Interdisciplinary Physics Example Cognate Plans

The Interdisciplinary Physics concentration allows students substantial flexibility to define the thematic focus of their study. This flexibility comes with a responsibility; each student must work with a physics concentration counselor to define a cognate course plan when declaring the IP concentration. The plans defined at this early stage serve as the basis for your final path and will likely evolve as you learn more and understand better where you want to go with your degree.

To help with this process, and to illustrate the range of options available within this concentration, we provide here a set of example cognate plans. Each is meant to illustrate how a student focusing in a particular area might best prepare themselves for the future. *They are only examples, and we expect most students will define their own unique cognate plans.*

The parameters:

**Prerequisites for Declaring an IP Concentration (Effective Fall 2011)**

- Interdisciplinary Physics Concentration Proposal
- Math courses up through Math 216 (Differential Equations) or the equivalent
- One of the following introductory sequences and labs
  - 135/136 & 235/236 (Life Sciences)
  - 140/141 & 240/241 (General Physics)
  - 160/161 & 260/261 (Honors — more in depth, smaller class size)
- Physics 340/341
- Physics 351

**IP Concentration Requirements**

The Interdisciplinary Physics program requires at least 24 credits, including at least 9 in Physics courses numbered 390 and above. A concentration plan must include the following:

- **Physics 390** (can be taken concurrently with Physics 401 or 405)
- Two additional Physics courses at the 400 level and beyond
- Physics 390 and these 400-level Physics courses must be completed with a minimum grade of a C- in each course and a cumulative average of C or higher
- Fifteen credits of cognate courses as part of an Interdisciplinary plan designed with an advisor during an advising appointment. Nine of these credits should be at the 200 level or above

**The examples:** (note PHYSICS 390 is included for all plans so is not relisted each time)

1: IP with a focus on Astrophysics
- **400 Level Physics Courses**
  - PHYSICS 405: Intermediate Electricity and Magnetism
  - PHYSICS 406: Statistical and Thermal Physics
- **Cognate Courses**
  - PHYSICS 453: Quantum Mechanics
  - PHYSICS 401: Intermediate Mechanics
  - ASTRO 160: Introduction to Astrophysics
  - ASTRO 361: Astronomical Techniques
  - ASTRO 404: Galaxies and the Universe

2: IP with a focus on Mathematical Physics
- **400 Level Physics Courses**
  - PHYSICS 401: Intermediate Mechanics
  - PHYSICS 453: Quantum Mechanics
- **Cognate Courses**
  - MATH 555: Introduction to Functions of a Complex Variable with Applications
  - PHYSICS 405: Intermediate Electricity and Magnetism
  - PHYSICS 435: Gravitational Physics
  - MATH 404: Intermediate Differential Equations and Dynamics
  - MATH 454: Boundary Value Problems for Partial Differential Equations

3: IP with a focus on Complex Systems
400 Level Physics Courses
- PHYSICS 406: Statistical and Thermal Physics
- PHYSICS 453: Quantum Mechanics

Cognate Courses
- MATH 395: Honors Analysis I
- MATH 396: Honors Analysis II
- MATH 463: Mathematical Modeling in Biology
- MATH 567: Introduction to Coding Theory
- One additional faculty approved Math course

4: IP with a focus on Physics and Computer Science
400 Level Physics Courses
- PHYSICS 457: Particle Physics and Cosmology
- PHYSICS 453: Quantum Mechanics

Cognate Courses
- PHYSICS 411: Introduction to Computational Physics
- PHYSICS 405: Intermediate Electricity and Magnetism
- EECS 280: Programming and Introductory Data Structures
- EECS 203: Discrete Math
- EECS 182: Building Applications for Information Environments

5: IP with a focus on Environmental Physics
400 Level Physics Courses
- PHYSICS 401: Intermediate Mechanics
- PHYSICS 453: Quantum Mechanics

Cognate Courses
- PHYSICS 463: Introduction to Solid State Physics
- ENVIRON 376: Environmental Ethics
- ENVIRON 391: Sustainability and the Campus
- ENVIRON 401: Modeling Coupled Human-Natural Systems
- ENVIRON 442: Earth Surface Processes and Soils

6: IP with a focus on Geological Physics
400 Level Physics Courses
- PHYSICS 401: Intermediate Mechanics
- PHYSICS 453: Quantum Mechanics

Cognate Courses
- ASTRO 160: Introduction to Astrophysics
- PHYSICS 463: Introduction to Solid State Physics
- GEOSCI 422: Principles of Geochemistry
- GEOSCI 351: Earth Structure: Introduction to Structural Geology and Tectonics
- One additional faculty-approved Geological Sciences course

7: IP with a focus on Global Change
400 Level Physics Courses
- PHYSICS 401: Intermediate Mechanics
- PHYSICS 405: Intermediate Electricity and Magnetism

Cognate Courses
- ENSCEN 211: Introduction to Nuclear Engineering and Radiological Sciences
- ENVIRON 380: Mineral Resources, Economics, and the Environment
- ENVIRON 303: Topics in Environmental Natural Science
- ENSCEN 105: Our Changing Atmosphere
- ASTRONOMY 402: Stellar Astrophysics

8: IP with a focus on Energy Solutions
400 Level Physics Courses
- PHYSICS 401: Intermediate Mechanics
- PHYSICS 405: Intermediate Electricity and Magnetism

Cognate Courses
- PHYSICS 406: Statistical and Thermal Physics
- PHYSICS 442: Advanced Laboratory II
- PHYSICS 453: Quantum Mechanics
- ME 499: Special Topics in Mechanical Engineering
- ME 599: al Topics in Mechanical Engineering

9: IP with a focus on Public Policy
• 400 Level Physics Courses
  o PHYSICS 402: Optics
  o PHYSICS 453: Quantum Mechanics

• Cognate Courses
  o PHYSICS 481: Science, Technology and Public Policy
  o ASTRO 160: Introduction to Astrophysics
  o PUBPOL 201: Systematic Thinking About the Problems of the Day
  o HISTORY 285: Science, Technology, Medicine, and Society

10: IP with a focus on Economics
• 400 Level Physics Courses
  o PHYSICS 401: Intermediate Mechanics
  o PHYSICS 405: Intermediate Electricity and Magnetism

• Cognate Courses
  o PHYSICS 406: Statistical and Thermal Physics
  o PHYSICS 405: Electricity and Magnetism
  o ECON 401: Intermediate Macroeconomic Theory
  o ECON 402: Intermediate Macroeconomic Theory II
  o ECON 405: Introduction to Statistics (ECON 451 as of 2/13)
  o ECON 406: Introduction to Econometrics (ECON 452 as of 2/13)

11: IP with a focus on Biological Physics
• 400 Level Physics Courses
  o PHYSICS 405: Intermediate Electricity and Magnetism
  o PHYSICS 453: Quantum Mechanics

• Cognate Courses
  o CHEM 453: Biophysical Chemistry: Thermodynamics and Kinetics
  o CHEM 454: Biophysical Chemistry II: Macromolecular Structure and Dynamics
  o CHEM 260: Chemical Principles
  o CHEM 302: Inorganic Chemistry: Principles of Structure
  o CHEM 210: Structure and Reactivity I

12: IP with a focus on Microbiology
• 400 Level Physics Courses
  o PHYSICS 401: Intermediate Mechanics
  o PHYSICS 405: Intermediate Electricity and Magnetism

• Cognate Courses
  o BIOLOGY 305: Genetics
  o CHEM 260: Chemical Principles
  o BIOLCHEM 415: Introductory Biochemistry
  o MCDB 306: Introductory Genetics Laboratory
  o MCDB 427: Molecular Biology

13: IP with a focus on Biochemistry
• 400 Level Physics Courses
  o PHYSICS 401: Intermediate Mechanics
  o PHYSICS 406: Statistical and Thermal Physics

• Cognate Courses (not all required)
  o PHYSICS 417: Dynamical Processes in Biophysics
  o PHYSICS 450: Biophysics Laboratory
  o CHEM 210: Structure and Reactivity I
  o CHEM 215: Structure and Reactivity II
  o CHEM 216: Synthesis and Characterization of Organic Compounds
  o CHEM 211: Investigations in Chemistry
  o BIOLCHEM 415 or MCDB 310: Introductory Biochemistry
  o CHEM 260: Chemical Principles
  o BIOLOGY 305: Genetics

14: IP with a focus on Chemical Physics
• 400 Level Physics Courses
  o PHYSICS 453: Quantum Mechanics
  o PHYSICS 405: Intermediate Electricity and Magnetism

• Cognate Courses
  o CHEM 260: Chemical Principles
  o CHEM 461: Physical Chemistry I
  o CHEM 462: Computational Chemistry Laboratory
15: IP with a focus on Chemical Quantum Physics
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 453: Quantum Mechanics
   • Cognate Courses
     o PHYSICS 460: Quantum Mechanics II
     o CHEM 210: Structure and Reactivity I
     o CHEM 215: Structure and Reactivity II
     o CHEM 211: Investigations in Chemistry
     o CHEM 216: Synthesis and Characterization of Organic Compounds
     o CHEM 260: Chemical Principles

16: IP with a focus on Applied Physics (with honors)
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 405: Intermediate Electricity and Magnetism
     o PHYSICS 453 (for honors): Quantum Mechanics
     o PHYSICS 498: Introduction to Research for Honors Students (for honors)
     o PHYSICS 499: Introduction to Research for Honors Students (for honors)
   • Cognate Courses
     o EECS 215: Introduction to Electronic Circuits
     o EECS 216: Introduction to Signals and Systems
     o EECS 311: Electronic Circuits
     o MATH 454: Boundary Value Problems for Partial Differential Equations
     o EECS 330: Electromagnetics II

17: IP with a focus on Nuclear Science
   • 400 Level Physics Courses
     o PHYSICS 405: Intermediate Electricity and Magnetism
     o PHYSICS 453: Quantum Mechanics
   • Cognate Courses
     o NERS 250: Fundamentals of Nuclear Engineering and Radiological Sciences
     o NERS 311: Elements of Nuclear Engineering and Radiological Sciences I
     o NERS 312: Elements of Nuclear Engineering and Radiological Sciences II
     o NERS 471: Introduction to Plasmas
     o PHYSICS 406: Statistical and Thermal Physics

18: IP with a focus on Condensed Matter (with honors)
   • 400 Level Physics Courses
     o PHYSICS 405: Intermediate Electricity and Magnetism
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 406: Statistical and Thermal Physics (honors)
     o PHYSICS 498: Introduction to Research for Honors Students (for honors)
     o PHYSICS 499: Introduction to Research for Honors Students (for honors)
   • Cognate Courses
     o EECS 320: Introduction to Semiconductor Devices
     o MSE 500: Materials Physics and Chemistry
     o MSE 350: Structures of Materials
     o MSE 400: Electronic, Magnetic, and Optical Materials for Modern Device Technology
     o PHYSICS 460: Quantum Mechanics II

19: IP with a focus on Education- High School
   • 400 Level Physics Courses
     o PHYSICS 481: Science, Technology, and Public Policy
     o PHYSICS 405: Intermediate Electricity and Magnetism
   • Cognate Courses
     o EEB 390: Evolution
     o BIOLOGY 305: Genetics
     o Mat Sci 220: Introduction to Materials and Manufacturing
     o Aero 245: Performance of Aircraft and Spacecraft
PHYSICS 401: Intermediate Mechanics

20: IP with a focus on Musical Acoustics
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 405: Intermediate Electricity and Magnetism
   • Cognate Courses
     o MUSICOL 139: Intro to Music
     o MUSICOL 140: History of Music
     o THEORY 140: Basic Musicianship: Aural Skills II
     o Theory 150: Basic Musicianship: Writing Skills II
     o Jazz 471: Jazz Improvisation III
     o Jazz 472: Jazz Improvisation IV

21: IP with a focus on Science Writing
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 405: Intermediate Electricity and Magnetism
   • Cognate Courses
     o PHYSICS 406: Statistical and Thermal Physics
     o ENGLISH 223: Creative Writing
     o ENGLISH 229: Professional Writing
     o ENGLISH 313: Topics in Literary Studies
     o Philosophy 356: Issues in Bioethics

22: IP with a focus on Speech
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 405: Intermediate Electricity and Magnetism
   • Cognate Courses
     o LING 313: Sound Patterns
     o LING 315: Introduction to Syntax
     o LING 441: Computational Linguistics I
     o LING 615: Advanced Graduate Syntax
     o MATH 425: Introduction to Probability

23: IP with a focus on Philosophy
   • 400 Level Physics Courses
     o PHYSICS 401: Intermediate Mechanics
     o PHYSICS 405: Intermediate Electricity and Magnetism
   • Cognate Courses
     o PHIL 427: Science and Gender
     o PHIL 423: Problems of Space and Time
     o PHIL 420: Philosophy of Science
     o PHIL 303: Introduction to Symbolic Logic
     o PHIL 424: Philosophy of Quantum Mechanics
     o PHYSICS 438: Electromagnetic Radiation

24: IP with a focus on Medical Physics
   Students thinking about continuing on to medical school may distinguish themselves from typical applicants by designing an Interdisciplinary Physics concentration with a focus on Medical Physics. If you expect to apply for medical school, you should be sure to cover the typical pre-medical course requirements as well:
   - Two years of Chemistry
   - One year of Biology
   - One year of Physics
   - A course in Biochemistry
   - A course in Mathematics
   - Two courses in English

   • 400 Level Physics Courses
     o PHYSICS 413: Introduction to Nonlinear Dynamics and the Physics of Complexity
     o PHYSICS 401: Intermediate Mechanics
   • Cognate Courses
     o BIOLOGY 172: Introductory Biology – Molecular, Cellular, and Developmental
     o BIOLOGY 173: Introductory Biology Laboratory
     o BIOLOGY 305: Genetics
25: IP as preparation for a Health Physics graduate program
   • 400 Level Physics Courses
     o PHYSICS 405: Electricity and Magnetism
     o PHYSICS 453: Quantum Mechanics
   • Cognate Courses
     o Chemistry, biology, human physiology, statistics, electronics

26. IP with a focus on Physics and Economics of Energy
   • 400 Level Physics Courses
     o PHYSICS 405: Electricity and Magnetism
     o PHYSICS 405: Electricity and Magnetism
   • Cognate Courses
     o ENVIRON 404: Cars, Energy, and Chemistry
     o ECON 401: Intermediate Microeconomic Theory
     o ECON 401: Intermediate Macroeconomic Theory
     o ECON 406: Introduction to Econometrics
     o ECON 437: Energy Economics and Policy