Laboratoire LEPRINCE-RINGUET

École polytechnique - IN2P3/CNRS

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

IN2P3 INSTITUT NATIONAL DE PHYSIQUE NUCLÉAIRE ET DE PHYSIQUE DES PARTICULES

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Subject: measurement of the polarization of weak bosons in vector boson scattering with the CMS experiment at the LHC

Vector boson scattering (VBS) is a particularly interesting process to get new insight into the electroweak symmetry breaking mechanism (EWSB). In the standard model (SM) and in the absence of the Higgs boson, the scattering of longitudinal massive (weak) bosons diverges and ultimately violates unitarity for energies >~1 TeV. In the SM, the presence of the Higgs boson is expected to regularize this process by a delicate interference between the diagrams involving the Higgs and those involving trilinear and quartic gauge couplings. It is therefore essential to measure this scattering and in particular the VBS production of longitudinal weak bosons. The available data at the LHC have recently allowed the first observation of the VBS production in the WWjj channel, as well as to see a first signal in the ZZjj channel. The next step is to separate the longitudinal component from the dominant transverse polarizations.

The student will study the possibility to measure the longitudinal component in the VBS production of ZZ in the fully leptonic final state pp->ZZjj->4ljj. This decay channel is especially interesting because it is the only one in which the final state particles are fully reconstructed in the detector, allowing for a strong potential in the separation of the longitudinal and transverse components. The student will use a very recent calculation of the amplitudes for the production of ZZ in the different polarizations, produced for the purpose of this internship, and will work closely with the authors and in the context of the european VBSCan project. He will compare these predictions to those of the MadGraph generator, and will study the angular distributions to optimize a discriminant to optimaly separate the longitudinal polarization. He will study the impact of the extension of the angular coverage that is foreseen by CMS for the high luminosity phase of the LHC, for which the measurement of the longitudinal scattering of the weak bosons is among the major physics goals.

The student will benefit from the expertise of the LLR CMS group in the measurements of the inclusive ZZ production, of the VBS ZZjj production, as well as in H->ZZ->4l for which the group played a leading role before, during and since the discovery.

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