# PHYSIKALISCHES KOLLOQUIUM

## Wintersemester 2020/21

Das Kolloquium findet (soweit unten nicht anders angegeben)
**jeweils montags um 17:15 Uhr online via Zoom** statt.
(Der jeweilige Link wird noch zur Verfügung gestellt.).

**16.11.2020**

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**Cosmology meets AI – The Connection between Galaxies and Dark Matter**

**Abstract**

The field of cosmology is on the cusp of a tide of new data charting the spatial distribution of galaxies in the Universe. As the galaxies trace the dark matter and act as lighthouses, we can leverage these observations to better understand the dark sector. Empirical galaxy formation models provide a unique and direct link between galaxies and dark matter haloes, independent on model assumptions on unresolved physics. However, it is often unclear which form the relations between galaxy and halo properties should take. Artificial intelligence and machine learning methods can help to remedy this problem. Whereas for classical numerical methods all complex rules need to be known beforehand, machine learning algorithms can detect patterns automatically, which makes them the ideal tool for many analysis tasks.
In this talk, I will provide an overview of machine learning methods currently used in astrophysics, and elucidate how they can be used to bridge the gap between galaxies and dark matter. To this end, I will present our novel method GalaxyNet: a wide and deep neural network trained with reinforcement learning. GalaxyNet maps the properties of all dark matter haloes in a simulated cosmological volume to the corresponding galaxy properties. The weights and biases of the network are then found by reproducing observed statistics, such as the galaxy stellar mass function, employing particle swarm optimisation. Applying GalaxyNet to a huge cosmological volume of 200 Gpc^3 it becomes possible to predict the baryonic acoustic oscillation signal, the galaxy bias, and the clustering of active and passive galaxies up to a redshift of 4, which will be tested with next-generation surveys such as

LSST and Euclid. In this way these data can be deployed to constrain the cosmological model, and thus to obtain a deeper understanding of our Universe.

Für die Dozentinnen bzw. Dozenten der Fakultät

Prof. Dr. Hankiewicz, Prof Dr. Höfling, PD Dr. Meyer, Prof Dr. Sing und Hr. Frerichs