

## **PaNAGIC Report to IUPAP General Assembly**

August 30, 2008

The Particle and Nuclear Astrophysics and Gravitational International Committee (PaNAGIC) was established by IUPAP in 1998 as an inter-Commission committee to support the world-wide exchange of ideas and help in the convergence of the international scientific community in the large scale activity in the emerging field of particle and nuclear astrophysics and cosmology and of gravitational waves. Its purposes are:

- To promote and provide a forum for international coordination of large-scale projects in these areas of research.
- To develop a common culture in these emerging and rapidly evolving fields.
- To promote and help to organize regular world-wide meetings, workshops and schools in these areas.

These interdisciplinary sectors include:

- The study of basic constituents of matter and their interactions by non-accelerator means.
- The study of the sources, acceleration mechanism and propagation of high energy particles in the Universe.
- The study of nuclear and particle properties and processes of astrophysical and cosmological interest in the Universe.
- The study of gravity, including the detection and the astrophysical sources of gravitational waves.

PaNAGIC has the status of an IUPAP Working Group. Its mandate was extended at the 25th IUPAP General Assembly in October 2005 in Cape Town, South Africa, until the time of the next General Assembly. PaNAGIC reports to C4, C11, C12 and C19 with a primary relation to C4 and a connection to AC2. The Committee has 15 members, selected primarily on the basis of intellectual leadership and representing the major components of the field. One member is appointed by each of C4, C11, C12 and C19. One of the members acts as a link to AC2. The present and past membership is included below.

PaNAGIC also appoints or seeks advice from panels and committees for particular sub-fields when this is considered useful for carrying out its tasks. Two such sub-committees have been in existence:

- The HENAP (High Energy Neutrino Astrophysics Panel) panel was created by PaNAGIC with the specific mandate of writing a report with recommendations

for the development of High Energy Neutrino Astronomy world-wide. This panel has now completed its work. The report can be found at:

[http://www.lngs.infn.it/lngs\\_infn/contents/docs/pdf/panagic/henap2002.pdf](http://www.lngs.infn.it/lngs_infn/contents/docs/pdf/panagic/henap2002.pdf)

- The GWIC (Gravitational Wave International Committee) committee was an existing committee created by the initiative of the community of researchers in gravitational waves. GWIC asked to be associated to PaNAGIC and this was favorably considered. The activities of GWIC are described below.

## **PaNAGIC Activities**

The field of particle astrophysics and cosmology and of gravitational waves has been the subject of an intense activity in the last few years. It was described extensively in our report to IUPAP in 2000 (<http://www.iupap.org/wg/panagic/report-00.html>) and has continued to grow since then. What follows is a short summary of the current activities of PaNAGIC.

PaNAGIC has met a total of 12 times since its creation in 1998:

Atlanta, USA, March 1999 (during Centennial Meeting of the American Physical Society)  
Paris, France, September 1999 (during the TAUP- 1999 Conference)  
Sudbury, Canada, June 2000 (during the Neutrino-2000 Conference)  
Gran Sasso, Italy, September 2001 (during the TAUP-2001 Conference)  
Munich, Germany, June 2002 (during the Neutrino-2002 Conference)  
Seattle, USA, September 2003 (during the TAUP-2003 Conference)  
Paris, France, June 2004 (during the Neutrino-2004 Conference)  
Zaragoza, Spain, September 2005 (during the TAUP-2005 Conference)  
Santa Fe, New Mexico, USA, June 2006 (during the Neutrino-2006 Conference)  
Sendai, Japan, September 2007 (during the TAUP-2007 Conference)  
Christchurch, New Zealand and by phone, June 2007 (during the Neutrino 2008 conference and after)

The main activities of PaNAGIC are the following:

1) The regular meetings of PaNAGIC provide a much-needed forum for the discussion of its field of interest in a world-wide level, beyond the view of specific regions of the world. The objective is to foster global coordination in the field of science. The committee has received reports on activities of regional planning bodies such as ASPERA and in the new membership discussed below, it has added direct linkages to ASPERA, in Europe and P5 and DUSEL in the USA to further enhance its ability to provide meaningful guidance.

2) PaNAGIC co-organizes the very successful TAUP conference, the main conference in the field of particle astrophysics. TAUP was started by physicists involved in underground experiments on beta-decay and dark matter searches, notably Alessandro

Bottino and Angel Morales. TAUP has now become the principal international conference in astroparticle physics, covering all the subfields of the sector, and is held every two years in different regions of the world. As such TAUP gets IUPAP support and sponsorship as a “class B” conference.

The first three editions of TAUP took place at the Gran Sasso Laboratory in Italy (September 2001), at the University of Washington in Seattle, USA (September 2003) and at the University of Zaragoza, Spain (September 2005) and in Sendai, Japan (2007). They were attended by 225, 270, 270 and 233 people respectively. The slight decline in the attendance at the last meeting is attributable to the difficult financial situation in the US which meant that many US scientists were not able to attend. The meeting was as exciting as ever, however. Perhaps the key highlight was the announcement of the first results from the Borexino experiment showing the real-time detection of  $^7\text{Be}$  neutrinos from the sun. The Proceedings of these conferences are all published. Proceedings from the most recent conference will be published by IOP and are available on-line at <http://www.iop.org/EJ/volume/1742-6596/120>.

A major activity of PaNAGIC in the future will consist on helping to organize this conference and strengthen its international character, with the help of IUPAP. The 2009 edition will return to the Gran Sasso laboratory in Italy. PaNAGIC has representation on the TAUP steering committee and receives a report on each conference.

PaNAGIC also sponsored the application for IUPAP support (through C11) for the International Conference on Neutrinos in Christchurch New Zealand. This too was a very successful meeting covering many of the topics within the PaNAGIC mandate.

3) In the past PaNAGIC has maintained a web site with information on global facilities for astroparticle physics and on experiments in this area. This activity needs to be rejuvenated and plans are being developed to expand the information to include details of conferences and schools relevant to the field.

4) The field of gravitational waves (both on the ground and in space) has continued to be successfully managed by the GWIC committee (<http://gwic.ligo.org/>). This very active group reports regularly to PaNAGIC, the most recent report is appended to this report. Of particular note is the work that the committee has initiated to develop a global roadmap for future experiments in gravity wave detection.

5) Another action that was originally envisaged by PaNAGIC was the establishment of a high- level comprehensive school (or schools) in the field of particle astrophysics as this was considered to be of major importance to help in the development of a common culture in this field. The International School of AstroParticle Physics (ISAPP) is now established and a report on its activities is regularly presented to PaNAGIC. The ISAPP is primarily a European school which has accreditation from 26 academic institutions. The course is recognized by these institutions and students receive credit towards their doctorate by attending the course. Although it started as primarily a European school, it has now had students from Argentina, Canada, India and the US. This year schools were

held in Madrid (Dark Matter in Astrophysics and Particle Physics) and Valencia (Probing the Universe with Neutrinos). This school has been encouraged by PaNAGIC and it is publicized in the report of PaNAGIC to the TAUP conference and through the members of the committee.

## **Future Directions**

One of the most important roles fulfilled by PaNAGIC in the past has been the production of the HENAP report on the future of high energy neutrino research with a focus on international cooperation on large detectors. This report recommended balancing the IceCubed detector in the South with a  $\text{km}^3$  - scale detector in the Northern hemisphere. A central theme of the report is the need to make these massive detectors international and open to scientists from around the world. This main recommendation is being actively followed in the development of the European initiative to build such a detector in the Mediterranean. The production of the report followed a directive from the Global Science Forum of the OECD.

The Global Science Forum is again taking an interest in astro-particle physics and an initiative is being developed that would call for a global roadmap for this field of science. This initiative comes at a time when major new underground facilities and large scale detectors are being proposed. Many of the projects can only be done through international collaboration. PaNAGIC is again, likely to be tasked with organizing the development of this roadmap.

## **The Future of PaNAGIC**

The IUPPAP General Assembly is to consider the future of the PaNAGIC working group. In general working groups are established to carry out specific objectives and they are disbanded when the objectives are met. As PaNAGIC has now been in existence for a decade, it is very appropriate to review its usefulness and role.

The main justification for this working group is that it represents a constituency which cuts across conventional divisions in physics. It can therefore bring a unique perspective to the organization and coordination of activities in this area. However, this is an area where the boundaries are shifting. Twenty years ago particle astrophysics was a field which most scientist thought was good science so long as it was someone else's responsibility. (In contrast, nuclear astrophysics has always been a part of the main stream of the nuclear physics.) With the success of projects such as Super Kamiokande, SNO, Kamland and Borexino, aspects of particle astrophysics have become main stream. For example, the detailed study of neutrino oscillations has become a central area of conventional accelerator based high energy physics. However, there are many aspects of the field which remain orphaned. For example, even within individual countries and funding agencies there is no agreement on whether neutrinoless double beta decay is a part of nuclear physics, particle physics, or underground science.

The members of PaNAGIC have felt for a long time that a global plan for particle astrophysics would be valuable but in the past the working group has had no mandate to initiate development of such a plan. Thus we very much welcome the Global Science Forum initiative. The first step in developing a plan is to define the scope of the plan. It is critical to process to consider what areas of physics would benefit from being included in the review. This is likely to be the first step in the charge from the GSF. The new membership of the working group (presented below) has been chosen to broaden the geographical representation of the group to include the very important Chinese activities, and to strengthen its links to other planning processes, specifically to tackle this new mandate.

We recommend that

- (i) IUPAP extend the life of PaNAGIC to allow this review to go forward and,
- (ii) at the end of the process, determine whether the working group should have an ongoing role or whether there should be ad hoc groups set up to carry out specific mandates in this field of science such as HENAP and the global roadmap.

### **Membership of PaNAGIC**

A subcommittee was struck last year to review the membership of PaNAGIC as a number of members were coming to the end of their term of appointment. The panel made the recommendation of nominating D. Sinclair (Canada) as new Chair, replacing E. Fernandez (Spain). It also recommended to appoint five new members, C. Baltay (U.S.), H. Chen (China), H. Murayama (Japan), B. Sadoulet (U.S.) and Ch. Spiering (Germany), replacing five outgoing members whose term has expired: J. Blümer (Germany), E. Fernandez (Spain), J. Frieman (U.S.), M-K Fujimoto (Japan) and S. Ritz (U.S.). The recommendations were discussed in the meeting and unanimously accepted. The present membership is as follows:

Charles Baltay (2008 - )	Stavros Katsanevas (2004 - )
Leonid Bezrukov (2006 - )	Paolo Lipari(2004 - ) [C4]
Hesheng Chen (2008- )	Hitoshi Murayama (2008 - )
Eugenio Coccia (2006 - )	Angela Olinto(2004 - )
Victoria Fonseca (2004 - ) [C-1 9]	Bernard Sadoulet (2008 - )
Masa-Katsu Fujimoto (2004 - )	David Sinclair (2004 - ) Chair
Rohini Godbole(2004 - ) [C1 1]	Christian Spiering (2008-)
James Hough (2007 - ) [AC-2]	

### **Past members:**

Barry C. Barish (1998 - 2004),

Alessandro Bettini (1998 – 2006; Chair 1998 - 2005),  
Johannes Blümer (2003 – 2008),  
Massimo Cerdonio (1998 – 2007),  
Enrique Fernandez (2000 – 2008; Chair 2005-2008),  
Joshua Frieman (2003 – 2008),  
Thomas Gaisser (1998 - 2004),  
Isabelle Grenier (1998 - 2003),  
Wick Haxton (1998 - 2004),  
Takaaki Kajita (2003 – 2008),  
Eckart Lorenz (1998 - 2004),  
Karl Mannheim (2000 - 2003),  
Victor Matveev (1998-2006),  
Arthur McDonald (1998 - 2004),  
John Peoples (1998 - 2004),  
Martin Rees (1998 - 2000),  
Steve Ritz (2004 – 2008),  
Bernard Sadoulet (1998 - 2000),  
Michel Spiro (1998 - 2004),  
Yojj Totsuka (1998 - 2003),  
Alan Watson (1998 - 2003),  
Michael Wiescher (2004 – 2008).

# Report to PaNAGIC from GWIC

(prepared by Stan Whitcomb, Caltech [Secretary], with input from Jim Hough, University of Glasgow [Chair])

The Gravitational Wave International Committee (GWIC) was formed in 1997 to facilitate international collaboration and cooperation in the construction, operation and use of the major gravitational wave detection facilities world-wide. GWIC meets annually, with recent meetings in Pisa (2008), Sydney (2007), Maryland (2006), Okinawa (2005), and Dublin (2004).

The membership of GWIC represents all of the world's active gravitational wave projects, both ground-based and space-based. Each project has either one or two members on GWIC depending on size. Because the GWIC representatives are generally the leaders of each project, GWIC has access to the broader expertise throughout the community. GWIC also includes representation from the International Society on General Relativity and Gravitation and from the astrophysics/theoretical relativity community. At its 2008 meeting, GWIC heard presentations from the pulsar timing collaborations which are searching for very low frequency gravitational waves, and decided to invite these groups to join GWIC.

GWIC sponsors the biennial Edoardo Amaldi Conferences on Gravitational Waves. The Amaldi meeting is considered by many in the gravitational wave community to be their most important international gathering. The members of GWIC serve as the Scientific Organizing Committee for the Amaldi meetings. The next (8<sup>th</sup>) Amaldi meeting will be held at Columbia University from June 21-26, 2009. GWIC also supports the biennial LISA Symposium, and two workshop series, on data analysis and on advanced detectors.

In 2006, GWIC established an international prize, to be awarded annually to an outstanding Ph. D. thesis based on research in gravitational waves. The 2006 and 2007 Prizes have generated growing interest, with nominations from eight countries.

Most importantly, GWIC provides advocacy and a forum to foster international collaboration. By bringing together the leaders of the different projects on a regular basis, it has helped break-down the barriers and improved communication among the various gravitational wave projects. The growing collaboration among the various gravitational wave projects has been triggered in large part by discussions which have taken place at GWIC meetings. In particular, the 2007 agreement between LIGO/GEO and Virgo to analyze their data together has its roots in the GWIC meeting in the summer of 2005.

Last year, GWIC commissioned a committee to prepare a global road-map for the field of gravitational wave science, with the perspective to optimize the global science in the field. The charge to the committee is to cover both ground- and space-based detectors with a 30-year horizon. The final report will use broad input from the communities

involved to identify relevant science opportunities and the facilities needed to address them. We hope that this study – the report from which should be available during winter 2008/9 - will help focus the global R&D work in the field for the next few years, and help guide the funding agencies to support the highest priority projects.