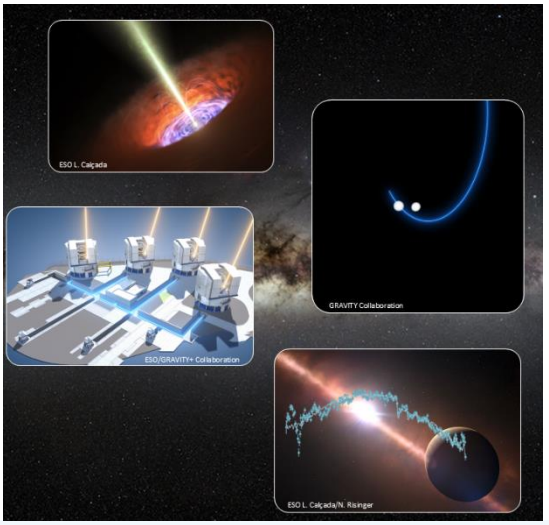
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Frank Eisenhauer
Max Planck Institute for extraterrestrial Physics, Garching

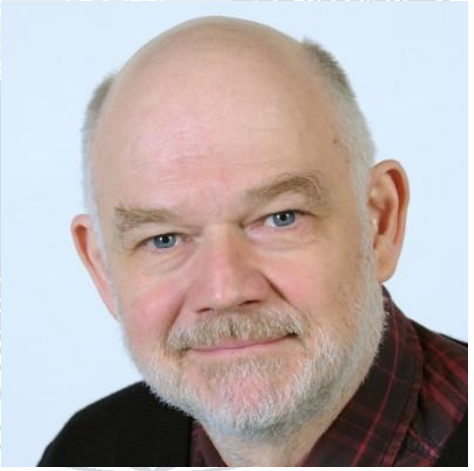
Astronomy at Highest Angular Resolution – the GRAVITY Revolution in Optical/IR Interferometry

3.12.2024
16^{30} Uhr
HS III

The GRAVITY experiment at the European Very Large Telescope Interferometer has transformed high angular resolution astronomy, now routinely offering milli-arcsecond resolution imaging, a sensitivity increase by factor thousands over previous interferometers, 30-100 micro-arcsecond astrometry, and micro-arcsecond differential spectro-astrometry. Our presentation takes us from exoplanets all the way to distant quasars, with special focus on the Galactic Center. The ongoing instrument upgrade is about to boost interferometry to the next level, then opening up the extragalactic sky, providing ever higher contrast for observations of exoplanets and more sensitive observations of the Galactic Center. We will present first results and discuss the discovery space opening up, e.g. the detailed view on Black Holes at cosmic dawn, the detection and characterization of exoplanets and their atmospheres, and the spin of the Galactic Center black hole.



Großes Physikalisches Kolloquium an der Universität zu Köln

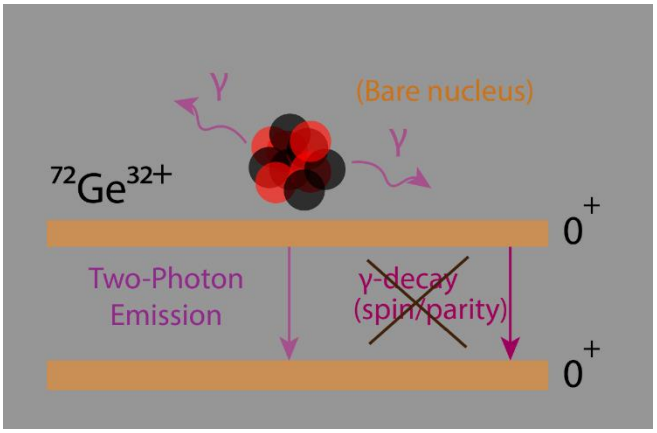


Dr. Wolfram Korten
Université Paris-Saclay, 91191 Gif-sur-Yvette, France

7.01.2025
16^{30} Uhr
HS III

Measurement of the isolated nuclear two-photon decay

The nuclear two-photon or double-gamma (2γ) decay is a second-order electromagnetic decay process whereby a nucleus in an excited state emits two gamma rays simultaneously. Compared to first-order decay pathways, such as single photon emission or internal conversion, the two-photon decay branch is very small. Ideal cases for this search are $0^+ \rightarrow 0^+$ transitions, where single photon emission is prohibited. So far, this decay was only observed in ^{16}O, ^{40}Ca and ^{90}Zr, where the high transition energy is favorable for the 2γ branch. At lower energies the 2γ branch becomes prohibitively small for γ-ray spectroscopy (10^{-6-7}). We have therefore combined Schottky + Isochronous Mass Spectrometry (S+IMS) at the Experimental Storage Ring at GSI. This novel technique allowed us to conduct the first measurement of the half-life for the isolated nuclear two-photon decay of the 0^+ isomer in ^{72}Ge. The obtained mass resolving power enables future experiments on nuclear isomers with excitation energies down to ~100 keV and half-lives as short as ~10 ms.



Großes Physikalisches Kolloquium an der Universität zu Köln

Dr. Irmgard Niemeyer
Institute of Fusion Energy and Nuclear Waste Management (IFN-2), Forschungszentrum Jülich GmbH

Verifying nuclear disarmament – technical possibilities and (political) limits

14.01.2025
16^{30} Uhr
HS III

The world's nuclear-armed states possess a total of over 12.000 warheads today. While many of these states work on modernising their nuclear forces or on increasing the size of their nuclear stockpile respectively, the reduction or elimination of nuclear weapons remains the ultimate goal for many countries.
Disarmament of nuclear weapons requires effective verification. Under bilateral arms control agreements only the dismantlement of nuclear weapon delivery systems was confirmed so far. However, the dismantling of a nuclear warhead has not yet been independently verified, but this may be required in future disarmament agreements.
The technical challenges for multilaterally verifying the dismantlement of nuclear weapons are complex: The actual disassembly of nuclear warheads is not expected to take place under inspectors' presence, to not violate military secrecy or international non-proliferation obligations. Therefore, procedures and techniques are needed to provide sufficient confidence that no nuclear material is diverted during the dismantlement and that the nuclear warhead is dismantled as declared and no longer usable.

The talk will provide an overview on the most promising techniques and technologies for disarmament verification. It will also highlight some technical gaps in the verification of nuclear disarmament and the role of scientific work towards a world free of nuclear weapons.

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Ulrike Endesfelder
Institute for Microbiology and Biotechnology, Bonn University

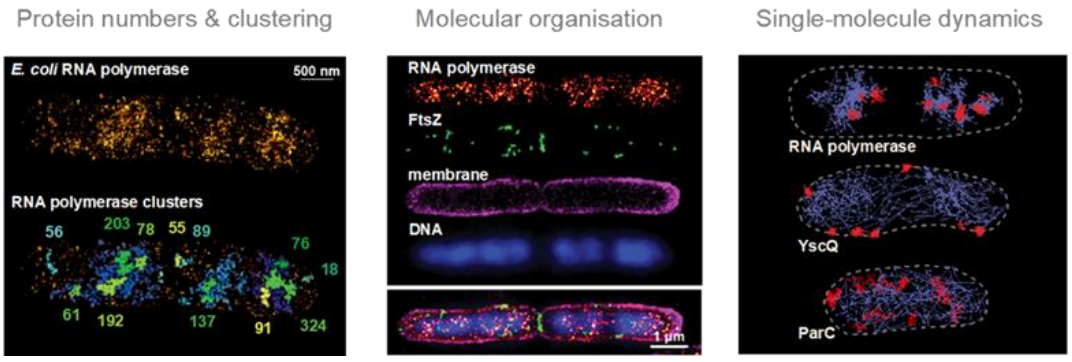
Insights into Microbial Inner Life Using Single-Molecule Microscopy

28.01.2025
16^{30} Uhr
HS III

We investigate how cellular life emerges and is regulated by molecular processes, using microbes from all life domains: archaea, eukaryotes, and prokaryotes. Our interdisciplinary group focuses on cell biology, employing techniques such as molecular biology, biophysics, and computational methods, with a special emphasis on quantitative single-molecule microscopy.

We aim to understand how the spatial organization and dynamics of molecules in the cellular environment determines cell function and regulates life; e.g. by transient molecular interactions and the plasticity of complexes. By quantifying these molecular details in vivo, we create a spatially and temporally resolved picture of microbial cells.

In this talk, tailored to a physics audience, I will discuss the potential of single-molecule techniques in cell biology, highlighting examples from our work and future directions. I will also emphasize our technical “fuel” - method developments in fluorescent labels, sample preparations, analysis software, and detectors.



Großes Physikalisches Kolloquium im Wintersemester 2024/25 – Hörsaal III der Physikalischen Institute, Zülpicher Str. 77, 50937 Köln
https://physik.uni-koeln.de/veranstaltungen-ordner/veranstaltungen/oeffentliche-vortraege/gpk Zoom Zugang: siehe dort

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Helmut Ehrenberg
Institute for Applied Materials, Karlsruhe Institute of Technology

Electrochemical Energy Storage beyond Lithium

4.02.2025
16^{30} Uhr
HS III

The transition to renewable energy sources is driving significant changes in energy technology and impacting ecosystems worldwide. Mobile energy supply and intermediate energy storage are encountering new challenges that necessitate innovative technologies. Beyond functionality, the sustainability of batteries throughout their entire life cycle must also be considered. This talk will introduce electrochemical energy storage, review established battery concepts, and discuss the strengths and weaknesses of these technologies. Additionally, it will explore the challenges and opportunities of future technologies beyond Li-ion batteries, through the perspective of the Cluster of Excellence "POLiS," with a focus on battery materials, their characterization during operation, and sustainability.