1. General
President: Michael A. McRobbie
Vice-President: (Bloomington)
Dean of Graduate School: James Wimbush
Department Chairman: Richard J. Van Kooten
Department Telephone Number: (812) 855-1247
Type of Institution: University
Control: Public
Setting: Small town
Total Faculty: 1,441*
Total Graduate Faculty: 1,522*
Total Students: 38,990*
Total Graduate Students: 8,162*
Annual Graduate Tuition:
In-state residents: Full-time—$291.97/credit hr.
Out-of-state residents: Full-time—$850.33/credit hr.
Tuition rates for: 2008–09
Deferred tuition plan: No
Other Fees: $431.52 per semester
Term: Semester
*Bloomington Campus
*Including professional schools

2. Number of Faculty in Department
The combined total of full-time faculty in the three professorial ranks is 40. The combined total of full-time, part-time, and other faculty at all ranks is 40.

3. Admission, Financial Aid, and Housing
Address admission inquiries to: Chairman, Graduate Admissions, Dept. of Physics
Graduate application fee required: $50 (domestic); $60 (foreign)
Admission deadline (Fall admission): 1/15 (domestic); 12/1 (foreign)
Admission requirements: For fall admission, 2007–08, 64 students were offered admission from 190 applicants.
Admission requirements: For admission to the graduate programs, a Bachelor’s degree in physics is required with a minimum undergraduate GPA of 3.0. The GRE and GRE Advanced are required for applicants who wish to be considered for financial support. Students from non-English speaking countries are required to demonstrate proficiency in English via the TOEFL exam. The minimum score for admission is 550 paper, 213 computer based, 80 Internet based.
Address financial aid inquiries to: Chairman, Graduate Admissions, Physics Dept.
GAPSFAS application required: No
Loans available: Yes
Address housing inquiries to: Halls of Residence, 801 N. Jordan
On-campus, single student housing available: Yes

Cost/academic year: $4,346–5,758 (single rm.)
$3,778–4,338 (double rm.)
On-campus, apartment student housing available: Yes
Cost/month: $495–1,068 (furnished and unfurnished)

Table A—Faculty, Enrollments, and Degrees Granted

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Master’s</td>
<td>Doctorate</td>
</tr>
<tr>
<td>Astrophysics</td>
<td>4</td>
<td>0(0)</td>
</tr>
<tr>
<td>Biophysics</td>
<td>13</td>
<td>0(0)</td>
</tr>
<tr>
<td>Chemical Physics</td>
<td>1</td>
<td>0(0)</td>
</tr>
<tr>
<td>Condensed Matter</td>
<td>7</td>
<td>0(0)</td>
</tr>
<tr>
<td>Physics</td>
<td>30</td>
<td>0(0)</td>
</tr>
<tr>
<td>Particles &amp; Fields</td>
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<td>0(0)</td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>1</td>
<td>0(0)</td>
</tr>
<tr>
<td>Physics Education</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Physics of Beams</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Other Theoretical/</td>
<td>2</td>
<td>0(0)</td>
</tr>
<tr>
<td>Math.</td>
<td>2</td>
<td>0(0)</td>
</tr>
<tr>
<td>Non-specialized</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

| Total              | 95              | 10(93)           | 2(14)          | 9(51)            |

| Full-time Grad.    | 1               | 95               | 10             |
| Part-time Grad.    | 8               | 0                | 0              |
| First-year Grad.   | 2               | 13               | 0              |

| Median Years in Grad. | 3.5yr | 3yr | 3.5yr |

| Undergraduate Degrees, 2007–08 (2003–08): 15(68) | 3.5yr |

*Students not yet committed to a research specialty are entered under non-specialized.

4. Graduate Degree Requirements
http://physics.indiana.edu/~brochure/GraduateHandbook/degreetinfo.html

Master’s: 30 semester hours, at least 20 in physics, 14 of which must be in courses numbered P501 and higher, passed with an average grade of “B” or higher. Physics courses numbered below P501, and passed with a grade of “B-” or lower do not count toward this degree. (Seminar, research, and reading courses may not be counted toward the 14 hour requirement.) Master’s examination.

Master’s in Beam Physics and Technology: [A national program in collaboration with the U.S. Particle Accelerator School (USPAS)] 30 credit hours, including the following: P441 (or equivalent at another institution), P506 (or equivalent), P570, one course at the 500 level or above in laboratory techniques or computational methods, and a Master’s thesis course (P802). Four advanced courses in beam physics should be chosen from among the Special Topics courses P571, P671, and P672, with topics to be listed in a syllabus prepared jointly by the I.U. Physics Department and the USPAS. A grade point average of 3.0 or better must be maintained in the courses satisfying the 30 credit-hour requirement. In particular, both P441 and P506 (or equivalents) must be passed with a grade B- (3.0) or above. Thesis required. Either an oral defense of the thesis or a written final examination is re-
quired, and should take place at Indiana University. The written examination may be substituted for the oral defense only with the permission of the thesis committee.

**Doctorate:** 90 semester hours in course, reading, and research credits; a minimum of 9 credit hours per semester at the P501 level or above with an average grade of "B" or higher (first-year students are allowed a minimum of 7 credit hours at the P501 level or above); minor requirement can be met either outside of Physics or within Physics but outside of student’s area of thesis research; written qualifying exam; thesis; final oral exam; a minimum of two consecutive semesters in residence. All candidates are required to undertake supervised teaching as an Associate Instructor for at least one semester. All first time teaching Associate Instructors must enroll in a one-hour graduate credit course, “Practicum in Physics Laboratory.” Associate Instructors whose native language is not English are required to take an “Associate Instructor English Exam,” which they must pass in order to be qualified to teach. This exam must be passed by the end of the second year of study.

**Other Programs: Master of Arts for Teachers:** 36 credit hours with a minimum of 20 in physics. Ph.D. in Astrophysics: If in residence in the Physics Dept., a student must pass specifically designated parts of the qualifying examinations of both departments; thesis; final oral exam. Ph.D. in Chemical Physics: If in residence in the Physics Dept., same qualifying exam as above; minor in chemistry with eight hours in designated courses; thesis; final oral exam. Ph.D. in Mathematical Physics: If in residence in the Physics Dept., same qualifying exam as above, and a special qualifying examination in the Mathematics Department; thesis; final oral exam.

**Thesis:** Thesis may be written in absentia.

**Special Equipment, Facilities, or Programs:** There is a large joint library for astronomy, computer science, math, and physics in the same building. The Indiana University Cyclotron Facility (IUCF) is a multipurpose laboratory that supports basic research in nuclear, particle, accelerator, and condensed matter physics, and applied research in proton radiation effects and medical physics. The facility operates two coupled cyclotrons used primarily for radiation effects studies at the Radiation Effects Research Program (RERP) and for treatment of cancer at the Midwest Proton Radiotherapy Institute (MPRI). Also at IUCF, the new Low Energy Neutron Source (LENS) is the first pulsed cold neutron source located at a university; it will provide cold neutrons for three beamlines for small-angle neutron scattering, neutron radiography, and neutron spin echo spectroscopy. Specialized shops for scintillator, wire chamber, and target fabrication are available, with capabilities for design, construction, and testing of large or complex detector and electronics systems. Research equipment in other areas includes facilities for construction and testing of instrumentation for high-energy physics experiments. A 192-node parallel PC cluster is available for research computing. The University provides extensive supercomputing support including an IBM SP cluster with 300 CPUs and access to the High Performance Storage System (HPSS). Condensed matter and low-temperature equipment include two x-ray diffractometers, one with a high temperature (up to 1300°C) sample chamber; a multi-source high vacuum sputtering system; a 14T superconducting solenoid, other low temperature cryostats with 8T solenoids, two dilution refrigerators, a 3He refrigerator; a helium liquefier; two Auger spectrometers; three low-energy electron diffraction apparatus (LEED); three electron energy low spectrometers (EELS); two scan-

<table>
<thead>
<tr>
<th>Title of Appointee</th>
<th>Appointments</th>
<th>Academic Load</th>
<th>Hours of Service</th>
<th>Stipend for Academic Year ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>84</td>
<td>First year</td>
<td>16</td>
<td></td>
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</table>

**5. Personnel Engaged in Separately Budgeted Research, 7/07 – 6/08**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<td>Personnel</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professors</td>
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<td></td>
<td></td>
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<tr>
<td>Postdoctoral</td>
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<td></td>
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<td></td>
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<tr>
<td>Graduate Students</td>
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<td></td>
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<tr>
<td>Scientists (nteach)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
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<td></td>
</tr>
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</table>

**6. Separately Budgeted Research Expenditures by Source of Support**

<table>
<thead>
<tr>
<th>Source of Support</th>
<th>Departmental Research</th>
<th>Research Outside Department</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>$12,312,127</td>
<td>$2,519,762</td>
<td>$14,831,889</td>
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<tr>
<td>Business and industry</td>
<td>103,260</td>
<td>$560,320</td>
<td>$663,580</td>
</tr>
<tr>
<td>Total</td>
<td>$12,415,387</td>
<td>$3,080,082</td>
<td>$15,495,469</td>
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</table>

**Table C—Separately Budgeted Research Expenditures**

<table>
<thead>
<tr>
<th>Research Specialty</th>
<th>No. of Grants</th>
<th>Expenditures ($)</th>
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</thead>
<tbody>
<tr>
<td>Accelerator</td>
<td>3</td>
<td>$547,776</td>
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<tr>
<td>Astrophysics</td>
<td>3</td>
<td>$1,031,820</td>
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<tr>
<td>Biophysics</td>
<td>2</td>
<td>$398,652</td>
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<tr>
<td>Condensed Matter Physics</td>
<td>7</td>
<td>$259,637</td>
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<tr>
<td>Nuclear Physics</td>
<td>12</td>
<td>$8,008,676</td>
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<tr>
<td>Particles &amp; Fields</td>
<td>13</td>
<td>$2,058,826</td>
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<tr>
<td>Other (Instructional)</td>
<td>1</td>
<td>$110,000</td>
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<tr>
<td>Total</td>
<td>41</td>
<td>$12,415,387</td>
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Table D—Physics-related Research Outside Department

<table>
<thead>
<tr>
<th>Field and Unit</th>
<th>No. of Grants</th>
<th>Expenditures ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Physics</td>
<td>21</td>
<td>3,080,082</td>
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<tr>
<td>Chemistry Department</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>3,080,082</td>
</tr>
</tbody>
</table>

FACULTY

Professors

Glazier, James, Ph.D., University of Chicago, 1989. Biophysics (experimental).
Kostelecký, V. Alan, Ph.D., Yale, 1982. Theoretical physics; elementary particles.
Sokol, Paul E., Ph.D., The Ohio State University, 1981. Condensed matter physics (experimental).

Professors Emeriti

Bent, Robert D., Ph.D., Rice, 1954. Experimental nuclear physics; nuclear structure, reactions; astrophysics.
Miller, Daniel W., Ph.D., Wisconsin, 1951. Nuclear physics (experimental); nuclear reactions.
Nann, Herman, Ph.D., Goethe Univ., 1967. Intermediate energy nuclear physics (experimental).
Newton, Roger G., Ph.D., Harvard, 1953. Distinguished Professor. Theoretical and mathematical physics; scattering theory.
Swihart, James C., Ph.D., Purdue, 1955. Condensed matter theory.
Walker, George E., Ph.D., Case Western Reserve, 1966. Theoretical nuclear physics; intermediate energy.

Associate Professors

Messier, Mark, Ph.D., Boston University, 1999. Astrophysics (experimental).

Associate Professor Emeritus


Assistant Professors

Bossev, Dobrin, Ph.D., Institute for Chemical Research, Kyoto University, 1999. Condensed matter physics (experimental).

Other Graduate Faculty


RESEARCH SPECIALTIES AND STAFF

Theoretical

Accelerator Physics. Nonlinear beam dynamics; beam-beam interactions; transition energy problems; transverse and longitudinal coherent instabilities and Landau damping; bunched beam cooling; electron storage ring physics; spin motion in synchrotrons. Lee, Hess. 2 IUCF staff physicists. 1 research associate.


Chemical Physics. Electronic transport in alloys; electron-phonon interaction in metals; electronic properties of atoms, molecules, and surfaces; photoelectron cross sections; phase transitions and self-organization; infrared photometry for adsorbates and quantum wells, phasmonics on the nanoscale. Schach, 2 faculty in Chemistry Department.

Condensed Matter. Quantum Hall effect; superconductivity, spin transport and magnetoresistance; mesoscopics; soft matter; colloidal and biological materials; electron-phonon interaction in metals; optical and electrical properties of solids; collective excitations; many-body theory; surface electromagnetics; random alloys; quantum computation; correlated electronic materials; many-body physics, strongly correlated systems: high-$T_c$, heavy fermions, fermions in high magnetic fields; exotic superconductors; magnetism and spin systems; quantum fluids and solids; ultracold Fermi and Bose gases; topologically quantum ordered systems; quantum statistical mechanics and field theory methods in condensed matter; quantum information and computation; quantum measurement theory. Fertig, Ortiz, Schaich.

Elementary Particles and Fields. Phenomenology of elementary particle properties and interactions; quantum chromodynamics and electroweak interactions; lattice gauge field theory; solar neutrinos; grand-unified theories; supersymmetry; gravity and supergravity; superstring theory; CPT and Lorentz symmetry. Berger, Gottlieb, Kostelecky. 2 research associates.

Nuclear Physics. Study of nuclear structure; medium and high energy nuclear reactions; quantum chromodynamics; hadron spectra and structure, gluon dynamics, relativistic quantum hadrodynamics; neutron stars and nuclear astrophysics, stellar evolution and neutrino transport. Research performed at the Indiana University Nuclear Theory Center, Horowitz, Londergan, Serot, Szczepaniak. 2 research associates.

Experimental

Accelerator Physics. Nonlinear beam dynamics; electron cooling; properties of cooled beams; damping of transverse and longitudinal instabilities; spin motion in synchrotrons, with spin rotators (snakes); overlapping spin resonances and snake resonances. Lee, Hess. 4 IUCF physicists. 1 research associate.

Astrophysics. Magnetic monopoles; antimatter; supernovae; dark matter searches; bigbang cosmology; neutrino oscillations, dark energy, solar neutrino. Facilities include an assortment of computers, particle detectors, electronics development equipment, data acquisition systems, and spectrophotometers. Experiments are being performed at Fermi National Laboratory, Superkamiokande, and at a number of balloon launch facilities. Bacher, Bower, Heinz, Messier, Mufson (Astronomy Dept.), Musser, computer specialist, 1 postdoc and 2 technicians.


Chemical Physics. Optical properties of solids; low-temperature properties of metallic solids; chemisorption and catalysis; high-energy electron scattering; nuclear chemistry; chemical vapor deposition of ceramic and other materials; high-temperature x-ray diffraction; solid state NMR. Baxter, Carini, Keshmodel, 5 faculty in Chemistry Department.


Elementary Particles. Searches for new particles (Higgs bosons, supersymmetric particles, exotics, hybrid systems, glueballs), heavy quark physics (top, bottom, charm), light quarks, neutrino oscillation, testing of fundamental symmetries. Detectors used include drift chambers, drift tubes, scintillating fibers, transition radiation detectors, Cerenkov counters, and calorimeters. IU facilities include data acquisition and numerous data analysis computers, detector construction areas including a high-bay area and large class-10000 cleanroom. Work on DO and MINOS at Fermilab, ATLAS at CERN, experiments at Jefferson Laboratory, and preparing for the Linear Collider. Dziurba (note: keep him in even if retired, i.e., still active in research), Evans, Messier, Musser, Ogren, Shepherd, Urheim, Van Kooten; scientists Gagnon, Luehring,
Zieminska. 1 CAD designer, 6 research associates, 2 engineers, 2 software specialists, 5 technicians.

Nuclear Physics: Nucleon structure studies: gluon spin distributions, anti-quark and sea quark contributions to nucleon properties, using the STAR detector at RHIC. Weak interaction studies with slow neutrons: precision measurements of neutron decay, /n-p/ and /n-4He/ weak interactions at NIST, LANSCE, and the new Spallation Neutron Source at Oak Ridge; methods for production of ultra-cold neutrons; search for neutrino oscillations and studies of neutrino-nucleon interactions with the MiniBooNE and SciBooNE detectors at Fermilab. Fundamental symmetry tests: searches for time-reversal violation via electric dipole moments of the electron and neutron. Formation and decay of hot nuclei, damped collisions between heavy nuclei, and nuclear fission at MSU, ATLAS and other labs. Jacobs, Liu, Long, Snow, Sowinski, Stephenson, Taylor, Wissink. Two additional faculty (de Souza, Viola) in Nuclear Chemistry. Eight research associates and 30 staff scientists.