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FOR ASTROPARTICLE  
PHYSICS



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# *The Bamberg photographic plate archive*

## *The digitizing project*

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Germany

# Bamberg Southern Photographic

## Patrol Survey (Strohmeier 1963)

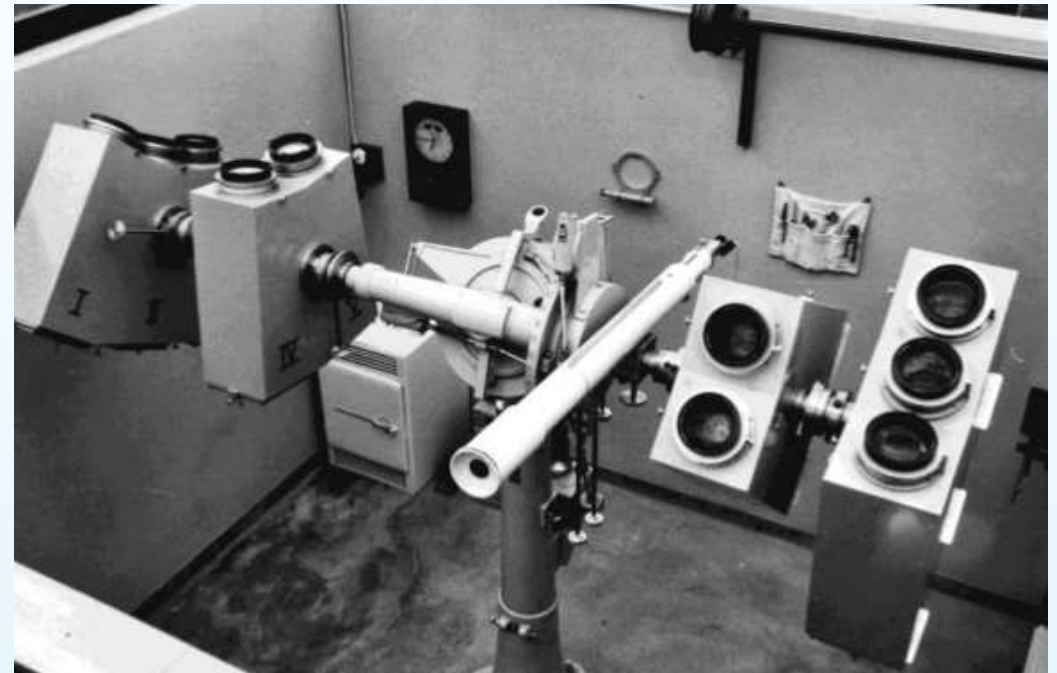


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- Boyden, South Africa, 1963-1976  
aim: search for variable stars  
→ 22,000 plates
- direct images,  $B \leq 14.5\text{mag}$ ,  
 $16\text{cm} \times 16\text{cm} = 14^\circ \times 14^\circ$
- very homogenous sample  
(22 identical wide field cameras)
- **all southern data from this time  
is primarily based on this survey**



Astrograph, Boyden

# Need for Preservation



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- **historian's point of view:**
  - oldest plates at Bamberg from 1910s
  - photographic emulsions already begin to decompose and dissolve from their glass plates
- **scientist's point of view:**
  - former results using blink comparator
    - **1.736** Bamberg variables (e.g. Strohmeier & Knigge 1961, Friedrich & Schöffel 1971, Knigge & Sosna 1977)
  - only a fraction of observed plates have been looked on (each field has several dozen images)

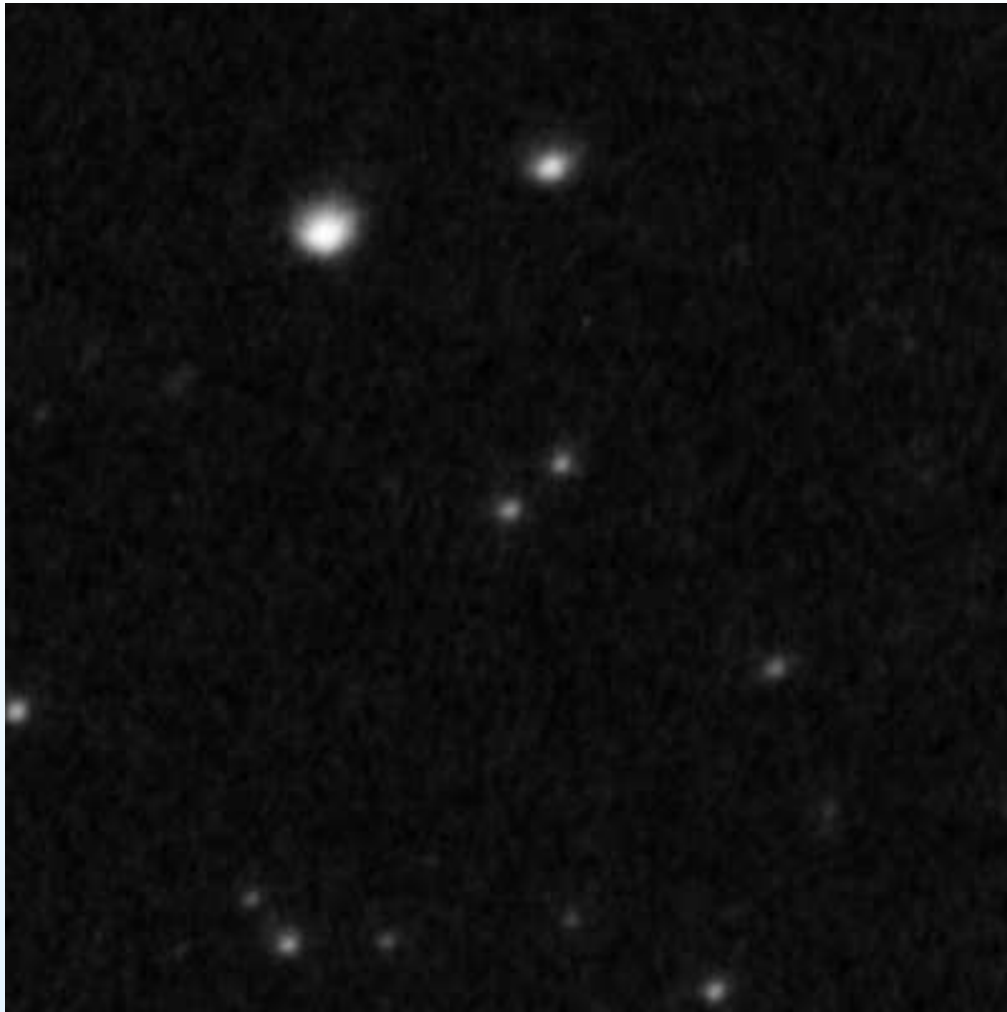
# Need for Preservation



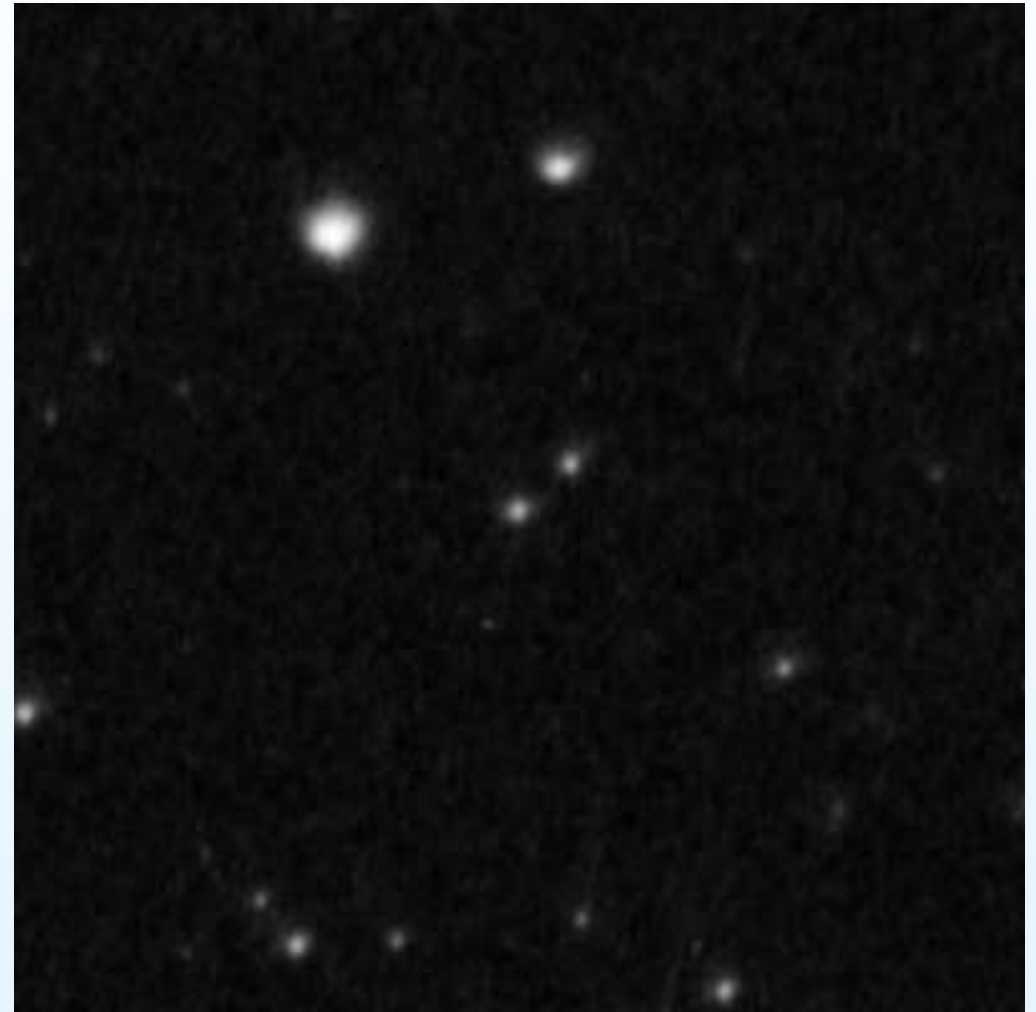
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1963 July 16



1963 July 23

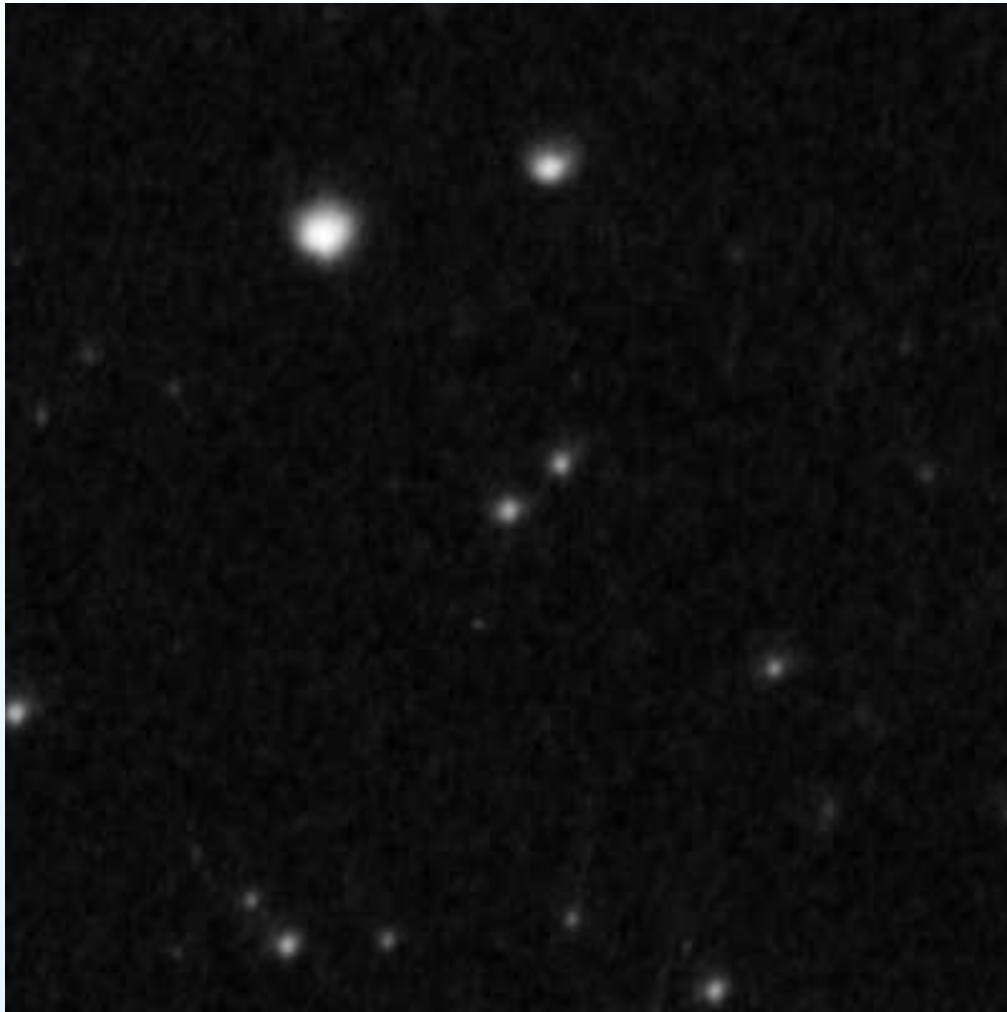
# Need for Preservation



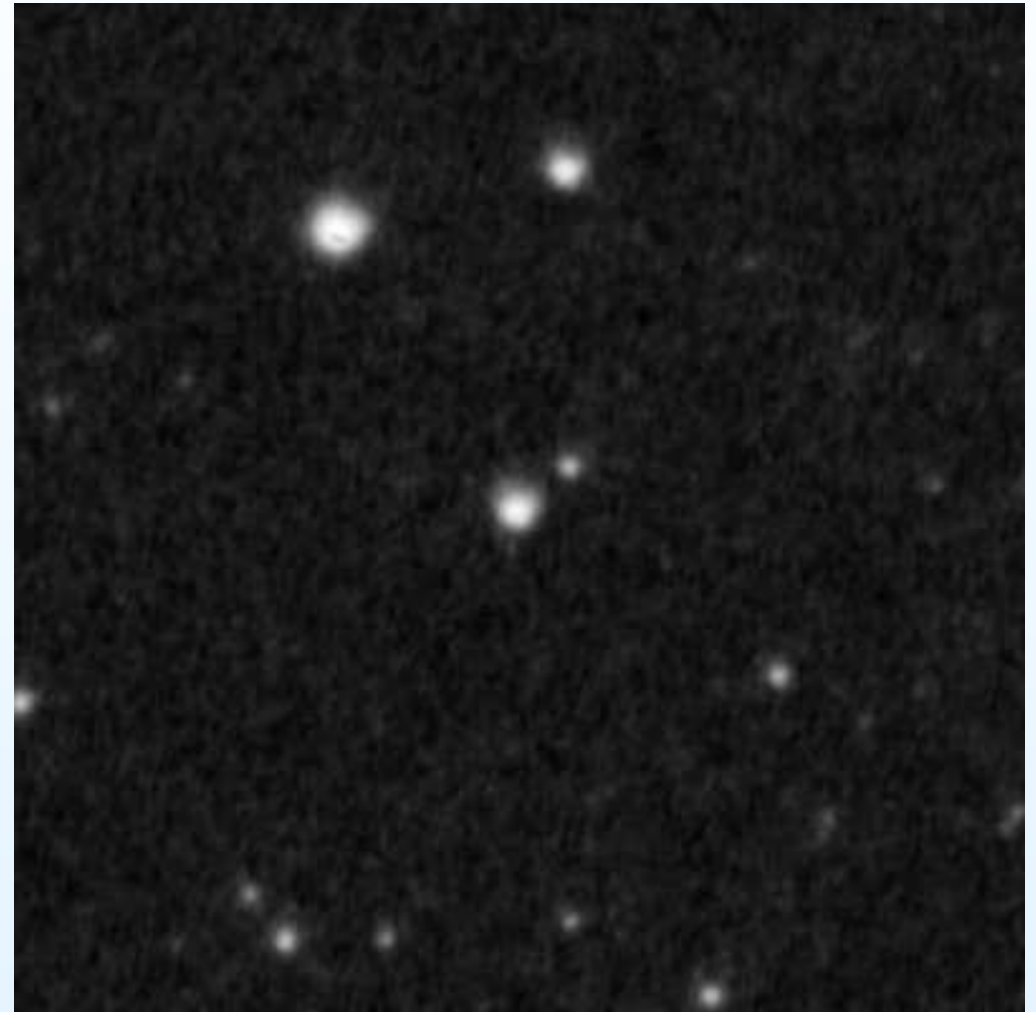
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1963 July 23



1964 May 13

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- **25.000 - 200.000** stars on one plate
  - **1.736** Bamberg variables → just '**tip of the iceberg**'
  - equipment became affordable  
→ large amount of storage space
  - give access to the community (Virtual Observatory)
- ⇒ **digitizing project** (DFG funded)
- in collaboration with the Leibniz Institute for Astrophysics at Potsdam (AIP) and the Hamburg Observatory

# Metadata



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- **12 years ago:**

start of project to incorporate all metadata into Wide-Field Plate Database

(Tsvetkov et al. 2005,

Tsvetkova et al. 2006)

→ [www.skyarchive.org](http://www.skyarchive.org)

OBJECT		No.	hial 4274
R.A.	17 <sup>h</sup>	DECL.	-38 <sup>m</sup>
EMULSION	Perutz-A410	DATE	1964 June 2
FILTER		SID. TIME	16. <sup>03</sup> -17. <sup>03</sup>
OBSERVER	Wuyts	U.T.	21. <sup>33</sup> -22. <sup>33</sup>
SKY COND.	clear, moon	J.D.	2438549,488
REMARKS		QUALITY	1



# Scan



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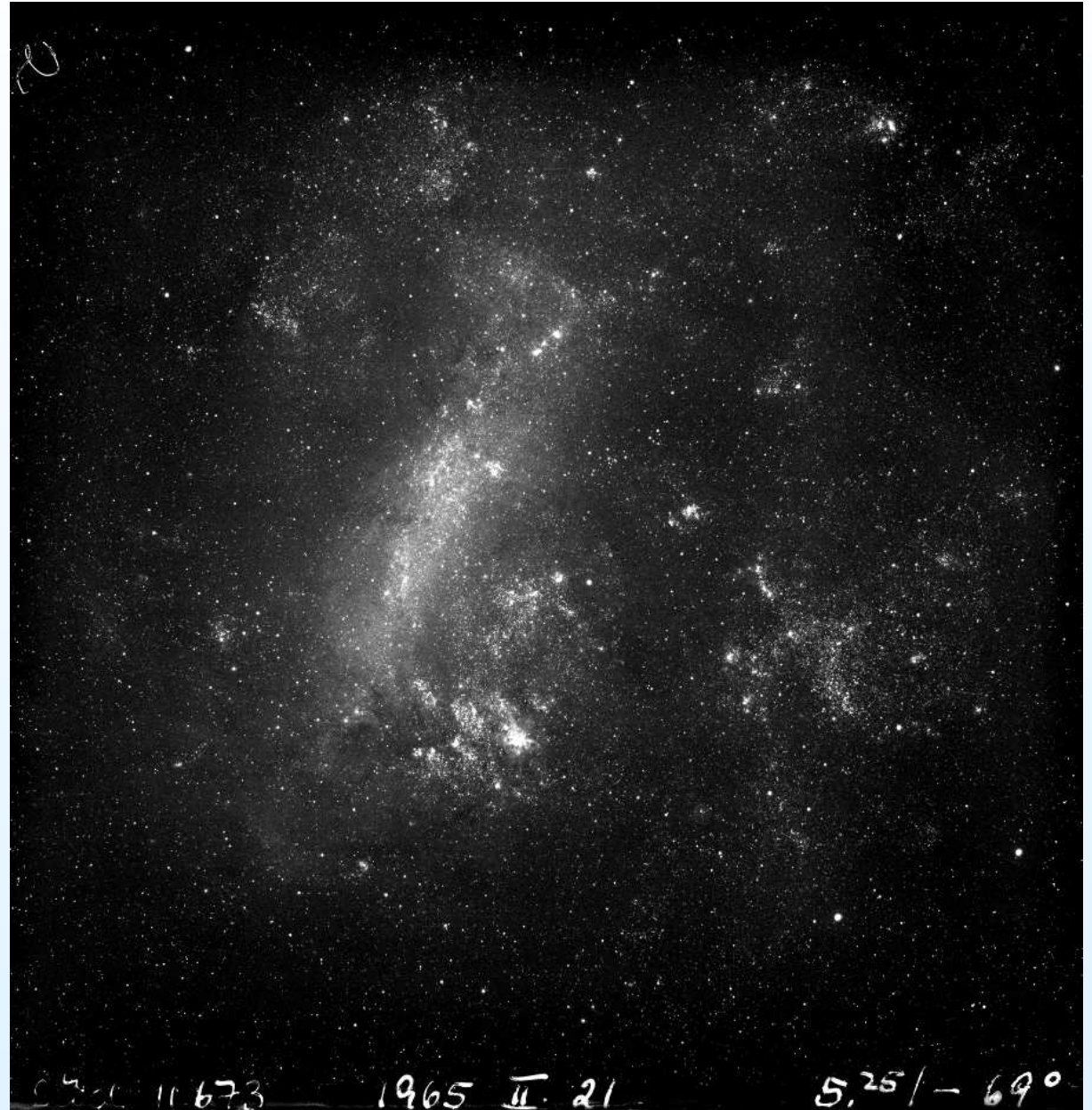


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- flatbed scanner:  
EPSON Expression 10000XL
  - each scan (per plate):
    - resolution:  
 $2.400 \text{ dpi} = 10 \mu\text{m}$   
 $= 3''.6/\text{pix}$
    - duration: 5 minutes
    - size: 400 MByte

⇒ so far: >10,700 scans







- implementation in **APPLAUSE** database  
(**A**rchive of **P**hotographic **P**lates for **A**stronomical **U**SE)
    - all scanned data (inclusive logbooks)  
+ metadata
    - FITS-header (Wide-Field Plate Database)
    - storage, web based interface
- Leibniz Institute for Astrophysics at Potsdam (AIP)
- **next talk (T. Tuvikene)**



- **Astrometry**

- PyPlate (SExtractor, astrometry.net, SCAMP)

$x, y \rightarrow \text{RA, DEC}$

$\rightarrow$  **next talk (T. Tuvikene)**

- $\langle \text{RA, DEC} \rangle = \pm 2''$  (note: scan resolution =  $3''.6$  / pix)

$\rightarrow$  better than expected

$\rightarrow$  search for e.g. asteroids, comets

- **Photometry**

- SExtractor  $\rightarrow$  relative magnitudes (using Zero point value)

- calibration: catalog (Tycho2/UCAC4)  $\rightarrow$  magnitudes

(Høg et al. 2000, Zacharias et. al. 2013)

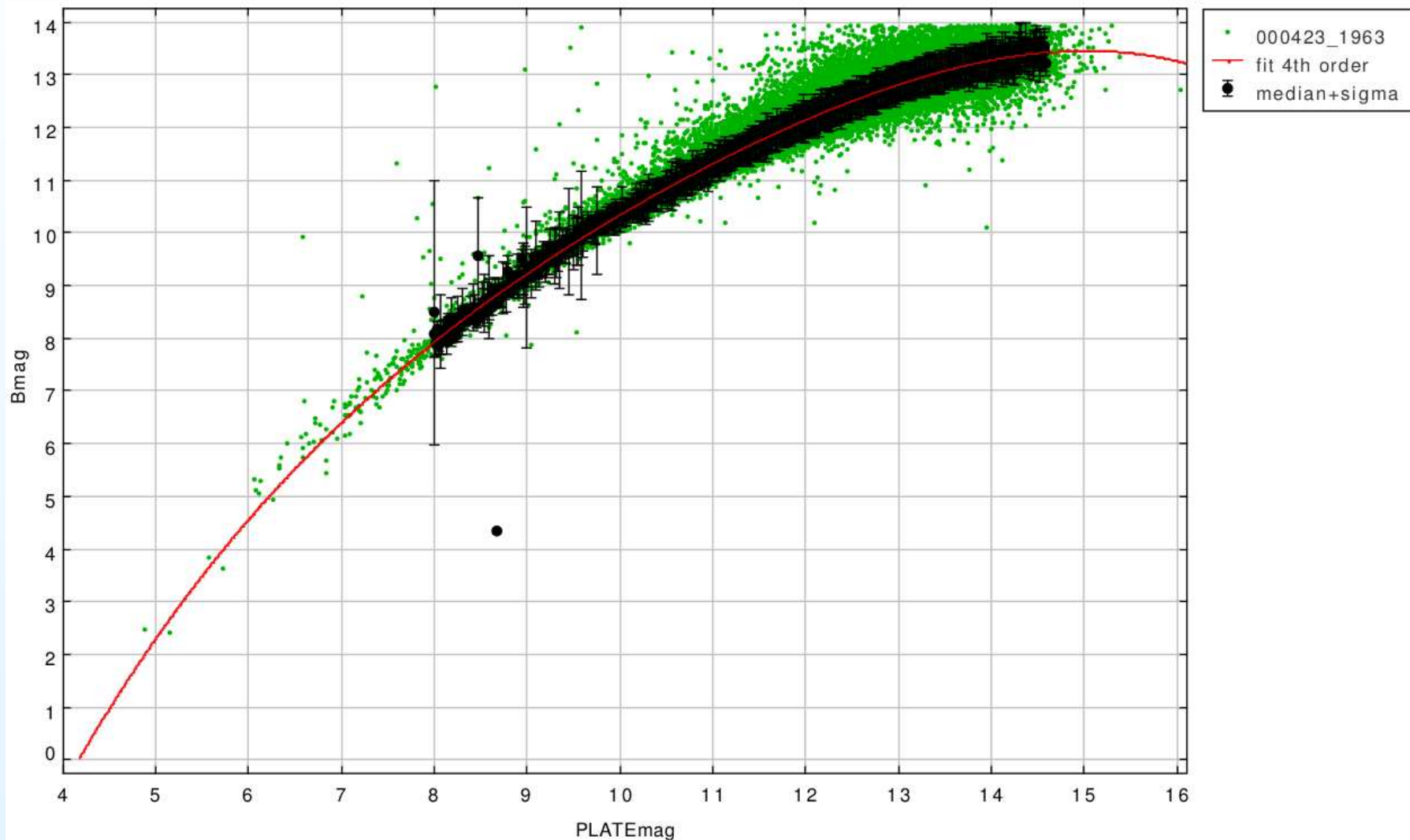
# Scientific Investigations



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Platte vs. Tycho2 ( $B \leq 10.0\text{mag}$ ) / UCAC4 ( $B > 10.0\text{mag}$ )

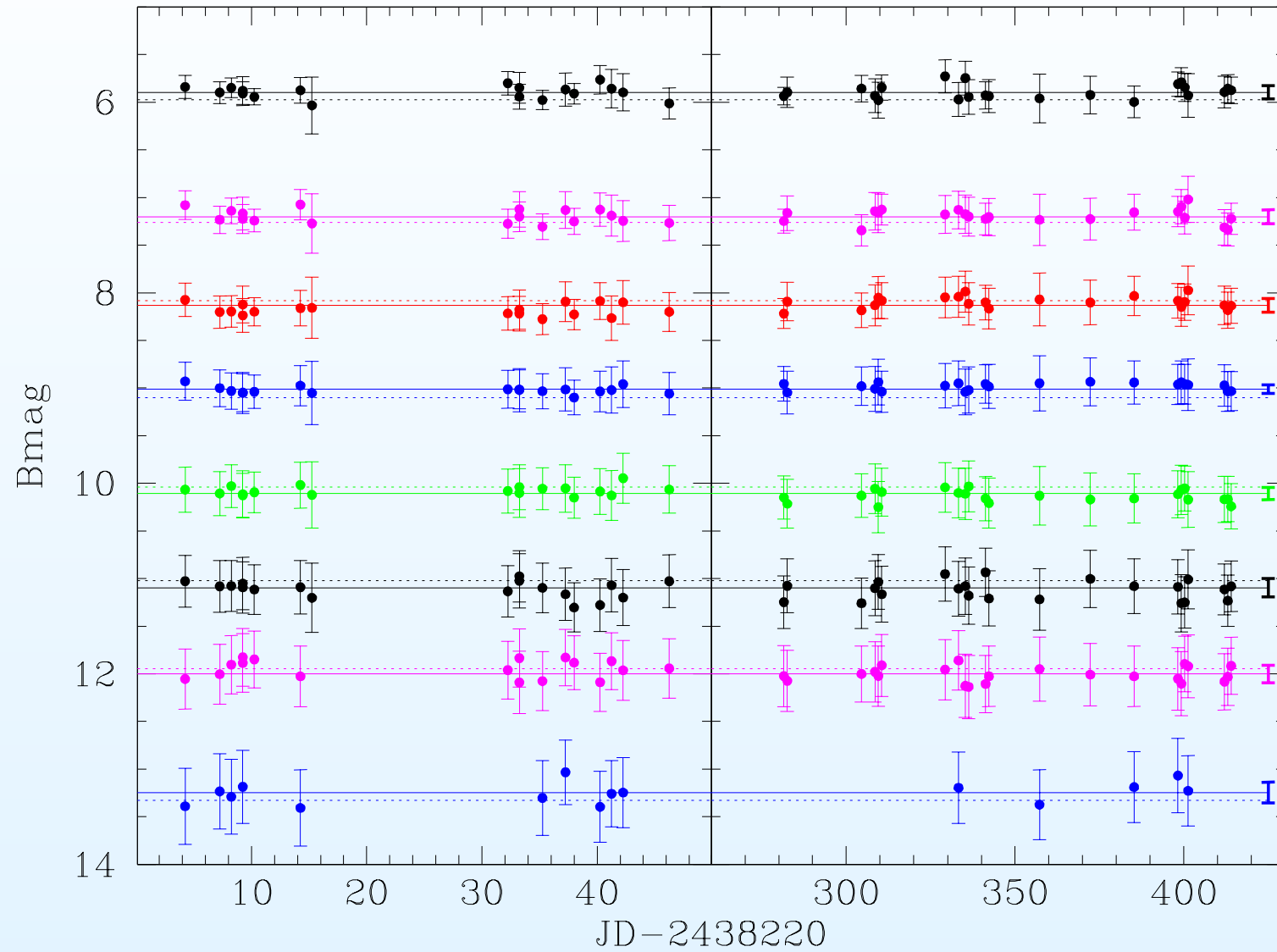
# Preliminary Results



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# UCAC4 252-118418

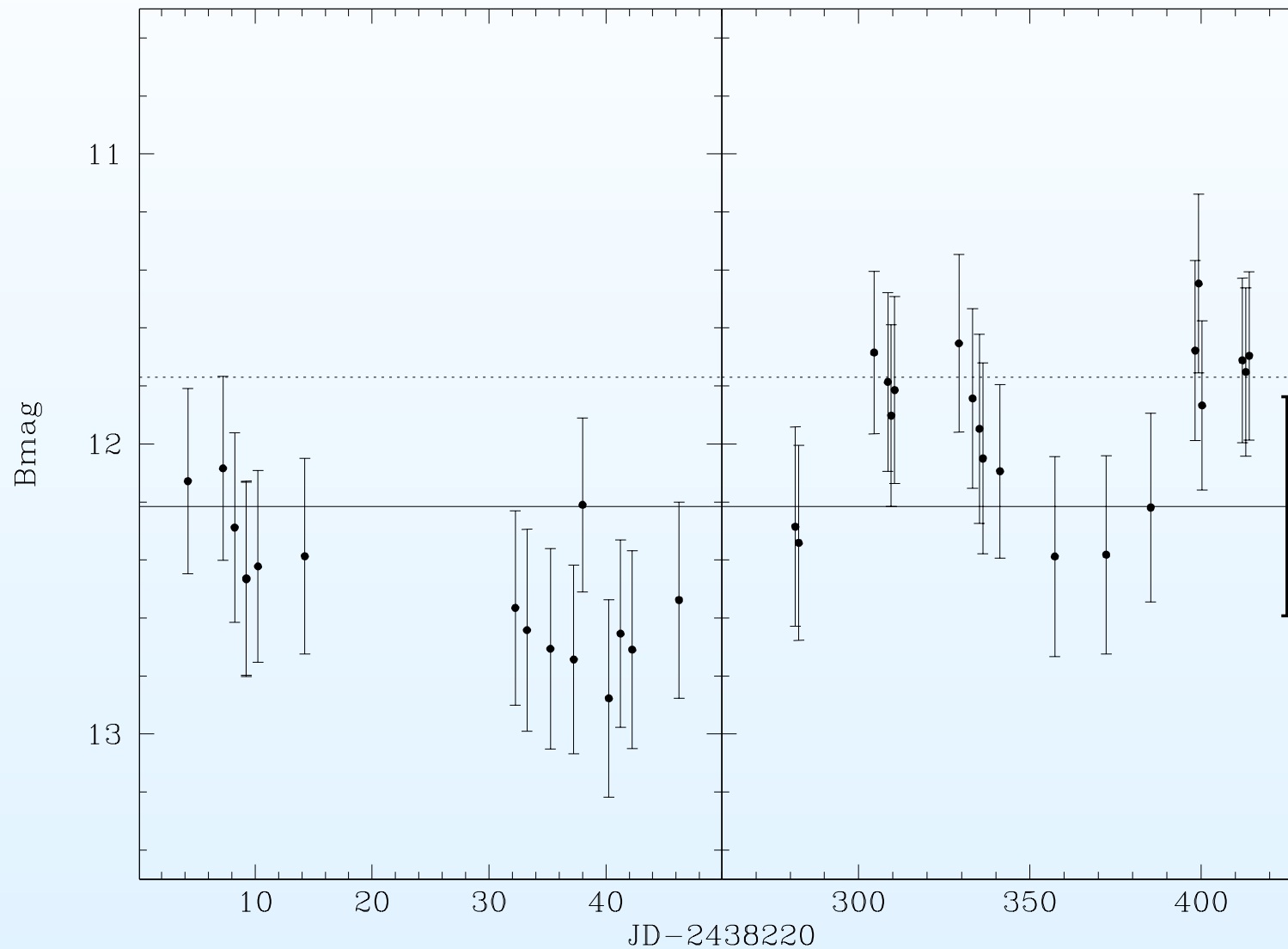


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= V\* V1184 Sco - Semi-regular pulsating Star





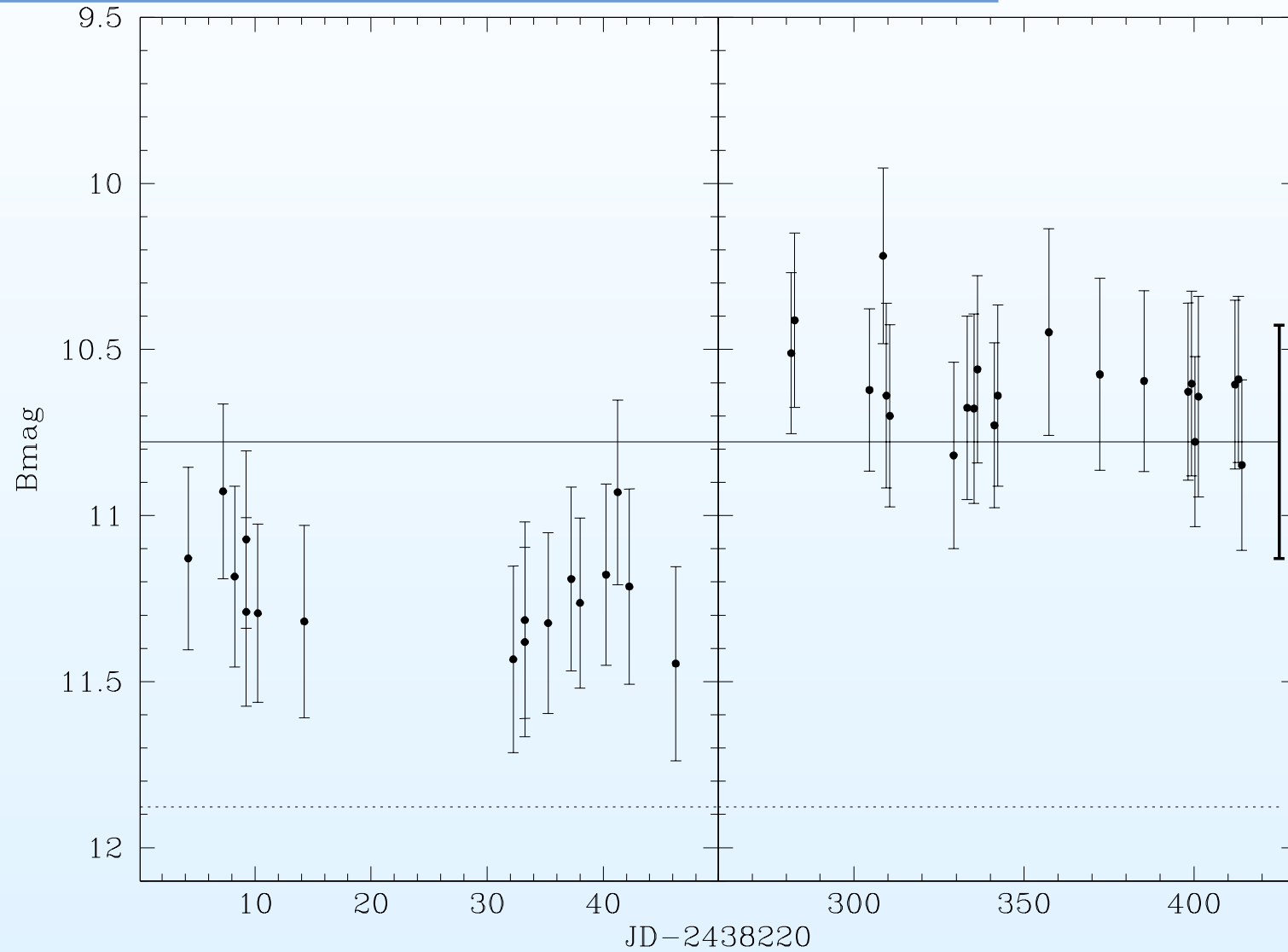
# UCAC4 241-127154 = CPD-41 8037 - Star



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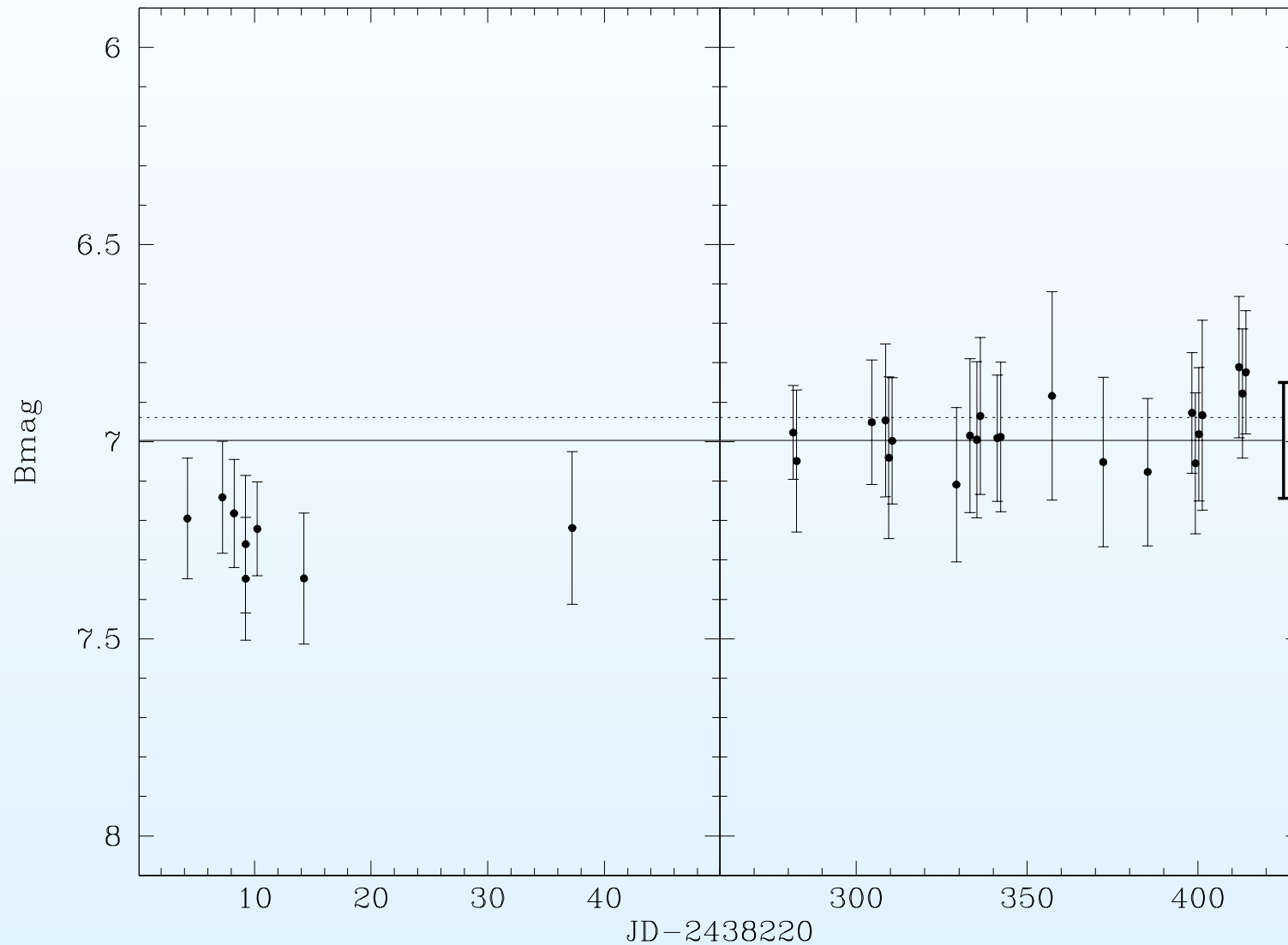
# UCAC4 226-131332 = HD 153234 - Star = BV 1738 (new)



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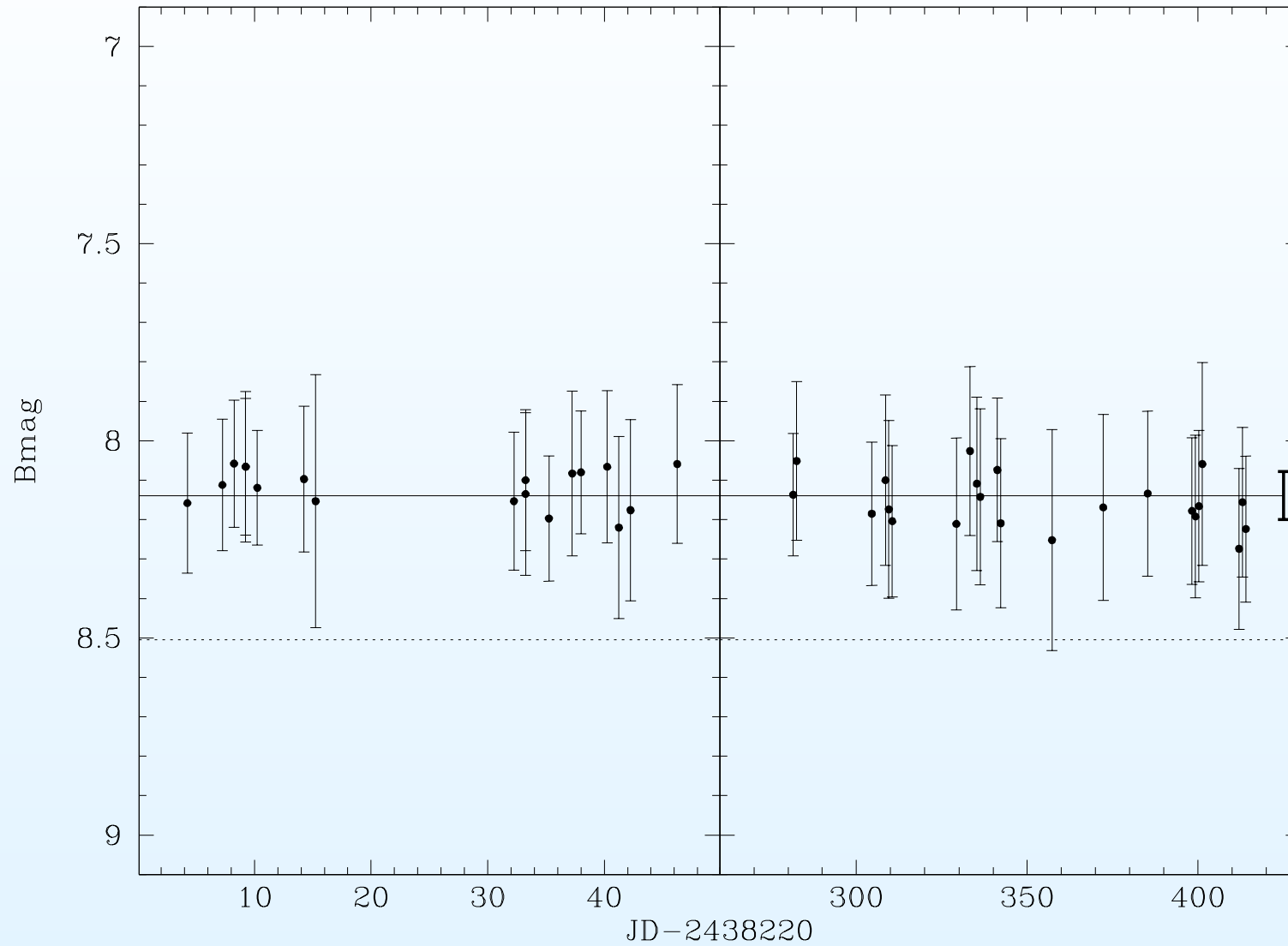
# UCAC4 267-112143 = HD 158724 - Star



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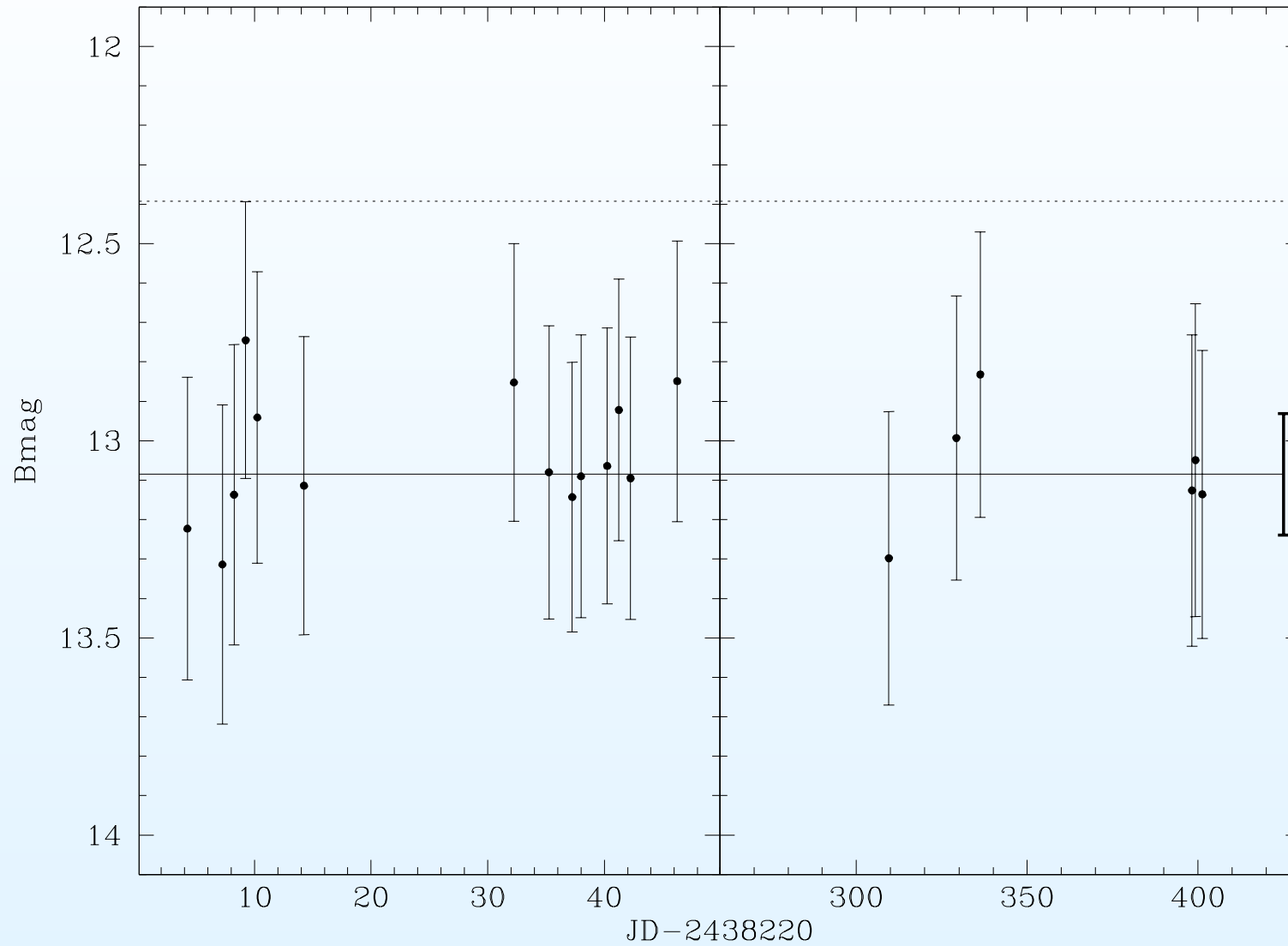
# UCAC4 231-128493 - Star



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- Friedrich D., Schöffel E. 1971, "*Mitteilungen über Veränderliche der Bamberger Liste*", Veröff. Remeis-Sternw. Bamberg, Astron. Inst. Univ. Erlangen-Nürnberg, Vol. 8, No. 95, p. 19
- Høg E., Fabricius C., Makarov V.V., Urban S., Corbin T., Wycoff G., Bastian U., Schwekendiek P., Wicenec A. 2000, "*The Tycho-2 catalogue of the 2.5 million brightest stars*", A&A 355, L27
- Knigge R., Sosna F.M. 1977, "*Mitteilungen über Veränderliche der Bamberger Liste. Neue Veränderliche Sterne am Südhimmel*", Veröff. Dr. Remeis-Sternw. Bamberg, Astron. Inst. Univ. Erlangen-Nürnberg, Band 12, Nr. 125, p. 7
- Strohmeier W., Knigge R. 1961, "*Mitteilungen über Veränderliche der Bamberger Himmelsüberwachung*", Astronomische Nachrichten, Vol. 286, p. 133
- Strohmeier W. 1963, "*The Bamberg Search for Bright Variable Stars*", Sky and Telescope, Vol. 26, p. 264
- Tsvetkov M., Tsvetkova K., Borisova A., Kalaglarsky D., Bogdanovski R., Heber U., Bues I., Drechsel H., Knigge R. 2005, "*Bamberg southern photographic patrol survey: incorporation in the WFPDB*", Publications of the Astronomical Society "Rudjer Boskovic", Vol. 5, p. 303
- Tsvetkova K. P., Tsvetkov M. K., Heber U., Bogdanovski R. G., Kalaglarsky D. G. 2006, "*Bamberg Northern Sky Survey: Catalogue and Incorporation into the WFPDB*", Virtual Observatory: Plate Content Digitization, Archive Mining and Image Sequence Processing, iAstro workshop, Sofia, Bulgaria, 2005 proceedings, ISBN-10 954-580-190-5, p. 109-114
- Zacharias N., Finch C.T., Girard T.M., Henden A., Bartlett J.L., Monet D.G., Zacharias M.I., 2013, "*The fourth U. S. Naval Observatory CCD Astrograph Catalog (UCAC4)*", AJ 145, 44