T 40: Astro Particle Theory

Time: Tuesday 17:00–18:00 Location: POT/0112

T 40.1 Tue 17:00 POT/0112

Inferring the properties of the Solar magnetic field via the temporal evolution of Sun shadow and the produced secondaries — •Alex Kääpä — Ruhr-Universitaet Bochum D-44780 BOCHUM

The Sun shadow of cosmic rays (CRs) constitutes an unlikely intersection between Solar and CR physics. Previous work based on Monte-Carlo-based propagation studies has shown that properties of the Solar magnetic field (SMF) can be inferred from the temporal evolution of the size of the shadow. One main observation is the tempral correlation with the 11-year Solar cycle. During low activity, the SMF can be described as a dipole, whereas the structure of the field becomes exceedingly complex during high activity.

In this talk, we discuss follow-up and expansive simulation studies, based on these previous findings. Particular focus is put on the production of secondaries, i.e. photons and neutrinos. Our aim is to constrain the properties of the SMF during high activity and confirm or improve upon the dipolar description during low activity. We further discuss the prospects of experimentally testing said studies.

T 40.2 Tue 17:15 POT/0112

The radial field in the axion kinetic misalignment mechanisms — •Vera Butz — Institut für Astroteilchenphysik, Karlsruher Institut für Technologie (KIT), Germany

The axion kinetic misalignment mechanism introduces an initial velocity for the phase of a complex scalar field thereby creating axion dark matter with a lower decay constant. The introduction of a velocity in angular direction however gives rise to the question of what would happen if we also introduced a velocity in radial direction and allowed the radial field to change its value away from the PQ symmetry breaking scale f_a. In this work we study the behaviour of the radial field by solving the coupled equations of motion for the radial and angular fields at different times. We allow the radial field to decay into Standard Model particles, which damps the velocity in radial direction.

T 40.3 Tue 17:30 POT/0112

Neutrino fluxes from Z'-mediated Dark Matter annihilation in the Sun — •Miriam Neumann[1], Amin Aboubrahim[2], Luca Wiggering[2], Michael Klasen[2], and Alexander Kappes[1] — [1]Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany — [2]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Germany

While there is various experimental evidence for the existence of dark matter (DM), its nature remains unclear. If DM scatters from conventional matter, it can be gravitationally captured in the Sun, leading to a local overdensity and enhanced annihilation of DM into Standard Model particles. When the unstable particles from this interaction decay further this leads to a neutrino flux that can be searched for with the IceCube neutrino observatory. Thus, IceCube can be used for an indirect DM search, complementing direct DM searches. To describe the DM and its interactions, we use a minimal model that extends the Standard Model by only a few fields. We specifically investigate a Z'-mediated leptophobic model featuring Majorana DM. Due to the Majorana character, the DM nucleon scattering is completely spin-dependent, making this model particularly interesting for the search of neutrinos from the Sun with IceCube. We perform a scan of the model parameter space taking into account the recent constraints from DM direct and indirect detection experiments as well as LHC searches of a heavy Z' resonance. In this talk, we present some first results showing the parts of the parameter space that have evaded all constraints to date and can potentially be probed by IceCube.

T 40.4 Tue 17:45 POT/0112

Looking for massive ALPs from SN1987A with Cherenkov detectors — •Tim Kretz — KIT TTP, Karlsruhe, Deutschland

In this talk I will discuss the production of massive axion-like-particles (ALP) via nucleon Bremsstrahlung in supernova 1987A, and review the resulting exclusion limits for the nucleon-nucleon-ALP coupling in the large coupling regime. Following an earlier suggestion by Engel et al. for QCD axions, such ALPs may be absorbed by oxygen nuclei and lead to photon signals in the MeV regime induced by de-excitation. For massive ALPS the flux at Earth is essentially mono-energetic, due to the long time of flight from SN1987A that stretches out their spectral distribution. This allows to estimate the number of detectable events in water Cherenkov detectors like Super-Kamiokande or SNO+, which I will use to derive novel exclusion limits and motivate new dedicated searches for this signal.