The lay summary is a brief summary intended to facilitate knowledge transfer and enhance accessibility, therefore the language used should be non-technical and suitable for a general audience. (See the Degree Regulations and Programmes of Study, General Postgraduate Degree Programme Regulations. These regulations are available via: <http://www.drps.ed.ac.uk/>.)

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| Title of thesis: | High Energy Resummation and Electroweak Corrections in Dijet Production at Hadronic Colliders | | | |

Insert the lay summary text here - the space will expand as you type.

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| Click here to enter text.  At experiments like the Large Hadron Collider (LHC) we seek to explore new areas of particle physics by accelerating hadrons (such as protons) into one another. Because hadrons are comprised of more fundamental particles, namely; quarks, anti-quarks and gluons, what we see after these collisions is the result of two (or more) of these particles scattering off each other. We use a Relativistic Quantum Field Theory called Quantum Chromodynamics (QCD) to describe these encounters. When using QCD to investigate an interaction between any two of these fundamental particles we quickly find that there are an infinite number of possible ways in which the collision could have happened (each possible way being symbolised by a Feynman Diagram); since we cannot hope to calculate all of these we must chose the most important subset of this infinity and calculate those. Traditional approaches focussed on selection the subset with the fewest factors of the strong coupling constant, known as a\_s, because a\_s is small and therefore any diagrams with extra factors will contribute less to the overall sum. Here we use a more subtle technique known broadly as `resummation'. In this approach we focus not only on the number of a\_s factors present but also the number of `large logarithms' at play. In this way we find a different subset of this infinity of diagrams which we consider to be the most important and instead focus on calculating those. Here we present a new calculation for the final state where we have a Z0 boson or a high energy photon, gamma\*, decaying to an electron-positron pair in association with at least two high energy QCD fundamental particles (which we observes experimentally as `jets'). Our resummation captures the `leading' (i.e. the largest) logarithms in this process and is further improved by matching our result to the `Leading Order' result (the result obtained by the aforementioned traditional techniques). We present comparisons of our new theoretical prediction to data gathered at the ATLAS and CMS experiments at the LHC and see that it gives good agreement across a wide range of observables. Further we also present two new experimental studies. Firstly, we show a comparison of our prediction matched to an extra `parton shower' resummation to an ATLAS study of QCD radiation patterns. We see that our description agrees well with the data throughout. Secondly, we present a study of Z0/gamma\* plus dijets at 100 TeV (a collision energy roughly ten times higher than that used at the LHC). We compare the behaviour of the high energy logarithmic enhancements at 7 TeV and 100 TeV and see that at any high energy hadronic Future Circular Collider (FCC) the effects described by our resummation become significantly more important. |