DEPARTMENT OF PHYSICS

FACULTY

- John Hagelin, Ph.D., Chair, Professor of Physics, Director of the Institute of Science, Technology and Public Policy
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INTRODUCTION

It is said that, if you understand the laws of physics, you are halfway to understanding the world. It's in that spirit – of physics as the basic core of today's most important scientific disciplines – that Maharishi University of Management offers an exciting and comprehensive minor program in physics.

But the study of physics, as rigorous and compelling as it is as a field, also develops life-long problem-solving, computational and computer-related skills that enable a graduate to excel in the most demanding and cutting-edge areas of study and professional work.

At M.U.M., the physics minor is on the road to these discoveries. Whether the graduate steps into the fields of astronomy, chemistry or computer science, engineering, science writing, energy management or environmental policy (to name but a few fields that physics prepares you for) physics study at M.U.M. can be the ticket to employment in an endless variety of fascinating professional adventures.

This path is all the more powerful due to the program's emphasis on both the direct experience and theoretical understanding of human consciousness and its higher states – integral parts of M.U.M.'s physics curriculum. Down through the centuries, the most brilliant and creative physicists have emphasized human consciousness as the foundation for their discoveries. And an exciting momentum has built up over the past 30 years, as theoretical physicists have reached milestones toward a complete unified field theory of all the known force and matter fields of nature. Inspired by the guidance of His Holiness, Maharishi Mahesh Yogi, the physicists at Maharishi University of Management have proposed that this complete unified field at the basis of the whole universe is the same as the Unified Field of Consciousness, the experience of which has been recorded in the ancient Vedic literature and revived through the advanced technologies of consciousness, the Transcendental Meditation and TM-Sidhi programs.

Now, with the increasingly widespread recognition that consciousness is much more than a localized offshoot of brain functioning, the spotlight is even brighter on physics as a leading discipline in the field of consciousness studies. That same light is also focused on M.U.M., now taking a leadership role in the field of consciousness studies, especially as

we begin to explore the true potential of higher states of consciousness. Which means our physics program is in the exciting and unique position of being able to explore new territory – the rich and fertile connections between consciousness, brain research and the study of physics.

There are too many universities where the study of physics is regarded as attainable by only an elite few. But at M.U.M., consciousness-based education nourishes and supports every student's ability to understand the most advanced new theories, out of reach at many other universities. With a faculty committed to individual attention and learning styles, any conscientious student who wants to learn physics will succeed. Beginning with an understanding of the mathematical precision, so essential to embracing physical concepts, and taken in a step-by-step manner, with generous classroom support, no student need be left behind.

As they approach the conceptual breakthroughs of advanced physics, students embark on a journey that will take them to an entire new way of thinking, a journey that will take them beyond ordinary, waking-state experience and into the realm of higher states of consciousness, woven into M.U.M.'s academic program.

The experience of these higher states, coupled with a unique understanding of the entire process, makes M.U.M.'s physics students naturally feel at home with even the most sophisticated concepts and puts them in a rare position in the boundary-breaking world of the leading edge of physics.

DEPARTMENTAL REQUIREMENTS

Graduation Requirements for the Minor in Physics
To graduate with a minor in physics, students must successfully complete the following Mathematics courses

- MATH 281 Calculus I
- MATH 282 Calculus II

And at least two of the following General Physics courses:

- PHYS 210 Introduction to Classical Mechanics
- PHYS 230 Introduction to Electromagnetism
- PHYS 240 Introduction to Harmonics, Waves, Optics and EEG
- PHYS 250 Introduction to Modern Physics

Plus any three additional 4-unit Physics courses numbered PHYS 210 or higher.

COURSES

All courses are 4 units unless otherwise indicated.

PHYS 110 Foundations of Physics and Cosmology: Discovery of the Unified Field and Its Practical Applications for Perfection in Life
This course gives a deep and non-mathematical understanding of the differences between classical and quantum physics. It explains the meaning and mechanics of unification and symmetry, and the main concepts of unified quantum field theories and superstring theory. It shows that at the basis of the universe lies a complete unified field, a self-interacting entity from which all particles and forces arise through the process of spontaneous symmetry breaking. The course gives students experience and understanding of the interconnectedness between the laws of physics, the universe and themselves. As an important section of the course, students are encouraged to take part in a two-day field trip to Fermilab and the Adler Planetarium in Chicago.

PHYS 210 Introduction to Classical Mechanics
Classical mechanics provides an accurate description of the objects and phenomena of everyday experience, and constitutes the basis of most of engineering, science and technology. In this course, students analyze the forces and motions of classical particles and extended bodies in space and time. Topics include the study of velocity and momentum as well as energy and forces, with particular emphasis on gravitation and the laws of conservation. Calculus I & II recommended.

PHYS 230 Introduction to Electromagnetism
Electrical forces largely determine the observable properties of matter in the whole range of science from atomic theory to cell biology. The integration of electricity and magnetism constitutes the first unified field theory, anticipating contemporary approaches by more than a century. In this course, students are introduced to electrostatic and electromagnetic fields, electric currents and electromagnetic interactions. Topics include Coulomb's, Gauss's, Ampere's and Faraday's laws, along with Maxwell's equations. Calculus I & II recommended.

PHYS 240 Introduction to Harmonics, Waves, Optics and EEG
This course begins with mechanical aspects of harmonics, waves and sound. It then combines these principles with those of the electromagnetic field for the investigation of geometrical and physical optics. In addition, special attention is given to the analysis and interpretation of EEG brain wave patterns. Topics include simple harmonic motion, resonance, wave properties such as refraction, diffraction, interference, polarization and optical phenomena related to lenses and mirrors. Calculus I & II recommended.

PHYS 250 Introduction to Modern Physics
Quantum mechanics and Einstein's theory of relativity are the major themes of this course. Topics include special relativity, the birth of quantum mechanics, Schrödinger's equation, wave mechanics of one-dimensional problems and the hydrogen atom. Calculus I & II recommended.

PHYS 260 Hands-On Physics
This is a project-oriented course intended to support the Sustainable Living major. The physical principles underlying renewable energy—such as solar, wind, geothermal and biofuels—will be explained and applied. In addition, students will examine and work with the physics of building materials, energy conservation and environmental science, generally.

PHYS 270 Introduction to Astronomy
In this course students learn about sky maps, astronomical observation and the whole universe. Topics include the history of astronomy, sky charts, telescopes, spectroscopy, sun and planets, stellar formation and evolution, black holes, galaxies, cosmology and the early universe.

PHYS 290 The Evolution of Physics: From Einstein to Maharishi
Some of the most extraordinary, mind-expanding concepts of the past century have emerged from modern physics. This course is an engaging, minimally mathematical course, emphasizing the profound principles and concrete examples from physics that best illuminate the foundations of Maharishi Vedic Science. Topics will include the Principle of Least Action, Einstein's Relativity Theory, the Meissner Effect, quantum measurement theory, the EPR paradox, Bell's theorem, and quantum teleportation.

PHYS 313 Classical Mechanics I
PHYS 314 Classical Mechanics II
Students explore the formal structure of Newtonian mechanics with application to single-particle systems. Topics include kinematics, dynamics, the harmonic oscillator, three-dimensional motion, constraints, non-inertial systems, central force problems and scattering. Calculus I & II required.

PHYS 330 Electromagnetism I
PHYS 331 Electromagnetism II
Students apply the calculus of vector fields to the study of electromagnetic fields and their sources. Maxwell's equations and their application to relativistic and non-relativistic phenomena are examined in detail, along with the principles of physical optics. Calculus I & II required.

PHYS 340 Relativity Theory I
PHYS 341 Relativity Theory II
This course discusses special relativity and introduces general relativity, including Riemannian geometry, Mach's Equivalence Principle, Einstein's field equation, the Newtonian limit, experimental tests, black holes and the structure of spacetime. Calculus I & II required.

PHYS 360 Quantum Mechanics I
PHYS 361 Quantum Mechanics II
Topics include wave mechanics, one-dimensional potential, operator methods and the Dirac formulation, the harmonic oscillator, Schrödinger and Heisenberg representations,

the classical limit and the WKB approximation. In addition, these courses consider identical particles, quantum paradoxes and interpretations, angular momentum, central potentials and the hydrogen atom, electrons in electromagnetic fields, spin and general two-state systems, addition of angular momenta, the EPR paradox and Bell's theorem, perturbation theory, the variational method, fine structure, atoms and molecules, emission and absorption of radiation scattering theory, density matrices and measurement theory. Calculus I & II required.

PHYS 370 Thermodynamics and Statistical Mechanics
Thermodynamics studies the transformations of energy in macroscopic systems. It is chiefly concerned with the general laws governing the transformation of heat into work and the effect of these laws on the thermal properties of bulk matter. Statistical mechanics derives these laws, as well as the more fundamental properties of bulk matter, from the dynamical behavior of underlying microscopic constituents. Calculus I & II required.

PHYS 375 Astrophysics
Topics include stellar structure, energy generation in stars, white dwarfs, neutron stars, black holes, the dynamics of star formation, the structure of the universe, cosmology and the Big Bang. Calculus I & II required.

PHYS 380 Mathematical Methods for Physicists I
PHYS 381 Mathematical Methods for Physicists II
The intelligence of nature is encoded and expressed in the language of mathematics. This course is designed to develop and refine the mathematical skills needed for successful study in physics and related sciences. By making these mathematical skills second nature, the mind is freed to comprehend the deeper principles of natural law embedded in the formulas and equations. Calculus I & II required.

PHYS 390 Methods of Experimental Physics I
PHYS 391 Methods of Experimental Physics II
This course focuses on experimental research methods, giving students experience in designing and performing laboratory experiments. In addition to laboratory work in traditional areas such as mechanics and electromagnetism, students will be encouraged to design and carry out experiments in the EEG laboratory.

PHYS 410 Philosophy of Science
Understanding foundational issues underlying the scientific method is essential for the contemporary thinker and, especially, for the practicing scientist. The scientific method is the systematic, repeatable empirical approach to acquiring knowledge, involving the discovery and testing of hypotheses against the experimental evidence. The issue of alternative explanations for a given empirical result, including the null hypothesis, is examined from both an abstract, philosophical perspective and the pragmatic perspective of working scientists and statisticians. The important contrast between normal science and paradigm-change is studied with reference to the reaction in the wider scientific community to the Maharishi Effect research. Finally, we examine the significance for the