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1-1 correspondence reconstruction at electron-positron Higgs factories

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Particle flow reconstruction has become the standard paradigm for event reconstruction at current high-energy collider experiments. Its ultimate goal is to establish a one-to-one (1-1) correspondence between reconstructed and truth incident particles, while achieving highly efficient particle identification. In realistic experimental environments, however, this ideal correspondence is inevitably compromised by factors such as limited detector acceptance, finite spatial granularity, and intrinsic limitations of reconstruction algorithms. In this talk, I will take the CEPC as an example to introduce studies on 1-1 correspondence in particle flow reconstruction at future electron-positron Higgs factories. By utilizing truth links, we conduct a detailed analysis and categorization of reconstructed particles. In combination with advanced machine learning techniques, this enables efficient identification and suppression of fake particles—which currently represent a major bottleneck in CEPC analyses. Consequently, the invariant mass resolution for di-jet Higgs boson final states is improved by 15%. In addition, the developed method enables efficient identification of nine particle species. For five charged particle types (electron, muon, pion, kaon, and proton) as well as photons, identification efficiencies exceed 97%. For the three neutral hadron species (long-lived neutral kaon, neutron, and antineutron), identification efficiencies reach 75–80%. These results considerably extend the range of particle species that can be reliably identified compared to conventional methods.

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