LONG-TERM EVOLUTION OF COLOUR INDICES OF THE SYMBIOTIC SYSTEM AX PERSEI

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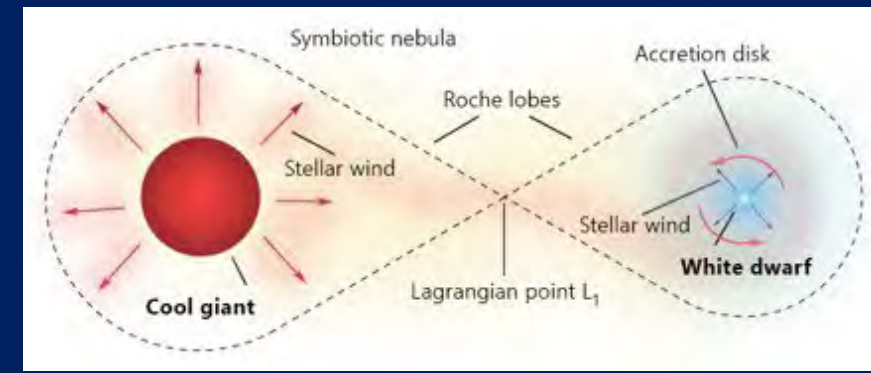
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THE GOALS OF OUR RESEARCH

- Detailed analysis of the long-term evolution of $U\text{-}B$, $B\text{-}V$, $V\text{-}R_c$, $V\text{-}I_c$ and $R_c\text{-}I_c$ colour indices of the symbiotic system AX Persei.

- Determination and interpretation of the timing and the magnitudes of the extrema of the curves of indices.

- Correlation analysis of the curves of indices.

AX PERSEI

The model of symbiotic system.
Source: Merc et al., 2019

- Symbiotic character discovered by P. W. Merill and L. Humason in 1932.

- Consisting of a M4.5 III giant and a white dwarf surrounded by symbiotic nebula.

- Classical symbiotic binary – active and quiescent phases.

- Outbursts – the sign of activity, significant photometric and spectroscopic changes.
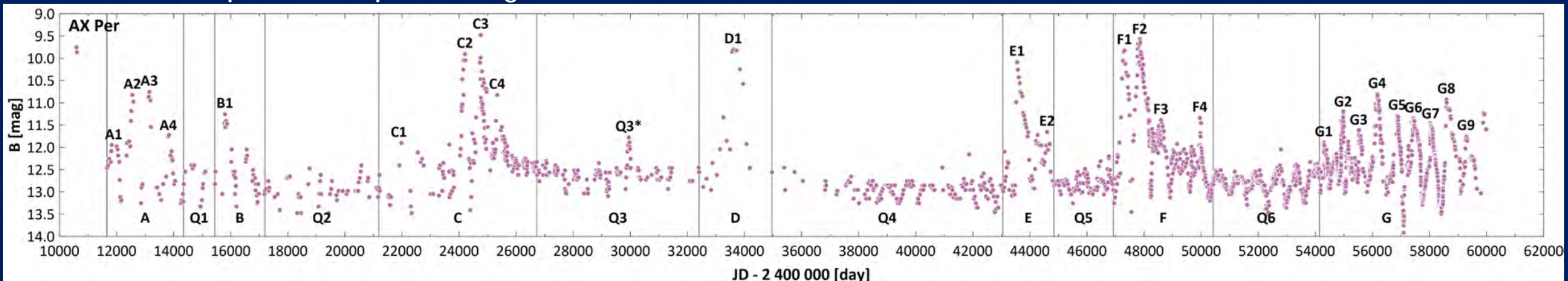
Light curve of AX Persei in the *B* filter.

ORBITAL PERIOD OF AX PERSEI

- Basic parameter of binary systems.

- Light curves in U, B, V, R_c and I_c filters: orbital period of **(680.4 ± 4.3) days** (Mártonfi et al. 2021)

- Radial velocity curve (radial velocity values adopted from literature and obtained by the cross-correlation analysis): orbital period of **(681.2 ± 4.2) days** (Mártonfi & Gális 2022).

- Eclipses, minima and maxima of the light curve of the system are regularly repeated with this period.

- Employed linear ephemeris from Skopal et al. (2011):

$$JD_{min} = 2\,447\,551.26 + E \times 680.83$$
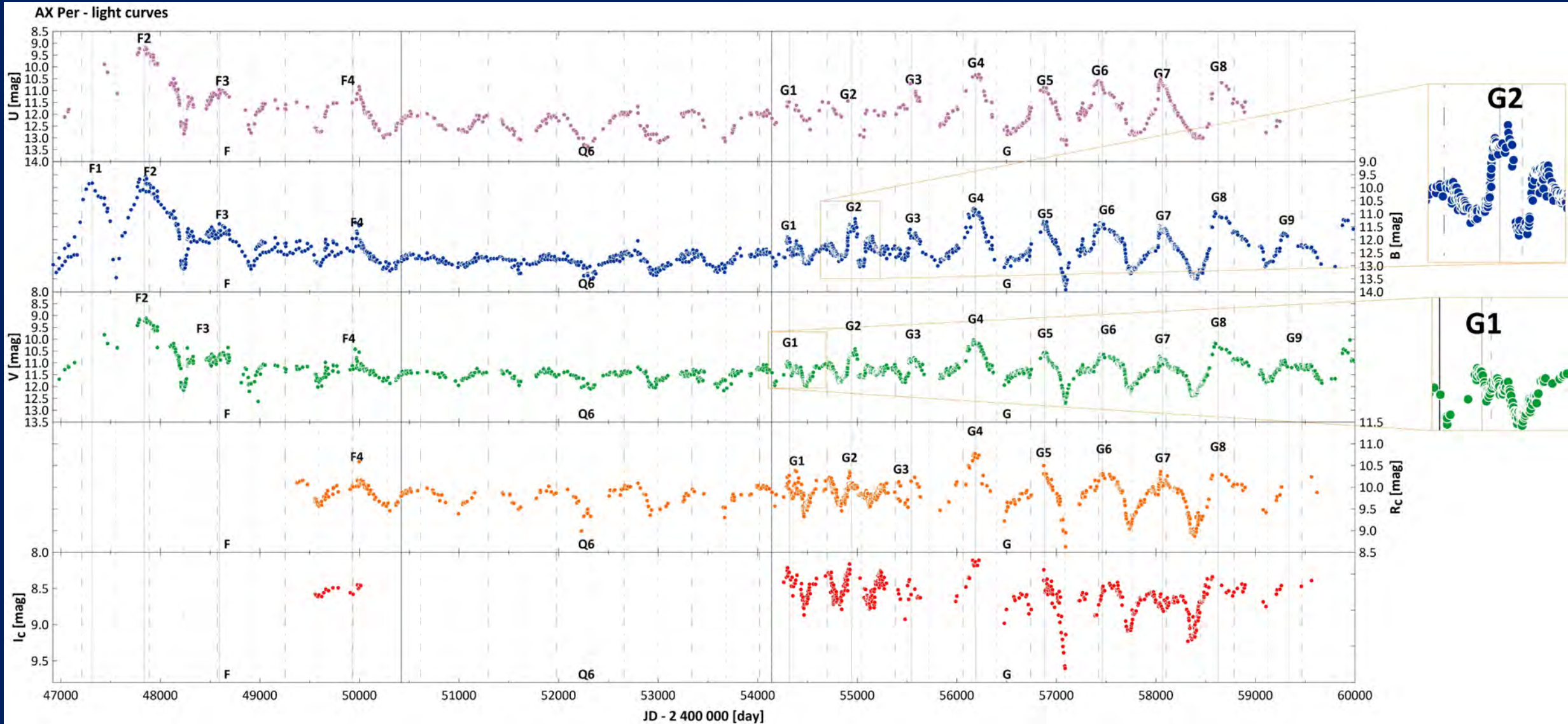
DATA PROCESSING AND ANALYSIS

- **Sources of the photometric data:** available scientific publications – papers, telegrams (Atel, CBET), circulars (IAUC) and the database of American Association of Variable Star Observers* (AAVSO).

- Magnitudes in U, B, V, R_c and I_c filters; light curves constructed and analysed in the previous research (Mártonfi et al. 2021).

*https://www.aavso.org/

DATA PROCESSING AND ANALYSIS

- **Derivation of colour indices:** searching for pair of magnitudes (in the filters of the given colour index) with the Julian date (JD) difference < 1 day.

- Omitting the points with the deviation > 2σ of the given part of the curve of indices.

- The curves of the 5-day averages of the indices were constructed.

- **Extremes determination:** MAVKA software, 3 methods of approximation (polynomial, parabolic spline, asymptotic parabola).

- **Correlation analysis:** *CorrLAB* software, classical and discrete correlation analysis.

AX Per - light curves

THE CURVES OF INDICES OF AX PERSEI

AX Per - colour indices
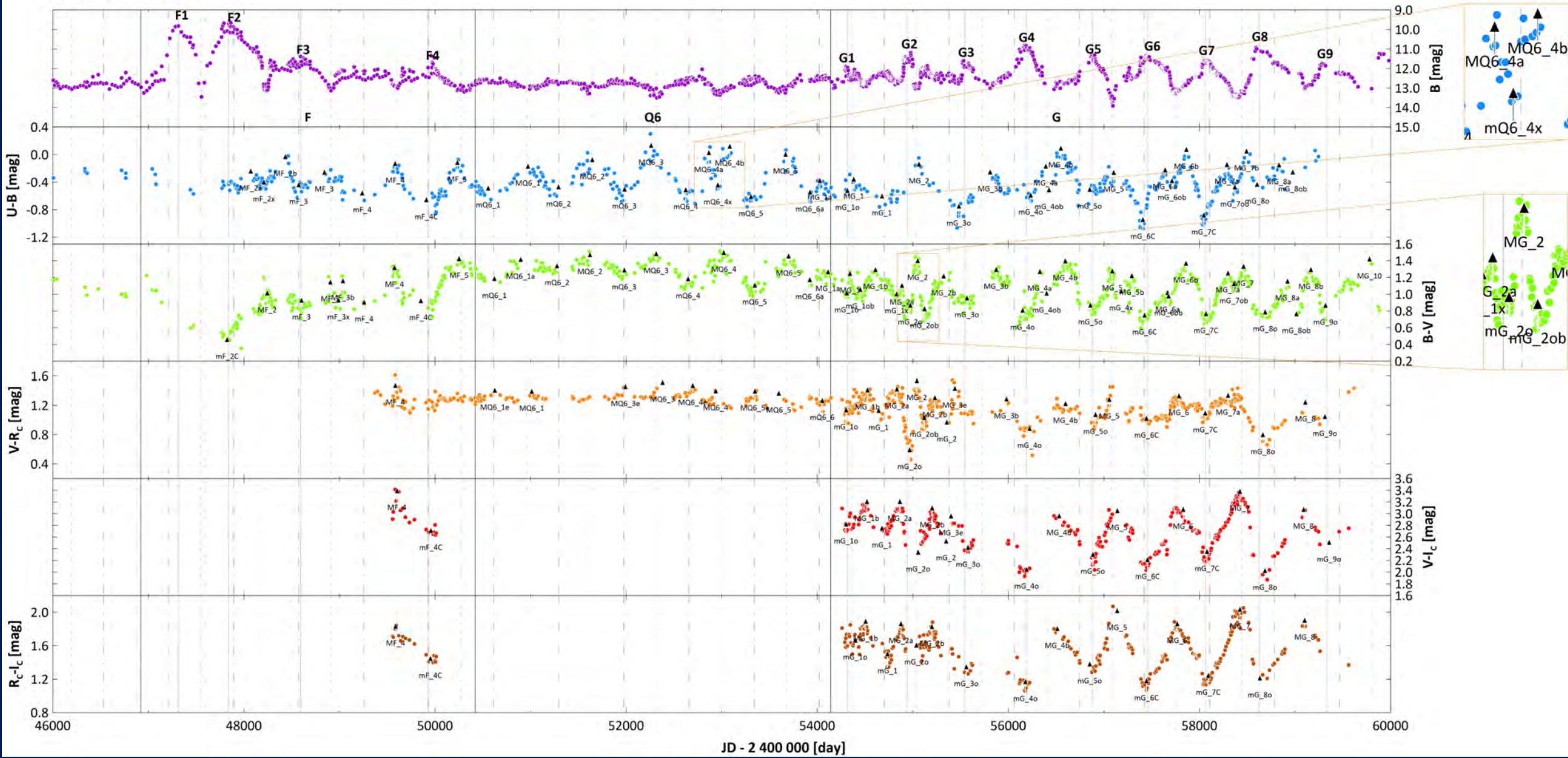
CORRELATION ANALYSIS OF COLOUR INDICES

- Strong correlation between light curves mutually (except I_c light curve) and light curves and colour indices.

- Curves of indices: mutual correlation coefficients are lower than with light curves.

- V-R_c in Q6: no correlation with other light and indices curves: different character of variations during the Q6 phase.

- U-B: lower correlation coeficients with light curves and other curves of indices due to the double-peak structures during reddenings.

	U	B	V	R_c	I_c	U-B	B-V	V-R_c	V-I_c	R_c-I_c
U	1,00	0,87	0,83	0,83	0,50	0,60	0,72	0,56	0,83	0,80
B	0,87	1,00	0,96	0,84	0,61	0,31	0,78	0,72	0,82	0,69
V	0,83	0,96	1,00	0,88	0,71	0,22	0,62	0,73	0,82	0,70
R_c	0,83	0,84	0,88	1,00	0,76	0,32	0,49	0,46	0,76	0,75
I_c	0,50	0,61	0,71	0,76	1,00	0,04	0,19	0,44	0,40	0,37
U-B	0,60	0,31	0,22	0,32	0,04	1,00	0,46	-0,02	0,33	0,50
B-V	0,72	0,78	0,62	0,49	0,19	0,46	1,00	0,51	0,60	0,49
V-R_c	0,56	0,72	0,73	0,46	0,44	-0,02	0,51	1,00	0,67	0,43
V-I_c	0,83	0,82	0,82	0,76	0,40	0,33	0,60	0,67	1,00	0,88
R_c-I_c	0,80	0,69	0,70	0,75	0,37	0,50	0,49	0,43	0,88	1,00

Correlation coefficients – phase G

	U	B	V	R_c	U-B	B-V	V-R_c
U	1,00	0,87	0,80	0,84	0,92	0,83	-0,09
B	0,87	1,00	0,84	0,81	0,69	0,68	0,10
V	0,80	0,84	1,00	0,86	0,61	0,45	0,15
R_c	0,84	0,81	0,86	1,00	0,68	0,61	-0,02
U-B	0,92	0,69	0,61	0,68	1,00	0,77	-0,25
B-V	0,83	0,68	0,45	0,61	0,77	1,00	-0,10
V-R_c	-0,09	0,10	0,15	-0,02	-0,25	-0,10	1,00

Correlation coefficients – phase Q6

CONCLUSION

- **Specific characteristics of the light curves:** Q6: variations due to reflection effect and eclipses, active phases: strong effect of outbursts, different orbital phase of outburst in the phase G.

- **The curves of indices:** Q6: variations due to the reflection effect (except $V\text{-}R_c$ colour index), reddenings in primary minima, blueings in the phase 0.5 or outbursts, double-peak structures of reddenings.

- **Correlation analysis of colour indices:** strong correlation between light curves and curves of indices, lower mutual coefficients between curves of indices, different behaviour of $V\text{-}R_c$ (Q6) and $U\text{-}B$ (G) curves.

- **Future research:** period analysis of curves of indices, colour index – magnitude diagram, new ephemeris of AX Persei.

REFERENCES

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