HK 6 Kern- und Teilchen-Astrophysik

Zeit: Freitag 14:00–16:00 Raum: TU MA144

Gruppenbericht

HK 6.1 Fr 14:00 TU MA144

LUNA: A Status Report — •Frank Strieder for the LUNA collaboration — Institut für Physik mit Ionenstrahlen, Ruhr-Universität Bochum

This talk will give an overview about the experiments in the framework of the LUNA project. In short, the LUNA collaboration (Laboratory Underground for Nuclear Astrophysics) studies at the Gran Sasso underground laboratory, Assergi, Italy, the low energy cross section of capture reactions of astrophysical interest close to the Gamow window. Therefore, a 400 kV high current, electrostatic accelerator was installed in the underground lab and is contiously running in long term experiments. Recently, the measurement of the reaction ^{14}N(p,γ)^{15}O was completed. The cross section was measured in the energy range below 400 keV complementary with a N_2 gas target in combination with a 4π BGO summing crystal as well as with a solid target station in combination with a high resolution germanium detector. The different approaches allowed on one side a high efficiency measurement down to very low energies and on the other hand a high resolution experiment, which was able to discriminate clearly all diffenrent contributions to the total cross section. The final results of these measurements will be discussed.

The experimental program of the LUNA collaboration will be continued with the measurement of the reactions ^{3}He(α,γ)^{7}Be and ^{25}Mg(p,γ)^{26}Al, which will start in 2005. The experimental status and the prospects of these experiments will be presented.

The projects are supported by Bundesministerium für Bildung und Forschung (05CL1PC1/1).

HK 6.2 Fr 14:30 TU MA144

Electron screening in $d(d,p)t$ for deuterated metals: temperature dependence — •Francesco Raiola für die LUNA-Kollaboration — Inst. für Experimentalphysik III, Ruhr-Universität Bochum, Germany

The electron screening effect in the $d(d,p)t$ reaction has been studied at the Ruhr-Universität Bochum for most of the metals and some insulators/semiconductors by using deuterated targets [1]. The deuterated targets were produced via implantation of low-energy deuterons. As compared to measurements performed with a gaseous D_2 target, a large effect has been observed for all metals. In particular work has been done to investigate the high solubility for the metals of groups III and IV and the lanthanides, at a sample temperature $T = 200°$C. The hydrogen solubility in the samples dropped to a level of few percent (compared to $T = 20°$C) and a large screening became thus observable.

An explanation of the large effect in metals is provided by the plasma model of Debye applied to the quasi-free metallic electrons. A first evidence of the aplicability of Debye's model is that the deduced number of free electrons per metallic atom agrees with the calculated number from the Hall coefficient [2], for all metals investigated. A critical test of the classical Debye model is the temperature dependence $U_e \propto T^{-1/2}$. This temperature dependence measurement is in progress and new results will be presented.

Supported by BMBF(05CL1PC1/1), DFG(Ro429/31-1), and Dynamitron-Tandem-Laboratorium. [1]F.Raiola et al.: Eur. Phys. J.A19(2004)283; [2]C.M.Hurd: "The Hall effect in metals and alloys"; (Plenum Press, 1972).

HK 6.3 Fr 14:45 TU MA144

The total S factor of ^{14}N(p,γ)^{15}O — •J.N. Klug, C.E. Rolfs, F. Schümann, F. Strieder, and H.P. Trautvetter — Ruhr-Univ. Bochum

The ^{14}N(p,γ)^{15}O reaction is the slowest reaction in the hydrogen burning CNO cycle and thus of high astrophysical interest.The reaction rate determines the CNO neutrino spectrum of our sun and influences sensitively the age determination of globular clusters. A recent work [1] done at the LUNA facility at the Laboratori Nazionali del Gran Sasso at energies below 400 keV shows that R-matrix fits to the existing data reveal good agreement for the energy regime below 500 keV. Nevertheless, a precise determination of the astrophysical S factor at zero energy depends strongly on the data above 500 keV. Therefore a new measurement of ^{14}N(p,γ)^{15}O in the energy range of 500 to 2000 keV was performed at the Dynamitron Tandem Laboratory (DTL) of the Ruhr-Universität Bochum in order to remove systematic uncertainties in the existing data, e.g. summing corrections. supported by BMBF (05CL1PC1/1)

[1] A. Formicola et al., Phys. Lett. B **591**, 61-68 (2004).

HK 6.4 Fr 15:00 TU MA144

The European Recoil separator for Nuclear Astrophysics — •Daniel Schürmann for the ERNA collaboration — Institut für Experimentalphysik III, Ruhr-Universität Bochum, Universitätsstr. 150, 44780 Bochum

The fusion of Carbon and Helium in the nuclear reaction ^{12}C(α,γ)^{16}O takes place in the helium burning phase of red giant stars. This reaction is commonly refered to as a key reaction in nuclear astrophysics. Still the uncertainties of the astrophysical S(E) factor used in stellar model calculations are too large. To improve this situation we are performing a new measurement of the ^{12}C(α,γ)^{16}O cross section. Previous measurements are mainly based on the detection of the reaction gamma rays.

As a new tool for this research field the European Recoil separator for Nuclear Astrophysics (ERNA) was developed at the Dynamitron Tandem Laboratory of the Ruhr-Universität Bochum. In ERNA a ^{4}He gas target is bombarded by a ^{12}C ion beam. A combination of two Wien filters and a dipole magnet filters reaction products from beam particles. The oxygen recoils are then identified and detected freely, i.e. without the necessity of γ-ray coincidences. Such coincidences can be performed additionaly, resulting in background-free γ-ray spectra.

The talk will discuss key parameters of the separator, such as suppression and acceptance. The importance of knowledge about charge state distributions and charge exchange effects will be pointed out. First results will be shown on the ^{12}C(α,γ)^{16}O case and upcoming measurements of ^{3}He(α,γ)^{7}Be will be introduced. This project is supported by the Deutsche Forschungsgemeinschaft (RO 429/35-3).

HK 6.5 Fr 15:15 TU MA144

The Electron Asymmetry A in the Decay of free neutrons — •Daniela Mund[1], Hartmut Abele[1], Stefan Baessler[2], Markus Brehm[1], Jochen Krempel[1], Michael Kreuz[1,3], Bastian Märkisch[1], Alexander Petoukhov[3], Marc Schuman[1], and Torsten Soldner[2] — [1]Physikalisches Institut Universität Heidelberg — [2]Institut für Physik Universität Mainz — [3]Institut Laue-Langevin (ILL)

We measured the β-asymmetry A, the correlation between the neutron spin and the electron momentum, in the decay of free polarized neutrons. From A and the neutron lifetime τ, you can derive the first element of the quark mixing CKM matrix, V_{ud}. Previous experimental values on V_{ud} and V_{us} violate the unitarity condition of the first row of this matrix. Hence we seek for clarification with this measurement.

Our spectrometer PERKEOII was placed at the ILL at the cold neutron beam PF1B. We improved our setup in systematics, like polarisation, background and detector function, and in statistics. We will report about our experiment and its results.

HK 6.6 Fr 15:30 TU MA144

Suche nach dem Mischungwinkel Theta13 — •Lothar Oberauer, Franz von Feilitzsch, Christian Grieb, Christian Lendvai, Tonias Lachenmaier, Walter Potzel und Marianne Neff — Physik Departement E15, Technische Universität München

Neutrinos haben Masse. Die Flavour-Eigenzustände sind Linearkombinationen von Masseneigenzuständen. Dieser Zusammenhang wird mit der unitären leptonischen Mischungsmatrix beschrieben. Mit atmosphärischen, solaren und Reaktorneutrinoexperimenten konnten kürzlich zwei der drei möglichen Winkel dieser Matrix bestimmt werden. Sie sind, im Gegensatz zu den Mischungswinkeln der hadronischen CKM-Matrix, groß und beschreiben die Kopplung der ersten zur zweiten und die der zweiten zur dritten Familie. Für die Kopplungsstärke zwischen erster und dritten Familie bestehen bisher nur obere Grenzen. Die Bestimmung des fehlenden Mischungswinkels Theta-13 ist aber wichtig für das Gebiet der schwachen Wechselwirkung, da z.B. zukünftige Experimente zur Suche nach einer leptonischen CP-Verletzung von dem Wert von Theta-13 abhängen. Mit neuen Reaktorexperimenten sowie zukünftigen Beschleunigerexperimenten wird in den nächsten Jahren nach Theta-13 gejagt werden. In dem Vortrag wird die Sensitivität der Projekte besprochen und insbesondere das neue Reaktorexperiment Double-Chooz vorgestellt werden.

HK 6.7 Fr 15:45 TU MA144

Loss and Depolarization Studies of Ultra-cold Neutrons — •Peter Fierlinger[1], I. Altarev[2], T. Brys[1], M. Daum[1], M. Gupta[1], R. Henneck[1], S. Heule[1], M. Gupta[1], M. Kasprzak[1], K. Kirch[1], M. Lasakov[3], M. Makela[4], A. Pichlmaier[1], U. Straumann[5] und A. Young[6] — [1]Paul Scherrer Institut, Villigen-PSI, Switzerland — [2]Technische Universität München — [3]Petersburg Nuclear Physics Institut — [4]Virginia Institute of Technology — [5]Universität Zürich — [6]North Carolina State University

Storage and depolarization of ultra-cold neutrons (UCN), although important for numerous experiments in fundamental and particle physics, is still not fully understood. We have carried out an experiment based on a cylindrical storage vessel with a magnetic shutter on the bottom, gravity and material walls. The loss and depolarization probability per wall interaction of the stored UCN was measured as a function of energy and temperature. We tested diamond-like carbon (DLC) coatings on Aluminum and quartz as wall materials and compared them to Beryllium. We also made a storage container using DLC coatings on plastic and Aluminum foil. We found the DLC loss parameters to be comparable to Beryllium.