

## Foreword

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This volume grew out of the international workshop “Large Language Models for the History, Philosophy, and Sociology of Science” held at Technische Universität Berlin, April 2–4, 2025, and organized by us, the Editors of this volume.<sup>1</sup> The workshop featured eighteen contributed short talks and two keynote presentations—one by Iryna Gurevych on Natural Language Processing for the analysis of intertextual relationships and the other jointly by Nina Tahmasebi and Pierluigi Cassotti on large-scale text analysis for the study of cultural and societal change. All contributions focused on the potential of large language models (LLMs) to address long-standing challenges in the history, philosophy, and sociology of science (HPSS). Participants explored concrete use cases and more general proposals for integrating LLMs into HPSS research. Video recordings of most presentations are available online.<sup>2</sup>

The workshop had two seeds. One was the ERC-project “Network Epistemology in Practice (NEPI)”, led by Adrian Wüthrich. As part of NEPI, Arno Simons was among the first to pre-train a BERT model exclusively on texts from physics<sup>3</sup> and suggested that this kind of work should be discussed in a broader HPSS setting. It did not take much to convince Michael Zichert, also a member of the NEPI team and likewise working with LLMs to analyse conceptual developments in physics, that this was a worthwhile topic for a focused meeting. The second seed was Gerd Graßhoff, who has long advocated the use of computational methods in the history and philosophy of science, especially for the analysis of discovery processes. As a cooperation partner of the NEPI project, he had been considering a workshop on novel AI-assisted methods in history and philosophy of science. The Berlin event and this volume resulted from our decision to join forces.

The workshop centered on two key themes. First, the participants discussed the specific needs and desiderata of HPSS researchers and what they hoped LLMs can contribute to their work. Second, they critically assessed the current state of LLM development and

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1 <https://www.tu.berlin/hps-mod-sci/llms-for-hpss/workshop-llms-for-hpss>

2 YouTube playlist “Large Language Models for the History, Philosophy, and Sociology of Science”: [https://youtube.com/playlist?list=PL5rAX6ywmP7O\\_nT99Osd74uino78BJMVT&si=4W5zB V4pJot3XuyF](https://youtube.com/playlist?list=PL5rAX6ywmP7O_nT99Osd74uino78BJMVT&si=4W5zB V4pJot3XuyF)

3 <https://huggingface.co/arnosimons/astro-hep-bert>

asked what extent their research goals are already becoming attainable with these systems.

The use of LLMs in HPSS connects to recent trends in these disciplines. In the history of science, computational approaches are in the process of establishing themselves among the standard repertoire of tools, with remarkable successes already achieved, for example through network analyses. Subfields of sociology of science have long relied on quantitative methods such as bibliometrics and scientometrics. More recently, the philosophy of science has experienced a shift towards more empirical work, including large-scale, algorithmic analyses of scientific or methodological concepts. Across these areas, computational tools can not only help reduce the workload in traditional research but, more importantly, also open up new avenues which to explore would otherwise be out of reach.

Analyses of co-occurrences and word frequencies, as well as more advanced techniques such as topic modeling, have made it possible to move beyond purely structural features of scientific activity and begin to touch the semantics of scientific language. However, a deeper understanding of scientific concepts, the structure of scientific arguments, and the process through which knowledge is transformed and circulates have remained formidable challenges for computational approaches in these fields.

The main motivation for the workshop and for this volume was that, with the advent of LLMs, the sketched situation might be changing. Natural language processing and machine learning have made rapid progress in capturing and analyzing meaning and grammatical structures of texts. This creates the prospect that LLMs can help HPSS researchers address some of the challenges just mentioned. At the same time, beyond general issues such as opacity, bias and interpretability, the use of LLMs for HPSS raises specific obstacles that stem from the specialized nature of scientific language and from the particular perspectives and aims of HPSS. A central goal of the workshop was therefore to ask how, given these obstacles, recent advances in LLM development might help tackle long-standing challenges in HPSS, and where their limits lie.

The invitation to contribute to this volume was circulated among workshop participants and attendees, with additional co-authors explicitly welcomed. Not all workshop speakers appear in this book, and some authors joined the project later, but all chapters bear the imprint of the discussions in Berlin. Arno Simons took the lead in developing the focus of the volume, coordinating the collective writing process with all contributors and managing the interaction with the publisher. All four of us—Simons, Wüthrich, Zichert and Graßhoff—were involved in the reviewing process for the volume. Julia Kim supported the organisation of the workshop in administrative matters, and Svenja Goetz and Lea Stengel helped with various organisational tasks during the workshop days and with the recording of talks, which was set up by Oliver Ziegler's uniCam team. We thank them all for their valuable support. Of course, neither the workshop nor this volume would have been possible without the many contributions of workshop presenters, the audience and the chapter authors. We thank all of you.

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*The Editors*