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ERC Advanced Grants for six UvA researchers

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The European Research Council (ERC) has awarded prestigious Advanced Grants to UvA academics particle physicist Gianfranco Bertone, astronomer Carsten Dominik, political scientist Marieke de Goede, logician/philosopher Luca Incurvati, AI scientist Maarten de Rijke and mathematical psychologist Eric-Jan Wagenmakers. The grants, which amount to 2.5 million euros per project, are awarded on the basis of the proven scientific excellence of the academics and their research proposals.



Prof. Gianfranco Bertone is professor of Theoretical Astroparticle Physics. His project is entitled: *De Tenebris ("On Darkness"): Dark matter phenomenology in strong gravity*

De Tenebris ("On Darkness") pioneers a new way to detect dark matter - the elusive substance comprising most of the Universe's mass - by "listening" to ripples in spacetime called gravitational waves. When two black holes spiral together and merge, they send out gravitational waves that we can detect here on Earth. If dark matter is present around those black holes, it can subtly change the shape and timing of those waves.

Bertone's project will develop models and computer codes to predict exactly how different types of dark matter would alter a black hole merger signal, and to identify key waveform signatures that reveal dark matter's nature. By 2031, De Tenebris will deliver all of its models, computer codes, and event catalogs so that, when next-generation detectors begin operating, scientists will be fully equipped to hunt for dark matter through the "sound" of merging black holes.



Prof. Carsten Dominik is professor of Astronomy, in particular the study of the formation and evolution of planets and stars. His project is entitled: *GT4Pebbles, Ground-Truth for Pebbles.*

Understanding how planets form is central to uncovering the origins of Earth - and ourselves. Thousands of exoplanets are now known, and with advanced instruments, we can observe the disks of dust and gas where planets are born. The process begins with dust grains colliding and sticking together, gradually forming compact millimeter- to centimeter-sized particles known as Pebbles. Once Pebbles exist, we understand how full planets can form. But can enough Pebbles form with the right properties? That's still unclear.

Dominik's project aims to answer this through advanced simulations of dust growth and compaction in planet-forming disks. To anchor the models in reality, a unique laboratory experiment will be built (in cooperation with Prof. Jürgen Blum at the Technische Universität Braunschweig): a 2-metre-wide, 5-ton rotating vacuum chamber simulating disk conditions. The experiment will let scientists watch Pebble formation live and also measure their properties - providing planet formation models with the "ground truth" they need.



Prof. Marieke de Goede is professor of the Politics of Security Cultures. Her project is entitled: *COLFIN: Colonial Financial Infrastructures*

COLFIN analyses and responds to the colonial durabilities in modern financial infrastructures. Financial innovation co-evolved with early modern colonial expansion and vice versa. The longer time horizons, transnational payments and novel uncertainties of colonialism are at the heart of modern financial innovation. Academic literature acknowledges this but – with some exceptions – writes colonial violence out of the history of finance. The aim of De Goede's project is to understand and analyse how the experimental beginnings and development of financial instruments were shaped by and through colonial exploitation and appropriation. The project's novel approach is to focus on financial infrastructures, understood as socio-technical and historically durable ways of organizing political-economic life. COLFIN focuses on three key financial technologies, namely credit, currency and collateral. Methodologically, the project combines digital financial forensics with qualitative postcolonial case studies. The project mines newly digitised archives of early modern public-private colonial companies including the Dutch and British East India Companies, while also being attentive to the silences in these archives.



Dr Luca Incurvati is an associate professor in the Department of Philosophy and the Institute for Logic, Language and Computation. His project is entitled: *GOOD INTENSIONS: New Foundations for Intensionality.*

Intensional notions - such as property (‘Water has the property of being potable’), content (‘The content of mental states is less developed in children'), provability (‘Some truths aren’t provable’), and modality (‘Certain actions may be necessary’) - are central to philosophy, logic, mathematics and linguistics. Yet, these notions face paradoxes similar to those that once challenged the foundations of mathematics. While the latter now enjoys a stable foundation, intensional paradoxes remain unresolved. These paradoxes undermine leading theories of content that have fueled the recent "hyperintensional revolution" with wide-ranging applications.

Incurvati’s project seeks to develop new philosophical, semantic, and logical foundations for intensional notions, offering a uniform solution to these paradoxes. It proposes a fundamentally new approach to intensionality, leading to new theories and logics of properties, content, proof, and modality. As a proof of concept, these theories will be applied to core philosophical issues - such as whether the mind can be understood as a machine.



Prof. Maarten de Rijke is university professor of AI and Information Retrieval. His project is entitled: *UNITE: Robust Generative Information Retrieval*

In today's information-driven world, search engines are vital connectors. Yet, they often prioritize immediate results over broader societal values like fairness and diversity. De Rijke’s project tackles this challenge head-on, proposing a paradigm shift towards generative retrieval systems. The research will concentrate on three critical areas to ensure generative information retrieval systems can uphold verifiable guarantees. The first concerns accuracy, where the goal is to ensure that information is precise and presented within well-defined, explained contexts of usage. The second is reliability, where the aim is to demonstrate consistent and equitable retrieval performance across various sensitive attributes. And third is resilience, building robustness against unexpected data shifts and deliberate manipulation attempts.

Furthermore, the project will develop methods to probe these generative information retrieval systems, enhancing their explainability, reproducibility, and overall safety for the search engines of tomorrow. De Rijke’s project represents a significant step towards developing more trustworthy, equitable, and robust information access for everyone.



Prof. Eric-Jan Wagenmakers is professor of Neurocognitive Modelling; interdisciplinary integration. His project is entitled: *BAYESIAN BOOST:* *Coherent Hypothesis Tests for Experimental Research*

In psychology and related fields, most data analysis relies on traditional "frequentist" methods, like p-values and confidence intervals. These techniques are widely taught and used but have significant limitations. This project aims to develop and promote a modern alternative: Bayesian statistics. Bayesian methods offer clearer, more flexible ways to interpret data and test scientific ideas. They can, for example, tell us whether a lack of results truly means no effect—or just not enough evidence. They also let researchers combine past knowledge with new data, compare multiple models at once, and track how evidence builds as more data are collected.

The project will expand current Bayesian tools, test them on real-world data, and make them accessible through free, user-friendly software like R and JASP. While focused on psychology, the results will benefit many scientific fields. Online tutorials and examples will help researchers learn and adopt these methods, encouraging more insightful and robust science.

Read the ERC press release (https://erc.europa.eu/news-events/news)