ICFA Activities Report for IUPAP C&CC Meeting
October 2016

Pushpa Bhat, ICFA Secretary

1. Introduction

The International Committee for Future Accelerators had two meetings in 2016. The first meeting was held February 25-26, 2016 at J-PARC in Japan, and the second meeting on August 7, 2016, during the International Conference on High Energy Physics (ICHEP) in Chicago, USA. As as has been the practice for the past two decades, directors of the world's leading particle physics laboratories were also invited to the February meeting to allow an extensive discussion of both the current and the future status of particle physics.

2. Announcements

At the February meeting, it was announced that Roy Rubinstein has stepped down as ICFA Secretary. Pushpa Bhat (Fermilab) was appointed Secretary for a five-year term. The current ICFA membership is given in Appendix I.

ICFA has also launched a new web-site: http://icfa.fnal.gov/

3. Linear Collider

The Linear Collider Collaboration (LCC) under ICFA's Linear Collider Board (LCB) continues its work with organizations in Japan and around the world on the possible hosting of the ILC in Japan. ICFA sent a detailed response to a report on the ILC produced by a Panel advising the Japanese government's MEXT ministry. LCC is also providing information to a new Panel looking into the human resources needed to design, build, and operate the ILC.

Previous mandate for the LCB/LCC will expire at the end of 2016. An update to LCB/LCC mandate was developed by the working group comprising Joachim Mnich, Nigel Lockyer, Fabiola Gianotti and Masanori Yamauchi, over the past few months, as charged by ICFA. The mandate was approved by ICFA at the meeting on August 7, 2016. The new mandate goes into effect on January 1, 2017, and will be reviewed before the end of three years. The primary objectives of the LCB/LCC over the coming years are to (i) provide oversight on world-wide LC R&D efforts, (ii) continue the successful close collaboration and synergy between the International Linear Collider (ILC) and the Compact Linear Collider (CLIC) and (iii) promote LC with governments and general public across the globe. At the ICFA executive session, members also unanimously voted for Lyn Evans to continue as the LCC Director.

The new LCB/LCC mandate can be found at
http://icfa.fnal.gov/panels/linear-collider-board/

4. ICFA Panels

ICFA has eight panels including a recently initiated panel on Sustainable Accelerators and Colliders with Mike Seidel of PSI as the Chair. There were discussions at the ICFA meetings on the activities of the panels under ICFA, their mandates, terms, and procedures for renewing leaderships and memberships. It was decided that the panels should be launched with specific term limits and reviewed at the end of the term. Over the next two years, ICFA will continue to review and update the mandates and memberships of the panels. ICFA is in the process of appointing a new Chair for the Beam Dynamics Panel, to replace Weiren Chou, who has stepped down after serving for several years in the role. ICFA continues to monitor the workshops and conferences organized under the direction of various ICFA panels.

5. Global planning for HEP

ICFA heard reports from Fabiola Gianotti, Nigel Lockyer and Yifang Wang, on projects that are ongoing and/or being planned in Europe, America and Asia, respectively. Gianotti gave an update on the LHC operations, and on the future High Luminosity LHC (HL-LHC) project, and outlined accelerator R&D projects undertaken at CERN. She also mentioned collaborative work with Fermilab on its neutrino program. Lockyer discussed the short baseline and long baseline neutrino programs that are either underway or planned to get underway through the next decade. He also mentioned the muon beam based program at Fermilab, accelerator complex upgrades, and strides in the CMS experiment at the LHC. Lockyer also outlined the very good progress in the Astrophysics/cosmology program. Wang reported on progress in the current particle physics and cosmic ray physics programs at IHEP in China, and plans for the CEPC project.

6. Other Reports

Reports were made at ICFA meetings by FALC, InterActions, the ICFA/ICUIL collaboration, ICFA Panel representatives, and by members of the labs, countries, and regions represented at the meetings.

7. Future ICFA Meetings

The next ICFA meeting will be in Valencia, Spain, on Thursday/Friday 16/17 February 2017; the following meeting will be at LP2016 in Guangzhou, China, on August 9, 2017. There will be a 5-day ICFA seminar to be hosted in Canada in the fall of 2017. The venue and dates for the seminar are now being discussed and will be decided soon.

Appendix I

ICFA MEMBERSHIP

July 2016

CERN Member States

H. Abramowicz
F. Gianotti
J. Mnich (Chair)

USA

N. Hadley
N. Lockyer
D. MacFarlane

Japan

T. Mori
M. Yamauchi

Russia

A. Bondar
S. Ivanov

Canada

M. Roney

China

Y. Wang

Other Countries

M. Cho
L. de Paula
V. Matveev

C11

J. Fuster

Secretary: P. Bhat

WG2 Report for IUPAP C&CC Meeting – October 2016

Activity for WG2 in the next months will include:

1. Identify a replacement for members who have retired/left the field
2. Advise IUPAP on any position it should take on
   a) Open publication
   b) Open Data
3. Advise IUPAP on whom it should appoint as Chair of the Working Group for the three years following the 2017 General Assembly
4. Advise IUPAP on the membership of the Working Group for the three years following the 2017 General Assembly

This should bring the WG back on track.

Activities of the Working Group on Women in Physics (Working Group 5)

Oct 2015-Sep 2016

Irvy (Igle) Gledhill, Chair of IUPAP Women in Physics

1. Working Group

IUPAP recognises that, globally, the involvement of women and girls in physics is very different across countries and is still limited in most of them. Although progress has been made, much remains to be done. The General Assembly of 2014 resolved to extend the work of Working Group 5 for 3 years, and charged the WG to organise the 6th IUPAP International Conference on Women in Physics.

Figure 1 Working Group members

The Working Group members are (left to right in Figure 1) are Manling Sui, China, Lilia Meza Montes, Mexico, Gillian Butcher, UK, Prajval Shastri, India, Silvina Ponce Dawson, Argentina, Jackie Beamon-Kiene (Associate), USA, Nicola Wilkin, UK (Associate), UK, Shohini Ghose, Canada, Kwek Leong Chan, Singapore, Igle Gledhill, South Africa, Renee Horton, USA, and, not in photo, Dina Izadi, Iran. The Working Group met in Birmingham in June 2016.

2. IUPAP International Conference on Women in Physics

The conference is the major mechanism adopted by IUPAP, through its Working Group on Women in Physics, to foster the advancement of women in physics, and the attraction of girls into physics, across the world.

The 5th ICWIP was held in Waterloo, Canada, August 5-9, 2014. Proceedings have been published by the AIP (American Institute of Physics) and are available at http://scitation.aip.org/content/aip/proceeding/aipcp/1697 (no username or password are needed). All papers are open access. Workshop summaries are included as papers. Over 200 physicists from 52 countries participated, including, notably, from 16 African countries. The Working Group raised funds to cover full Travel Grants for 45 participants from 36 developing countries.

The conference is a working conference, and is open only to Country Teams appointed through physical societies across the world. The size of Country Teams is limited to 5 people, unless the country subsidises a participant from the developing world, or is the host country. In this way, the voices of small states, island states, and regions with small numbers of physicists can be heard. The WG raises funds to provide Travel Grants to participants from developing countries.

The bid to host ICWIP2017 was won by the UK, and the Conference will be held in Birmingham, in the UK, July 2017. The Working Group is inviting six plenary speakers; organising five workshops; contacting Country Team Leaders across the world and calling for submission of country papers, which report progress over the last 3 years, and scientific papers. Regional meetings will be held.

Visas are an ongoing concern for the conference and the Working Group and pose the major constraint and risk for the conference. In terms of the statement of the Universality of Science[1], ICSU makes efforts to enable visas for the travel of scientists where its staff can exercise influence. The appropriate ICSU staff will be contacted in terms of ICWIP2017.

3. IUPAP at the UN: Women in Physics

On Thursday February 11, 2016, Dr. Renee Horton and Jacquelyn Beamon-Kiene, attended the first United Nations International Day of Women and Girls in Science representing the IUPAP Working group 5, Women in Physics.

[1] http://www.icsu.org/freedom-responsibility/cfrs/statute-5

Dr. Horton's presentation on behalf of the IUPAP WG on Women in Physics was the only presentation in the field of Physics on the agenda. Dr. Horton provided background on IUPAP and the accomplishments of the WGWIP since its realization in 1999. Additional information on the International Day of Women and Girls in Science can be found at http://womeninscienceday.org/.

4. ICSU and the Global Survey

The second major mechanism adopted by the Working Group has been the Global Survey of Physicists. The baseline survey, carried out by the American Institute of Physics in 2010, was remarkable for having 14932 respondents in 8 languages. The ICWIP2014 conference resolved to find ways of pursuing follow-up surveys in future; the chief barrier is funding.

In 2016, ICSU called for proposals for projects with at least two Unions leading an initiative in collaboration. The Working Group contacted IUPAC (Chemistry), and IMU (Mathematics), and a proposal was drafted jointly. The proposal was rejected at the IUPAP level but has been submitted to ICSU by the IMU and IUPAC with the support of: IAU (Astronomy), ISSC (Int. Social Sciences Council), IUBS (Biological Sciences), and the ICSU Regional Office for Africa, among others.

The proposal covers a Global Survey extended across Mathematics and Chemistry, a bibliometric study of publication profiles, public awareness, particularly in developing countries, and the implementation of good practice.

5. Travel Grants

IUPAP Travel Grants were established to give an opportunity to women physicists who might not otherwise be able to attend a regional or international conference. In the 2015 year 103 applications were received and approximately 20 grants have been allocated.

6. IUPAP

Prof Alinka Lépine-Szily is the IUPAP Gender Champion, and has issued a report which covers gender representation on Commissions and committees of IUPAP, and among plenary speakers at IUPAP-sponsored conferences. The WG was grateful for the report and recommends that the representation of women in Commissions, Working Groups, and Organising Committees should be improved. Since a key to success lies in providing enough women in selection pools, the WG is happy to provide the names of its contacts on request.

The WG now liaises with C13 (Prof Lilia Meza-Montes) and C14 (Renee Horton and Dina Izadi).

7. Policy on Harassment

The IUPAP President has asked WG 5 whether IUPAP should have a policy on harassment; a draft has been submitted to Prof Bruce McKellar as IUPAP President.

8. The Waterloo Statement on Women in Physics

The present draft is being prepared for comment by a reference group, which will include country representatives, IUPAP representatives, and interested institutional representatives.

9. Comments

Comments and feedback to WG5 are very welcome.

ICUIL
INTERNATIONAL COMMITTEE FOR ULTRA-HIGH INTENSITY LASERS

Annual Report to IUPAP
September 2016

www.ICUIL.org

ICUIL Activity Overview

ICUIL continues to promote the advancement of the international field of ultra-high intensity lasers. Our goals are to provide a venue for discussions, among representatives of high-intensity laser facilities and members of user communities on a variety of subjects including; international collaborations to define and develop the next generation of ultra-high intensity laser capabilities, exploration of new areas of fundamental and applied research and formation of a global research network for access to facilities by users. This report to IUPAP highlights progress made by members of the ICUIL community over the last year.

ICUIL represents the global community working with ultra-intense lasers, i.e. lasers with capabilities exceeding 10^{19} W/cm^2. This community is rapidly increasing in size both in terms of capability and investment. The cumulative laser power from all "ICUIL" qualifying lasers in 2010 was estimated to be ~11 PW. By present estimates this total will exceed 120 PW by 2018. Ultra-high intensity laser projects worldwide now total more than $4B in research investment and involve more than 1500 FTEs of technical staff.

A multitude of laser facilities continue to push towards multi-petawatt power capability. For example, the Chinese initiative at the Shanghai Institute of Optics and Fine Mechanics (SIOM) is advancing towards a 10-PW laser facility. Lawrence Livermore National Laboratory (LLNL) activated their multi-kJ Advanced Radiographic Capability (ARC) PW scale laser and the PETAL laser at CEA began operations toward the 2-PW level this year. In South Korea, the Gwangju Institute for Science and Technology is presently commissioning a 4 PW capability that should be available to users in 2017. The University of Rochester's Laboratory for Laser Energetics continues to work on the OPAL multi-phase laser initiative that could evolve from 5-PW to 75-PW capability. In addition, the European ESFRI roadmap project, the Extreme Light Infrastructure (ELI), consisting of ELI-Beamlines (Czech Republic), ELI-Nuclear Physics (Romania), and ELI-ALPS (Hungary), is rapidly approaching initial operations.

ICUIL and ICFA (International Committee for Future Accelerators), another arm of the IUPAP Working Groups, are now jointly promoting the development of efficient, high-power, laser technology to enable laser-driven wakefield acceleration for future high energy accelerators. ICUIL has continued to collaborate with and support the activities of the Asian Intense Laser Network and has helped sponsor the Russian Summer School on Intense Lasers to promote involvement by young scientists in the advancement of ultra-high intensity lasers.

ICUIL Biennial Conferences

The 7th Conference of the International Committee on Ultrahigh Intensity Lasers (ICUIL 2016) was held in Montebello, Québec, Canada from the 11th to the 16th September 2016. The ICUIL biennial meeting aims to gather ultrahigh intensity enthusiasts from around the world, to report new results, exchange information and to establish and enhance collaborations across borders. Following past conferences, ICUIL 2016 focused on the following themes: (i) ultra-intense laser design and performance (such as Nd:glass-based, Ti:sapphire-based, DPSSL-based and OPCPA-based ultra-intense lasers, in addition to their pump lasers); (ii) novel technologies for ultra-intense lasers (such as grating and compressor modeling and fabrication, high-damage-threshold and ultra-broadband laser components, devices for spatial and temporal pulse control, diagnostics for ultra-intense lasers), and (iii) applications of ultra-intense lasers (such as laser acceleration, short-wavelength sources, attosecond sources, high-field physics and applications of extreme light). ICUIL 2016 included more than 100 presentations that showcased the latest on multilateral projects such as ELI, XCELS and IZEST, in addition to the efforts in individual institutions across the world.

The conference was chaired by Dino Jaroszynski (U. Strathclyde, UK) and Tsuneyuki Ozaki (INRS, Canada), with strong support from the Technical Program Committee Co-Chairs, Marco Borghesi (Queen's U. Belfast, UK), Hiromitsu Kiriyama (QST, Japan) and Christophe Dorrer (UR/LLE, USA), along with 24 members of the Technical Programme Committee. The program consisted of 19 invited talks, 61 contributed talks and 77 poster presentations, held over the five days of the conference. The total number of participants was 148, coming from 56 institutes and 18 countries from around the world. We also had strong participation from young researchers, with 17 postdoctoral fellows and 11 PhD students, who are the future of the ICUIL community. The ICUIL 2016 conference was also strongly supported by a total of 22 companies, agencies and universities. Participation from these companies was also active, with 44 participants, some of whom gave oral presentations, while the majority of companies presented posters during the conference. The total number of conference attendees was 192, again showing continual growth in this field.

For contributions to the two poster sessions at ICUIL 2016, Student Poster Awards were awarded to three students: First Prize (including a US$500 cash award) went to Mr. N. Stuart (Imperial College, UK), for his poster on "OPCPA Pump-Depletion Contrast Enhancement using a Seeded OPCPA Fluorescence Diagnostic", Second Prize (US$300 cash award) went to Mr. J. Pilar (Czech Technical U Prague, Czech Rep), for his poster on "Adaptive optics development at HiLASE", and the Third Prize (US$200 cash award) went to Ms. S. Bucht (UR/LLE, USA) for her poster on "Transforming the Idler to Seed Raman Amplification". There were also five Student Travel Grants (US$1,000 each) were awarded to promote student participation. These went to Ms. C. Scullion (Queen’s University Belfast, UK), Ms. G. Cantono (Université Paris-Saclay, France), Mr. R. Budriunas (Vilnius U., Lithuania), Mr. D. E. Cárdenas (Ludwig-Maximilians-Universität, Germany) and Mr. J. Pilar (Czech Technical U Prague, Czech Rep).

ICUIL 2016 provided an occasion to honour and remember an important figure of the ICUIL committee and community, Prof. Wolfgang Sandner, who passed away unexpectedly in December 2015. Among his many illustrious roles (including Director of the Max Born Institute, Coordinator of Laserlab-Europe, President of the German Physical Society, and the General Director of the ELI-Delivery Consortium), Prof. Sandner served as Co-Chair of the ICUIL committee for many years. To pay tribute to Prof. Sandner, the ICUIL 2016 conference dedicated one of its plenary sessions in his honour. This special session was organized by Dr. Catalin Miron of the ELI-Delivery Consortium, and included invited speakers who worked closely with Wolfgang over many years. We also had the privilege of Mrs. Sandner accepting an invitation to attend the conference, and to remember Prof. Sandner with all his professional colleagues and friends.

The ICUIL 2016 was a great success, owing to the excellent presentations from the participants from around the world, and to the support from the various sponsors. The conference again showed the strength of the ICUIL community. Four potential sites were proposed for the 2018 ICUIL conference in Europe. Compelling proposals were provided by Germany, Russia, the UK, and Hungary; the largest number of proposals in the 12 year history of ICUIL. Although the General Assembly member votes were distributed among the proposals, Germany received the largest number of votes and was selected as the 2018 host. T. Kuehl will serve as Chairman of the next conference. Subsequently, T. Kessler agreed to serve as Co-Chairman. The exact location and venue will be made available early in 2017.

ICUIL Membership Rotation

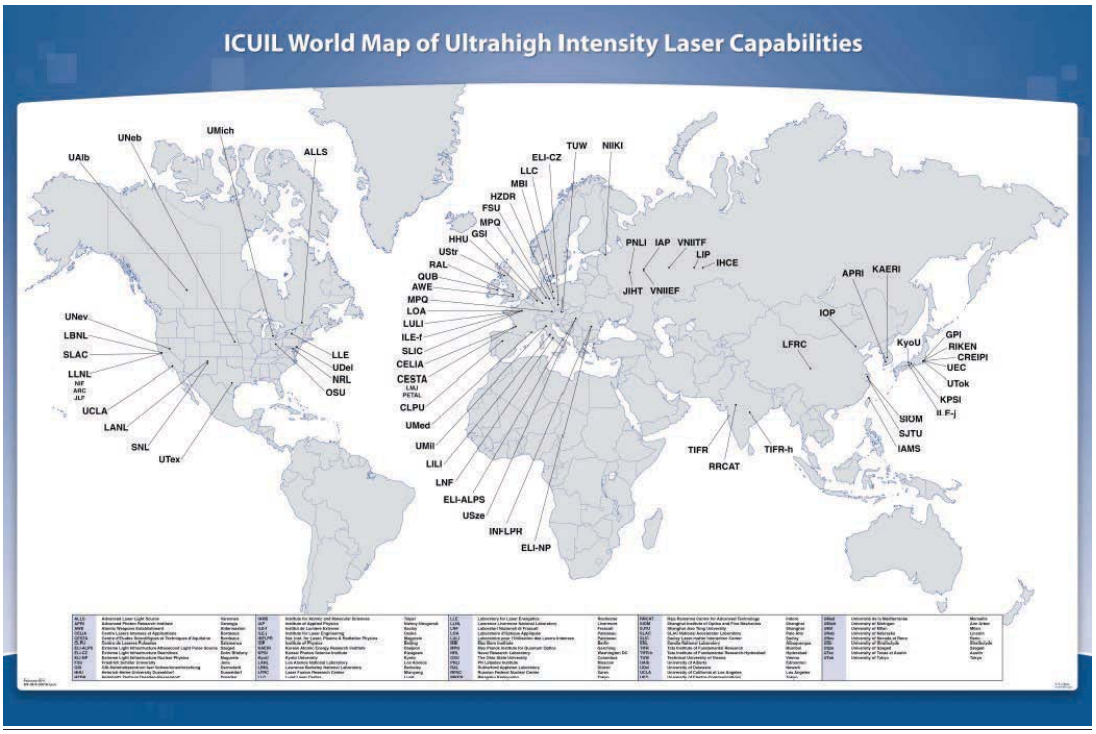
After eight years of service, Toshiki Tajima stepped down from his Chairman position, but remains a voting member of the GA. Toshi nominated Chris Barty as the next ICUIL Chairman which was seconded by Tsuneyuki Ozaki. Following General Assembly (GA) deliberation, including questions posed to the candidate, the GA unanimously voted to have Chris serve as Chairman of ICUIL for the next four years. Chris will prepare a vision statement to elucidate his plans for the future of ICUIL. T. Tajima recommended adopting a rotation philosophy that includes two types of succession plans where the Board members are rotated from and to the GA, while the regular members of the GA are rotated in from the high intensity laser community. After lengthy deliberation of candidates who could take the vacant Co-Chair position, Chris Barty nominated Ravindra Kumar, an active GA member, for the position with Terry Kessler seconding the nomination. The GA unanimously voted to have Ravi serve as Co-Chair along with the existing Co-Chair, Alexander Sergeev. For the purpose of promoting overall diversity (continental, gender, racial, etc.) GA members were asked to generate a list of candidates for future rotation with an emphasis on increasing overall diversity. Several ICUIL members have completed two terms of service and are required to step down according to the bylaws of the ICUIL charter. The bylaws may be changed to allow continued participation by active members after two terms of service.

ICUIL Charter

The bylaws of the ICUIL Charter are being revised to maintain the experience and dedication of the current membership that has been assembled over the last decade. In exceptional cases, more than two terms of service would be allowed for members who continue to be active in this field and are able to provide service to the ICUIL community. A vote on the revised charter is anticipated to occur at the end of 2016. A more gradual member rotation will be used to maintain continuity and ensure that ICUIL continues to advance while maintaining balance both geographically and between the various high field science working groups of IUPAP.

ICUIL Website and Newsletter

One of the features of the ICUIL website is an interactive world map that highlights the high intensity laser facilities around the world as shown later in this report. Surveys of the worldwide laser community are conducted by ICUIL in an effort to provide an accurate accounting of all existing and planned ultrahigh intensity laser facilities that are capable of reaching intensities above 10^{19} W/cm^2. An updated survey was carried out at the 2016 ICUIL conference.



ICUIL continues to achieve its goal of publishing an annual newsletter. The seventh ICUIL Newsletter (Volume 7) was sent out to the high intensity laser community in June 2016 and is also available at the ICUIL website. The chief editor, Alexander Sergeev, managed the illustration and publication resources to distribute a twelve-page newsletter to hundreds of readers, highlighting the major laser construction and laser science projects within the HIL community, major conferences, and related workshops.

Fund Raising

ICUIL has continued its corporate support program to afford maintenance of the ICUIL website, publish an annual newsletter, support biennial conferences, and provide prize funds to students. In addition, IUPAP provides 2500 euros per year for the general operation of ICUIL as a working group. The ICUIL Treasurer will formally request that IUPAP provide these funds biennially, so that a large portion of the amount could be used to finance the Wolfgang Sandner Prize for Leadership at the biennial ICUIL conference. Student travel funds in the form of five US$1000 grants were derived from the conference budget which was funded through registration fees and corporate sponsorships. Student poster prizes (US$500, US$300 & US$200) were also derived from the conference budget.

Recent Awards to ICUIL Members

Enrico Fermi Prize 2015

Toshiki Tajima
Norman Rostoker Chair Professor,University of California at Irvine, USA

For the invention of the laser-wakefield-acceleration technique which led to a large number of fundamental and interdisciplinary applications ranging from accelerator science to plasma physics and astrophysics

The Infosys Prize 2015 in Physical Sciences

G. Ravindra Kumar
Tata Institute of Fundamental Research, Mumbai

For his pioneering experimental contributions to the physics of high intensity laser matter interactions. In particular for providing, for the first time, unequivocal evidence of turbulent magnetic fields and the discovery of terahertz frequency acoustic waves, in laser produced hot dense plasmas. These results have significance to testing stellar and astrophysical scenarios.

Frederic Ives Medal / Quinn Prize 2016

Gerard Mourou
Distinguished Professor Emeritus from the University of Michigan and the Ecole Polytechnique in Palaiseau, France

For numerous pioneering contributions to the development of ultrafast and ultrahigh intensity laser science and for outstanding leadership of the international and commercial communities impacted by these technologies.

Harold E. Edgerton Award 2016

Christopher P. J. Barty
Lawrence Livermore National Laboratory

In recognition of his efforts in the development of foundational techniques that have enabled ultrafast, intense lasers and for pioneering contributions to time-resolved, x-ray and gamma-ray science conducted with such lasers

2016 ICUIL Membership

Chris Barty	Chairman	United States
Alexander Sergeev	Co-Chairman	Russia
Ravi Kumar	Co-Chairman	India
Terry Kessler	Secretary	United States
Tsuneyuki Ozaki	Treasurer	Canada
Gerard Mourou		France
Toshiki Tajima		International
Hiroshi Azechi		Japan
John Collier		United Kingdom
Dino Jaroszynski		United Kingdom
Thomas Kuehl		Germany
Christine Labaune		France
Wim Leemans		United States
Ruxin Li		China
Chang Hee Nam		Korea
Bedrich Rus		Czech Republic
Heinrich Schwoerer		South Africa
Ken-ichi Ueda		Japan

Associate Members (without vote)

Ryosuke Kodama	Japan
Sandro de Silvestri	Italy
Nilson Dias Vieira Jr.	Brazil
Claes-Goran Wahlstrom	Sweden

ICUIL Related Science and Technology Highlights

I. Extreme Light Infrastructure (ELI)

ELI is a pioneer among the research infrastructures contained in the European ESFRI Roadmap in that it is using EU structural funds and not science funds for construction of its facilities. ELI consists of three separate sites of roughly equal funding magnitude: ELI-Beamlines, ELI-Nuclear Physics, and ELI-ALPS (attosecond science pillar). ELI-NP, a European research center to study ultra-intense lasers interaction with matter and nuclear science using gamma and laser driven radiation beams is located in Magurele, Romania. The total cost of the facility will be 300 million Euros and commissioning is scheduled to take place in 2018. The ELI-NP facility combines a high power laser system (HPLS) with two arms of 10 PW having intensities on the target in the range of 10^{23} W/cm^2. A gamma beam system (GBS) will deliver up to 19 MeV photons with extreme brilliance and bandwidth and is based on Compton scattering of a high repetition pulsed laser beam on a relativistic electron beam produced by a warm linac of 720 MeV. A new, international conference entitled Nuclear Photonics 2016 and devoted to science of direct relevance to ELI-NP will held this October in Monterey, California. (www.nuclearphotonics2016.org). Members of

ICUIL have been instrumental in the formation of this new biennial meeting series. The 2018 meeting of the Nuclear Photonics series will be hosted by the ELI-NP facility and team.

II. International Center for Zetta-Exawatt Science and Technology

IZEST endeavors to unify a number of exawatt class facilities around the world. Almost 30 laboratories in 13 countries have signed a collaboration agreement. A new pillar within the IZEST organization, known as ZeptoScience, was formed. A ZeptoScience team is performing experiments to test the methods to efficiently compress existing laser technologies to the few-cycle, femtosecond regime with a sufficient intensity to pursue the creation of zeptosecond pulses. This work is being performed by a team based at Ecole Polytechnique (France), National Institute for Laser, Plasma and Radiation Physics (INFLPR, Romania), and ELI-NP (Romania).

III. The International School on Ultra-Intense Lasers

The School is organized by the International Committee on Ultra-Intense Lasers (ICUIL), Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS), National Research Nuclear University MEPhI and Russian Federal Nuclear Center (RFNC-VNIIEF). The school was held in the Hotel@Resort “Yunost” 40 km from Moscow, Russia, from 4 to 9 October, 2015. The main objective of the School was to give an opportunity for postgraduate students and other early career researchers working in ultra-intense laser science to meet in person and listen to the lectures given by world renowned experts in high power laser physics, laser-matter interaction physics, laser-plasma accelerators, laser-based x-ray sources and inertial confinement fusion. Also, a poster session was organized for the young participants where they could present and discuss their own results. In addition to the lectures and poster session, evening interactive classes were conducted by distinguished specialists in the field. The main idea behind them was to make contact of students and teachers as close as possible. The classes were divided into 4 topics; High average power and high-energy lasers, Femtosecond-laser-plasma interaction and particle acceleration, Laser ceramics: fabrication and application and Interaction of strong lasers with quantum systems. About 80 young scientists from Asia, Western Europe and Russia took part in the school.

IV. Collaborations with the Accelerator Community

For laser-based particle accelerators, one of the main issues is the need to improve the laser technology, in particular laser efficiency and repetition rate, so that the beam generated has high enough luminosity for practical applications. Along this line, the ICUIL community is supporting the development of the Coherent Amplification Network (CAN) laser technology based on phased arrays of fiber lasers. A successful CAN system will have applications beyond particle acceleration and in particular a separate community is now considering the potential of this technology for laser-based management and removal of orbiting space debris.

Discussions of the CAN concept, updates on experimental demonstrations and consideration of other areas of overlap between the intense laser and high energy physics communities took place at an IZEST Conference at CERN last October and represented a giant step in collaboration between the communities of ICUIL and ICFA. The possibility of future collaboration on high fluence laser technology at CERN will be discussed in the future.

The 76th International Committee for Future Accelerators (ICFA) meeting was held at the J-PARC site (KEK Tokai campus) in Japan on 25th and 26th February 2016 and included discussion of ICUIL/ICFA collaborative science. The meeting summary can be found on the web page of ICFA at http://icfa.fnal.gov/.

In 2015 a working started with seed funding from the Japanese government to consider plasma-based deceleration as a technique for dramatically reducing the environmental issues associated with the 10-MW beam dump for the planned International Linear Collider (ILC). The members of the so-called “Green ILC Beam Dump” group include; KEK, UCI, SLAC and LAPP/IN2P3/CNRS.

In 2016 ICUIL, Chris Barty (at the time co-chair of ICUIL) became a member of the newly-formed, IUPAP Working Group on Accelerator Science (WG14). The first meeting of WG14 took place in May in Pusan, South Korea. Chris participated in this meeting via teleconference and provided insight with respect to generic issues faced upon formation in 2004 of the ICUIL working group.

V. XCELS

This project was launched in October 2015 and is aimed at fostering scientific cooperation between the Russian Federation and the European Union in the development and scientific exploitation of large-scale research infrastructures. 19 European research centers, including 6 Russian institutions, established a consortium to develop concrete coordination and support measures for each research infrastructure and common best practice and policies on international participation. The project is intended for 3 years during which each consortium member will organize working meetings and/or focus workshops with participation of other CREMLIN members to discuss problems of mutual interest and find ways for their solution. In addition, meetings of Consortium Board (CB) and Project Management Board with representatives of each party will be held regularly. An external Science Policy Advisory Board (SPAB) appointed by the CB shall assist and facilitate the CB decisions.

The CREMLIN kick-off meeting took place on 06-07 October 2015, at the National Research Center “Kurchatov Institute” in Moscow, Russia. The objectives, management and

financial issues, exchange platform, milestones and other issues were addressed at the meeting. It was agreed that the CREMLIN project should be seen as a vehicle and platform to move the discussions around large-scale research infrastructures and as a means to establish links between the project participants and the European Strategy Forum on Research Infrastructures (ESFRI) and other relevant EU organizations. The first CREMLIN working meeting on exchange on policy and ESFRI-related issues was held at the Joint Institute for Nuclear Research in Dubna, Russia on the 20th April 2016. The meeting was intended to stimulate and enable mutual learning and exchange of best practice within the community, with a focus on policy issues. A second working meeting took place on 28–30 June 2016 and was dedicated to international relations to the megascience facilities. It was held at the European Spallation Source in Lund, Sweden. Still another CREMLIN event was organized by the Institute of Applied Physics of the Russian Academy of Sciences (IAP RAS). It was a workshop on novel applications of exawatt laser sources, with a focus on the XCELS facility developed at IAP RAS. The workshop was held on board a river ship cruising from Nizhny Novgorod to Saint Petersburg, Russia from the 17th to the 23d of July 2016.

VI. 2016 Highlights - High Intensity Laser Facilities

National Ignition Facility's ARC

The commissioning of the Advanced Radiographic Capability (ARC) laser system in the National Ignition Facility (NIF) was completed. ARC is designed to ultimately provide eight beamlets from one quad of NIF beams with pulse duration adjustable from 1 to 50 ps, and energies up to 1.7 kJ per beamlet. A special front end laser system enables ARC to achieve the high pulse contrast (80 dB) needed for unperturbed solid target interactions. The ARC beamlets will be used to create x-ray point sources for dynamic, multi- frame high-energy x-ray radiographs of the imploded cores of ignition targets. ARC x-rays are critical for precision x-ray imaging of NIF experiments studying complex hydrodynamics and material strength at extremely high energy densities. In principle, ARC can also produce MeV protons and electrons for future experiments in advanced fusion, TeV acceleration and proton radiography.

Extreme Light Infrastructure (ELI)

A High Power Laser System (HPLS) is being constructed for the ELI-NP (Nuclear Physics) pillar in Magurele, Romania. The HPLS consists of two main beams, each delivering 10 PW peak power at a repetition rate of 1 shot per minute. In addition, each leg will be capable of delivering 100 Terawatt at 10 Hz and 1 PW at 1 Hz. The ELI-NP team recently achieved compressed pulses with 28 J at 1 Hz with 21 fs pulsewidth, yielding 1.3 PW in a beam measured to have a Strehl ratio of 0.92.

National Energetics is working to deliver the L4 beamline, a 10 PW (1.5 kJ in 150 fs) at 1 shot per minute, to ELI Beamlines in Czech Republic. The laser system is based on Nd-doped glass as a gain medium. The thermal management of the power amplifiers includes liquid cooling of multiple slabs in a split-disk configuration. The spectral width is increased to support 150 fs pulses by mixing Silicate and Phosphate glass amplification media.

Texas Petawatt Laser

Researchers at the University of Texas, Center for High Energy Density Science have benefitted from a successful project to improve the pulse contrast on the Texas Petawatt Laser while reaching 150 J in 150 fs. This laser has produced the brightest ultrashort pulse neutron source yet measured (>10^{18} n/cm^2 in a 50 ps pulse), the highest measured positron-to-electron ratio pair creation in a solid (~50% in a Pt rod), and high energy (~100 MeV) proton yields. Following improvements to the laser wavefront and focusing system, the Texas group expects to reach intensities above 10^{22} W/cm^2.

CEA's PETAL

Petawatt Aquitaine Laser (PETAL) will allow unique experiments in the field of ultrahigh intensity sciences, extreme plasma physics, astrophysics, radiography, and fast ignition by a combination of its own multipetawatt kilojoule beam and the nanosecond multikilojoule beams of the Laser Mégajoule (LMJ). The PETAL facility is designed and constructed by the French Commissariat à l'énergie Atomique et aux énergies alternatives (CEA) to deliver laser pulses in the kJ-picosecond range at the wavelength of 1053 nm and is an additional short pulse beam to the Laser MegaJoule (LMJ) facility. In May 2015, PETAL had achieved 1.4 kJ at 2 ns with a 3.5 nm bandwidth to produce 1.15 PW. In December 2016, PETAL delivered 0.9 PW to the LMJ target chamber. The PETAL goal is to reach 10^{20} W/cm^2 on target.

SIOM's Petawatt Lasers

The Shanghai Institute of Optics and Fine Mechanics (SIOM) in China introduced their 10 PW laser project called SULF (Shanghai Superintense Ultrafast Laser Facility). At the end of 2014, a high gain chirped pulse amplifier based on a 150 mm diameter, Ti:sapphire crystal was demonstrated. To date the highest output pulse energy has been 192.3 J when pumped by laser energy of 312 J, corresponding to a pump-laser efficiency of 50.4%. With the grating compressor efficiency of 72% and the 27.0 fs compressed pulse width obtained with part of the energy, this Ti:sapphire laser system could support a peak power of 5.13 PW. A CPA/OPCPA hybrid laser system has achieved the peak power of 1.02 PW, where an LBO of 100 mm in diameter was used in the final OPCPA, and the output energy of 45.3 J was obtained. A 10 PW level femtosecond laser system, combining the Ti:sapphire based CPA chain and the OPCPA booster amplifier, is currently being constructed.

Kansai Photon Science Institute (KPSI)

The J-KAREN laser system at the KPSI National Institutes for Quantum and Radiological Science and Technology (QST) was upgraded over a two-year period between 2014 and 2016. Previously, J-KAREN system delivered laser intensities of 10^{21} W/cm^2 to high field physics experiments to successfully obtain energetic hadron beams. The J-KAREN-P laser is a Ti:sapphire system with double-chirped pulse amplification (CPA), capable of providing a laser pulse with intensity over 10^{22} W/cm^2 and a high contrast ratio of 10^{-10} at -500 ps. The laser system has successfully amplified a pulse up to 65 Joules and compressed it to 30 fs (FWHM) on target. The J-KAREN-P laser system promises to open the door to relativistic particle acceleration, especially hadron beams, bright x-ray and γ-ray radiation generation and photo-nuclear science.

IUPAP Working Group 9: Report to the C&CC Meeting October 2016

Nuclear Science Symposia

One of the tasks of the IUPAP working Group 9 [WG.9] is to organize with regular intervals a Nuclear Science Symposium in order to be appraised of the currently most relevant nuclear science questions, to discuss the research efforts required to address these nuclear science questions, as well as to assess the research facilities in operation or planned for pursuing these research efforts.
With this in mind WG.9 organized a first nuclear science symposium at TRIUMF, Vancouver, Canada, on July 2 – 3, 2010. A second one at Laboratori Nazionali di Frascati, Italy, on May 31, 2013, and the third one at South-Eastern Universities Research Association headquarters in Washington, DC, USA, on June 4 – 5, 2015. At these nuclear science symposia an effort has been made to invite and to have government/funding agency representatives participate in the deliberations. Overviews of current forefront nuclear science research being addressed or intended to be addressed together with the upgrading of current facilities and planned large new facilities are to be given by representatives from Asia, Europe, and North-America.

Changes in IUPAP WG.9 membership

Faical Azaiez has been appointed as Director of i'Themba Laboratories as of February 1, 2016, replacing Kobus Lawrie as member of IUPAP WG.9.

The incoming Scientific Director of GSI as of January 1, 2017, is Paolo Giubellino; he will replace Karlheinz Langanke as member of IUPAP WG.9 at that time.

As of May 1, 2016, the Chair of NSAC is David W. Hertzog of the University of Washington and Donald F. Geesaman of ANL is then the Past-Chair; both are members of IUPAP WG.9. Susan Seestrom of LANL as the former Past-Chair of NSAC will rotate off IUPAP WG.9.

Dominique Guillemaud-Mueller who was the Deputy-Director of IN2P3/CNRS until September 1, 2016 has resigned as member of IUPAP

WG.9 as of that date. Her replacement will be decided by the present director of IN2P3/CNRS Reynald Pain.

At its AGM IUPAP WG.9 has invited the Director of the Rare Isotope Science Project (RISP) in Korea, Sun-Chan Jeong, to serve as a member of the Working Group.

The current membership of IUPAP WG.9 can also be found on the website:
(http://www.triumf.info/hosted/iupap/icnp/index.html)

Open access to scientific data

The four major international science organizations: ICSU – International Council of Scientific Unions, ISSC – International Social Science Council, IAP – Inter-Academy Panel, and TWAS – Third World Academy of Sciences, have jointly created an accord "Open Data in a Big Data World", which details principles and practices to support open access to "big data" in publicly funded research.
The Executive of IUPAP WG.9 endorses this accord, but was informed that at present there does not exist unanimous agreement on the wording of the document.

Forschungszentrum Juelich – Institut fuer Kernphysik and Cooler Synchrotron and storage ring COSY

The Executive was informed about the actions under consideration by the Board of Management of the Forschungszentrum Juelich:
to terminate all contributions of the Forschungszentrum Juelich to the FAIR, HESR, and PANDA projects at GSI, Darmstadt, by the end of 2018;
to end the operation of the Cooler Synchrotron and storage ring COSY for the proton/deuteron EDM experiment by the end of 2019;
to phase-out the Institut fuer Kernphysik (IKP) at the beginning of 2020.

Subsequently, the Executive has been in communication with both the Scientific Coordinator for the Directors of the IKP of the Forschungszentrum Juelich and with the Scientific Director of GSI.

Based on its assessment of the above mentioned information the Executive has written letters to the Staatssekretaer Dr. Georg Schuette,

Bundesministerium fuer Bildung und Forschung (BMBF), to Dr. Karl Eugen Hutmacher, BMBF, Chair of the Science Board of the Forschungszentrum Juelich, and to Staatssekretaer Dr. Thomas Gruenewald, Ministerium fuer Innovation, Wissenschaft und Forschung of the Bundesstaat Nordrhein-Westfalen, Deputy-Chair of the Science Board of the Forschungszentrum Juelich, expressing concerns about the actions under consideration.

More recent information has indicated that the above dates have been put forward starting in 2022.

Super-Heavy Elements: Validation and Acceptance and Naming for the Periodic Table

The existing controversy about the various actions undertaken by IUPAC (the International Union of Pure and Applied Chemistry) with regards to the validation of the Super-Heavy Elements has resulted in rather difficult negotiations between IUPAP and IUPAC. The latter organization taking essentially credit for the discoveries of the Super-Heavy Elements as per the announcements which appeared in the scientific and regular press. IUPAP WG.9 received a long expose from Victor A. Matveev, Director of JINR-Dubna, one of the institutions where the relevant research was performed, about the progression of actions leading to the announcement of the validation and naming of the new Super-Heavy Elements by IUPAC. The IUPAP Commission on Nuclear Physics, C12, has undertaken formulating a set of recommendation regarding this matter.

Next Nuclear Science Symposium and AGM of IUPAP WG.9 and IUPAP C12

IUPAP WG.9 has met on Sunday, September 11, 2016, in Adelaide, SA, at the start of the International Conference on Nuclear Physics (INPC2016). Draft Minutes of this AGM of IUPAP WG.9 can be found on the above mentioned website.

A date for the next Nuclear Science Symposium and the date for the next IUPAP WG.9 AGM as well as the IUPAP C12 AGM have been tentatively set just prior to PANIC 2017 (August 28 – September 2). A three day meeting is being envisioned. The Nuclear Science Symposia, giving an overview of current nuclear physics and the facilities required to address

these, follow a biennial cycle as per the recommendations by the funding agency/government representatives at the last nuclear science symposium.

Rare Isotope Science Project (RISP) and Accelerator Complex RAON in Korea

The Executive of IUPAP WG.9 has been approached by the Chair of ANPhA to write a letter to the Honorable Dr. Choi Yanghee, Minister of Science, ICT and Future Planning, about establishing Research Groups/Users Organization within the existing research structures for the above.

Willem van Oers
Secretary of IUPAP WG.9

Robert E. Tribble
Chair of IUPAP WG.9

TRIUMF, October 1, 2016

WORKING GROUP 10

Activities of the Astroparticle Physics International Committee (IUPAP WG 10)

September 2015 – September 2016

Minutes of the ApPIC meeting held at Berkeley on September 2, 2016

Michel Spiro (Chair of ApPIC)

ApPIC mandate, history

M. Spiro summarized the origins of ApPIC, which arose from the dissolution of the former PANAGIC committee. ApPIC was conceived to review the field of astroparticle physics on a regular basis, to engage in dialogue with and provide scientific advice to the Astroparticle International Forum (APIF), whose members are all members of funding agencies (with the exception of the chair) and to liaise with similar national and international bodies, in particular in road-mapping exercises. APIF was established in 2011, while ApPIC was formed in 2013. M. Spiro reported to APIF in May 2014 following the first ApPIC meeting, but since then the expected connection between ApPIC and APIF has not been realized. ApPIC has concerned itself with data policy and open data issues, multi-messenger high energy astrophysics, and the connections between cosmology and neutrino physics. Presentations at multiple conferences and other meetings have provided an opportunity to engage in dialogue with the community.

Dialogue with APIF

The current chair of APIF, M. Turner, joined the meeting for a discussion regarding the future of APIF and its relationship to ApPIC. After two three-year terms under the auspices of the Global Science Forum of OECD, the OECD sponsorship is now coming to an end. The members of APIF wish to continue, and will determine how to achieve this at their next meeting, planned for Oct. 10 – 12 in Paris. This will also be M. Turner's last meeting as chair of APIF. A new chair will be named, likely from the same country that accepts the task of organizing future meetings and providing administrative support. A final report will be submitted to the GSF after the October meeting; this will be made public and will constitute the only public record to date of the APIF meetings. Turner summarized the main purposes served by APIF: to provide a venue for funding agency managers to meet in private for mutual discussions and information exchange; to discuss best practices; to educate and provide scientific context; and to visit major facilities in different countries during meetings hosted at various laboratories. Examples of recent topics of interest have included a more nuanced understanding of the US P5 roadmap, the status of CTA, and open data policies. The agenda always included a "tour de table" with reports from all members present, a presentation by the host country, laboratory visits, and a strategic topic sometimes including a talk by an invited expert. There are a total of 18-20 members, and typical attendance is 12-15. M. Turner stressed that the members of APIF value the privacy it affords for useful discussions, and so far have not felt the need for external scientific input from ApPIC.

Consolidation of ApIC progress to date

ApPIC has held three meetings in May 2014, April 2015 and September 2016. We have formulated messages on the following topics:

- Open data policies and data sharing;
- Multi-messenger high energy astrophysics;
- Complementarity of cosmology with neutrino physics

These topics have been shared with the community in presentations by M. Spiro on behalf of ApPIC at ICRC (July 2015), TAUP (Sept 2015), ICFA panel on neutrinos and the 2nd meeting on Large Neutrino Infrastructures (Feb. 2016) and at the 3rd meeting on Large Neutrino Infrastructures (June 2016). Feedback from the community has been received and incorporated. A connection has also been established with ICFA (WG1) and there is an agreement that the chairs of ICFA and ApPIC will be invited to attend one another's meetings in alternate years.

Future ApPIC topics

A white paper describing the ApPIC position in open data policy and data sharing was discussed. This could be a useful communication tool with the broader community.

Road-mapping exercises have been conducted recently in a number of countries, and APPEC is updating the European astrophysics roadmap following the recent APPEC town hall meeting. ApPIC could play a role in synthesizing the various roadmaps and pointing out the overlaps and/or gaps between them.

Gravitational waves are a subject that has become highly visible and is already well organized through GWIC (WG11). Additional aspects relevant for ApPIC include the muti-messenger approach to GW follow-up, quantum gravity, complementarity between ground and space, and the promotion of the next generation of mega-facilities.

The corresponding IUPAP WG for international cooperation in nuclear physics, WG9, writes a scientific summary and sponsors a symposium attended by many representatives of funding agencies every other year. This is similar to the ICFA seminar which takes places every 3 years for particle physics, but also recently has included cosmology and astrophysics.

The ApPIC membership and chairmanship are due for renewal. M. Spiro is stepping down after serving for 3 years as the founding chair of ApPIC; his service has been much appreciated. N. Roe has been nominated to serve as the next chair. Five members are retiring and will need to be replaced. Consultations with other relevant IUPAP WGs and Commissions will be undertaken to identify suitable candidates.

Appendix: **MEMBERSHIP**

Chair: Michel Spiro, France
Secretary: Pierre Binetruy, France
Roger Blandford, USA
Zhen Cao, China
Eugenio Coccia, Italy
Don Geesaman, USA
Kunio Inoue, Japan
Naba Mondal, India
Angela Olinto, USA
Natalie Roe, USA
Sheila Rowan, GB
Valery Rubakov, Russia
Bernard Sadoulet,USA
Subir Sarkar, GB/Denmark
Christian Spiering, Germany
Yoichiro Suzuki, Japan

Karl-Heinz Kampert, Germany, ex-officio as C4 Chair

Ani Aprahamian, USA, Associate member (C12)

Gravitational Wave International Committee (WG.11) report to IUPAP

6 October 2015

prepared by David Shoemaker [*MIT,* Executive Secretary],
Stan Whitcomb [*Caltech,* co-Secretary], and Sheila Rowan, [*U. 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. From 1999 until 2011, GWIC was recognized as a subpanel of PaNAGIC (IUPAP WG.4). In 2011, GWIC was accepted by IUPAP as a separate Working Group (WG.11).

GWIC meets annually adjacent to an appropriate conference. In July 2016, GWIC met in New York City, in conjunction with the twenty-first International Conference on General Relativity and Gravitation (GR21). Other recent meetings have been held in Gwangju (2015), Banff (2014), Warsaw (2013), Rome (2012), Cardiff (2011), Hannover (2010), and Pasadena (2009). Other business during the year is conducted via email or other electronic communication.

GWIC maintains a website at https://gwic.ligo.org/ which contains an up-to-date listing of members, its by-laws, announcements of its activities, and links to other items of interest to the gravitational wave community.

GWIC Membership

The membership of GWIC represents all of the world's active gravitational wave projects, as well as other relevant communities, covering gravitational wave frequencies from nanohertz to kilohertz. Each project has either one or two members on GWIC depending on size. GWIC also includes representatives from ISGRG (IUPAP AC2), International Astronomical Union (IAU) Commission on Gravitational Wave Astrophysics, and from the astrophysics/theoretical relativity community, to help facilitate communication with those bodies. Two members of GWIC (Eugenio Coccia and Sheila Rowan) are also members of ApPIC (WG.10), ensuring close communications.

The GWIC Chair is elected by its membership at its annual meeting in odd years. In 2015, GWIC chose Sheila Rowan as its Chair, serving until 2017. The GWIC Chair appoints the Executive Secretary. This year, after serving for nine years, Stan Whitcomb asked to be replaced. Sheila selected David Shoemaker (MIT) as the new Executive Secretary. Stan agreed to stay on as co-Secretary for a one year transition period.

Each member project in GWIC determines its representatives on GWIC. In this year, the US LISA Collaboration appointed a new representative: James (Ira) Thorpe, replacing Robin Stebbins.

GWIC Activities in 2014-2015

GWIC convenes the biennial Edoardo Amaldi Conference on Gravitational Waves, sponsored by IUPAP as a "class B" Conference. 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 2017 Amaldi meeting will be held in Pasadena (USA) from 9-14 July 2017. GWIC heard a report on planning for the meeting. Preparations are proceeding smoothly, and GWIC took an action item to appoint a subcommittee to begin planning the program.

A major decision at the 2016 GWIC meeting concerned the 2019 Amaldi meeting. Every six years, the biennial Amaldi meetings and the triennial ISGRG-sponsored International Conference on General Relativity and Gravitation take place in the same year. Because these two meetings attract many of the same scientists, joint meetings were held in 2007 (Sydney) and 2013 (Warsaw). ISGRG proposed a continuation of this practice in 2019. GWIC discussed this proposal and agreed to this arrangement. Two groups presented proposals to host a joint GR22/Amaldi12 meeting, in Valencia (Spain), and in Budapest (Hungary). All proposals were judged to be very good. GWIC communicated its willingness to accept either proposal to the ISGRG Committee, which made the final selection of Valencia.

Since 2006, GWIC has awarded an annual international prize for an outstanding Ph.D. thesis based on research in gravitational waves. Since 2013, GWIC has coordinated its prize with the Stefano Braccini Thesis Prize, (sponsored by the Friends of Stefano Braccini). GWIC manages the solicitation of nominations and selection of the two winners. The two prizes are distinguished by emphasizing the impact to the field for the GWIC Thesis prize and by emphasizing creativity and innovation for the Stefano Braccini Prize.

There were 20 theses nominated this year, from four different countries. The 2015 GWIC Thesis Prize was awarded to Denis Martynov from Caltech, and the 2015 Stefano Braccini Prize was awarded to Vikram Ravi from the University of Melbourne. Both theses were nominated for publication in the Springer Thesis Series, per GWIC's agreement with Springer.

With Advanced LIGO's recent detection of gravitational waves from two binary black hole mergers and with the impending initial operation of Advanced Virgo and KAGRA and the construction approval of LIGO-India, substantial attention in the ground-based interferometer community has been turned to the longer term future, with initial discussions concerning possible future facilities. At its 2015 meeting, there was

considerable sentiment within GWIC that such discussions should include international collaboration and planning. GWIC decided to charge a small group of members to discuss forming a GWIC subcommittee focused on this area. This group reported back that it recommended that GWIC form such a subcommittee and presented a draft charge for this subcommittee. GWIC discussed the benefits and the possible pitfalls that might arise and gave guidance to the Chair on how to minimize conflicts. This subcommittee is being formed and it will both interact with the ground-based gravitational wave community and the government agencies that fund this work.

Membership of GWIC (as of October 2016)

Chair: Sheila Rowan
ACIGA: Bram Slagmolen
AURIGA: Massimo Cerdonio
Einstein Telescope: Michele Punturo
European Pulsar Timing Array (EPTA): Michael Kramer
GEO 600: Karsten Danzmann, Sheila Rowan
IndIGO: Bala Iyer
KAGRA: Takaaki Kajita, Yoshio Saito
LIGO, including the LSC: Gabriela Gonzalez, David Reitze
LISA: Neil Cornish, Bernard Schutz, Ira Thorpe, Stefano Vitale
NANOGrav: Xavier Siemens
NAUTILUS: Eugenio Coccia
Parkes Pulsar Timing Array (PPTA): George Hobbs
Spherical Acoustic Detectors: Odylio D. Aguiar
VIRGO: Fulvio Ricci, Jean-Yves Vinet
Theory Community: Clifford Will
AC2 Representative: Beverly Berger
IAU Commission D1 Representative: Neil Gehrels
Executive Secretary: David Shoemaker, *co-Secretary*: Stan Whitcomb

Report from WG 12, September, 2016

Mandate
At the working group's meeting in Tokyo in July 2013, the following mandate was approved

- The working group (WG 12) shall review current energy issues and through International Union of Pure and Applied Physics (IUPAP) make briefs available for the global physics community and policy makers as well as the public at large.
- The group meets once or twice a year to review selected topics taking advantage of local experts where the meeting is held.
- The topics considered should include energy supply, carriers, storage and use. Both advanced and low tech systems shall be looked into.

It was agreed to make briefs on selected issues rather than technical reports.

Publications

Drafts for some 15 briefs have been received or are in the process of being prepared for publication. These include solar energy, wind energy, hydro power, ocean wave energy, ocean tidal energy, geothermal energy, nuclear power, fusion, coal, gas hydrates, biogas, biofuel, bioenergy (solid), energy storage, batteries. Included is a survey paper on the various energy resource estimates.

At the meeting in Oslo, the drafts were discussed and it was agreed to publish them in a series of EnergyPages similar to the Canadian SciencePages (http://sciencepages.ca/publications/). Each document will have an ISBN and the key authors will be named on behalf of the group. The typical length of a brief will be 6 pages that can be printed in paper format.

The briefs are planned to be published in batches of four. The first four briefs in preparation are hydro power, gas hydrates, coal and biofuels. The target date is Fall 2016. Before publication, the briefs will be peer reviewed. The next batch will cover several topics within bioenergy like biogas, woody biomass, liquid biofuels, etc.

Several members of the group have been involved in the SCOPE Bioenergy assessment. It is published as volume 72 in the SCOPE report series and is available for free download at

http://bioenfapesp.org/scopebioenergy/index.php

During 2015, the Bioenergy report has been launched at FAPESP in Sao Paulo, EU's energy week in Brussels, and World Bank in Washington DC.

The group plans to meet in Sao Paulo in 2017. Funding for the workshop is currently being sought by the local organizer from FAPESP. SCOPE is in the process of setting up a new website where the briefs can be downloaded.

IUPAP-SCOPE ENERGYPAGE

Gas hydrates

The IUPAP-SCOPE EnergyPages are part of series meant to provide basic information in a simple and still accurate form on selected topics related to energy issues. They will be updated at regular intervals.

Short intro to gas hydrates

Gas hydrates can be found in deep sea water and as deposits in geological formations. It is an energy source that is not exploited today, but may be so in the future. In principle it is ice containing individual methane molecules, which are released when the ice "melts". It is used as natural gas.

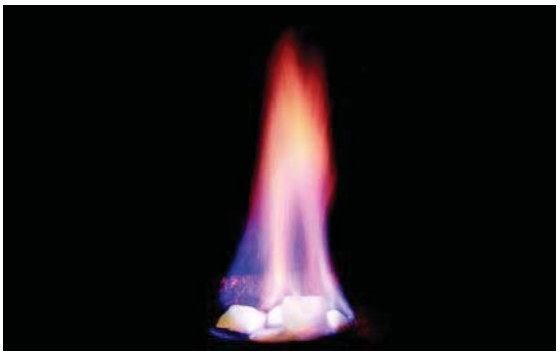


Figure: Burning gas hydrate. Source: USGS

Resources - potential

Keywords: Location, distribution, Mackenzie delta, Nankai Trough

Methane hydrates are found most commonly in two different environments. The first one is underneath the permafrost in the Arctic. But more important as an exploitable energy resource are the deposits under and outside the continental shelf in the oceans. In both environments the hydrates are stable under high pressure and low temperature conditions.

One popular belief is that the methane hydrate resource exists in the form of nodules on the deep sea floor. Even though they were first seen in the Black sea in 1974, they appear to be relatively rare compared to the estimates given in the 1990s. The previous estimates indicated that the gas hydrates were more abundant that the petroleum resource, some 10,000 Gt C. However, recent assessments range the resource to 500-2,500 Gt C (gigatonnes carbon). The most technically easily recoverable hydrates are considered to be those in sandy deposits which are currently assessed to amount to 150 Gt C or ~3×10^{14} m^3.
http://pubs.rsc.org/en/Content/ArticleLanding/2011/EE/C0EE00203H#!divAbstract

The hydrate deposits are predominately in the form of hydrate bearing sediments in various geological formations. These sediments can contain smaller or larger amount clays, sand, gravel, etc. Their appearance is like dirty ice. These deposits may in some instances penetrate and be visible on the ocean floor.

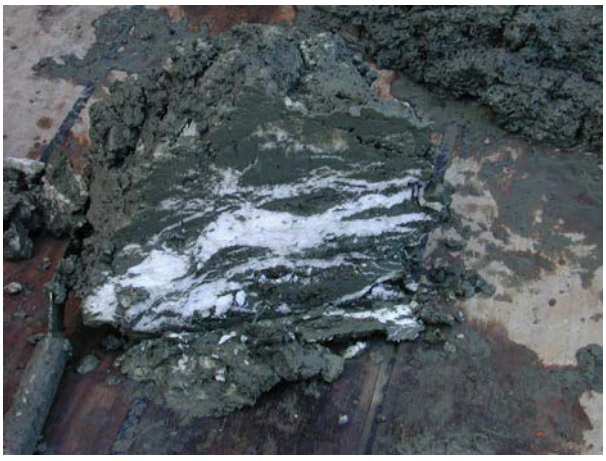


Figure: Gas hydrate-bearing sediment, subduction zone off Oregon
https://commons.wikimedia.org/wiki/File:Gashydrat_im_Sediment.JPG

Figure: Gas hydrate mound on seafloor
https://commons.wikimedia.org/wiki/File:Seafloor_mounds.jpg

Major deposits have been located in the Mackenzie Beaufort region of Arctic Canada, in the Nankai Trough in the Pacific Ocean south of Japan and in the Gulf of Mexico.

So far only Japan has plans to exploit this resource.

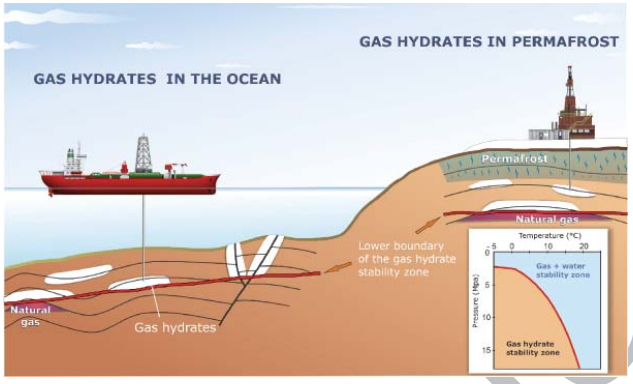


Figure: Gas hydrate exploration
http://iopscience.iop.org/1748-9326/4/3/034007/fulltext/

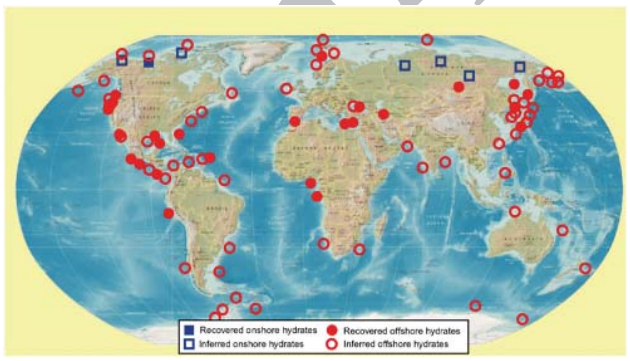


Figure: Global gas hydrate resource map
http://www.nap.edu/openbook.php?record_id=11094&page=193

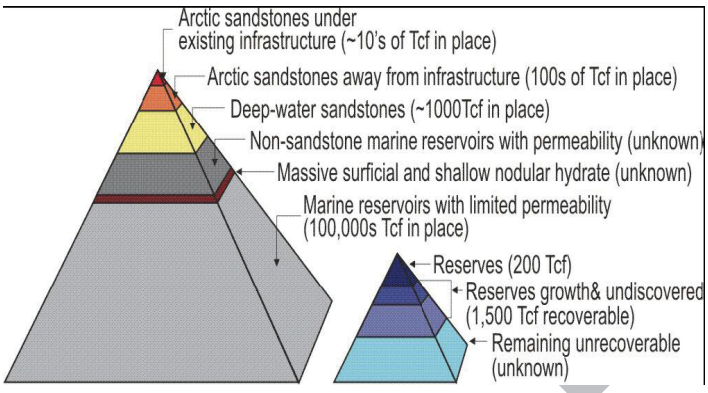


Figure: Resource pyramid

Use

Keywords: Electricity, direct heat

The gas produced from gas hydrates is used in all natural gas applications like gas fired power plants, domestic heating and cooking, petrochemical feed.

Physics

Keywords: structure, phase diagram

A gas hydrate is a solid where a single gas molecule is bound within a "cage" formed by water molecules. It has the appearance of snowy ice. Most commonly occurring in nature is methane, but other gases such as CO_2 can be trapped in such cages.

The force that keeps the cage together is the hydrogen-bond between water molecules. Some times the term gas clathrate is used for these compounds.

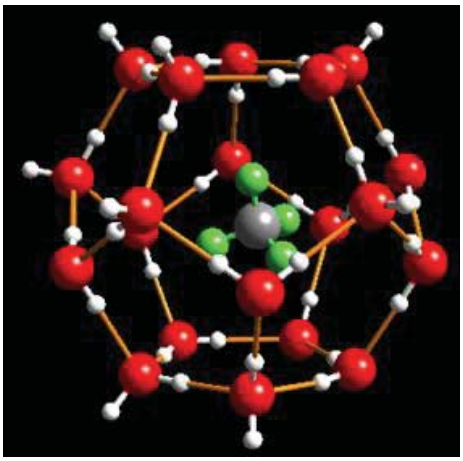


Figure: Water molecule (red and white) cage with a methane molecule (green and gray) (Structure I)
http://woodshole.er.usgs.gov/project-pages/hydrates/primer.html

The hydrate structure depends on how the organic material was broken down. If the gas was formed by micro-bacterial activity, biogenic, in the sediment, almost pure methane is formed. On the other hand, if the organic matter was broken down at greater depth through thermal decomposition, thermogenic, without presence of oxygen, heavier fractions were formed. When a gas hydrate is formed, this gives rise to 2 different hydrate structures depending on whether the decomposition was biogenic or thermogenic.

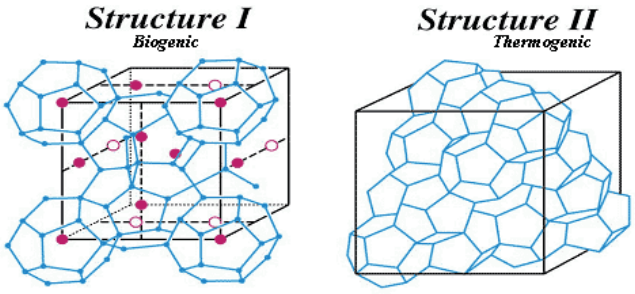


Figure: Biogenic (I) and thermogenic (II) gas hydrate structure.

Gas hydrates cannot exist at all temperatures and pressures. They are only stable at relatively high pressure and low temperature. If they are brought to a warmer or depressurized condition, they will dissociate or "melt" and the gas will be released. Given the particular phase behavior, methane hydrates can only exist in so-called stability zones at depth between 1200 and 1500 meters in open oceans and between 600 and 1000 meters in permafrost regions. Underneath these zones, the temperature is too high, more than 30°C and the methane may be present in the form of free gas. For a methane hydrate to form, the pressure must be at least 3 MPa (30 atm) at 0°C.

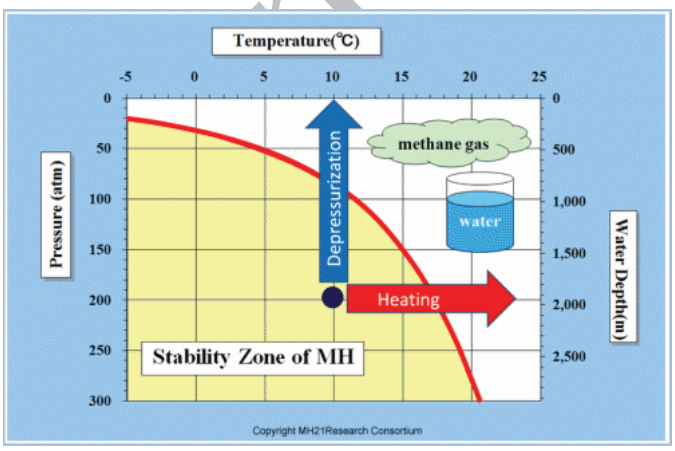


Figure: Methane hydrate stability zone curve
http://www.mh21japan.gr.jp/english/mh21-1/3-2/

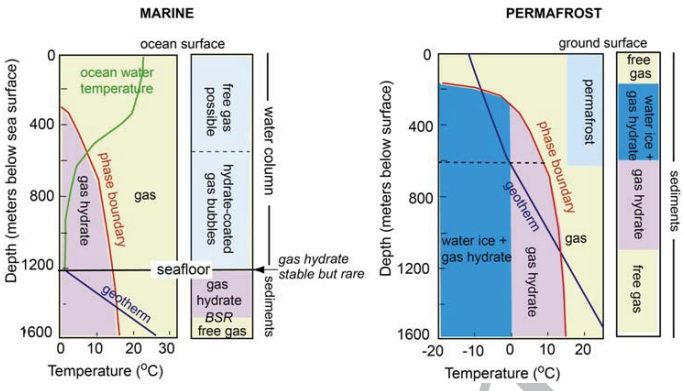


Figure: Gas hydrates in marine and permafrost environments
http://woodshole.er.usgs.gov/project-pages/hydrates/primer.html
http://large.stanford.edu/courses/2010/ph240/harrison1/

When a methane hydrate dissociates at the surface in atmospheric conditions, it releases about 164 times the volume of gas as the hydrate itself.

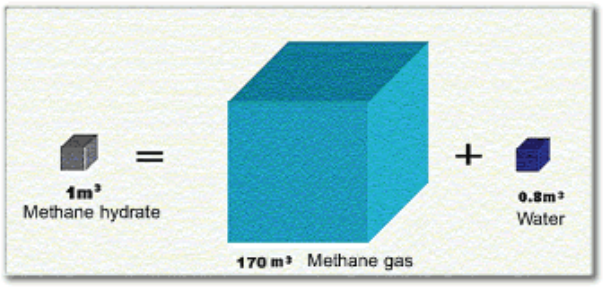


Figure: Methane hydrate composition

Video methane molecule release:
http://www.eurekalert.org/multimedia/pub/39873.php?from=202863

Exploration

Keywords: Seismic, BSR (Bottom Simulated Reflector)

Seismic methods are the most common technique used to find gas hydrates today. It relies on the reflection of sound waves from the boundary between different geological layers. These techniques are not very sensitive to the presence of gas hydrate and the deposit must exceed about 40 % of hydrates in order to be detected.

If the hydrate layers are accompanied with a thin layer of free gas below the hydrate, this boundary will strongly reflect the seismic signal. It is called a BSR (Bottom Simulated Reflector) and can be located several hundred meters below the sea floor.

Any detection must be verified through traditional drilling techniques.

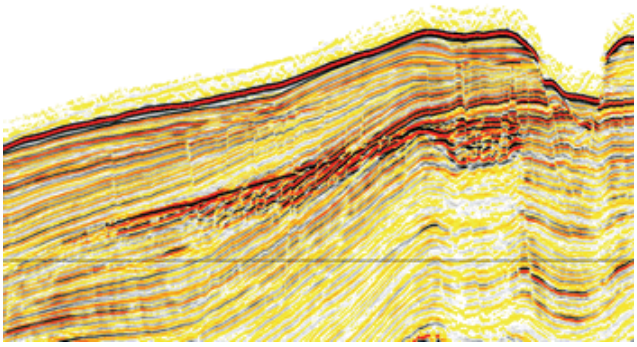


Figure: Seismic image. (to be replaced)

Technology

Keywords: Drilling, mining

Traditional petroleum drilling technology is used to reach the hydrate sediments. The bore hole is lined with a casing to prevent the fluids to leak out into other geological formations. At the level of the hydrate bearing sediments, the casing is perforated. The drilling operation at sea is performed from drilling ships whereas on land traditional drilling rigs are used.

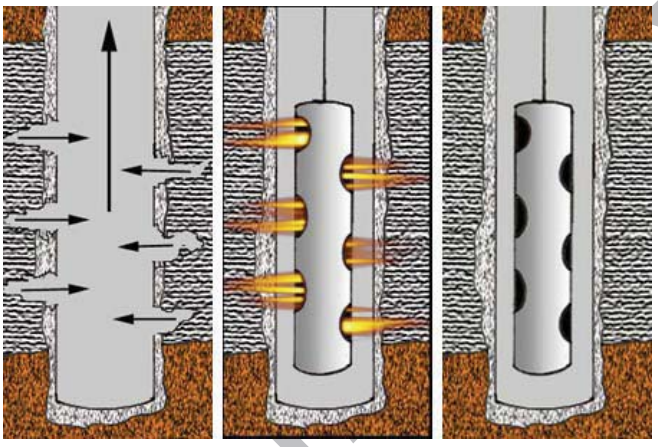


Figure: Perforating casing at production level
http://www.usoilandgas.net/cementing.htm

Exploitation

Keywords: Heat stimulation, depressurization

Contrary to production of conventional natural gas, which is done by letting the gas expand through releasing the pressure in the reservoir, gas hydrates in sediments must be produced by in-situ decomposition followed by conventional gas production. This can be done either by introducing heat or lowering the pressure to a place in the phase diagram, where the hydrates no longer are stable and the heat in the reservoir is enough to melt the hydrate.

In the first method, so-called heat stimulation, hot water or steam is injected into hydrate reservoir. As the ice melts, natural gas is released and is produced from the head of the well in the same fashion as conventional natural gas is produced, but for hydrates, the pressure is lower.

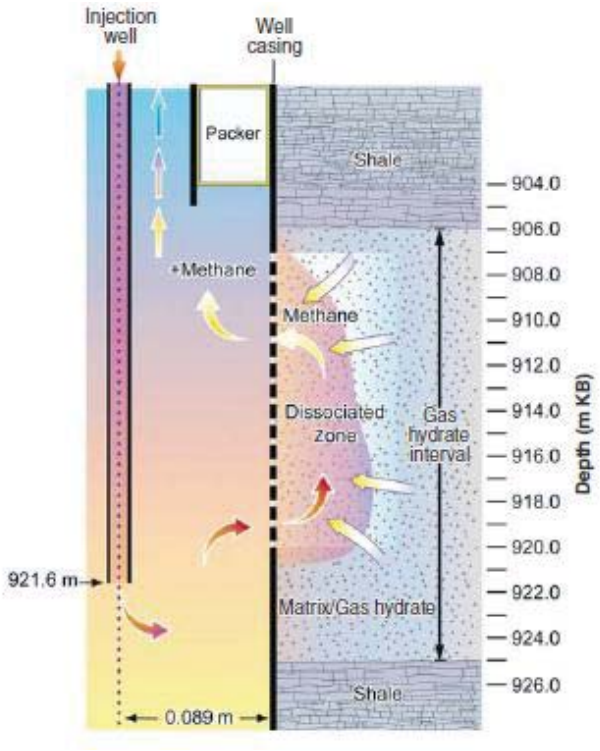


Figure: Heat stimulated production

In the second method, the reservoir is depressurized to a level where the heat from the surrounding rock is sufficient to melt the hydrate. This is done by pumping water out of the well at such a rate that the water level in the well remains constant such that the pressure in the well is low enough for the hydrates to become unstable. The heat from rock will eventually dissociate the hydrates and the produced gas will move to the surface.

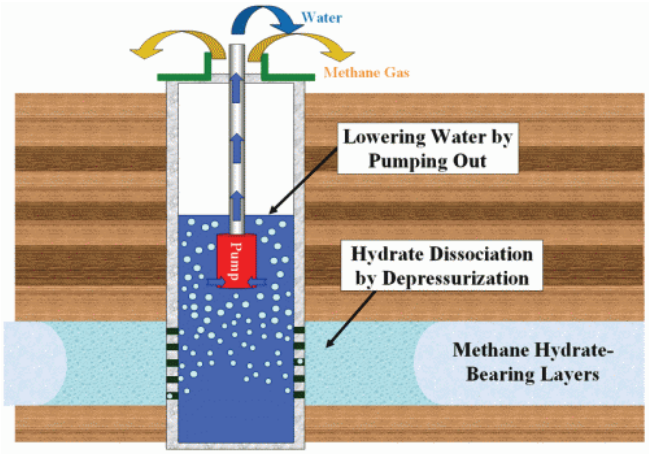


Figure: Production by depressurization
http://www.mh21japan.gr.jp/english/mh21-1/3-2/

Globally, there have been two test fields. The first one was an onshore test well in a permafrost covered deposit at Mallik in the Mackenzie delta in Canada. The second is an offshore site in the Nankai Trough formation in the Pacific ocean southeast of Japan.
https://en.wikipedia.org/wiki/Mallik_gas_hydrate_site
https://en.wikipedia.org/wiki/Nankai_Trough_gas_hydrate_site

Environmental impact

Key words: methane, CO2, NOX

Gas hydrates is considered a source of unconventional natural gas. Its environmental impact is through release of flue gases from combustion. The main ones are CO_2 and NOX. As with other sources of natural gas, free methane gas can be released during the exploration and processing of the gas. Even though methane is an important green house gas, it reacts with oxygen in the atmosphere, photo oxidation. Virtually all the methane in the atmosphere is converted to CO_2 with 10 years through photo oxidation.

Similarly, most slow releases from deep deposits will also be oxidized in the water before it will reach the surface. Since dissociation of hydrates requires energy, endothermic reaction, any rapid release of methane from the methane bearing deposits will also require large amounts of heat in a short time or large scale rapid depressurization. Such processes, like new volcanic eruptions or massive subsea landslides, are only likely on a geologic time scale.

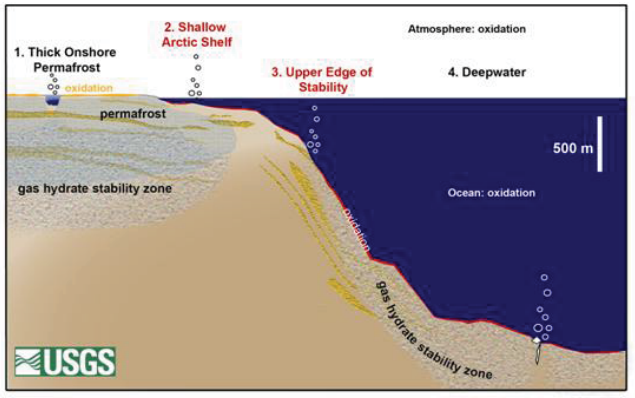


Figure:
http://www.usgs.gov/blogs/features/usgs_science_pick/gas-hydrates-and-climate-warming/

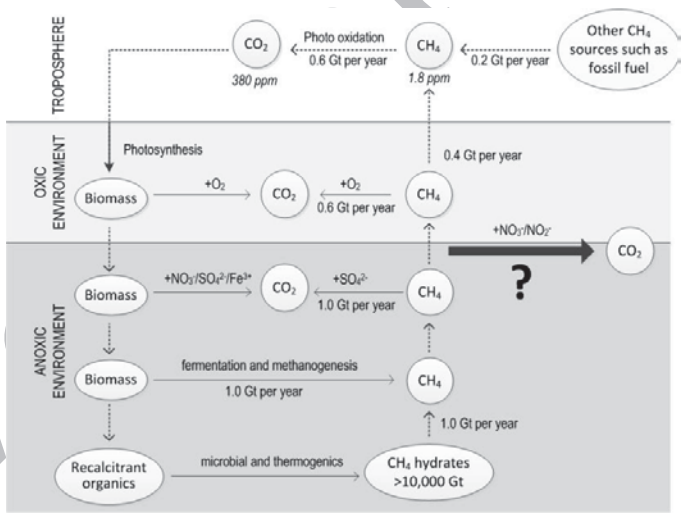


Figure: Decomposition of methane released from gas hydrate reservoirs.
http://www.awmc.uq.edu.au/establishing-a-missing-link-between-the-global-nitrogen-and-carbon-cycles-anaerobic-methane-oxidation-coupled-to-denitrification

Safety and security

Keywords: Spontaneous ignition, depressurization and volume expansion

The health and safety issues are mostly the same ones encountered for production and use of conventional natural gas. They relate to release and leakage from wells, and collapse of well casing. Because the hydrate deposits are in a solid state, rapid build up of gas pressure is less likely. As with all petroleum production installations, a safety flame, torching, is a required part of any operation.

http://oceanleadership.org/wp-content/uploads/2013/01/MH_Science_Plan_Final.pdf

http://www.netl.doe.gov/kmd/cds/disk10/labelle.pdf

Future development

Keywords: Solvents

If exploitation of the gas hydrates is commercialized, other techniques for production will be investigated. One is using a solvent like methanol to dissociate the hydrates, another one is using CO_2 to replace methane in each hydrate cage.

Web resources

Petrowiki
http://petrowiki.org/Gas_hydrates_in_nature

OSGS http://woodshole.er.usgs.gov/project-pages/hydrates/

Other related EnergyPages

Coal
Natural gas
Oil

Authors: Jon Samseth

ISBN
ISSN

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Activities of the Working Group on the Newtonian Constant of Gravitation

September 2015 – September 2016

Stephan Schlamminger – WG chair

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Introduction

The working group on the Newtonian Constant of Gravitation was created at the 28th General Assembly of IUPAP in November 2014. The purpose of this working group is to coordinate experimental efforts to measure the Newtonian constant or gravitation, *G*. This fundamental constant of nature describes the strength of gravity, the weakest of the four known fundamental interactions. The first laboratory measurement of the gravitational constant was carried out by Henry Cavendish at the end of the 18th century. In modern times, more than a dozen measurements have been described in the literature in the last 30 years. However, the agreement between the results is poor. The best results achieve relative standard uncertainties of about 20 parts in a million, but the relative difference between the largest and smallest value exceeds 500 parts per million. Clearly something is amiss. One task of the working group is to understand this problem.

Activities

The activities of the working group in the reporting period can be sorted in three broad categories.

Support of Experimental Work

In spring of 2016, a torsion balance that has been used by T.J. Quinn and collaborators at the Bureau International des Poids et Mesures (BIPM) to measure the gravitational constant was shipped to the National Institute of Standards and Technology. The idea behind this move is to repeat the experiment at a new site with different scientists. Being able to reproduce results is an important feature of the scientific method and it seems surprising that for big G measurements this has never been attempted before, especially since the results are discrepant. First result of the apparatus in the new location can be expected in 2017.

Currently some members of the working group are involved in securing another big G experiment. The apparatus used by Faller and Parks is at the Joint Institute for Laboratory Astrophysics in Boulder Colorado and is no longer in use. There is danger that the international community may lose this apparatus. To avoid this, the working group will move the apparatus to NIST. This move will allow for maintenance of the experimental equipment so that eventually this measurement can be repeated, too.

Communication and Outreach

The working group helped to organize an invited session on the measurement of the gravitational constant at the April Meeting of the American Physical Society in Salt Lake City. Three members of the working group gave invited talks on the subject. This event prompted several articles in the press, most notably an article by Adam Mann in the Proceedings of the National Academy of Sciences of the USA. The working group wrote an article for the IUPAP newsletter.

Providing expertise to scientists

The National Science Foundation held an Ideas Lab on the measurement of the gravitational constant. The goal of the Ideas Lab was to interest new groups in measuring big G and to come up with new techniques. The participants of the ideas lab were guided by mentors which were provided by the IUPAP working group on the gravitational constant.