Galactic Science
DECam Community Workshop

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Plan of talk

- Global characteristics
- Globular clusters
- Open clusters
- Ages of stars

Global characteristics

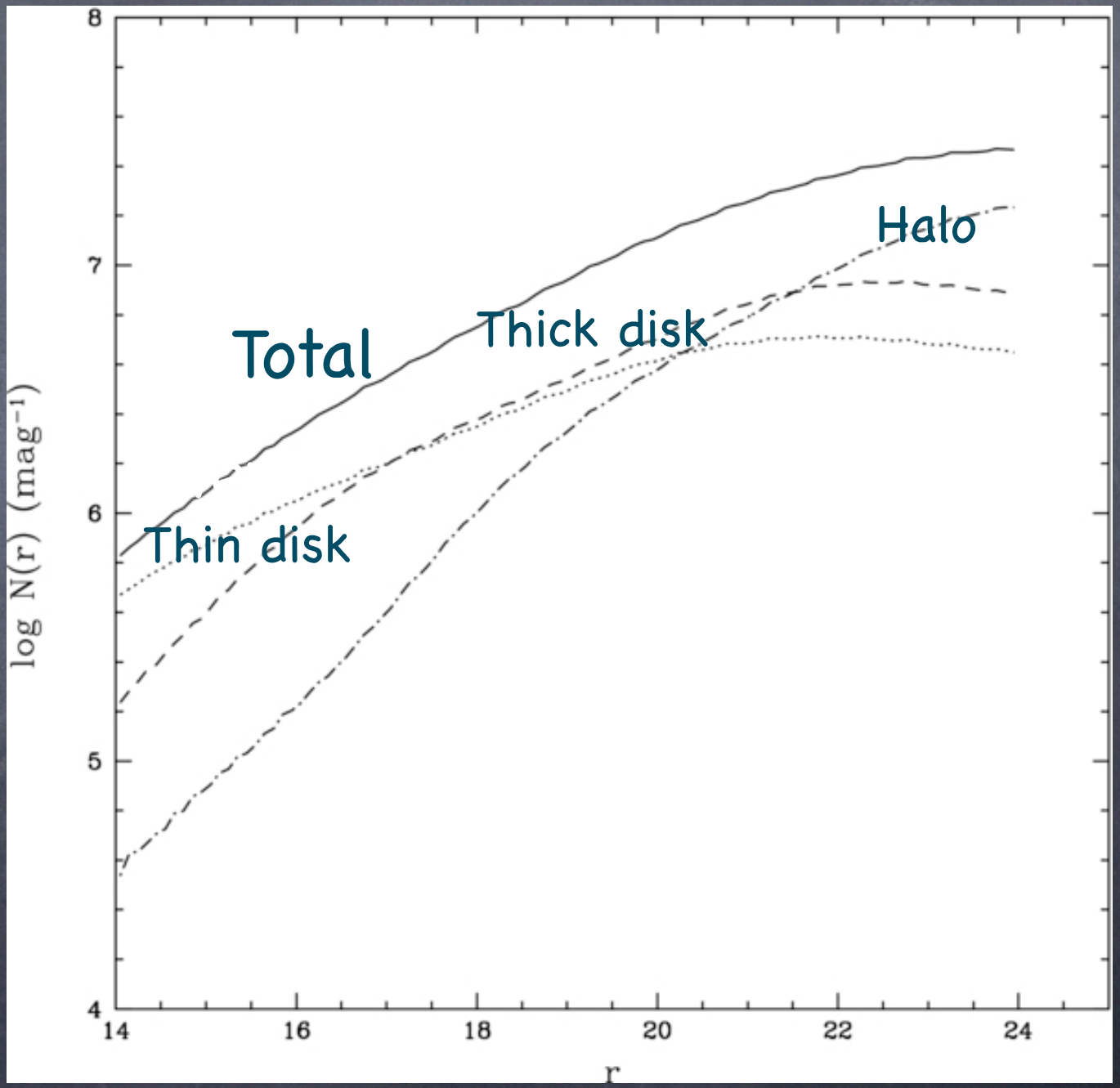
Expected Star counts

Rosetto+ 2011,
also Santiago+ 2010

TRILEGAL
(Girardi+ 2005)

1.2×10^8 stars

includes BDs, WDs



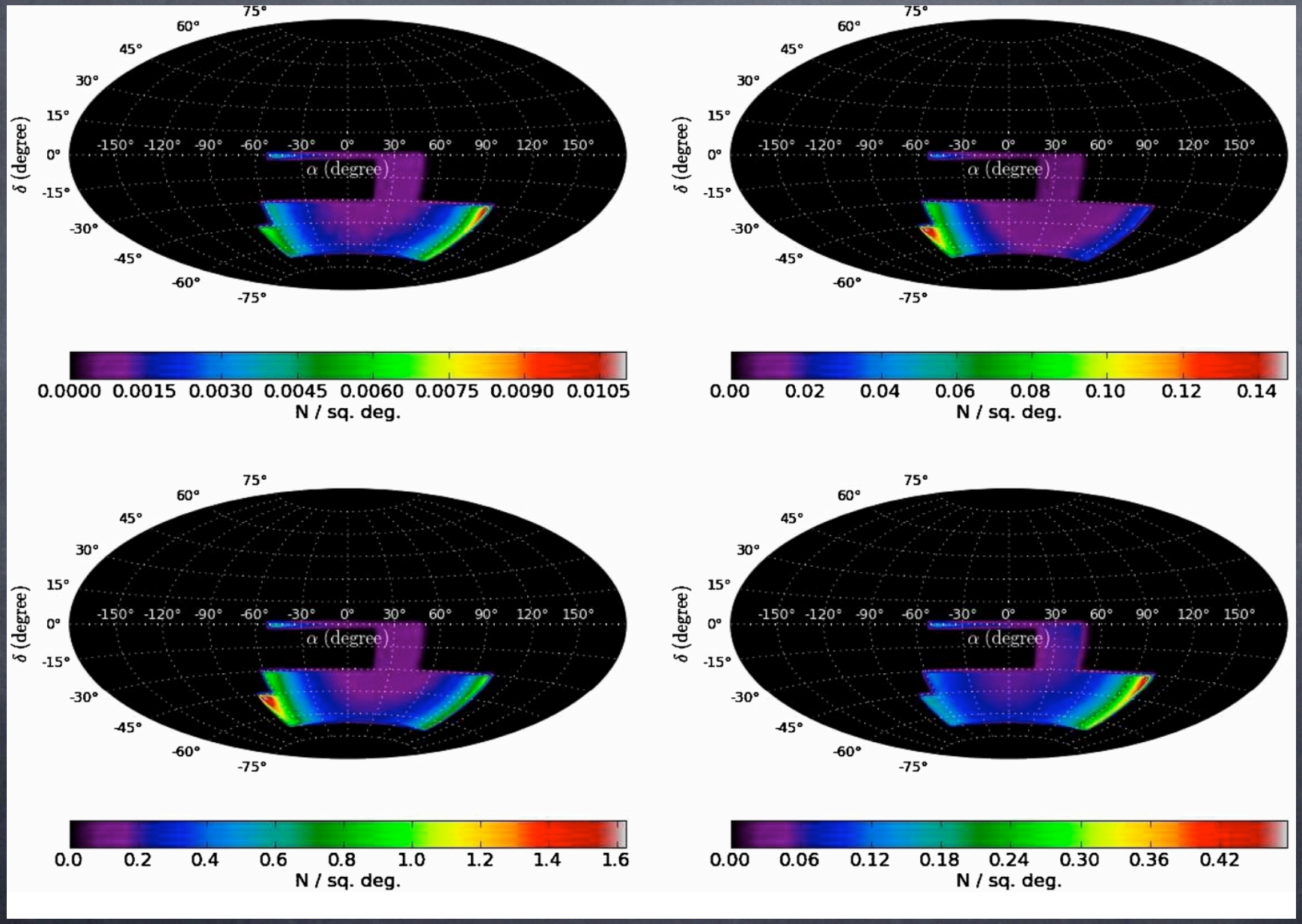
Spatial distribution of stars (Rossetto+ 2011)

OB

AF

GK

ML

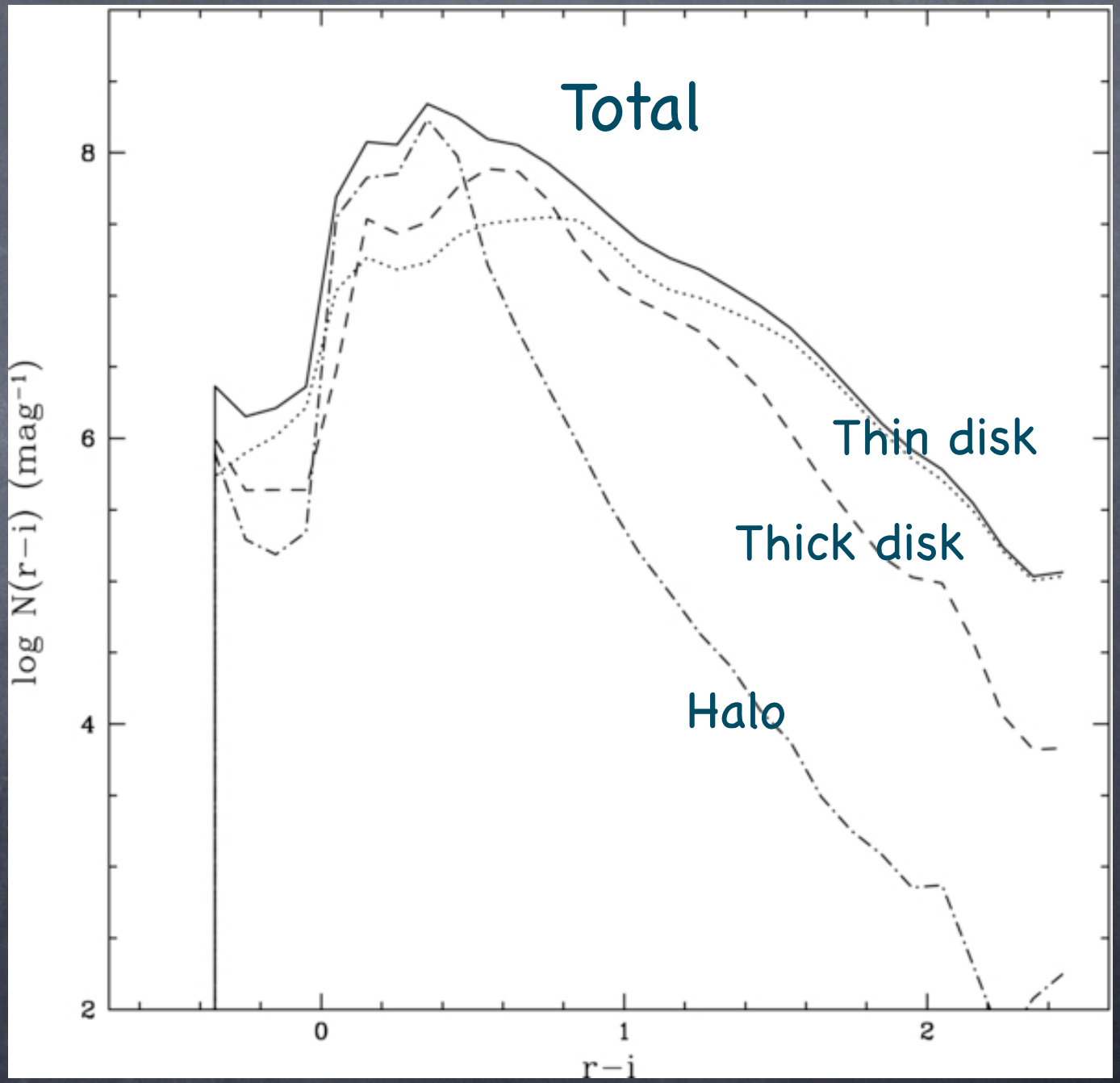


Expected Colors (Rossetto+ 2011)

TRILEGAL
(Girardi+ 2005)

1.2×10^{8} stars

lots of G & K stars

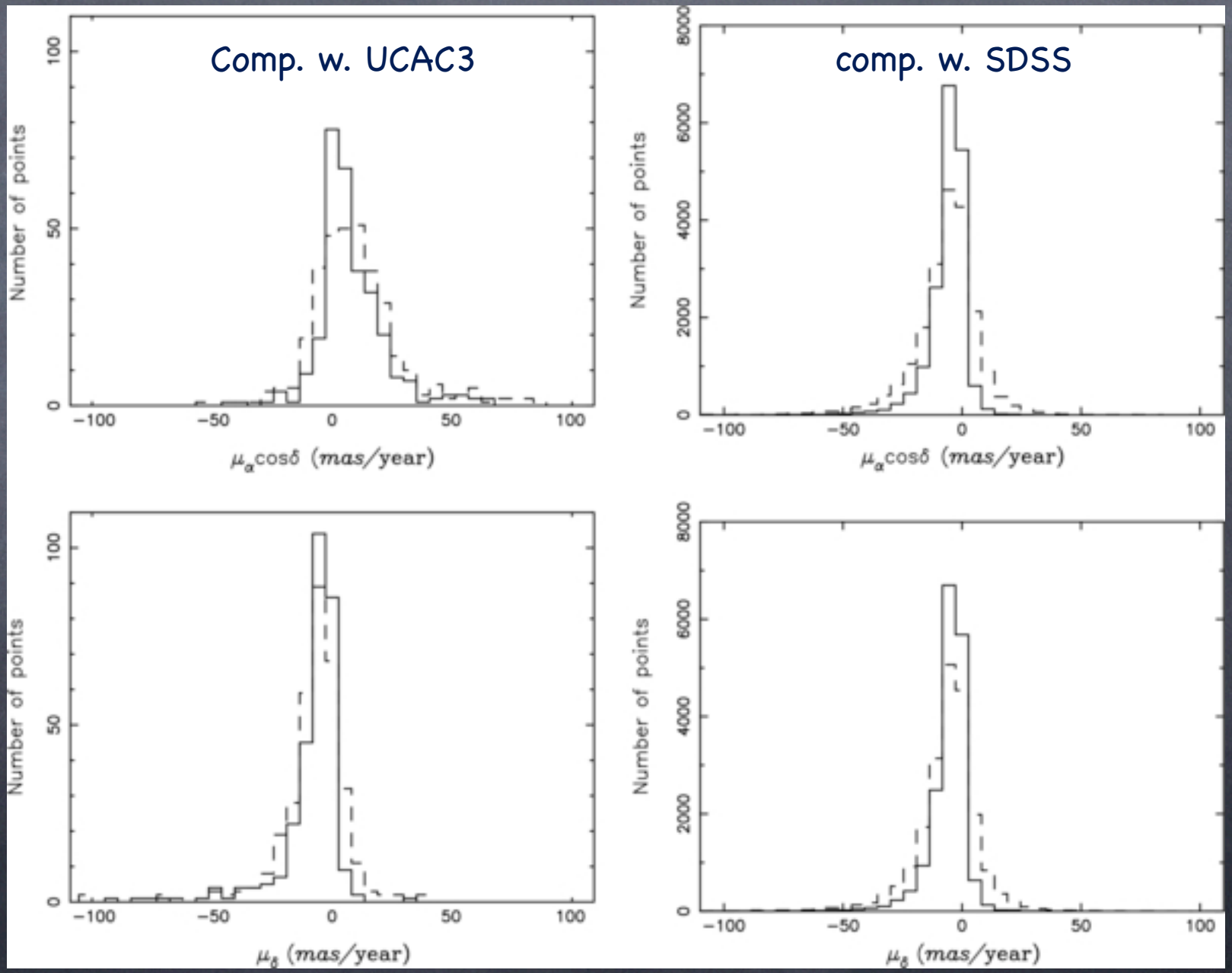


Proper Motions (Rossetto+ 2011)

Finding WDs
For d = 500pc
and V_T = 200km/s
mu = 80mas/yr

Measurable with DES
5yr baseline

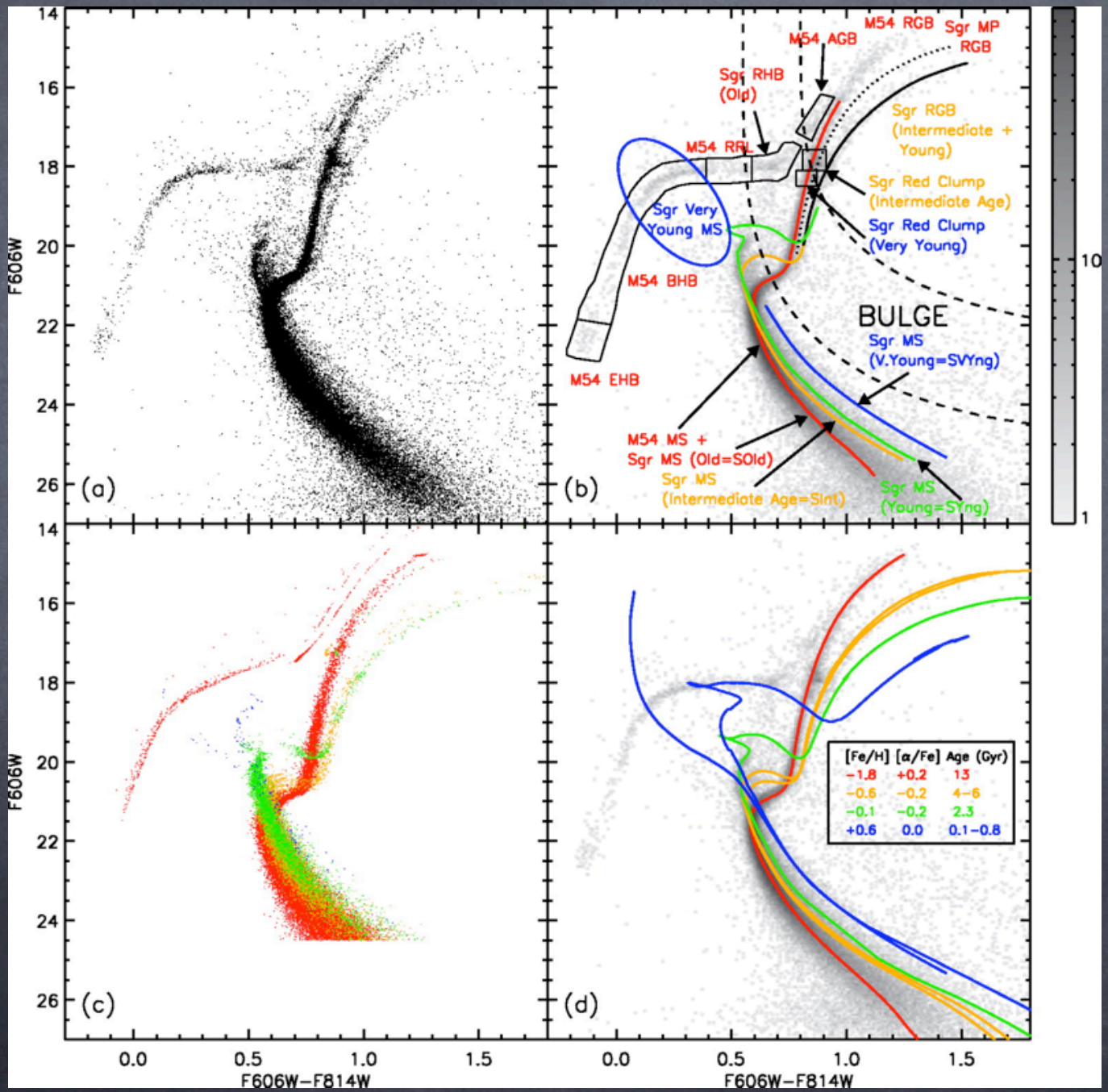
c.f. SUPERBLINK
(Lepine & Gaidos 2011)
40mas/yr



M54 & young pops in Sgr DSph (Siegel+ 2007)

CMD

Schematic



Simulation

Isochrones

Global characteristics summary

- Substructures in halo and thick disk
- Global structure of outer stellar halo
- Low luminosity stars in thick disk and halo
- Tidal tails of Globulars
- Astrometric catalog, alone or in combination

Globular clusters

7 Globular clusters in main survey fields

Name	RA	Dec	#GCs	Name
SPT	-60<RA<105	-65<Dec<-30	4	AM 1, NGC 1261, NGC 1851, NGC 2298
Galactic Cap	-30<RA<30	-30<Dec<-25	1	NGC 288
Connecting	30<RA<55	-30<Dec<-1	1	Whiting 1
Stripe 82	-50<RA<55	-1<Dec<1	1	M2 (NGC 7089)

What makes these Globulars interesting?

Name	Notes	Literature
AM 1	Outer halo globular, R_GC = 120 kpc, 11 Gyr	Dotter+ 2008
NGC 1261	Multiple populations, more work needed	Kravtsov+ 2010
NGC 1851	Multiple populations and abundances, merger of 2 globs?	Caretta+ 2011 Walker 1992
NGC 2298	One of smallest globs, tidal tails, mass segregation	Balbinot+ 2011 Pasquato+ 2009
NGC 288	2 distinct RGBs, 12.2 Gyr, 13.7 Gyr, (\pm 0.3 Gyr)	Roh+ 2011
Whiting 1	Youngest, most metal-rich globular	Carraro+ 2007
M2 (NGC 7089)	Tidal tails, color gradients	Dalessandro+ 09

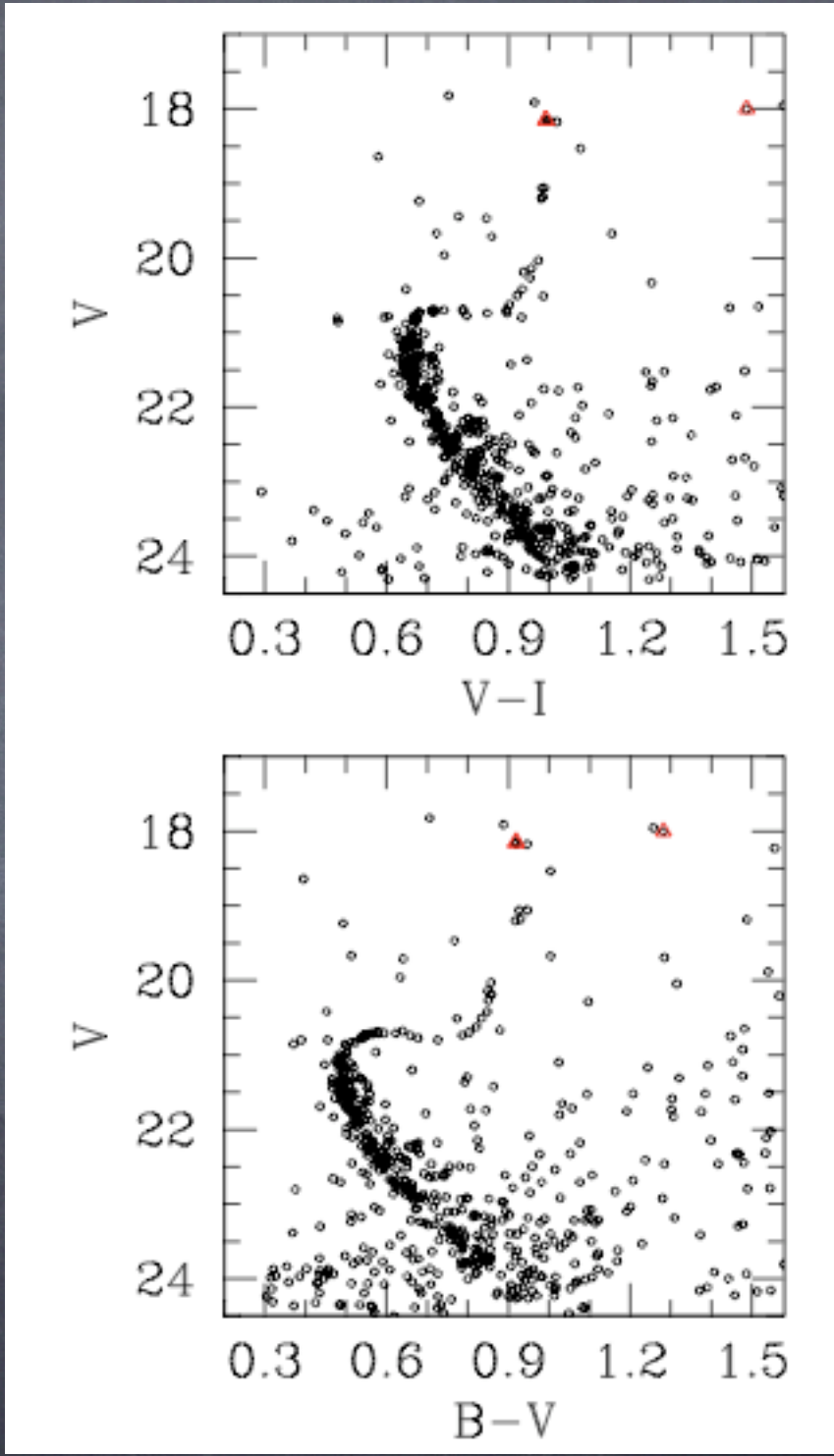
The story of Whiting 1 (assoc. w. Sgr DSph)

Discovery: Whiting+2002 (young open cluster)

Carraro 2005,
Carraro+ 2007

Youngest (6.5 Gyr) globular
most metal rich, [Fe/H]=-0.65

Implications for galaxy formation, disrupted dwarf galaxies



Open clusters

Open Cluster science

- Membership to faint levels
  - Immediately provides an indication of the richness
  - Other `classical' properties such as age
- Science with open clusters
  - `Newer' topics such as rotation and activity
  - Dynamical properties of stars

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	

What is known about these Open clusters?

NGC	Dist (pc)	Mod	E_ B-V	Age	ST	Z	D '	Fe/H	RV	pm RA	pm Dec
1252	640	9.09	0.02	9.5		-496	14				
1891											
1963											
2061											
2132											
2220											
2243	4458	13.4	0.05	9.7		-1379	5	-0.44	+62.0		
Blanco1	269	7.18	0.01	7.8	B5	-264	70	+0.23		+20.2	+3.0

What is known about these Open clusters?

ESO	Dist (pc)	Mod	E_ B-V	Age	ST	Z	D '	Fe/H	RV	pm RA	pm Dec
461-38							4				
236-07							30				
245-09							14				
252-14							3				
424-25							9				
426-26							7				
309-03							6				
Alessi 13	110	5.33	0.04	8.72		-90.9	384		20.1	36.97	3.18
AM 0430-392							2				

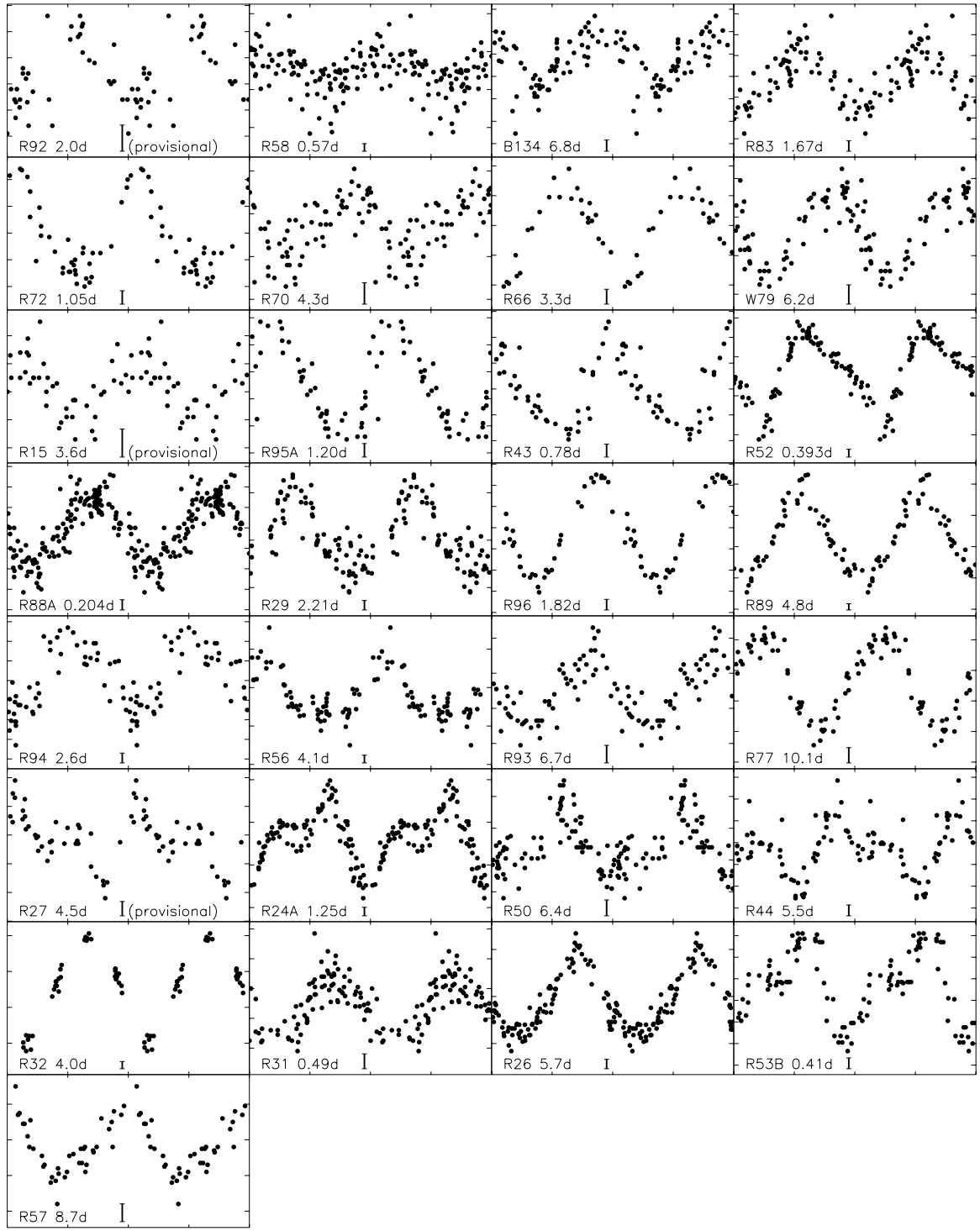
Ages for field stars

(Additional dimension to the data)

Gyrochronology

Preliminaries: light curves

IC 2602
30 Myr

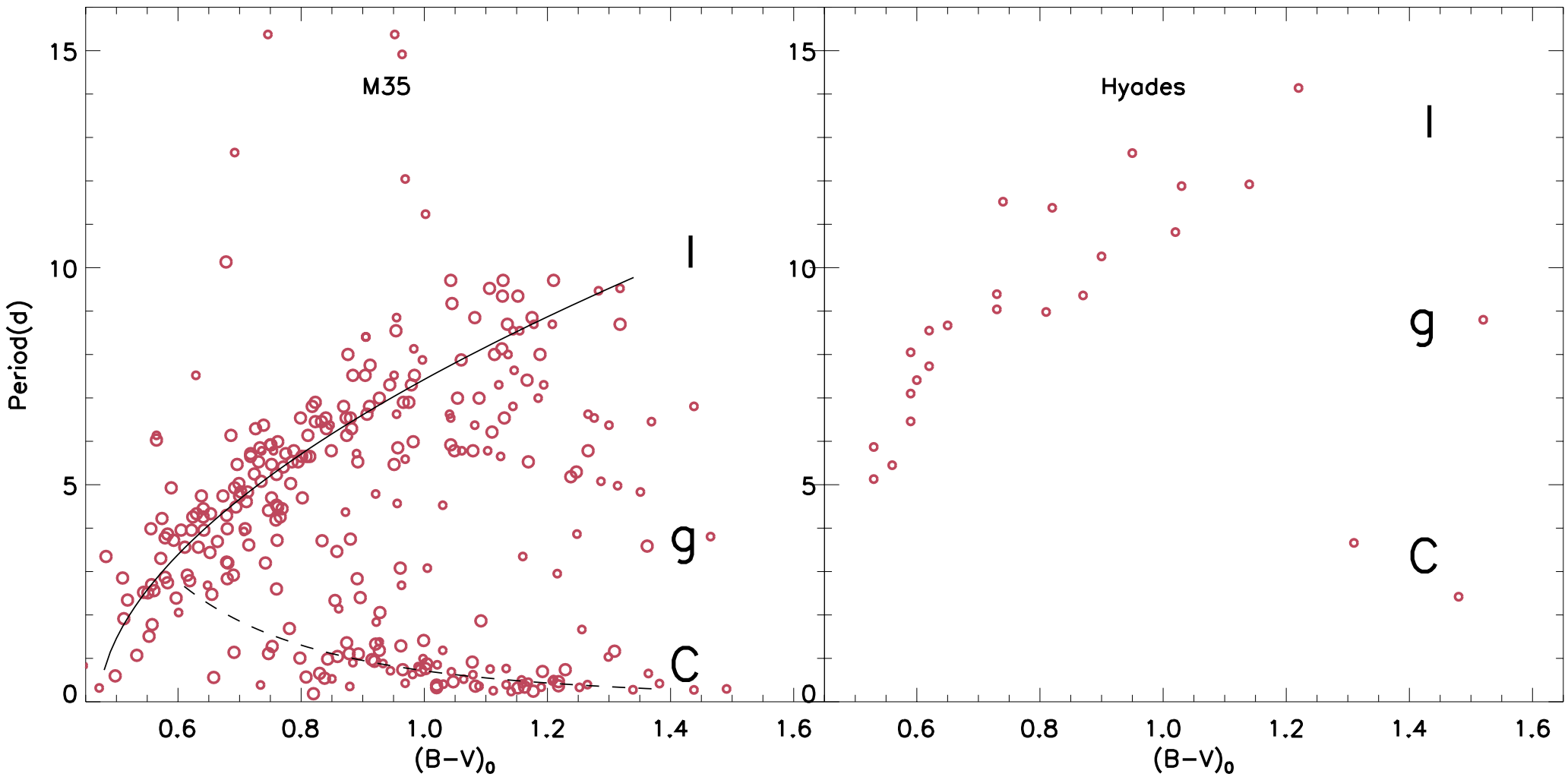


V (mag)

Phase

M35, Hyades color-period diagrams

Meibom et al. 2009 | 150 Myr → 600 Myr | Radick et al. 1987



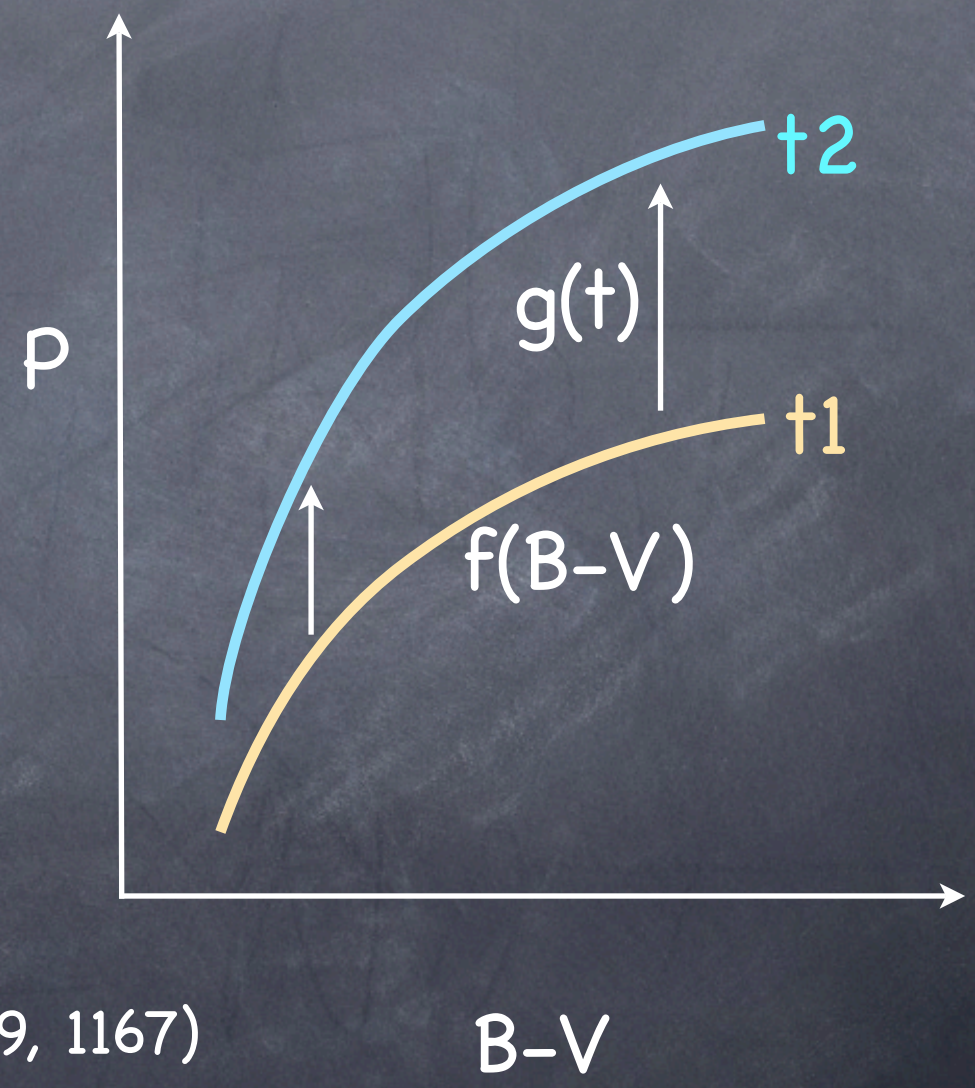
I-type stars spin down Skumanich-style

$$P_I(B-V,t) = f(B-V).g(t)$$

$$g(t) = \sqrt{t}$$

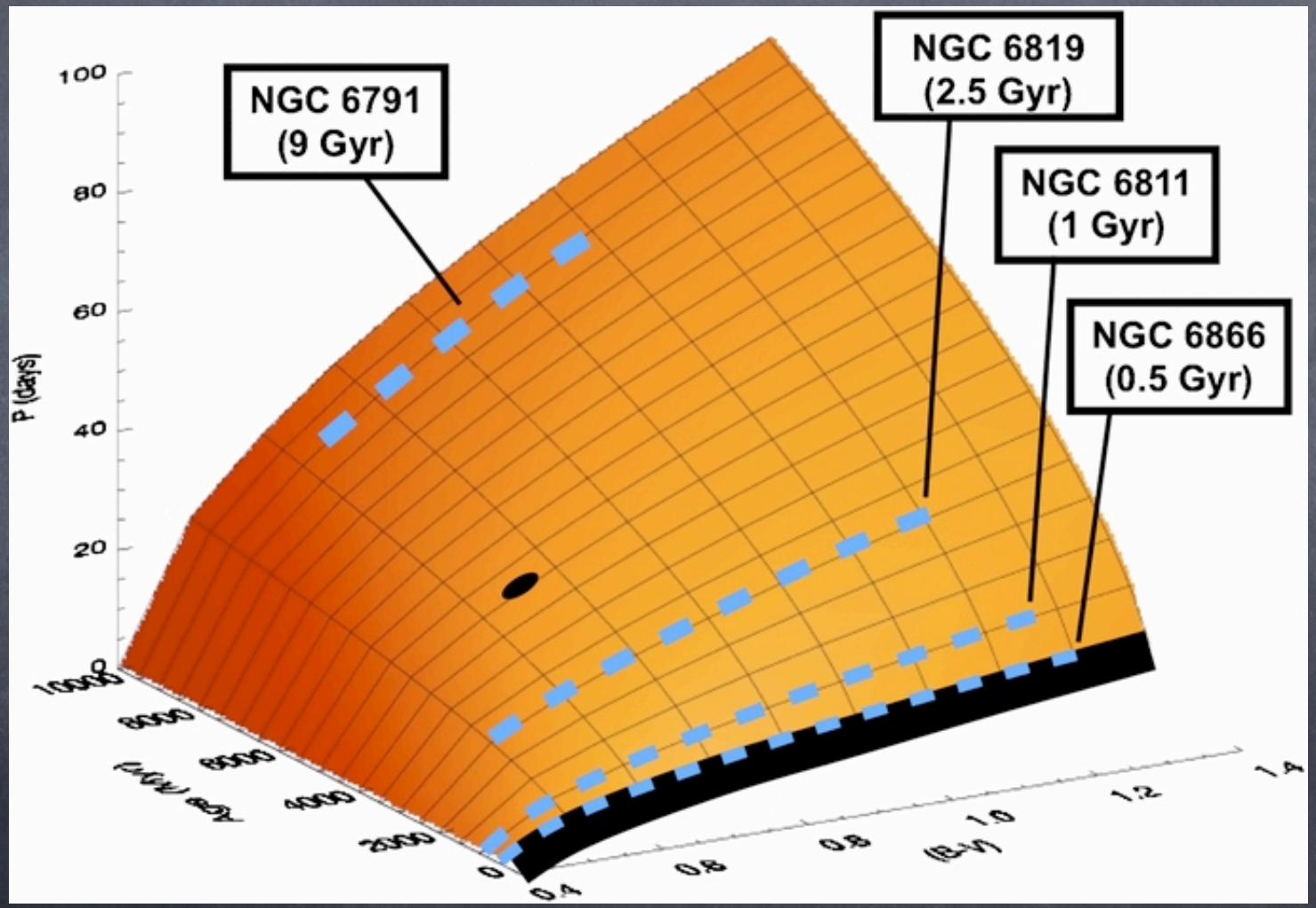
$$f(B-V) = a(B-V-c)^b$$

$$a,b,c = 0.778, 0.519, 0.4$$



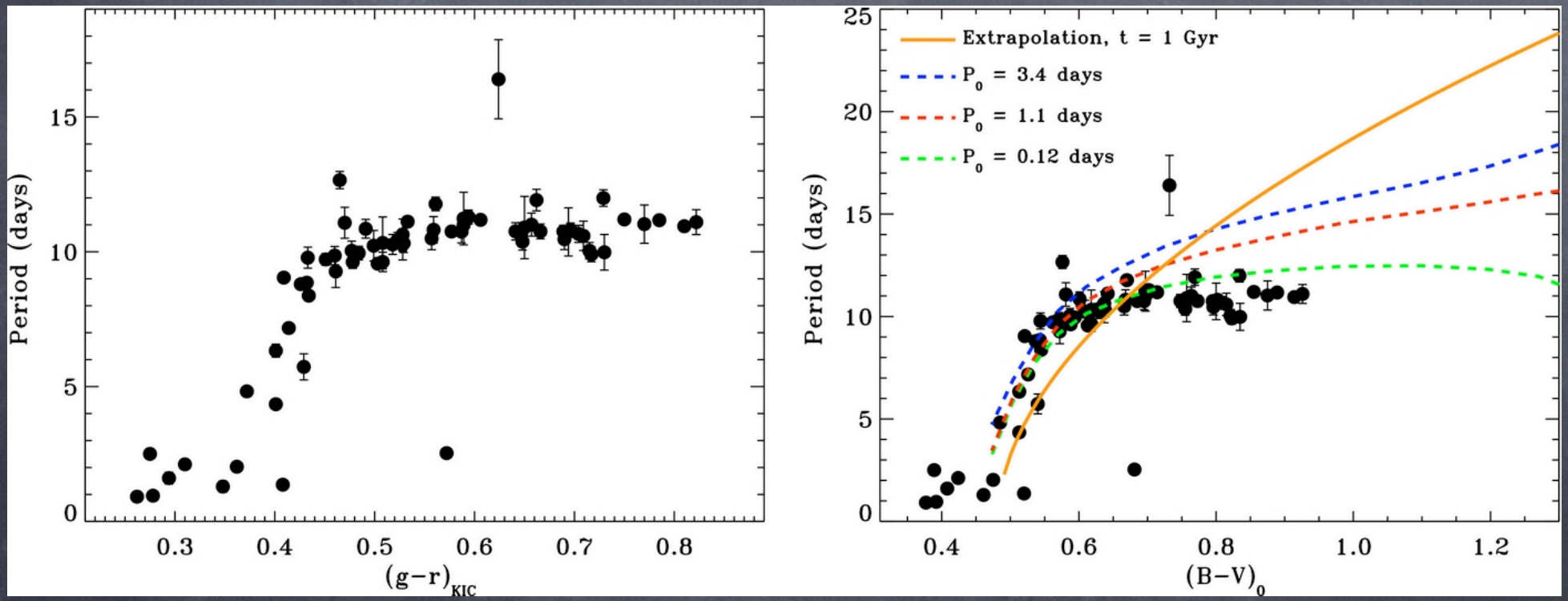
(Barnes 2007, ApJ, 669, 1167)

Kepler will construct this surface.....



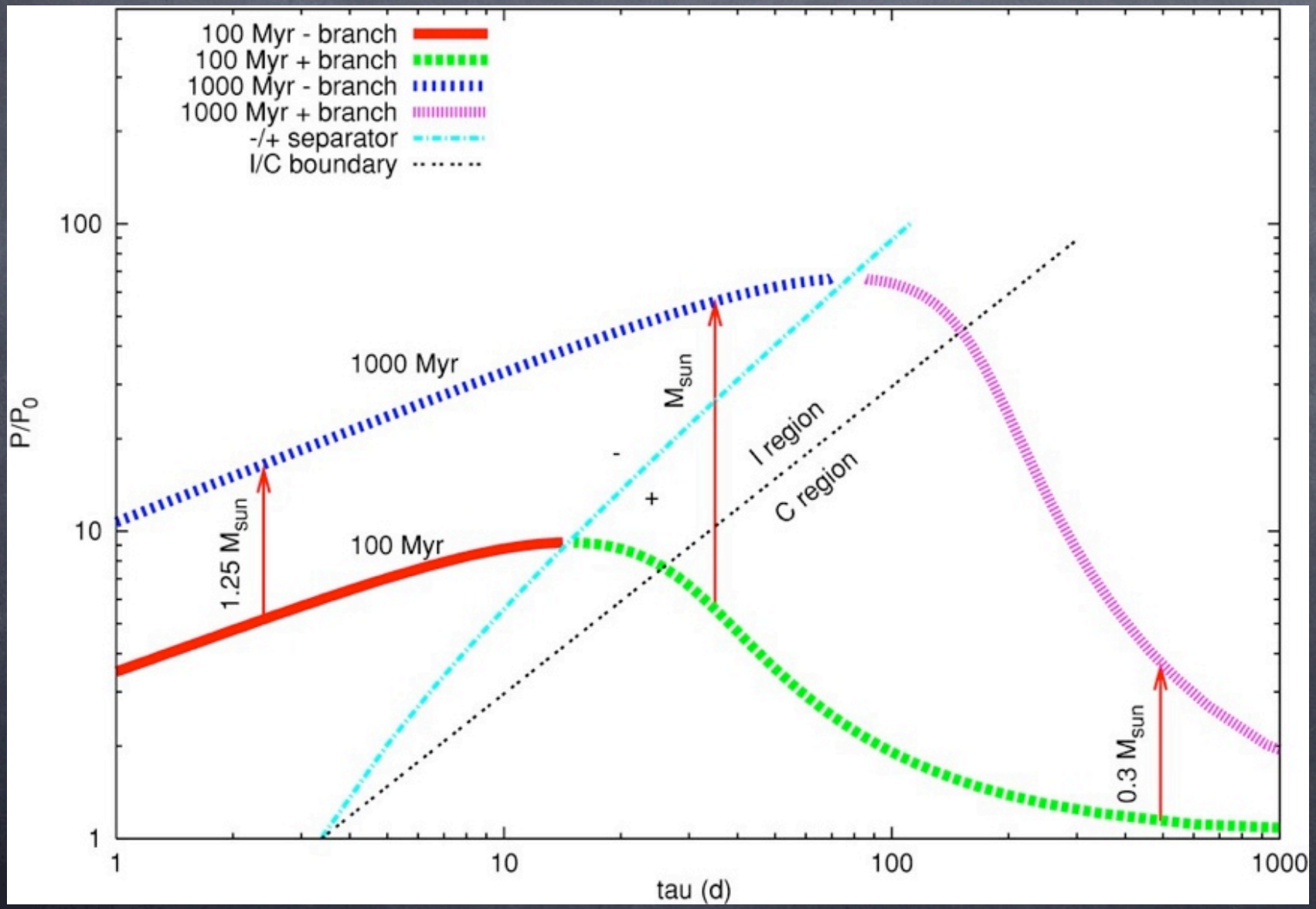
NGC 6811 (1Gyr) color-period diagram

(Meibom et al. 2011, ApJL, 733, 9)



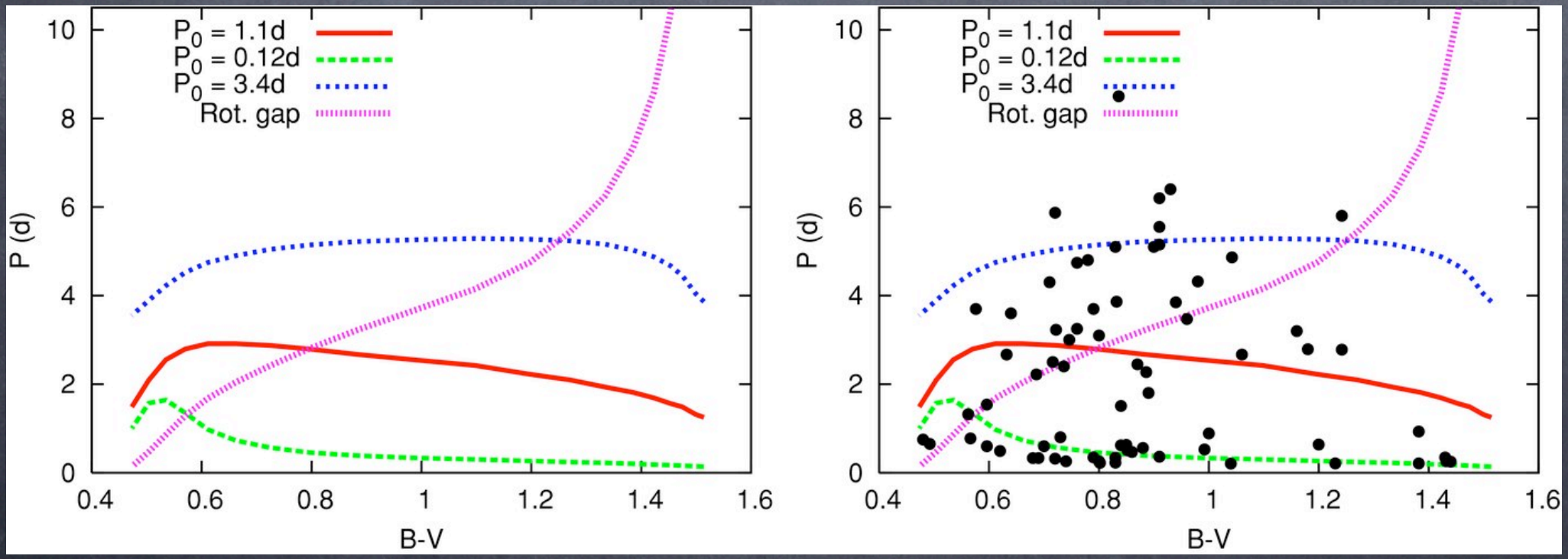
Theory

(Barnes & Kim 2010; Barnes 2010)



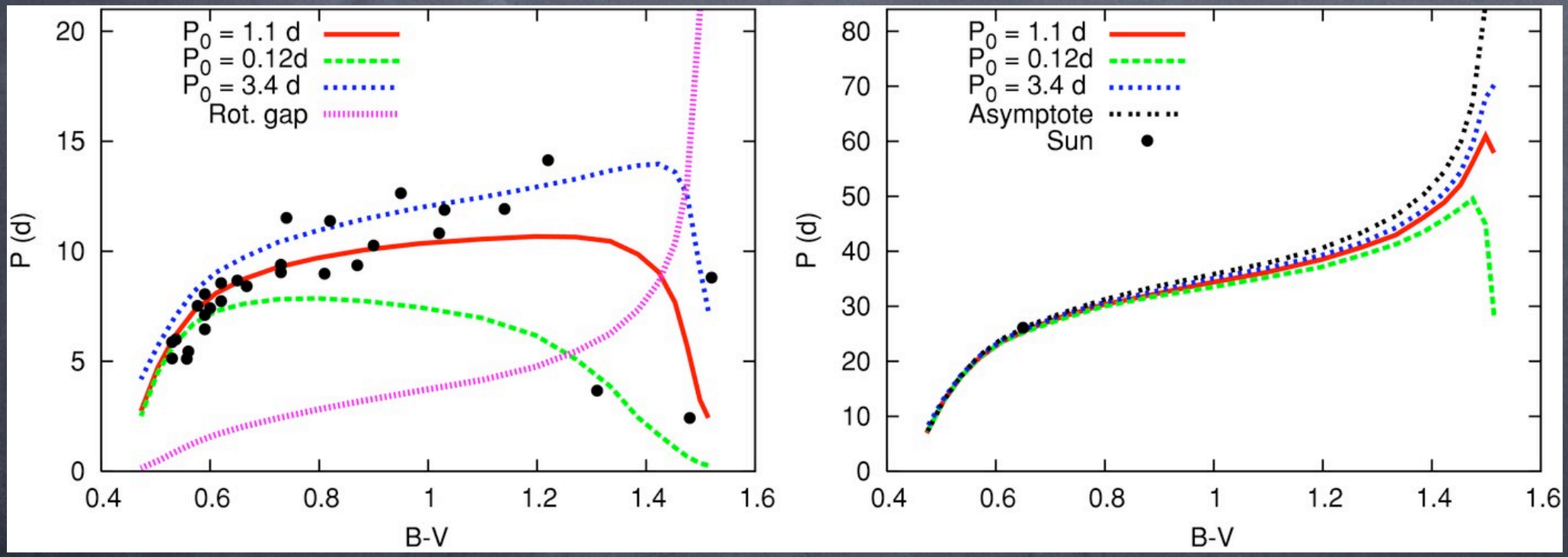
100 Myr color-period diagram

(Barnes 2010, ApJ, 722, 222)



600Myr, 4.5Gyr color-period diagrams

(Barnes 2010, ApJ, 722, 222)



Ages for old pops using M dwarfs

- Supernova program, 10 fields, 30 deg^2
- Other programs + LSST

Field M dwarfs

(data from Irwin+ 2011, ApJ, 727, 56 & DeWarf+ 2010, ApJ, 722, 343)