The Danish Experience From 47 Years in ESO

Johannes Andersen

The Niels Bohr Institute
University of Copenhagen

Danish Astronomy < 1967..

Brorfelde Observatory 1966

50 cm Schmidt Telescope

(efficient in bad climate!)

25, 40 & 50 cm Telescopes

Meridian Circle ⇨ Digital era

Small observatory in Aarhus; larger photometric programmes at Lowell.

Danish Research Profile ~1965

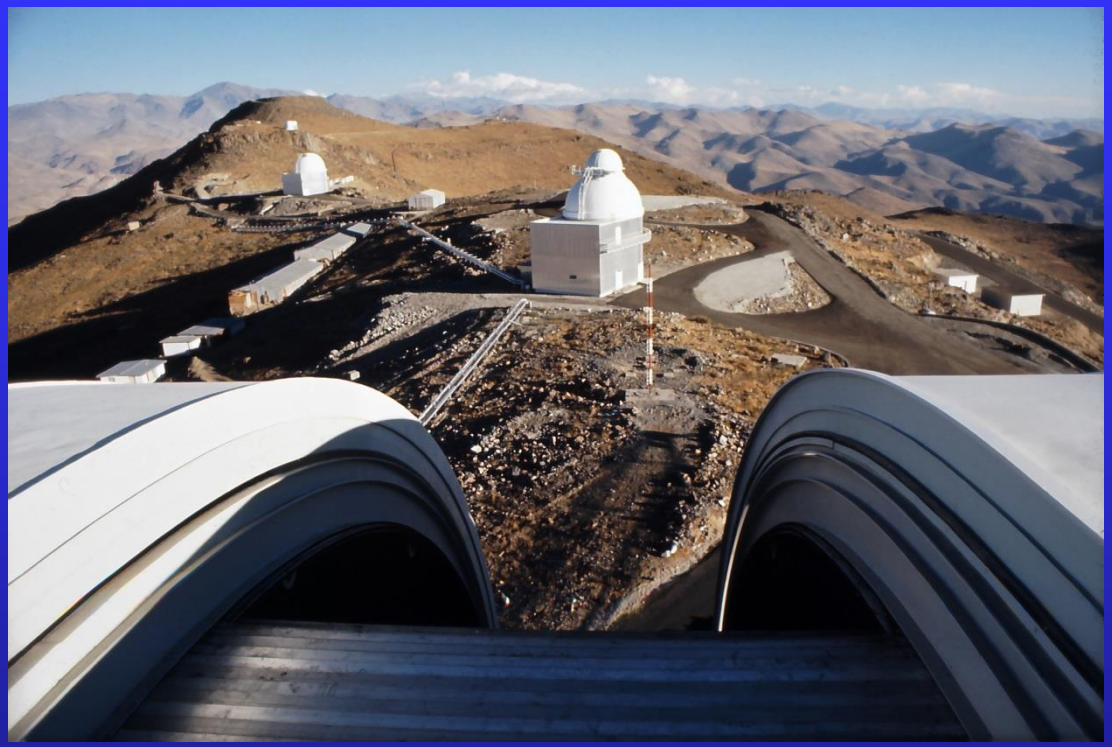
Theory: Stellar pulsations
Stellar evolution
Stellar atmospheres

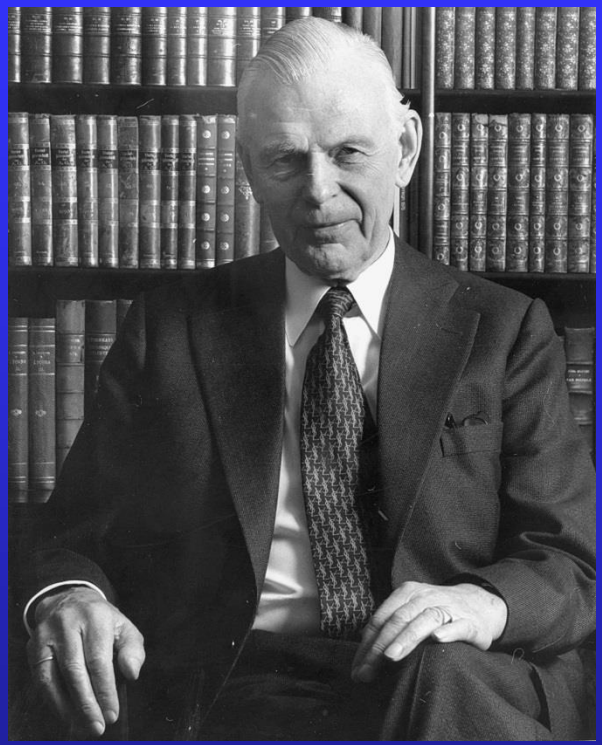
Astrometry: Photographic meridian circle observations
Test Schmidt Telescope astrometry (JA MSc!)

Photometry: Light curves of W Uma binaries (short P!)
Narrow-band photometry of GK giants @ Lowell

Spectra: Experimental (digital!) classification of Schmidt objective prism spectra

1967: Three Things Happened…





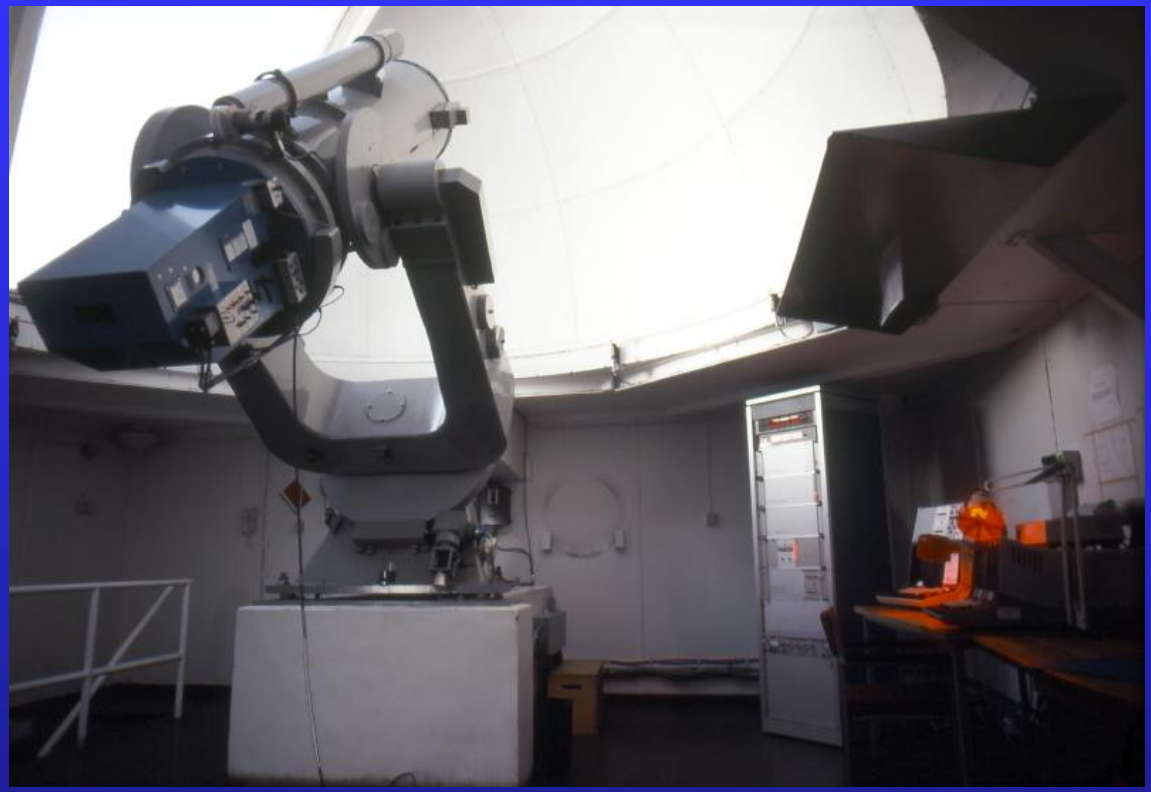
- Denmark joined ESO (parliament was quicker than us!);
- B. Strömgren (a founder of astrophysics) returned from USA;
- Brorfelde was *de facto* obsolete before it was completed…

JA 1970: Change of Science, Location, Life…

Several Parallel Initiatives Undertaken:

- **Introduce spectroscopy in Danish astronomy**
  - Accurate eclipsing binary orbits (*M, R*) to test models and ages (Popper & theory group)
  - Photograpic spectra for RVs of BAFG☆ in BSC
  - Study modern instrumental techniques (Victoria, USA)
- **Instrument to mass produce *uvbyβ* photometry in South**
  - Move Brorfelde 50 cm to La Silla
  - *ubvyβ* photometry for Bright Star Catalogue BAFG☆
  - Far more massive *ubvyβ* surveys in S (and N)
  - Convert last Brorfelde plan into 1.54m telescope @ ESO

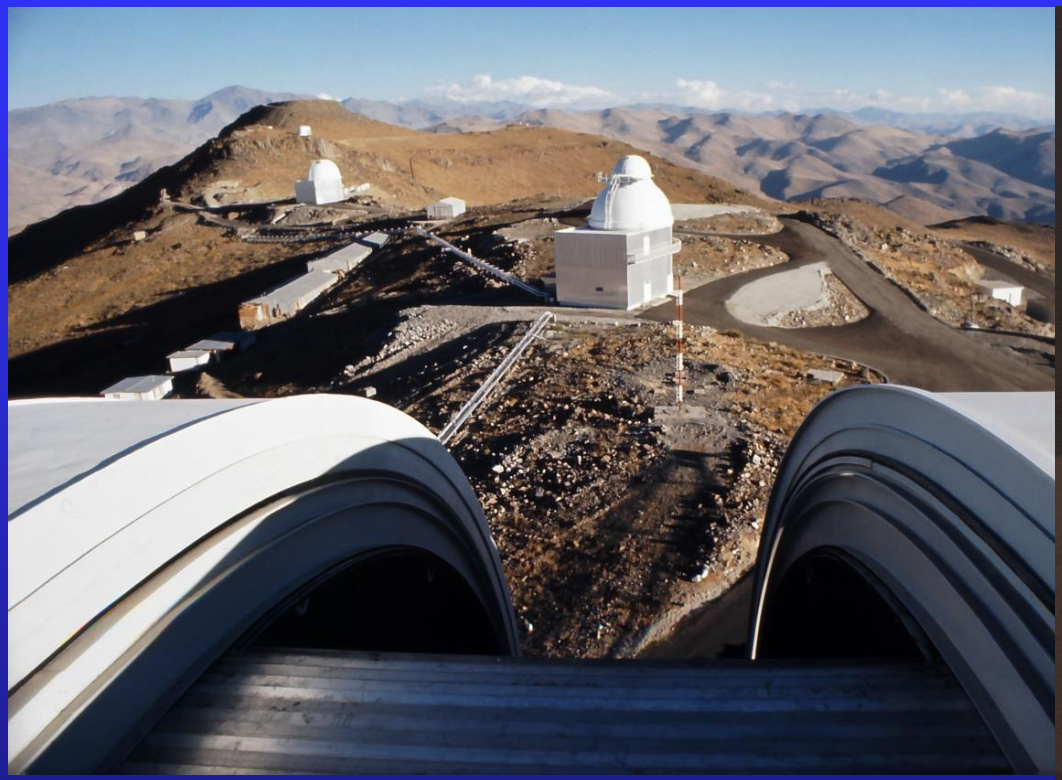
uvbyβ Photometry @ La Silla: Binaries++



Multi-channel, photon cts., digitigal output!

DK 50 cm @ La Silla: Manual + paper tape ⇨ Strömgren Automatic Telescope

- and ~4,500 Coudé Spectra (140 Nights)

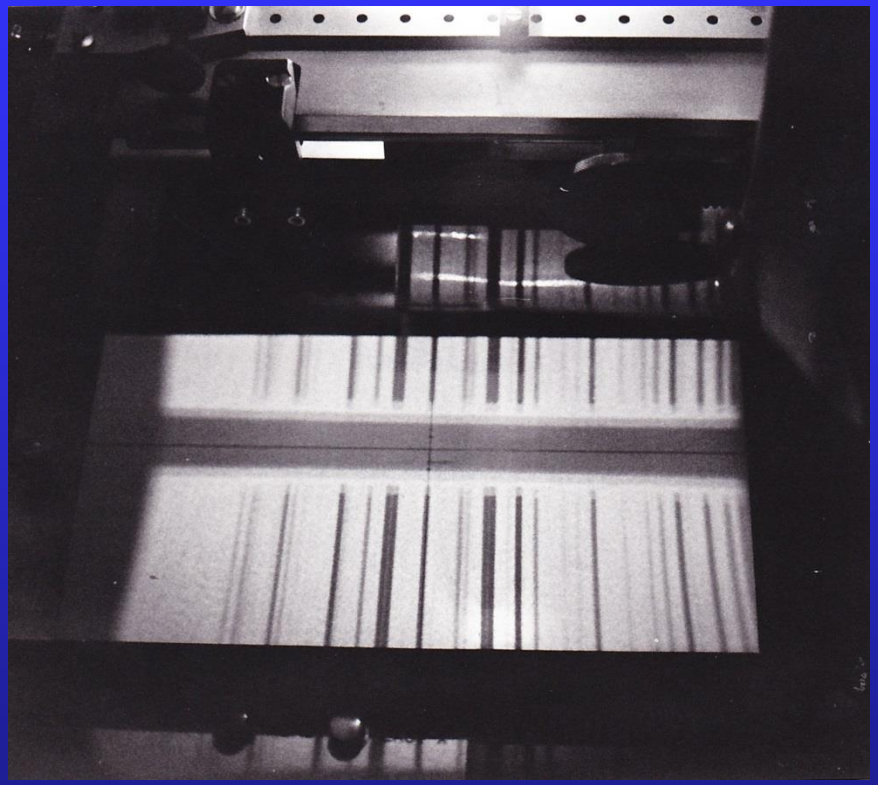


The ESO 1.52m telescope and a 1974 run of ~700 coudé plates

- from which RVs had to be measured

Modified Abbe comparator with line profile display & encoder

- from broad and/or blended double lines



- Checking each line!…

Total: ~4,500 coudé spectra from the ESO 1.52m telescope

Typical Data Set and Basic Results

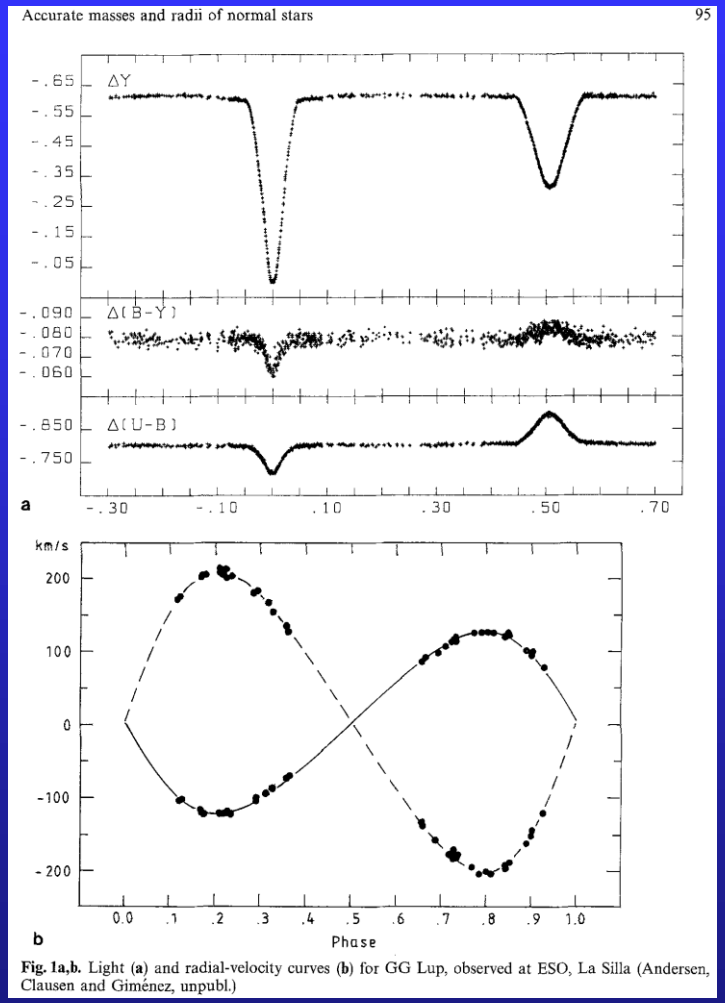
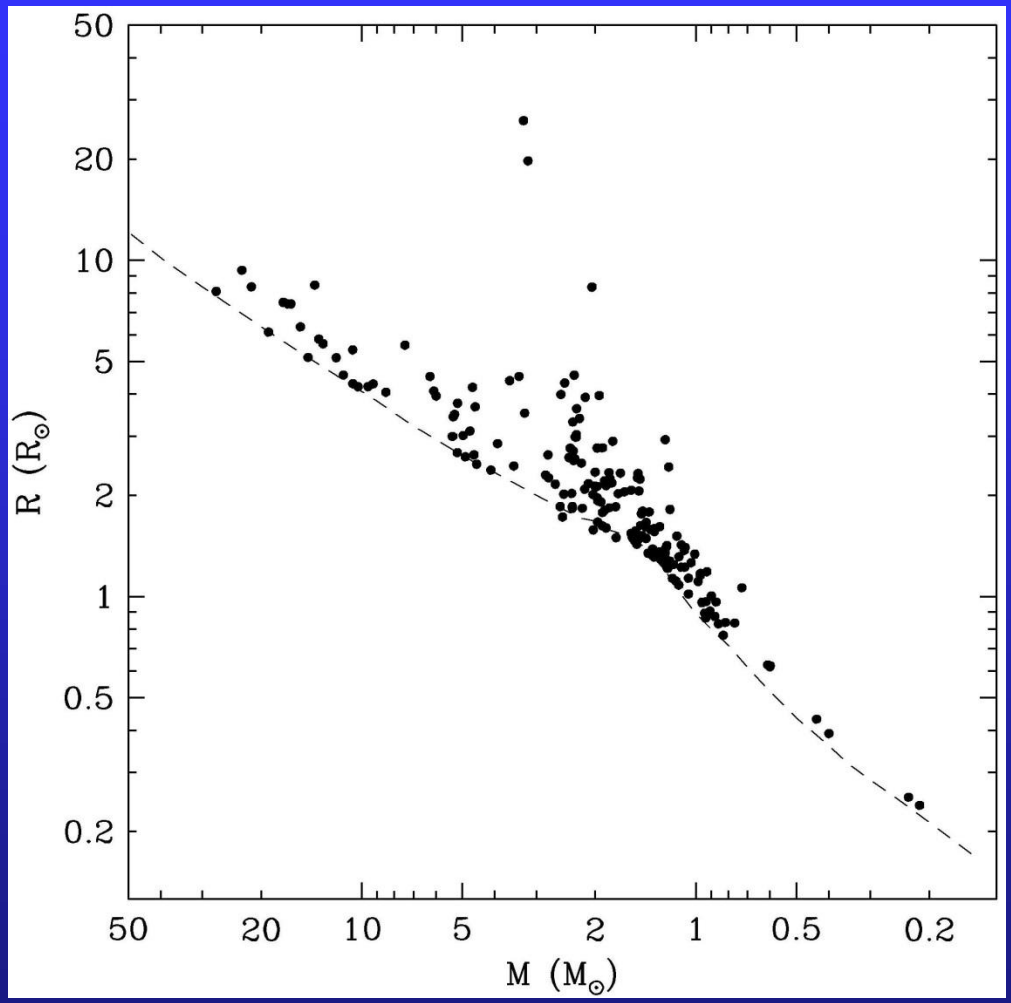
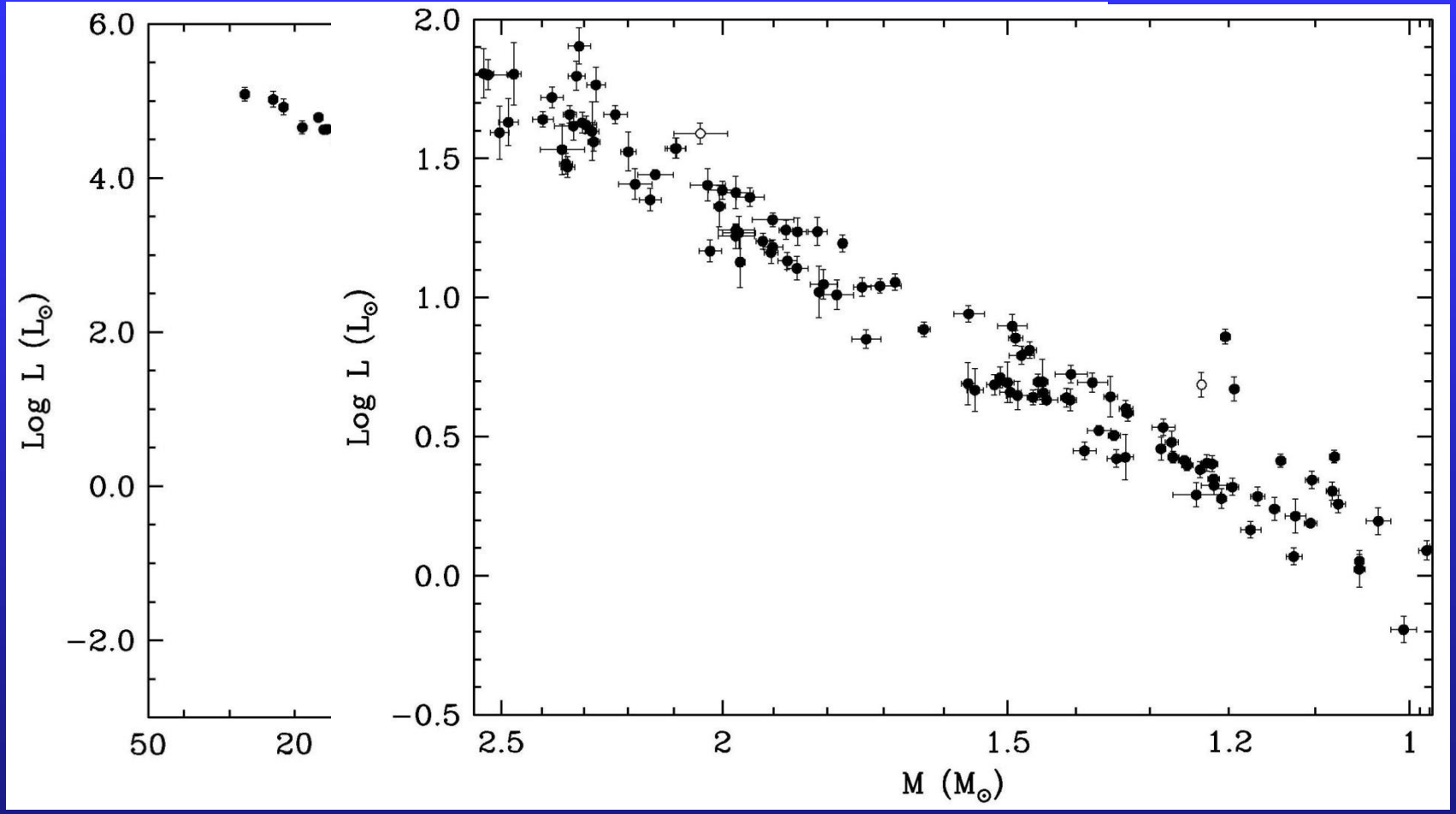


Fig. 1a,b. Light (**a**) and radial-velocity curves (**b**) for GG Lup, observed at ESO, La Silla (Andersen, Clausen and Giménez, unpubl.)



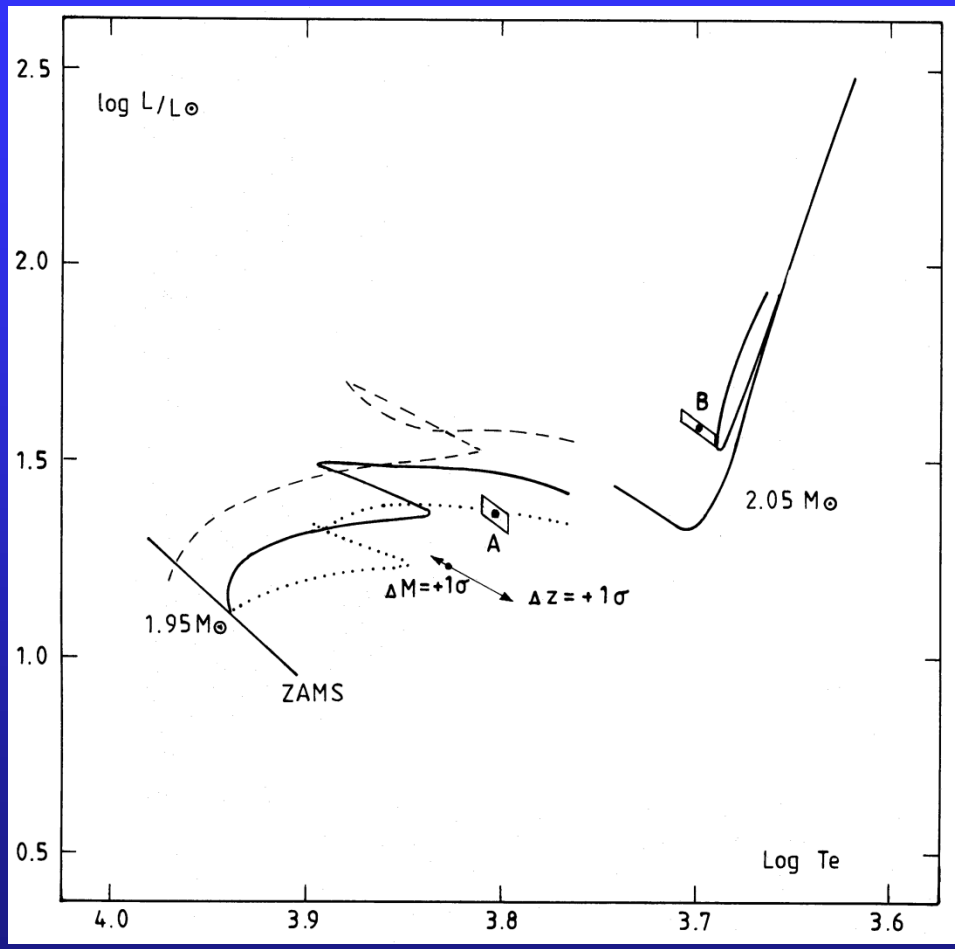
Raw material for one system and *M-R* diagram for sample

“The” Mass-Luminosity Relation:

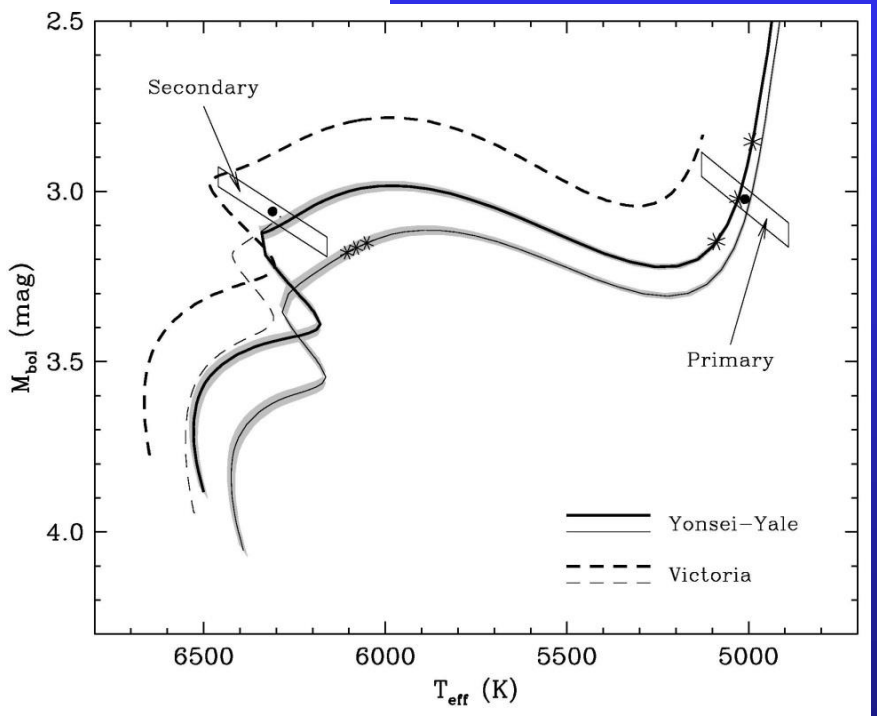


The overall relation looks very nice, but take a closer look…

Testing: When Accuracy Matters!



Do the ages agree to 1%?



Issue: Distinguish between overshooting & standard models

Pushing ESO Into Modern Spectroscopy

Spectrograph plans for ESO 3.6m telescope anno 1973:

- Coudé spectrograph with 1m long photographic plates and 0.″1 slit
- Cassegrain spectrograph with 3 – 300 Å/mm and removable slit(!)

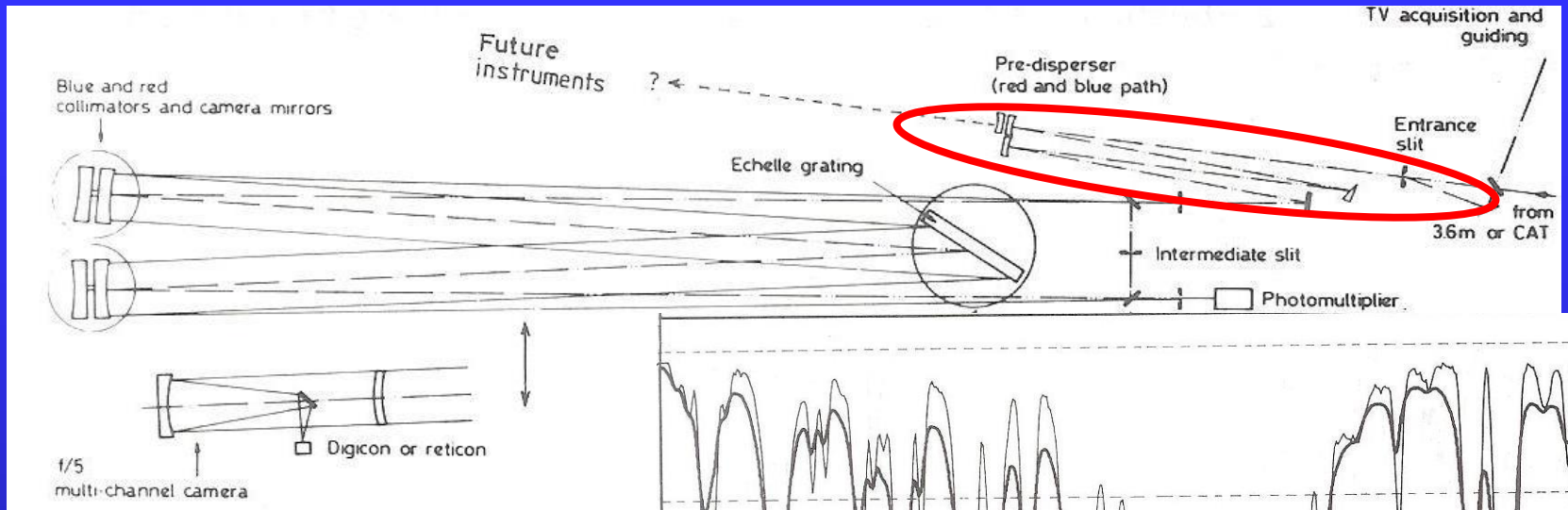
Scientific requirements from state-of-art theory:

- High resolution, up to ~100,000
- Freedom from scattered light (remove, measure, model)
- Linear, accurate photoelectric detectors with multichannel option

Answer: The Coudé Echelle Spectrometer (CES) and CASPEC

- CES designed for 3.6m coudé, but optimized CAT was ‘too’ efficient!
- Science case for CASPEC: GC giants; calibrate with CES

CES Characteristics and Performance



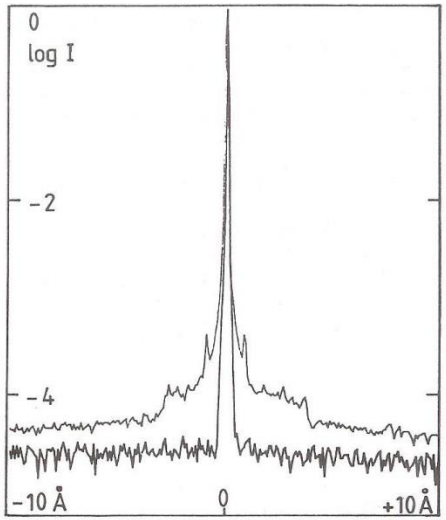


Fig. 3: *Part of the measured instrumental profiles at 6328 Å in single (upper) and double pass (lower).*

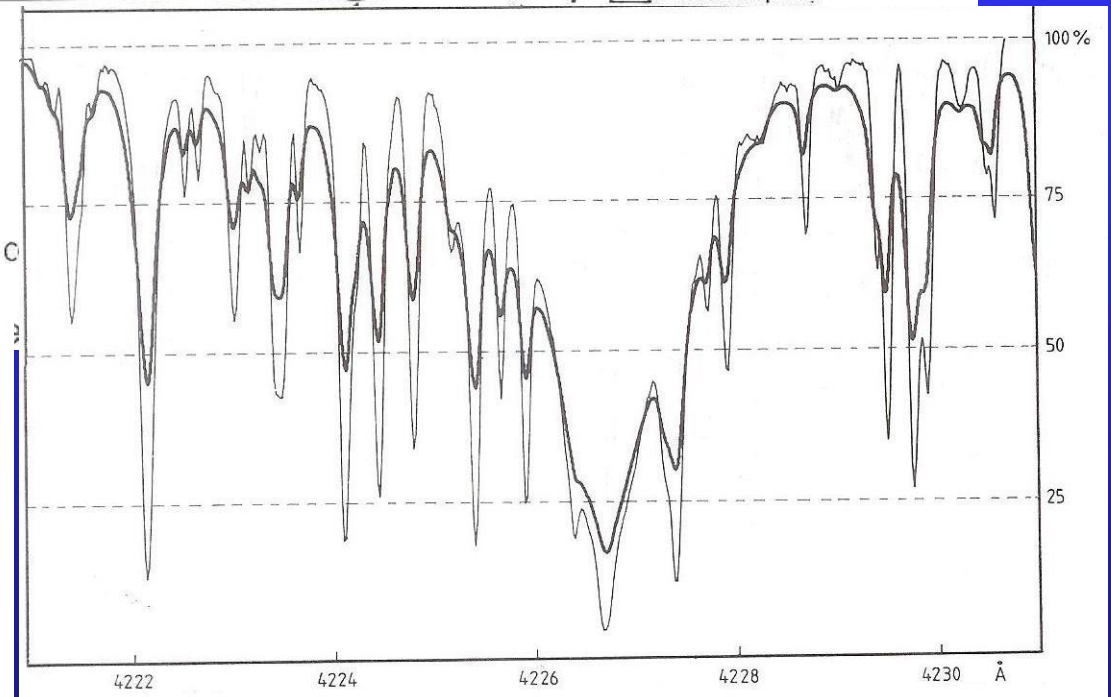


Fig. 4a: *True spectrum of integrated sunlight in the region of the strong Ca I line at 4226 Å (upp*
panel).
Fig. 4b: *The same region in the solar spectrum as actually observed in the laboratory with the CES i*
double pass (fine trace), and as it would appear if observed with the 3.2 Å/mm dispersion of the ES
1.5 m coudé spectrograph (heavy trace).

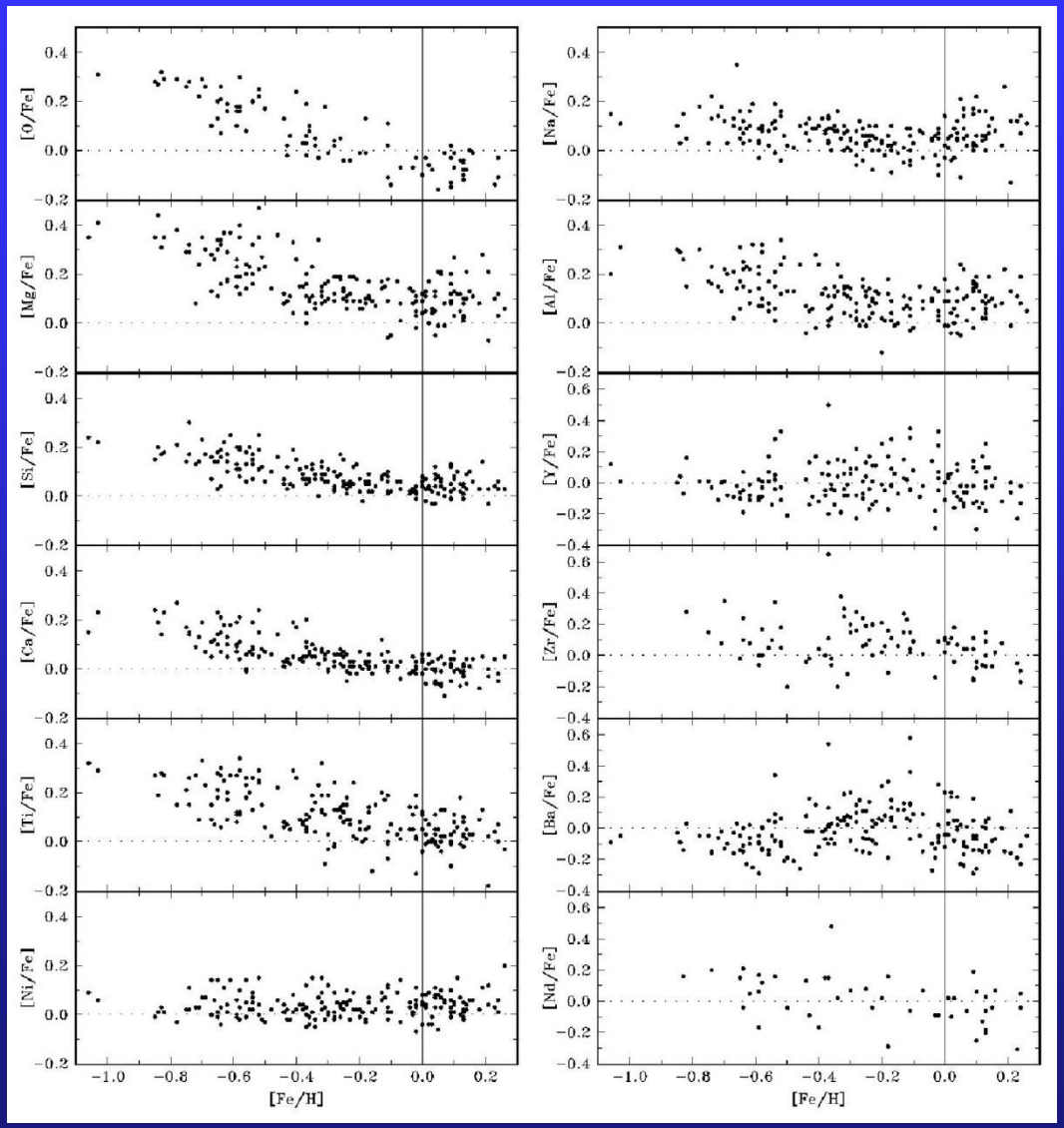
[Fe/H] vs. Detailed Element Abundances

- **Q: What stars made which elements: How, where, when?**
  - 1: Test the best atmospheres & synthetic spectra w. CES
  - 2: Use CES to obtain *accurate* abundance analyses

First visitor run
December 1981

- with a young
David Lambert

Chemical Evolution of the Milky Way Disk

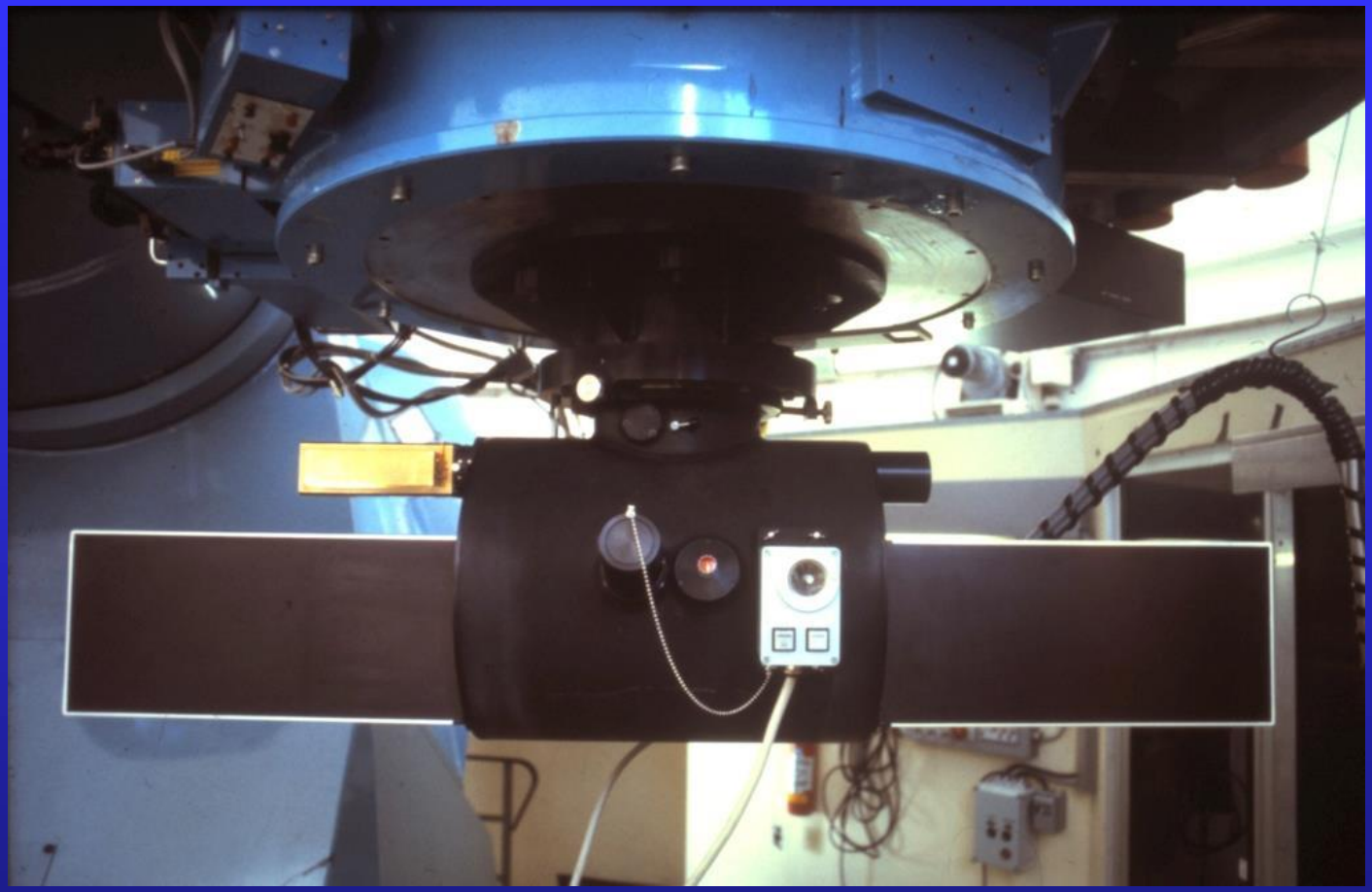


Subsample of 189 FG dwarfs

Edvardsson et al. (1993)

now >1,500 cit

1.54mD and Radial Velocities: CORAVEL



Synergy: DK, ESO and Geneva obs.

~1,800 nights
>100,000 obs

Projects: LMC, SMC, Cen, 47 Tuc, Binaries, clusters, GCS, HIPPARCOS++

Testing Stellar Models in NGC 3680

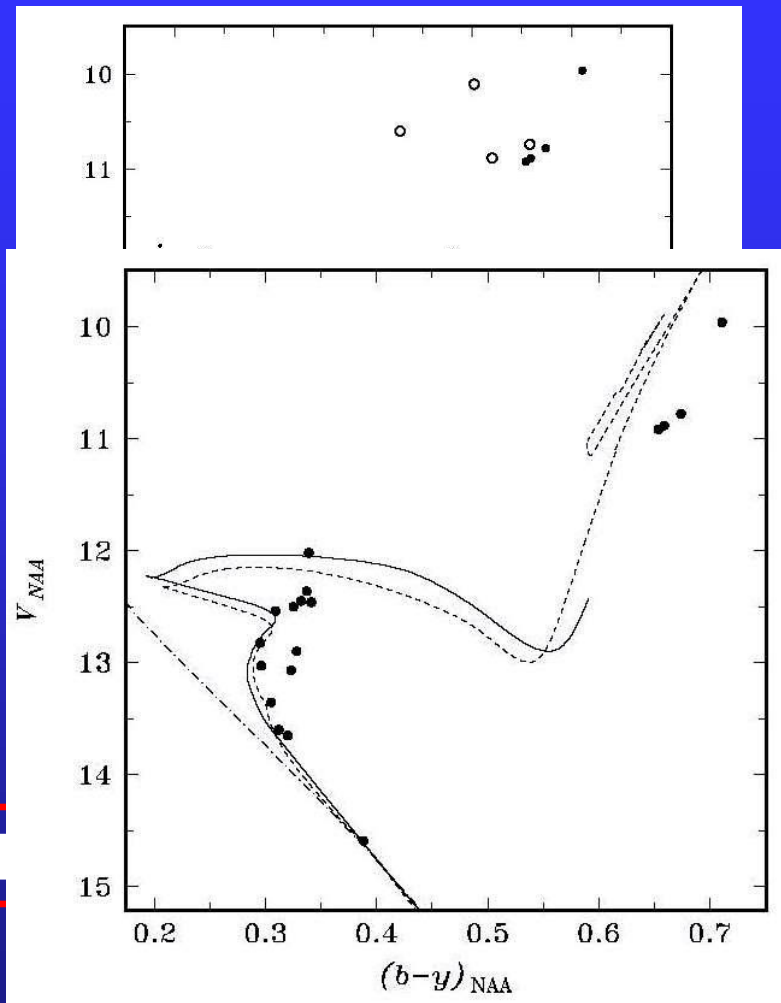


Fig. 13. Isochrone fit to the single members of NGC 3680 for the solar-metallicity standard models of VandenBerg (1985; full) and Castellani et al. (1992; dashed), both for an age of 1.5 Gyr and $(m\text{-}M)_0 = 10.25$

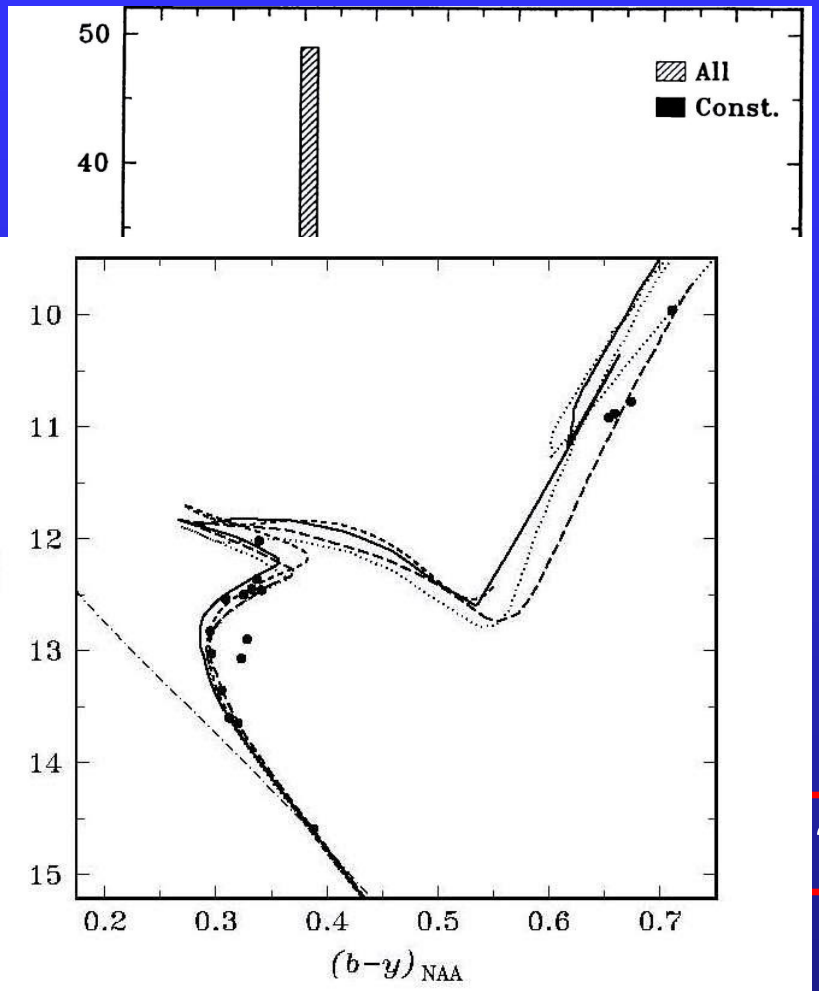


Fig. 14. As Fig. 13, but for the solar-metallicity overshooting models of S92 (1.6 Gyr, $(m\text{-}M)_0 = 10.17$; full), Claret (1995, 1.6 Gyr, $(m\text{-}M)_0 = 10.28$; long-dashed), DV96 (1.6 Gyr, $(m\text{-}M)_0 = 10.25$; short-dashed), and Bertelli et al. (1993, 1.6 Gyr, $(m\text{-}M)_0 = 10.25$; dots)

Political Disaster in Denmark in 1987

In 1987, the ESO Council decided to build the VLT, doubling the ESO budget. The Danish Government voted against. A full-blown disaster for Danish astronomy was imminent.

Implications were as immediately clear as they were unpleasant:

- Loss of ESO membership (DK would pay ~1% of new ESO budget)
- Loss of access to the Danish telescopes
- Loss of credibility with funding agencies
- Loss of credibility with universities
- No prospect of renewing staff positions anytime soon
- **In short: No future!**

The VLT Calamity (II): The Report

A reversal of such a political setback is always difficult and expensive and requires hard work. But no price was too high.

We were ordered *as a community* to submit a report addressing these points unequivocally (**NB:** No lead research institute!) :

- The Danish success rate in obtaining and publishing ESO observations;
- The role and lifetime of the Danish telescopes at ESO *and at home;*
- The balance between observational and theoretical research efforts;
- Plans for future scientific initiatives with or without VLT access;
- Organisational and geographic rationalization of research and teaching(!);
- The role of Danish instrumentation contributions to ESO+VLT etc.;
- The obligation to successfully run the fledgling Nordic telescope (NOT)

The VLT Calamity (III): The Rescue

The Goverment reversed its decision and maintained the full Danish membership in ESO in 1989, but the price was high.

Key elements in the solution were:

- A higher-ranked project had been approved and was no longer competing
- The report addressed ***all*** the thorny issues head-on; no equivocating!
- We lost 40% of our annual funds to run the DK telescopes ***and*** the NOT
- The Brorfelde and Copenhagen Observatories would be closed
- We would be monitored closely for ~5 years whether promises were kept
- The government realised the embarrassment of being kicked out of ESO
- The Carlsberg Foundation granted 25% of the Danish investment in VLT

- but it took >5 years of hard work to restore credibility!

Planning for Danish Astronomy 1987 -2017

DK in ESO Service: The STC 1993 - 1995

Scientific Priorities for La Silla Operations: Report of the Working Group

Final version, October 23, 1993

J. Andersen (ESO STC, Chairman)

J. Breysacher (ESO, Garching)

D. Hofstadt (ESO, La Silla)

J. Krautter (ESO OPC)

J. Lub (ESO UC)

M. Mayor (ESO STC, Past Chairman)

J. Melnick (ESO, La Silla)

J. Wampler (ESO, Garching)

Scientific Priorities for La Silla in the VLT Era

(Aka "La Silla 2000")

Report of the Working Group

6th and final version, November 20, 1995

J. Andersen (ESO STC), WG Chair
J. Bergeron (ESO)
J. Crocker (ESO)
M. Dennefeld (ESO UC)
J. Melnick (ESO)
G. Monnet (ESO)
S. Ortolani (ESO STC)
H. Schild (ESO UC)

Net Consequences of These Reports:

For ESO:

- Agreed, science-based priorities for the operations on La Silla
- Agreed, science-based priorities for what operations would remain in the longer-term future for La Silla, developed in a bottom-up process with extensive feedback from the community
- General acceptance – very few complaints later!

For Danish astronomy:

- 50 cm telescope closed 1994; 1.54m telescope closed 2004
- A young, forward-looking generation of astronomers recruited
- Huge influx of external grants, students and young scientists
- Science-based Danish share in the hugely successful **X-shooter**

Bottom Line (I):

After 47 years in ESO:

- Our own telescopes have been built, moved, and are now closed
- The scientific fields we knew in 1967 are all gone (uvbyβ photometry, stellar evolution and pulsation models, astrometry, local galactic structure, eclipsing binaries, …); most of the people are retired or fired(!)
- The institutes and observatories we knew are all closed.

But Danish astronomy is stronger than ever in history:

- Danish astronomers remain heavy users of ESO, the VLT and ALMA
- Synergy between observations & theory, ground & space is healthy
- Innovative research fields have sprung up, foreshadowing the E-ELT
- Huge influx of external grants, students and young scientists
- NOT is a successful northern complement; X-shooter clone on the way

Bottom Line (II):

- Welcome competition – it makes you stronger
- Risk is a fact of life; stagnation is scientific death
- Be open to the world – that's where the future is

THANK YOU!