

Symmetries in physics and metaphysics

John Dougherty

SoSe 2023

Meeting:	Fridays, 14:00–16:00 (s.t.) Ludwigstr. 31 / 021
Office Hours:	Thursdays, 14:00–16:00, or by appointment Ludwigstr. 31 / 131
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Description

This course is a survey of philosophical issues concerning symmetries in physical theories. Such issues come in roughly two kinds: (i) first-order interpretive questions about how to understand a particular symmetry and its role in a physical theory, and (ii) issues concerning other topics of philosophical interest that are bound up with the concept of symmetry (e.g., the relationship between mathematics and the physical world). In this course we will deal with both kinds of issues. After looking at examples of general philosophical reasoning about symmetries, we will look at symmetries in specific physical theories of spacetime and matter. The second half of the course then investigates particular philosophical issues that intersect with these interpretive debates.

Objectives

By the end of the course, you should be able to (i) formulate one or more philosophical problems that arise from philosophical reflections on symmetries and (ii) assess one or more strategies for solving these problems. Exhibiting ability (i) means giving a statement, in academic writing, of a question—or inconsistency, paradox, puzzle, or similar—along with an explanation of why it poses a problem for some particular philosophical view. Exhibiting ability (ii) means describing, again in academic writing, a new or existing attempt to answer this question and explaining why this is or is not a plausible answer.

Materials

All materials for this course are available online, either on preprint servers like the PhilSci archive or through the LMU Library. The list of readings below includes links to these sources, some of which require you to log in through the library. For assistance in accessing articles using the Library's license, see the Library's web page on "E-Media Login" ([here](#)). If you have any difficulty accessing a reading, please let me know.

Assessment

The evaluation for this course will be by means of a term paper submitted at the end of the semester. If you would like to submit a term paper, you must register through LSF during the registration period (26.06–07.07.2023) and submit it to me by email by the term paper deadline (22.09.2023). Please note that extensions of this deadline are not up to me; if you need an extension, please contact Fabian Widerna (f.widerna@lmu.de) at the Prüfungsamt für Geistes- und Sozialwissenschaften (PAGS).

Your paper should be on a topic related to symmetries in physics and metaphysics. I will distribute a list of suggested questions and grading criteria before the registration period. You may write your paper on topic not on that list; if you do, then I recommend speaking to me before writing the paper, so that I can advise on the topic and scope of your planned alternative. The term paper should be 3000 words for BA students and 6000 words for MA students. In either case, it should be written in 12pt font, with 1.5 spacing, 3cm margins on the left and right, and a standard academic typeface (Computer Modern, Palatino, Times New Roman, Calibri, etc.).

Resources

Questions about the administration of philosophy teaching at LMU should be directed to Thomas Wyrwich (thomas.wyrwich@lrz.uni-muenchen.de). The Erasmus coordinator for philosophy at LMU is Peter Adamson (office.peter.adamson@lrz.uni-muenchen.de). The list of women's representatives (Frauenbeauftragte) for the Philosophy Faculty can be found on the Faculty's webpage (<https://www.philosophie.lmu.de>).

[uni-muenchen.de/fakultaet/frauenbeauftragte/index.html](https://www.uni-muenchen.de/fakultaet/frauenbeauftragte/index.html)). Issues regarding the economic, social, and cultural aspects of student life—including studying with a child or studying with a disability—are the responsibility of the Munich Student Union (<https://www.studentenwerk-muenchen.de>).

Tentative schedule of readings

Identifying symmetries

21.04 No reading

28.04 Belot, G. (2001). The principle of sufficient reason. *The Journal of Philosophy*, 98(2):55–74

05.05 Dasgupta, S. (2016). Symmetry as an epistemic notion (twice over). *The British Journal for the Philosophy of Science*, 67(3):837–878

Spacetime

12.05 Earman, J. (1989). Choosing a classical space-time. In *World Enough and Space-Time*, chapter 3, pages 41–60

19.05 Pooley, O. (2003). Handedness, parity violation, and the reality of space. In *Symmetries in Physics*, ed. K. Brading and E. Castellani, pages 250–280

26.05 Greaves, H. (2011). In search of (spacetime) structuralism. *Philosophical Perspectives*, 25:189–204

Quantum mechanics

02.06 Huggett, N. (1999). Atomic metaphysics. *The Journal of Philosophy*, 96(1):5–24

09.06 Shech, E. (2018). Idealizations, essential self-adjointness, and minimal model explanation in the Aharonov–Bohm effect. *Synthese*, 195:4839–4863

Quantities

16.06 Smith, S. R. (2008). Symmetries and the explanation of conservation laws in the light of the inverse problem in Lagrangian mechanics. *Studies in History and Philosophy of Modern Physics*, 39:325–345

23.06 Greaves, H. and Wallace, D. (2014). Empirical consequences of symmetries. *The British Journal for the Philosophy of Science*, 65(1):59–89

Physical and mathematical symmetry

30.06 Belot, G. (2018). Fifty million Elvis fans can't be wrong. *Noûs*, 52(4):946–981

07.07 NO MEETING

Metaphysical consequences

14.07 Ney, A. (2007). Physicalism and our knowledge of intrinsic properties. *Australasian Journal of Philosophy*, 85(1):41–60

21.07 Baker, D. J. (2020). Some consequences of physics for the comparative metaphysics of quantity. *Oxford Studies in Metaphysics* 12:75–112