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Updated meson, tauon and Z boson limits on invisible particles: without infrared divergences

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Some (light) particles ϕ can couple to the neutrinos and charged leptons in the standard model (SM), and thus be relevant to neutrino self-interactions, heavy neutrinos, and dark (matter) particles etc. Such particles will induce exotic decays of some SM particles, such as pion and kaon mesons, tauon, and the Z boson. The precision measurements of these SM particle can be used to set limits on the new (light) particles. We examine the limits on the decays $\pi,\ K \to \ell + \nu + \phi, \tau \to \pi + \nu + \phi$ and $Z \to \nu + \bar{\nu} + \phi$ from the corresponding SM decay channels. In particular, we include the 1-loop corrections to remove the infrared divergences involved in these channels. This might have implications for some ongoing and future experiments such as NA64.

Primary author(s) : ZHANG, Yongchao

Presenter(s) : ZHANG, Yongchao