A test for new physics, including string theory

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Detractors of string theory have been deriding it for years, claiming that there is no way to test it. However, with a paper published in *Physical Review Letters* titled “Falsifying Models of New Physics via WW Scattering”, that could change. Coauthors Jacques Distler at the University of Austin in Texas, Benjamin Grinstein from the University of California, San Diego, and Rafael A. Porto and Ira Z. Rothstein at Carnegie-Mellon University in Pittsburgh, Pennsylvania, address a way of falsifying some models of string theory in their Letter.

“Everybody wants to find an experimental test that proves what you thought before was wrong,” Distler tells *PhysOrg.com*. “Our aim is to suggest something that would rule out some ultraviolet completions of known physics. The physics that we know is described by an ‘Effective Field Theory.’” But that EFT breaks down at some energy, where it must be replaced by something else — perhaps another EFT. “Ultimately,” says Distler, “one wants to find a theory that's good to arbitrary energies. That's what we call a ‘UV completion.’”

“Particle physicists grew up assuming that, whatever the UV completion is, it would have certain properties, and it is these properties of the presumptive UV completion that lead to our bounds. String theory arose as a way to satisfy those assumptions,” Distler adds.

Distler says that the test proposed would possibly be performed with information from the Large Hadron Collider (LHC), which is scheduled to go online in Switzerland this year. However, he believes that the up-

and-coming International Linear Collider (ILC), which is in the early planning stages still doesn't even have an announced location, will likely offer more insight.

"One of the things measured will be the unknown parameters of the EFT," explains Distler. "If they turn out to lie in a region forbidden by our bounds, that says something about profound about high energy physics." (More on how the test would work can be found in another PhysOrg.com posting)

Distler is fairly certain that when the test is applied, generic models of string theory will, in fact, hold up. However, if string theory is ruled out, the test would mean that there is more hope for what Distler terms "conceivable alternative theories" like loop quantum gravity. "This would still offer insight into important fundamentals," he says. "What we're probing is whether the UV completion satisfies axioms we think it ought to."

There is a caveat to this string theory test, though. "If a light Higgs [boson] is discovered, we'd have to redo all our calculations." While the Higgs particle is suggested in theory, it still has yet to be discovered, and therefore its mass is not known, making it difficult to include in this calculation, Distler explains. "But," he adds, "the idea will still be there and we will have set out the procedure. A similar calculation, including the Higgs, will still be possible, even if this specific analysis won't be applicable."

Even with this limitation, however, the work by Distler and his colleagues offers something profound — a way to actually test string theory. "We are pointing out what experimentalists should look for," he says, "and I am of the opinion that these bounds will be satisfied." He pauses before continuing: "But even if they're not, at least I'll be somewhat mentally prepared."