In search of a light Higgs boson

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(PhysOrg.com) -- "It's pretty clear that the standard model of physics is not enough to explain all the phenomena in nature," Tomasz Skwarnicki tells *PhysOrg.com.* "Through looking at a variety of phenomena – one of them being dark matter – we know that there is a whole set of interactions beyond our standard model." Skwarnicki's work doesn't deal with dark matter, but the Syracuse University physicist has been working on models of physics that go beyond the standard.

Like many other scientists, Skwarnicki is interested in the Higgs boson. This is an elementary particle that, according to theory, gives mass to other particles. The Higgs boson is the only particle in the standard model that has yet to be discovered in a physical and experimental sense. Skwarnicki has been associated with the CLEO Collaboration, a group of scientists from a variety of physics programs in the U.S., Britain and Canada. CLEO is based at Cornell University, in Ithaca, New York, and experiments are done at the Cornell Electron Storage Ring (CESR).

Data from CLEO experiments have been analyzed on an ongoing basis, and a recent article published by the collaboration in *Physical Review Letters* offers some insight regarding the probability of one of the super symmetric extensions to the standard model. The article is called "Search for Very Light CP-Odd Higgs Boson in Radiative Decays of $\Upsilon(1S)$", and Skwarnicki points out that it offers new constraints on parameters of Next to Minimal Super Symmetric Model (NMSSM).

"Our measures restricted the range of new physics models," Skwarnicki explains. "We closed some gaps in measurements that had existed before."

Skwarnicki says that while the standard model of physics allows for only one Higgs boson, designated CP-even, the NMSSM suggest seven total Higgs bosons, including a CP-odd boson. "The presence of this CP-odd boson would change all knowledge of all Higgs decays," he explains. "But to make it work, this CP-odd Higgs boson would need to be very light."

The data analysis done involved looking for evidence of production and decay of this very light Higgs boson. The CLEO team looked for a decay of what is called an Upsilon state, $\Upsilon(1S)$, which would produce a CP-odd boson, which would in turn decay to a pair of heavy electron-like particles . "Unfortunately," Skwarnicki points out, "we did not find this. So the search for experimental evidence of the Higgs boson continues."

He did say that the new bounds established by the experiment, setting a new upper limit, do have an effect on scientific theory. "Our data analysis shows that it would be very hard to speculate with a light Higgs in the Next to Minimal Super Symmetric model. We cannot rule out this model completely, but we ruled out a great deal. Chances are that another theory will have to be used. And the bounds can be used in future ideas of what new interactions beyond the standard model are possible."

Skwarnicki is fairly optimistic that evidence for the existence (or non-existence) of the Higgs boson will be found soon. "The whole point of the Large Hadron Collider, though other experiments will be performed, is basically to create the energy needed to find the Higgs boson," he points out. "The LHC should be fully operational next year, and then we'll have a better idea of whether we need to throw everything out the window."

Skwarnicki himself is lined up for an experiment at the LHC. “Non-standard models, which are needed to explain some phenomena, will also be affected by this. What we find out about the Higgs boson in Geneva will apply to non-standard models as well.”