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Optimizing Ditau Mass Reconstruction with Deep Learning: Toward Experimental Applications

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As key fundamental questions about nature remain unsolved, searches for physics beyond the Standard Model and precision measurements have become increasingly relevant throughout the years. In particular, tau physics has gained particular interest due to the role of third-generation fermions in many BSM scenarios, where enhanced couplings to the third generation can lead to distinctive signatures involving tau leptons. One of the main observables that can help us discriminate between signal and background in ditau channels is the reconstructed mass of the tau pair. However, this mass reconstruction is challenging, as crucial information is lost due to the neutrinos present in the decay, which are not directly detectable in the LHC context. This talk focuses on the development, optimization, and evaluation of a deep neural network (DNN) for the mass reconstruction of the ditau system, with future experimental applications in mind. The DNN is evaluated in terms of mass resolution and its potential for signal-background discrimination, using a hypothetical (Z') particle resonance as the case study and three different benchmark models: the Sequential Standard Model, the (B-L) model, and the 4321 model.

Academic position of the presenting author

MSc. Student

Primary authors: PARRA OVELENCIO, Angie Catalina (Universidad de los Andes); FLOREZ BUSTOS, Carlos Andrés (Universidad de los Andes); JONES-PEREZ, Joel (Pontificia Universidad Católica del Perú (PUCP)); REYES VEGA, Jose Antonio (Universidad de los Andes); Dr RODRIGUEZ CRUZ, Cristian Fernando

Presenter: PARRA OVELENCIO, Angie Catalina (Universidad de los Andes)

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