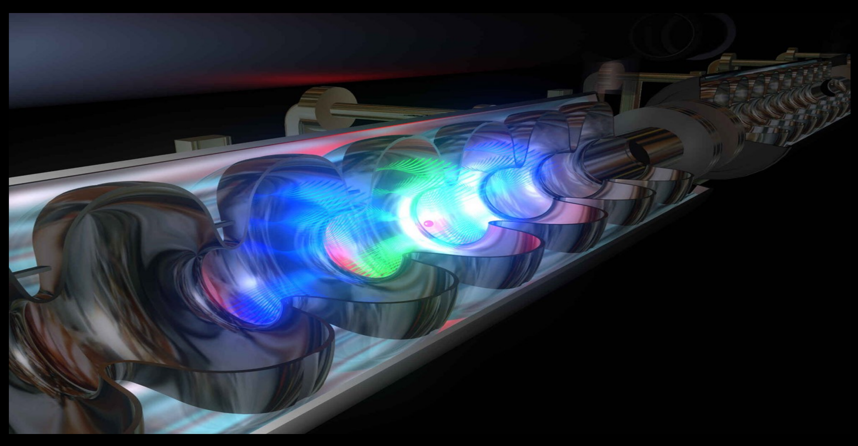
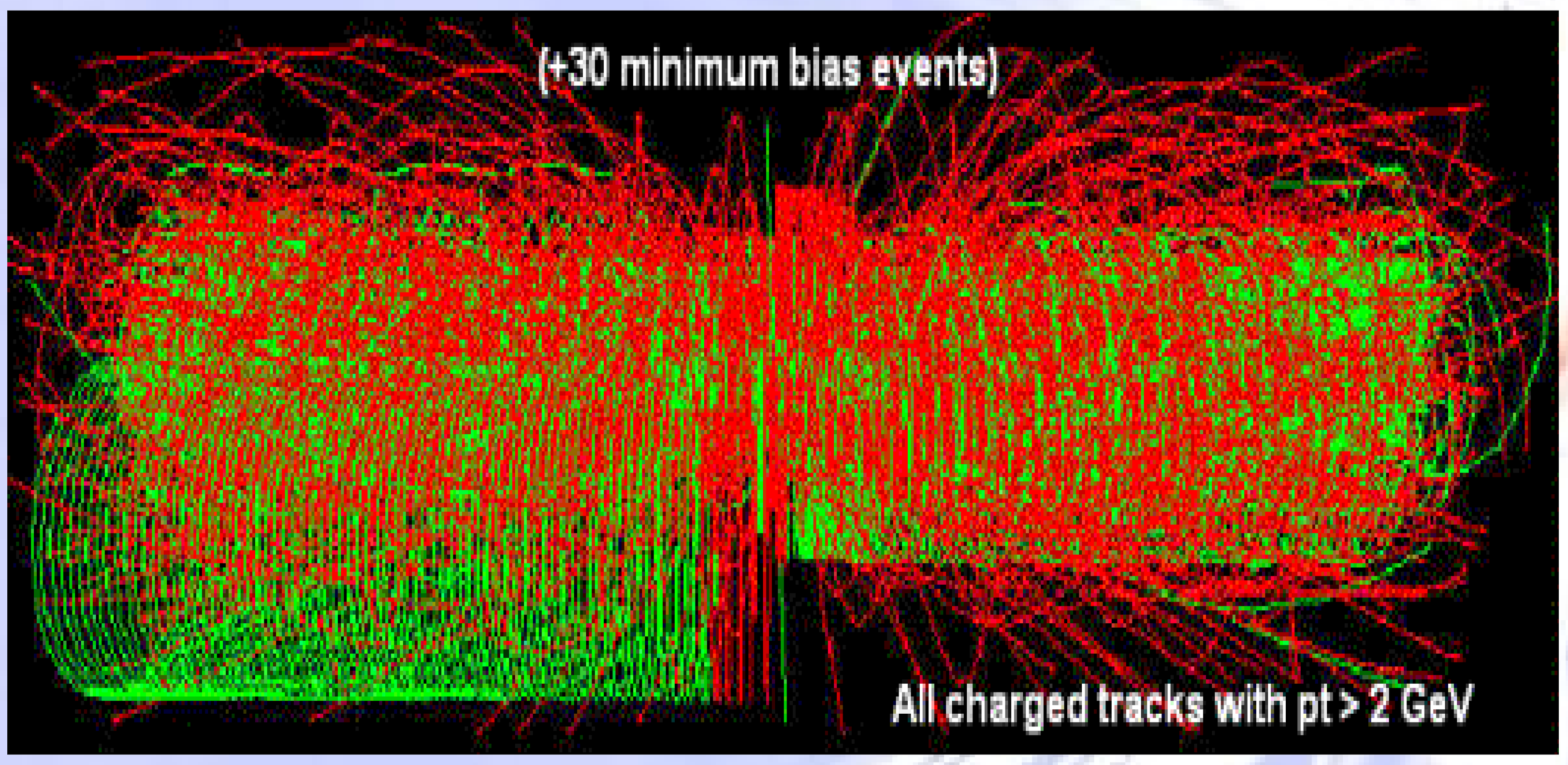
Durham University

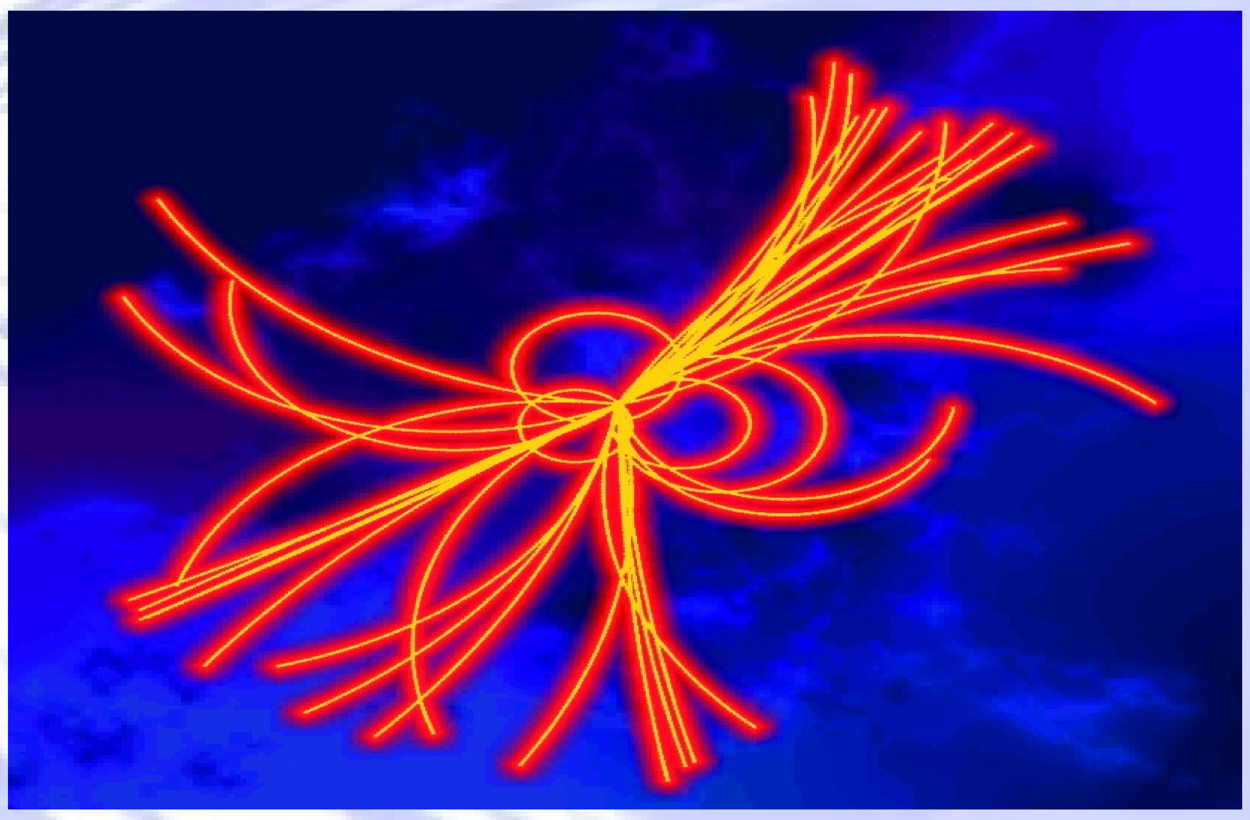
SYNERGY OF LHC AND ILC



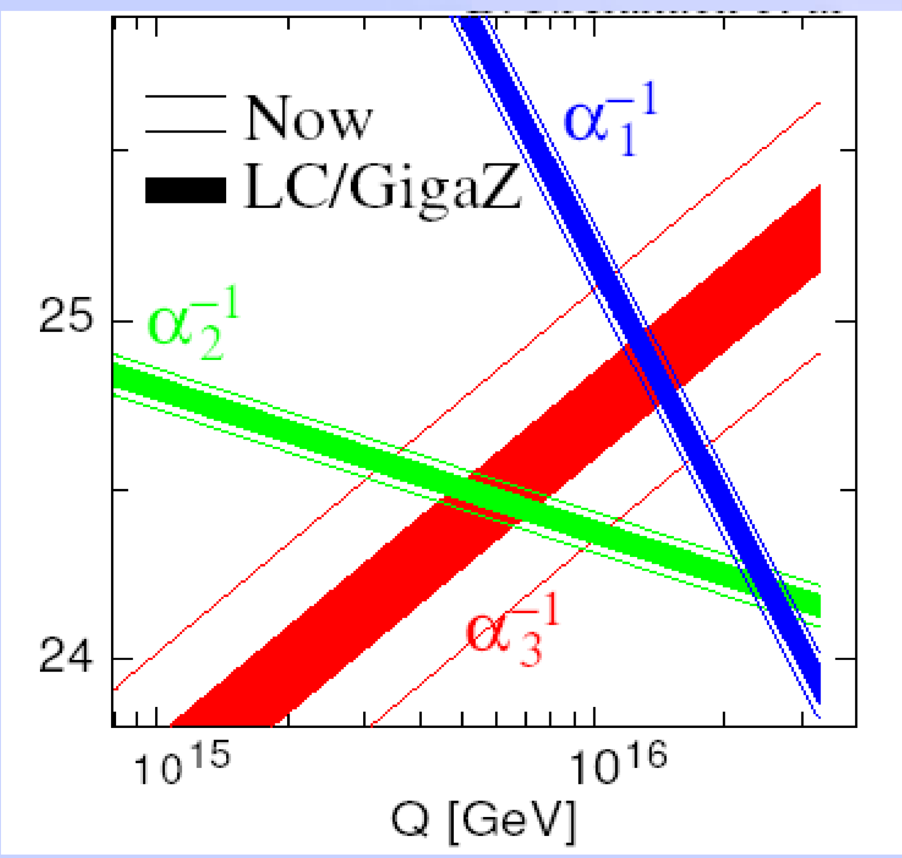
At the Large Hadron Collider (LHC), protons will be fired around the CERN ring. Protons are composite particles – each proton is composed of three quarks. The LHC is a discovery machine, and will shed light on high energy physics.

At the International Linear Collider (ILC), electrons and their anti-particles, positrons, will be fired towards each other and annihilate into pure energy. Since electrons are fundamental particles, these collisions will produce clean, clear signals.

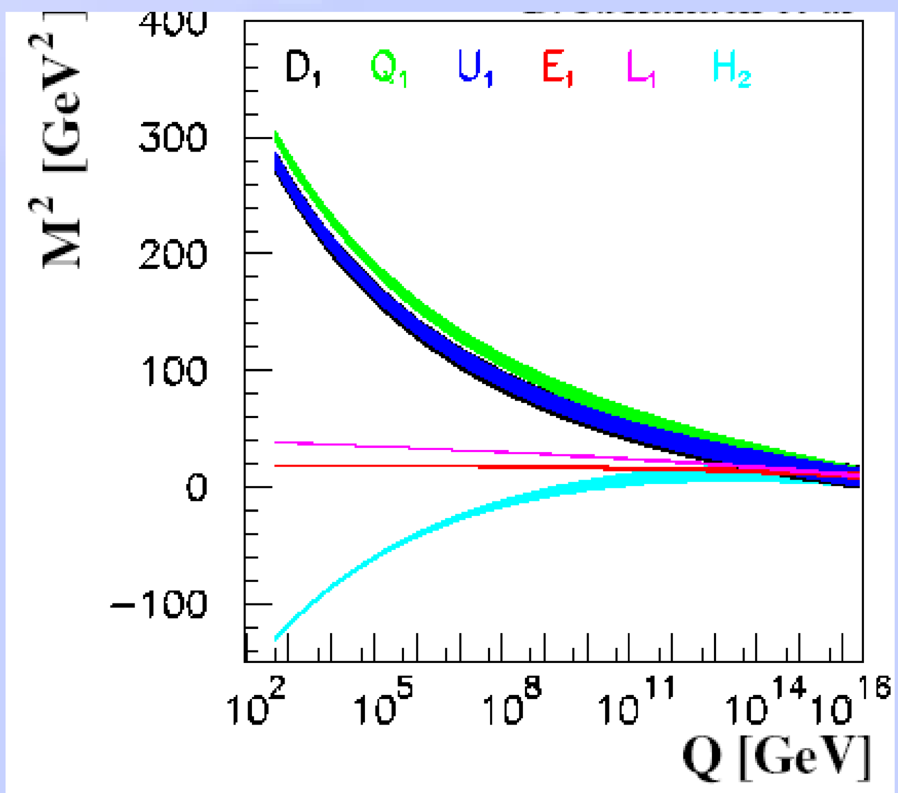




The synergy between the LHC and the ILC during simultaneous running of the two machines has the potential to maximise the physics gain from both facilities. Due to its high collision energy and luminosity, the LHC has a large mass range for the discovery of new heavy particles, and the ILC's clean experimental environment and tunable collision energy allows it to perform detailed studies of directly accessible new particles. The ILC also has exquisite sensitivity to quantum effects of unknown physics - indeed, the fingerprints of very high scale new physics will often only show up in small effects whose measurement requires the greatest possible precision.



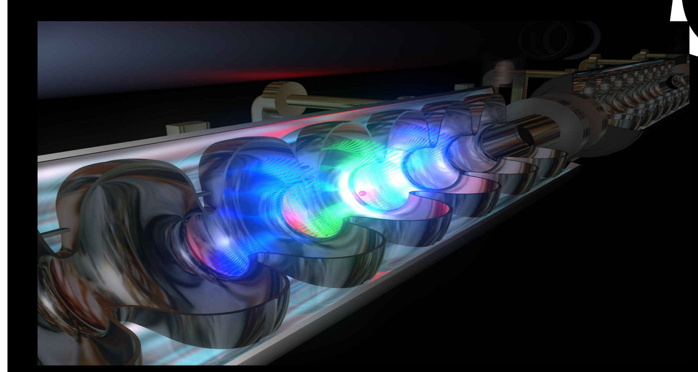
The International Linear Collider together with the Large Hadron Collider: Fundamental research towards the Theory of Everything

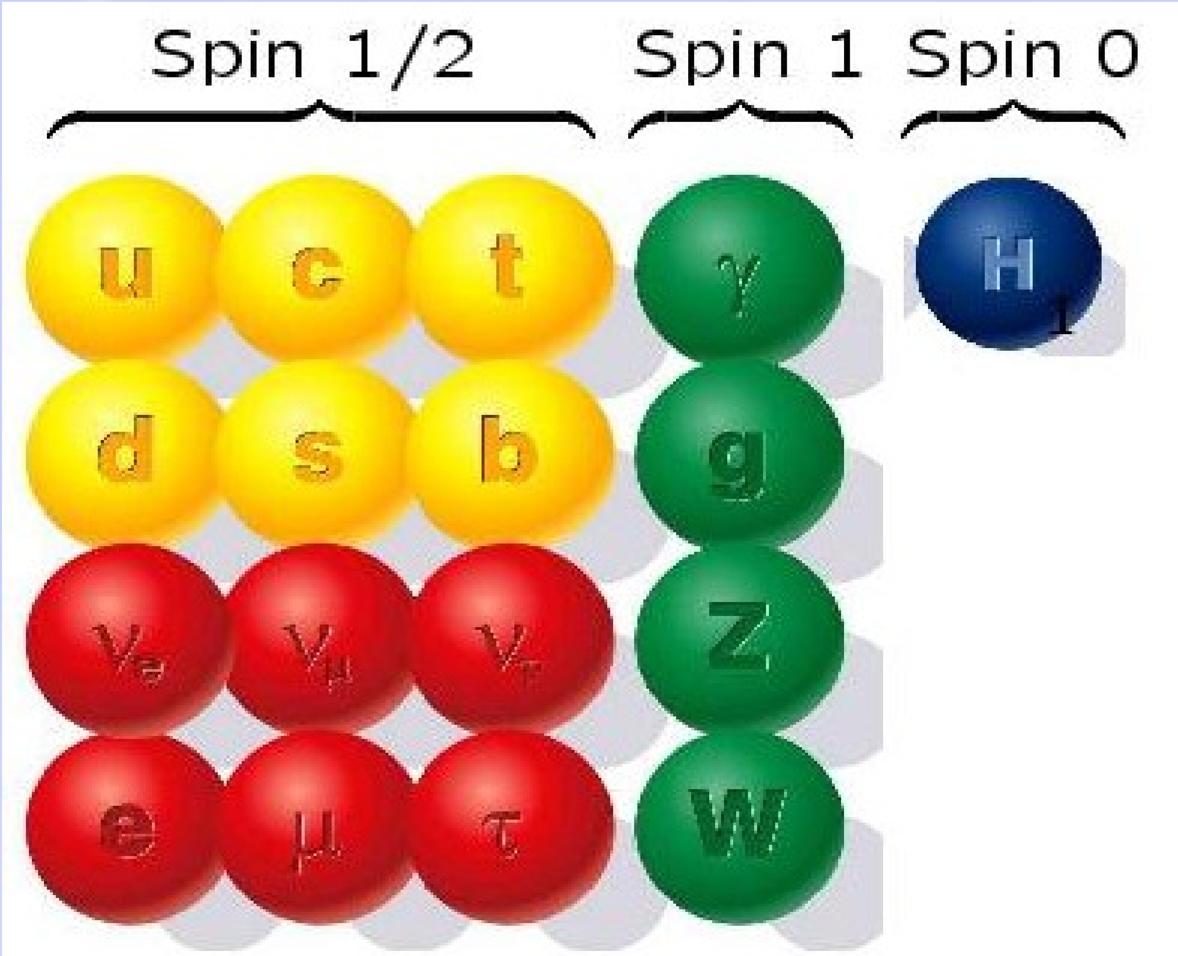


LHC / LC Study Group World-wide working group:

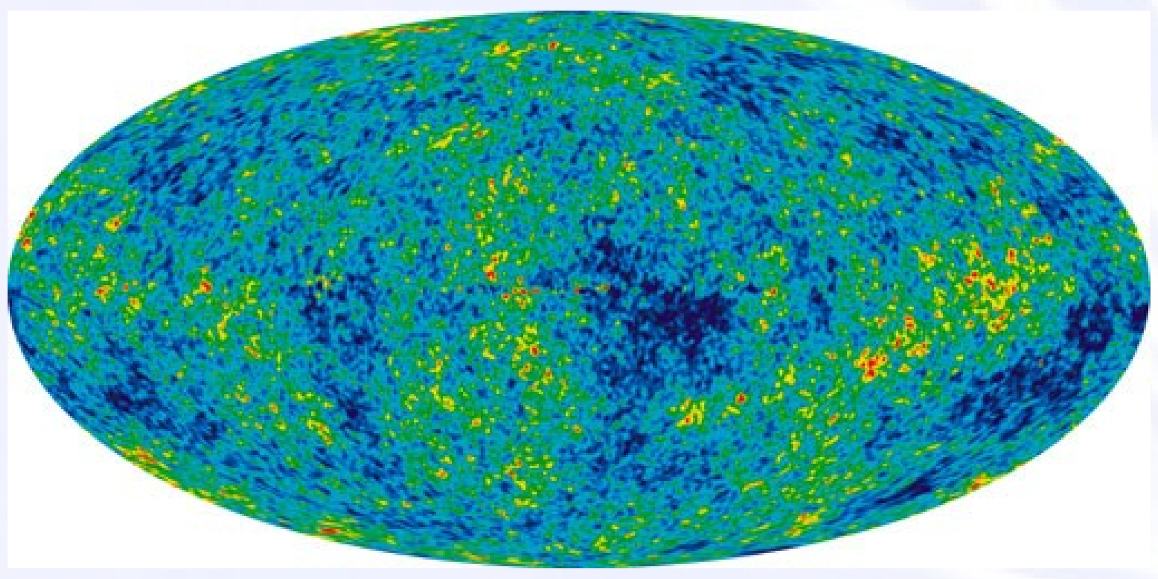
www.ippp.dur.ac.uk/~georg/lhclc

SUPERSYMMETRY AT THE ILC

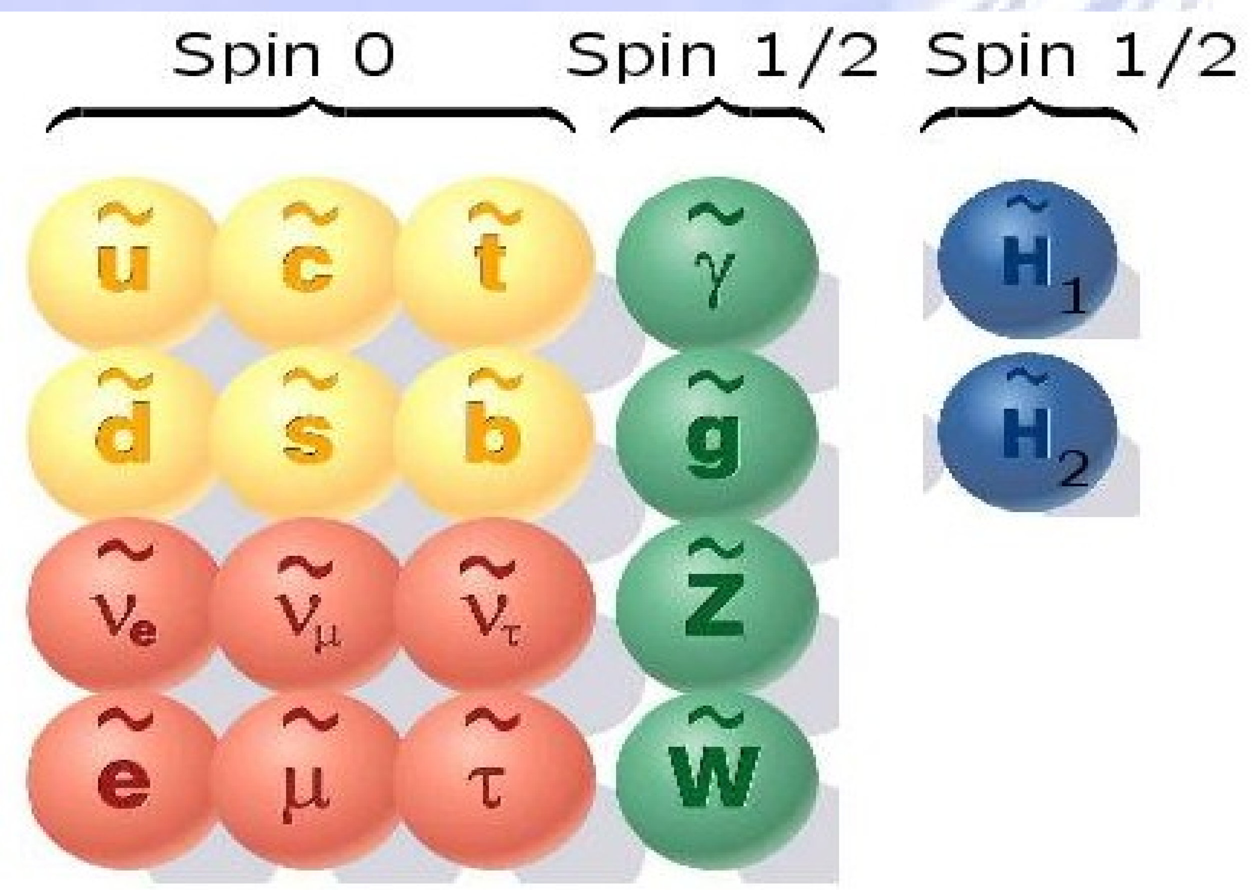




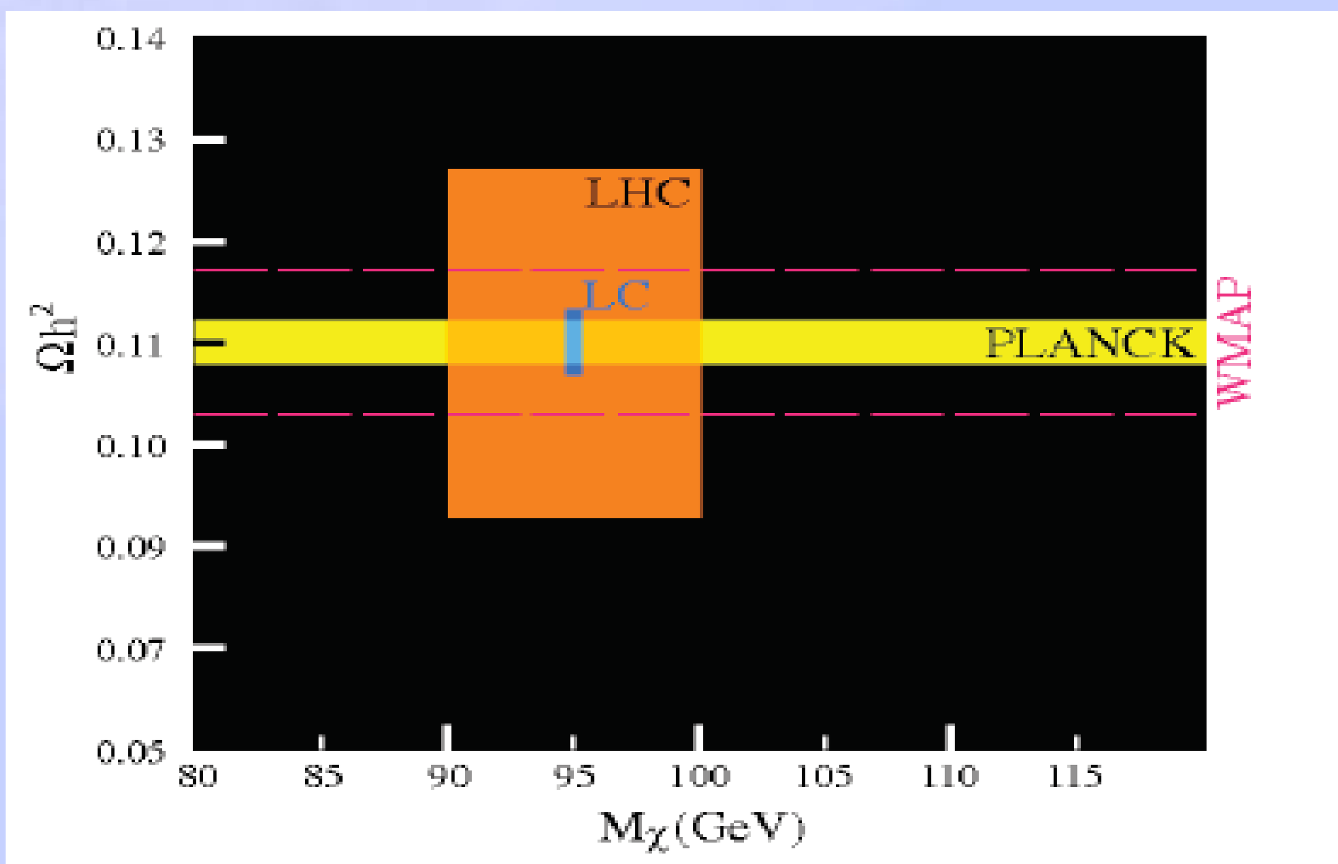
The Standard Model is an extremely precise model of the particles in our Universe and their interactions. There are two types of particle – particles of matter (fermions) and particles of force (bosons). All of the matter around us is made up of fermions, like electrons and quarks. The bosons are responsible for carrying the three forces of the Standard Model: electromagnetism, the strong force and the weak force.



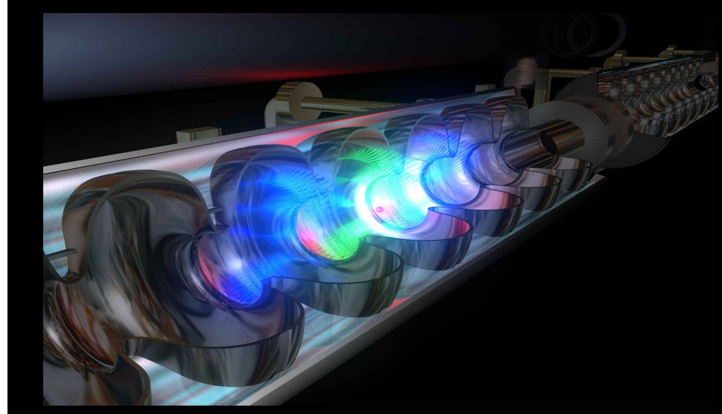
Despite its many triumphs, there are some problems with the Standard Model. For example, by studying the cosmic microwave background, and the rotation curves of galaxies, astronomers have determined that there is far more mass in the Universe than can be accounted for by the normal 'shiny' matter that makes up stars and gas. Approximately a quarter of the Universe consists of dark matter, which isn't made up of any of the particles that are included in the Standard Model.



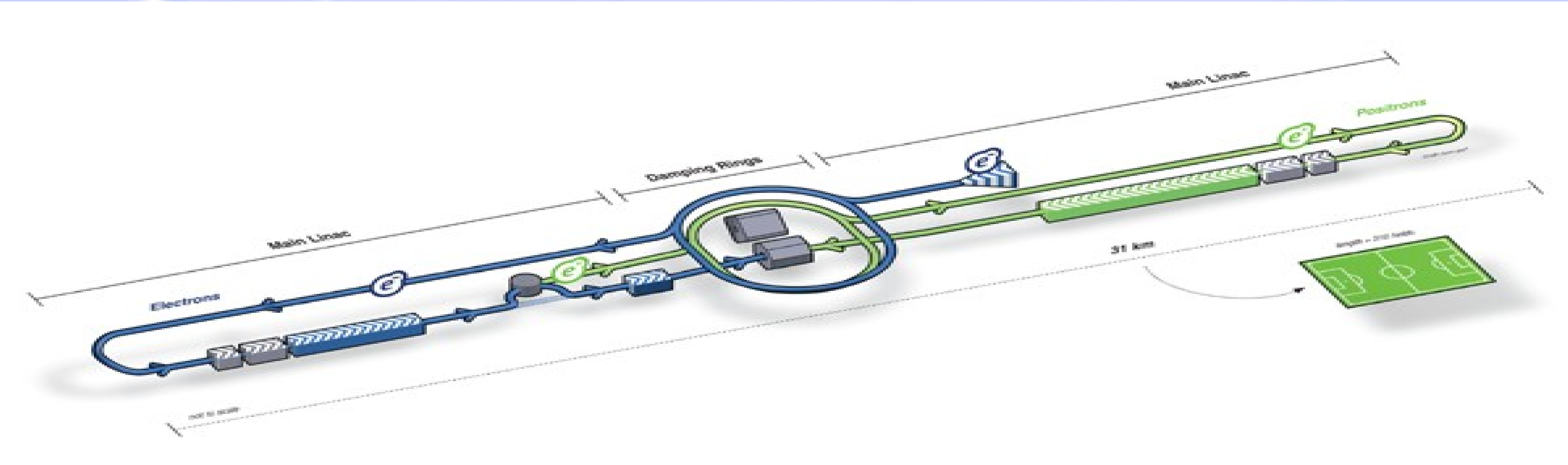
Supersymmetry is a way of directly relating particles of matter (fermions) and particles of force (bosons). The theory postulates that every particle in the standard model has a supersymmetric partner of the opposite type: for every Standard Model fermion, there is a corresponding supersymmetric boson, and for every boson there is a corresponding fermion.



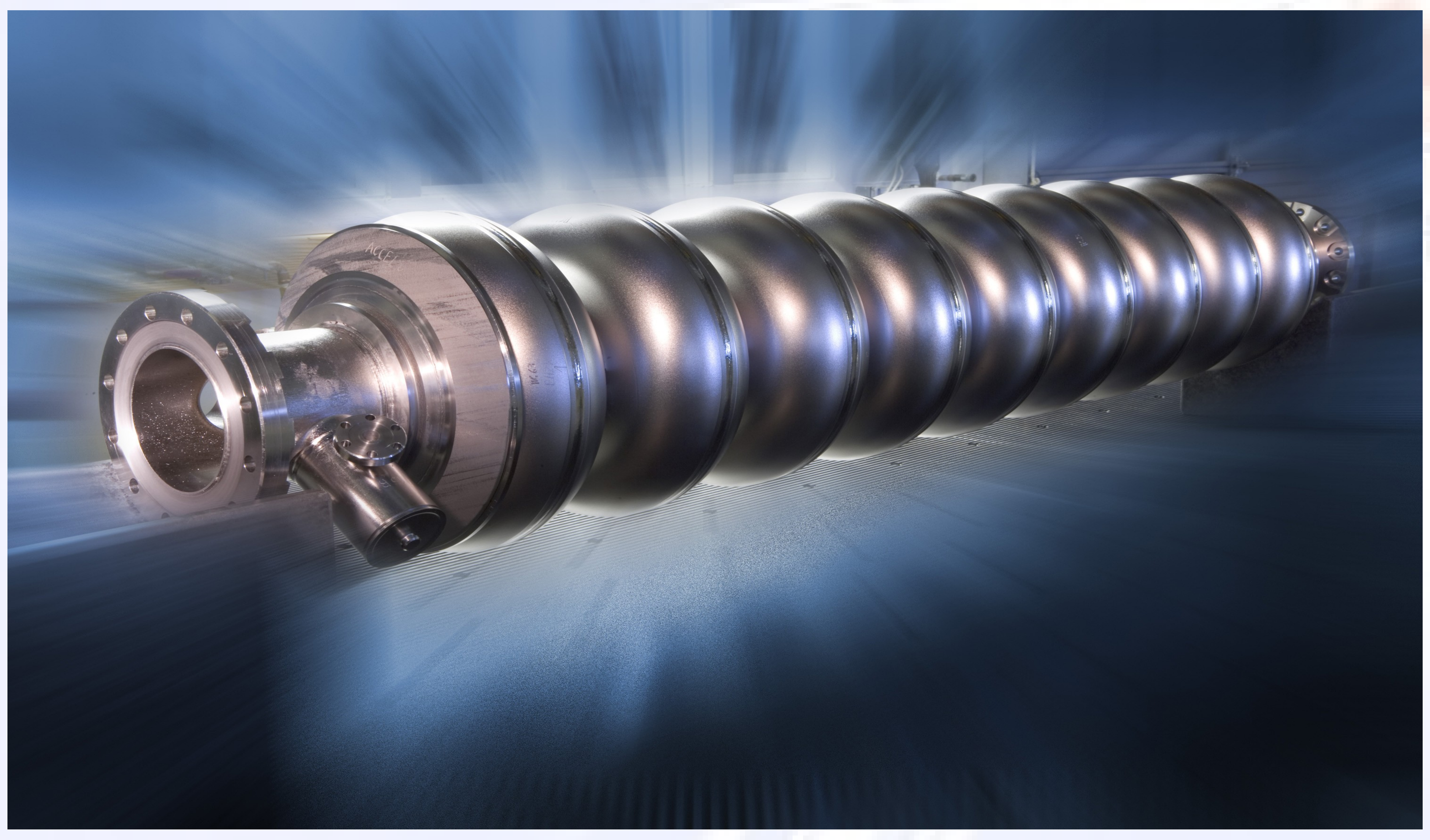
The lightest supersymmetric particle provides an ideal candidate for dark matter. Precise measurements are needed to verify whether the properties of the lightest particle are consistent with cosmological data. The ILC will give us the chance to discover and study supersymmetry in depth, allowing the most precise measurements of supersymmetric particles.



THE INTERNATIONAL LINEAR COLLIDER



At 31km in length, the **ILC** will be the largest and also the most complex accelerator ever built. Besides the main linacs, damping rings with a circumference of 6 km for electrons and positrons are needed to produce the high quality beam required at interaction point. Physicists from all over the world participate in its design, but it is not yet known where the machine will be built.



The ILC proposes 250 GeV (ugrade: 500 GeV) beams at a luminosity of over 10^{34}. That is ten times more energetic and corresponds to a hundred times more interactions per second than the SLC at SLAC. The main linac consists chiefly of superconducting acceleration structures with an acceleration gradient of 31MeV per metre. The beam delivery system prepares the beam to be focused by a final quadrupole magnet to a vertical beam size of 5 nm. This ensures a high e^+e^- interaction rate since unlike circular colliders non-interacting electrons are lost. Every second 5 trains of 3000 bunches of electrons and positrons will be sent to interact in the middle of the detector.

The ILC includes study of Higgs, SUSY or any other new phenomena. Precision achieved at ILC will allow for model independent observation of Higgs and will study in detail the mass generation mechanism of the Standard Model. If SUSY exists in Nature, ILC can determine its symmetry breaking mechanism and precisely measure properties of accessible supersymmetrical particles