The Magellanic Clouds

Ernst Paunzen

+ many colleagues at the DTPA, FSc MU, Brno

Astrophysics Division

Department of Theoretical Physics and Astrophysics
Faculty of Science, Masaryk University

Magellanic Clouds

- LMC:
  - $V - M_V = 18.5$ mag
  - $E(B - V) = 0.05$ to 0.1 mag
  - Distance about 50 kpc
- SMC:
  - $V - M_V = 19.0$ mag
  - $E(B - V) = 0.05$ to 0.1 mag
  - Distance about 60 kpc
- Intrinsic reddening up to 0.2 mag for "normal" regions in the bulge

Magellanic Clouds

- Irregular Galaxies
- Disintegrate because of gravitational interaction with the Milky Way
- Global elemental abundance is lower than in the Milky Way: $-2 < [Fe/H] < -0.3$ dex
- Total masses about 20 times lower than in the Milky Way
- No significant differential rotation (?)
- Lower global magnetic field

Rotation of the LMC

- van der Marel & Kallivayalil, 2014, ApJ, 781, 121
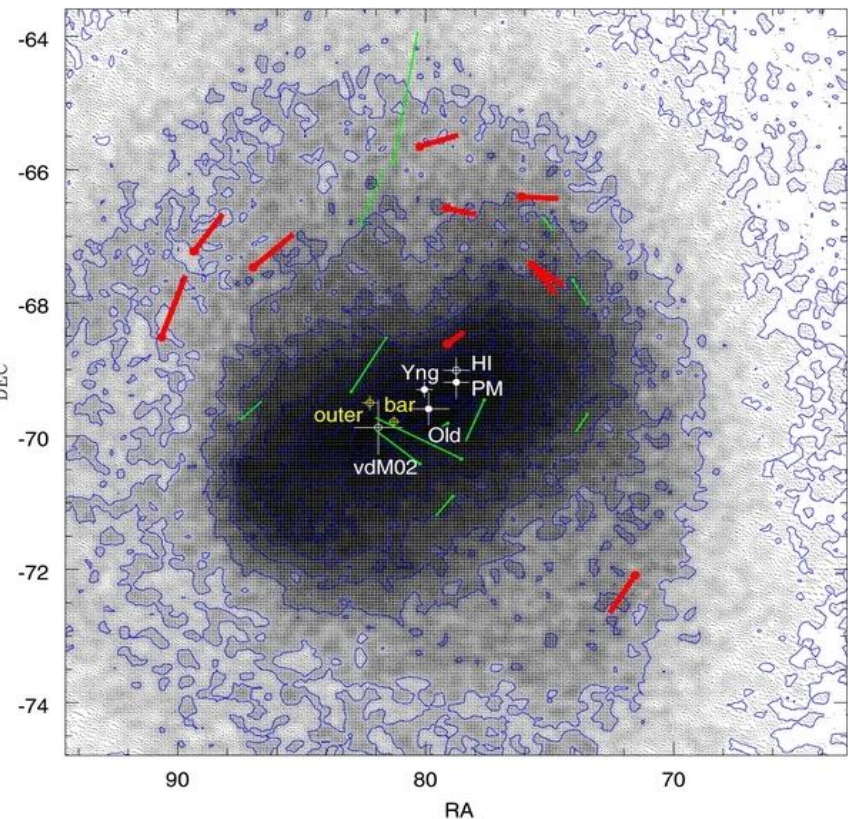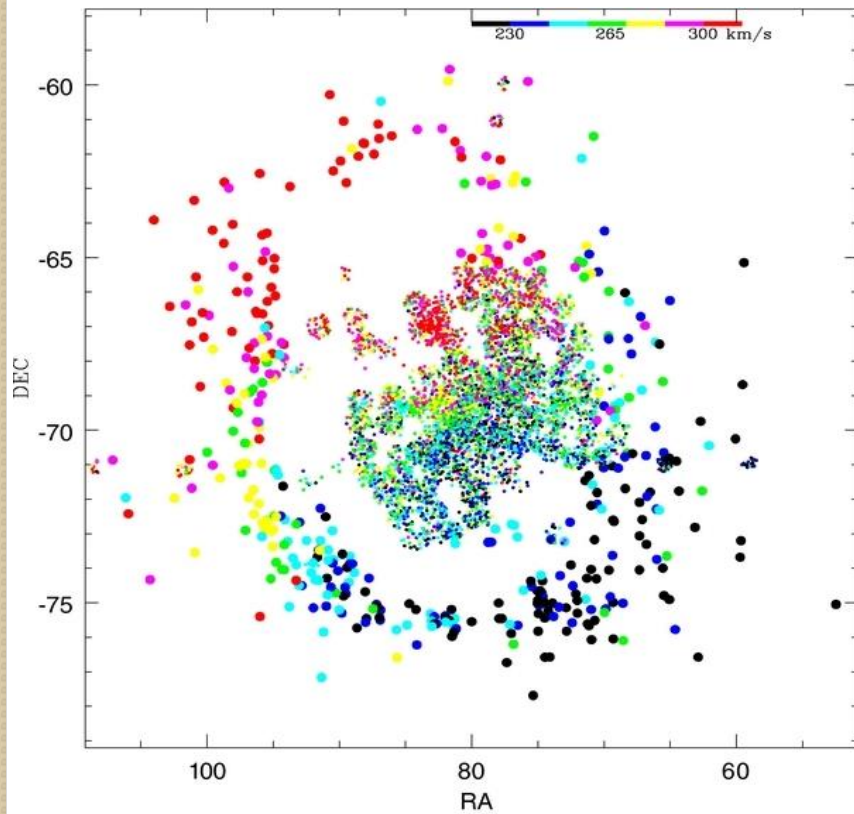
VMC - VISTA Magellanic Survey

- NIR - YJK_s band photometry
- K_s = 20.3 (Vega) at S/N=10
- 4 meter telescope
- Started in November 2009
- Description in Cioni et al., 2011, A&A, 527, A116
- Up to now, ten papers published, last: Moretti et al., 2014, MNRAS, 437, 2702

VMC - VISTA Magellanic Survey

- Star formation history
- 3D structure
- Stellar clusters
- Magellanic System's simulations
- Planetary Nebulae
- Proper motion
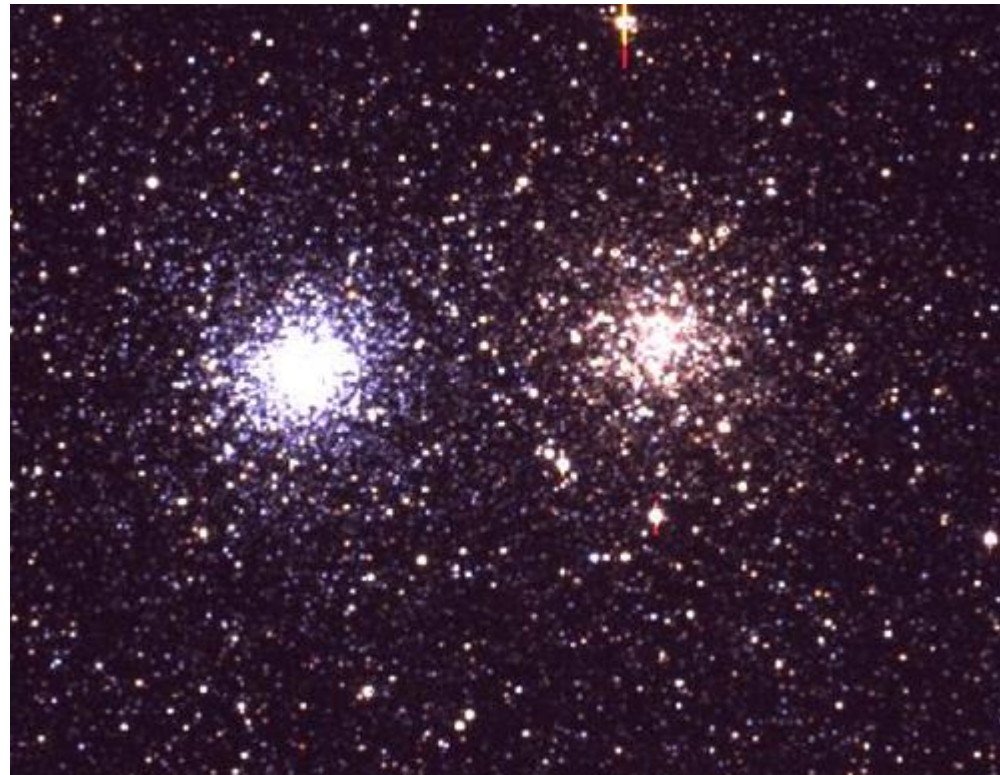- Star formation
- Distance scale

Overview of our project

- Three years duration, started 09/2013
- Δa, UBV photometry of LMC and SMC
- Archival data mining
  1. DENIS
  2. OGLE
  3. 2MASS
  4. VISTA Magellanic Cloud Survey
- WEBDA
- Additional observations 1.54D

Star clusters in the MCs

Same absolute scale

NGC 1866

LMC, Age about 100 Myr

NGC 2298

Milky Way, Age about 15 Gyr

Star clusters in the MCs have the same morphology as GCs in the Milky Way

Overview of the project

- Aims toward
1. Chemically peculiar stars
2. Be/Ae stars
3. Variable stars
4. Star Clusters
5. Cluster and stellar parameters
6. Trace the local magnetic field
7. Trace the local metallicity
8. Trace the stellar rotational distribution

Observed fields
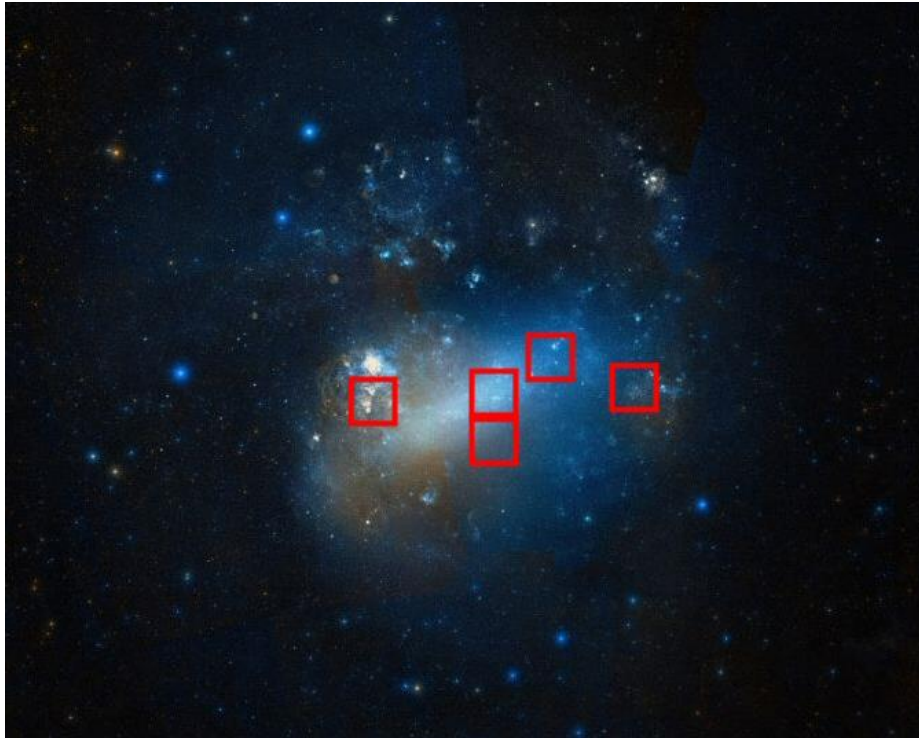
$\triangle$a photometry of 5 representative LMC fields of bulge, star forming regions, field population + 1 SMC field
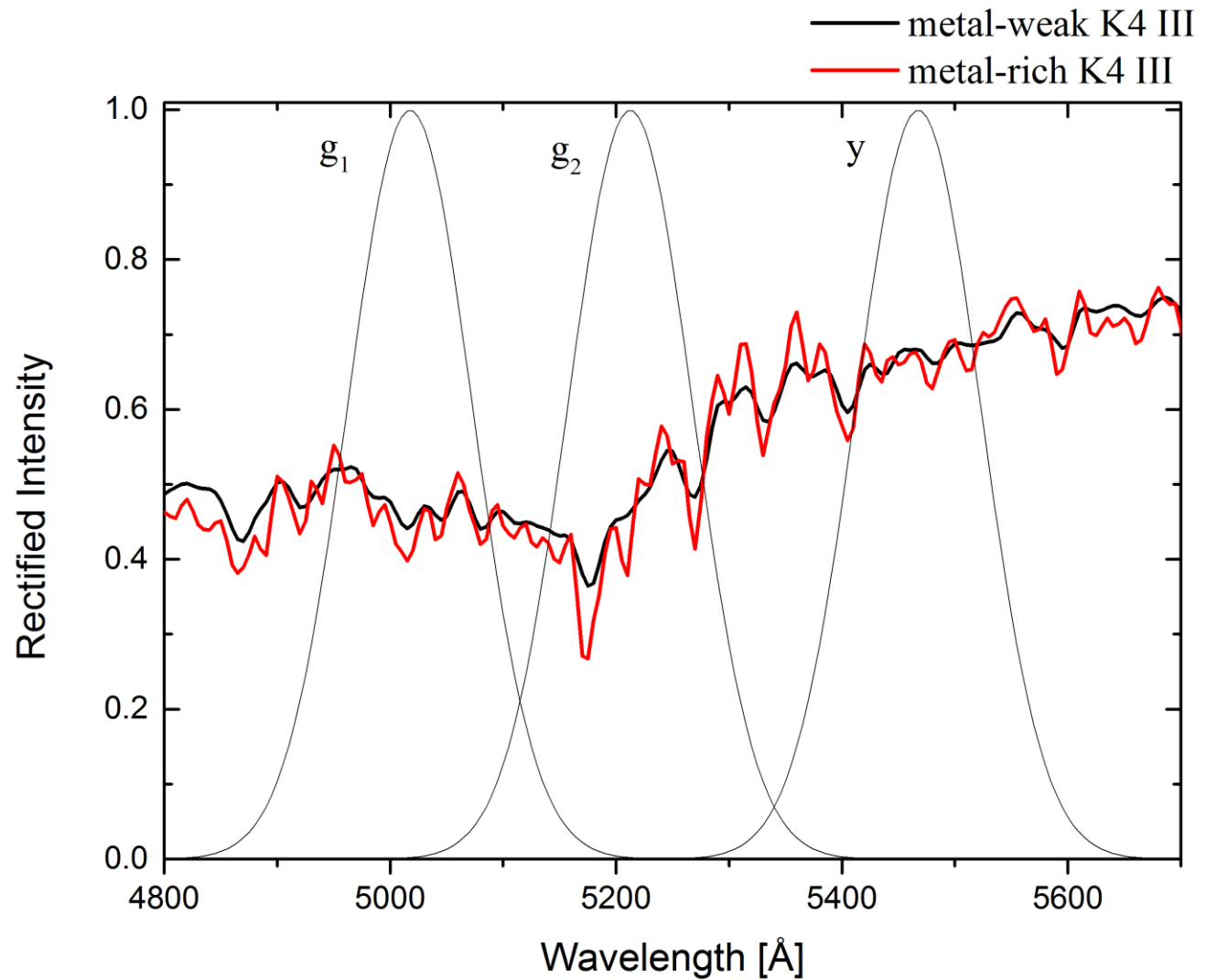
all obtained with ESO 2.2 WFI

Brightness limit of 19th to 20th magnitude (V)

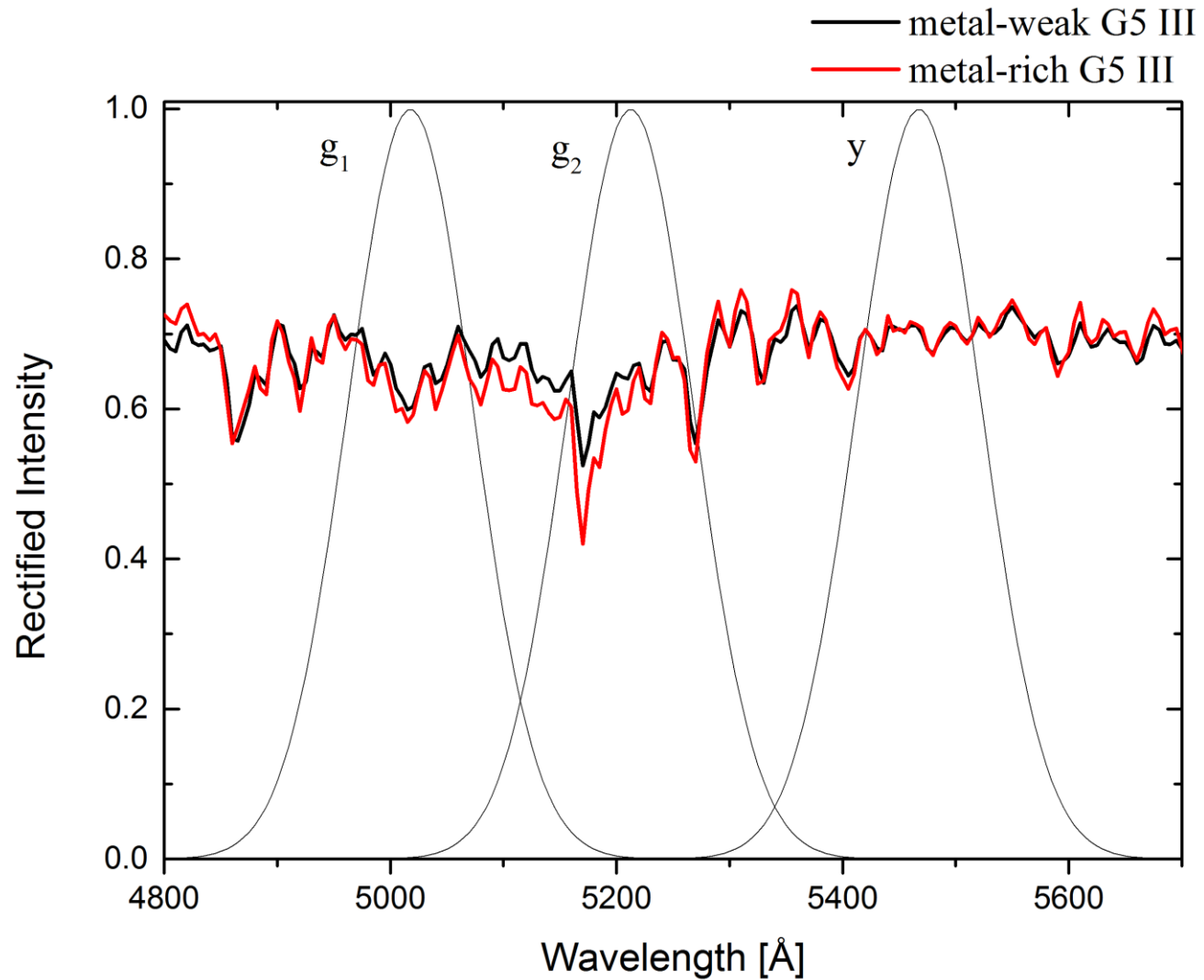Will reveal some 1000s of extragalactic CP stars = number of known ones in the Milky Way!

Flux depression at 5200Å

Stigler et al., 2014, A&A, 562, A65
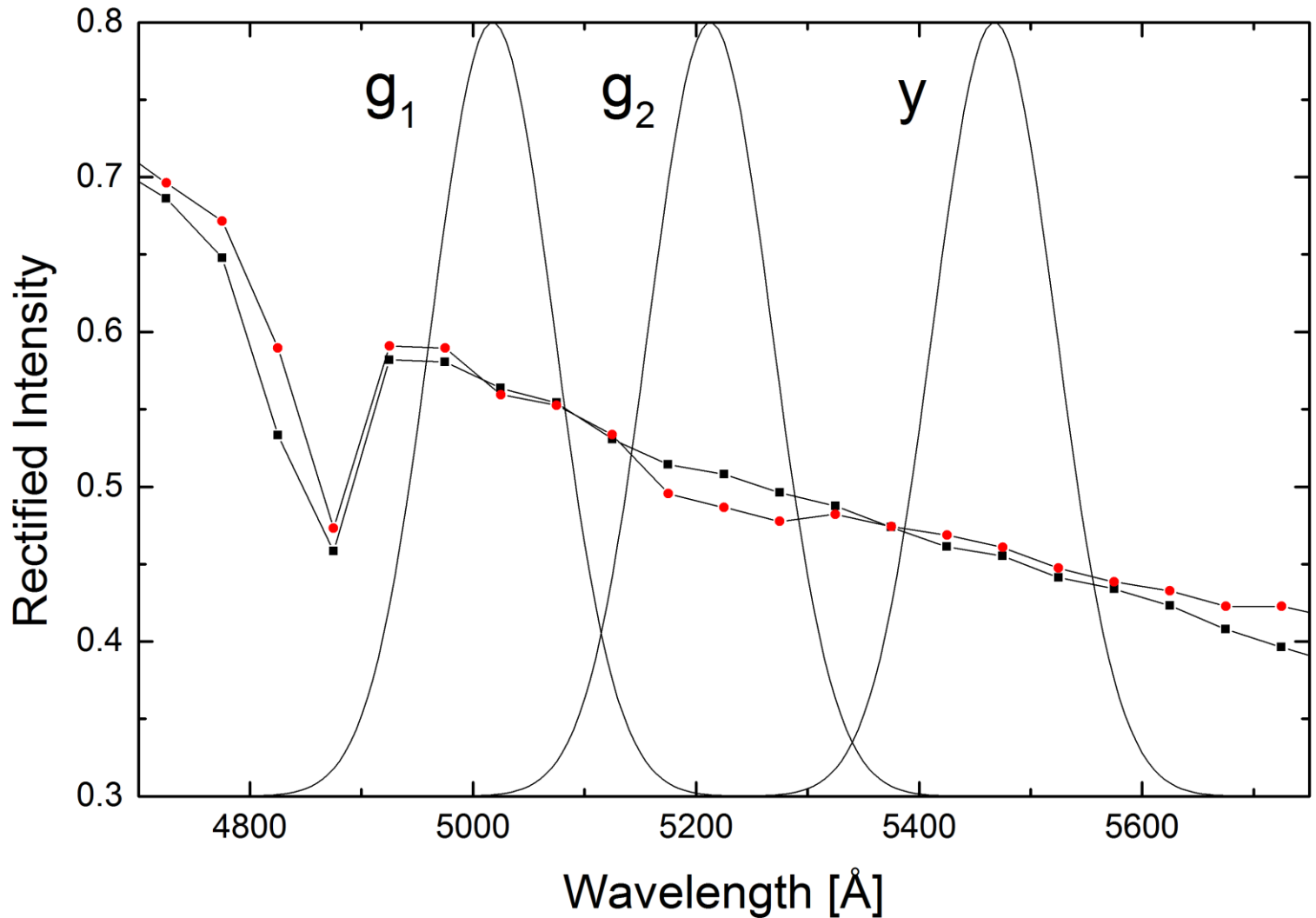
Detection of cool peculiar stars?

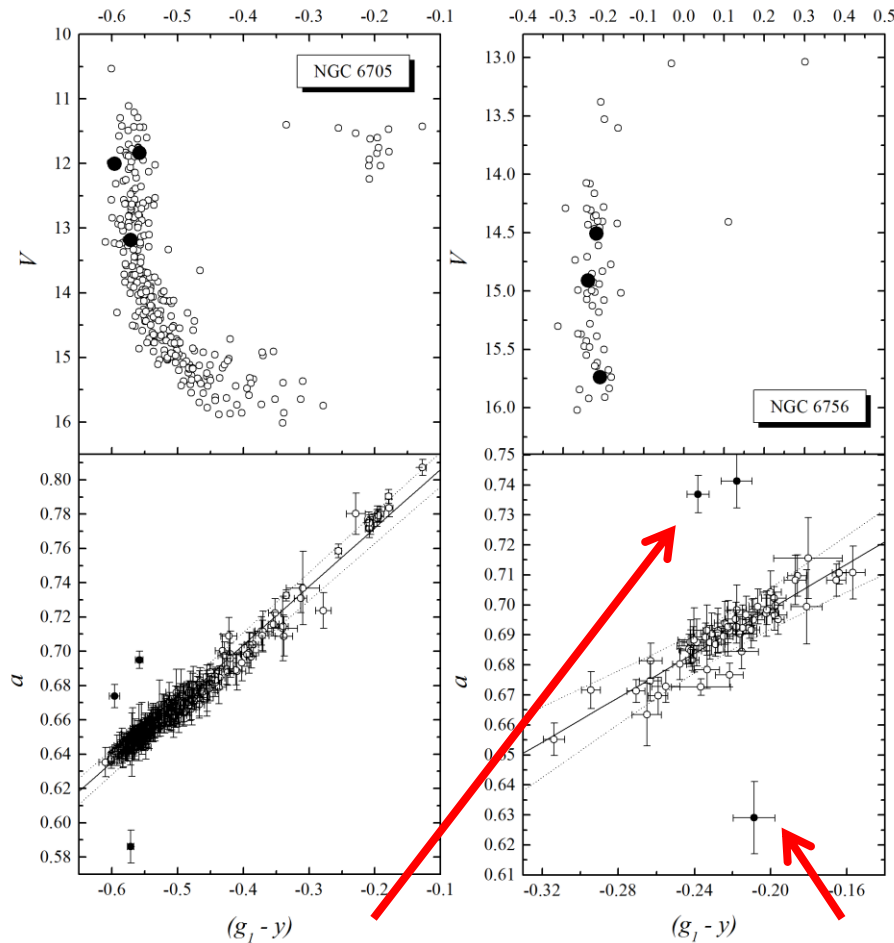# Detection of cool peculiar stars?

Δa photometry

- "Invented" by Maitzen, 1976, A&A, 51, 223
- Several slightly modified filter system used
- The most efficient
  - g_1: λ_c = 5000Å, FWHM =130Å
  - g_2: λ_c = 5220Å, FWHM =130Å
  - y: λ_c = 5500Å, FWHM =130Å
- $a = g_2 - [(g_1 + y)/2]$ = "measures" flux (depression) at 5200Å
- Δa = a(normal stars) − a(obs)
- a versus (g_1 − y) or (B − V) or (b − y)

Δa photometry

Paunzen et al., 2003, A&A, 412, 712

80 OCL in MW
3 GCL in MW
1500 field stars
Six small fields LMC
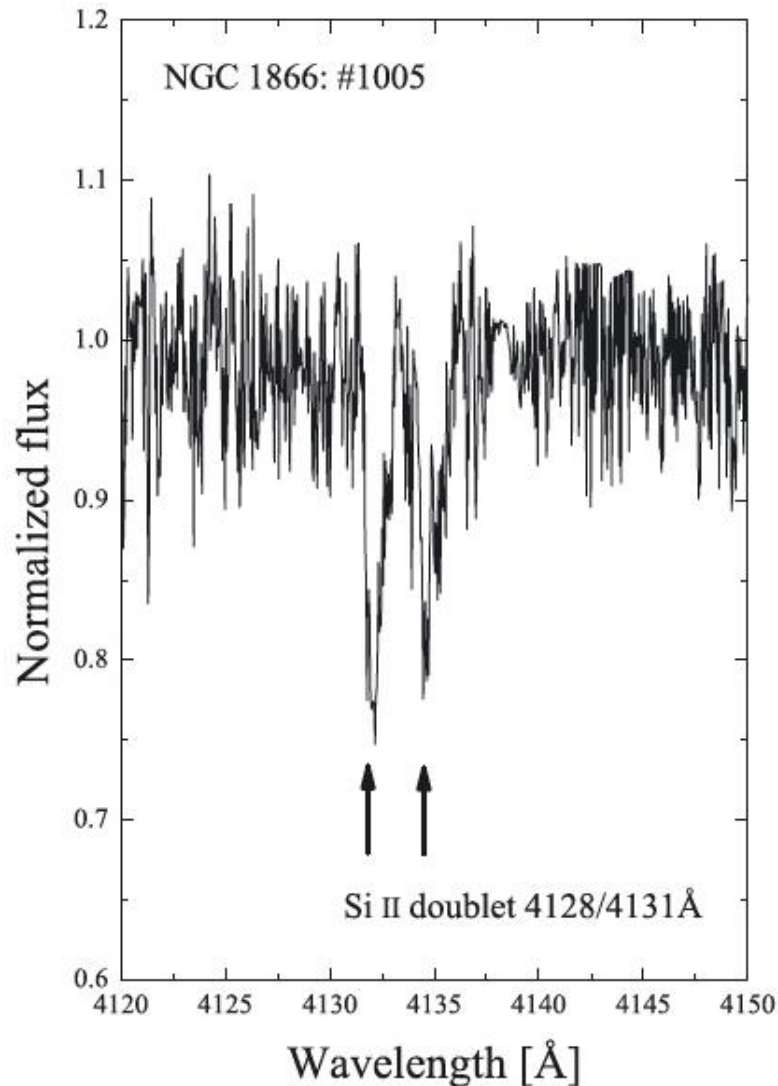
Peculiar stars   emission type/metal weak stars

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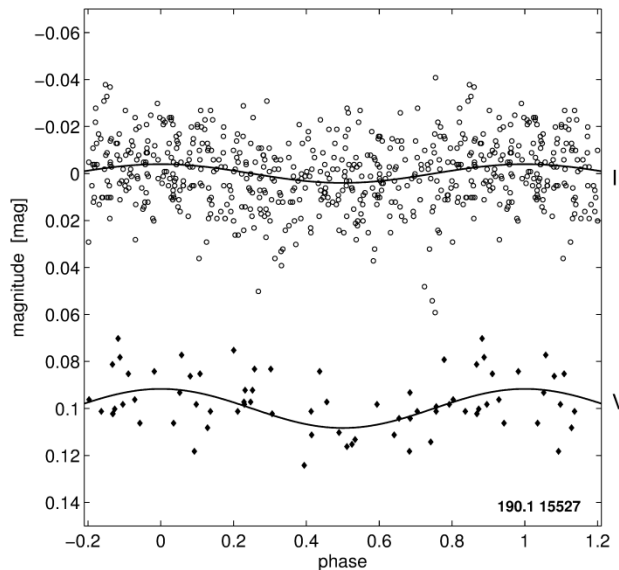
Results of the LMC

Classical CP2 star

Detected via Δa; spectroscopically confirmed using 6.5m Magellan II (Las Campanas)
Paunzen et al., 2011, MNRAS, 411, 260

Be star
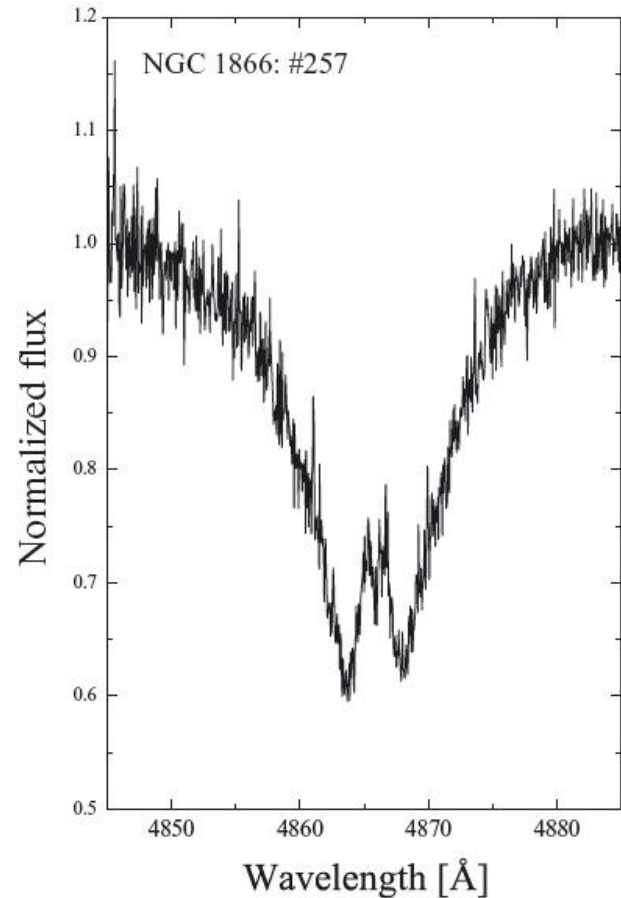
Rotation – CP stars - LMC

- Paunzen et al., 2013, A&A, 556, A12
- CPs – LMC from Δa in OGLE III archive
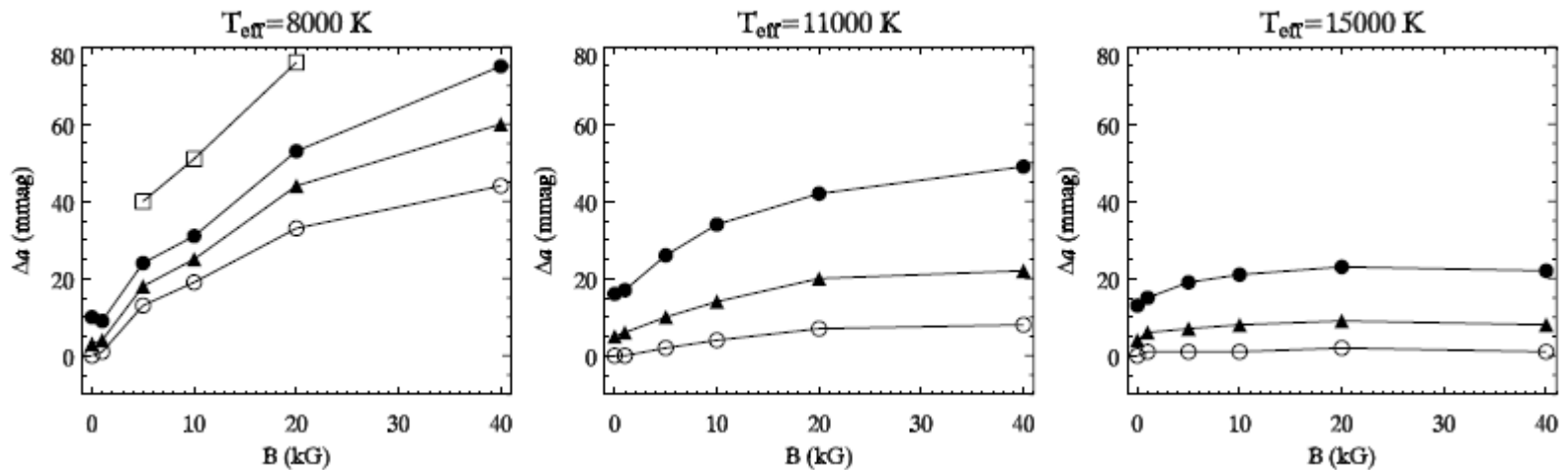- 12 stars investigated, only two show hints for variability

Peculiarity maybe different to MW?

Larger sample needed

Δa photometry – magnetic field

Kochukhov et al., 2005, A&A, 433, 671

Depending on Teff and [Z], Δa is sensitive to [B]

WEBDA - **W**eb **b**ase de **d**onnées de **a**mas d'étoiles

- WEBDA is a site devoted to open star clusters, presenting the available data and knowledge together with a unified numbering system => allows an easy comparison of datasets
- 4 million measurements of 2 million stars in 1000 clusters
- 70 publications per year acknowledge the use of WEBDA
- http://webda.physics.muni.cz