Conceptions of Space from Zeno to Einstein

ARLT 100g (35227R) Fall Term 2014

Administrative Information

Instructor: Dr. Tom Pashby
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Class Time: Tues/Thurs 11:00am-12:20pm
Location: VKC 154

Office Hours: Tues 2:00-3:00pm, Weds 11am-12pm or by appointment.

Course Description

According to Isaac Newton, "Absolute space, in its own nature, without relation to anything external, remains always similar and immovable." On the other hand, Albert Einstein's Theory of Relativity seems to demonstrate that space and time are relative. Or does it? What does it mean for space to be absolute, or for something to be relative? This course will explore the answers to these questions, and more, by tracing the development of the scientific and philosophical understanding of space from ancient Greece up to the present day. We will follow the evolution of our ideas of space through three successive revolutions in our conception of the world: first the Copernican revolution, which displaced the Earth from the center of the cosmos, through the scientific revolution in which Newton played a key role, and then the revolution in our understanding of space and time brought about by Einstein at the beginning of the twentieth century. Primary readings will include selections from Plato, Aristotle, Euclid, Copernicus, Galileo, Descartes, Newton, Leibniz, Kant, Poincaré, Mach, and Einstein. Aside from gaining an understanding of these classic texts, we will relate the views of these historical figures to current philosophical debates regarding the nature of space. Although the history and philosophy of science will provide the context for these views, we will also seek to understand the role of the idea of space within the writers' philosophical systems and the significance of these philosophical ideas for a wider culture, including the visual arts.

Course Goals

This course aims to provide a historical introduction to the philosophy of science. By taking this course you will gain an understanding of the historical interrelation of philosophy and science through a detailed examination of several key controversies and philosophical debates. You will learn to speak and write knowledgably about some theories of physics and mathematics but you will not be applying these theories—this is not a physics course. Instead, you will demonstrate this understanding by learning how to construct, evaluate and compare philosophical arguments regarding the nature of space. In addition, we will seek to develop an appreciation of the cultural significance of some of these ideas within the arts and a wider culture, as well as the close relation of art and science in some of the historical episodes we will explore.

Learning Objectives

By successfully completing this course you will learn to:

- Read and interpret primary source texts from the history of natural philosophy.
- Analyze philosophical and scientific arguments in their historical context.
- Evaluate philosophical claims about scientific theories.
- Use scientific theories to argue for and against rival metaphysical views.
- Develop a reasoned position regarding a philosophical topic, making appropriate use of historical and theoretical details.
- Construct and interpret space-time diagrams of motions in relativistic space-time.
- Write knowledgably about the role of geometry in early modern and modern art.

Reading Materials

There is one **required** text:

[SZE] Huggett, Nick. (1999) *Space from Zeno to Einstein: Classic Readings with a Contemporary Commentary,* Bradford Books.

Huggett's collection of readings and notes will form the backbone of the course. However, I will be drawing on additional primary and secondary readings as required. We will cover the entire contents of the book in class, and considerably more.

Copies of weekly readings along with links to online resources and additional course materials will be available from the course website. Course reserves can be found at the Hoose Library of Philosophy, located in the Mudd Hall of Philosophy. Among others, we will be making use of the following resources:

[BWS] Lindberg, David C. (2007). *The Beginnings of Western Science* (2nd Edition), University of Chicago Press.
[CMS] Westfall, Richard S. (1977). *The Construction of Modern Science*, Cambridge University Press.
[DD] Barbour, Julian B. (2001). *The Discovery of Dynamics*, Oxford University Press.
[CR] Kuhn, Thomas S. (1992). *The Copernican Revolution*, Harvard University Press.
[EE] Norton, John D. (2013). *Einstein for Everyone*, online at www.pitt.edu/~jdnorton/.
[FH] Toulmin, Stephen and June Goodfield (1999). *The Fabric of the Heavens*, University of Chicago Press.
[SEP] Zalta, Edward N. (Editor). *The Stanford Encyclopedia of Philosophy,* online at plato.stanford.edu/.

Assessment

Grades will be determined as follows:

Assignments	**20%**
Midterm	**20%**
Final	**20%**
Term Papers	**30%**
Attendance/Participation	**10%**

Assignments will be due weekly, and will mostly concern reading comprehension. Reading primary and secondary source material effectively and productively is an essential component of the course. Your weekly assignments provide 20% of the total grade (calculated by dropping the three lowest grades).

This is a discussion-based class and so your regular attendance is required. Your **attendance** and **participation** grade will reflect your contribution to class discussions and activities. To score highly you must be present, well-prepared, and actively engaged. Missing more than three classes without **advance** permission will adversely affect your grade.

The **midterm** will be a closed book exam covering material in the first part of the course i.e. up to and including the Scientific Revolution. The **final** will be an open book exam concerning the entire course, but with an emphasis on the last part of the course i.e. the 19th Century onward.

You will write two 2500 word **term papers** on a topic of your choice. You will choose a suitable topic from a range of options and will be required to submit an outline before you write the paper. Term papers are due on **October 9th** and **December 9th**.

Course Topics and Tentative Schedule

A detailed and up to date schedule of lectures and readings is available from the course website, linked to from Blackboard (blackboard.usc.edu). Readings are password protected; the password is 'Zeno2Einstein' (without quotes). It is your responsibility to check both Blackboard and the course website regularly (tompashby.info/CSZE/).

1. Space in Early Science (Weeks 1-3)
2. The Copernican and Scientific Revolutions (Weeks 3-5)
3. Philosophical Controversies (Weeks 6-7)
4. The Development of Geometry (Weeks 8-9)
5. Einstein's Relativity and Space-Time (Weeks 10-14)
6. The Fourth Dimension in Art and Science (Weeks 14-15)

Writing Center Services

This course is writing intensive but it is not a writing course. While you will be given guidance regarding the expectations for your written work I am not able to offer you help with your writing difficulties. For that purpose there is the Writing Center, located in the Taper Hall of Humanities Room 216. Call (213)-740-3691 to make an appointment, or see http://dornsife.usc.edu/writingcenter/ for more details. If you expect to need help with your writing you should visit them as soon as possible to form a plan. Do not leave it until the week your paper is due!

Email Policy

It is your responsibility to check your email account regularly. Failure to do so is not a valid excuse for failing to meet the requirements of the course. If you email me you can expect a response within 24 hours, except when circumstances intervene (in which case I will let you know). Please check the syllabus and course website for the answer to your question before emailing me—if the answer can be found there you can expect a very terse response! Also,

please recognize that emails to your instructor should respect the formal nature of the relationship: over familiarity and poor grammar are unacceptable.

Academic Integrity

All students are expected to understand and abide by the principles laid out in SCampus, the Student Guidebook, which contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A:

http://www.usc.edu/dept/publications/SCAMPUS/gov/.

Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. Details of the review process can be found at:

http://www.usc.edu/student-affairs/SJACS/.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to us as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.