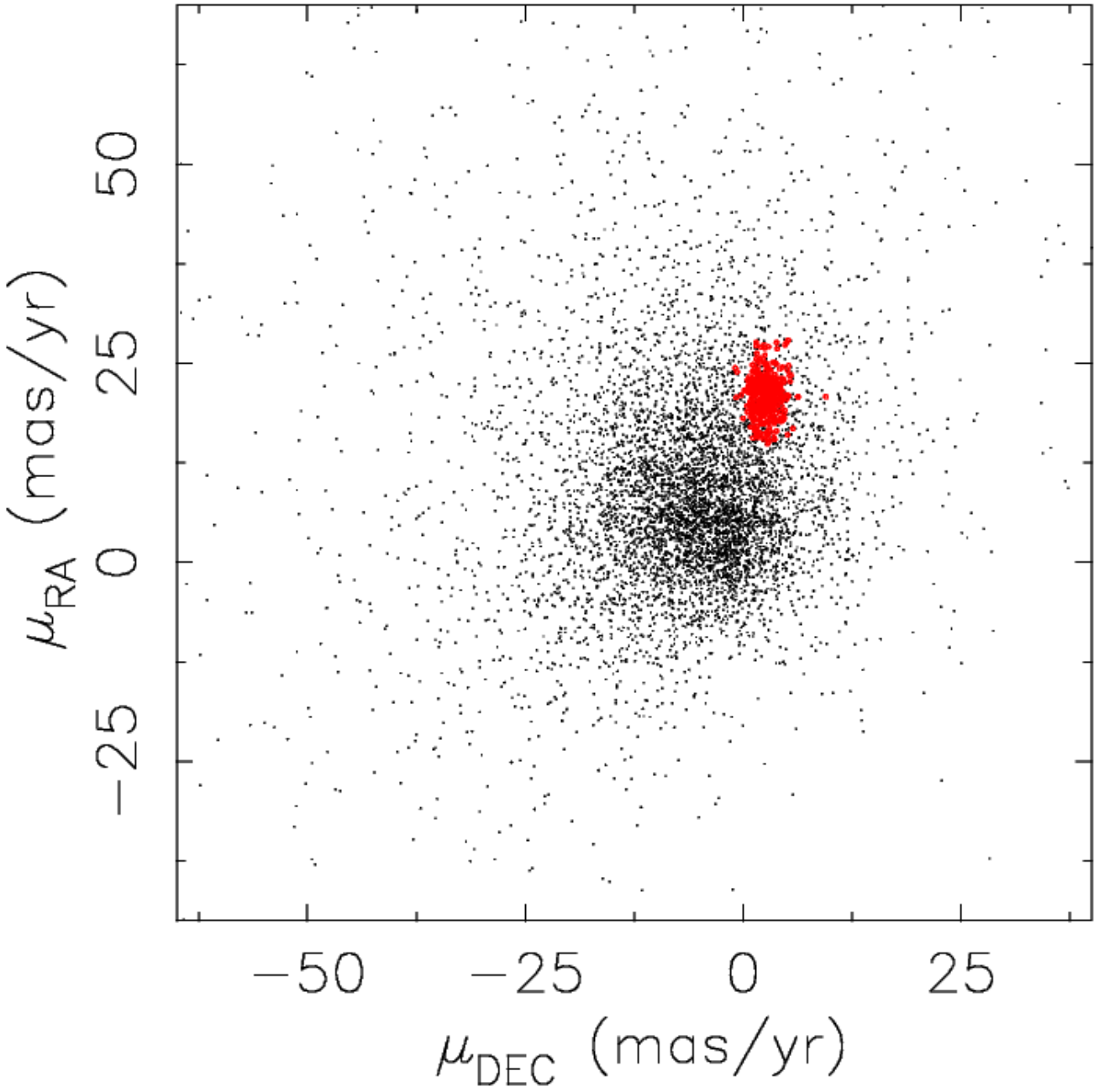


17 Open clusters in main survey fields

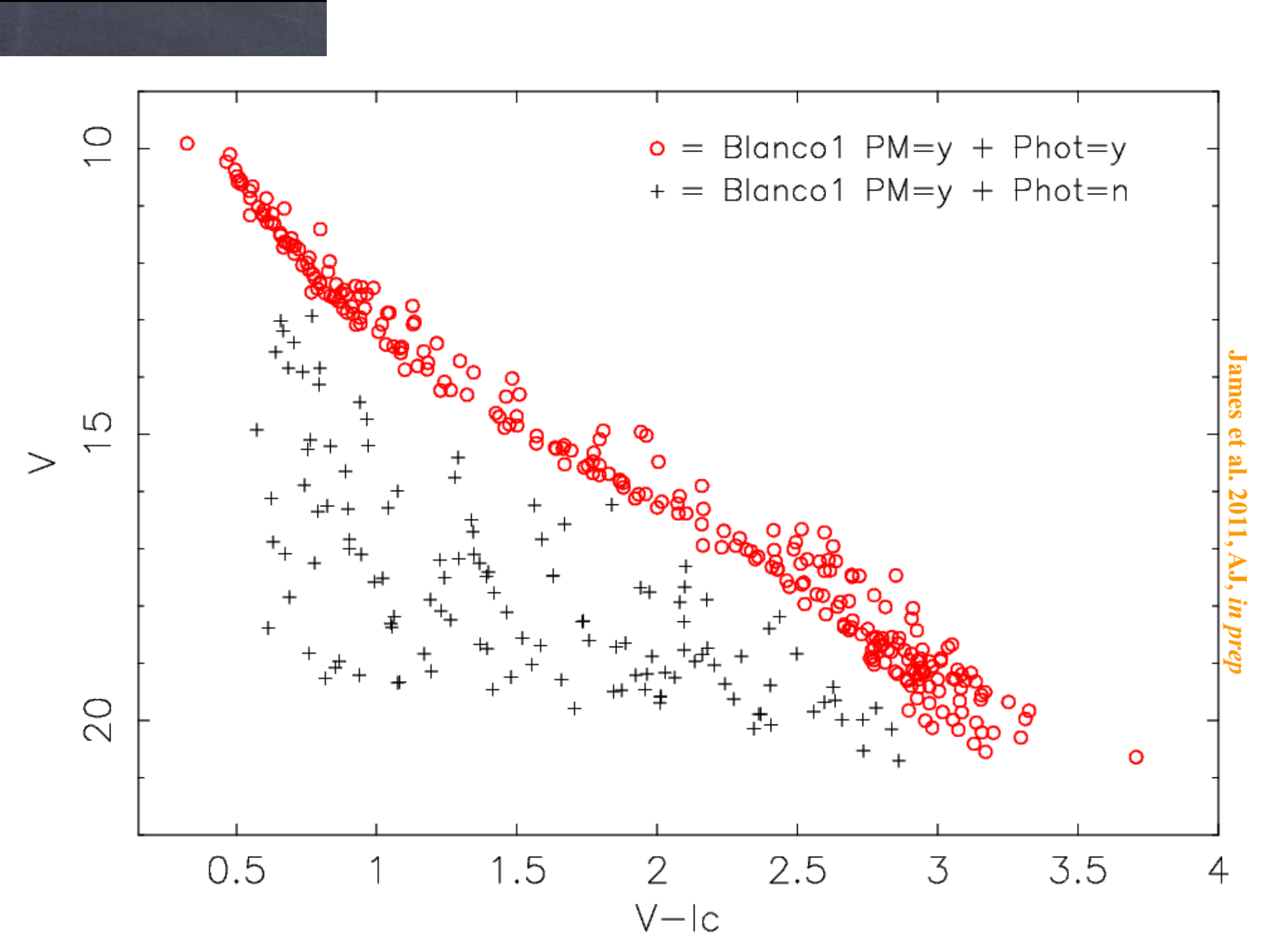
Name	RA	Dec	#OCs	Name
SPT	-60<RA<105	-65<Dec<-30	16	7 NGC clusters, 7 ESO clusters
Galactic Cap	-30<RA<30	-30<Dec<-25	1	Blanco 1
Connecting	30<RA<55	-30<Dec<-1	0	(-Whiting 1)
Stripe 82	-50<RA<55	-1<Dec<1	0	

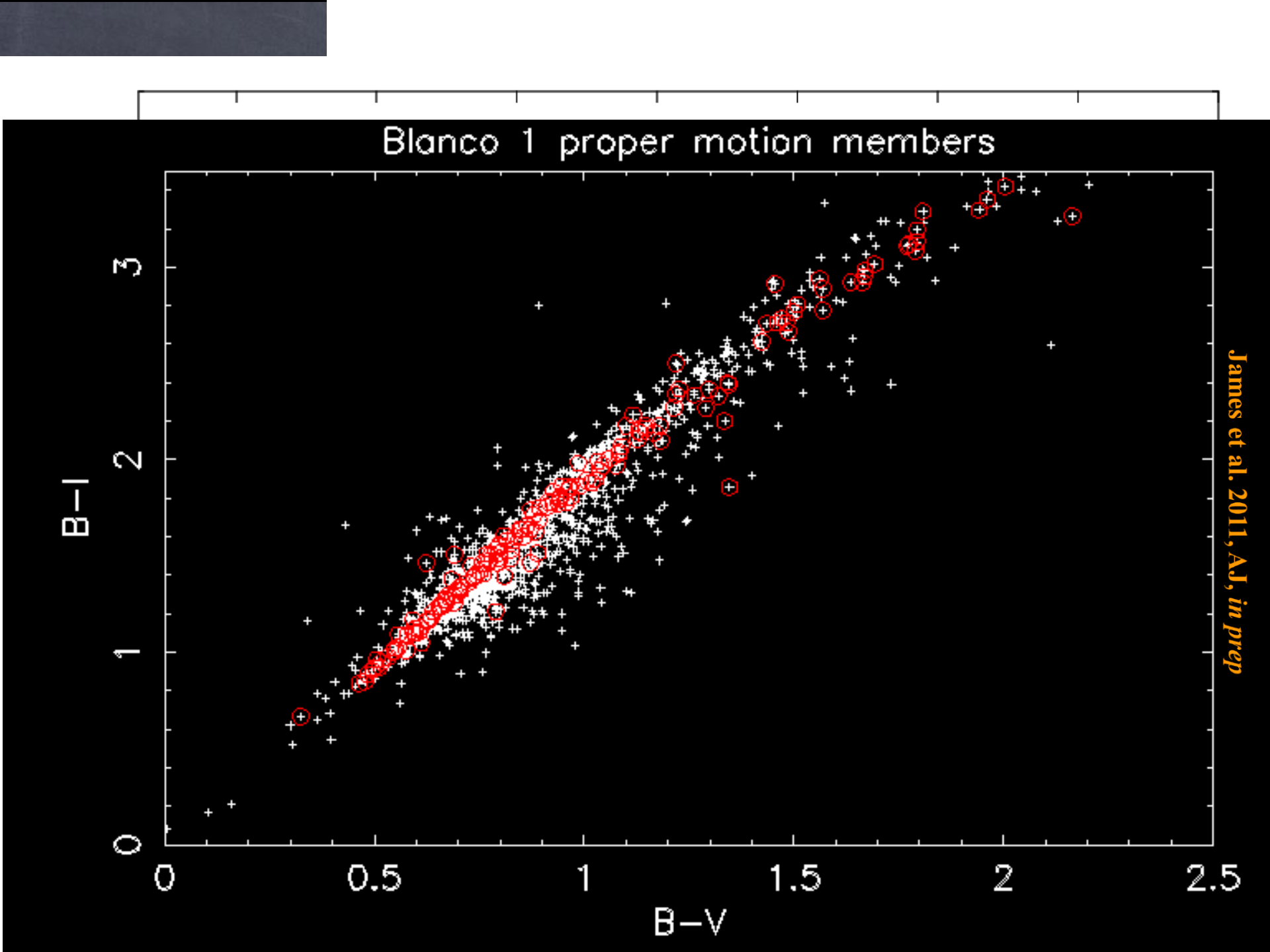
17 Oper

Name	
SPT	-
Galactic Cap	-
Connecting	
Stripe 82	-



Plataisetal.2011,MNRAS,413,1024
James et al. 2011, MNRAS, 413, 1024
in prep


o = Blanco1 PM=y + Phot=y
+ = Blanco1 PM=y + Phot=n
V
10
15
20
0.5
1
1.5
2
2.5
3
3.5
4
V−Ic
James et al. 2011, AJ, in prep


Blanco 1 proper motion members
B−I
B−V
0
0.5
1
1.5
2
2.5
0
1
2
3
James et al. 2011, AJ, *in prep*