All in the Timing

Tambe Ebai Norbert is a graduate student working with Yuichi Kubota on physics beyond the standard model. He is part of the Compact Muon Solenoid (CMS) experiment located at the Large Hadron Collider (LHC) in Switzerland. Norbert’s expertise is in working with electronics of and analyzing data from the Electron Calorimer (ECAL) portion of the experiment. The ECAL is a made up of lead tungsten crystals which detect electromagnetic objects, i.e. photons and electrons. Part of Norbert’s work has been to help calibrate the timing mechanism of the ECAL to be as precise as possible. Norbert says that ECAL not only tells physicists the energies of the particles in the detector, but also their precise arrival time. Arrival time is important because physicists know when certain particles are supposed to arrive at the detector. Those that arrive late represent new or novel physics.

Possible new physics interactions include supersymmetry, though they have only found one event that is possibly supersymmetry and need more data to say they have made a discovery. They ares earching for supersymmetric particles called neutralinos (which are neutral and supersymmetric in nature) which decay into a photon and a possible dark matter candidate particle called gravitino which is also supersymmetric. A gravitino is the superparticle of the graviton, the particle which creates gravity and the neutralino is the superpartner of photons.

It is possible that the late-arriving particles found in the detector are photons produced from the decay of a slow-moving neutralino on an indirect path. These would arrive at the ECAL late compared to photons that are produced by other non-standard model particles. “We know when the particles should get there, so if there is a delay then that represents a new particle. We search for delayed or displaced photons. These delayed photons do not only have to come from neutralino decays, they could come from new exotic form of matter particles. “

Norbert has also helped to upgrade the read out electronics on the HCAL or hadron calorimeter which measures hadronic particles such as pions and kaons. This upgrade is part of the effort to increase the efficiency of the experiments during Long Shutdown 1, the planned period where the collider is being upgraded to begin working at 13 TeV (the data Norbert is looking at is from previous 8 TeV runs. Norbert will be continuing to look for new physics as the LHC starts up again in 2015 with greater energy.