



**Progress Report May-August 2004**

**8 September 2004.**

**R.J. de Meijer**

This document presents an overview of the essential events related to the Earth Antineutrino Tomography (EARTH) programme in the period May-September 2004.

### *Funding*

On May 7<sup>th</sup> agreement is reached with prof. Harvey Butcher, director of ASTRON, Dwingeloo, NL, on a start-up funding for the project. A letter is drafted to secure the funding and the matching by the KVI. Due to the discussions on the future of the KVI the final decision of the KVI matching is delayed and becomes effective during a meeting with the KVI directorate on 5 July.

In May contact is made with Technology Centre Northern Netherlands (TCNN) to explore the possibilities of funding. In discussions with Patrick Cnubben (TCNN) a draft is made to assist him in preparing an application in the programme Innovatiesamenwerking Subsidie of the Dutch Ministry of Economic Affairs. In July, as part of the application a proposal is prepared by FOCUS OIL and Gas, the Dutch drilling consulting firm, that suggested the antenna layout.

In August Mr. Patrick Cnubben has discussed a draft version with SENTERNOVEM. The draft focuses on a pilot antenna at Curaçao, containing two essential technological topics: detector technology and drilling technology. From the discussion it becomes clear that SENTERNOVEM considers the project rather scientific and proposes that we work out the two parts as separate Research and Development projects, likely preceded by a feasibility study. It is important to have industrial partners in addition to FOCUS OIL and Gas. Some suggestions will be investigated further.

Dr. Khotso Mokhele, director of the South African National Research Foundation (NRF), pays a visit to the KVI on 11 June. One of the purposes is to discuss the way the South African team can participate. This discussion was started in March during a meeting at iThemba LABS. Dr. Mokhele has discussed the project with Dr. Rob Adam, director of the South African Department of Science and Technology. Dr. Adam likes the scientific challenges addressed by the programme. There are some small personal obstacles that have to be resolved, but in principle the funding for the South African part of the first phase is granted. Due to a stay abroad by the iThemba director, the issue gets resolved on 5 July. Dr. Mokhele will come back on the way to secure the funding by the end of August.

### *Contacts with Curaçao*

Since the end of April there is contact by e-mail with Jacob Gelt Dekker, a Dutch entrepreneur living at Curaçao. He has reacted positively on Rob's request on advice with regards to the implementation of the first antineutrino antenna at Curaçao. He discussed, based on some articles, the project with members of the new government of the Dutch Antilles and the director of Aqua Electric, a firm producing both water and electricity to the island. Aqua Electra has invested in several technological projects.

On 28 June, Emiel van der Graaf and Rob meet Jacob Dekker at his house in Amsterdam. Jacob expresses his interest in the project and asks whether he is allowed to discuss the project with politicians in The Netherlands and in Curaçao. We appreciate his actions very much. He also suggests working out an organisational set-up for the project, including an



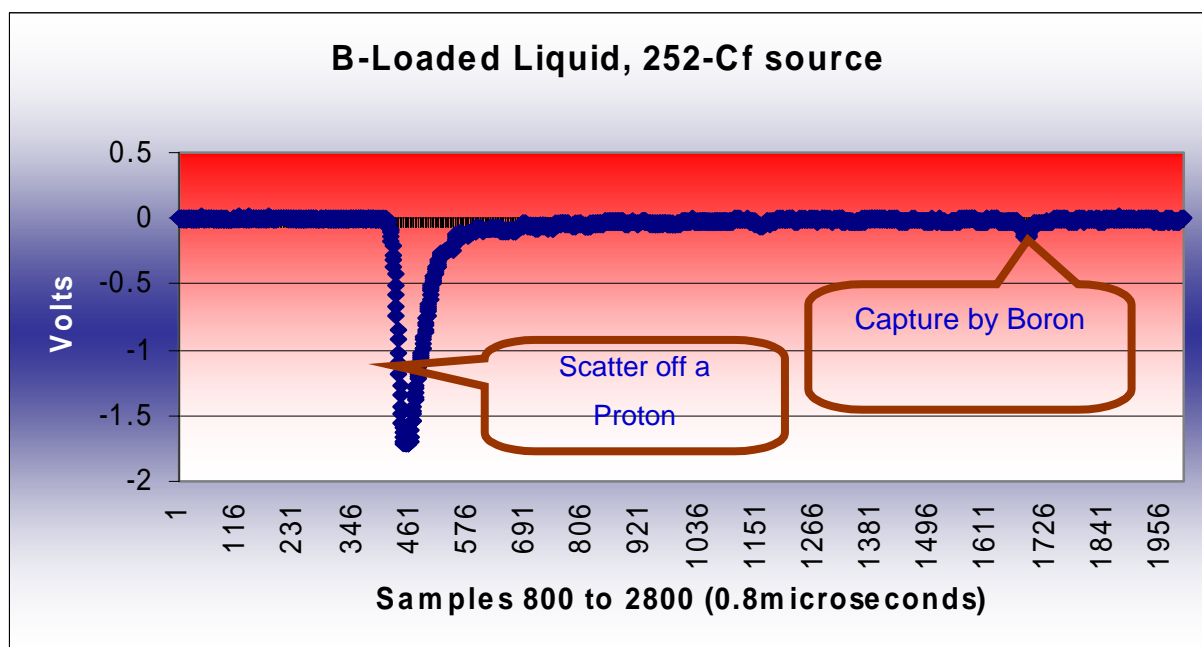
Advisory Board comprising scientists and public figures. As the first four members of the Board the following persons agreed to participate: prof. Harvey Butcher (ASTRON), Prof. Harry Priem (Emeritus professor isotope geology), Dr. Simon Kuipers (Chairman of the Board of the Rijksuniversiteit Groningen) and Jacob Gelt Dekker.

A short description of a possible proposal for the programme Programma Samenwerking Nederlandse Antillen has been sent to SENTERNOVEM to inquire about its suitability. The programme is still closed and some questions have been raised about its suitability. Especially the fact that the University is not a company seems to be problematic. The issues will be investigated further. Further action is postponed pending a likely discussion with the prime minister (see below).

The prime minister of the Dutch Antilles, Mr. Ys, will visit The Netherlands at the end of August-beginning of September. Jacob Dekker has made contact to investigate a possible meeting of Rob with Mr. Ys. The meeting has taken place on 2 September.

#### *Detector development*

The South-African team has experimentally simulated antineutrino detection by using an existing test cell to investigate the feasibility of delayed neutron detection and particle identification based on pulse-shape discrimination. The cell is filled with a liquid scintillator doped with B. As a source of radiation, neutron from AmBe and Cf sources were employed. The reactions differ from the antineutrino capture in that instead of a positron a recoil proton is formed in the reaction. The tests show clearly the delayed coincidences between protons and captured neutrons (see figure). Moreover pulse-shape discrimination allows the distinction between the recoil-proton pulses and recoil-electron pulses generated by gamma rays. This result is an important step in the demonstration of the feasibility. A draft report is



presently being discussed.

### *Industrial applications*

Emiel van der Graaf discussed at NRG-Petten, NL possible application of compact antineutrino detectors for monitoring nuclear power plants on 26 May. NRG is interested in collaboration. On 21 July Emiel has sent to NRG a pre-proposal. NRG will provide additional information and will investigate the interest of potential finances and users, i.c. Siemens and Borsele. Emiel expects a reply from NRG in the beginning of September.

### *Seminars and presentations.*

R.J. de Meijer, *Elementaire toepassingen*, KVI alumni meeting, Groningen, NL, 12 June 2004.

F.D. Smit, *Is there a reactor at the centre of the Earth? How can we tell?*, Invited non-specialist lecture, South African Institute of Physics, Bloemfontein, RSA, 1 July 2004

F.D. Smit, *Investigating the distribution of the radiogenic sources in the Earth*, Colloquium Physics Department, University of Cape Town, Cape Town, RSA, 4 August 2004.

### *Publications and publicity.*

- Two scientific publications have come out in print:

R.J. de Meijer, E.R. van der Graaf and K.P. Jungmann, *Quest for a nuclear georeactor*, Nuclear Physics News International **14/2**, 2004, 20-25

R.J. de Meijer, E.R. van der Graaf and K.P. Jungmann, *Quest for a nuclear georeactor*, Radiation Physics and Chemistry, **71**, 2004, 769-774.

- In popular scientific journals articles appeared that mentioned the antineutrino antenna at Curaçao.:

Antilliaans Dagblad, 24 June 2004.

Discovery Magazine, *What is cooking at the Center of the Earth?*, July 2004.

Science et Vie, *Centre de la Terre*, **1042**, July 2004, 36-43. (in French).

New Scientist, *Fire down below*, **183**, 7 August 2004, 26.

- Radio interviews were broadcasted:

26 July, Dutch Radio 1 (KRO).

27 July, Wereldomroep.

### *Website and ppt-mastersheet.*

A beginning is made to have a web site. Initially it will be part of the KVI website. A document has been produced as basis. Moreover a logo has been designed.

For Power Point presentations a background sheet is available for members of the consortium.

### *Teams.*

The Dutch team consists of:

- KVI:

Dr. A.M. van den Berg (0.25 fte)

Dr. E.R. van der Graaf (0.1 fte)

Prof.dr. R.G.E. Timmermans (0.2 fte)

Dr. H.J. Wörtche (0.3 fte)

Prof. dr. R. J. de Meijer (0.5 fte)

- FOCUS OIL and GAS, BV



Ir. R. Stapel  
J. Haantjes

The South African Team consists of

- iThembaLABS

Dr. F.D. Smit (iThemba LABS), (0,25 fte)

- UCT

Prof. Em. dr. F.D. Brooks

Dr. R.Nchodu (0,1fte)