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AM³ and lepto-hadronic gamma-ray burst afterglow spectra up to TeV energies

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Recent multi-wavelength observations of gamma-ray burst afterglows observed in the TeV energy range challenge the simplest Synchrotron Self-Compton (SSC) interpretation of this emission and are consistent with a single power-law component spanning over eight orders of magnitude in energy. To interpret this generic behaviour in the single-zone approximation without adding further free parameters, we performed an exhaustive parameter space study using the public, time-dependent, multi-messenger transport software AM³. This description accounts for the radiation from non-thermal protons and the lepto-hadronic cascade induced by pp- and $p\gamma$-interactions. In this talk, I will first introduce AM³ and give an update about recent code developments on behalf of the AM³ team. Then, I will summarise the main afterglow scenarios which we have found (SSC, Extended-syn, Proton-syn, pp-cascade, and $p\gamma$-cascade), and discuss their advantages and limitations in the multi-messenger context.

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