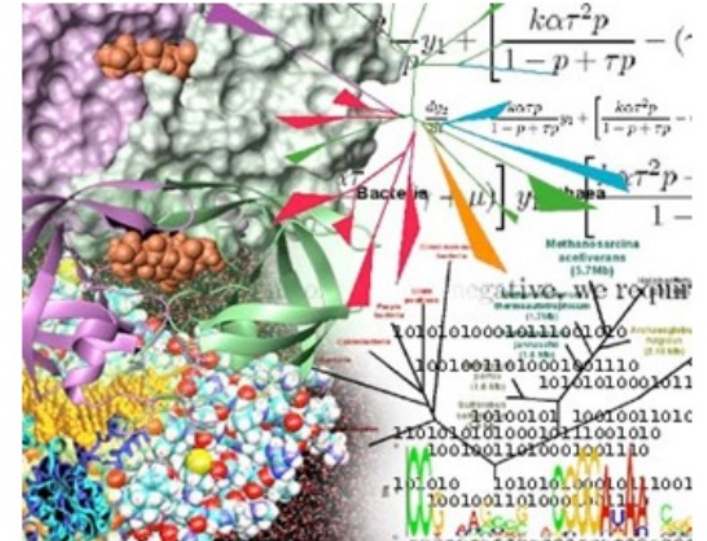# Variable Stars

An iPhone Database Project

Motivation

The Post-Genomic Era: Bioinformatics is a major scientific endeavor driving research in biomedical science and drug discovery.

The rise of survey astronomy: current and future wide-field surveys across the spectrum creating massive astronomical catalogues (and exciting opportunities for *in silico* discovery through data-mining).

GOAL: Create a generic framework for converting modest data sets (< 1 million records) into an app for the iOS platform (iPhone, iPod Touch, and iPad) that would enable searching, sorting, and viewing of data (with data analysis capability to follow).
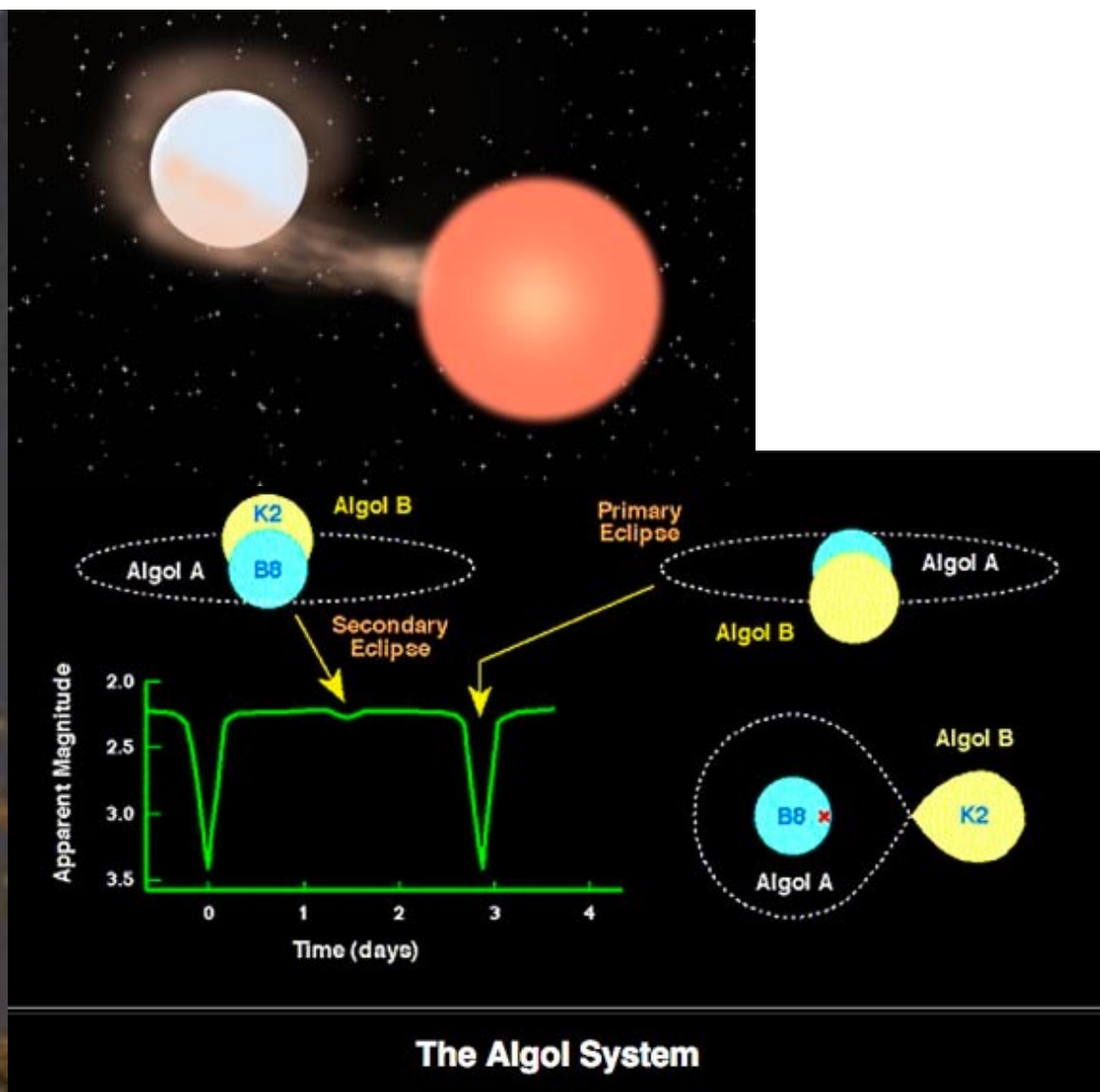
What are variable stars?

Variable stars are stars that vary in brightness.

There are many different kinds of variable stars.

Over 450,000 variable stars have been catalogued, most of them within the last 10 years.
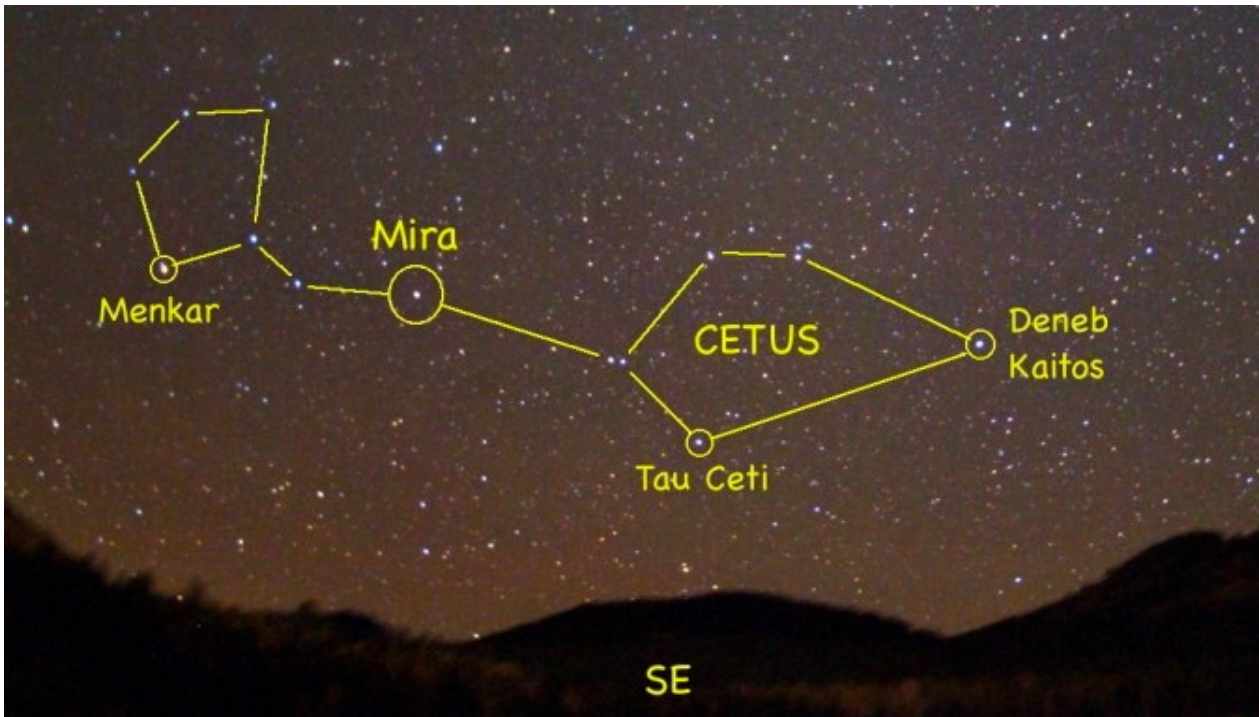
Algol – an eclipsing binary

The Algol System

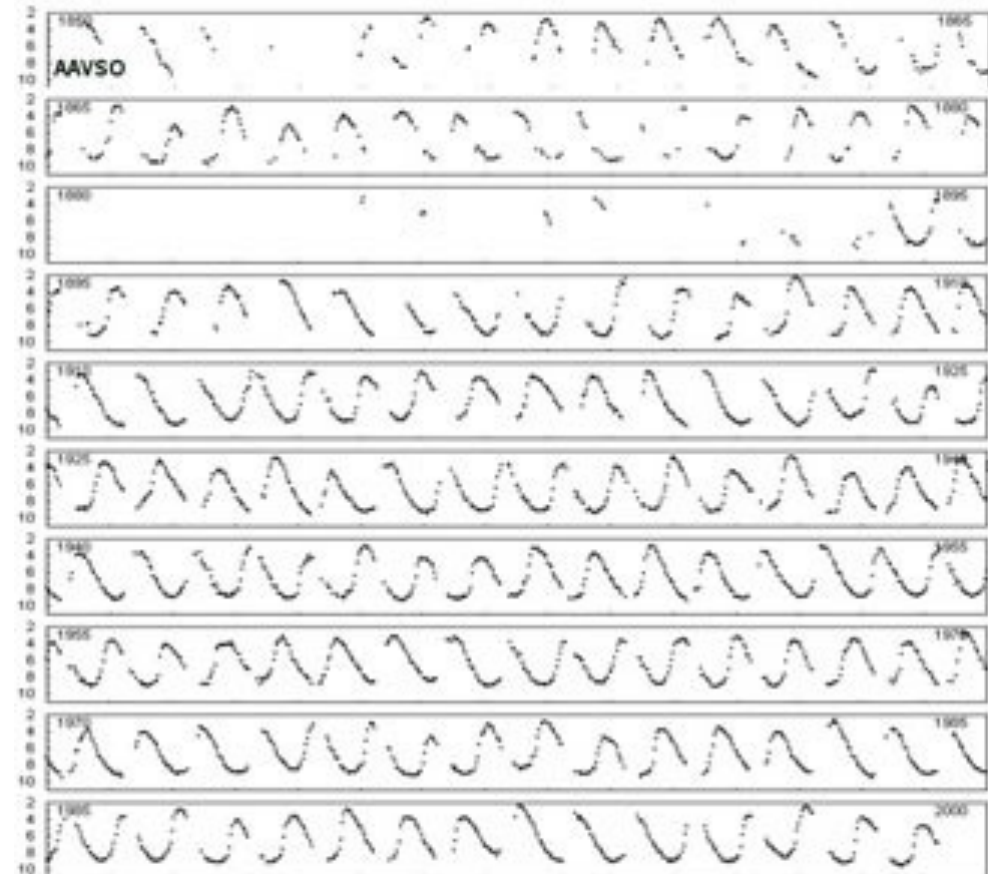# Omicron Ceti ("Mira") – Long Period Variable (LPV)

Range: 2.0 – 10.1
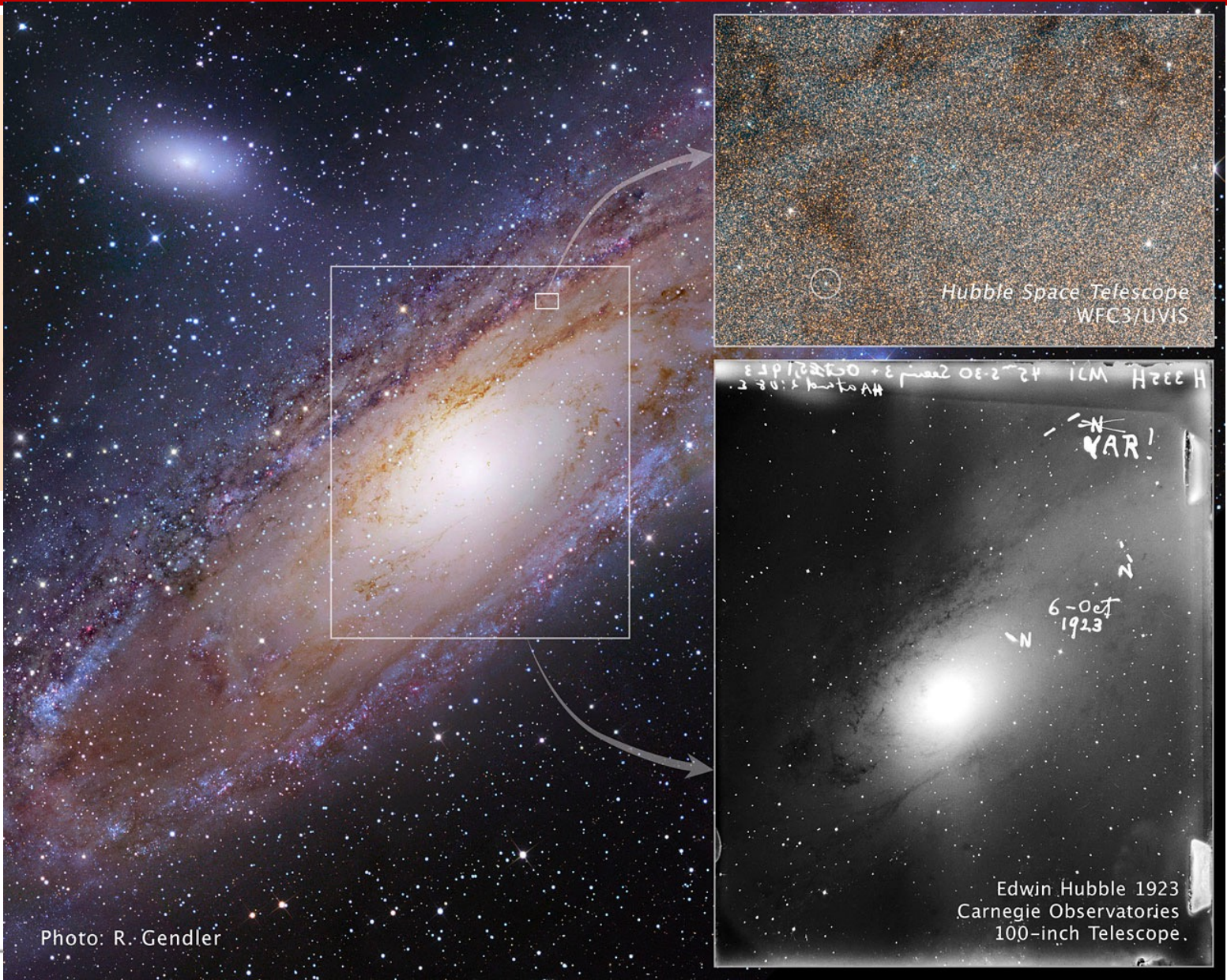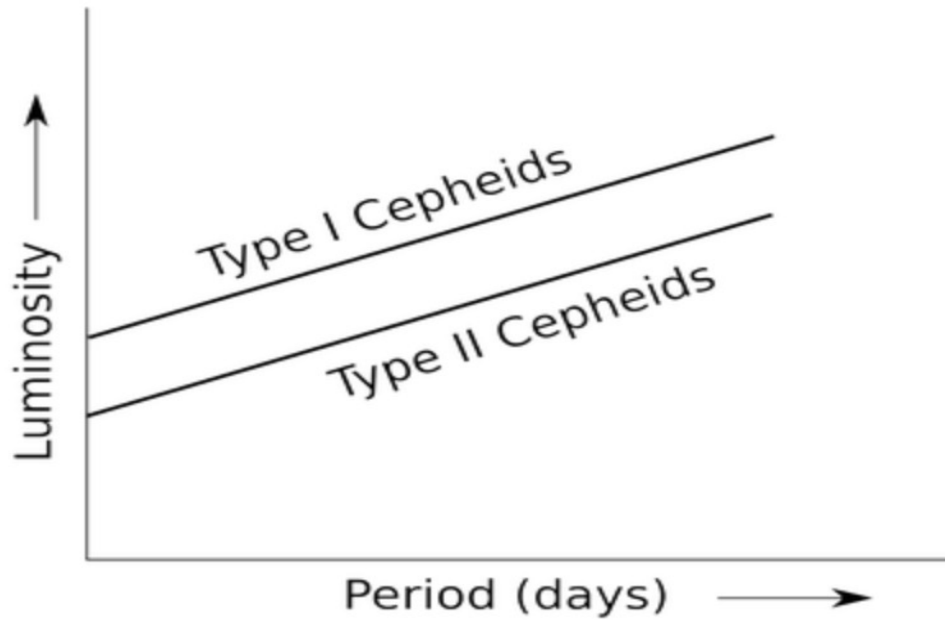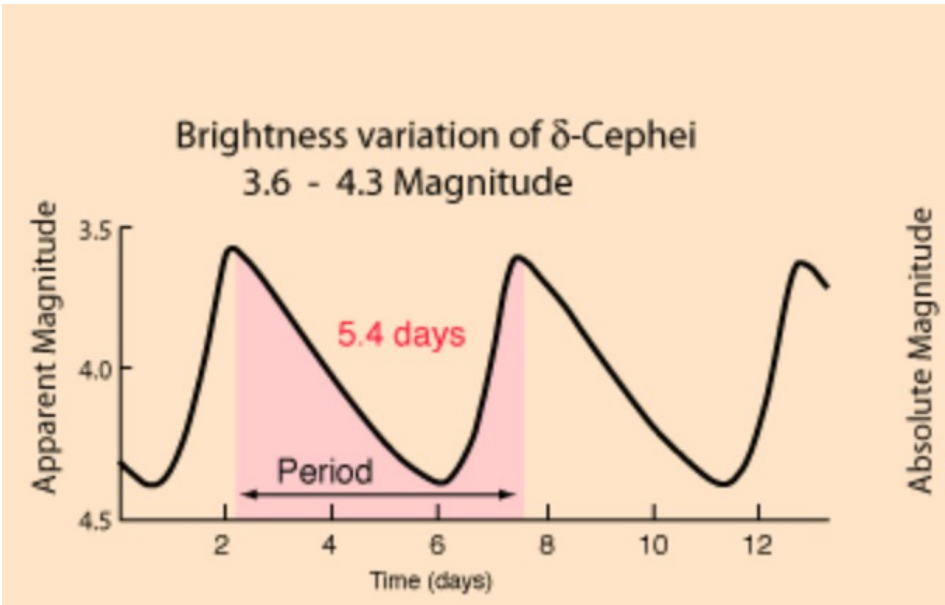Period: 332 days

Mira (LPV)
1850-2000 (10-day means)

Mira (omicron Ceti) is the prototype of pulsating long period variables and the first star recognized to have changing brightness. It has a period of 332 days. Generally, Mira varies between magnitudes 3.5 and 9, but the individual maxima and minima may be much brighter or fainter than these mean values. Its large amplitude of variation and its brightness make Mira particularly easy to observe.

Mira is one of the few long period variables with a close companion which is also variable (VZ Ceti).

AAVSO

Cepheid Variables – A Cosmic Yardstick
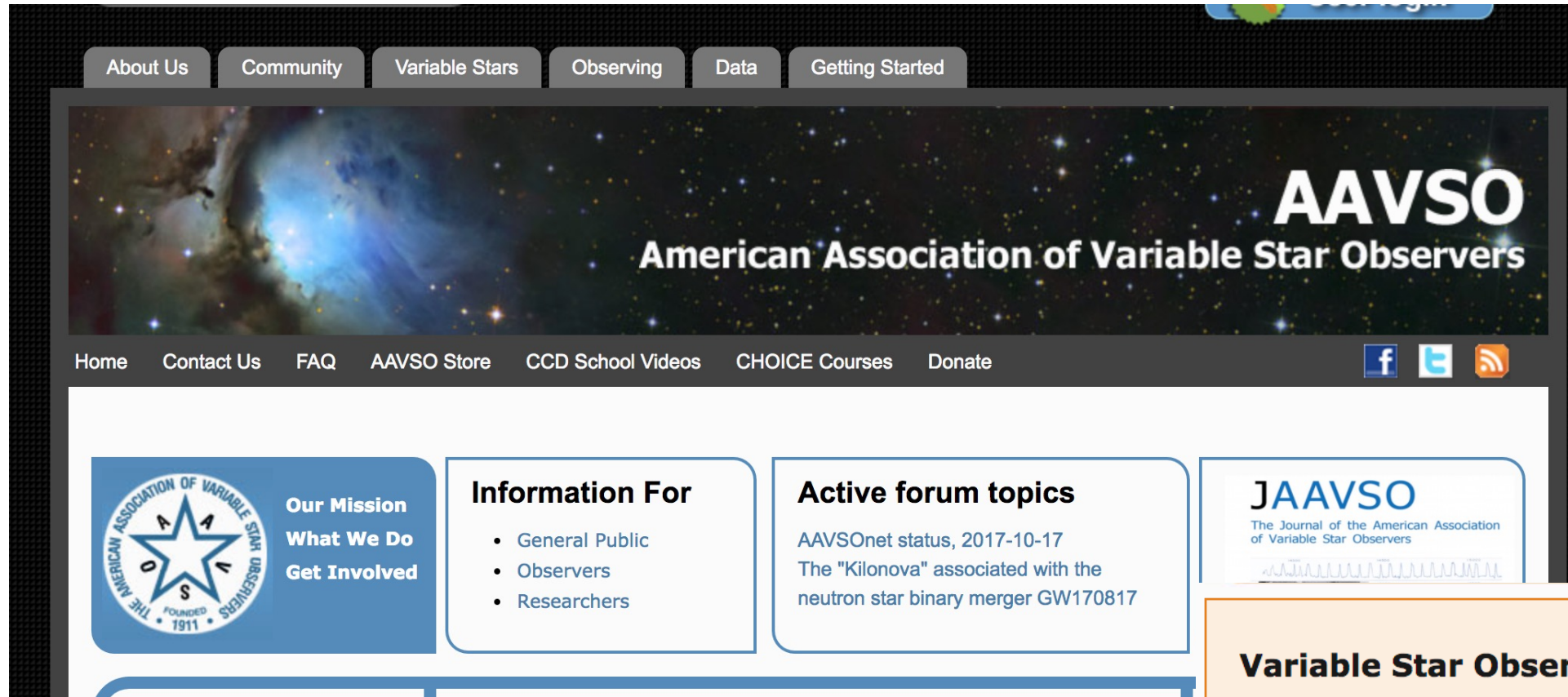
Brightness variation of δ-Cephei
3.6 - 4.3 Magnitude

5.4 days

Period

Type I Cepheids

Type II Cepheids

Hubble Space Telescope
WFC3/UVIS

VAR!

6-Oct
1923

Edwin Hubble 1923
Carnegie Observatories
100-inch Telescope.

Photo: R. Gendler

The AAVSO – www.aavso.org

Observing Variable Stars

XZ Cygni is an RR Lyrae type star, that pulsates with a period of 11.2 hours.

Its brightness ranges from 8.7 to 10.4 magnitude.

It climbs from minimum to maximum in about one hour.

XZ Cyg

Magn: 8.9 - 10.16 V
Period: 0.4666
Type: RRAB/BL
Spec: A5-F5

XZ Cyg
(2000) 19:32:29.31 +56:23:17.5

AAVSO Chart
X21289DH

FOV = 1.0°

Please use the photometry table for CCD observations.

https://www.aavso.org/vsp/

Copyright © 2017 AAVSO
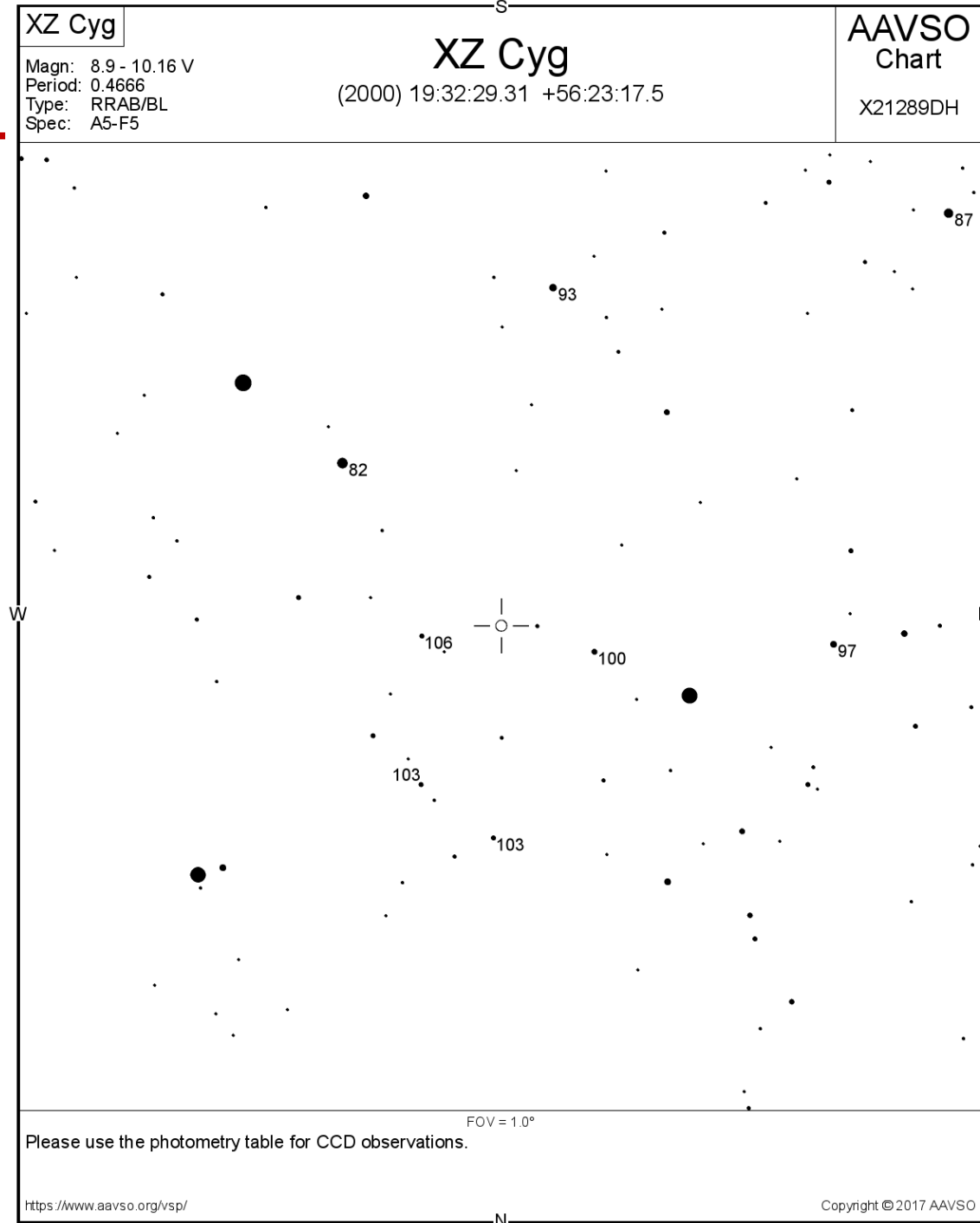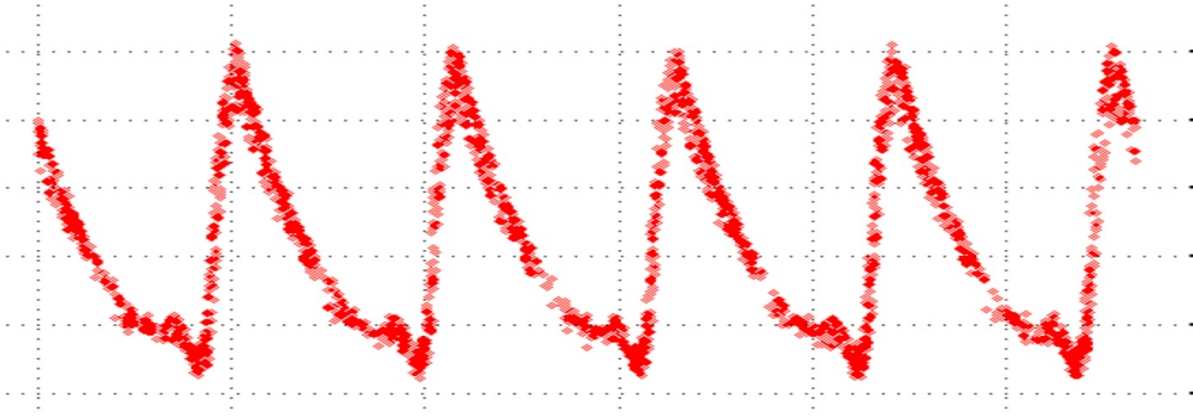
Centre de Données astronomiques de Strasbourg
Strasbourg astronomical Data Center

Fast Xmatch with large catalogs or Simbad

Target Name (resolved by Sesame) or **Position:**   Target dimension:

Clear [ ]   [J2000 ⇕]   [2] [arcmin ⇕]

⦿ Radius   ○ Box size

Search Criteria

Save in CDSportal

Keywords   [Back]

■ B/vsx/vsx

Tables   (Add)

| B/vsx |
| ..vsx |
| ..refs |
| ..vsx_id |

(Choose)

Preferences

max: [50]

[HTML Table ⇕]

☐ All columns

▼ Compute

☑ Distance ϱ

☐ Position angle θ

☐ Distance (x,y)

☐ Galactic

☑ J2000

☐ B1950

☐ Ecl. J2000

☐ default [≡]

⦿ Sort by Distance
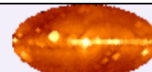
○ + order - ○

○ No sort

Position in:

⦿ Sexagesimal

○ Decimal °

		AAVSO International Variable Star Index VSX (Watson+, 2006-2014)	**Similar Catalogs**	2006SASS...25...47W	ReadMe+ftp
B/vsx		Post annotation			

1.B/vsx/vsx   Variable Star indeX, Version 2017-10-16 *(465200 rows)*

(Submit) (Reset All)

Query by Constraints ? **applied on Columns** *(Output Order:* ⦿ + ○ - *)*

Show	**Sort**	**Column**	(Clear)	**Constraint**	**Explain** *(UCD)*
☐	○	recno			Record number assigned by the VizieR team. Should Not be used for identification. (meta.record)
☑	○	OID			Internal identifier, can be used to link out to the VSX database *(Note 1)* (meta.id)
☑	○	n_OID		(char)	**B** indicates bibliography (in file " 👁 refs.dat"), **V** indicates an additional VSX name (in file vsx_id) (meta.ref.url)
☑	○	Name		(char)	Variable star identifier (meta.id;meta.main)
☑	○	V			[0,2] Variability flag *(Note 2)* (meta.note)
☑	○	Type		(char)	Variability type (see details of VSX type list) (meta.note;src.var)
☑	○	l_max		(char)	Limit flag on max (meta.code.error)
☑	○	max		mag	$^{(n)}$ Magnitude at maximum, or amplitude (phot.mag)
☑	○	u_max		(char)	Uncertainty flag on max (meta.code.error)
☑	○	n_max		(char)	Passband on max magnitude *(Note 4)* (meta.note)
☑	○	f_min		(char)	[(] '(' indicates an amplitude (meta.code)

☐   (Reset All)   (Clear) $^{(n)}$ indicates a possible blank or NULL column   (Submit)

Left screen:

iPad   10:20 PM   68%

Home   **About**

Introduction   Observing

Types   Database

User Manual   Resources

AAVSO   Diatom Software

Catalog   Favorites   Visibility   Preferences   About   1x

Right screen:

iPad   10:20 PM   68%

Home   **About: Types**

Variability Types

The following type descriptions are as defined by the General Catalogue of Variable Stars (GCVS) which was the foundation for the AAVSO's International Variable Star Index (VSX) used in this application. Compiled by the Sternberg Astronomical Institute in Moscow, the GCVS remains one of the leading resources for variable star information. (We thank Dr. Nikolai Samus and the GCVS Research Group for permission to include their variable type descriptions in this app.)

Reference: N.N. Samus, et al., General Catalogue of Variable Stars. (Samus+ 2007-2009), 2009yCat....102025S

Catalog   Favorites   Visibility   Preferences   About   1x

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Filtering

- Meta-data defines whether you can filter on a particular column, and how (**Multi-Select, Numeric, Boolean**)

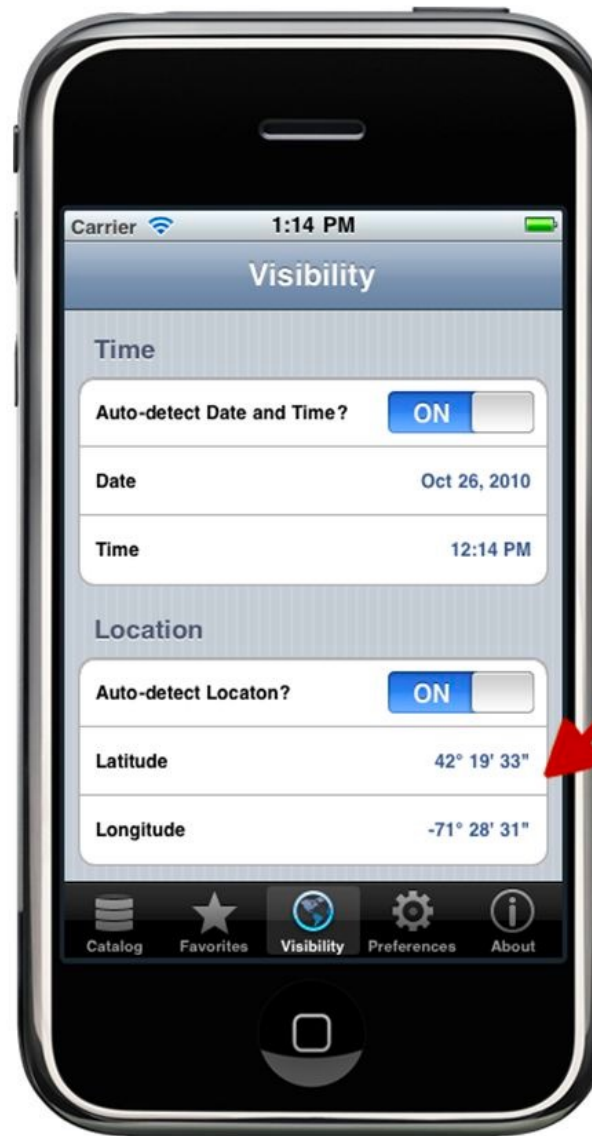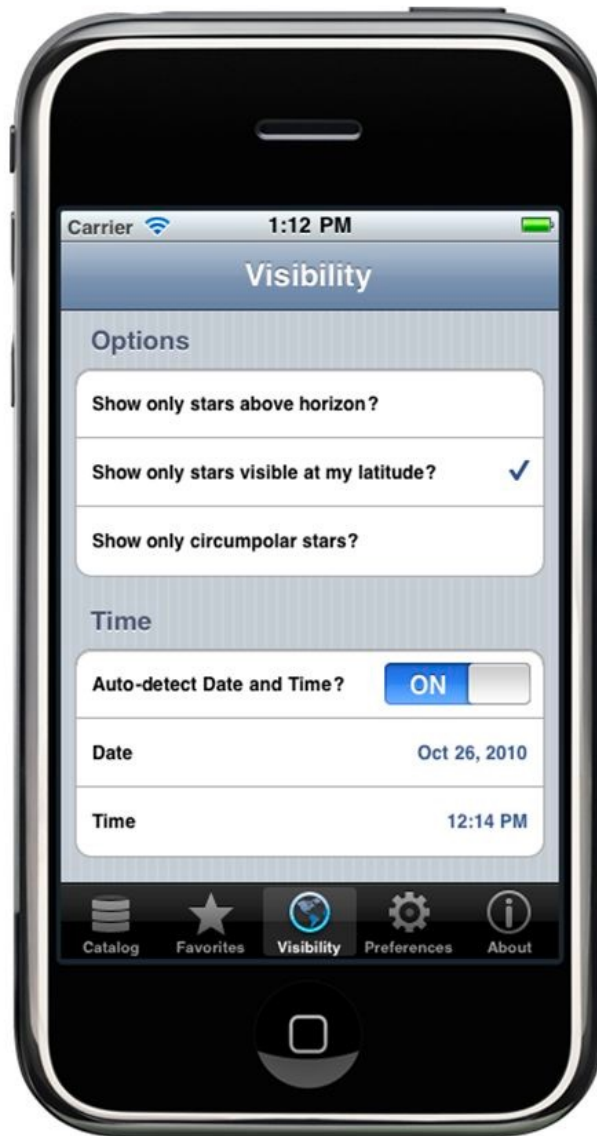- Number of hits is automatically updated
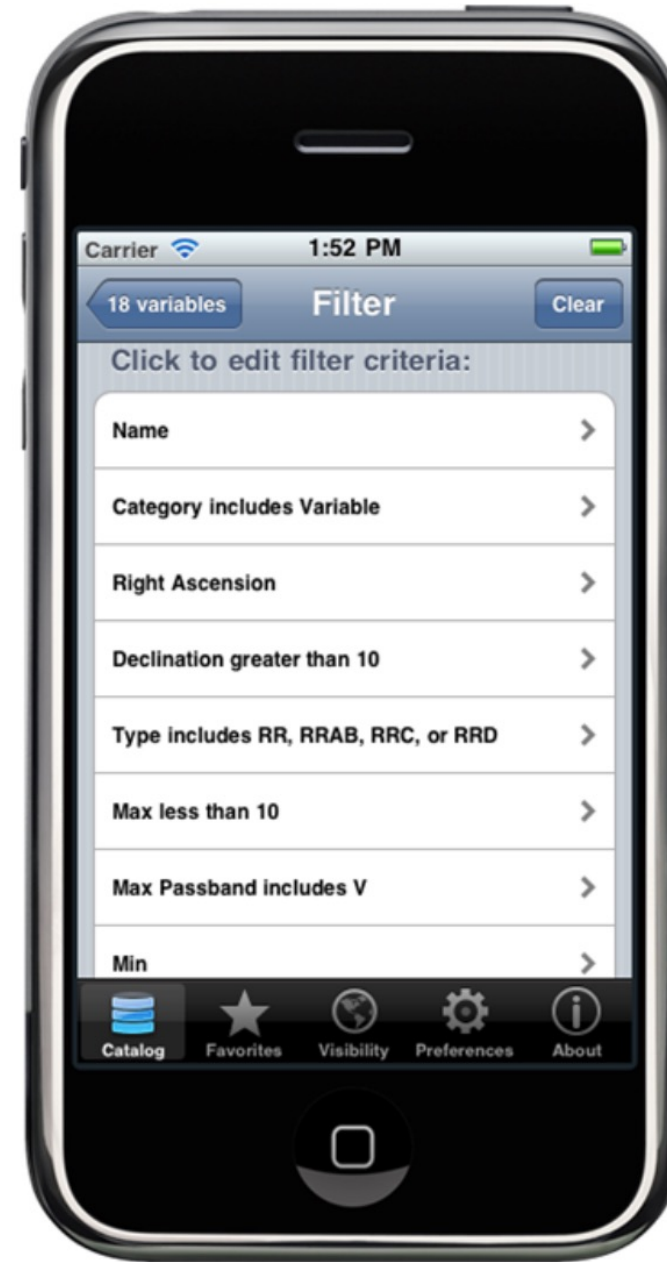
Sorting

- Sortable fields are defined in meta-data

- Ascending/Descending/Off

- Drag to reorder
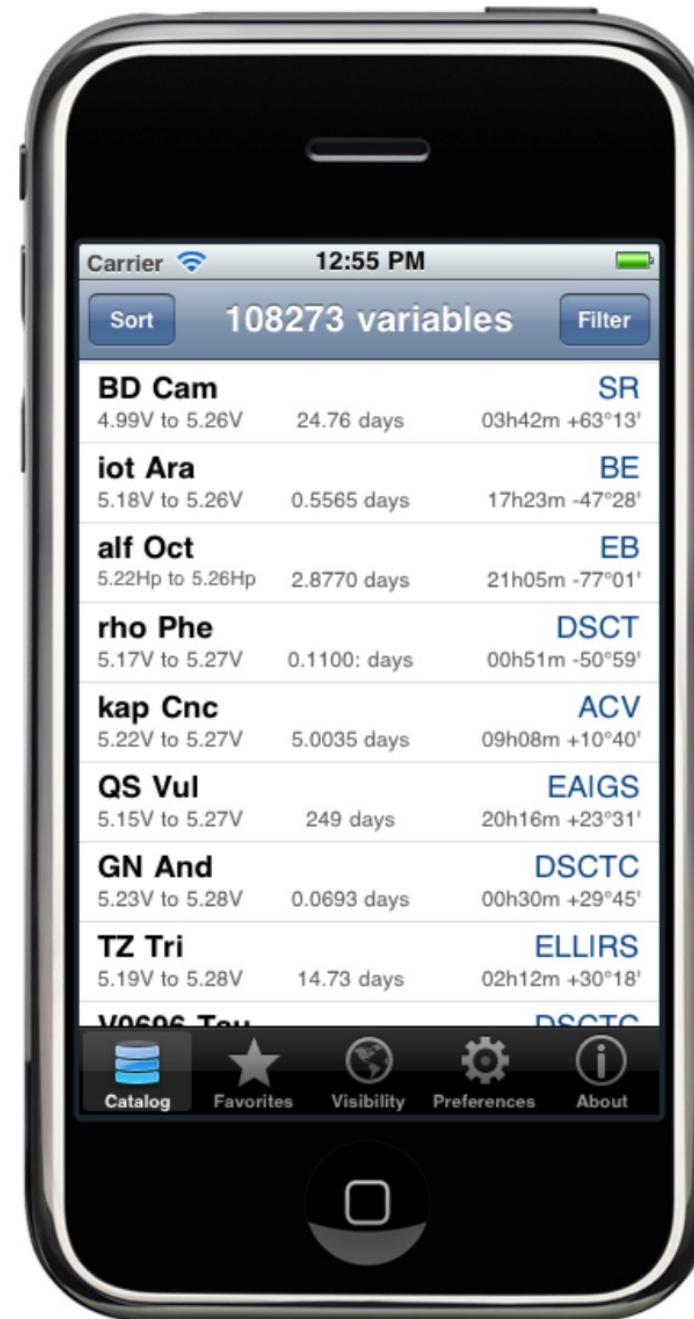
Visibility: Astronomical Extensions

Where to find
me on a clear night!

Northeastern Ur

Viewing matches

- The summary table provides a sorted list of all matching variables

- Key information displayed: name, type, range, period, position

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Project Significance

- Created a metadata-driven framework for querying small to mid-sized datasets on the Apple iOS platform

- Provided research support for variable star observers and amateur astronomy enthusiasts. This citizen science effort, in turn, supports professional research in astrophysics and cosmology.

- Learned how to build and deploy iOS applications on the Apple Store, and gained insight on the market demand for free vs. paid apps. (Free apps get 10-100x more downloads!)