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Time-dependent multi-messenger modeling in the open source era

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The IceCube experiment has now accumulated over a decade of observations, and a suite of next-generation multi-messenger experiments line up on the horizon. Theorists try to keep pace by developing increasingly refined astrophysical neutrino source models. In this talk, I discuss recent advancements in numerical modeling tools. I introduce a cutting-edge numerical cosmic-ray simulation tool developed at DESY and recently published as open-source software. I discuss some of the recent applications and future directions, including modeling of multi-wavelength catalogs and time-domain multi-messenger data.

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