Group Report: KTH Phenomenology and Theory

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General Scientific Goals

- Incorporation of massive neutrinos in the SM.
- Search for neutrino oscillation pattern.
- Number of neutrino flavors? Sterile neutrinos?
- High-precision measurements and determination of all neutrino mixing parameters.
- Origin of the baryon asymmetry of the Universe.
- What is the dark matter? WIMPs?

The Research Group

Research Topics & Interests:

- Neutrino oscillations (three flavors, in matter)
- Alternative scenarios: damping effects and non-standard Hamiltonian effects
- Matter density and non-standard effects for LBL experiments
- Neutrino mass models *e.g.* see-saw mechanism
- Leptogenesis and baryogenesis
- Phase transitions, inflation, and cosmology
- Deconstructed large extra dimensions
- Dark matter (WIMPs)

  See talk by M. Blennow: “Neutrinos from solar WIMPs”

  See talk by S. Sivertsson: “Gamma rays from WIMP annihilations around the Sun”

The Research Group

Personnel – KTH Phenomenology and Theory:

- Tommy Ohlsson, associate professor
- Håkan Snellman, professor emeritus
- Thomas Konstandin, postdoc
- Mattias Blennow, PhD student
- Tomas Hällgren, PhD student
- Sofia Sivertsson, PhD student
- Henrik Melbéus, diploma student
- Mattias Westerberg, diploma student

The Research Group

International Collaborators:

- Evgeny Akhmedov, MPI Kernphysik, Heidelberg, Germany
- Florian Bauer, DESY, Hamburg, Germany
- Joakim Edsjö, Stockholm University, Stockholm, Sweden
- Björn Garbrecht, University of Wisconsin, Madison, USA
- Stephan Huber, University of Sussex, Brighton, UK
- Manfred Lindner, MPI Kernphysik, Heidelberg, Germany
- Michele Maltoni, Universidad Autónoma, Madrid, Spain
- Davide Meloni, Università “La Sapienza”, Rome, Italy
- Gerhart Seidl, Uni. Würzburg, Würzburg, Germany
- Michael G. Schmidt, Uni. Heidelberg, Heidelberg, Germany
- Alexei Smirnov, ICTP, Trieste, Italy
- Walter Winter, Uni. Würzburg, Würzburg, Germany

Current Research Projects

Akhmedov, Blennow & Ohlsson:
"Approximative framework for neutrino oscillations with non-standard interactions"

We develop approximative two-flavor neutrino oscillation formulas including sub-leading non-standard interactions. Especially, the limit when the small mass squared difference approaches zero is investigated.

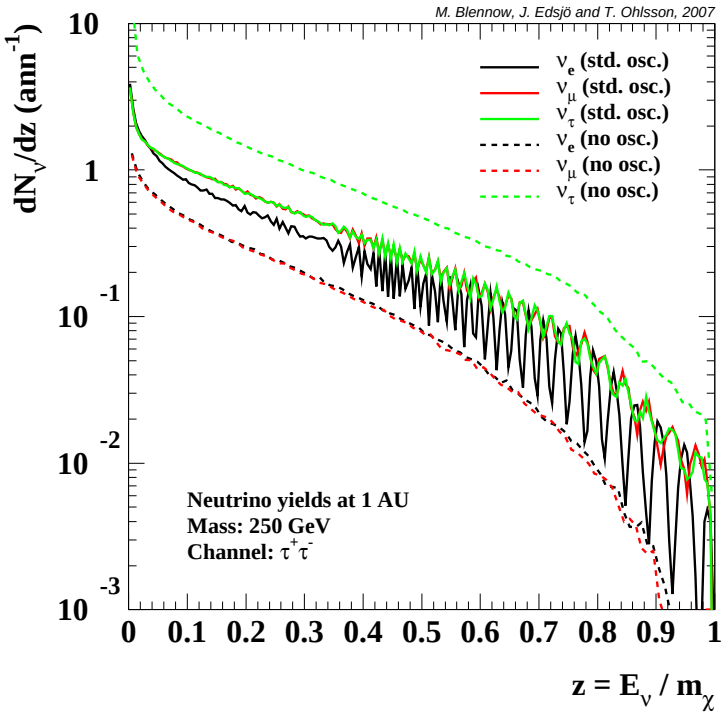
Current Research Projects

Blennow, Edsjö & Ohlsson:
"Neutrinos from WIMP annihilations using a full three-flavor Monte Carlo"

The prospects for detecting neutrinos from the Sun and the Earth arising from dark matter annihilations in the core of the Sun and the Earth are reviewed. Emphasis is placed on new work investigating the effects of neutrino oscillations on the expected neutrino fluxes.

Current Research Projects

Preliminary results:



Annihilation to $\tau^+\tau^-$ at $m_\chi = 250\,\mathrm{GeV}$
Neutrino yields at 1 AU (with and without oscillations).
Blennow, Edsjö & Ohlsson (2007)

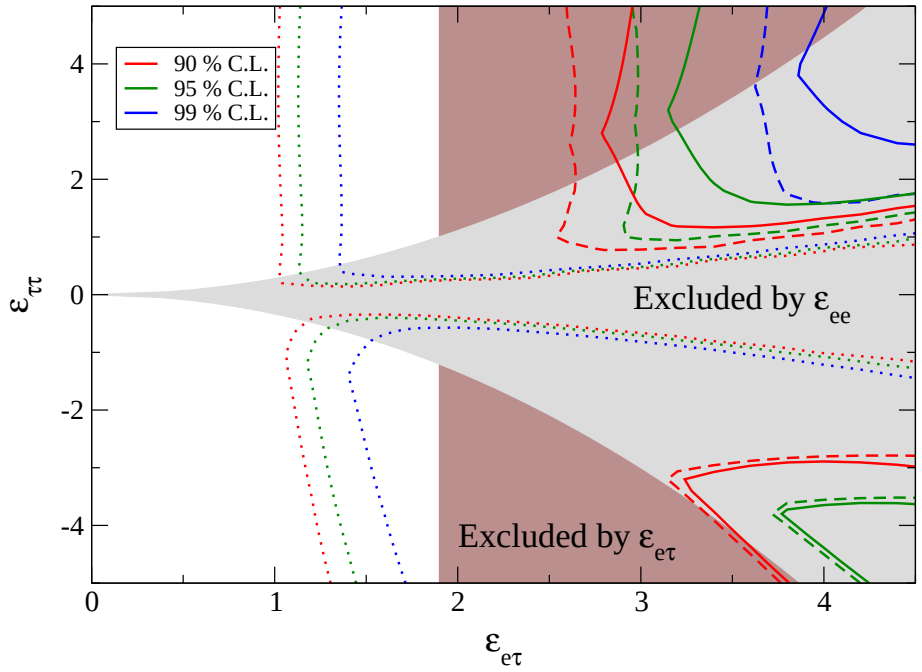
Current Research Projects

Blennow, Ohlsson & Skrotzki:
"Effects of non-standard interactions in the MINOS experiment"

In this project, we examine the sensitivity of the MINOS experiment to non-standard neutrino interactions. In addition, we also study how the inclusion of non-standard interactions affect the sensitivity to the standard neutrino oscillation parameters.

Current Research Projects

Preliminary results:



NSI sensitivity reach for MINOS

Blennow, Ohlsson & Skrotzki (2007)

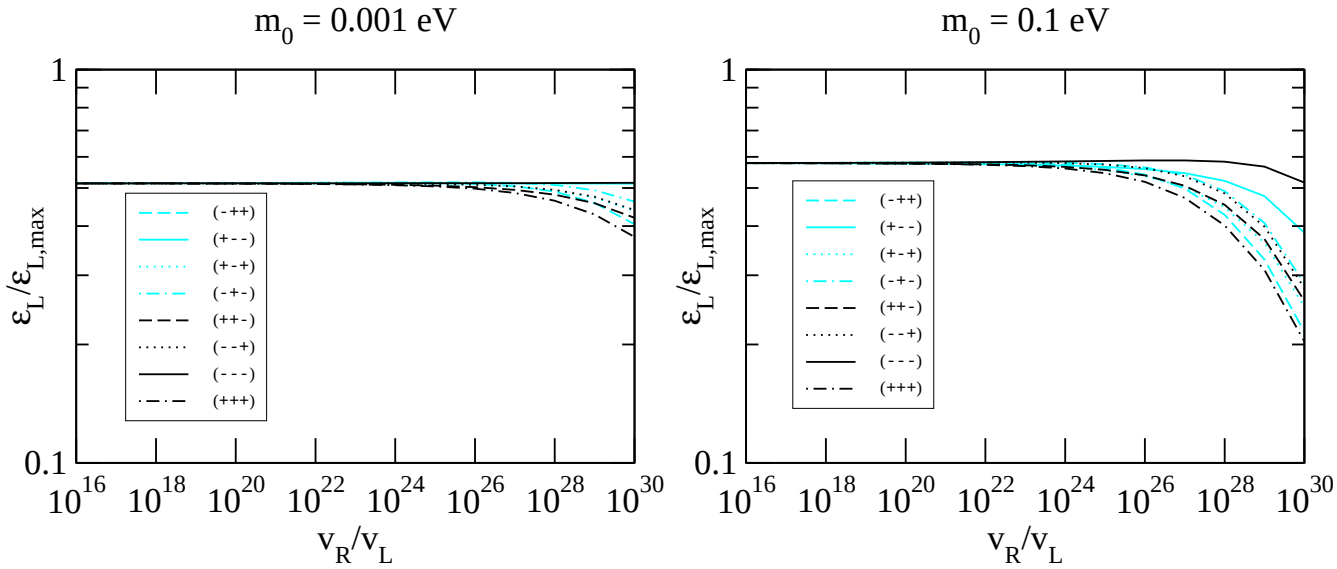
Current Research Projects

Hällgren, Konstandin & Ohlsson:
"Triplet leptogenesis in left-right symmetric seesaw models"

Left-right symmetric models contain generically triplets in order to generate the Majorana masses required for the seesaw mechanism. In this project, the produced baryon asymmetry by triplet decay is analyzed and discussed in comparison to usual leptogenesis driven by right-handed neutrino decay.

Current Research Projects

Preliminary results:



The normalized CP asymmetry for the eight possible leptogenesis solutions as a function of the ratio of VEVs
Inverted hierarchy and $m_0 = 0.001$ eV (left plot) and $m_0 = 0.1$ eV (right plot)
Hällgren, Konstandin & Ohlsson (2007)

Current Research Projects

Hällgren, Melbéus & Ohlsson:
"Extra dimensions with hyperbolic geometry"

Extra dimensions provide novel solutions to some of the problems in Standard Model physics. We study models for extra dimensions with hyperbolic geometry, which are less fine-tuned than ADD models that have flat geometries. Especially, we determine signatures observable at the LHC.

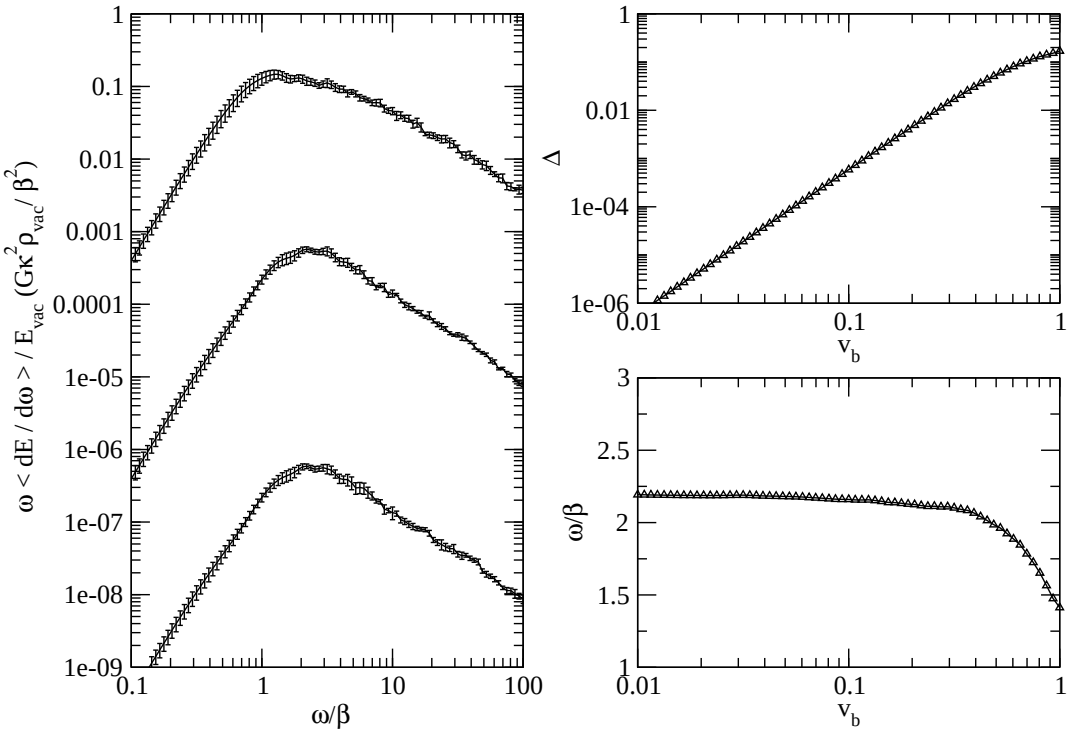
Current Research Projects

Huber & Konstandin:
“Gravitational wave production by collisions”

At the end of a cosmological strongly first order phase transition, part of the latent heat is released into gravitational radiation by bubble collisions. The resulting spectrum of the stochastic gravity wave spectrum is determined.

Current Research Projects

Preliminary results:



The resulting gravitational wave spectrum as a function of the frequency for different wall velocities. Simulation with 200 nucleated bubbles.

Huber & Konstandin (2007)

Current Research Projects

Konstandin & Sivertsson:
"Phase transitions by dimensional transmutation"

String-inspired models contain a variety of scalars that only couple to the SM Higgs field. In these models it is possible to obtain an electroweak scale even without dimensionful parameters in the Higgs sector, which results from dimensional transmutation of the couplings to the hidden sector.

Recent Publications (2006 –)

- E. Akhmedov, M. Blennow, T. Hällgren, T. Konstandin, and T. Ohlsson

  Stability and Leptogenesis in the Left-Right Symmetric Seesaw Mechanism

  J. High Energy Phys. 04 (2007) 022

  [hep-ph/0612194]

- E. Akhmedov and M. Frigerio

  Interplay of Type I and Type II Seesaw Contrib. to Neu. Mass

  J. High Energy Phys. 01 (2007) 043

  [hep-ph/0609046]

- E. Akhmedov, M. Maltoni, and A. Smirnov

  1-3 Leptonic Mixing and the Neu. Oscillograms of the Earth

  J. High Energy Phys. 05 (2007) 077

  [hep-ph/0612285]

Recent Publications (2006 –)

- F. Bauer, T. Hällgren, and G. Seidl

  Discretized Gravity in 6D Warped Space

  Nucl. Phys. B 781 (2007) 32-63

  [hep-th/0608176]

- M. Blennow, T. Ohlsson, and J. Skrotzki

  Effects of Non-Standard Interactions in the MINOS Experiment

  hep-ph/0702059

- M. Blennow, T. Ohlsson, and W. Winter

  Non-Standard Hamiltonian Effects on Neutrino Oscillations

  Eur. Phys. J. C 49 (2007) 1023-1039

  [hep-ph/0508175]

Recent Publications (2006 –)

- B. Garbrecht and T. Konstandin

  Hybrid Inflation Exit through Tunneling

  J. High Energy Phys. 01 (2007) 033

  [hep-ph/0610321]

- A. Hernandez, T. Konstandin, and M.G. Schmidt

  Effective Action in a General Chiral Model: Next to Leading Order Derivative Expansion in the Worldline Method

  arXiv:0708.0759 [hep-th]

- S.J. Huber, T. Konstandin, T. Prokopec, and M.G. Schmidt

  Electroweak Phase Transition and Baryogenesis in the nMSSM

  Nucl. Phys. B 757 (2006) 172-196

  [hep-ph/0606298]

Recent Publications (2006 –)

- T. Hällgren and T. Ohlsson

  Indirect Detection of Kaluza-Klein Dark Matter from Latticized Universal Dimensions

  J. Cosmol. Astropart. Phys. 06 (2006) 014

  [hep-ph/0510174]

- T. Konstandin and S.J. Huber

  Numerical Approach to Multi-Dimensional Phase Transitions

  J. Cosmol. Astropart. Phys. 06 (2006) 021

  [hep-ph/0603081]

- T. Konstandin and T. Ohlsson

  The Effective Matter Potential for Highly Relativistic Neutrinos

  Phys. Lett. B 634 (2006) 267-271

  [hep-ph/0511010]