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# ***Neutrino Masses in the sub-eV Range***

*International workshop on future direct measurements of the electron neutrino mass and their implications*

Bad Liebenzell / Schwarzwald , Germany, January 18 – 21, 2001



## ***First Circular***

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Dear Colleagues,

we are planning an international workshop on future direct neutrino mass measurements and their implications for particle physics, astrophysics and cosmology.

The workshop will be held in

**Bad Liebenzell / Schwarzwald , Germany, January 18 – 21, 2001**

Due to the restricted space on the castle (55 participants at maximum) the attendance is by invitation only.

### **Workshop Organizers**

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The workshop is supported by the *Forschungszentrum Karlsruhe*.

## Scientific Programme :

The purpose of the workshop is to discuss the future perspectives of direct neutrino mass measurements and to address the implications of next-generation experiments for particle physics, astrophysics and cosmology.

The actual results of experiments with atmospheric and solar neutrinos provide strong evidence for neutrino flavour oscillations and hence non-zero neutrino masses. While neutrino oscillation experiments are sensitive only to differences of squared neutrino masses, the neutrino mass measurements with tritium  $\beta$ -decay yield direct information on the **absolute neutrino mass scale** (assuming small differences between the various neutrino mass eigenstates – as indicated by oscillation experiments – a measurement of the electron neutrino mass would probe the masses of *all neutrino species*).

Current tritium  $\beta$ -decay experiments in Troitsk and Mainz, using the magnetic adiabatic collimation technique, set an upper limit on the mass of the electron neutrino of about 2-3 eV/c<sup>2</sup>. A next-generation tritium  $\beta$ -decay experiment, which is presently in the early design phase and which would combine both a gaseous as well as a frozen T<sub>2</sub>-source with a high resolution electrostatic spectrometer, could improve the current experimental sensitivity by a factor of 10 and investigate an **electron neutrino mass in the sub-eV range**.

A next-generation experiment with sub-eV mass sensitivity would have two major physics objectives : a) In the field of **astrophysics** and **cosmology** it would determine the cosmological relevance of the primordial neutrinos from the Big Bang. In particular, it would clarify the role of neutrinos as hot dark matter with regard to the evolution of large scale structures in the universe. b) In the field of **particle physics** it would determine the yet unknown absolute neutrino mass scale and would thus provide a stringent test of theoretical neutrino mass models, which currently predict either a hierarchical mass spectrum or a degenerate mass pattern.

The neutrino mass workshop at Bad Liebenzell will cover the following topics :

- the physics and techniques of the current and next generation direct neutrino mass measurements
- the implications of high sensitivity direct neutrino mass measurements for models of neutrino masses and mixings, as well as for astrophysics and cosmology
- the perspectives and implications of alternative measurements such as direct mass measurements using cryogenic detectors, double  $\beta$ -decay searches, cosmic microwave experiments and galaxy surveys

In addition, the workshop will cover selected topics, which are of fundamental importance for future high precision direct mass measurements (i.e. our current understanding of the shape of the T<sub>2</sub>  $\beta$ -spectrum, high precision electron spectroscopy and new physics, the application of the magnetic adiabatic collimation technique in other areas of particle and nuclear physics)

## Organisation

The workshop will consist of two days of invited plenary talks covering all topics mentioned above (Friday, January, 19 and Saturday, January, 20). Time is reserved for additional (also ad-hoc) presentations by the participants on Sunday morning (January, 21), which will be allocated by the organizers upon request.

The regular programme will start on Friday morning, January 19, 2001 at 08:30 and will end on Sunday, January, 21, after lunch. Workshop participants are expected to arrive on Thursday, January 18, 2001 in the early afternoon at Burg Liebenzell.

## **Pre-Workshop**

Before the official start of the neutrino mass workshop, there will be a one day workshop on Thursday, January, 18, 2001, dedicated to various technical aspects of a next-generation tritium  $\beta$ -decay experiment. If you are interested in participating at this pre-workshop, please contact the organizers.

## **Workshop Fee:**

The workshop fee includes full board, all refreshments during coffee breaks, the housing on Burg Liebenzell, as well as the Workshop Banquet on Friday evening. Due to financial support by the Forschungszentrum Karlsruhe, this fee will be **300 DM** (or **US \$ 140**) per person, only. The fee has to be paid cash (DM or US \$) at the registration desk upon arrival.

## **Venue and Transport:**

The castle Burg Liebenzell (450 m above sea level) is a medieval castle situated on a hill next to the small town of Bad Liebenzell in the northern part of the Black Forest - about 180 km south of Frankfurt, 50 km south-east of Karlsruhe and 40 km west of Stuttgart. International flights may be booked best to Frankfurt. The railway station (**Frankfurt(M) Flughafen**) at the airport has frequent connections to Karlsruhe, from there you can continue to Pforzheim and Bad Liebenzell. Also the Stuttgart airport offers frequent train connections to Bad Liebenzell via Stuttgart Main Station and Pforzheim. You can look up train connections in the internet:

<http://bahn.hafas.de/bin/query.exe/en>

We will be happy to help you with your travel plans, if you mail your flight details to us.

For those who plan to arrive by car: Bad Liebenzell is situated 20 km south of Pforzheim, which is right on the Autobahn **A8** between Karlsruhe and Stuttgart. At Pforzheim follow the road B463 which goes to Bad Liebenzell, Calw and Nagold. At Bad Liebenzell a small road leads to the castle Burg Liebenzell, which is to the west just above the town.

## **Accommodation:**

Burg Liebenzell hosts an international conference center which has housed more than 90.000 people from 120 nations. It can accommodate up to about 55 workshop participants in single and twin-bed rooms. Several rooms share common showers on the corridors. We intend to house all participants on the castle. Only on special request some participants may be staying in hotels in Bad Liebenzell at extra costs.

## **Tourist and Weather Information:**

Burg Liebenzell was built by the Counts of Eberstein at the beginning of the 13<sup>th</sup> century. It is situated at an altitude of 450 m in the middle of a forest with a nice view down the valley and to Bad Liebenzell, which is in about 20 minutes walking distance. There is plenty of opportunity for walking and hiking in the immediate vicinity. In addition to the lecture hall and study group rooms there is a table tennis room (bring your equipment) and a beer and wine cellar, open in the evenings. Bad Liebenzell offers many leisure opportunities for swimming (including thermal spa and sauna), tennis, squash, horse riding, golf, skiing, and many others. Train connections e.g. to Heidelberg or Baden-Baden are frequent and take less than 2 hours.

The weather in this part of Germany can be rather cold in mid-January with day temperatures ranging from -10C to +10C (snowfall may occur – be prepared).

**Further Information:**

Updated information on the programme as well as more travel and tourist information will be provided on the WWW page of the workshop

<http://www-ik1.fzk.de/tritium/liebenzell/>

which is under construction.

**Registration and Contact :**

Please return the registration form to the conference secretariat (preferably by FAX) to

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at your earliest convenience, but before *November 30, 2000*.

During the workshop (January, 18 – 21) the conference secretariat will be located at the Burg Liebenzell.

We hope that you can attend the workshop and participate in order to make this meeting as productive and useful as possible.

Best regards

The Organizers

*Guido Drexlin and Christian Weinheimer*