Impact of the ASAS-SN survey and the Moscow's photographic plates archive on the nature of the emission line star HBHA 1704-05*)

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1. A neglected emission-line star HBHA 1704-05
2. Discovery of the outburst by the ASAS-SN survey
3. HBHA 1704-05 as a symbiotic star in outburst
4. 1962 – 1995 light curve from the Moscow's plates archive:
   (i) 1968 – 1990 nova-like outburst
   (ii) periodic variability – orbital elements
5. Conclusions

*)Supported by the Slovak Research and Development Agency under the contract No. APVV-15-0458
Neglected emission-line star HBHA 1704-05 and its 2018 outburst

Kohoutek & Wehmeyer (1999): HBHA 1704-05 as an emission-line star

VSX: ASASSN-V J195442.95+172212.6  19 54 42.95 +17 22 12.7 (2000)  
Var. type: SR+ZAND,  Period: 418-d, Mag. Range: 10.7 – 13.2 V

August 2018: The All Sky Automated Survey for SuperNovae (ASAS-SN) indicated rapid brightening:

Munari et al., Atel #11937 on Aug. 2018:  M-type features, TiO bands + blue continuum + strong emissions of HI, Hel, Hell, OIII gives a previously unknown symbiotic star in outburst.
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August 2018: The All Sky Automated Survey for SuperNovae (ASAS-SN) indicated rapid brightening:

Following high-cadence photometric and spectroscopic observations clarified the nature of HBHA 1704-05 as a symbiotic star in outburst.

UBVR\textsubscript{C}I\textsubscript{C} photometry – Z And-type outburst
The widest interacting binary systems: **Cool giant** + **White dwarf**  
$P \sim 100 \times (\text{days} - \text{years})$

Basic interaction: Mass loss from the **RG** + Accretion by the **WD**

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Accretion from the RG wind  
(at $10^{-8}-10^{-7} \, M_{\odot}/\text{yr}$)  

=> Hot & Luminous WD  

=> Ionization of the RG wind  

=> Symbiotic nebula

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Bamberg 2019, March 11
Symbiotic binaries - composite continuum

The spectrum consists of different components of radiation

\[ F(\lambda) = F_H(\lambda) + F_N(\lambda) + F_G(\lambda) + F_D(\lambda) \]

Aim: disentangling the composite spectrum to obtain physical parameters of individual components of radiation
HBHA 1704-05 as symbiotic binary: spectroscopic confirmation

Model SED:

\[ F_H(\lambda) - \text{negligible in opt.} \]
\[ F_N(\lambda) - \text{green} \]
\[ F_G(\lambda) - \text{orange} \]

Giant: M2.6 III  \( L_G = 1100 \left( \frac{d}{3.6 \text{kpc}} \right)^2 L_{\text{Sun}} \),  
\( T_{\text{eff}} = 3600 \text{ K} \),  
\( R_G = 87 \left( \frac{d}{3.6 \text{kpc}} \right) R_{\text{Sun}} \)

Nebula:  \( EM \approx 1.1 \times 10^{61} \left( \frac{d}{3.6 \text{kpc}} \right)^2 \text{ cm}^{-3} \),  
\( T_e \approx 43000 \text{ K} \)

Optical spectrum of HBHA 1704-05 obtained by 1.3 m telescope at the Skalnate Pleso observatory on August 13, 2018 (R ~ 35000). The strongest emission lines are of H\( \text{I} \), Hel and Hell 4686 Å + fain features of Fell, Till. CrII, [OI] 6300, Raman OVI.
HBHA 1704-05 as symbiotic binary: photometric confirmation

Historical light curve from the Moscow photographic plates archive

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Wave-like orbitally-related variation -
caused by extended partially optically thick symbiotic nebula

\[ JD_{\text{Min}} = 2440855.4 + 495 \times E \]
Wave-like orbitally-related variation – a typical feature of symbiotic stars during quiescent phases

\[ P_{\text{orb}} = 495 \, d, \quad \Delta V \sim 0.7 \, \text{mag}, \quad \Delta B \sim 1.1 \, \text{mag}; \quad \Delta B > \Delta V \]
HBHA 1704-05 as a twin to AG Pegasi

AG Pegasi:
symbiotic star with $P_{\text{orb}} = 818$ days
Fig.: Final stage of the nova-like outburst and 2015 eruption.
(Skopal et al. 2017)

AG Pegasi:
Quiescent phase - wave-like orbitally-related variation.
Z And-type outburst in June 2015.
After 165 years of its nova-like eruption
(Sekeras et al. 2019)
Conclusions

The ASAS-SN survey and the Moscow's photographic plates archive confirmed that

(i) HBHA 1704-05 is a symbiotic binary, and revealed its orbital period of ~ 500 days.


(iii) Indicated the wave-like orbitally-related variation in the V and B light curves.

(iv) Showed a strong similarity with other symbiotic Stars. For example AG Pegasi and AG Draconis.
Thank you for your attention !