X-ray/optical correlations in the transient black hole system KV UMa (XTE J1118+48)

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From January to August 2000 the bright X-ray transient XTE J1118+48 (=KV UMa), a binary system containing a 6 solar mass black hole, provided a unique opportunity for simultaneous X-ray and optical observations. The MPE fast timing optical photometer OPTIMA was used on July 4-7, 2000 at the 1.3m telescope of Skinakas observatory, Crete for observations of KV UMa simultaneous with RXTE. A total common exposure of 2.5 hours with accurate single photon timing (few μs) was accumulated. X-ray and optical variations were found to be strongly correlated, with the optical emission rising very fast ($\sim 30ms$) after an increase in X-ray brightness. The maximum of the optical response lags the X-ray peaks by typically 500 ms. A curious dimming of the optical light is also apparent 2-5 s before the X-ray outbursts. Although this delayed optical emission is suggestive of a reprocessing scenario (light echo), the autocorrelation of the X-ray and optical time series shows that the latter has intrinsically a much faster timing structure. This argues strongly against reprocessing. A possible scenario to explain this result invokes a slow (0.1 c) magnetically controlled outflow from the black hole. The optical light is generated as cyclosynchrotron emission in a region about 20000 km from the center. The optical response is then explained as the propagation delay of an accretion triggered disturbance.