GR 4: Cosmology II

Zeit: Dienstag 14:00–15:30 Raum: HS 4

GR 4.1 Di 14:00 HS 4

Relativistic effects in N-body simulations of cosmic large-scale structure — •Julian Adamek[1], Chris Clarkson[1], Louis Coates[1], Ruth Durrer[2], and Martin Kunz[2] — [1]Queen Mary University of London, UK — [2]Université de Genève, CH

As our advanced telescopes produce ever larger and deeper maps of our Universe we need to consider that observations are taken on our past light cone and on a spacetime geometry that is pervaded by small distortions. A precise understanding of the weak-field regime of General Relativity allows one to model these aspects consistently within N-body simulations of cosmic structure formation. The subtle relativistic effects in cosmic structure can tell us how gravity operates on the largest scales that we observe and may hold the key to unravelling the mystery of dark energy.

GR 4.2 Di 14:15 HS 4

Non-linear cosmic structure formation with Fuzzy Dark Matter using Kinetic Field Theory — •Carsten Littek — Zentrum für Astronomie Heidelberg, Heidelberg, Germany

In recent years, Fuzzy Dark Matter (FDM) such as an Ultra-Light Axion has attracted much interest. The FDM particle is an extremely light scalar boson, and the FDM dynamics is that of a condensate. The particles are therefore subject not only to gravity but also to a quantum potential which acts repulsively. Kinetic Field Theory (KFT) is a non-equilibrium statistical field theory which describes structures as ensembles of classical Hamiltonian particles in phase-space. I will present how FDM and the quantum potential can be included in the KFT approach to structure formation. In comparison to Cold Dark Matter we find differences in the power-spectrum on scales near the onset of non-linear structure formation.

GR 4.3 Di 14:30 HS 4

Void dynamics as a probe of cosmology and gravity — •Nico Hamaus — Universitäts-Sternwarte München, Fakultät für Physik, Ludwig-Maximilians Universität München, Scheinerstr. 1, 81679 München, Germany

Redshift surveys measure the location of millions of galaxies in the observable Universe, thereby constructing a three-dimensional map of its large-scale structure. This structure is characterized by dense clusters of galaxies, connected by filaments and sheets of lower density. The remaining and dominant volume within this cosmic web is taken up by voids, vast regions of relatively empty space. I will highlight some recent advances in modeling average void density and velocity profiles, as well as their anisotropic shapes in redshift space on the basis of simulations and mock galaxy catalogs. While clusters, filaments and sheets have entered various stages of nonlinearity in the past, voids represent structures whose dynamic evolution can be described remarkably well by linear theory, suggesting them to be among the most pristine objects to consider for future studies on the nature of dark energy, dark matter and gravity. I will present first results in this context, obtained via the analysis of galaxy survey data from the Sloan Digital Sky Survey.

GR 4.4 Di 14:45 HS 4

A halo mass function from the non-linear density field: an analytic approach — •Johannes Schwinn — ZAH, ITA, Universität Heidelberg, Heidelberg, Germany

The halo mass function is a very important probe for testing cosmological models and our theory of structure formation. However, the only analytical deduction of the halo mass function (apart from fitting formulas) is based on the linear evolution of the cosmic density field and spherical collapse. Since both of these assumptions are not ideal, we derived an analytical estimate of the HMF from the non-linearly evolved density field. Our approach is based on excursion set statistics with correlated steps, which we combine with a PDF model of the cosmic density field. The parameters of this PDF model are fixed by the Kinetic Field Theory (KFT) of cosmic structure formation. This yields a closed-form expression of the HMF that only depends on the overdensity threshold. Treating this threshold as a free parameter, we find very good agreement with measurements from numerical simulations over the mass range from 10^{10} to 10^{16} $M_{\odot}$.

GR 4.5 Di 15:00 HS 4

Kosmische Strukturbildung für doppelbrechende Materietheorien — •Hans-Martin Rieser und Björn Malte Schäfer — Zentrum fuer Astronomie der Universitaet Heidelberg, Astronomisches Rechen-Institut

Die jüngsten Fortschritte in der konstruktiven Gravitation [1] erlauben die Betrachtung von Phänomenen auf kosmologischen Distanzen für materieinduzierte, insbesondere nichtmetrische Gravitationstheorien. Ausgehend von einer potentiell doppelbrechenden Materietheorie, die mit einer generalisierten Elektrodynamik der Form $\mathcal{L} \propto G^{abcd} F_{ab} F_{cd}$ beschrieben werden kann, und der zugehörigen Raumzeitstruktur aus dem Algorithmus der konstruktiven Gravitation lassen sich Wachstumsgleichungen für kosmische Strukturen herleiten.

Die Verwendung der neuen Theorie führt eine zweite Längenskala zusätzlich zu der durch die lokale Schallgeschwindigkeit festgelegten Skala ein. Dies führt zu einer Modifikation des Wachstumsverhaltens, das sich beispielsweise in der Veränderung von Größen wie der Jeans-Länge zeigt.

[1] Düll, M.; Fischer, N; Schäfer, B; Schuller, F (2019): Constructive Cosmology. In Vorbereitung.

GR 4.6 Di 15:15 HS 4

Weltpotentialtheorie (WPT) – Urknall, beschleunigte Expansion und Krummräume: alles nur Trugbilder müden Lichts — •Peter Wolff — Wolff Grundlagenforschung, Balterswil

Den Schwerpunkt des Vortrags werde ich auf die äusserst einfache Erklärung der beschleunigten Expansion und damit der dunklen Energie als Trugbild „müden“ Lichts legen: Sie beruht auf Einsteins originalem Äquivalenzprinzip von 1907 und dem neuen Weltpotential mit zugehöriger universeller, gravitativer Bremsbeschleunigung Hc, die die kosmische Zeitdehnung und Rotverschiebung als Schwere- statt Expansionseffekt erklärt.

Weiter verstärkt die Weltbremsbeschleunigung Hc „genügend“ schwache lokale Schwerefelder und gaukelt so Dunkle Materie vor. Als leicht freier Parameter bleibt nur noch die mittlere Dichte des in der WPT als aktual unendlich angenommenen Weltalls. Trotzdem kann die WPT die Beobachtungen gesamthaft betrachtet besser erklären als die Standardkosmologie.

Für näher Interessierte: www.wolff.ch/astro/WPT-Lesetipp.pdf