The Work of the BAV

Overview of the technical work of the „Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e. V. (BAV)“

Contents

History of the BAV

The “Berliner Arbeitsgemeinschaft für Veränderliche Sterne” was founded 1950 by amateur astronomers at the Archenhold Observatory in Berlin-Treptow. The intention was - and still is - to support amateurs in the systematic observation of variable stars.

The observations are published and therefore may give professionals additional information for their work. The observation programs of the BAV are composed in cooperation with professionals in regard to their research foci.

Due to the increasing number of members and their multi-regional distribution the BAV was introduced to the register of associations in 1962. BAV sections were established in 1981 for specific topics of variable star observation. In addition, the BAV became the section “Variable Stars” of the “Vereinigung der Sternfreunde e. V.” (VdS) in 1983. At the 14th BAV-convention in September 1992 in Sonneberg the “Berliner Arbeitsgemeinschaft für Veränderliche Sterne e. V.” (BAV) and the “Arbeitskreis Veränderliche Sterne im Kulturbund der DDR” (AKV) joined to become the “Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e. V.” (BAV).

Today the BAV counts more than 200 members, mainly from Germany. It exchanges publications with more than 80 astronomical institutes worldwide.

Observation of Variable Stars

Observation Goals

It is the intention of the BAV to support amateurs in the systematic observation of variable stars. Especially long-term observations are highly valuable and enable us to deduce the physical characteristics of variable stars. From measurements or estimations of brightness variations the times of highest or lowest brightness (maximum or minimum) are derived. These are called the "observation results".

Moreover, the elements of brightness variations of specific stars are derived and new variables are systematically sought and classified.

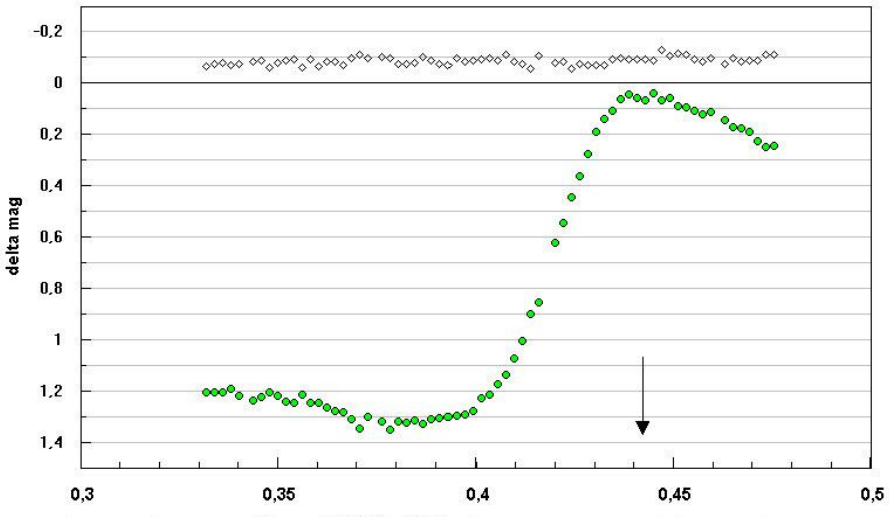
Observation Techniques

Until the 1980s visual observations dominated. Later the light-electric photometry was established, while nowadays the CCD-technology prevails. Today more than 2,000 maxima and mimima are observed per year.

The Observation Programs of the BAV

The following variable types are systematically observed: Eclipsing binaries, short-period pulsating stars (RR Lyrae, delta Scuti and delta Cephei stars), long-period pulsating stars (Mira stars, RV-Tauri and semi-regular stars), eruptive and cataclysmic stars.

RR Leo 2007-04-04 / 5



MAX:	22:36:20	UTC,	JD geo:	2454195,4419	
			JD hel:	2454195,4457	± 0,0005
			JD(TT) hel:	2454195,4465	± 0,0005

Beobachter: W. Quester (QU) n = 67

Vergl-Sterne: C = GSC 1968.860 (V = 9.97; B-V = 0.632)
K = GSC 1968.912 (V = 11.38; B-V = 1.083)

Instrument: ST-7E mit V-Filter an 20 cm Cass. f/6,4. Beli 90 sek.

Luftmasse X = 1,5...1,0 Zunehmend Zirren, die zum Abbruch führten.

Fotometrie mit MUNIWIN 1.0 Grafische Auswertung (Pogson)

Die Rauten bei delta mag -0,1 zeigen die Differenz zwischen den Vergleichssternen + Konstante.

Mittlerer Fehler der Einzelmessung ±0,01 mag.

Gegen Circular 2007 ist das Max 0,03 d = 3/4 Std. verspätet. Gute Darstellung mit meinen quadratischen Elementen von 1999: Max = JD 24 43295,3959 + 0,45239235 *E + 1,86E-10 * E^2

an BAV: 2007-04-17 Datei: RRLeo071
Leo_RR_54195_QU.jpg

Fig. 1 CCD-observation of an RR Lyrae star

Light Curve Diagrams and the BAV Light Curve Database
Since the early beginning light curve diagrams document the observation results. They contain a graph of the measurements or estimations, the derived time of maximum or minimum brightness and a description of the instrumentation as well as the evaluation method used. An example is shown in Fig. 1. All of the more than 45,000 collected light curve diagrams are digitally available.

The Publication of Observation Results in the BAV Mitteilungen
The observation results are communicated in the BAV Mitteilungen. Between 1950 and 1981 these were mainly published in the Astronomische Nachrichten, since then primarily in the Information Bulletin on Variable Stars (IBVS) of the commissions 27 and 42 of the IAU. Until 2010 212 BAV Mitteilungen were published with more than 43,000 observed maxima and minima. These are also available as ASCII-file data.

According to the international cooperation of amateur observers estimations of Mira stars, semi-regular and irregular variables and cataclysmic stars are sent to the American Association of Variable Star Observers (AAVSO) and the Association Francaise des Obsevaterus d'Etoiles Variables (AFOEV).

Collaboration within the BAV

BAV-Sections
Since 1981 the BAV is organized in sections to promote teamwork in specific fields of observation and to encourage and support the members. A main aspect was to develop the interest in the different types of variables. There are sections for eclipsing binaries, short-period pulsating stars, Mira stars, semi-regular and irregular stars, cataclysmic variables, CCD-observation, data evaluation and publication of observation results.

Bulletin BAV Rundbrief and BAV-Conventions
Since 1952 a quarterly bulletin is published for members, the so-called BAV Rundbrief. Since 1966 a biennial convention is held at different places in Germany, preferably near to new observers.

BAV-Website
The Internet presentation of the BAV can be found at www.bav-astro.de for more than 10 years. It provides up-to-date and extensive information on variables, proposals for observations and auxiliary material of the BAV. Links connect to other variable star observation organizations worldwide. The BAV email forum is established as a platform for exchange and discussion.

Collaboration with Professional Astronomers

The fundamental and still valid, but substantially extended, observation program of the young BAV was created 1950 in close collaboration with the professional astronomers Prof. Cuno Hoffmeister and Paul Ahnert in Sonneberg and Prof. Dr. H. Schneller of the astrophysical observatory in Potsdam. It covers many types of variables and was oriented towards the visual observing potentials of amateurs with small instruments (e.g. 4”-refractors) and visually observable amplitudes of greater than 0.5 mag. In the 50s many professionals still observed visually or evaluated photographic plates. Only a few institutes measured variables by light electric means. There was a great interest among professionals to include the systematically generated results of amateurs in their publications. And so the observation results of the BAV were published in the Astronomische Nachrichten, Potsdam, for example.

In the 1960s the publication of the “Information Bulletin on Variable Stars” (IBVS) of the IAU commissions 27 and 42 started. The CCD-observation results of our members are published here due to the high quality.

Professionals tracked variable stars which were found by amateurs, like V364 Lacertae and FF Cancri, originally discovered by our member Peter Frank. On the other hand, amateurs were able to classify new bright variables discovered by the Hipparcos-project through systematic monitoring. The light curve of HD143213 (V335 Serpentis), for example, could be derived on the basis of a period determination by Eckhard Born. This result was published in IBVS. In addition, there are more than 250 discoveries of new variables by our members Dr. Klaus Bernhard, Franz Agerer and Wolfgang Quester.

The professionals are interested in the collaboration with amateurs as long as they can rely on high quality CCD-results which are typical for the BAV observations. At the biennial BAV conventions professionals do not only present their work, but also express wishes for support by amateurs. Here are a few examples of the collaboration with professionals.

TU Ursae Majoris

In 2004 our member Wolfgang Quester contacted Prof. Wade of Pennsylvania State University USA, because the published times of maximum differed about 3 to 5 hours from his own measurements. The following discussion led to the abdication of the Pogson evaluation method for TU UMa.

Since then W. Quester observes for Prof. R. Wade maxima of TU UMa with CCD-camera and V-filter. The evaluation is based on a template light curve provided by Prof. Wade. Due to the V-measurements and evaluation with the template light curve the times of maximum are now as precise as approx. +/- 1 minute (Fig. 2). Such an approach is applicable for this RR Lyrae star because of its smooth brightness variation. The measurements are used to improve the orbit data of the TU UMa double star system.

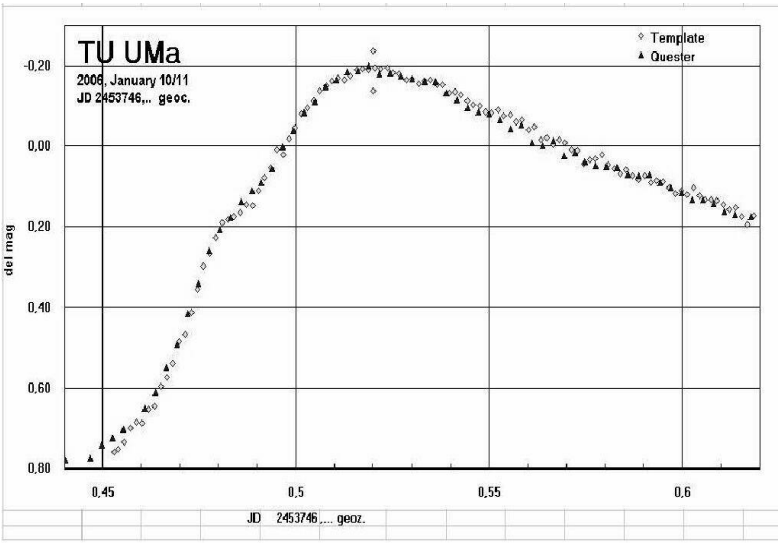


Fig. 2 Superposition of measurements by W. Quester with V-Filter (solid triangles) and WADE-template (diamond). The two diamonds at JD ...,5202 above and below the curve show the time of maximum.

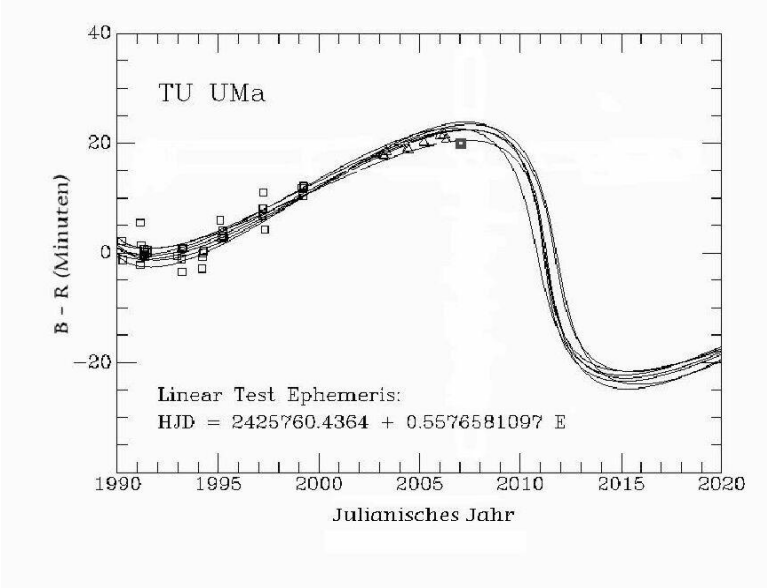


Fig. 3 (O-C) diagram of TU UMa according to orbit models calculated by Wade (priv. communication, 2006). The curves correspond to the calculated orbits, the symbols represent the used times of maximum. The last square shows the result of February 2007.

From the observed stability of the light curve a stable period could also be assumed. But the star resisted all trials to interpret its large variations in the O-C-diagram for decades. In the 1980s a model was proposed that described TU UMa as the bright component of a double star system with the O-C-variations caused by the brightness variation during the orbit. In 1990 additional spectroscopic measurements hinted a highly excentric orbit with a period of approximately 20 years. Since then professional astronomers track this star because it provides the opportunity to derive the exact mass of an RR Lyrae star. Furthermore an influence of the companion on the light curve near the periastron is suspected. This is foreseen to happen in 2011 with a distance of only 2 AE between the two stars (Fig. 3).

MORO

Prof. H. Drechsel and Dipl.-Phys. St. Nesslinger (Dr. Remeis-Observatory, Bamberg) made the Wilson-Devinney software program MORO for the determination of the system data of eclipsing binaries available to the BAV (Wolfgang Quester). At the 2005 BAV regional convention in Hartha Stefan Nesslinger presented the basics for the derivation of star system parameters.

MORO is written in FORTRAN. Our member Dr. Hans Jungbluth (Karlsruhe) worked on the user interface to improve the usability. Furthermore Prof. Kallrath (University of Florida USA), a co-author of several books about the WD-program, was contacted. Prof. Kallrath works at BASF and lives only about 80 km away from Karlsruhe.

Absolute dimensions of eclipsing binaries can only be calculated, if their radial velocities are known, too. So it's one task to find professional observatories which measure the spectra over a whole period and are willing to provide them for our analysis.

Rosat

Dr. K. Dennerl (MPI Garching) and our member Franz Agerer, using CCD-camera and V-filter, measured simultaneously for comparison with Rosat-observations.

Newly Discovered Variables

Professional astronomers (especially Dr. Chris Lloyd, Open University, UK) support our member Dr. Klaus Bernhard in the analysis and publication of the variables he discovered with his survey software tool. A recent collaboration was on the the new dwarf nova GSC 02736-01067, which was derived from the data of the professional sky survey program ROTSE (IBVS 5750).

(These examples were assembled by the end of 2006.)

The Lichtenknecker-Database of the BAV

Collection of observation results of eclipsing binaries
with more than 160,000 times of minima of about 2,000 stars

In the late 1970s Dieter Lichtenknecker started to collect the times of minima of eclipsing binaries. His intention was to gather all available observations since their discovery. Except for Algol he accomplished this goal very well. His work required extensive investigations of the relevant literature in several libraries as well as the data recording on computers of that time. After his death in 1990 Franz Agerer continued the collection.

In 2004 this data collection – to honor its creator now called "Lichtenknecker-Database of the BAV" – was opened to the experts. It is available online at www.bav-astro.de/LkDB/index.php. The BAV does not have any rights on the recorded observation results; these are still with the authors and observers. But particularly with regard to the enormous efforts we expect the citation of the official title "Lichtenknecker-Database of the BAV" whenever using its data.

The observations were collected from many worldwide available literature sources. In our understanding they are nearly complete, especially with regard to historic observations. The search covered more than 200 publications and periodicals. The criteria for including stars in the database are a brightness of more than 13 mag in normal light and a declination north of -20 degree. There is no limit for the amplitude or period.

The Lichtenknecker-database also contains a library – the actual knowledge base – with nearly all literature sources of the database entries. These sources were mainly copied from publications and are archived on more than 25 meters of shelf space.

To give an impression of the usage of the Lichtenknecker-Database of the BAV the next two pages show two O-C-diagrams. The diagrams show the difference between observed times of minima and the predicted times under the assumption of a constant period.

Fig. 4 shows the O-C-diagram of U Cep. This eclipsing binary has often been observed since 1880 with only a few gaps in the time series. In contrast, Fig. 5 shows the O-C-diagram of AM CMi. Until JD 37500 results from photographic plates exhibit large variations. After a 25 years gap the last 9 observation results indicate a significant change of period. This example shows that especially the long period without observations hamper the interpretation seriously.

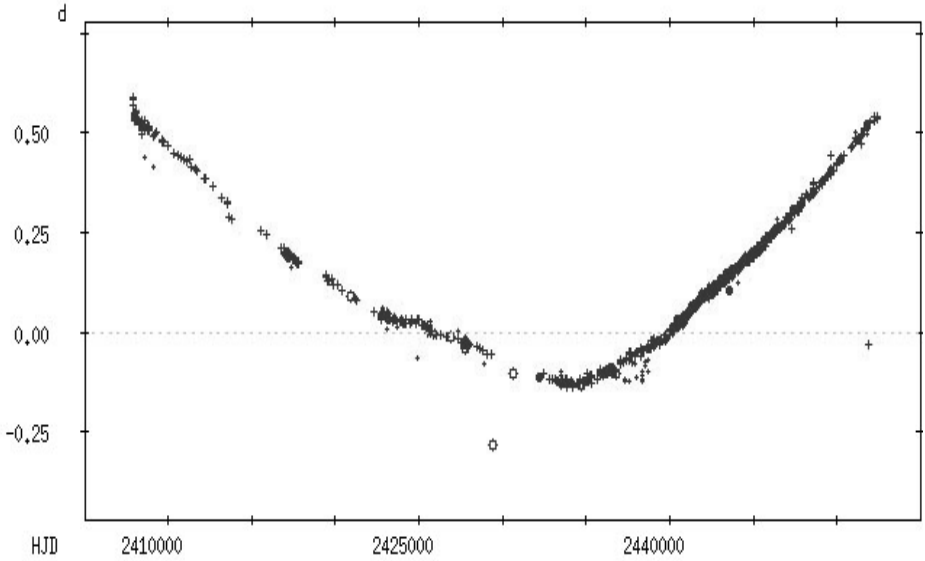


Fig.4 O-C-diagram of the eclipsing binary U Cephei
Elements Min I: 2444541,4241 + 2,49296991 ***** E

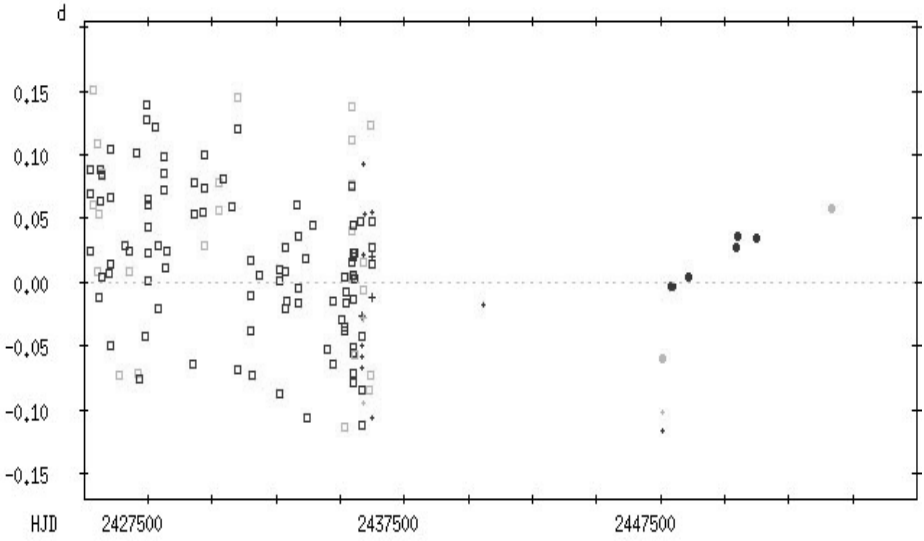


Fig.5 O-C-diagram of the eclipsing binary AM Canis Minoris
Elements Min I: 2447913,4651 + 1,01919192 ***** E

BAV Publications

BAV Mitteilungen
Since the foundation of the BAV the observation results from BAV members have been published in 200 communication papers, called BAV Mitteilungen. The main target audience of the bulletin are professional astronomers. You will find them upon our BAV-Website.

BAV Rundbrief
The quarterly BAV information bulletin, called BAV Rundbrief, is published since 1952. It contains observation reports, BAV internal information and relevant literature summaries. Main target audiences are the members of the BAV and friends of variable star observation in general. The Simbad database contains papers with English abstracts from the BAV Rundbrief for more than 10 years.

BAV Circular
The BAV Circular is an annual publication to support the observation planning and preparation. Volume 1 contains essential data for all variables in the BAV observation programs. Volume 2 contains the ephemeris of eclipsing binaries, RR Lyrae and Mira stars.

Materials for Observers

BAV Introduction to the Observation of Variables Stars
Since March 2007 the third, totally revised and largely extended edition of the BAV introduction is available, following the first two editions from 1965 and 1983.

It describes methods for preparing, performing and evaluating observations. Prof. Dr. Edward Geyer explains the astrophysical basics of the different types of variable stars. The annex contains a description of the recent star classification scheme, an extensive reference list, Internet addresses and various tables.

BAV-Finder Charts
More than 300 finder charts for the stars of the BAV observation programs are available in formats DIN A5 as well as DIN A4. A digital version is also available on CD-Rom.

BAV-Files
Maxima and minima, all observational results of the BAV (more than 43,000).

BAV-Papers
Means for preparing, performing and evaluating observations as e.g.:
- Light curve templates (Reference for the layout of light curve diagrams),
- Photo-series for practical exercises of the Argelander method,

The BAV-Conventions

The biennial BAV-conventions are held since 1966 together with the general meeting of the society to encourage collaboration. Members do not only meet each other but also learn about their work and methods. In addition professional astronomers present their fields of research.

1. BAV-Convention 1966 Recklinghausen; speaker
   Prof. Dr. Kippenhahn, Göttingen, Prof. Dr. Kopal, Manchester, UK
2. BAV-Convention 1968 Weil der Stadt
3. BAV-Convention 1970 Hannover speaker Prof. Dr. Vogt, Bochum
4. BAV-Convention 1972 Darmstadt; speaker
   Prof. Dr. Detre, Budapest, Ungarn, Prof. Dr. Walter, Tübingen
5. BAV-Convention 1974 Hamburg; speaker Prof. Dr. Weigert, Hamburg
6. BAV-Convention 1976 Würzburg; speaker
   Prof. Dr. Mauder, Tübingen, Dr. Baschek, Heidelberg
7. BAV-Convention 1978 Berlin; speaker
   Frau Prof. Dr. Seitter, Münster, Dr. Dürbeck, Daun
8. BAV-Convention 1980 Bonn; speaker
   Prof. Dr. Geyer, Daun, Dr. Gieseking, Bonn
9. BAV-Convention 1982 Wertheim; speaker Frau La Douce, München
10. BAV-Convention 1984 Hannover; speaker Prof. Dr. Mauder, Tübingen
11. BAV-Convention 1986 Landshut; speaker
    Prof. Dr. Herczeg, Oklahoma, USA, Dr. Ritter, München
12. BAV-Convention 1988 Dortmund; speaker
    Prof. Dr. Geyer, Bonn, Prof. Dr. Gieren, Bonn, Fr. Thiering, Hamburg
13. BAV-Convention 1990 Violau; speaker
    Dr. Götz, Dr. Richter, Sonneberg, Prof. Dr. Mauder, Tübingen
14. BAV-Convention 1992 Sonneberg; speaker
    Dr. Richter, Sonneberg, Dr. Luthardt, Sonneberg, Frau Prof. Dr. Bues, Bamberg
15. BAV-Convention 1994 Violau; speaker
    Prof. Dr. Drechsel, Bamberg, Prof. Dr. Heber, Bamberg
16. BAV-Convention 1996 Nürnberg; speaker Frau Dr. La Douce, Sonneberg
17. BAV-Convention 1998 Hildesheim ; speaker
    Prof. Dr. Jürgen Staude, Potsdam, Frau Prof. Dr. Wolfschmidt, Hamburg
18. BAV-Convention 2000 Sonneberg; speaker Dr. Neuhäuser, München
19. BAV-Convention 2002 Osnabrück; speaker Dr. Engels, Hamburg
20. BAV-Convention 2004 Göttingen; speaker Dr. Reinsch, Göttingen
21. BAV-Convention 2006 Heidelberg; speaker Dr. Jordan, Heidelberg
22. BAV-Convention 2008 Potsdam; speaker Prof. Dr. Klaus G. Strassmeier, Potsdam
23. BAV-Convention 2010 Recklinghausen; speaker Dr. Gisela Maintz, Bonn

Managing Committee of the BAV

1st Chairman	Prof. Dr. Lienhard Pagel, Klockenhagen
2nd Chairman	Dietmar Bannuscher, Herschbach
Executive director	Dipl. Kfm. Joachim Hübscher, Berlin

Services for Scientists
http://www.bav-astro.de/sfs/index.php

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translated by Thomas Zimmermann

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