In 1985, Robert Bussard (an UCLA graduate) came up with a Polywell fusion concept that combines electric fusion with magnetic cusp confinement. A Polywell device would operate stably at high plasma pressure due to stable cusp magnetic field geometry. High energy electron confinement would be achieved in a cusp at high plasma pressure from strong diamagnetism based on a theoretical conjecture by Harold Grad and his team at NYU. Electron beam injection would produce excess electrons resulting in a deep electric potential well for ion acceleration and confinement.

The successful development of Polywell reactor has hinged on the validity of this theoretical conjecture about the magnetic cusp confinement. Between 1955 and 1958, Harold Grad and his team conjectured (and to some extent calculated) that the confinement properties of a magnetic cusp would be dramatically improved if the confined plasma had sufficiently high pressure to exclude the B-field from the interior. For example, their calculation indicates a confinement enhancement by a factor of ~500,000 for 100 keV electrons in a reactor situation. We have carried out an experiment that demonstrates, for the first time, that this effect is real. This has dramatic implications for the future of Polywell fusion, which may offer a low cost and rapid development path for an economical fusion power reactor.

A preprint of recent experimental results can be found in http://arxiv.org/abs/1406.0133.