Group Report: KTH Theory / Neutrino Phenomenology and Theory

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Present Values of the Neutrino Oscillation Parameters

Neutrino mixing:

$$U = \begin{pmatrix} C_{13}C_{12} & S_{12}C_{13} & S_{13}e^{-i\delta_{CP}} \\ -S_{12}C_{23} - S_{23}S_{13}C_{12}e^{i\delta_{CP}} & C_{23}C_{12} - S_{23}S_{13}S_{12}e^{i\delta_{CP}} & S_{23}C_{13} \\ S_{23}S_{12} - S_{13}C_{23}C_{12}e^{i\delta_{CP}} & -S_{23}C_{12} - S_{13}S_{12}C_{23}e^{i\delta_{CP}} & C_{23}C_{13} \end{pmatrix}$$

where $S_{ab} \equiv \sin\theta_{ab}$ and $C_{ab} \equiv \cos\theta_{ab}$.
Neutrino mass squared differences:

$$\Delta m_{ab}^2 = m_a^2 - m_b^2,$$

where m_a $(a = 1, 2, 3)$ is the mass of the ath neutrino mass eigenstate.

Present Values of the Neutrino Oscillation Parameters

Parameter	Best-fit value	Range
Δm^2_{21}	$8.1 \cdot 10^{-5}$ eV^2	$(7.2 - 9.1) \cdot 10^{-5}$ eV^2 (3σ)
Δm^2_{31}	$2.2 \cdot 10^{-3}$ eV^2	$(1.4 - 3.3) \cdot 10^{-3}$ eV^2 (3σ)
$\sin^2\theta_{12}$	0.30	$0.23 - 0.38$ (3σ)
$\sin^2\theta_{23}$	0.50	$0.34 - 0.68$ (3σ)
$\sin^2\theta_{13}$	0.000	$\leqslant 0.028$ (3σ)
δ_{CP}	-	-

M. Maltoni, T. Schwetz, M. Tortola, J. Valle, N.J. Phys. 6 (2004) 122

The Research Group

Research Topics & Interests:

- Phenomenology of neutrino oscillations
- Alternative off-mainstream scenarios
- Theory of neutrino masses and mixings
- Astrophysics and astroparticle physics

The Research Group

Personnel – KTH Neutrino Theory:

- Håkan Snellman, professor
- Tommy Ohlsson, associate professor
- Mattias Blennow, PhD student
- Tomas Hällgren, PhD student
- Mattias Andersson, diploma student

The Research Group

International Collaborators:

- Evgeny Kh. Akhmedov, TUM, Munich, Germany

- Samoil M. Bilenky, Joint Institute for Nuclear Research, Dubna, Russia

- Manfred Lindner, TUM, Munich, Germany

- José W.F. Valle, Universitat de Valencia, Valencia, Spain

- Patrick Huber, University of Wisconsin, Madison, USA

- Thomas Schwetz, SISSA, Trieste, Italy

- Gerhart Seidl, Oklahoma State University, Stillwater, USA

- Ricard Tomàs, Max-Planck-Institut für Physik, Munich, Germany

- Walter Winter, IAS, Princeton, USA

Effective neutrino mixing and oscillations in dense matter

Blennow, Ohlsson

- Effective two-flavor neutrino oscillations for infinitely dense matter.

- Comparison with numerical three-flavor results.

- Model could be used to probe θ_{13} and ν mass hierarchy.

M. Blennow and T. Ohlsson, Phys. Lett. B 609 (2005) 330

Exact series solution to two flavor oscillations in matter

Blennow, Ohlsson

- Non-linear differential equation for two-flavor neutrino oscillation problem.

- Exact series solution is presented.

- Convergence of solution examined numerically for various density profiles.

M. Blennow and T. Ohlsson, J. Math. Phys. 45 (2004) 4053-4063

Damping signatures in future neutrino oscillation experiments

Blennow, Ohlsson & Winter

A phenomenological approach:

- Exponential damping factors in neutrino oscillation probabilities.

- Motivated by alternative flavor transition scenarios such as e.g. ν decoherence and ν decay.

- Damping effects could fake a value of e.g. θ_{13}.

Cf. talk by Mattias Blennow.

M. Blennow and T. Ohlsson, and W. Winter, hep-ph/0502147

Neutrinos in deconstructed dimensions

Hällgren, Ohlsson & Seidl

Deconstruction can be considered as a UV-completion of higher-dimensional gauge theories.

- Model for neutrino oscillations in deconstructed dimensions.

- Large lattice spacings from hierarchy of energy scales.

- Probe discretization and non trivial field configurations.

- Subleading corrections to standard three-flavor solution.

T. Hällgren, T. Ohlsson, and G. Seidl, J. High Energy Phys. 02 (2005) 049

Recent Publications (2003 –)

- T. Ohlsson and W. Winter

  The role of matter density uncertanties in the analysis of future neutrino factory experiments

  Phys. Rev. D 68 (2003) 073007

  hep-ph/0307178

- M. Jacobson and T. Ohlsson

  Extrinsic CPT violation in neutrino oscillations in matter

  Phys. Rev. D 69 (2004) 013003

- M. Blennow, T. Ohlsson, and H. Snellman

  Day-night effect in solar neutrino oscillations with three flavors

  Phys. Rev. D 69 (2004) 073006

Recent Publications (2003 –)

- A. Akhmedov, R. Johansson, M. Lindner, T. Ohlsson, and T. Schwetz

  Series expansion for three-flavor neutrino oscillation probabilities in matter

  J. High Energy Phys. 04 (2004) 078

- M. Blennow and T. Ohlsson

  Exact series solution to the two flavor neutrino oscillation problem in matter

  J. Math. Phys. 45 (2004) 4053-4063

  hep-ph/0405033

- M. Blennow and T. Ohlsson

  Effective neutrino mixing and oscillations in dense matter

  Phys. Lett. B 609 (2005) 330

  hep-ph/0409061

Recent Publications (2003 –)

- T. Hällgren, T. Ohlsson, and G. Seidl

  Neutrino oscillations in deconstructed dimensions

  J. High Energy Phys. 02 (2005) 049

  hep-ph/0411312

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

  Damping signatures in future neutrino oscillation

  experiments

  hep-ph/0502147