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MP Gem: VY Scl-type star, finally

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Abstract

MP Gem has long been suspected as a long-period eclipsing binary, which had not been seen in faint state for 71 years since the discovery in 1944. Its nature has been a mystery. Using Public Data Release of Zwicky Transient Facility observations, I finally reached a conclusion that this object is a VY Scl-type cataclysmic variable by the detection of the deep faint state and the rising phase in 2018.

MP Gem was discovered as a variable star by Hoffmeister (1963). Hoffmeister (1963) noted that the object was invisible on a total of nine plates taken on 1944 February 24/25 and 1944 February 25/26. Hoffmeister (1963) classified the variable as "Algol?" (eclipsing binary). No other "eclipse" was recorded on Sonneberg plates according to Gessner (1973). Böhme (2012) studied further Sonneberg plates between 1981 and 1994 and found no further event. Böhme (2012) suggested that the object could be an eclipsing binary with a very long period.

Böhme (2014) described further details of the research given in Böhme (2012) and also provided time-resolved photometry with a CCD camera together with observations by Timo Kantolo. Although short-term variations were recorded, they could not find a period nor obtain a hint for the classification of this object.

Böhme (2017) continued observations and found a significant drop in brightness in 2016 September, first time in 72 years. The object faded to 19.5 mag on 2016 October 20. Böhme called attention to this object through the American Association of Variable Star Observers (AAVSO). At that time, Böhme (2017) found that the fading was neutral in color and suspected that the object would be an R CrB star. Böhme also reported this finding to VSNET (Kato et al., 2004) as vsnet-alert 20211 on2016 October 5.[1] No further call for attention was issued through VSNET and I was not aware that this could be an event of a cataclysmic variable (CV).

In 2018, I picked up candidates of CVs from the General Catalogue of Variable Stars (GCVS, Samus' et al. 2017) using the newly available Gaia parallaxes and colors (currently Gaia Collaboration et al. 2021). MP Gem was one of them and I obtained a light curve using the All-Sky Automated Survey for Supernovae (ASAS-SN, Shappee et al. 2014, Kochanek et al. 2017). Due to the blending with a nearby star (see Böhme 2017), the deep fading starting from 2016 September was recorded only as a systematic brightness decrease by ∼1.0 mag. I was not confident about the nature of this object at that time although the blue Gaia color (BP=16.05 and RP=15.88) and the faint absolute magnitude ($M_V \sim +4.0$) were clearly indicative of a CV.

Using Public Data Release 6 of the Zwicky Transient Facility (Masci et al., 2019) observations[2] , I found that MP Gem was in deep faint state in 2018 around 20.0 mag and slowly returned to the bright state between 2018 August and November (figure 1). This light curve is characteristic to VY Scl-type novalike CVs, which show fading episodes caused by temporary decreases in the mass-transfer rate (see Hellier 2001, Chapter 12). MP Gem is now finally classified as a VY Scl-type object with rather infrequent fading episodes.

[1] http://ooruri.kusastro.kyoto-u.ac.jp/mailarchive/vsnet-alert/20211

[2] The ZTF data can be obtained from IRSA <https://irsa.ipac.caltech.edu/Missions/ztf.html> using the interface <https://irsa.ipac.caltech.edu/docs/program_interface/ztf_api.html> or using a wrapper of the above IRSA API <https://github.com/MickaelRigault/ztfquery>.

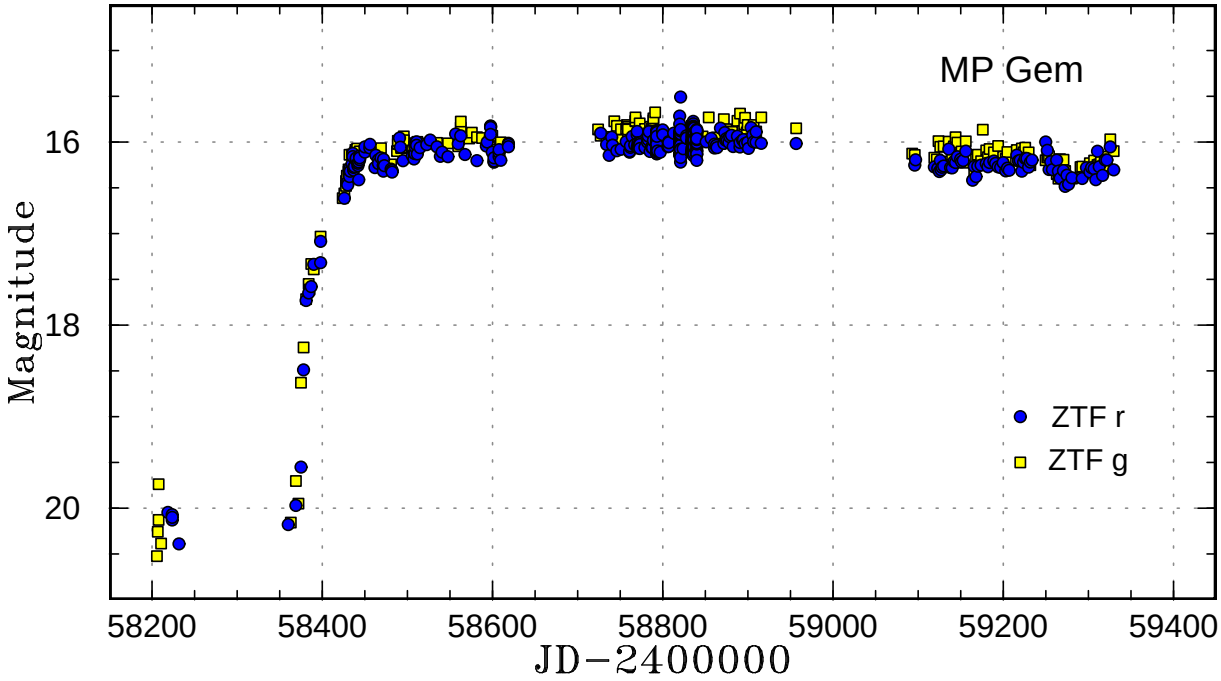

Figure 1: ZTF light curve of MP Gem. The light curve and blue color are characteristic to a VY Scl-type object.

I noticed that the AAVSO collected a considerable record of the 2016–2018 event in the AAVSO International Database[3] . According to their observations, there was a temporary rise to 17.5 mag in 2017 December to 2018 January. Such temporary brightening during the faint state is frequently seen in VY Scl-type objects (see e.g. Honeycutt and Kafka 2004).

Historically, eclipsing binaries, R CrB stars and VY Scl-type CVs have often been confused. For an example of V504 Cen, see Kato and Stubbings (2003). They can usually be easily distinguished by colors (R CrB stars also show infrared excesses) and absolute magnitudes when Gaia parallaxes are meaningfully measured.

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