

The photographic heritage of astronomy in Bonn

Michael Geffert

now:

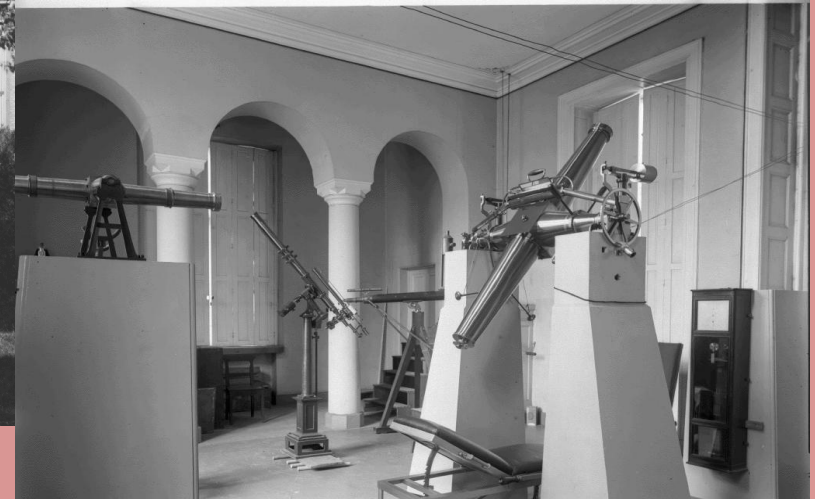
Birtzberg Observatorium, Bornheim



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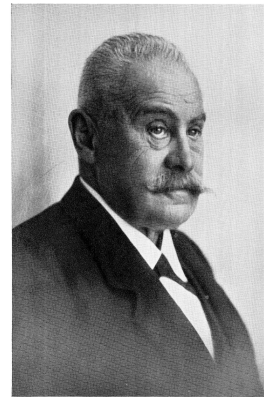
F.W.A. Argelander (1799-1875)



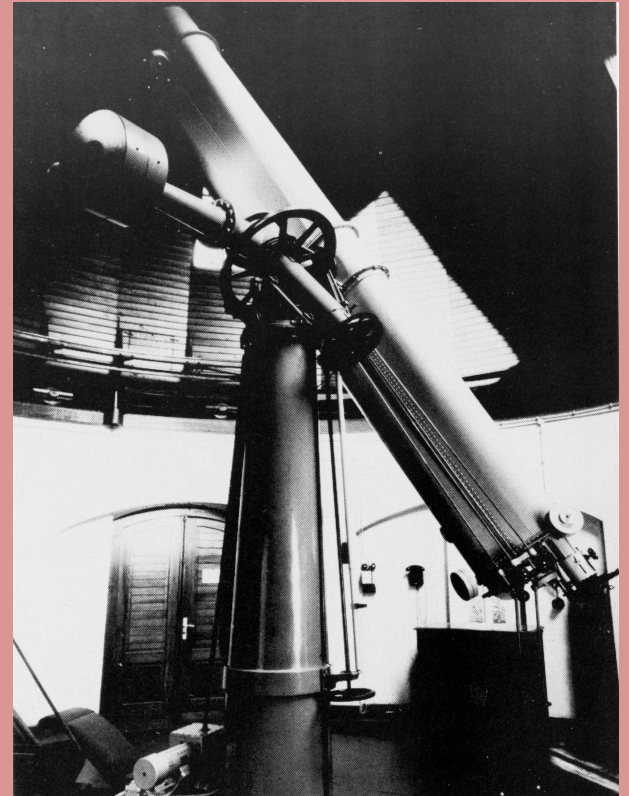
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Astronomical photography started in Bonn with K.F. Küstner (1856-1936)



KARL FRIEDRICH KÜSTNER
GEB. 22. AUGUST 1856, GEST. 15. OKTOBER 1936



**Astronomical unit (rad. vel. of Arcturus); AN 169, 241[1905])
rad. vel. of ~ 320 stars; ApJ 27, 301[1908]; AN 198, 409 [1914]**

Steinheil-Refractor:

D=30cm/36cm; F=5m

Scale: 40"/mm

$B_{\text{lim}} = 16.5 / \text{time} = 4\text{h}$

From 1899 to 1922

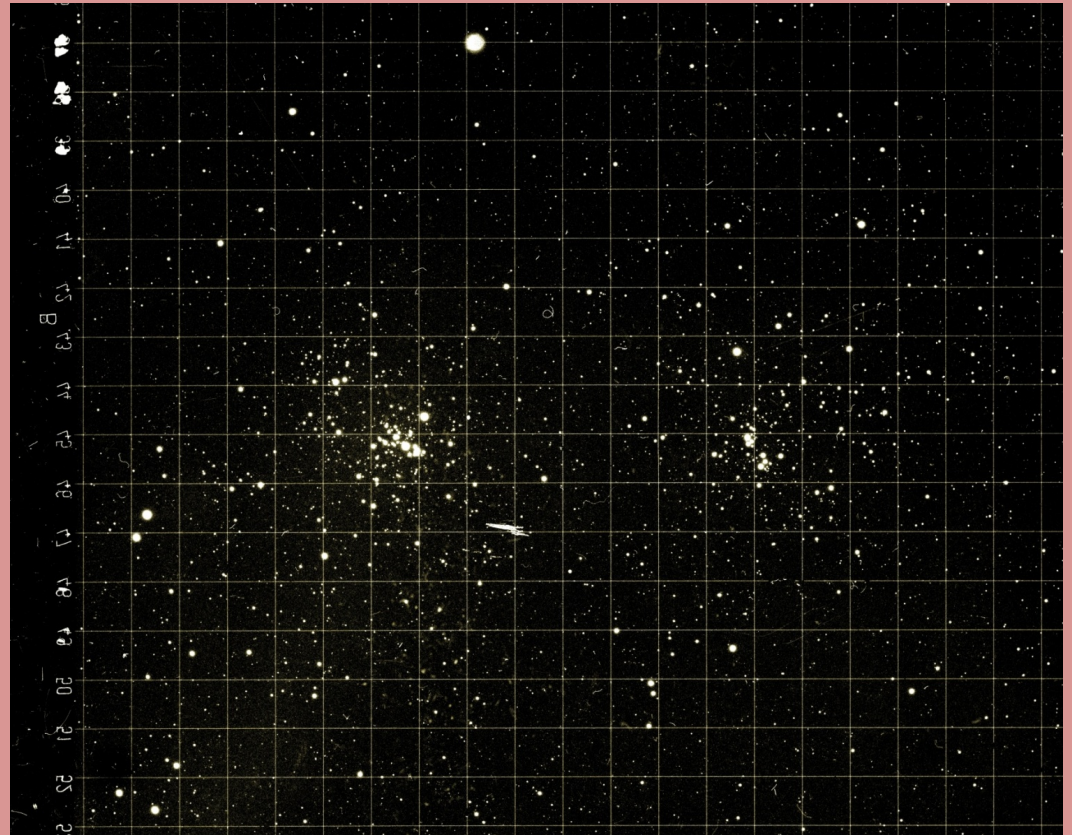
~600 plates

(16 cmx16 cm)

+ spectra

Since 1914:

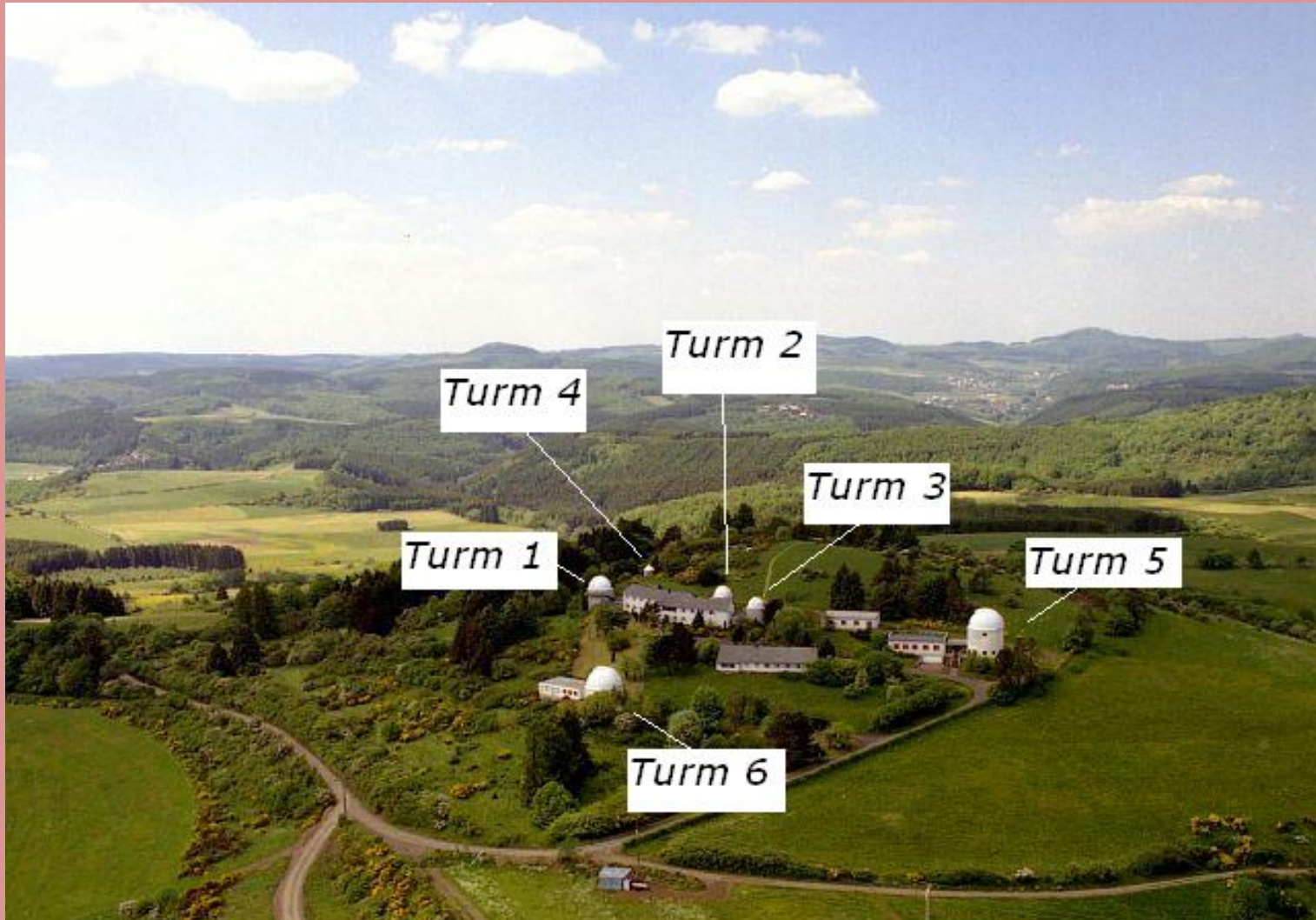
**Observations taken
for future proper
motion work**



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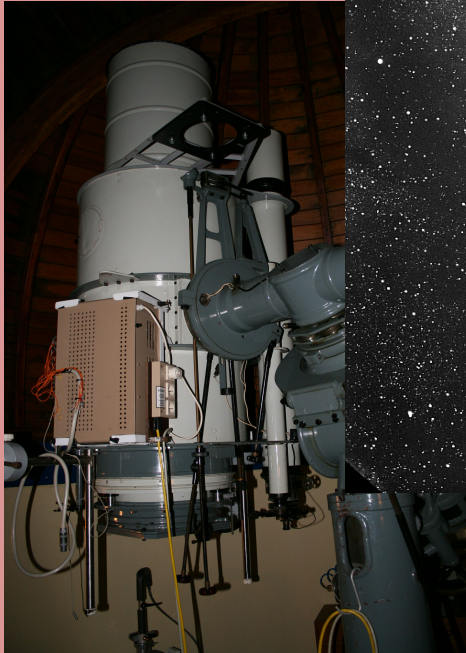
Observatorium Hoher List (1954-2012)

Astrograph (D=30cm, f=150cm); Schmidt telescope (f=130cm, D=36cm)





Observations
of special
regions
(1969-1973)
 $B_{\text{lim}} = 17.5$



Associations: Lac OB1, Cep OB2, Per OB2



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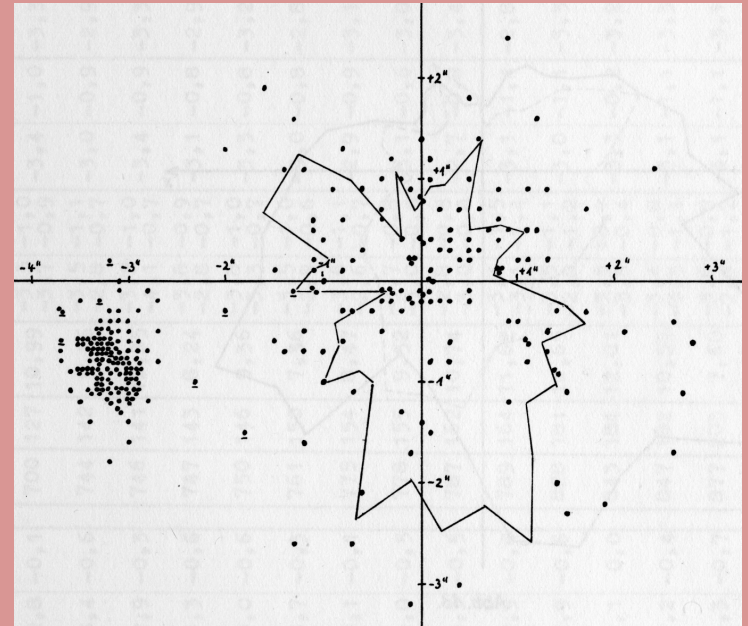
Proper motions of stars in open star clusters

(using first epoch plates of the double refractor of Bonn)

- Plates from 41 open clusters taken by Küstner from 1901-1922
 - 15 publications in the "Bonner Veröffentlichungen":
 - K.W. Schrick (1953) Nr. 40
 - H.H. van Schewick (1971) Nr. 84, Mitt. AG. 31, 119 (1972)
- => Determination of Solar motion and Oort's constants

Problems:

- emulsions, telescope, reduction, reference stars



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From 1980 to 2000

proper motion work on open
and globular clusters

- Kodak emulsions,
- measuring engines (PDS, MAMA, APM)
- computers

Problem: reference stars =>
HIPPARCOS

<= Brosche & Geffert A&A 127, 415 (1983)

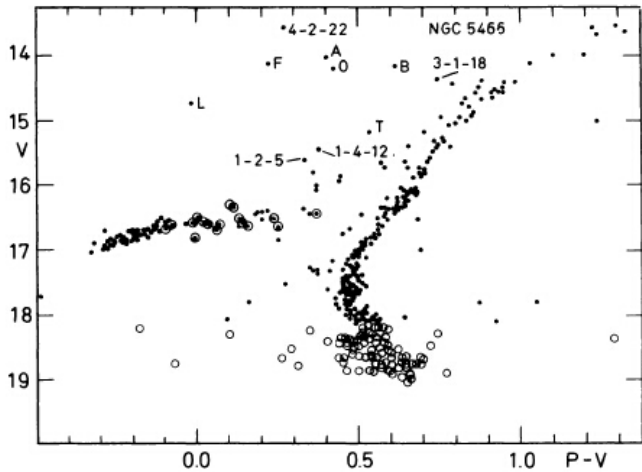


Fig. 1. The colour-magnitude-diagram from Cuffey (1961)

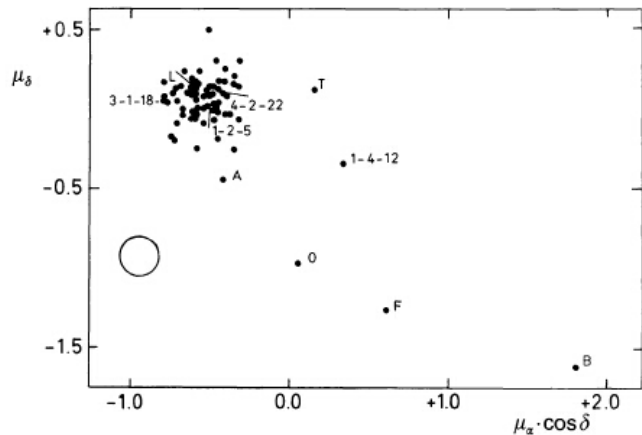


Fig. 2. Proper motion diagram. The proper motions were given in "/100 yr. The circle in the lower left corner has the radius of one individual proper motion



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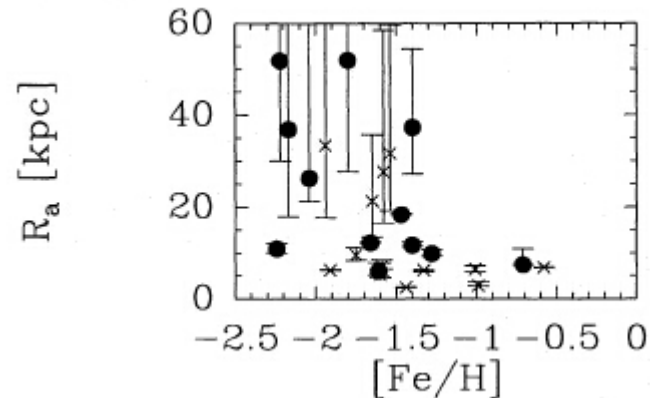
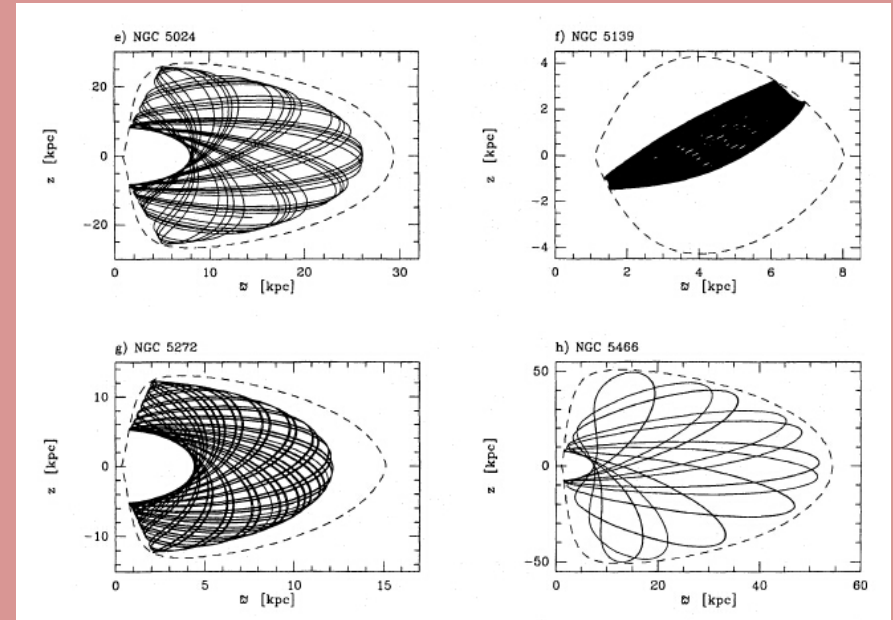
Globular cluster kinematics

(e.g. Dauphole, Geffert et al. A&A 313, 119 [1996])

Table 2. List of the most reliable absolute proper motions of the globular clusters used in this work. An extragalactic calibration of the proper motions is indicated in the last column

Object		$\mu_{\alpha\cos\delta}$ [mas/a]	μ_{δ} [mas/a]	extragal. calib.
NGC 104	47 Tuc	+5.5	-1.6	yes
NGC 288		+5.0	-6.8	yes
NGC 362		+3.5	-2.6	yes
Pal 3		+0.33	+0.30	yes
NGC 4147		-2.7	+0.9	yes
NGC 5024	M 53	-0.3	-4.0	yes
NGC 5139		-2.2	-7.3	no
NGC 5272	M 3	-3.1	-2.3	yes
NGC 5466		-5.4	+0.6	yes
Pal 5		-2.44	-0.87	yes
NGC 5904	M 5	+6.7	-7.8	yes
NGC 6121	M 4	-11.6	-15.7	no
NGC 6171	M 107	-0.7	-3.1	no
NGC 6205	M 13	-0.9	+5.5	no
NGC 6218	M 12	+3.1	-7.5	yes
NGC 6254	M 10	-14.0	-6.3	no
NGC 6341	M 92	-4.4	+1.1	yes
NGC 6397		+3.3	-15.2	no
NGC 6626	M 28	+0.3	-3.4	no
NGC 6656	M 22	+8.6	-5.1	no
NGC 6712		+4.2	-2.0	no
NGC 6779	M 56	+2.1	+5.4	no
NGC 6838	M 71	-2.3	-5.1	no
NGC 6934		-1.1	+1.4	no
NGC 7078	M 15	-1.0	-10.2	yes
NGC 7089	M 2	+5.5	-4.2	no

For the source of the data see Sect. 2.



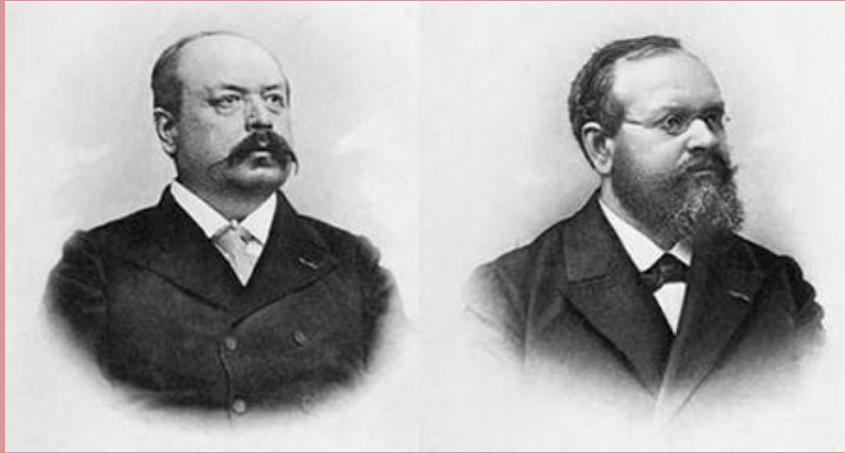
The Carte du Ciel project



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<https://twitter.com/vaticanobserv/>

<http://www.astro.oma.be/en/science-and-culture-at-the-royal-palace-2016/>

20 observatories,
2⁰x2⁰ field
20.000 glas plates

Catalogue

Measurements with
different engines and
methods
up to B=11.5

Charts

up to B=14

Participating observatories and stars measured in the
context of the Astrographic Catalogue^[1]

Observatory (Zone)	Declination		Epoch	No. of stars
	From	To		
Greenwich	+90°	+65°	1892–1905	179,000
Vatican	+64°	+55°	1895–1922	256,000
Catania	+54°	+47°	1894–1932	163,000
Helsingfors	+46°	+40°	1892–1910	159,000
Potsdam	+39°	+32°	1893–1900	108,000
Hyderabad north	+39°	+36°	1928–1938	149,000
Uccle	+35°	+34°	1939–1950	117,000
Oxford 2	+33°	+32°	1930–1936	117,000
Oxford 1	+31°	+25°	1892–1910	277,000
Paris	+24°	+18°	1891–1927	253,000
Bordeaux	+17°	+11°	1893–1925	224,000
Toulouse	+10°	+05°	1893–1935	270,000
Algiers	+04°	-02°	1891–1911	200,000
San Fernando	-03°	-09°	1891–1917	225,000
Tacubaya	-10°	-16°	1900–1939	312,000
Hyderabad south	-17°	-23°	1914–1929	293,000
Córdoba	-24°	-31°	1909–1914	309,000
Perth	-32°	-37°	1902–1919	229,000
Perth/Edinburgh	-38°	-40°	1903–1914	139,000
Cape Town	-41°	-51°	1897–1912	540,000
Sydney	-52°	-64°	1892–1948	430,000
Melbourne	-65°	-90°	1892–1940	218,000

Solving the triple image problem

- **Dick et al. (1993) A&A 279, 262**

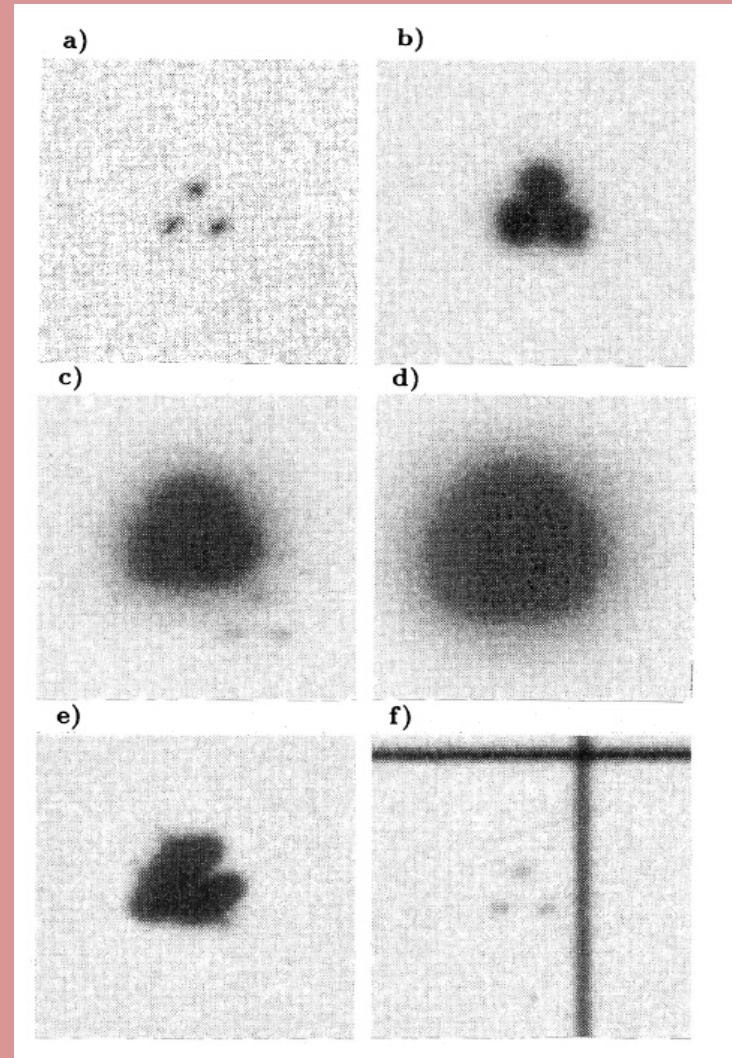
Overlapping three elliptical
Gaussian distributions

- **Geffert, Guibert, Bonnefond et
al. (1996) A&A Suppl. Ser. 118,
277 [NGC 1647]**

[Multithreshold scanning]

- **Ortiz Gil et al.(1998) A&A Suppl.
Ser. 128, 621**

[Non linear fitting three Gaussian
distributions]



After closing of Hoher List observatory in 2012

15.000 plates

5000 plates from Schmidt tel. ($D=36\text{cm}$, $f=136\text{cm}$) [1956-1990]

5000 plates from astrograph ($D=30\text{cm}$, $f=150\text{cm}$) [1970-1990]

2000 plates from refractor ($D=30\text{cm}$, $f=513\text{cm}$) [1900-1990]

1000 plates from refractor of Göttingen ($D=40\text{cm}$, $f=400\text{cm}$)
[1933-1955]

2000 plates from different observatories (ESO, Boyden...)

=> summer 2019



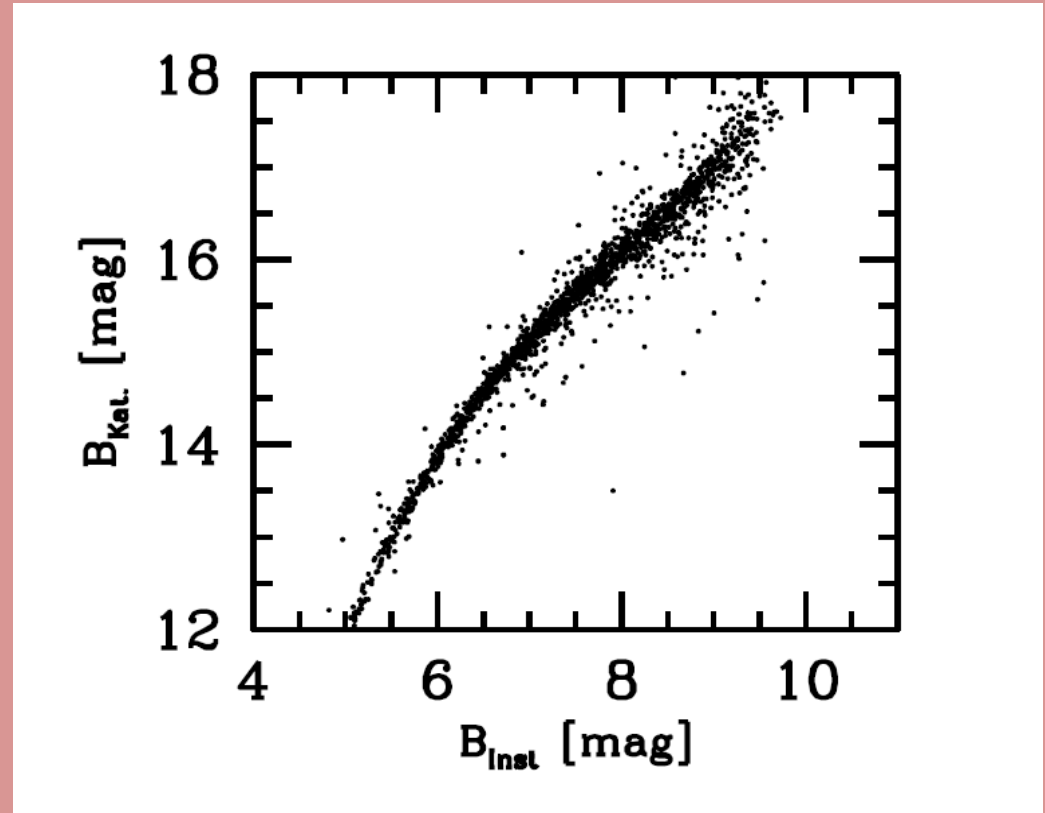
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Photometry of the ADH [Boyden] plates

Photometric accuracy

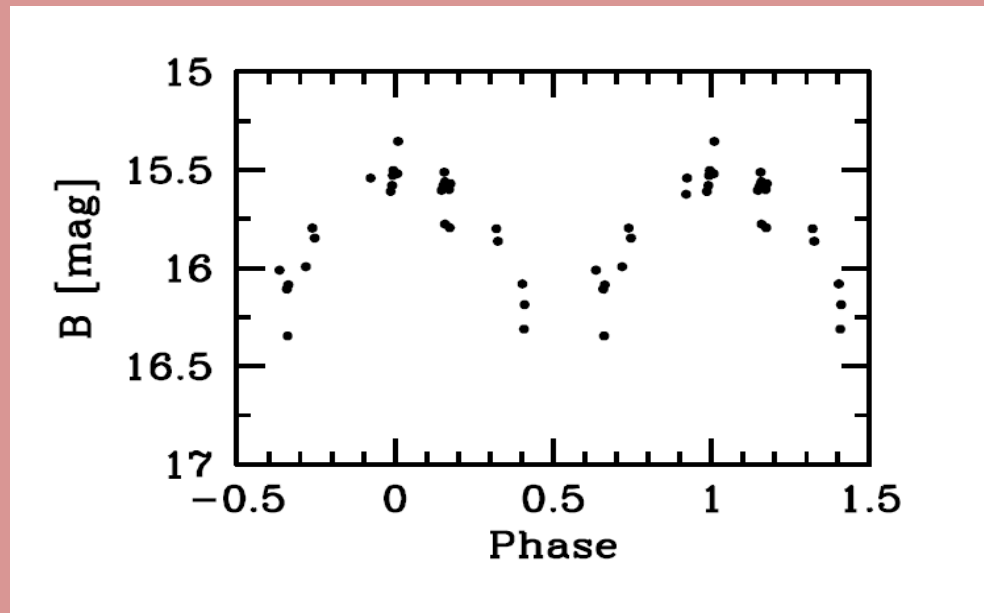
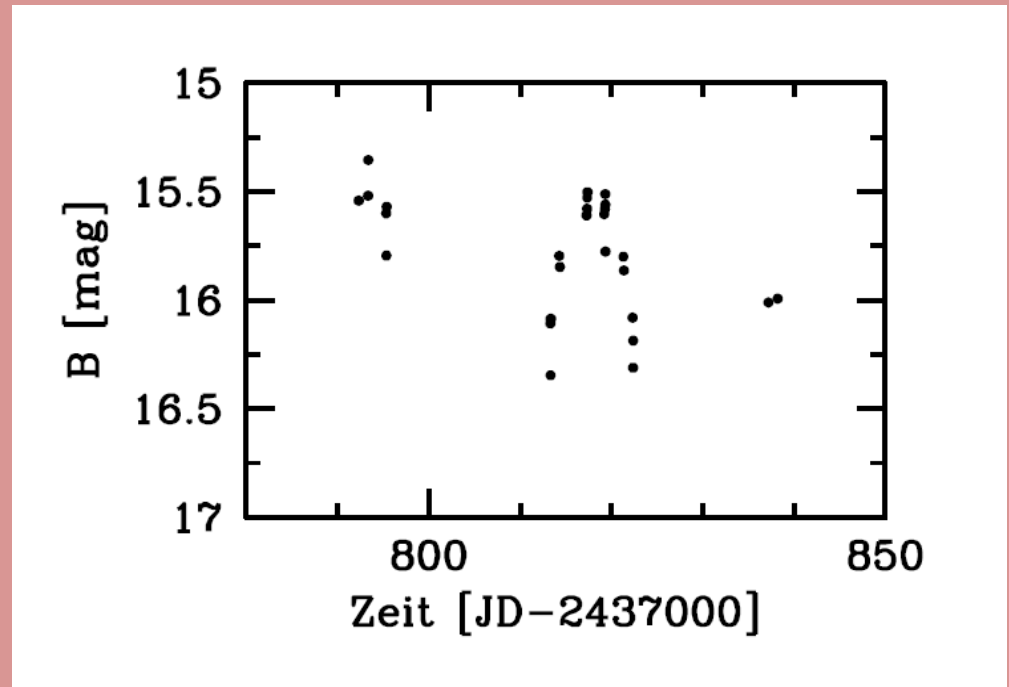
- Scanning with EPSON 4990 in different orientations (astrometry!)
- Calibration with UCAC 4
- Single plate :
rms = 0.14 mag



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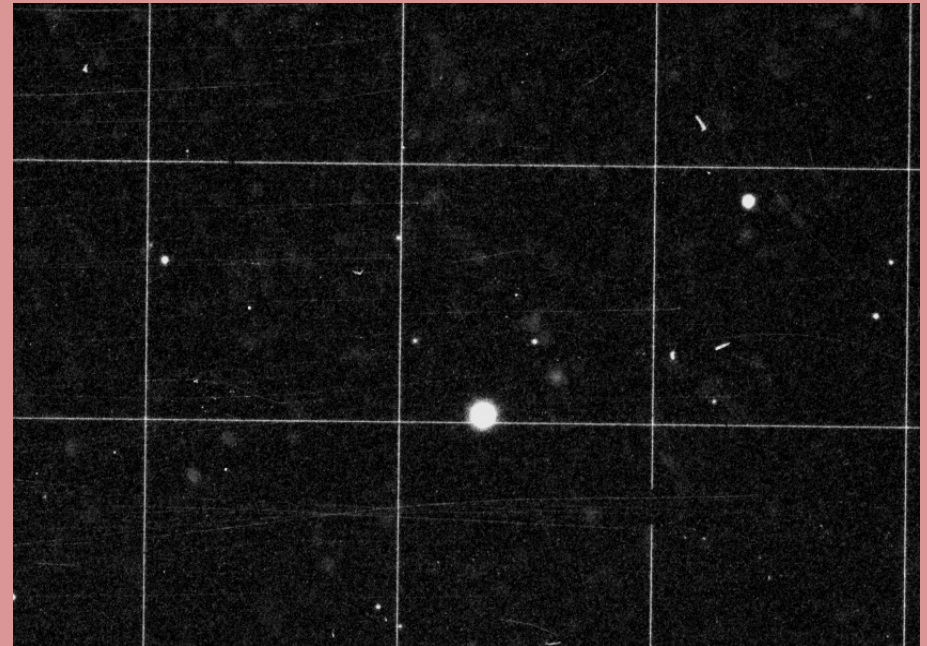
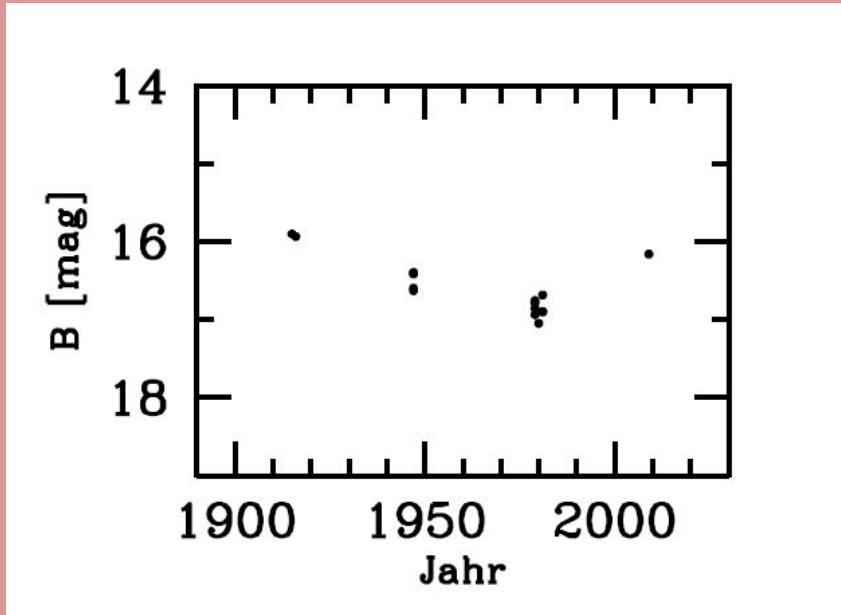
New variable stars in 2017

- No entry (Simbad, AAVSO)
- $P=12.09190\text{d}$
- Catalina Survey
 $\Delta V = 0.6\text{mag}$



Light Curve from OQ 208

Geffert, Baumgärtner, Brauer, Chatzigeorgiou, Kashtanjeva, 2015
BAV Rundbrief 3/2015

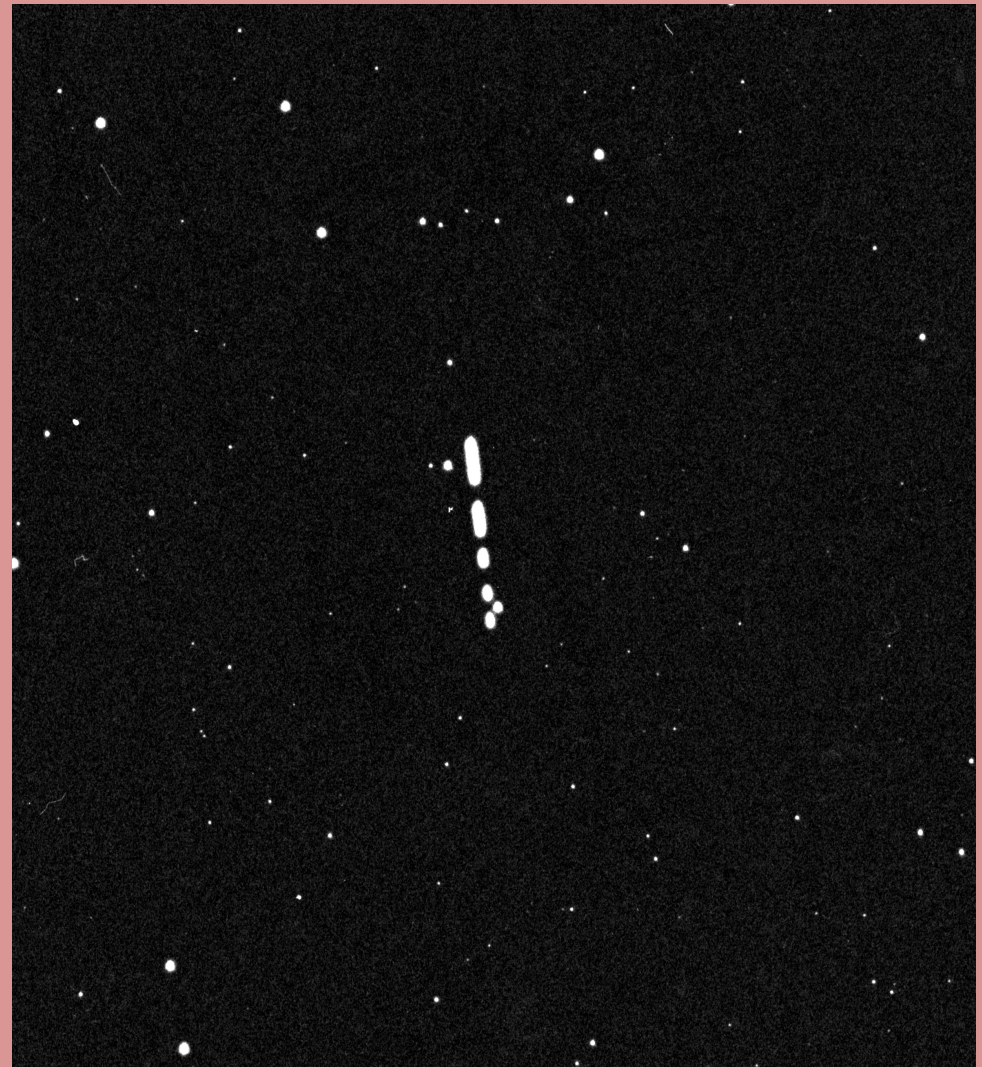
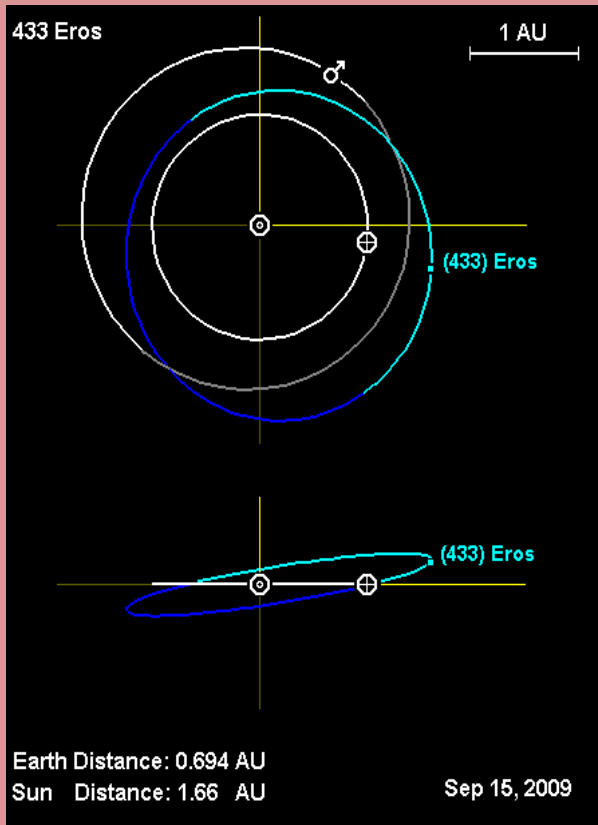


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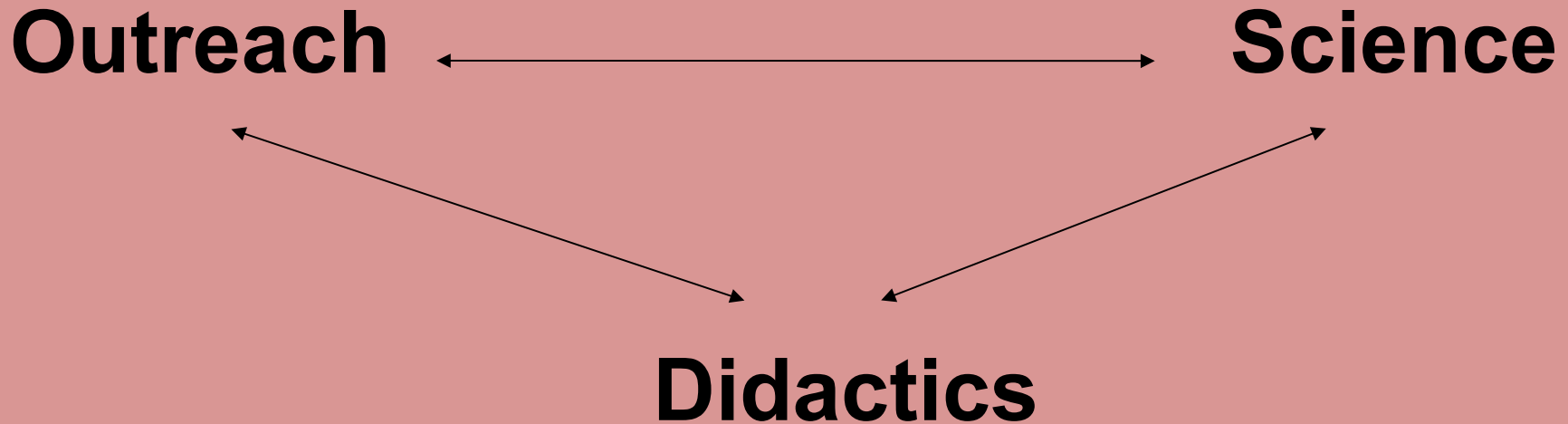
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Projects since 2013

Telescopes, 15.000 plates, books of J. Schmidt (1825-1884)



Individual lab courses for 70 students from schools
80 public talks, 35 publications [didactic, history, science]



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