

New tools for the Higgs search in tau tau channel at CDF experiment

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An overview of a search for the Higgs boson in the $H \rightarrow \tau\tau$ decay channel in data collected with CDF detector at the Tevatron collider is presented. To fully explore the discovery potential of this channel sophisticated methods are required for identification and energy measurements of tau leptons decaying hadronically as well as the for accurate reconstruction of the mass of $\tau\tau$ system, which is particularly challenging due to presence of multiple neutrinos from tau decays. Two new methods are presented to address both problems. The first method employs a particle flow algorithm complemented with a likelihood-based method for separating contributions of overlapping energy depositions of spatially close particles. In addition to superior tau energy resolution provided by the method, the estimate of the probability of the observed detector response for a given particle hypothesis allows improved rejection against quark or gluon jets background. The second method was developed for full mass reconstruction of $\tau\tau$ system and it relies on a requirement that mutual orientations of the neutrinos and other decay products are consistent with the mass and decay kinematics of a tau lepton. This is achieved by minimizing a likelihood function defined in the kinematically allowed phase space region. The method provides significant improvements over existing methods for mass reconstruction of $\tau\tau$ resonances. The performance of both methods is tested on a sample of data $Z \rightarrow \tau\tau$ events.

Presenter: ANDEY ELAGIN

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