

Variability of Young Massive Stars in the Arches Cluster

Our goal

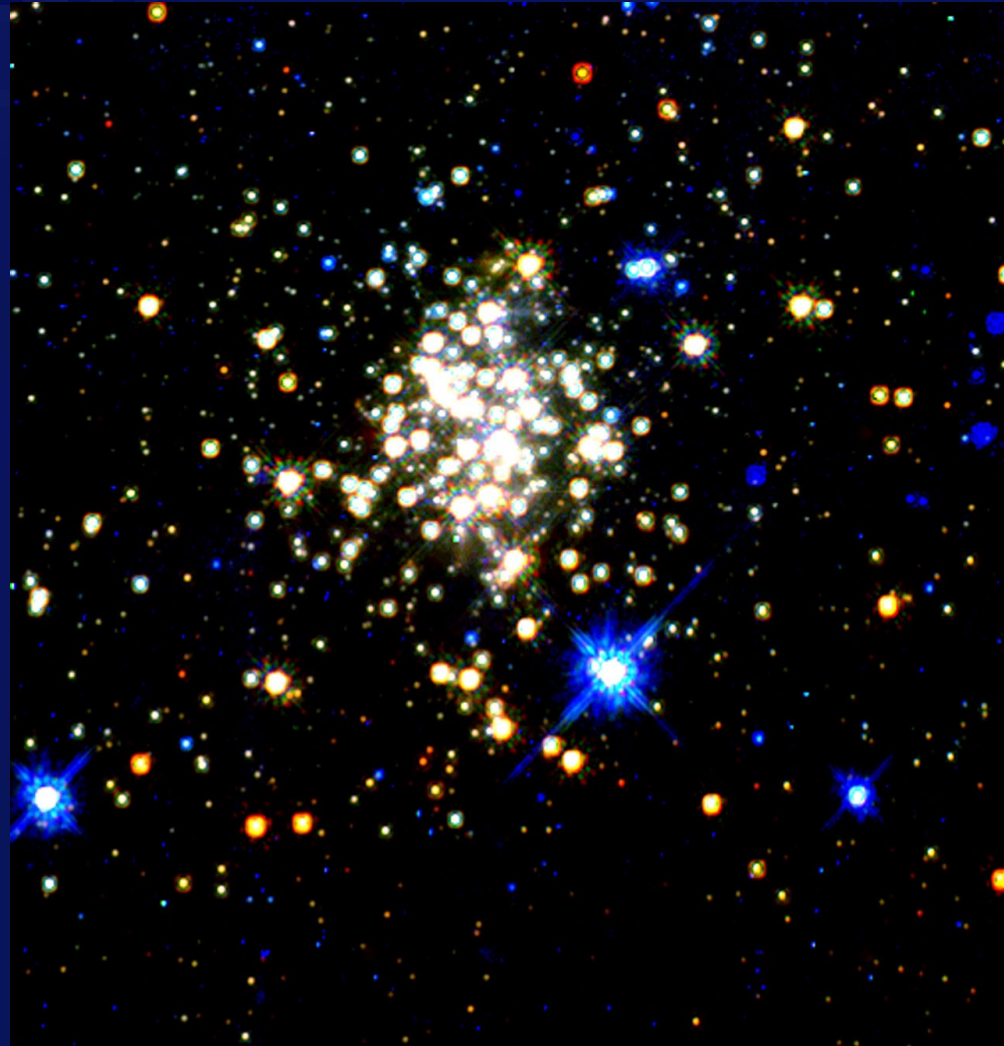
- ✓ Discover massive eclipsing binaries.
- ✓ Determine physical parameters with follow-up spectroscopy.
- ✓ Constrain star formation and evolutionary models.
- ✓ Discover an upper limit of the initial mass function.

Our laboratory

- ✓ Arches Cluster.

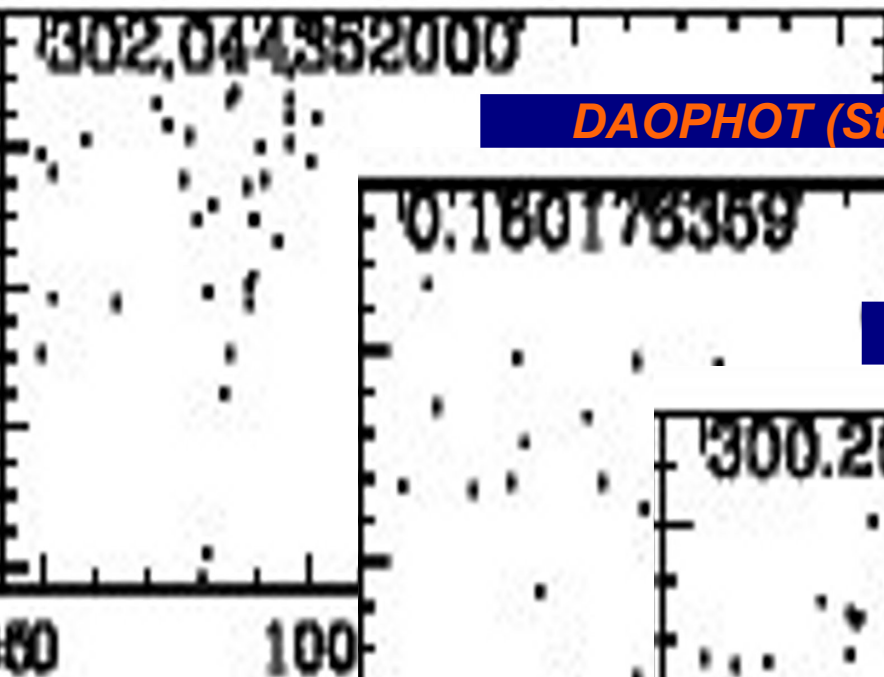
Challenges on the way

- ✓ Adaptive Optics data – Complex PSF structure.
- ✓ Mathematical PSF failed to model the stellar light profile.
- ✓ Empirical PSF is mandatory for accurate photometry.

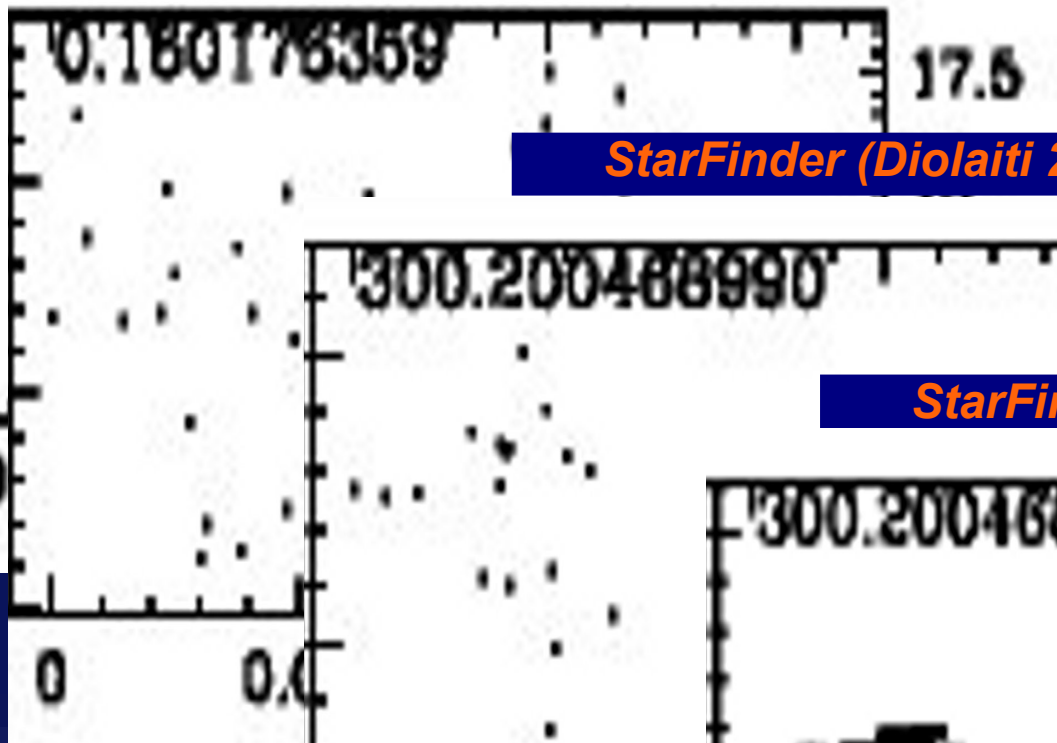


Light curves

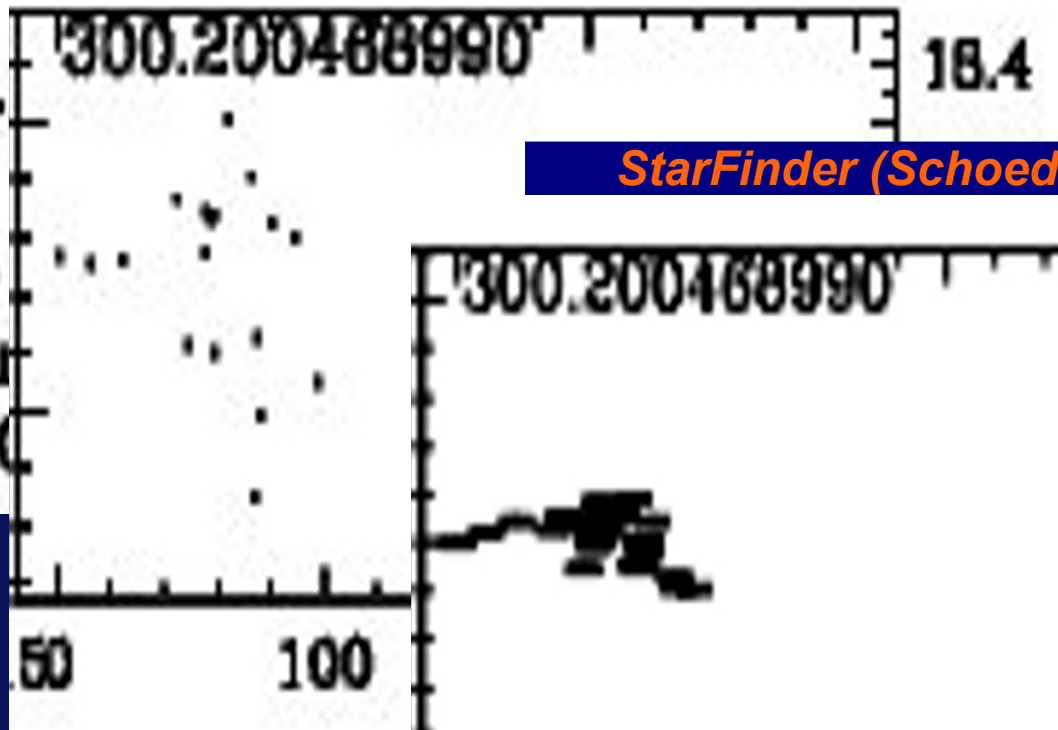
ISIS (Alard 2000)



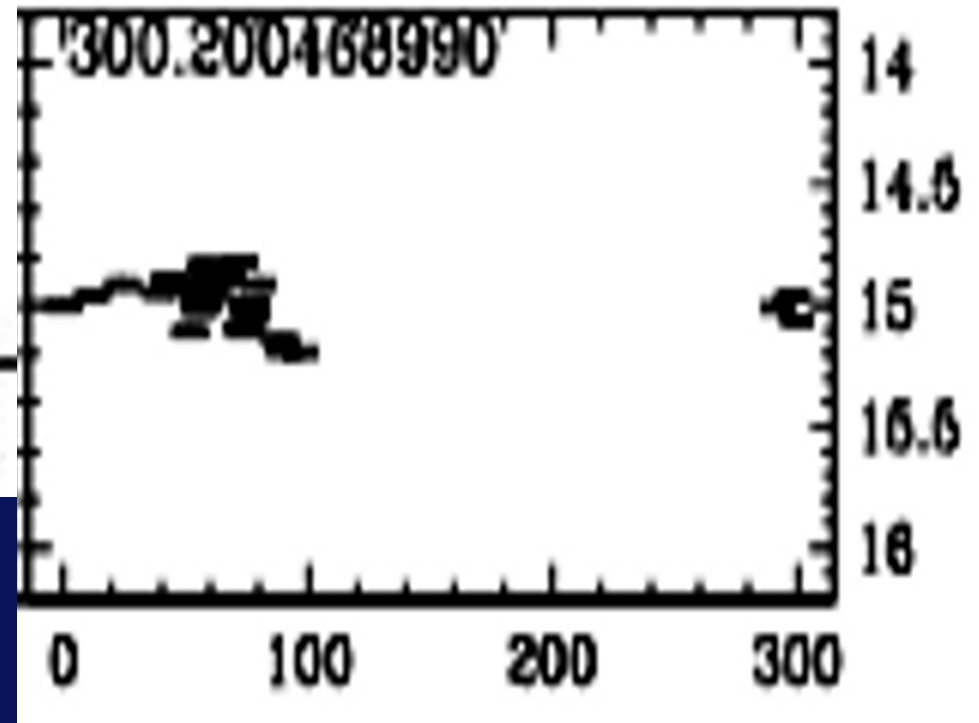
DAOPHOT (Stetson 1987)



StarFinder (Diolaiti 2000)



StarFinder (Schoedel 2010)



Are you curious????

Poster G06

Well in this case
you can start by
searching for
something that
looks like this...



Thank you

Variability of Young Massive Stars in the Arches Cluster

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Abstract

We present preliminary results of the first near-infrared variability study of the Arches cluster, using adaptive optics data from NRI/Gemini and NACO/VLT. The goal is to discover eclipsing binaries in this young (2.5 ± 0.5 Myr), dense, massive ($7 \times 10^4 M_{\odot}$) cluster for which we will determine accurate fundamental parameters with subsequent spectroscopy. Given that the Arches cluster contains more than 200 Wolf-Rayet and O-type stars, it provides a rare opportunity to determine parameters for some of the most massive stars in the Galaxy.

Data

- Two datasets in the Ks band.
- Gemini, NRI (April - July 2006).
- VLT NACO (June 2008 - March 2009).

Reduction

- NRI images with IRAF's NRI package.
- NRI Linearity problem.
- NACO images with the GPU (Common Pipeline Library).

Results

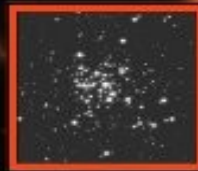
- The use of Adaptive Optics leads to a complex PSF structure.
- Programs that use a mathematical model for the PSF estimation fail to model such a complex PSF accurately.
- Deconvolution improves the deblending of very dense stellar fields as well as the photometric accuracy.
- We conclude that using an empirical PSF is mandatory for accurate photometry on AO data.
- We caution that any measurements resulting from photometry obtained with a mathematical model for the PSF on AO data may lead to large uncertainties.

Future work

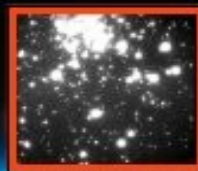
- Correction for possible contamination of our dataset with low quality individual exposure frames due to false AO operation.

Photometry

- ISIS (Alard & Lupton 1998). Mathematical PSF. 1 to 3 magnitude differences in the light curves.
- DAOPHOT (Stetson 1987). Mathematical PSF. 1 to 3 magnitude differences in the light curves.
- StarFinder (Dolaj 2000). Empirical PSF. Magnitude differences around 1 magnitude.
- Underestimated errors. Clear improvement.
- StarFinder (Schoedel 2010). Empirical PSF. Photometry of Wiener-deconvolved image. Local PSF feature. Underestimated errors. Magnitude difference will be below 1 magnitude. Further improvement.



VLT-NACO 20 sec exposure
Filter: Ks
(image scale: 27.3 x 27.2 arcsec)



Gemini-NRI 20 sec exposure
Filter: Ks
(image scale: 22.4 x 22.4 arcsec)

