A tudományos közlés művészete

III. Egy tudományos cikk 2.

Kiss László
MTA KTM Csillagászati Kutatóintézet

Miről lesz szó?

- Egy cikk megvalósítása
- Tippek és trükkök
- Mit ne tegyünk

Nagyon jó összefoglalás: Sterken, C., 2006, Advice on Writing a Scientific Paper, in: "Astrophysics of Variable Stars", ASP Conf. Series, Vol. 349, pp. 445-467

- Még egy kicsit rágjuk a bekezdések szerepét:

  kis szövegelemzés Szatmáry et al. (2003), A&A, 398, 277-282, “The He-shell flash in action: T Ursae Minoris revisited” cikkéről.

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The He-shell flash in action: T Ursae Minoris revisited

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Abstract. We present an updated and improved description of the light curve behaviour of T Ursae Minoris, which is a Mira star with the strongest period change (the present rate is an amazing -3.8 ± 0.4 days/year corresponding to a relative decrease of about 1% per cycle). Ninety years of visual data were collected from all available databases and the resulting, almost uninterrupted light curve was analysed with the O–C diagram, Fourier analysis and various time-frequency methods. The Choi-Williams and Zhao-Atlas-Marks distributions gave the clearest image of frequency and light curve shape variations. A decrease of the intensity average of the light curve was also found, which is in accordance with a period-luminosity relation for Mira stars. We predict the star will finish its period decrease in the meaningfully near future (c.c. 5 to 30 years) and strongly suggest to closely follow the star's variations (photometric, as well as spectroscopic) during this period.

Key words. stars: variables: general – stars: oscillations – stars: AGB and post-AGB – stars: individual: T UMi

1. Introduction

analyses witnessed a considerable development in time-

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1. Introduction

During the last several years, there has been an increasing number of Mira stars discovered to show long-term continuous period changes (see some recent examples in Sterken et al. 1999; Hawkins et al. 2001 and a comprehensive reanalysis of R Hydrae, an archetype of such Mira stars, by Zijlstra et al. 2002). The widely adopted view of their period change is based on the He-shell flash model, outlined by Wood & Zarro (1981). According to this model, energy producing instabilities appear when a helium-burning shell, developed in the early Asymptotic Giant Branch (AGB) phase, starts to exhaust its helium content. Then the shell switches to hydrogen burning, punctuated by regular helium flashes, called also as thermal pulses (Vassiliadis & Wood 1993). During these flashes the stellar luminosity changes quite rapidly and the period of pulsation follows the luminosity variations.

Rapid period decrease in T Ursae Minoris (= HD 118556, $V_{max} \approx 9\overset{m}{.}0$, $V_{min} \approx 14\overset{m}{.}0$) was discovered by Gál & Szatmáry (1995), who analysed ~45 years-long visual data distributed in two distinct parts between 1932 and 1993. Mattei & Foster (1995) analysed almost 90 years of AAVSO data collected between 1905 and 1994 and concluded that the period decreasing rate of T UMi (2.75 days/year as determined by them) is twice as fast as in two other similar Mira stars (R Aql and R Hya). Most recently, Šmelcer (2002) presented almost three years of CCD photometry of T UMi, resulting in four accurate times of maximum.

The main aim of our paper is to update our knowledge on T UMi. The eight years passed since the last two detailed analyses witnessed a considerable development in time-frequency methods, which allow more sophisticated description of light curve behaviour. On the other hand, these eight years yielded more than 10 new cycles of the light curve prolonging quite significantly the time-base of the period decreasing phase. The paper is organised as follows. Observations are described in Sect. 2, a new and more sophisticated light curve analysis is presented in Sect. 3. Results are discussed in Sect. 4.

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2. Observations

Four sources of visual data were used in our study. The bulk of the data was taken from the publicly available databases of the Association Française des Observateurs d'Étoiles Variables (AFOEV[1]) and the Variable Star Observers's League in Japan (VSOLJ[2]). (Besides the visual data, the AFOEV subset contains a few CCD-V measurements, too.) Since these data end in early 2002, the latest part of the light curve is covered via the VSNET computer service. The merged dataset showed a quite large gap between JD 2431000 and 2437000. Therefore, we have extracted data collected by the American Association of Variable Star Observers (AAVSO) with help of the Dexter Java applet available at the Astrophysical Data System (these data were published by Mattei & Foster 1995 as light curves, which can be converted into ASCII data with that Java applet). Basic data of individual sets are summarized in Table 1.

We found the different data to agree very well (similarly to the case of R Cygni in Kiss & Szatmáry 2002) and that is why we simply merged the independent observations to form the final dataset. It is almost uninterrupted between 1913 and 2002

1 ftp://cdsarc.u-strasbg.fr/pub/afoev
2 http://www.kusastro.kyoto-u.ac.jp/vsnet/gcvs

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JD (-2400000)

whose period decreased from 495 days to 380 days between 1700 and 1950. These authors examined different assumptions, including luminosity decrease from a P-L relation (Feast 1996), evolution at constant L and even evolution with slightly increasing L. From the visual light curve it was concluded that no luminosity change can be proven as the average visual magnitude has not changed since 1910. However, they noted the decreased visual amplitude explained by the non-linearity of pulsation (cf. Kiss et al. 2000 discussing the period-amplitude relation for Y Persei). A similar amplitude decrease was described for another He-shell flash Mira, R Centauri (Hawkins et al. 2001).

However, we feel it necessary to point out that for a large amplitude Mira star one has to be careful when concluding the luminosity constancy from the constant average magnitude. This is because of the logarithmic nature of the magnitude scale. As an illustration, let us consider two Mira stars with $m_{1,\max} = 7$ mag, $m_{1,\min} = 13$ mag, $m_{2,\max} = 8$ mag and $m_{2,\min} = 12$ mag. The average magnitude is 10 mag in both cases. However, the physically relevant parameter is the intensity being $i \sim 10^{-0.4m}$. After calculating average intensities, one can convert them to meaningful average magnitudes, in our cases to $7^{\rm m}.75$ and $8^{\rm m}.73$. The difference is almost one magnitude. This is a fairly trivial consideration but it has to be kept in mind when averaging large amplitude Mira light curves.

As expected, both R Hya and R Cen showed such amplitude decrease that resulted in fainter maxima and brighter minima (Figs. 1 in Hawkins et al. 2001 and Zijlstra et al. 2002). We found a similar behaviour for T UMi, too, which has already been predicted by Whitelock (1999). To take into account the necessity of intensity averaging, we have converted the binned light curve to intensities and calculated mean intensities per cycles (Fig. 7). The scatter in Fig. 7 is, of course, quite large, due to typical cycle-to-cycle changes of the maximum brightness. However, there is an indication at the end of data for a slight decrease of the intensity. A simple linear fit of the last 7500 days (JD 2 445 000–2 452 500) was used to infer

Fig. 7. The intensity average per cycle against time and the O–C variation before the period decrease.

$\Delta\langle m\rangle = -0^{\rm m}.47 \pm 0^{\rm m}.4$. This value was compared with calculated absolute magnitude changes (see next paragraph). The general appearance of the intensity average curve as a function of time reminded us the shape of the O–C diagram and that is why we added the O–C points (before JD 2445000) in Fig. 7. The parallel trends suggest that there is a positive correlation between the full intensity and corresponding cycle length.

As a rough approximation, we assumed that averaging along the full cycle smooths out the effects of varying bolometric correction and the mean magnitude difference found from the observations corresponds directly to $\Delta M_{\rm bol}$. Adopting a period change from 315 days to 215 days, the P-L relation derived from LMC Mira stars (Feast 1996)

$$M_{\rm bol} = -3.00 \log P + \alpha$$

gives $\Delta M_{\rm bol} = -0^{\rm m}.49$. The close agreement is probably pure coincidence, though remarkable.

Another comparison was made with theoretically expected luminosity change as discussed in Wood & Zarro (1981) when deducing their Eq. (10). From that relation it follows that the luminosity change depends only on the period change and two ambiguosly determined constants (b and β in their notation). For $\beta = 16.67$ and $b = 1.5$ or 2, we calculated $\Delta M_{\rm bol} = -0^{\rm m}.45$ and $-0^{\rm m}.34$. The agreement is again demonstrative. Therefore, we conclude that the tenuous intensity decrease is consistent (at least partly) with the assumption of P-L relation being applicable in this case. Another effect with similar outcome is the amplitude reduction due to the non-linearity of pulsation. The most likely scenario is that both processes occur in T UMi.

Figure 3 in Wood & Zarro (1981) led Gál & Szatmáry (1995) to conclude that T UMi is just after the onset of a He-shell flash and it is likely to have core mass similar to R Aql and R Hya. Presently available data shift the core mass to a slightly

Hogyan segítsük az ihletet beindulni? (szubjektív javaslatok)

- időben kezdjük el a kézirat szerkesztését
- állítsuk össze a téma legfontosabb 6-8 (esetleg 10) cikkének gyűjteményét, célszerűen nyomtatásban
- olvassunk (és több szemmel figyeljünk), mielőtt írunk
- minden nap tűzzünk ki realisztikus célokat
- ha semmi más menekvés nincs, csináljuk meg a (közel) zérus agyat igénylő feladatokat (demonstráció)
- gyakran nyomtassuk ki az aktuális változatot, firkáljuk össze, gondolkodjunk felette
- minimalizáljuk a LaTeX-szerkesztés technikai nehézségeit (példák; google: “latex frontend”; “syntax highlighting”)

Amiket ne tegyünk

1. Ne írj le dolgokat, amiket nem értesz!

   Pl. latin kifejezések, rövidítések: ad hoc, per se, i.e., et al., e.g.

2. Akronímák (betűszók) túlzott használata

   Biztos muszáj újat kitalálni? Első alkalommal mindig fel kell oldani. Két-három alkalmazás még nem indokolja a használatot. Ha lehet, figyeljünk az esetleg obszcén jelentésű akronímákra. Absztraktban ne legyen. Birtokos esetbe ne helyezzük (WET's results vs. results obtained by WET)

Amiket ne tegyünk

3. Amerikai és brit stílus keverése:

   pl. color-colour, catalogue-catalog, analise-analyze.

4. Klisék

   Biztos, hogy asztroszeizmológia három frekvencia meghatározása?

Amiket ne tegyünk

5. Ronda és/vagy használhatatlan ábrák, táblázatok

   Ábrák: színes szimbólumok ügyetlen használata (n.b. zöld és piros együtt kerülendő)

   feliratok olvashatók legyenek nyomtatva is

   mértékegységek feltüntetése

   ábrázolt adatok töltsék ki a tengelyek által közbezárt területet

   egy cikken belül a feliratok stílusa és mérete legyen hasonló (identikus)

   Táblázatok: oszlopok elrendezése (nem csak központozott rendezés létezik)

   mínuszjelek és kötőjelek

   értékes vs. feltüntetett tizedesjegyek

Amiket ne tegyünk

6. Nagy kezdőbetűk inkonzisztens használata

   pl. galaxy - Galaxy, moon - Moon, figure - Figure, table - Table

7. Lábjegyzetek: csak ha nagyon-nagyon muszáj

8. Óvatosan a matematikában vagy fizikában szigorú jelentéssel bíró kifejezésekkel

   pl. chaos, linear, robust, mode

   különösen a σ jelentésére figyeljünk

9. Felesleges kihangsúlyozás

   pl. szedési stílusban (félkövér, dőlt betűk)

   locsogó kifejezésekkel (pl. existing calibrations, published results in the literature)

Amiket ne tegyünk

10.Kötőjel, vessző, aposztróf helytelen használata

Expressions like "zero mean uncorrelated random variable" are difficult to understand, and therefore the English language uses the hyphen (dash) between related words: zero-mean and random-variable. Other examples are radial-velocity curve, light-time effect, 60-cm telescope (not 60cm-telescope), close-binary system. The hyphen in "20-th century" is superfluous since 20th is an abbreviation and contraction.

The comma serves to indicate a pause, and ommission or transposition of a comma may completely change the meaning of the sentence. Consider, for example, the following sentences in which only the number and place of the commas differ: "*Chris said, Conny lets meet tomorrow*" and "*Chris, said Conny, lets meet tomorrow*".

An apostrophe is a mark used to indicate the omission of letters or the possessive case (genitive): Mira (plural Miras – not Mira's), LBV (plural LBVs not LBV's).

Amiket ne tegyünk

11. "Hamis barátok": nagyon hasonló alakú szavak két nyelvben, de a jelentésük nagyon különböző (where - wer, who - wo)

12. Nemek téves használata ("his, her"). Csak ha biztosak vagyunk a hivatkozott szerző nemére.

13. Nem-standard nevezéktan (égitesteknél különösen zavaró)

V* del Cep -- Classical Cepheid (delta Cep type)

query around with radius 2 arcmin

Other object types:	cC* () ,* (*,AG,BD,CSI,FK5,GC,GCRV,GEN#,GSC,HD,HIC,HIP,HR,N30,PLX,PMC,PPM,ROT,SAO,SKY#,TYC,UBV,uvby ,** (ADS,CCDM,IDS,WDS) ,IR (IRAS,IRC,2MASS) ,V* (V*,AAVSO) ,UV (CEL,TD1)
ICRS coord. (ep=2000) :	22 29 10.2663 +58 24 54.715 (~) [6.30 5.69 102] A 1997A&A...323L..49P
FK5 coord. (ep=2000 eq=2000) :	22 29 10.266 +58 24 54.71 (~) [6.30 5.69 102] A 1997A&A...323L..49P
FK4 coord. (ep=1950 eq=1950) :	22 27 18.52 +58 09 31.8 (~) [35.07 32.50 99] A 1997A&A...323L..49P
Gal coord. (ep=2000) :	105.1943 +00.5306 (~) [6.30 5.69 102] A 1997A&A...323L..49P
Proper motions *mas/yr* [error ellipse]:	16.47 3.55 [0.69 0.64 99] A 1997A&A...323L..49P
Radial velocity / Redshift / cz :	V(km/s) -16.8 [0.9] / z(~) -0.000056 [0.000003] / cz -16.80 [0.90] (~) A 1953GCRV..C......0W
Parallaxes *mas*:	3.32 [0.58] A 1997A&A...323L..49P
Spectral type:	F5Iab: C ~
Fluxes (6) :	B 4.81 [~] C ~ V 4.07 [~] C ~ I 3.219 [~] D 2006MNRAS.369..723N J 2.865 [0.200] C 2003yCat.2246....0C H 2.608 [0.190] C 2003yCat.2246....0C K 2.354 [0.216] C 2003yCat.2246....0C

Identifiers (35) :

V* del Cep	FK5 847	IDS 22254+5754 A	SAO 34508
* 27 Cep	GC 31421	IRAS 22273+5809	SKY# 42788
* del Cep	GCRV 14138	IRC +60356	TD1 29132
ADS 15987 A	GEN# +1.00213306	2MASS J22291029+5824549	TYC 3995-1479-1
AG+58 1460	GSC 03995-01479	N30 4955	UBV 21546
BD+57 2548	HD 213306	PLX 5443	uvby98 100213306 V
CCDM J22292+5825A	HIC 110991	PMC 90-93 594	WDS J22291+5825
CEL 5480	HIP 110991	PPM 40731	AAVSO 2225+57
CSI+57 2548 1	HR 8571	ROT 3272	

Amiket ne tegyünk

14. Helytelen kifejezések

Ez talán a legnehezebb a nem angol anyanyelvű szerzőknek. Angol-angol szótár (pl. www.dict.org) sokat segíthet a példákkal. Google: találatgyakoriság bizonytalan esetben.

English is becoming the *de facto* scientific language, and a very substantial fraction of science papers are written by non-native English-speaking authors. This leads to many problems, which can be handled with due training. Always look up the meaning of a word whenever you are in doubt, especially when words with different meanings have almost the same pronounciation (for example "whole" and "hole"). Words which are considered synonyms in your mother tongue, may have a different connotation in English (like large/great/big, intriguing/interesting or claim/maintain/prove). Beware when acknowledging the ministry: make sure that you refer to the office of the minister, and not the clergy (the body of ministers of religion).

One of the most difficult issues is the proper use of the definite article "the". A definite article is used before singular and plural nouns when the noun is specific. It does not change according to the gender or number of the noun it refers to. This is not so in many other languages, some even do not use the definite article at all, or insert "the" when it is not done in English. The only way to learn is to read a lot, and have your papers proofread by a native English-speaking scientist.