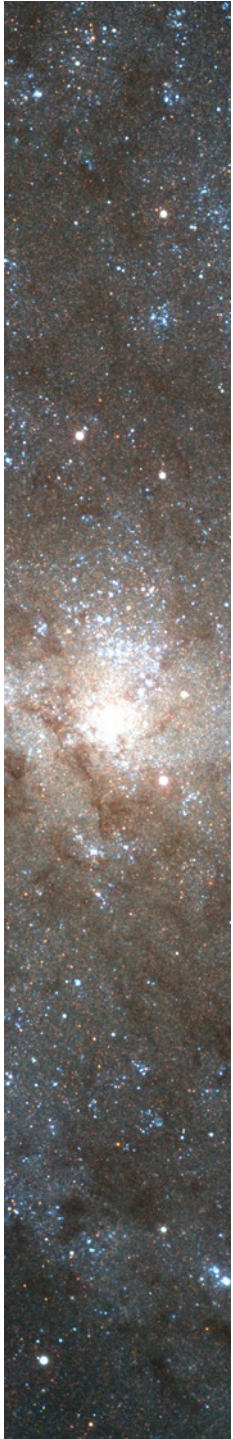


# A WIYN+ODI Synoptic Survey of M31 & M33

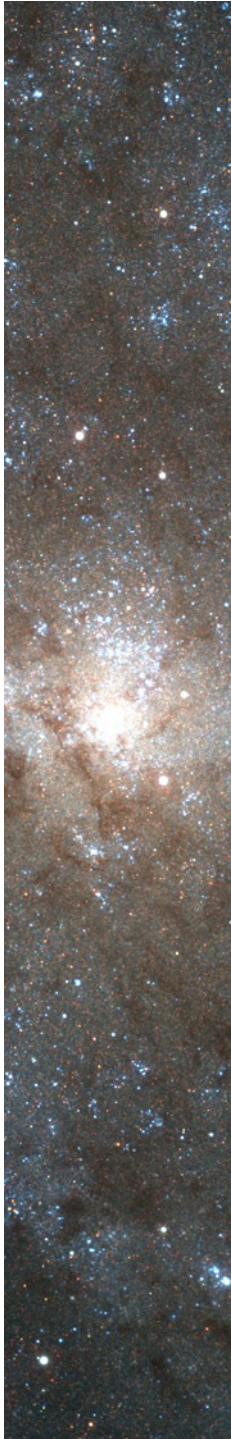
Lucas Macri

Texas A&M University



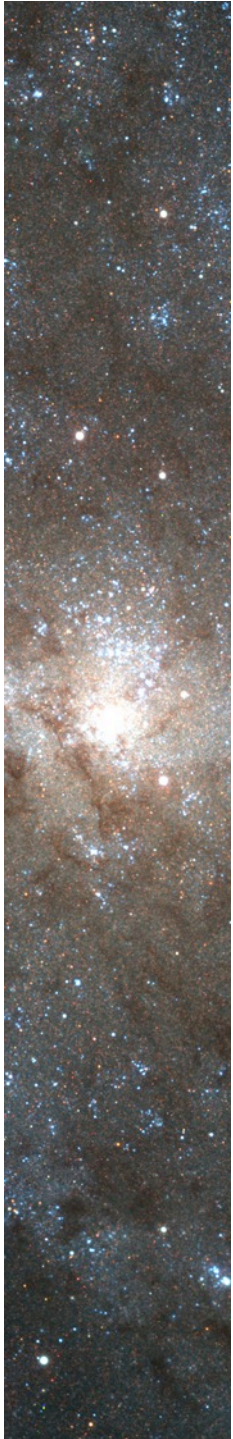
## M31+M33

- Nearest spiral galaxies
- $m-M \sim 24.5$  mag
  - TRGB:  $I \sim 20$  mag
  - HB:  $V \sim 25.5$  mag
- Relatively high Galactic latitude
  - $E(B-V) \sim 0.05$  mag, low MW stellar density
- Large range of  $[Fe/H]$



## M31+M33

- Until recently, their large angular size presented a challenge for complete surveys
  - M33 ~ 15 MiniMosaic pointings
- Advent of degree+ imagers enables efficient surveys
  - CFHT
  - PANSTARRS
  - PTF



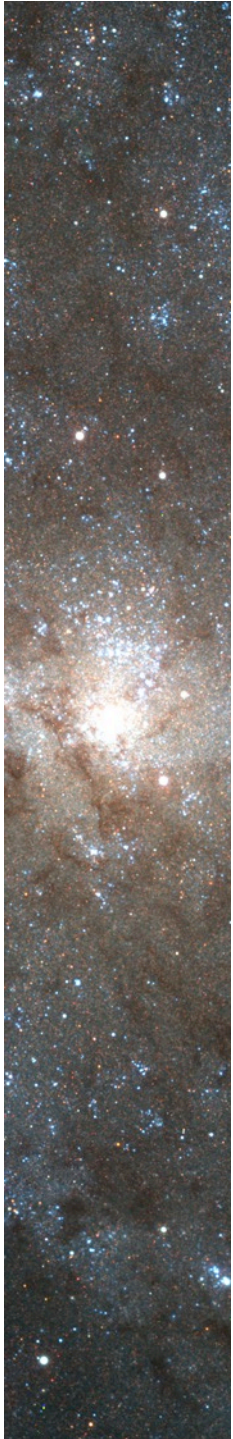
# M31+M33

- What can WIYN+ODI contribute?
- CFHT: PANDAS (tidal streams)
  - See previous talk by J-C Cuillandre
- PANSTARRS1: Pandromeda (microlensing)
- Palomar Transient Factory (transients)

# M31+M33

- Accurate distances, will only get better
  - $\sigma(D)/D \sim 5\text{-}10\%$  from DEBs
  - Rotational parallaxes from GAIA
- Can serve as fundamental calibrators for Extragalactic Distance Scale
  - Motivation for DIRECT project (Stanek et al.)
  - M31 DEB survey (Ribas, Guinan, et al.)

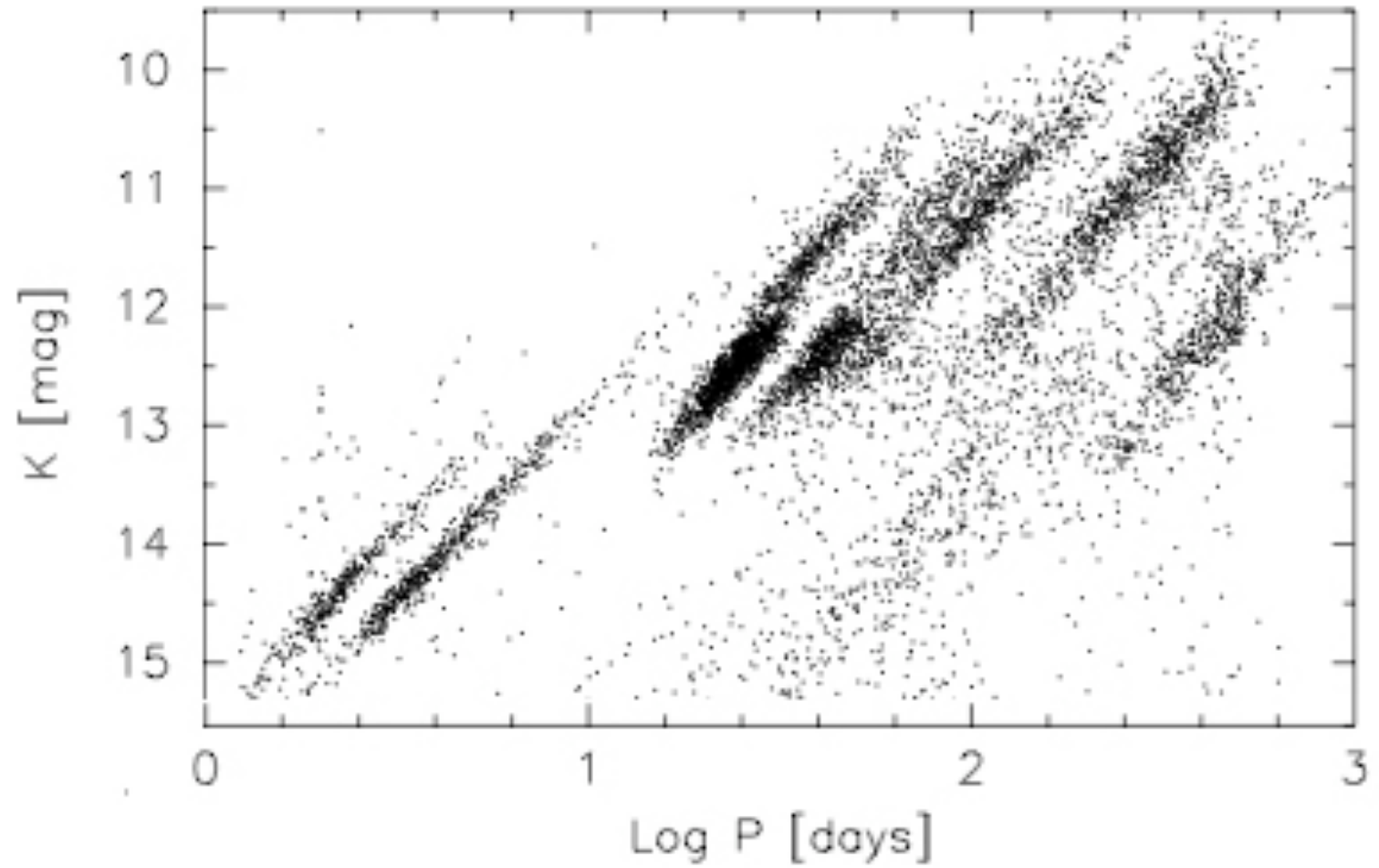
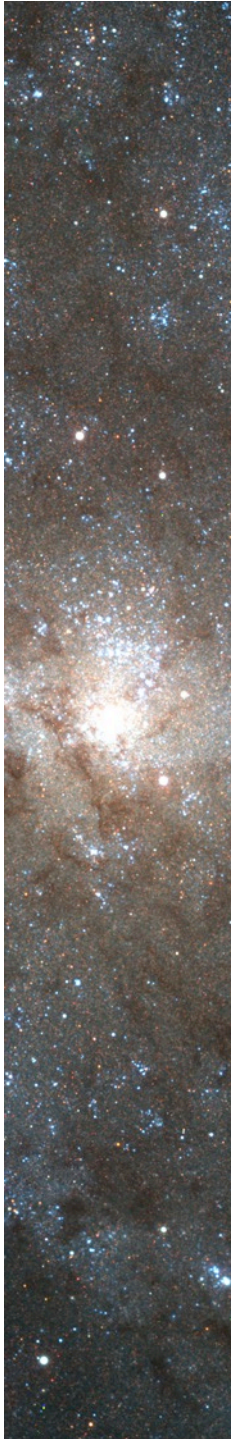


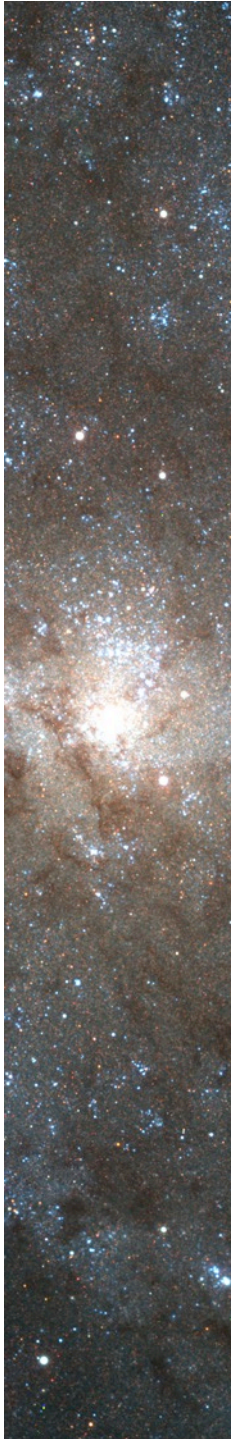


## M31+M33

- Only galaxies outside of MW & MCs where we can characterize the absolute properties of Cepheids & LPVs
  - Wide range of abundances, same distance
- LPVs have great potential as distance indicators at near-IR wavelengths
  - JWST single-step distances into Hubble flow

# M31+M33

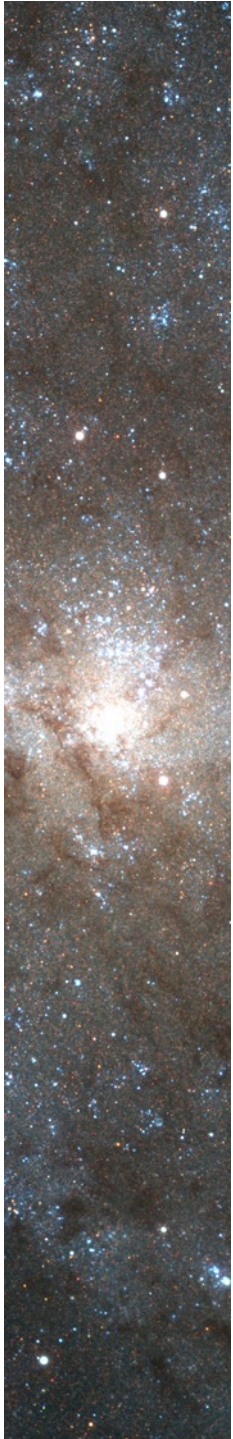




## WIYN+ODI survey of M31+M33

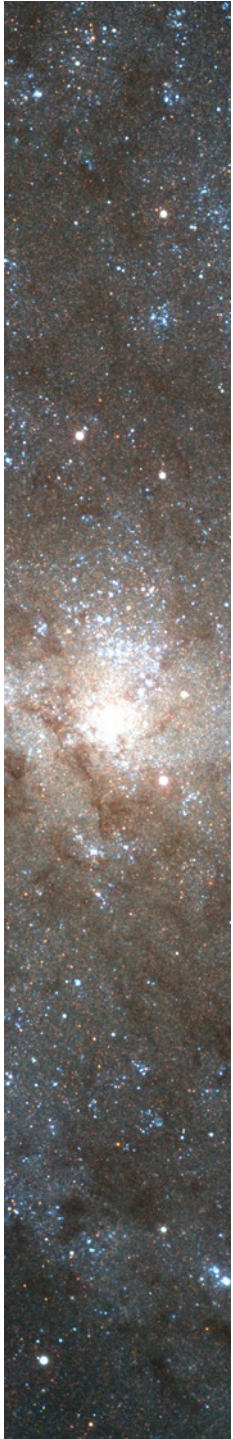
- Cepheids:  $4^{\text{d}} < P < 150^{\text{d}}$ ,  $21 < I < 16$
- LPVs:  $100^{\text{d}} < P < 1500^{\text{d}}$ ,  $22 < I < 17$
- 1min exposures x 5 dithers = 5 min/epoch
- SNR=10 @  $I=23.3$ ,  $V=24.5$  per epoch
- 3 fields (2 in M31, 1 in M33), < 1 hr total
- 4 /month x 5 months x 3 yr = 60 epochs
- Would be nice to extend to 5+ yr  
at lower cadence for longest LPVs





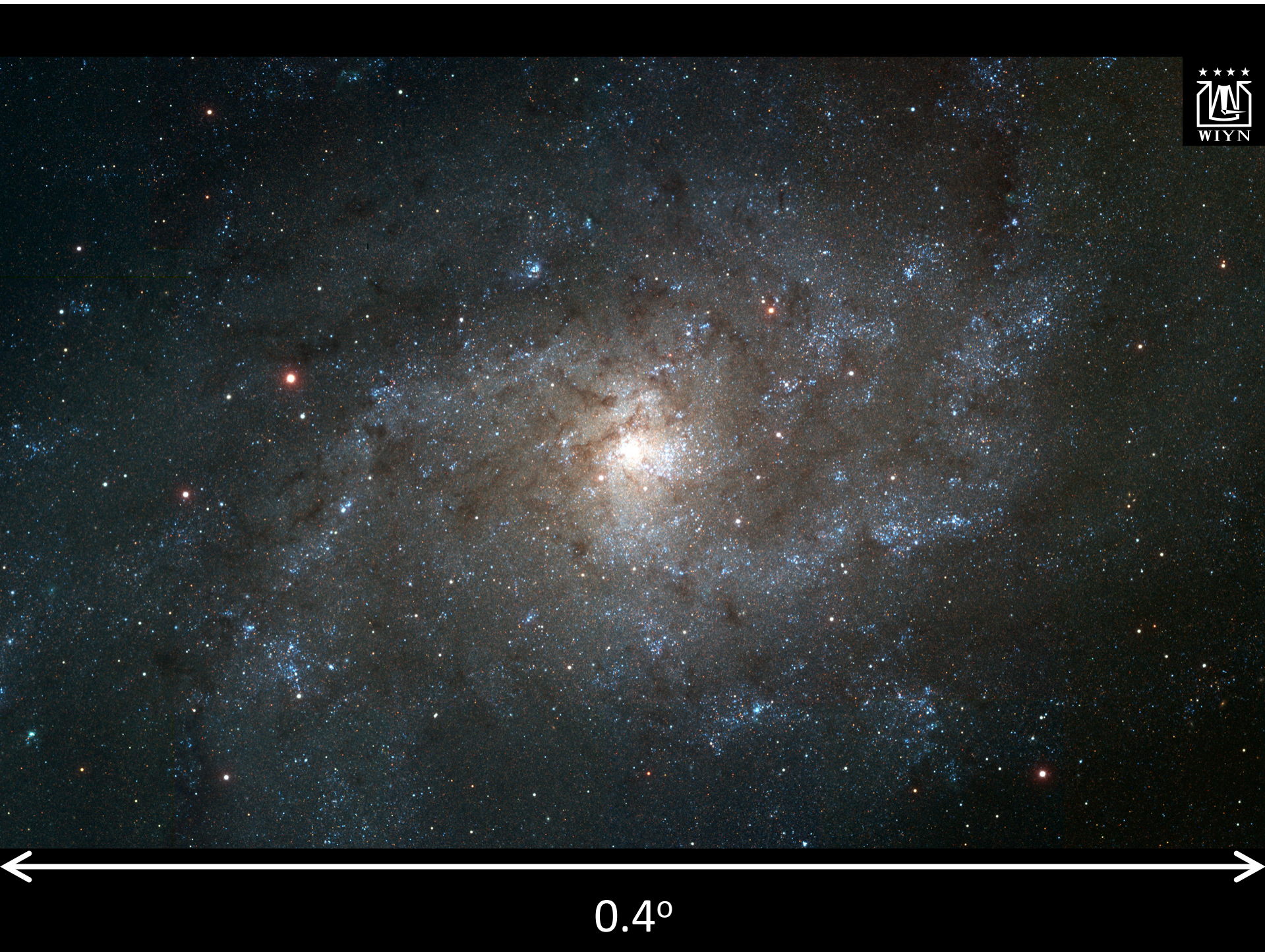
# WIYN+ODI survey of M31+M33

- Other science
- SN light echoes
- Novae + other transients
- Insert your favorite here...

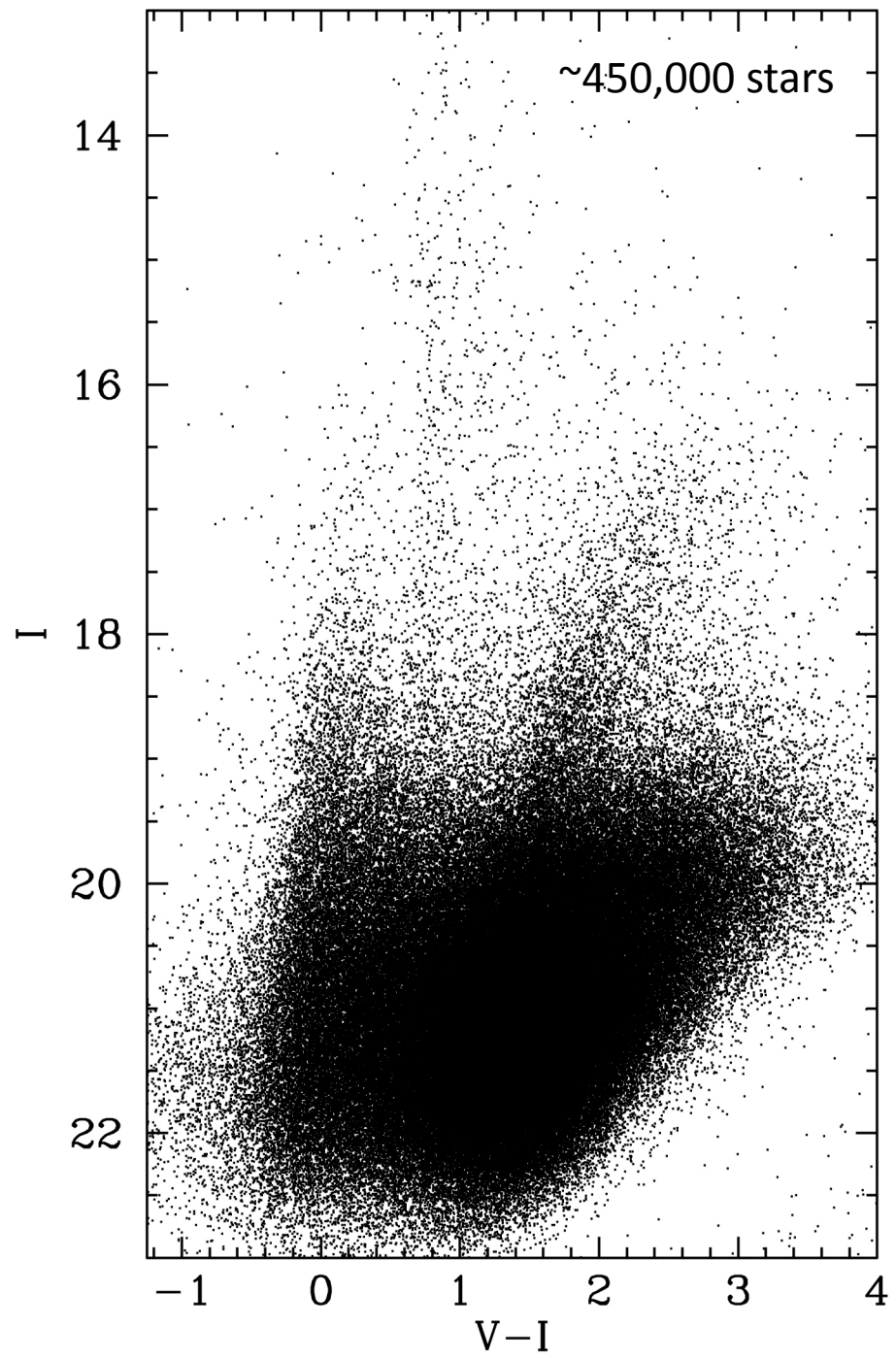
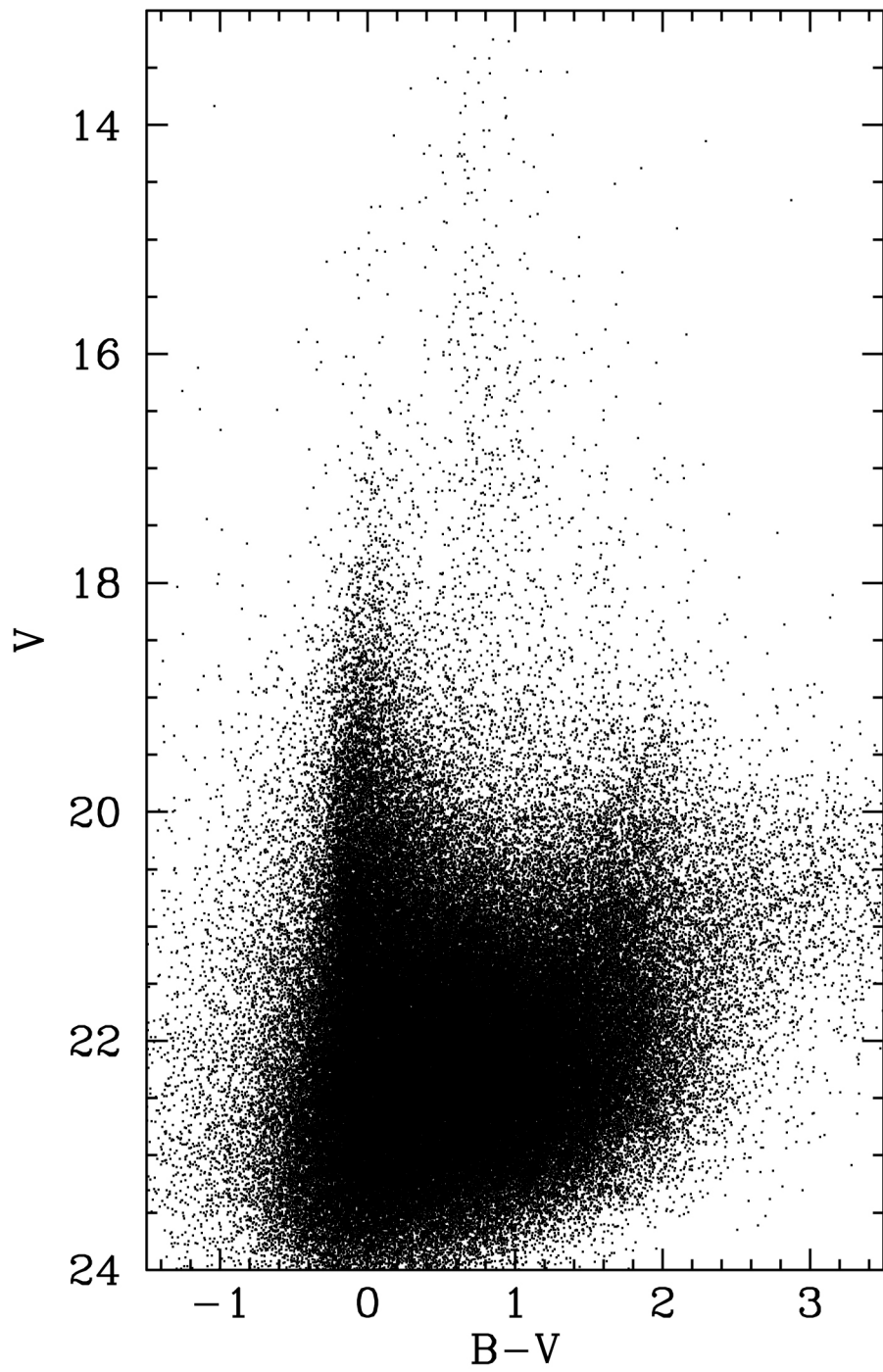


# WIYN+MiniMosaic survey of M33

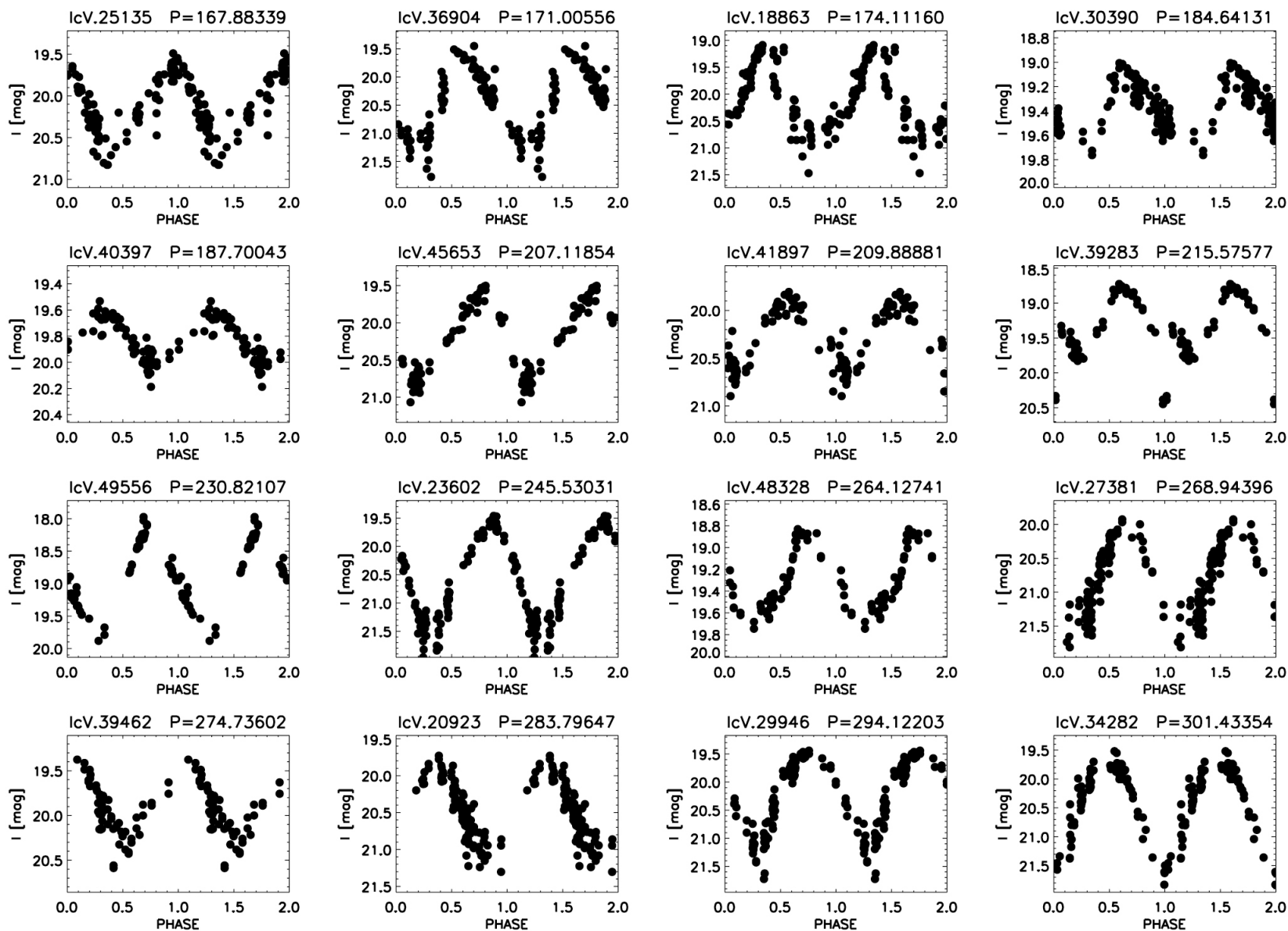
- 12 epochs in Fall of 2002 & 2003
- 15 MiniMosaic fields
- 60s in BVI (the operators loved me!)
- Follow-up to DIRECT survey
  - 100+nights over 4 years  
@ 1.2m with 1.3" seeing



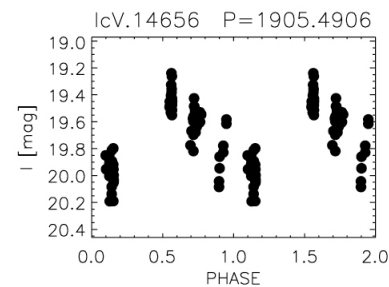
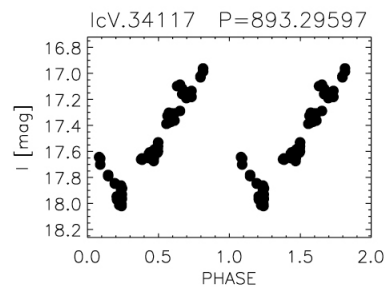
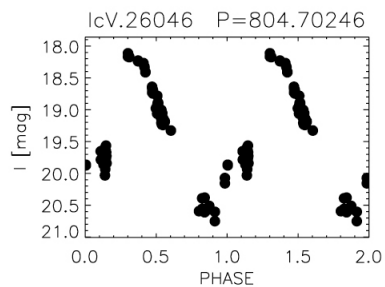
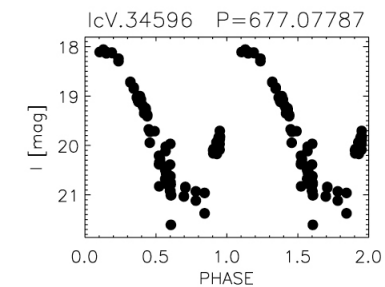
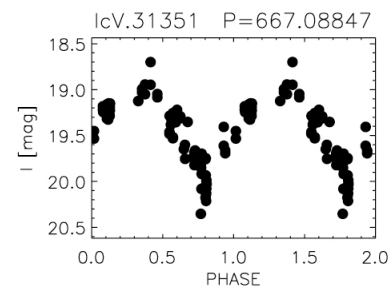
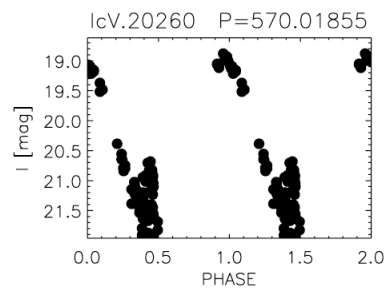
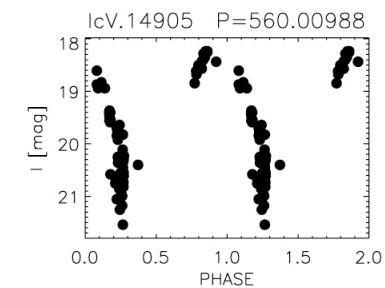
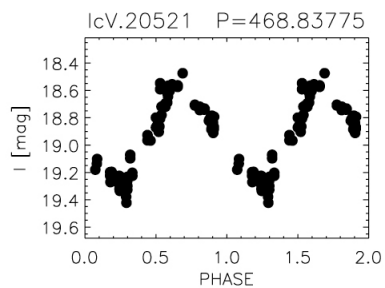
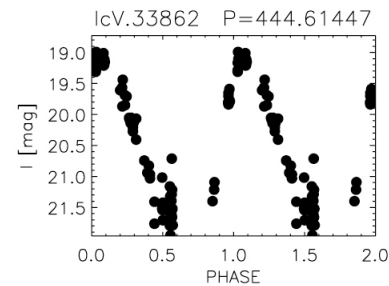
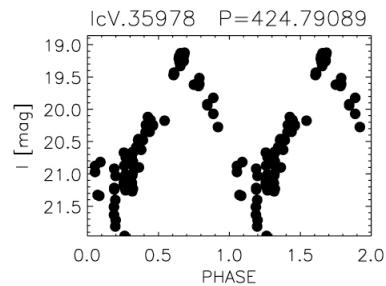
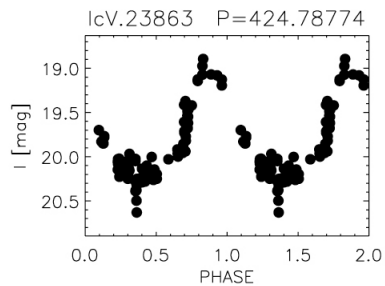
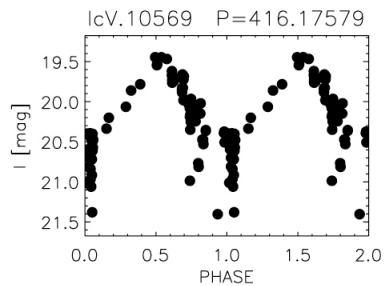
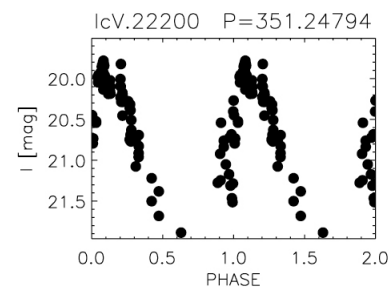
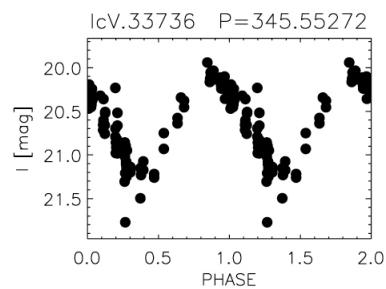
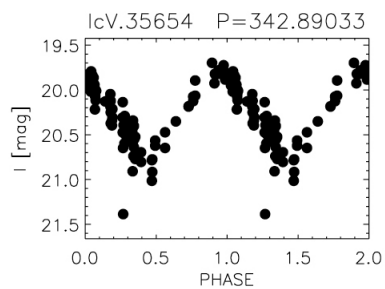
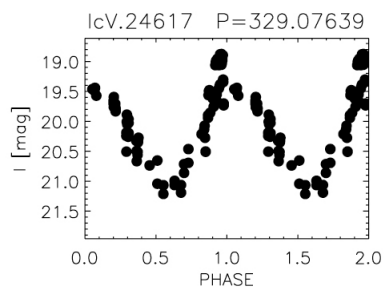
0.4°



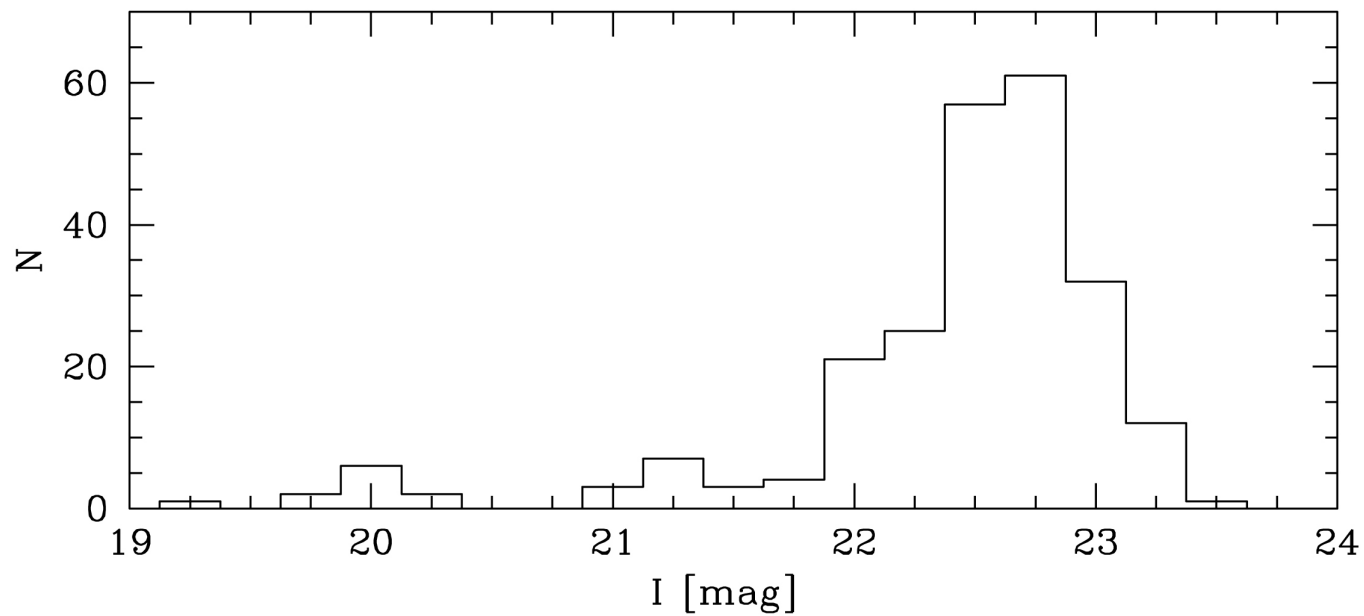
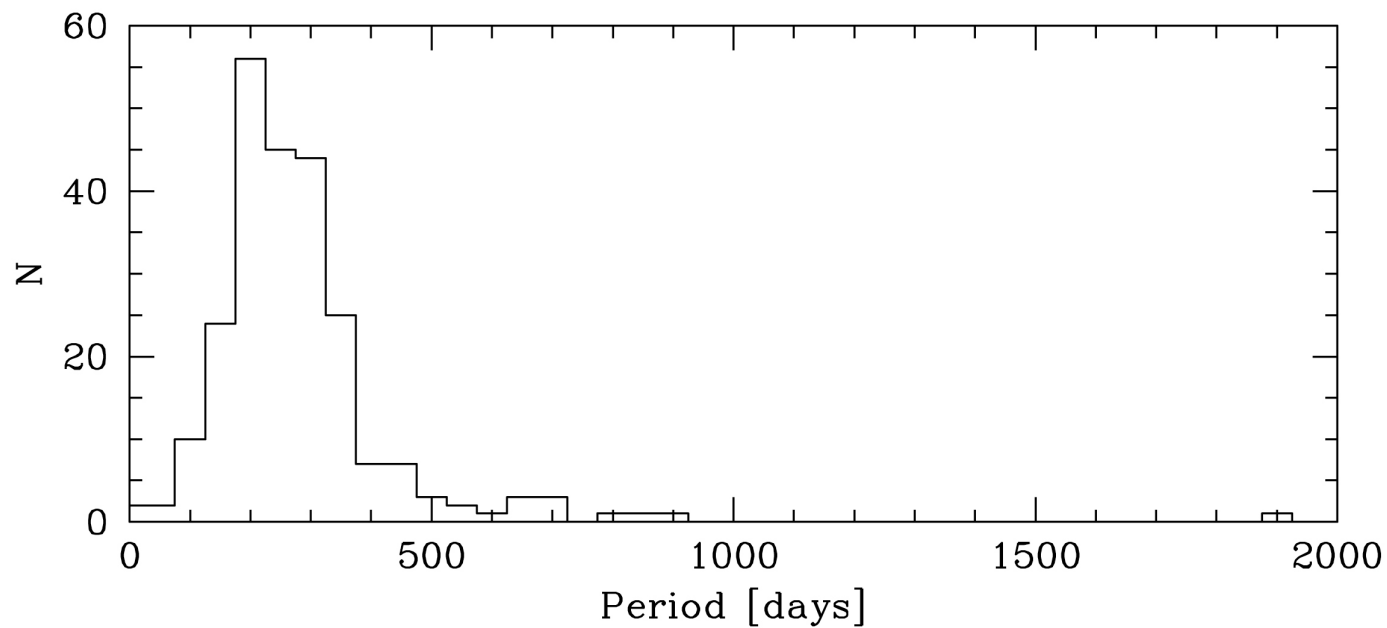
# LPVs in M33



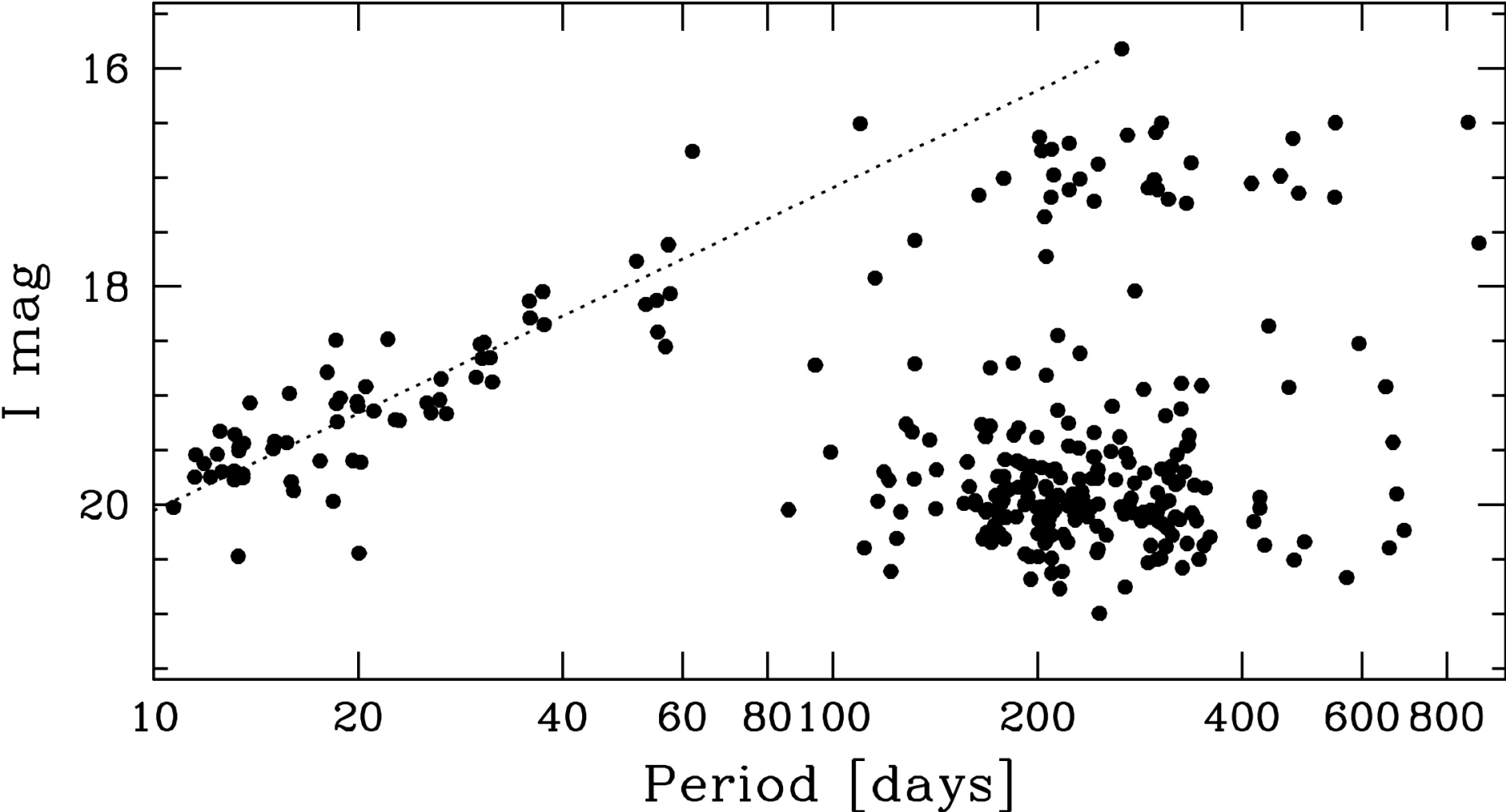
# LPVs in M33



Number of LPV Stars in m0b Field



# Preliminary I-band PLs (one field)





# Conclusions

- Shallow, synoptic survey of M31+M33
  - 5 min/epoch, 60 epochs over 3 years, 3 fields
  - ~ 6 nights total (propose through NOAO TAC)
  - Complete census of Cepheids, LPVs
  - Follow-up of selected fields at NIR with WHIRC
  - Searches for other variables, transients, echoes
  - Stacked images would reach HB in outskirts...