# T 20: Astroteilchenphysik und Kosmologie (Theorie)

Convenor: Thomas Schwetz-Mangold

Zeit: Montag 16:45–19:00 Raum: VG 3.101

T 20.1 Mo 16:45 VG 3.101

**Loop-induced photon spectral lines from neutralino annihilation in the NMSSM.** — •Guillaume Chalons[1] and Andreï Semenov[2] — [1]Karlsruher Institut für Technologie (KIT), Institut für Theoretische Teilchenphysik — [2]Laboratoire d'Annecy-le-Vieux de Physique Théorique (LAPTH)

We have computed the loop-induced processes of neutralino annihilation into two photons and, for the first time, into a photon and a Z boson in the framework of the NMSSM. The photons produced from these radiative modes are monochromatic and possess a clear "smoking gun" experimental signature. This numerical analysis has been done with the help of the SloopS code, initially developed for automatic one-loop calculation in the MSSM. We have computed the rates for different benchmark points coming from SUGRA and GMSB soft SUSY breaking scenarios and compared them with the MSSM. We comment on how this signal can be enhanced, with respect to the MSSM, especially in the low mass region of the neutralino. We also discuss the possibility of this observable to constrain the NMSSM parameter space, taking into account the latest limits from the FERMI collaboration on these two modes.

T 20.2 Mo 17:00 VG 3.101

**Constraints from electroweak bremsstrahlung and prospects for gamma ray detection** — Mathias Garny[1], Alejandro Ibarra[2], and •Stefan Vogl[2] — [1]DESY — [2]TUM

It is well known that the annihilation of Majorana dark matter particles into light leptons can be significantly enhanced by electromagnetic bremsstrahlung processes, which give rise to potentially observable signal in gamma-rays. Due to the gauge invariance, this mechanism inevitably leads to electroweak bremsstrahlung processes, which in turn lead to the production of antiprotons even when the leading order hadronic annihilation channels are forbidden. We investigate the constraints on the electroweak bremsstrahlung processes from the present measurements of the antiproton-to-proton fraction and we discuss the prospects to observe a gamma-signal in view of the antiproton constraints.

T 20.3 Mo 17:15 VG 3.101

**Spectral features in indirect dark matter searches** — •Francesca Calore[1], Torsten Bringmann[1], Gilles Vertongen[2], and Christoph Weniger[3] — [1]II. Institute for Theoretical Physics, University of Hamburg, Luruper Chaussee 149, DE-22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, 22603 Hamburg, Germany — [3]Max-Planck-Institut fuer Physik, Foehringer Ring 6, 80805 Munich, Germany

Gamma rays from the annihilation of dark matter particles in the Galactic halo provide a very promising means of indirectly detecting dark matter. In this contest, pronounced spectral features near the kinematic cutoff at the dark matter particles' mass - a generic prediction for most models - represent a 'smoking gun' signature for dark matter indirect detection. In this talk, we present projected limits on such features and show that they can be much more efficient in constraining the nature of DM than the model-independent broad spectral features expected at lower energies. In particular, we discuss how they can significantly improve the sensitivity of current and future gamma-ray telescopes to dark matter signals.

T 20.4 Mo 17:30 VG 3.101

**Sommerfeld enhancement effect in neutralino relic abundance calculations** — Martin Beneke[1], •Charlotte Hellmann[1], and Pedro Ruiz-Femenia[2] — [1]TTK, Aachen University — [2]IFIC, Valencia University

We address the Sommerfeld enhancement effect in neutralino dark matter relic abundance calculations in the MSSM using non-relativistic effective field theory techniques.

Our work includes an analytical calculation of all S- and P-Wave (co-)annihilation rates with nearly mass degenerate particles in the neutralino/chargino sector up to order $v^2$ in the velocity expansion, where we especially account for off-diagonal annihilation reactions. All spin-dependent and spin-independent potential interactions through Higgs and gauge boson exchange are taken into account and annihilations into all accessible Higgs and standard model final states are considered.

We present numerical results for selected realistic MSSM scenarios.

T 20.5 Mo 17:45 VG 3.101

**Impact of SUSY-QCD Corrections to Neutralino-Squark Coannihilation on the Dark Matter Relic Density** — •Julia Harz[1], Björn Herrmann[2], Michael Klasen[3], Karol Kovařík[4], and Quentin Le Boulc'h[5] — [1]Deutsches Elektronen-Synchrotron, Hamburg, Germany — [2]Laboratoire d'Annecy de Physique Théorique, Annecy-le-Vieux, France — [3]Institute for Theoretical Physics, University of Münster, Germany — [4]Karlsruhe Institute of Technology, Karlsruhe, Germany — [5]Laboratoire de Physique Subatomique et de Cosmologie, Grenoble, France

A powerful method to constrain the parameter space of theories beyond the Standard Model is to compare the predicted dark matter relic density with data from cosmological precision measurements, in particular from the WMAP satellite. On the particle physics side, the main uncertainty on the relic density arises from the (co-)annihilation cross sections of the dark matter particle. After a motivation for including higher order corrections in the prediction of the relic density, the project DM@NLO will be presented. This software package allows one to compute the neutralino (co-)annihilation cross sections including SUSY-QCD corrections at the one-loop level and to evaluate their effect on the relic density using a link to the public codes MicrOMEGAs and DarkSUSY. Recent results of the impact of SUSY-QCD corrections on the neutralino pair annihilation cross section will be discussed, and first results on neutralino-squark coannihilation will be shown.

T 20.6 Mo 18:00 VG 3.101

**Constraints on Dark Matter Annihilation from the Rare B Decay $B_s \to \mu^+\mu^-$ in the MSSM with Sources of Non-Minimal Flavor Violation** — •Christoph Borschensky, Guillaume Chalons, Florian Domingo, and Ulrich Nierste — Karlsruher Institut für Technologie (KIT) - Institut für Theoretische Teilchenphysik

In my talk I will present constraints on the parameter space of the dark matter annihilation cross section which gives us the correct relic density as measured by WMAP. Here, the constraints come from the calculation of the $B_s \to \mu^+\mu^-$ branching fraction, for which strong experimental upper bounds exist. The branching fraction for this process will be calculated in an effective Two Higgs Doublet Model, whose Higgs-fermion-fermion couplings are determined in the minimal supersymmetric standard model with non-minimal sources of flavor violation.

T 20.7 Mo 18:15 VG 3.101

**Lorentz Invariance Violation and Chemical Composition of Ultra High Energy Cosmic Rays** — •Andrey Saveliev[1], Luca Maccione[2,3], and Günter Sigl[1] — [1]Universität Hamburg, II. Institut für Theoretische Physik, Hamburg, Germany — [2]Ludwig-Maximilians-Universität, Fakultät für Physik, München, Germany — [3]Max-Planck-Institut für Physik, Werner-Heisenberg-Institut, München, Germany

After a general introduction to Lorentz Invariance Violation (LIV) we present constraints on Planck scale suppressed Lorentz breaking terms coming from the comparison between theoretical predictions and current observations of ultra high energy cosmic rays (UHECR). Finally, we will discuss further prospects and future developments in the topic, focusing in particular on the possible impact on the chemical composistion of UHECRs.

T 20.8 Mo 18:30 VG 3.101

**Simulation ultra-hochenergetischer kosmischer Teilchen im Universum im Vergleich mit Messungen** — Martin Erdmann, •Gero Müller, David Walz und Tobias Winchen — III Physikalisches Institut A, RWTH Aachen University

Für ein besseres Verständnis von den Quellen und der Propagation von ultra-hochenergetischen kosmischen Teilchen (UHECR) haben wir einen neuen Ansatz für die Monte Carlo Simulation entwickelt. Dieser Ansatz vereint drei Simulationsmethoden. Für sehr weit entfernte

Quellen wird der Beitrag zum Teilchenfluss anhand von üblicherweise verwendeten Parametrisierungen berechnet. Kosmische Teilchen aus dem lokalen Universum werden einzeln durch realistische Magnetfelder aus Simulationen der Universumsentstehung propagiert. Aus diesen beiden extragalaktischen Beiträgen werden Wahrscheinlichkeitskarten erstellt, welche die Ankunftswahrscheinlichkeit in Abhängigkeit der Richtung und der Energie enthalten. Im dritten Schritt wird mit der Hilfe einer Matrixmethode die Ablenkung im galaktischen Feld berücksichtigt. Die zugehörigen Matrizen werden aus der Rückwärtspropagation von Antiteilchen durch die Galaxis erstellt. Die oben erwähnten extragalaktischen Wahrscheinlichkeitskarten werden mit Hilfe der galaktischen Magnetfeldmatrizen transformiert. Mit den resultierenden Wahrscheinlichkeitskarten werden dann simulierte Datensätze erstellt. Vergleiche mit gemessenen UHECRs erlauben Rückschlüsse auf die verwendeten Modellparameter der Simulation.

T 20.9 Mo 18:45 VG 3.101

**Cosmic Rays in the Galactic Magnetic Field** — •Arjen René van Vliet — II. Institute for Theoretical Physics, Hamburg, Germany

Cosmic rays with energies up to $10^{20}$ eV have been detected by the Pierre Auger Collaboration and other experiments. There are still many unanswered questions concerning cosmic rays in this ultra-high-energy regime. For instance the measured structure of the flux, the incoming direction and the composition of the cosmic rays still bare question-marks. A possible explanation for these three problems, involving the interaction of these cosmic rays with the galactic magnetic field, will be presented in this talk.