Bernard Mulligan

Curriculum Vitae, Current as of January 1, 2010
Professor, The Ohio State University, Department of Physics
191 West Woodruff Ave, Columbus, Ohio 43212

Education:

Ph.D., Massachusetts Institute of Technology, 1962; Specializations: Theoretical Physics; Nuclear Physics
Dissertation Advisor: Herman Feshbach
B.S., University of Alabama, 1956; Major Areas: Physics and Mathematics; Minor Area: German

Employment:

The Ohio State University 1961–Present; Planned Retirement April 1, 2010
Consultant: Battelle Memorial Institute – 1966-1970
Postdoc: Massachusetts Institute of Technology – Summer, 1962

Recent Publications:

Mass, Energy and the Electron, *Annals of Physics* **321** (2006), 1865.
Effects of Nonlocality and Phase Shift Definitions in Generalizing Levinson's Theorem, (with S.B. Qadri, M.F. Mahmood, and J.Y. Al-Khal), *International Journal of Evolution Equations* **2** (2007), 99.

Research Interests:

My central research interest is in quantum gravity and a unified field theory, and the papers on which I am working are centered around that goal. In the *Annals* paper listed above I have successfully conquered the question of where inertial mass "resides" in the case of leptons. The next step in my work is to relate this to gravitational mass and to the cosmological constant as they appear in Einstein's equations of classical general relativity.

A feature of the Annals paper useful to my investigations is a demonstration of how to separate the Dirac equation into two, 2-component spinor equations–one for a particle with mass and the other for an antiparticle with mass. This is a process that eluded H. Weyl, who was able to obtain 2-component equations only for massless spin-1/2 fields. This separation results in explicit particle and antiparticle solutions, and assists in clarifying the difference between chirality and helicity for spin-1/2 particles with mass. (See Mark Srednicki, *Quantum Field Theory*, Cambridge University Press, 2007, Chapter 38, for a four-component discussion of this problem.)

Honor Society Memberships:

Phi Beta Kappa Sigma Xi Sigma Pi Sigma Pi Mu Epsilon Phi Eta Sigma

Professional Memberships (Past/Present):

American Physical Society
American Association of University Professors (Past President, The Ohio State University Chapter)

Manuscript/Proposal Referee (Past/Present):

The Physical Review
Journal of Mathematical Physics
Annals of Physics
Nuclear Physics
National Science Foundation
Journal of Physics: Condensed Matter

University Service (Past/Present):

Arts and Sciences Honors Committee
Phi Beta Kappa: Standards Committee (Chair); Elections Committee (Chair); OSU Chapter President
American Association of University Professors: Committee on Women and Minorities (Chair); OSU Chapter President
University Senate: Faculty Compensation and Benefits Committee; Committee on Traffic, Parking, and Public Safety; Senate Alternate
University College: Advisement Committee
College of Mathematics and Physical Sciences: Curriculum Committee (Chair);
Consolidated Science-Engineering Library Committee

Course Development:

Hands-On Physics Courses for Non-majors: Four Courses
Quantum Physics
Quantum Mechanics
Mathematical Methods of Physics
Physics of Solids
Honors Physics with Calculus

Teaching Experience:

Undergraduate Level Courses: Quantum Theory; Mechanics; Electromagnetic Fields and Waves; Modern Physics; Optics; Physics for In-Service Teachers; Introductory Physics (w/o Calculus); Introductory Physics (with Calculus); Hands-on Physics for Non-majors.

Graduate Level Courses: Classical Dynamics; Fluid Dynamics; General Relativity; Elasticity; Quantum Mechanics; Electromagnetic Fields and Waves; Nuclear Theory; Mathematical Methods; Quantum Field Theory.

Previous Funding:

As a principal investigator in research funded by the U.S. National Science Foundation

Papers in Preparation:

"Dark Energy, Dark Mass, and Quantum Gravity"
"Complementarity and the Electron"

Books and Book in Progress:

The Department of Physics prints and sells each year through Uniprint approximately 400 copies each of the following two books for Physics 103 (used Autumn, Spring, and Summer):

Textbook: THE WORLD OF ENERGY: PHYSICS 103
ACTIVITY BOOK FOR THE WORLD OF ENERGY: PHYSICS 103
These were written in collaboration with M. Wildermuth.

Approximately 150 copies of the following two books for Physics 104 are sold each year through Uniprint (used Winter and Summer):

Textbook: THE WORLD OF ENERGY: PHYSICS 104
ACTIVITY BOOK FOR THE WORLD OF ENERGY: PHYSICS 104
These were written in collaboration with M. Wildermuth and B.C. Clark (2004) and in collaboration with M. Wildermuth (2005).

All of the above books are sold to the students by Uniprint for an amount equal to the printing costs only. These books are also used at the Newark Campus.

BOOK IN PREPARATION: I am working on a book on mathematical physics, tentatively titled *Mathematics as a Tool in Physics Research*. At present the book is taking second place to my research interests.