

FAKULTÄT für PHYSIK  
LUDWIG-MAXIMILIANS-UNIVERSITÄT  
MÜNCHEN/GARCHING

PHYSIK-DEPARTMENT  
TECHNISCHE UNIVERSITÄT MÜNCHEN  
MÜNCHEN/GARCHING

## MLL-KOLLOQUIUM

**Donnerstag, 14.11.2019, 16<sup>15</sup> Uhr**

Hörsaal der LMU in Garching, Am Coulombwall 1  
Treffen zum gemeinsamen Kaffee 16 Uhr

**Dr. Jamie McDonald**

**(Physik Department, TU München)**

### **Probing axions with neutron stars and black holes: from ultra light scalars to dark matter**

Axion-like particles may exist across an extremely wide range of masses, with Compton wavelengths ranging from galactic scales to meters and below. Here, we discuss axions of various types in astrophysical environments involving black holes and neutron stars. The common theme will be to exploit the coupling of axions to electromagnetism. We present first a new rotational instability of neutron stars driven by the mixing of an ultralight axion field with electromagnetic modes in the surrounding magnetized plasma and analyse instability time scales and possible observational consequences. Next, we discuss optical properties of general axion backgrounds: this reveals a variety of polarization dependent effects including light bending, time-delays and frequency and momentum shifts. We also show how a plasma can enhance birefringence. We then apply this to photons passing close to a rotating black hole around which a strong axion field can develop via a superradiant instability and also consider the possibility of multiple primordial black holes along the line of sight enhancing the overall effect. Finally, we turn to dark matter QCD axions. We discuss a recent proposal that dark matter axions can fall into the neutron star magnetospheres and resonantly convert into photons giving a radio signal peaked at the axion mass.

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