'How do we make progress in science? Metascience and community (SciProgress)' Abstracts

Talks

How much of our best science is dismissed as disruptive?

Authors

John Baruch (1)

(1) RAS retired

Abstract

The best science is often disruptive. Would Galilleo be at home today? Would John Harrison's clocks be accepted? Bad philosophy had traditionally marked dramatic science progress as disruptive.
In May last year Nature produced a review "Is Bad Philosophy Holding Back Physics?" 15/05/25. According to Nature: "disruptive science in physics and cosmology has completely died." The Nature theoretical feature 22nd May 2025 "Are Groundbreaking Science Discoveries Becoming Harder to Find?" highlights a serious problem in the physical sciences. It suggests that the data indicates that disruptive science died in 1995. Nature's concern with the demise of disruptive Science: Park et al Nature 4/1/23 and Kozlov Nature 12/01/23, is to be welcomed especially the editorials 02/02/2023, & 8/5/2025. They should be a spur to accept disruptive science for general discussion.
How widespread is this "Bad Philosophy"? Today the publication of disruptive science is difficult verging on the impossible. Discussions with the Nature editors revealed that in their opinion reviewers rejected papers that take more than 20 minutes of their time. Does prejudice play a role? Kavangh in Nature (29/09/2025) quoted Kamal M.M. & Baten R.A. (2025) saying "Sometimes, it is difficult to unlearn the prevailing assumptions then adopt radically new ones", Kavangh suggested that "rookie researchers are better," but what happens to papers that question prevailing assumptions? What happens to disruptive papers? The Nature view is that they are generally rejected. Is this a physics and cosmology malaise?
Today we are seeing publications and preprints that completely disrupt the current view of the Universe struggling to emerge. At a recent private astronomy discussion around a set of disruptive ideas where considerable progress appeared to be made, the attendees declined to be included in the session photo. The PhD students claimed that it would ruin their chances of a post doc position. The post docs said that a photo would blight their future careers and the permanent staff expressed the view that their attendance would reflect on the department and undermine funding applications by colleagues. A senior member of staff was active in the discussion but completely opposed discussing the ideas at a subsequent session he was chairing.

Is our community stuck in a swamp of “bad philosophy” rejecting any groundbreaking science as disruptive? There is almost no support for loan researchers. This contribution will aim to identify patterns that are holding back science.

From Individual Achievement to Collective Progress: Behavioural Perspectives on Research Culture

Authors

Evelyn Svingen (1)

(1) University of Birmingham

Abstract

Scientific progress depends not only on ideas and instruments but on the social conditions that allow researchers to think well together. Yet the environments in which contemporary academics work are increasingly shaped by forces that undermine precisely those conditions. This paper argues that the tension between cooperative and individualistic orientations in research culture is not merely a matter of institutional values — it has deep behavioural roots that help explain why certain institutional structures consistently produce dysfunction, and why well-intentioned reforms so often make things worse. Drawing on evolutionary theory, behavioural economics, and the metascience literature on academic incentive structures, I examine how universities have progressively imported a managerial logic — built on individual performance metrics, competitive ranking, and constant policy churn — that is structurally misaligned with the cooperative norms on which productive research communities depend. These dynamics are not simply burdens imposed on academics: from a behavioural standpoint, they are norm violations that trigger predictable responses — disengagement, withdrawal, and the erosion of the reciprocal relationships that sustain good science and good teaching alike. The result is a system that measures the outputs of a cooperative culture while systematically destroying the conditions for one.

This problem is not uniform across disciplines. The natural sciences and social sciences have evolved distinct collaborative cultures with different norms around authorship, knowledge-sharing, and intellectual contribution. The imposition of a single managerial template across this diversity generates different kinds of damage in different fields — damage that is poorly captured by existing assessments of research quality or environment. The REF 2028/29 rebranding places people and environment explicitly at the centre of research quality for the first time. This is a promising signal — but without a clearer account of the mechanisms that make cooperative environments work, there is a real risk of simply adding new measurements to the same broken system. I propose that a more behaviourally informed understanding of how cooperative norms emerge, persist, and collapse offers a more productive basis for the interdisciplinary dialogue this session invites — and a more honest reckoning with what progress in science actually requires.

What Do We Mistake for Progress? Interdisciplinarity or Multidisciplinarity (Invited)

Authors

Simon Scott (1)

(1) University of Birmingham

Abstract

Interdisciplinarity is widely promoted as a response to complex problems, yet in practice it is often reduced to multidisciplinarity, which is a collection of perspectives that remain unintegrated. This provocation reflects on the gap between rhetoric and practice in interdisciplinary education and offers this distinction as a lens for thinking about progress more broadly. What would it mean to recognise progress not as the expansion of knowledge, but as the integration of perspectives that changes how problems are understood?

Matching the data does not mean understanding: keeping astronomy interpretable in the age of AI

Authors

Daniele Sorini (1)

(1) Durham University

Abstract

The last decade has seen a rapid expansion of artificial intelligence (AI) applications in astronomy. This is particularly the case in galaxy formation, where models are increasingly used to generate new predictions (Pimbblet & Richings, 2025). Effectively, this leads to the development of complex models that rely on a large number of parameters. While such models can reproduce observational data with impressive accuracy, they frequently lack interpretability, making it difficult to understand the underlying physical mechanisms that drive their success.

Even prior to the rise of AI, cosmological hydrodynamical simulations, a cornerstone of theoretical galaxy formation, were criticised for their limited interpretability. At the same time, analytical models have been progressively sidelined due to their perceived oversimplification of the physics. Yet, traditional paper-and-pen approaches can offer unparalleled human-interpretable insight into the governing physics, without the substantial computational and environmental costs associated with large simulations and AI models (Stevens et al., 2020).

I will argue that we as a community need to reserve AI for the tasks where it outperforms humans, such as object detection, classification, data augmentation, and efficient exploration of parameter space. But we should not over-rely on numerical and AI approaches for theoretical enquiry and making new predictions. This is not only an environmental responsibility, but an epistemological imperative. There is little use to developing complex, black-box models that match observations if we cannot understand the physical implications. Keeping our models human-interpretable is crucial for making genuine scientific progress.

Science fiction and scientific progress: Olaf Stapledon and Astrobiology (Invited)

Authors
John Holmes (1)

(1) University of Birmingham

Abstract
While it is a commonplace that many scientists are inspired by science fiction, the direct impact of literature on scientific theories and research is much less well known or understood. In the 1930s, the British philosopher Olaf Stapledon published two works of what would come to be considered science fiction, though he himself called them 'essays in myth': 'Last and First Men' (1930) and 'Star Maker' (1937). In this paper I will trace how they have shaped the field of astrobiology through their influence on Arthur C. Clarke, Martin Rees and others. I will consider how and why these books continue to be cited in the 'International Journal of Astrobiology' and show how the most consequential finding in astrobiological research to date - Gaia Theory, now more frequently called Earth System Science - derives from James Lovelock's reading of Stapledon.

Astronomical Discovery and AI Co-Science

Authors

Joshua Weston (1), Karli Gibson (2)

(1) Queen's University Belfast
(2) Queens University Belfast

Abstract

The scale of modern astronomical surveys, such as the Legacy Survey of Space and Time (LSST), is driving the development and adoption of AI Co-Scientists: machine-learning based tools that can be utilised to aid in any stage of the research cycle. Unlike previous technologies such as the telescope, which were developed to extend perception while preserving opportunities for understanding, AI Co-Scientists intervene at the level of interpretation itself. Drawing on the philosophy of Bernard Stiegler, we argue that these tools risk displacing noesis - the reflective, universalisable understanding through which knowledge is oriented. In LSST transient science, the detection of rare astrophysical transients can answer long-standing questions, open new ones, and engage society in the field. Over-reliance on AI to interpret and communicate these discoveries, however, risks decoupling this act from the human noesis that gives it meaning. We argue that this process is a continuation of the co-evolution between astronomers and their tools; here, however, it takes an intensified form that risks narrowing the diversity of knowledge from which new discoveries emerge. In turn, this risks progressive deskilling that deprives the astronomer of their own expertise. However, rather than outright rejecting the practice of AI Co-Science, we can build on Stiegler's pharmakon - the idea that tools are simultaneously poisons and remedies - as a framework to identify ways that machine learning can encourage rather than displace these opportunities, identifying existing examples in transient astronomy.

Interdisciplinary Ecosystems as Drivers of Scientific Progress

Authors

Dimple (1), Swetha Bhagwat (1), Debnandini Mukherjee (1)

(1) University of Birmingham

Abstract

Progress in astronomy and in science, more broadly, is commonly measured in terms of new facilities, larger datasets, and growing computational power. While these resources are undeniably central, they offer only a partial account of how knowledge advances. Equally fundamental, though far less visible, are the organisational structures of research communities, and the environments that nurture creativity, serendipity, collaboration, and intellectual risk-taking.

This contribution argues that fostering integrative research ecosystems, ones that deliberately extend beyond traditional disciplinary boundaries, is not a peripheral concern but a core driver of scientific progress. Bringing together researchers from diverse fields, such ecosystems create the conditions for novel problem framing, unexpected methodological transfers, and the kind of cross-pollination that single-discipline approaches rarely generate on their own.

Special attention will be given to the role of emerging tools, particularly artificial intelligence, in reshaping research practices and collaboration patterns. Rather than treating various methodologies merely as a technical accelerant for a single field, this talk explores how it can serve as a connective tissue across disciplines, enabling new forms of inquiry that would otherwise remain siloed.

This presentation aims to position interdisciplinary engagement as a constructive, evolving, and central component of scientific culture to sustain innovation, support intellectual risk, and keep curiosity at the heart of research.