Frontiers Beyond the Standard Model III was held at the University of Minnesota in October 2012. This was the third workshop in a series which explores the possible directions for particle physics beyond the standard theory of strong and electroweak interactions. The first two meetings were held in 2002 and 2004 respectively. All were hosted by the Fine Theoretical Physics Institute.

Currently there are no direct experimental data contradicting Standard Model (SM). The recent discovery of a particle with a mass of 125 GeV which is very probably the long sought for Higgs boson of the SM, and nothing else at LHC, poses a number of crucial questions which were discussed at the conference. At the Lagrangian level MSSM predicts that $M_H < M_Z$, where $M_Z \approx 90\,\mathrm{GeV}$ is the Z boson mass. To elevate the Higgs mass to the level of 125 GeV one needs a large radiative correction (not much smaller than the tree-level term). This can be achieved rather naturally if the stop mass (i.e. the mass of the t quark superpartner) is very heavy, perhaps from a few TeV to 10 TeV or heavier.

A number of talks were devoted to various modifications of the MSSM which could, at least in principle, explain the current situation. For example, D. Alves (Fermilab) suggested that in an expansion of the supersymmetric Higgs sector called Sister Higgs, there may be a Higgs field that participates in electroweak symmetry breaking but does not give any direct masses to the SM matter fields. There were two talks (C. Csaki and S. Matsuzaki) which examined whether or not the particle discovered at CERN is really the SM Higgs boson or rather a field related to a dilation symmetry in a new strongly coupled sector Y. Grossman (Cornell) considered a model which violates R-parity, but in an unusual multi-step way. He formulated a minimal flavor violation (MFV) hypothesis to the R-parity violating MSSM. In this framework squarks could be light and the proton long-lived, simultaneously, without producing missing energy signals at the LHC. J. Heckman (Harvard) assumed that Higgs could weakly mix with a nearly supersymmetric extra sector. Such mixing terms then could play an important role in raising the Higgs mass relative to the value expected in the MSSM. Y. Nomura (UC, Berkeley) researched the Landscape hypothesis in search of the so-called spread supersymmetry (a version of split supersymmetry).

There were also a series of talks by G. Kane, A. Line, L. Ibanez, and E. Dudas which explored the predictions of string theories on low energy phenomenology. For example, the related talks of Linde and Dudas argued that any theory with strongly stabilized moduli results in a low energy spectrum with necessarily heavy sfermions and relatively light gauginos. These theories naturally contain a Higgs boson with a mass of at least 125 GeV.

The overall conclusion of these talks is that (i) the scale of supersymmetry breaking cannot be universal; (ii) it is likely to be quite high (iii) nonminimal modifications

of MSSM are seemingly necessary.

There were also several talks relating dark matter to new phyics. There was a very impressive talk by P. Graham (Stanford). He suggested a new method for detection of axion dark matter. The axion field oscillates at a frequency equal to its mass when it is a component of dark matter. These oscillations induce time varying CP-odd nuclear moments, such as electric dipole and Schiff moments. The coupling between internal atomic fields and these nuclear moments gives rise to time varying shifts to atomic energy levels. This is the first fresh idea in this area for years! Other talks related to dark matter were given by K. Dienes who proposed a new multicomponent nature for dark matter. Y. Mambrino talked about the astrophysical consequences of dark matter candiates and H. Baer on the nature of dark matter candidates in so-called theories of natural supersymmetry.

There were also a few talks of a more formal nature. One stimulating talk was that of Z. Komargodski (Weizmann and IAS). He derived the most general low-energy representation on the string world sheet generalizing that of the Nambu-Goto action (i.e. including "higher" operators). Generalized Lüscher terms follow automatically.

The enthusiasm and interest in this series on workshops will certainly call more in the future as our emerging knowledge of the Higgs sector and physics beyond the Standard Model develops.