The Search for Proton Decay

JOSHUA ILANY, Stony Brook University — One of the major efforts in theoretical high energy physics today is the search for a theory that unifies the electromagnetic, weak and strong forces into a single field at high energies (higher than $10^{14}$ GeV). Though candidates for a Grand Unification Theory are plentiful today, most predict that the proton must decay. The prototypical GUT, the SU(5) Georgi-Glashow model, combines quarks and leptons into an irreducible representation, giving rise to Baryon number violating interactions. The Georgi-Glashow model predicts a proton lifetime of less than $10^{32}$ years, which has been experimentally refuted by the IMB proton decay experiment and more recently by experiments at Super-Kamiokande. More modern GUTs have been constructed around experimental constraints on the lifetime of the proton. The current lower limit on the proton’s lifetime, provided by the Super-Kamiokande experiments, is $6.6 \times 10^{33}$ years.