

Obscured Long Period Variables from the NIR VMC survey

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(& VMC consortium)

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Overview Talk

- Introduction
 - Asymptotic Giant Branch (AGB), last phase of 1-10 M_{\odot} stars
 - AGB star variability (Irr, SR, Mira; LPV; cf. Michele Trabucchi)
 - PL -relation
 - $P - M - R$ -relation; probe of stellar evolution
- VMC survey
- Finding LPVs: Analysis & Results

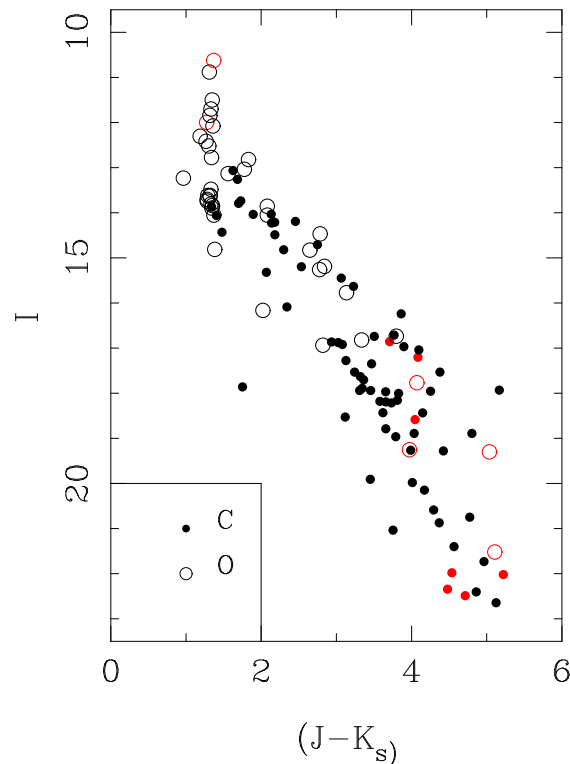
(AGB) Variability

OGLE-III

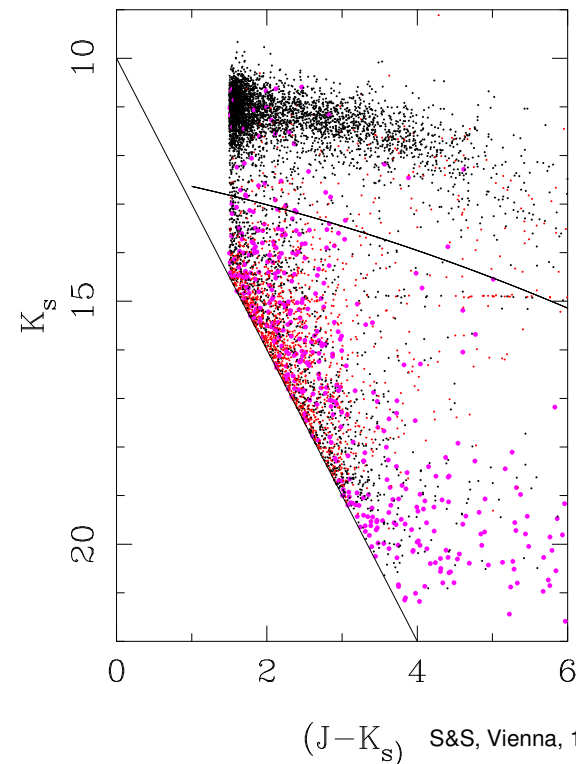
1663 / 352 Miras & 11132 / 2222 SRs L/SMC
faintest 1% are between $I = 20.2 - 20.7$

OGLE-IV

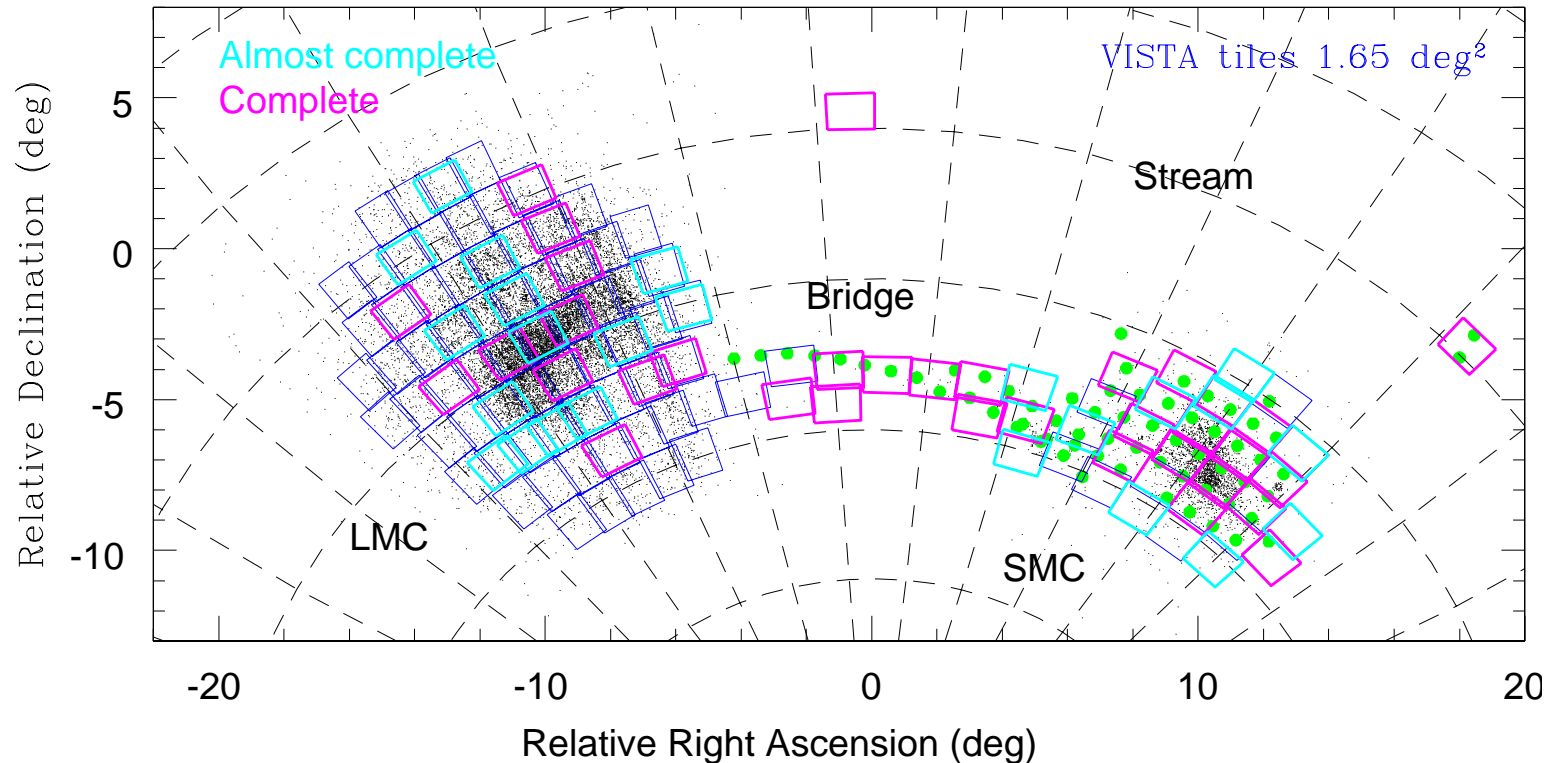
Not yet available. Larger area, not deeper



Groenewegen
& Sloan
(2018)
Synthetic
photometry



VMC



VMC = VISTA Magellanic Cloud Survey

PI. Maria-Rosa Cioni

(Leibniz-Institut für Astrophysik Potsdam)

VMC

- One of 6 Public Surveys selected by ESO
- Survey in YJK_s of LMC, SMC, Bridge & Stream
- Total area 170 sq.degrees = 110 "tiles"
- multi-epoch (typically 12 epochs in K)
- Already 30+ refereed papers
- SFH, proper motion, background galaxies, distance indicators (CC, T2C, RRL, TRGB, RC).
- DR5 available as of August 2019

Selection of Stars

- VMC only (requires J, K)
- VMC and WISE data ($K, W1, W2$)
- SAGE ($[3.6],[4.5],[5.8],[8.0]$), then VMC

3736 sources, 2014 unique

Known stars with $P < 450 d$ removed

Remain 1299 (about 600 stars with known $P > 450 d$)

Simbad classification and spectral types
(AGB, YSO, PNe, B/Be/Bsg, QSO/galaxies)

Literature data (DENIS, IRSF, 2MASS, 2MASS6X +
'specialized' works)

Code

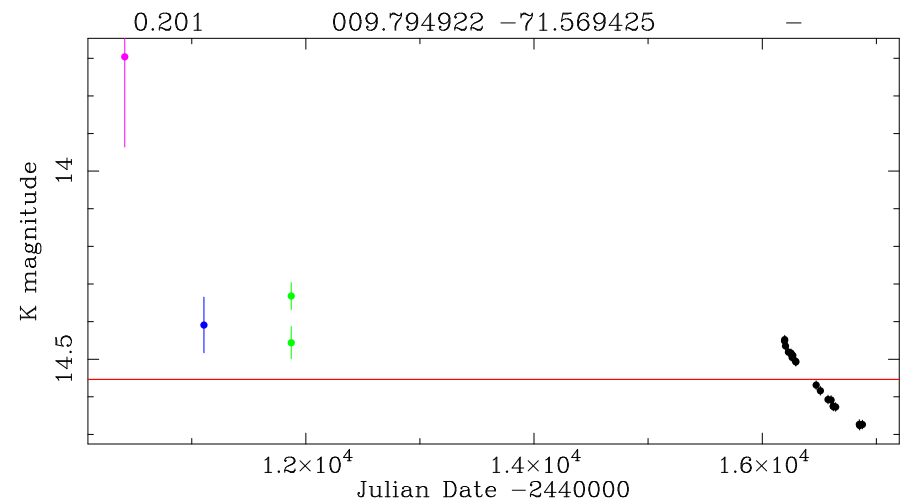
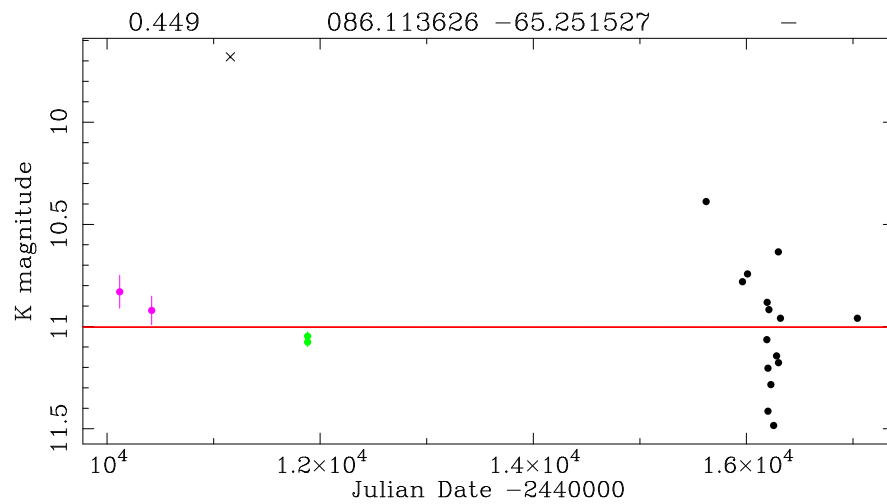
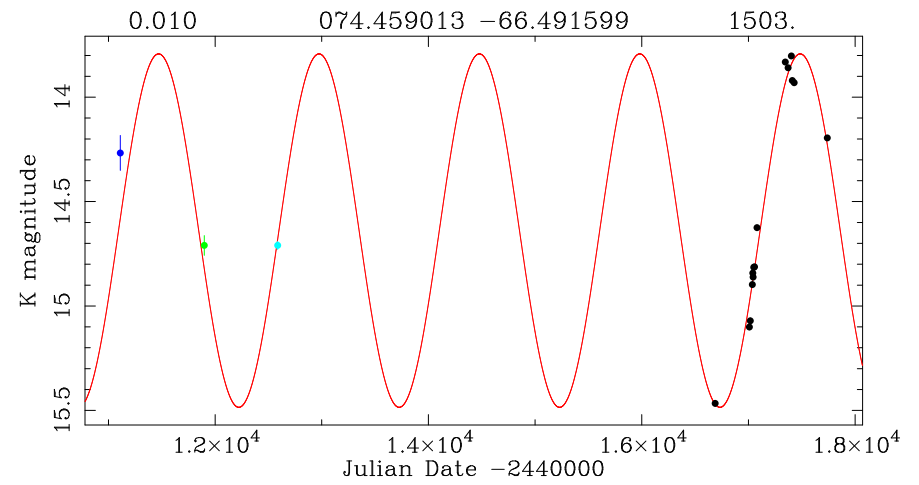
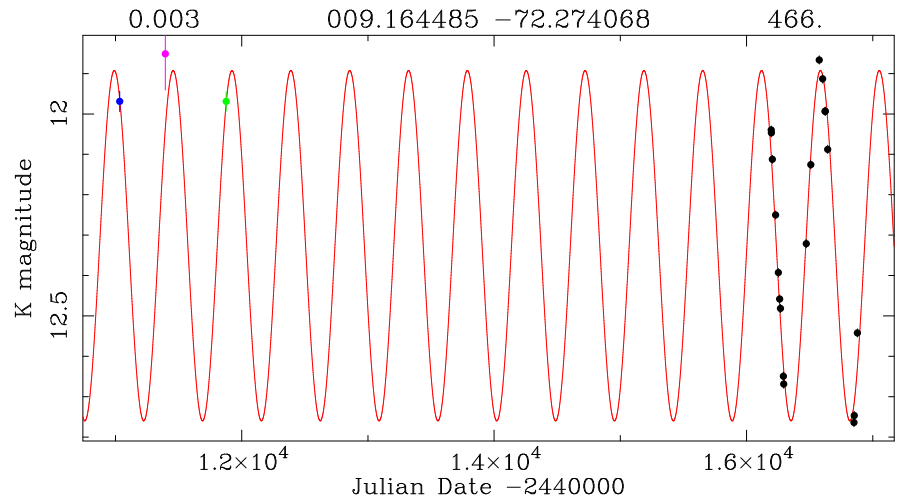
Revival of my old OGLE-II analysis code
(Groenewegen 2004)

- Find frequency (FASPER)
- If significant \Rightarrow Linear LSF (MRQMIN)

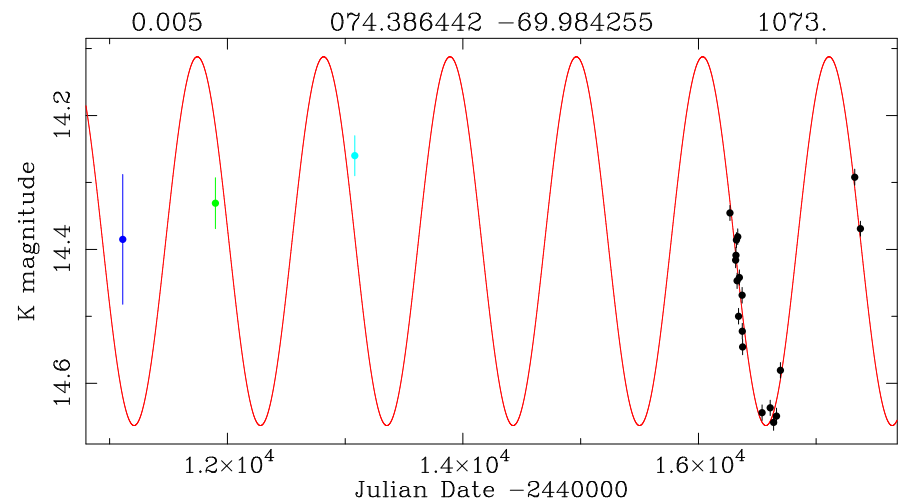
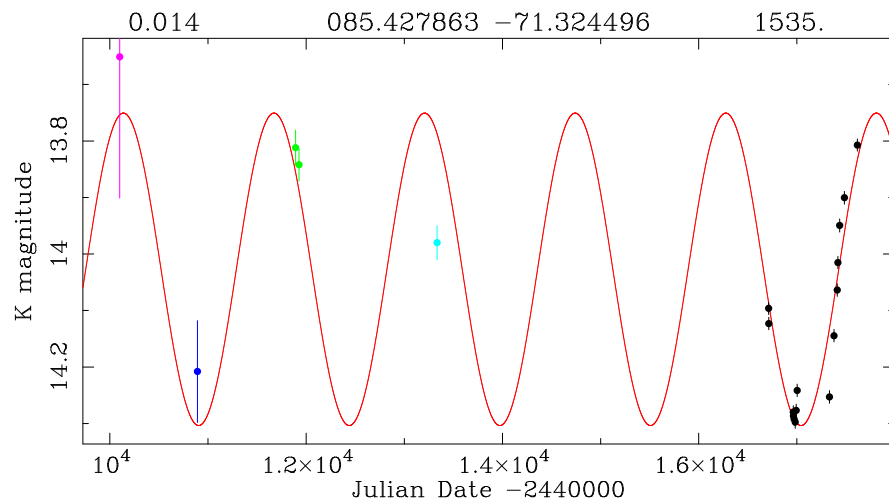
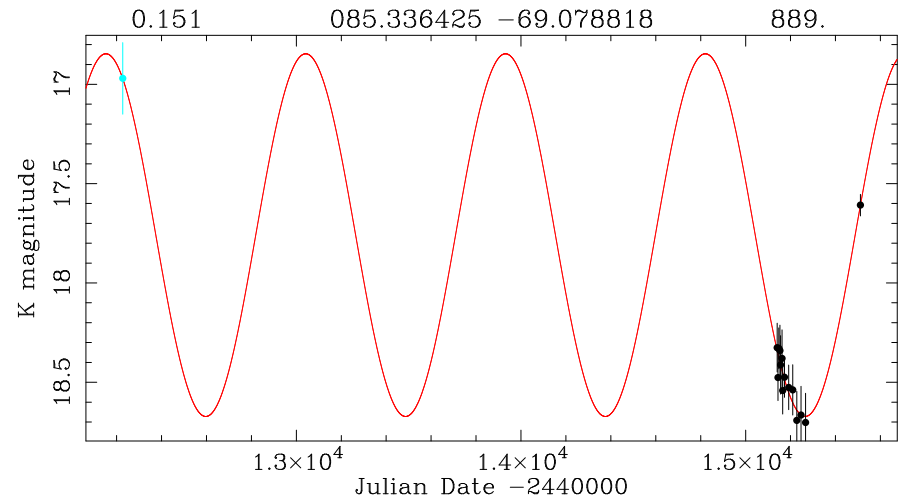
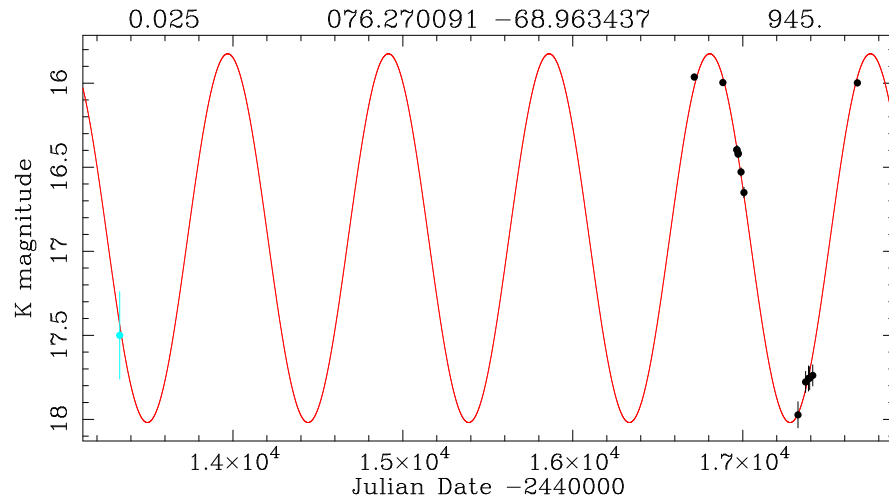
$$K(t) = K_0 + A_1 \sin(2\pi t \omega_1) + B_1 \cos(2\pi t \omega_1)$$

Manual checking: PERIOD04

Examples



Examples



Sample reduction

Use the properties of the KNOWN Miras (with small LSP) from OGLE to come up with selection criteria

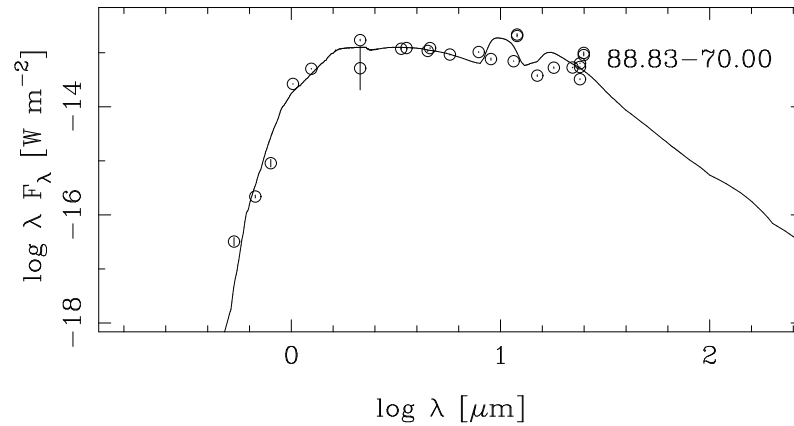
⇒ Apply, and remove all known OGLE Miras (with periods < 1000 days), and stars spectroscopically confirmed to be non-AGB stars:

254 stars left

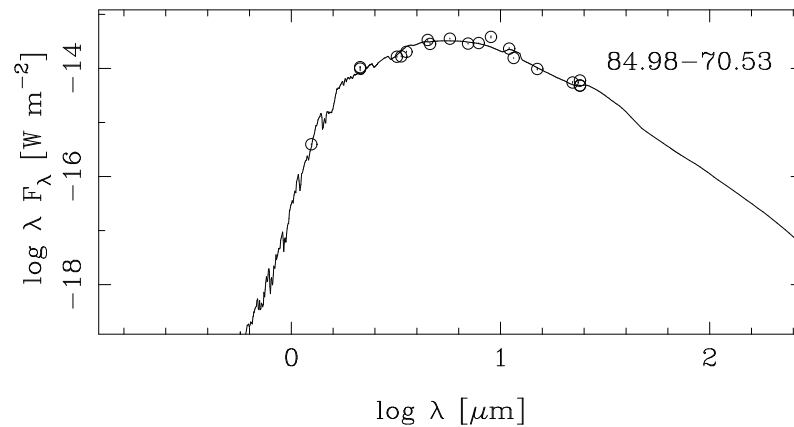
The SEDs were constructed and fitted to template spectra

217 likely AGB stars/LPVs

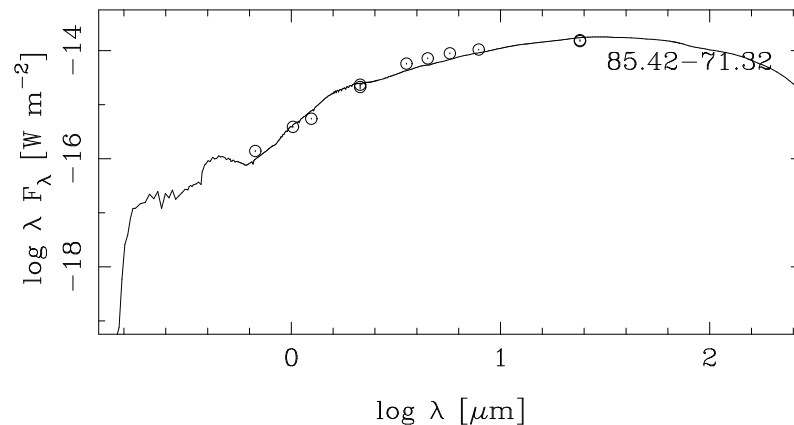
PL-relations



O-rich

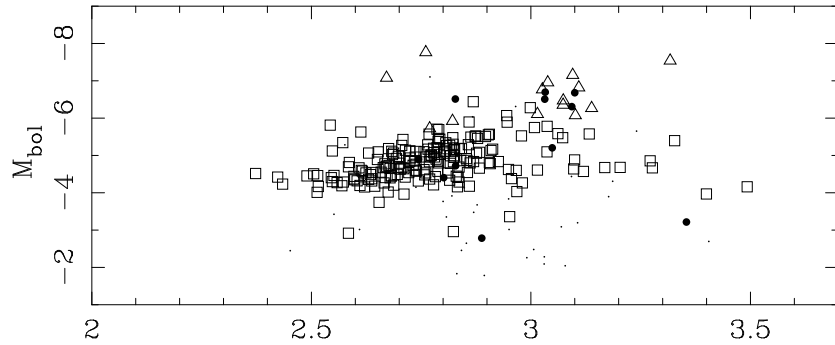


C-rich

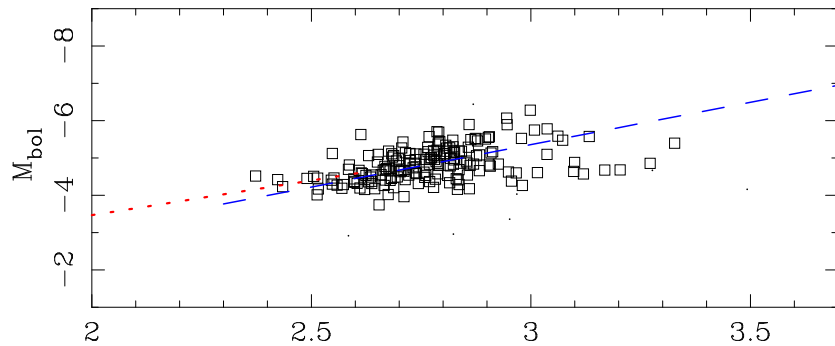


YSO

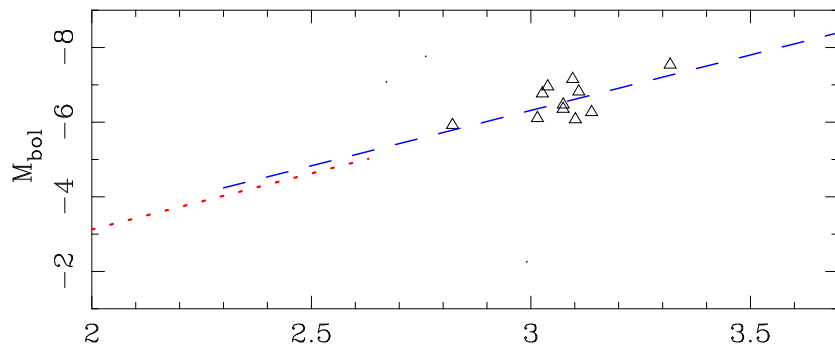
PL-relations



All




C-rich



O-rich

Summary

- K -band lightcurves for 1299 red stars in MCs
- sample of 254 with properties of miras variables
- SEDs of these 254 stars
- 217 likely AGB/LPV (34 with $P > 1000 d$)
- Longest previously known period is 1810 d (Gr & Sloan 2018). Pulsation mass of $\sim 9 M_{\odot}$. IR LC gives 2075 d .
- Two with longer periods
 $P = 2261 d$, $A = 0.20$ mag, $L \sim 1500 L_{\odot}$
 $P = 2510 d$, $A = 0.15$ mag, $L \sim 3000 L_{\odot}$
- IR LCs of YSO could be of interest



THE END