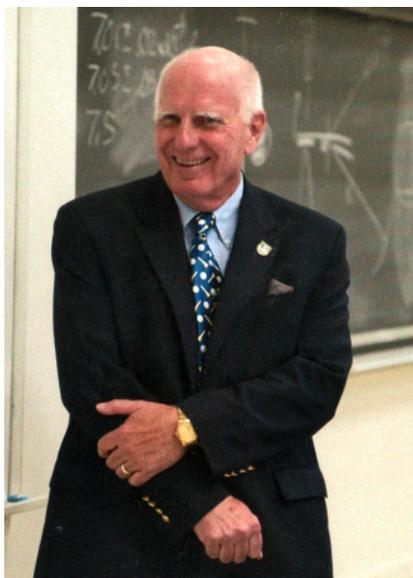


Samuel A. Werner Biography



Samuel A. Werner - Class of 1955 - 1935 Curators' Professor Emeritus, Department of Physics and Astronomy, The University of Missouri, Columbia, MO 65211, Guest Researcher, Neutron Physics Group, NIST

Education: AB Dartmouth College (1959), MS Dartmouth College (1961), PhD, The University of Michigan (1965). Research in Neutron Interferometry

In 1975 the first observation of the phase shift of matter waves induced by the Earth's gravity was achieved by Roberto Colella, Albert Overhauser and Samuel Werner (COW) in a neutron interferometry experiment carried out at the 2 MW Ford Nuclear Reactor (FNR) at the University of Michigan in Ann Arbor. Gravity and quantum mechanics do not simultaneously play an important role in most phenomena accessible in terrestrial physics. The COW experiment was the first time in physics where an observation necessarily depended upon both the Planck's quantum constant and Newton's gravitational constant

Several subsequent versions of this experiment carried out in Sam Werner's neutron physics laboratory at the University of Missouri Research Reactor (MURR) found that the principle of equivalence was verified to about 0.7 percent in the quantum limit. Shortly after the completion of the early versions of the COW experiment, the apparatus was used to observe two other fundamental physics effects. The neutron is a spin-1/2 Fermion. If it is allowed to precess in a magnetic field, the sign of its wavefunction changes upon a 360 degree precession. This characteristic spinor change of sign shows up in a neutron interferometry experiment as a phase shift of π radians. Since the COW experiment was carried out in the frame of our rotating Earth, a non-inertial frame of reference, there is an additional phase shift, analogous to the optical Sagnac effect. This phase shift was observed for the first time by Staudenmann, Werner, Colella and Overhauser in 1979 at the 10 MW MURR. These early experiments led to many other neutron interferometry experiments including the first observation of the topological Aharonov-Casher effect in 1989, the phase echo effect in 1991, the scalar Aharonov-Bohm effect in 1997, and the observation of Berry's geometrical phase using spin polarized neutrons in 1995. Sam Werner's neutron interferometry program at Missouri and at NIST was funded continuously by the Physics Division of the NSF for 28 years (1976-2004). This field is summarized in the book Neutron Interferometry, by Helmut Rauch and Samuel Werner, Oxford University Press (2000). A new edition of this book is now (December,2012) being prepared.