# T 92: Neutrino astronomy IV

Time: Thursday 16:00–18:30 Location: Tq

T 92.1 Thu 16:00 Tq

**Search for the DSNB in JUNO: Development of new Methods for Background Event Identification** — •Matthias Mayer[1], Lothar Oberauer[1], Raphael Stock[1], Hans Steiger[2], Julia Sawatzki[1], Konstantin Schweizer[1], Ulrike Fahrendholz[1], David Dörflinger[1], Sebastian Zwickel[1], and Ludwig Wallner[1] for the JUNO-Collaboration — [1]Physik-Department, TU München, James-Frank-Str. 1, 85748 Garching b. München, Deutschland — [2]**PRISMA**+ Cluster of Excellence, Staudingerweg 9, 55128 Mainz, Deutschland

The diffuse supernova neutrino background (DSNB) describes the total relic neutrino flux from past core-collapse supernovae over the entire visible universe. It is expected to be observable at the Jiangmen Underground Neutrino Observatory (JUNO), a 20 kton liquid scintillator detector currently in construction near Jiangmen, China. The detection channel to measure the DSNB signal at JUNO is the inverse beta decay (IBD). Besides irreducible background sources to the DSNB signal in the form of IBD events caused either by atmospheric or reactor electron anti-neutrinos, there are non-IBD background events. Those events can be discriminated applying the method of pulse shape discrimination (PSD). In this talk, I discuss the identification of neutron-induced background events and reactions due to atmospheric neutrinos of all flavours. This talk investigates how different PSD techniques can be used to discriminate IBD signal events against these two non-IBD event sources. This work is supported by the DFG within the project MO3 of the SFB1258.

T 92.2 Thu 16:15 Tq

**Reconstruction and selection of Supernova burst neutrinos in JUNO** — •Thilo Birkenfeld, Achim Stahl, and Christopher Wiebusch — RWTH Aachen University - Physics Institute III B, Aachen, Germany

Since the detection of neutrinos emitted by the supernova SN 1987A, no neutrinos from other supernovae have been observed to date. The Jiangmen Underground Neutrino Observatory (JUNO) will be capable of measuring the neutrino burst from a galactic supernova explosion. High statistics, a low detection threshold, and an excellent energy resolution will strongly constrain the details of the neutrino-driven supernova mechanism. JUNO will be sensitive to signals from all neutrino flavors via different detection channels. These comprise of the inverse beta decay, elastic scattering on protons and electrons, and various interactions with carbon. Separating these channels is challenging but crucial for flavor dependent analyses of the supernova burst. We present preliminary results of an event classification based on a full detector simulation including energy and vertex reconstruction.

T 92.3 Thu 16:30 Tq

**Development of the comprehensive analysis tools for the Supernova neutrino detectors** — •Vsevolod Orekhov and Michael Wurm — Institute of Physics and Cluster of Excellence PRISMA+, JGU Mainz, Germany

A galactic Supernova explosion is a unique neutrino source: detecting the neutrinos from deep inside the star will help us understand both the physics of the core collapse and properties of the neutrino themselves. If a SN neutrino burst arrived at Earth today, it would be detected by a variety of ton to kiloton scale neutrino detectors based on different technologies and target media. A full understanding of the observed signals can only be obtained by a combined analysis of the different interaction channels. This contribution presents an analysis framework developed to combine and fit the neutrino spectra from different detectors assuming a common flavour-dependent neutrino signal. We start the development from the six channels available on hydrogen, carbon and electrons that are available in large liquid scintillator detectors like JUNO. From there, the framework will be extended to include other detector types.

T 92.4 Thu 16:45 Tq

**Solar Neutrinos in JUNO** — •Sebastian Zwickel, Lothar Oberauer, David Dörflinger, Ulrike Fahrendholz, Matthias Mayer, Julia Sawatzki, Konstantin Schweizer, and Raphael Stock — TU München (TUM), Physik Department, James-Franck-Straße 1, 85748 Garching b. München

The detection of solar neutrinos can give deep insights in the understanding of the underlying processes in the sun and tests of the standard model. This is one of the scientific goals of the upcoming Jiangmen Underground Neutrino Observatory (JUNO), a 20 kt liquid scintillator detector. Its low-energy threshold, high energy resolution and large target mass make it a suitable candidate for high precision measurements. This talk will give an overview over the signal signature and relevant background sources including their potential suppression.

This work is based on past data analysis of solar neutrinos in the successful Borexino experiment and is supported by the DFG project number 284839683.

T 92.5 Thu 17:00 Tq

**Solar neutrino physics below 2 MeV with Juno** — •Luca Pelicci[1,2], Alexandre Göttel[1,2], Philipp Kampmann[1], Runxuan Liu[1,2], Livia Ludhova[1,2], Mariam Rifai[1,2], Giulio Settanta[1], and Cornelius Vollbrecht[1,2] for the JUNO-Collaboration — [1]Forschungszentrum Jülich - Institute for Nuclear Physics, IKP-2, Jülich, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

The Juno observatory, currently under construction in Jiangmen (China), is a 20 kt liquid scintillator detector. Thanks to the large fiducial volume, and thus the high statistics collectable, and excellent energy resolution, it represents a compelling opportunity for the detection of solar neutrinos. In order to be able to extract solar neutrino fluxes once data taking has started, a multivariate fitting strategy will be adopted to disentangle neutrino signals from backgrounds present in the detector. The key steps of the analysis is the estimation of signal and background rates and Monte Carlo PDF production including detector response function. The main aspects used to produce such distributions and their exploitation within the fitting procedure are explained in the following presentation. Depending on the level of contaminants within the detector, it will be possible to extract neutrino fluxes more accurately. For this reason, sensitivity studies conducted under varying background scenarios are presented.

T 92.6 Thu 17:15 Tq

**A Simulation Model for Solar Atmopheric Neutrinos** — •Kruteesh Desai and Stephan Meighen-Berger — TU München, Müunchen, Deutschland

We introduce a new Solar Atmospheric Neutrino Simulation Model. Solar atmospheric neutrinos are produced in cascades initiated by cosmic rays in the solar atmosphere. The model is based on the principles of cascade equations, widely studied for Earth's atmosphere. This provides a flexible environment to study the impact of solar, primary, and interaction models. The simulation model includes all relevant particles for the production of neutrinos, with the option to extend to other interacting particles. This could in turn be applied to the study of neutrinos produced due to dark matter. The Solar model used here is based on Helioseismic observations from the GOLF instrument onboard the SOHO satellite. This allows differentiating between fluxes generated in low and high impact parameter scenarios. These fluxes are expected to differ due to the rapidly varying density profile of the Sun. We present the different components of the simulation model and the resulting neutrino fluxes, as well as example applications for experiments, such as IceCube.

T 92.7 Thu 17:30 Tq

**Prospects for the Detection of Solar Neutrinos in DARWIN via Elastic Electron Scattering** — •Shayne Reichard for the DARWIN-Collaboration — Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT) — Physik-Institut, University of Zurich

The DARWIN observatory, a proposed experiment that would utilize tens of tonnes of liquid xenon to directly detect dark matter, will additionally exhibit sensitivity to solar neutrinos via elastic electron scattering. DARWIN will have the potential to measure the fluxes of five solar neutrino components: *pp*, $^{7}$Be, $^{13}$N, $^{15}$O and *pep*. A high-statistics observation of *pp* neutrinos would allow us to infer the values of the weak mixing angle, $\sin^2\theta_w$, and the electron-type neutrino survival probability, $P_e$, in the electron recoil energy region from a few keV up to 200 keV. Such measurements would be the first at these low energies. An observation of $pp$ and $^7$Be neutrinos would constrain the neutrino-inferred solar luminosity down to 0.2%. A combination of all flux measurements would distinguish between the high (GS98) and low metallicity (AGS09) solar models with 2.1-2.5$\sigma$ significance, independent of external measurements from other experiments or a measurement of $^8$B neutrinos through coherent elastic neutrino-nucleus scattering in DARWIN. Finally, the neutrino capture process on $^{131}$Xe may be observable with a target depleted of $^{136}$Xe. We present results of detailed calculations based on the anticipated properties of the DARWIN detector.

T 92.8 Thu 17:45 Tq

**Directional reconstruction of solar $^7$Be neutrinos in Borexino** — •Johann Martyn for the Borexino-Collaboration — Johannes Gutenberg-Universität Mainz

The Borexino detector is a liquid scintillator detector with a high radiopurity and a light yield of $\approx$ 12000 photons/MeV with the main goal of measuring the entire spectrum of solar neutrinos from very low energies (>150 keV). While the method of using the directional information of Čerenkov photons is readily used to discriminate between signal and background in water based detectors on an event-by-event basis this cannot be done in Borexino due to its large scintillation light yield and a relative fast scintillation time. In this talk we present a novel approach of directional analysis where the PMT hit patterns are summed up for a large number of events and plotted versus the angle of the known position of the sun and the direction of the photons given by the reconstructed event vertex and the PMT position. We use the $^7$Be neutrino energy region to investigate if it is possible to use this cumulative method to distinguish between directional neutrino signal and isotropic radioactive background.

This work is supported by the Cluster of Excellence PRISMA+.

T 92.9 Thu 18:00 Tq

**Search for ultra-high energy neutrinos from binary black hole mergers*** — •Michael Schimp for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The Surface Detector of the Pierre Auger Observatory is able to distinguish extensive air showers induced by ultra-high energy neutrinos (UHE neutrinos; $E_\nu > 0.1$ EeV) from those induced by atomic nuclei, provided that they are highly inclined (zenith angles from 60° to 95°). While its sensitivity to a diffuse UHE neutrino flux is comparable to IceCube's, the dependences on the direction and flavor are very different. For instance, the Pierre Auger Observatory is the only operational instrument sensitive to UHE neutrinos from the Northern Hemisphere. Close to the horizon, the effective area is much enhanced, leading to unrivaled instantaneous UHE neutrino sensitivities for searches following up transient sources in this part of the sky.

Binary black hole (BBH) mergers are among the most recently discovered classes of astrophysical objects, but have not yet been successfully observed by any other means than gravitational waves. Using the 3D sky localization probability distributions of the BBH mergers published so far, and the assumption of a universal time-dependent luminosity, a combined search for UHE neutrinos emitted by the BBH mergers is performed. We present constraints on the time-dependent luminosity for the exemplary hypothesis of an emission lasting for 24 hours beginning at the time of the merger.

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T 92.10 Thu 18:15 Tq

**Performance of new triggers used for neutrino detection at the Pierre Auger Observatory*** — •Srijan Sehgal for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Germany

The Pierre Auger Observatory, currently the world's largest cosmic ray detector, can also be used to identify highly inclined ($60^\circ < \theta < 95^\circ$ where $\theta$ is the zenith angle) neutrino induced extensive air showers by using its Surface Detector (SD). In 2013, two new SD triggers – time-over-threshold-deconvolved (ToTd) and multiplicity of positive steps (MoPS) – were installed to reduce the energy threshold of the SD and increase the trigger efficiency for neutrino induced air showers.

This talk presents an overview of the performance of the new triggers on neutrino simulations ($60^\circ < \theta < 75^\circ$; shower energy $< 10^{19}$eV) simulated using CORSIKA with detector simulations and signal reconstruction performed using the Auger software framework. Quantities such as zenith angle, shower energy, and slant depths are investigated to gauge performance.

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