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Probing same-sign WW in hadronic signatures (recorded)

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The production of two same-sign W bosons in association with two jets via vector boson scattering (VBS), ssWWjj, is a key probe of the mechanism of electroweak symmetry breaking, with the Higgs boson unitarising the process' cross-section. Longitudinal ssWWjj involves the spin-0 modes of the gauge bosons arising from EWSB, and is very sensitive to BSM physics.

With the Run-2 and Run-3 expected datasets, over 500 leptonic ssWWjj events are expected (W -> lv, l=e,mu), of which 35 events have two longitudinally polarised W boson, i.e. sWWjj(LL). More data is expected in Run-4 at the HL-LHC, but will not be sufficient to observe the process using only leptonic decays of the W boson.

The pool of ssWWjj(LL) events can be increased significantly increased by considering events with at least one hadronicically-decaying W (2/3 of W bosons decay hadronically). This is a very challenging final state given the large (by a few orders of magnitude) backgrounds.

We present ideas to systematically study ssWWjj VBS and the main backgrounds in semi-leptonic and hardonic VBS signatures, and, using substructure and jet charge techniques and deep learning, to extract the fraction of ssWWjj(LL) events.

This paper will rely on novel ideas to tackle the problem, and on combining existing tools and techniques in a novel way to probe the ssWWjj VBS signature. No use will be made of LHC experiment's infrastructure or codebases.

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