THE CONCEPT OF EVIDENCE IN ASTROPHYSICS

An international workshop on philosophical approaches
to evidence and data in astrophysics

FRIDAY 21 JUNE 2019

Salón de Grados, Faculty of Philosophy, Complutense University

9.30 – 10.30: Alan Heavens (Imperial College London): "Bayes in the Cosmos"

10.30 – 11.00: Coffee Break

11.00 – 12.00: Jaco de Swart (Amsterdam): "How the Universe Went Missing"

12.00 – 13.00: Siska De Baerdemaeker (Pittsburgh): "Method-Driven Experiments in Astro-Particle Physics"

13.00 – 14.30: Lunch

14.30 – 15.30: Bruno Merin (ESAC Science Data Centre, Madrid): "The Astronomy of Science Data Archives as Public Repositories of Facts"

15.30 – 16.30: Kerstin Kunze (Salamanca): "Constraining Cosmological Magnetic Fields with Data"

16.30-17.00: Coffee Break

17.00-18.00: Nora Boyd (Siena College): "Astrophysical Evidence: Observation and Intervention are Irrelevant"

18:00 – 18:45: Roundtable Discussion (Chair: Mauricio Suárez, UCM)

Metro Ciudad Universitaria – Google map: https://goo.gl/Kc8kqH

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Sponsored by Department of Logic & Theoretical Philosophy (UCM) and Methods of Scientific Representation (MSR): https://www.ucm.es/metcausa/

GOBIERNO DE ESPAÑA

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

UNIVERSIDAD COMPLUTENSE MADRID

ABSTRACTS:

Alan Heavens (Imperial College London): Increasingly, Bayesian reasoning is being used in cosmology (to the extent that it is now the norm), to infer model parameters, such as the expansion rate of the Universe in the Big Bang model, and for the probabilistic comparison of models using Bayesian Evidence. Complex Bayesian Hierarchical Models (BHMs) of cosmological data are now created and analysed, often involving the simultaneous determination of millions of parameters. Progress is possible because of highly efficient algorithms which draw samples from the very high dimensional posterior joint probability distribution of the parameters. These samples characterise our new state of knowledge.

Jaco de Swart (Amsterdam): Modern cosmology, as taught in textbooks and lectures alike, holds that 85% of the total mass in the universe consists of a form of mass called dark matter. The origin of this rather fantastical hypothesis is often accounted for by alluding to the appearance of new astronomical 'evidence' in the early 1970s. The current paper is an attempt to re-engage with this popular historical narrative. Rather than taking evidence for granted, I contend that tracing the history of dark matter opens up an opportunity to understand how evidence comes into being. Objects of knowledge are not born as evidence, but are (trans)formed and used as evidence somewhere and sometime in scientific practice. A historical study of this transformative practice is presented here. With the use of oral history interviews I highlight the rise of a new hybrid scientific environment in the early 1970s, that of physical cosmology. I show how within this novel cosmological practice certain readily-available observations from galactic and extra-galactic astronomy were turned into evidence. Evidence which, in turn, came to signal the existence of a new scientific object: missing mass.

Siska de Baerdemaker (Pittsburgh): Since the discovery of dark matter in the 1980s, multiple experiments have been set up to detect dark matter particle(s) through some other mode than gravitational effects on astrophysical and cosmological scales. Examples include production experiments at the LHC, as well as various so-called direct detection experiments. Particle physicists provide detailed justifications as to why these experiments should be able to detect dark matter. I show that these justifications take on a different form than what is usual in experimental practice in science, and I use this difference to raise some questions about the interpretation of the results and methodological pluralism in context of dark matter searches.

Bruno Merin (ESAC Science Data Centre): At least since the early seventies, all major data producers and observatories store carefully their digital observational data using the FITS standard in so called science data archives, where they are made available for all other scientists in the world. Typically, when a scientist had requested an observation, they have proprietary access to it for the first year, and then all the data becomes public afterwards. My presentation will describe the types of data available in current astrophysical data archives, how the data are collected, treated and modelled in astrophysics and how new statistical and big data techniques promise to revolutionize our understanding of the Universe by analysing large amounts of archival data together.

Kirsten Kunze (Salamanca): There is observational evidence for magnetic fields on nearly all scales in the universe, from stars and galaxies up to galaxy clusters and even beyond. After giving an overview of this evidence I will focus on one of the open questions concerning the origin of cosmological magnetic fields. This offers the opportunity to explain the different steps and problems involved in how to use observations of the cosmic microwave background to put constraints on the parameters of a cosmological magnetic field assuming its origin to be in the very early universe. Practical questions concern among others assumptions of the magnetic field model as well as models of the universe, the choice of observables and how to deduce constraints on the model parameters using data. The particular case that I will use to illustrate these points uses an adaption of the Monte Python cosmological parameter inference code based on a Markov chain Monte Carlo method and the Planck 2013 data which is based on my work with Eiichiro Komatsu.

Nora Boyd (Siena College): Empiricist accounts of evidence have traditionally relied on the epistemic primacy of observation. Yet, observation per se has little place in astrophysical practice. Moreover, as Ian Hacking put it: “Galactic experimentation is science fiction, while extragalactic experimentation is a bad joke.” In what sense is there astrophysical evidence absent observation of, or intervention on, the target system? I argue that attending to the distinction between the empirical and the virtual helps elucidate the nature of astrophysical evidence. Empirical astrophysical evidence must derive from a causal chain that has one end anchored in the worldly target of interest, but observation and intervention are irrelevant to the empirical nature of that evidence. I then apply this view to help us understand the nature of the evidence produced in instances of research on supernovae and black holes.