High time resolution multi-band photo-polarimetric observations of the binary millisecond redback pulsar J1023+0038 with the BTA

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An eclipsing binary 1.64 ms pulsar J1023+0038 with the 4.754 h orbital period and the $\sim 0.2 M_\odot$ non-degenerate secondary star belongs to the so-called 'redback' millisecond binary pulsar systems where the pulsar heats the companion's face. It is one of a few redback systems known, where the transition of a neutron star from a low-mass X-ray binary to a rotation powered pulsar, predicted a long time ago, is observed directly. The object was initially found in the low-mass X-ray binary stage. Since 2002, it was consistently observed as the radio pulsar. In 2013, the pulsar suddenly switched back to the low-mass X-ray binary raising new questions on mechanisms causing the stage transitions. Currently, it continues to be monitored in various spectral domains. We have observed J1023+0038 in 2017 in the optical with the Multichannel Analysis of Nanosecond Intensity Alterations (MANIA) instrument at the BTA 6 m telescope. The time resolution was varied from 10 to 150 ms depending on observational mode. Our data show that the pulsar still remains in the low-mass X-ray binary stage, that is characterised by rapid flaring at time scales of 10-100 s with amplitudes of 0.2-0.5 mag. We resolved a fine structure of the flares at time scales of a few seconds. We also set conservative upper limits on the linear polarisation degree of about 2-4% in quiet and flaring stages. We present preliminary results of the observations and discuss their possible implications.

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