

ORIGINS of the UNIVERSE -- Spring 2003

Physics 198/Theology 164

Tuesdays|Thursdays 11-12:15, WW 212

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Office Hours TBA and by appointment

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Office Hours Tu|Th 12:30-1:30 and by appointment

Background & Description

This special course aims to facilitate student thinking across the disciplines of physics and theology on a contemporary topic that defies strict departmentalization -- the origin and nature of the universe. While faculty members recognize the contributions their individual disciplines make to this topic, they acknowledge the limitations inherent in any one discipline to address the universe's beginnings and nature in a comprehensive way. Furthermore, they discern that one discipline opens to the other for a more unified, and, therefore, more intellectually satisfying understanding of the world, the human place within it, and God in relation to all beings that comprise the world. Students enrolled in this course will join this quest.

Theology 164/Physics 198 begins with an introductory historical overview of the development of cosmological ideas, noting any recognizable religious dimensions to these efforts, and an investigation of the distinguishing characteristics of physics and theology. After a written examination on these basics, the focus will turn to what each discipline provides toward understanding the origins and nature of the universe. Lectures, experiments, class discussions of assigned texts, audio-visually, and other means will be used to explore these perspectives. Two students will be assigned to research a specific topic from one discipline's perspective, most likely the discipline for which credit is being sought, and their work will culminate in their cooperative presentation with two students who are covering the other discipline on that topic. As a final project, each student will produce a paper in which the two disciplines' views on the topic are integrated.

Course Objectives

The student objectives for the course include: (1) to understand and appreciate each discipline's purview, methods, data and limitations; (2) to analyze contemporary thinking on the origins and nature of the universe from the perspectives of the two disciplines; (3) to investigate how they relate to one another on issues pertaining to the universe's origins and nature; (4) to exercise critical thinking skills in class discussion; (5) to research one discipline's approach to a designated topic; and, (6) to synthesize in a written paper the two disciplines' approaches to that topic.

Basis for Evaluation

Evaluation will be based on written and oral class participation in course sessions (15%), an examination on the characteristics of the two disciplines (35%), an outline and bibliography on one discipline's approach to a designated topic (10%), a presentation in class from an outline and bibliography prepared in cooperation with another student on one discipline's approach to that topic (15%), and a paper integrating the two disciplines on an approved topic pertaining to the origins and nature of the universe (25%).

Class Attendance Policy

Due to the nature of this course, attendance in class is mandatory.

Required Texts

Ian Barbour, *Religion and Science: Historical and Contemporary Issues* (HarperSanFrancisco 1997)

Leon M. Lederman and David N. Schramm, *From Quarks to the Cosmos* (Scientific American 1995)

Herbert Friedman, *The Astronomer's Universe* (Norton 1998)

Pontifical Biblical Commission, *Interpretation of the Bible in the Church* (Libreria Editrice Vaticana 1993)

Handouts and Readings on Reserve at Memorial Library (print and electronic) and Blackboard

Tentative Schedule of Classes

Introduction -- Drs. Karkheck & Schaefer

January 14 -- Overview of course and options; self-introduction of students and faculty; opportunity to sign up to report biographical background on historical figures; consideration of ideas for group research, presentations and final papers; initial student ideas about theology-science relationship; directions for signing up for Blackboard; and, directions for assigned readings.

Historical Overview of Cosmology in Relation to Theology -- Drs. Karkheck & Schaefer

January 16 -- Hellenic Period

Student vignettes of Meton, Plato, Eudoxus, and Aristotle (key biographical information, contribution to astronomy or cosmology, methods and materials used, purpose of efforts, any religious underpinning--five minute maximum); discussion of significant points in assigned readings.

Assigned: "The Hellenics" pp 64-84 (Marqcat electronic reserves for January 16), excerpts from Plato's *Timaeus*, and Grant's essay on Aristotle (handouts)

January 21 -- Hellenistic Period

Student vignettes and discussion of Heraclides, Aristarchus, Eratosthenes, Apollonius, Hipparchus, and Ptolemy.

Assigned: "The Hellenistics" pp 84-120, and essay on Ptolemy (electronic reserves)

January 23 -- Islamic Science

Student vignettes and discussion of Abu Mashar (Albumazar), Ibn Qurra, Al-Battani.

Assigned: "The Islamics" pp 177-183, 186-202, and Golshani's "Science and the Muslim Ummah" (electronic reserves)

January 28 -- Copernican Era

Student vignettes and discussion of Copernicus, Brahe, Bruno, Kepler, Galileo, Newton.

Assigned: "The Copernicans" pp 279-295; 299-309; 311-323, and selection from Galileo's "Letter to the Grand Duchess Christina" (electronic reserves), Kepler's "Mysterium Cosmographicum," or Newton's letters to Dr. Bentley (handouts).

Physics Basics -- Dr. Karkheck

January 30 -- The Nature of Physics

Lecture/discussion on the scientific method, experimentation and the data of physics, theory, physical laws, symmetry, unification and model building.

Assigned: Barbour 9-13, 17-19, 34-36, 106-110, 115-119; Lederman and Schramm 19-26, 118-120.

February 4 -- The Foundations

Lecture/discussion on energy, motion, radiation, the speed of light; space, time and spacetime, relativity and causality.

Assigned: Barbour 177-181; Lederman and Schramm 25-28, 41-47, 53-56, mid-134-135; Friedman 107-110, 221-228, 260-263, 272-273.

February 6 -- Thinking Small

Lecture/discussion on matter and stability, the atom and the nucleus, radioactivity, elementary particles, rocks, processes and "aging" the earth, temperature and heat, and complexity.

Assigned: Barbour 181-184; Lederman and Schramm 1-6, 12-14, 26-35, 99-103, 118-120; Friedman 81-84, 101-107, 113-122.

February 11 -- Nature's Unruly Nature

Lecture/discussion on temperature and heat, quantum theory, wave mechanics, the uncertainty principle and limits to knowing; quantum field theory and the vacuum; chaos and complexity.

Assigned: Barbour 165-177, 181-184; Lederman and Schramm 36-41.

Philosophy Lecture -- Dr. Peressini

February 13 -- Philosophical Assumptions and Considerations

The nature and extent of philosophy's mediating role; beginning assumptions regarding reality, truth and knowledge; philosophy of science and the question of origin, including reduction, materialism, confirmation, explanation, and traditional "proofs" and evidence of God; student sign-up to report on key figures who are interfacing theology and cosmology.

Assigned: "Introduction to the Discipline of Philosophy" by Graybosch and Wolff, pp. 9-18; "Realism in Philosophy" by Maddy, pp. 5-15; "What is Philosophy of Science" by Klemke, pp. 1-7; and, "Some Notes on Philosophy for Origins" by Peressini.

Theology Basics -- Dr. Schaefer

February 18 -- A Long, Diverse Past and Dynamic Present

Historical overview of ways in which God's relationship to the world is expressed by theologians and scientists from their understanding of the world (handout), concluding to predominantly human subject centered theological discourse in the 20th century uninformed by the natural sciences; student reports on key contemporary authors who are breaking this mold.

Assigned: Per sign-up of contemporary theologians and scientists; Barbour chap 1.

February 20 -- Contemporary Theology in Relation to the Natural Sciences

Discuss Barbour's "dialogue" and "integration" ways of relating theology and the natural sciences (natural theology, theology of nature and process theology); compare with Pope John Paul II's perspectives; lecture on ongoing Vatican efforts to encourage dialogue among scientists, theologians and philosophers; rules for dialogue.

Assigned: Barbour's chap 4 and Pope John Paul II's "Message" to Vatican Observatory in *Physics, Philosophy and Theology* (Blackboard External Link).

February 25 -- Definition, Data, Methods, Limitations

Lecture/discussion on definition, data, methods, purview and limitations; comparison with physics; importance of modeling for theology in comparison with physics/cosmology.

Assigned: Barbour's chap 5 (emphasis on 119-124, 127-136) and chap 6, pp. 157-161.

February 27 -- Methods to Seek Intended Meaning

Historical overview of Old and New Testament texts as primary data of Christian religion (handout); review of exegetical methods sanctioned by the Roman Catholic Church with emphasis on the historical-critical methodology used by Old Testament scholars to discern intended meaning.

Assigned: Pontifical Biblical Commission's chap 1 and Barbour's chap 6.

Last day to sign up for a research topic. Directions for examination.

March 4 -- Basics examination (objective and short essay format).

March 6 -- Assignment of students to topics; directions for outlines, research presentations and papers; group meetings to discuss initial strategy; introduction to cosmology sections; video on questions cosmologists and theologians are asking one another.

Spring Break March 9-16

Cosmology -- Dr. Karkheck

March 18 -- Nature's Unruly Nature

Lecture/discussion on laws of thermodynamics; quantum theory, wave mechanics, the uncertainty principle and limits to knowing; quantum field theory and the vacuum; chaos and complexity; rocks, processes, and "aging" the earth.

Assigned: Barbour 165-177, 181-184; Lederman and Schramm 36-41.

March 20 -- In the beginning....

Lecture/discussion on early (1920s) discoveries, galaxies, red shifts, and Hubble's law; expanding universe, observable universe, and the Big Bang.

Assigned: Lederman and Schramm 14-17, 129-41; Friedman 1-14, 269-71, 273-75, 282-83.

March 25 -- Thinking Big

Later discoveries, background radiation, and the edge of the universe; large-scale and small-scale structure of the universe, and inflation.

Assigned: Lederman and Schramm 6-8, 141-48, 151-57, 165-76; Friedman 14-22, 77-80, 275-82, 289-95, 297-300.

March 27 -- Anything Goes

Nucleosynthesis, the vacuum revisited, theory of everything, fate of the universe; is cosmology physics?

Assigned: Barbour 195-198; Lederman and Schramm 148-51, 159-65, 176-87; Friedman 22-29, 190-92, 284-87, 295-97, 300-2.

Philosophy Lecture -- Dr. Peressini

April 1 -- Evidence and Explanation--God and Science

Notions of fine-tuning and "beginning" with respect to cosmological theory; scientific explanation in comparison with other types; nature, laws of nature, and God's action in relation to nature's laws.

Assigned: "Natural Science and Belief in a Creator" (McMullin).

Disciplinary Team and Group Meetings -- Drs. Karkheck and Schaefer

April 3 -- Directions for team and groups; faculty rotate to groups to clarify responsibilities; student teams sign up for appointments through April 27 with the discipline's faculty member; groups indicate preference for presenting on April 29 or May 1.

Students submit individual outlines and bibliographies on the assigned discipline's contributions to the designated cosmology topic.

Introduction to and preparation for Theology sessions.

Theology Informed by Cosmology -- Dr. Schaefer

April 8 -- Meaning Conveyed through Creation Stories

Students on mythological accounts of the world's creation; focus on myths appropriated in Genesis 1 & 2 to convey meaning; identification/discussion of meaningful notions about God in relation to the world conveyed in other Old Testament texts examined by Clifford.

Assigned: Creation stories from selected texts and R. Clifford's "Creation in the Hebrew Bible" in *Physics, Philosophy and Theology* (on electronic reserves).

April 10 -- The Doctrine of Creation Across the Centuries

Ways in which theologians have reflected on God as Creator of the world and formulated the doctrine of creation (e.g., *creatio ex nihilo* and *creatio continua*) in the contexts of their times informed by their understanding of the world; problems when equating the doctrine of creation with "Big Bang" cosmology.

Assigned: A. Clifford's "Creation" in *Systematic Theology* (electronic reserves)

April 15 -- Theological Implications of Contemporary Cosmology

Theological implications of Big Bang cosmology; implications proffered by theologians, physicists and philosophers in "Soul of the Universe" video; Schmitz-Moorman's notion of *creatio appellata* and Polkinghorne's *creatio continua*.

Assigned: Barbour's chap 8; Polkinghorne's "Creatio Continua and Divine Action" (electronic reserves)

Easter Break April 17-21

April 22 -- Meaningful/Plausible Notions about God in Relation to the World

Students share meaningful/plausible models of God's relationship to the world chosen from Barbour, Polkinghorne, Schmitz-Moorman, the "Soul" video, and other authors consulted in individual research or explained in class; rules for reformulating doctrines in the Catholic tradition.

Assigned: Barbour's chap 12.

April 24 -- Reformulation of the doctrine of creation; student teams must have met with faculty of assigned discipline by this day; group meetings to finalize plans for presentations.

Assigned: Method for reformulating doctrines (Blackboard).

Presentations of Cosmology Themes

April 29 and May 1 -- Presentations by student groups from collaborative outlines/bibliographies prepared by disciplinary teams.

Teams distribute outlines/bibliographies to students and professors on assigned day of presentation.

Integration Papers and Course Evaluations

May 8, 9:30-10 a.m.– Students submit both to professors in WW 212.

Possible Topics for Research, Presentations, Papers

Freedom in the Universe (wave-particle duality)

Purposeful Universe

Anthropic Principle

Fine-Tuned Universe

Special Creation

Law-Governed Universe

Vacuum Genesis