

Gerald B. Cleaver

Research in the Free Fermionic and Randall-Sundrum Regions of the String/M-Theory Landscape

(Physics / Arts and Sciences)

Albert Einstein's dream was to uncover a *Unified Field Theory* that would explain all of the differing forces and the variety of matter in the universe. In 1955 Einstein died with his dream unfulfilled. In addition to electromagnetics and gravity, the strong and weak nuclear forces had been discovered by then, and no connections between any of the four could be identified. Over the following 20 years major steps towards Einstein's goal were realized by the next generation of elementary particle theorists, though only from the non-gravitational side: The three non-gravitational forces were discovered to result from mathematical structures known as local gauge symmetries generated by spin-one particles (photons, gluons, and the W's & Z). Connections between electromagnetics and the weak nuclear force were then developed into the *electroweak theory* that unified the two forces—the validity of which was confirmed by particle collider experiment at Stanford, Fermilab, and CERN. During the same era, the rationale for matter particles with mass was provided by the proposed existence of a spin-0 particle, the higgs, now on the verge of discovery at Fermilab or CERN. Then in the late 1970's and early 1980's *Grand Unified Theories* (GUTS) were proposed that theoretically merged the strong nuclear force with the electroweak force. By the early 1980's even a connection, termed supersymmetry, between matter and and the three (unified) non-gravitational forces was realized.

What remained unrealized of Einstein's dream was the connection of the non-gravitational forces with gravity. The dawn of a new era in the mid 1980's, that of *String Theory*, proffered a resolution. String theory, which unifies all forces in nature (gravity, electromagnetics, and the two nuclear forces) and all matter, is my research specialty. I earned my Ph.D. at Caltech in 1993 under one of its founders, John H. Schwarz. I am joined in my string research at Baylor by my two graduate students, Richard Obousy and Matthew Robinson. I am applying for a URC Grant to provide for partial (33%) release for Richard and Matthew from their TA duties this fall to allow them the research time needed to successfully continue/complete their research programs. This URC funding will enable Richard to complete his Ph.D. thesis research and defense one semester earlier, by end of the spring 2009 semester, rather than by end of summer 2009.