

Transnational access RUG-KVI

Description of the publicity concerning the new opportunities for access

As in the first reporting period, the opportunities for access were publicised by means of a dedicated web site: <http://www.rug.nl/kvi/ensar> . For details, see the first periodic report.

Description of the selection procedure

No Selection Panel meetings were held in the reporting period. In the meeting of 22 June 2011, experiments KVI-F18, KVI-S58 and KVI-T30 were approved. Also, the final approval for experiment KVI-T29 was given, after provisional approval in the previous Selection Panel meeting.

The approval for experiment KVI-P20 was given in 2012 after e-mail consult among the Selection Panel members.

Three more experiments were found eligible, but they were not selected.

See Annex 1 (Database) for the list of the Selection Panel members.

Transnational Access activity

Four projects have been supported during the reporting period:

- i. KVI-P20: β -delayed α -decay study of ^{16}N using the implantation method (spokesperson: H. Fynbo and O. Kirsebom, Aarhus University, Denmark);
- ii. KVI-S58: Study of electric dipole strength below the particle threshold ($p,p'\gamma$) (spokespersons: A. Zilges and J. Endres, Universität zu Köln, Germany);
- iii. KVI-T29: Radiation hardness of Avalanche Photodiodes, radiation damage and defect studies in PWO crystals, and hadron response of inorganic scintillating fibers (spokesperson: R. Novotny, Justus-Liebig University Giessen, Germany);
- iv. KVI-T30: Experiments for real time in-vivo dosimetry for ion therapy (spokespersons: F. Fiedler, Helmholtz-Zentrum Dresden-Rosendorf, and G. Pausch, OncoRay, Dresden, Germany).

All experiments mentioned above are in the field of physics. Experiments KVI-P20, KVI-S58 and KVI-T29 are in the discipline of nuclear physics, experiment KVI-T30 is in the discipline of other physics (medical physics).

See Annexes 2 and 3 (Database) for the List of User-Projects and the List of Users, respectively.

Scientific output of the users at the facilities

Highlights of important research results from the supported user-projects:

- i. KVI-P20 (β -delayed α -decay study of ^{16}N using the implantation method):
The main objective was to improve the understanding of oxygen production in stars and stellar evolution in general by determining the branching ratio for α -decay on an absolute scale and measuring the energy spectrum of the α -particles down to low energies. The experiment managed to lower the statistical uncertainty in the branching ratio significantly, down to 2%.
- ii. KVI-S58 (Study of electric dipole strength below the particle threshold ($p,p'\gamma$)):
The experiment used a proton beam to look in ^{140}Ce in order to clarify the origin of the splitting of the Pygmy Dipole Resonance (PDR). This splitting has raised a lot of interest in the nuclear-structure community, partly due to a connection to the nucleosynthesis in

explosive stellar-burning phases. First spectra showed that the states of the PDR could be excited and a detailed study of the structure of the states is possible.

- iii. KVI-T29 (Radiation hardness of Avalanche Photodiodes, radiation damage and defect studies in PWO crystals, and hadron response of inorganic scintillating fibers):
In irradiations by protons, all samples of Large-Area Avalanche Photodiodes (LAAPDs) and optical glue, which will be used to attach LAAPDs to PWO crystals, demonstrated sufficient radiation hardness, as required by the PANDA experiment. Further, it was shown that irradiation by low-energy protons of about 90 MeV influences optical properties of PWO crystals in a same way as protons with much higher energy range of about 10-100 GeV. This observation allows to make conclusions on the nature of created defects in the PWO crystals, caused by proton beams. The low-energy protons were used as well to determine probability of damage of the configuration on Xilinx Field Programmable Gate Array (FPGA). This information is crucial for planning of usage of the FPGAs in the PANDA experiment.
- iv. KVI-T30 (Experiments for real time in-vivo dosimetry for ion therapy):
A 150 MeV and 55 MeV proton pencil beam was shot on targets made from Polyethylene, Polymethylmethacrylate (PMMA) and Graphite as well as tissue-equivalent material, using beam currents between 10 and 200 pA. The measurements aimed at measuring prompt and secondary γ -rays as well as fast and thermalized neutrons for different target geometries with and without shielding. Spectra of the emitted γ -rays have been recorded and already partially compared to simulations. Emission profiles were measured for the gamma rays, fast and slow neutrons. The measured data will be used for sensitive tests and (hopefully) a verification of the modelling tools used for optimization of prompt-gamma imaging setups.
Further, measurements and load tests have been conducted with the prototype of the Compton camera in different configurations. It has been shown that CdZnTe is a suitable material for use in such a setup.

Please find in the Database, the publications on work carried out under the present contract. It is obvious that not many publications can be expected yet for the complex experiments at KVI supported under ENSAR. In Annex 4 (included in this document) the publications that have appeared in peer-reviewed journals resulting from work carried out under the previous access contract of the FP6 programme ('EURONS', no. 506065) are listed.

User meetings

No user meetings have taken place in the reporting period.

Annexes

See the Database for Annexes 1, 2, 3 and 4. As explained above, in the annex included in this document publications resulting from work carried out under the previous access contract of the FP6 programme ('EURONS', no. 506065) are listed.

Annex 4. List of publications resulting from work carried out under the Transnational Access activity in FP6

On EURONS experiment KVI-F16:

E. Stephan, St. Kistryn, A. Biegun, K. Bodek, I. Ciepał, A. Deltuva, M. Eslami-Kalantari, A.C. Fonseca, I. Gasparić, J. Golak, L. Joulaeizadeh, N. Kalantar-Nayestanaki, H. Kamada, B. Klos, A. Kozela, J.G. Messchendorp, H. Moeini, A. Nogga, W. Parol, A. Ramazani-Moghaddam-Arani, R. Skibiński, R. Sworst, A. Wilczek, H. Witała, J. Zejma

Vector analyzing powers of the deuteron-proton elastic scattering and breakup at 100 MeV

Eur. Phys. J. A **49** (2013) 36

<http://link.springer.com/article/10.1140/epja/i2013-13036-5>

St. Kistryn, E. Stephan

Deuteron-proton breakup at medium energies

J. Phys. G: Nucl. Part. Phys. **40** (2013) 063101

<http://iopscience.iop.org/0954-3899/40/6/063101>

I. Ciepał, B. Klos, St. Kistryn, E. Stephan, A. Biegun, K. Bodek, A. Deltuva, E. Epelbaum, M. Eslami-Kalantari, A.C. Fonseca

Investigations of few-nucleon system dynamics in medium energy domain

Few-Body Systems **54** (2013)

<http://link.springer.com/article/10.1007/s00601-012-0582-0>

On EURONS experiment KVI-P08:

T. Roger, J. Büscher, B. Bastin, O.S. Kirsebom, R. Raabe, M. Alcorta, J. Aystö, M. J.G. Borge, M. Carmona-Gallardo, T. E. Cocolios, J. Cruz, P. Dendooven, L. M. Fraile, H. O. U. Fynbo, D. Galaviz, L.R. Gasques, G. S. Giri, M. Huyse, S. Hyldegaard, K. Jungmann, W. L. Kruithof, M. Lantz, A. Perea, K. Riisager, A. Saastamoinen, B. Santra, P.D. Shidling, M. Sohani, A.J. Sørensen, O. Tengblad, E. Traykov, D.J. van der Hoek, P. Van Duppen, O.O. Versolato, H.W. Wilschut

Precise determination of the unperturbed ^8B neutrino spectrum

Phys. Rev. Lett. **108** (2012) 162502

<http://dx.doi.org/10.1103/PhysRevLett.108.162502>

On EURONS experiment KVI-S49/52:

J. Endres, D. Savran, P. A. Butler, M. N. Harakeh, S. Harissopulos, R.-D. Herzberg, R. Krücken, A. Lagoyannis, E. Litvinova, N. Pietralla, V. Yu. Ponomarev, L. Popescu, P. Ring, M. Scheck, F. Schlüter, K. Sonnabend, V. I. Stoica, H. J. Wörtche, A. Zilges

Structure of the pygmy dipole resonance in ^{124}Sn

Phys. Rev. C **85** (2012) 064331

<http://dx.doi.org/10.1103/PhysRevC.85.064331>

V. Derya, J. Endres, M. Elvers, M. N. Harakeh, N. Pietralla, D. Savran, M. Scheck, F. Siebenhühner, V. I. Stoica, H. J. Wörtche, A. Zilges

Study of the Pygmy Dipole Resonance in ^{94}Mo using the $(\alpha, \alpha'\gamma)$ Coincidence Technique Structure of the pygmy dipole resonance in ^{124}Sn

Nucl. Phys. **A906** (2013) 94

<http://dx.doi.org/10.1016/j.nuclphysa.2013.02.018>