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Search for VHE emission from Tidal Disruption Events with the VERITAS telescopes

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In recent years, associations of tidal disruption events (TDEs) with astrophysical neutrinos detected by IceCube indicate that these transient phenomena could be responsible for accelerating cosmic rays up to PeV energies. These energetic relativistic particles can potentially also give rise to high- and very-high-energy (VHE) gamma-ray components. Although over 100 events have been identified through wide-field high-cadence optical surveys, follow-up observations of TDEs in the VHE regime are scarce. To date, no TDE detection in the GeV or TeV ranges has been confirmed.

I discuss the first target of opportunity campaign dedicated to follow-up observations of TDEs with the Very Energetic Radiation Imaging Telescope Array System (VERITAS). The observing campaign for the events AT2022dbl, AT2022dsb and AT2023clx is presented. No detection is found within more than 10 hours of live-time observations per event. Therefore, flux upper limits were derived in the energy range of $\sim$ 100 GeV up to 10 TeV. We consider the scenario in which the potential gamma-ray emission is attenuated via pair production with ambient photons from the optical and ultra-violet components of the disruption flare. We infer that the medium is essentially optically thick $\tau_{\gamma\gamma} > 1$ at the energy range where VERITAS is sensitive (80 GeV $<$ E $<$ 30 TeV) if the radius of the target photon field, modelled as a blackbody spectrum, is in the range of $5 \cdot 10^{15}$ cm $<$ R $< 1 \cdot 10^{16}$ cm. In addition, we find that the medium should remain optically thick to gamma rays up to approximately 150 days after the peak of the UV light curve. Although no detection is found for AT2022dbl, AT2022dsb or AT2023clx, the flux upper limits enable the development of additional strategies for TDE follow-up in the VHE regime.

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