

GWIC Meeting Summary

Cascina, 19 May 2008

David McClelland	ACIGA
Massimo Cerdonio	AURIGA
Eugenio Coccia	EXPLORER/NAUTILUS
Jim Hough	GEO 600
Jay Marx, Dave Reitze, Albert Lazzarini	LIGO
Bernard Schutz	LISA
Kazuaki Kuroda	TAMA/LCGT
Benoit Mours, Francesco Fidecaro	Virgo
Jacques Cola	ET
Andrea Possenti (phone), Andrea Lommen	Pulsar Timing Community
Szabi Marka	2009 Amaldi Report
Stan Whitcomb	GWIC Executive Secretary

Minutes

1. Chair's Remarks

1.1. Welcomes and Introductions

- 1.1.1. Jim Hough, GWIC Chair, welcomed one new member to the GWIC: Francesco Fidecaro, the new Spokesperson of the Virgo, who replaces Adalberto Giazotto as one of the Virgo representatives. Jim expressed his appreciation for Adalberto's service in GWIC as one of its founding representatives. It was also noted that Kazuaki Kuroda was substituting for Masa-Katsu Fujimoto and Kimio Tsubono.
- 1.1.2. Jim welcomed invited visitors Szabi Marka, Andrea Lommen and Jacques Cola. Andrea Possenti was scheduled to attend but due to illness was later patched in by phone to talk about pulsar timing. The Agenda for the meeting (Appendix A) was briefly reviewed.

1.2. Report on PaNAGIC

Eugenio Coccia reported on the last meeting of PaNAGIC. Formally, GWIC is a sub-panel of PaNAGIC, which is itself a Working Group under IUPAP. (The most recent report from PaNAGIC to IUPAP on its activities is attached as Appendix B.) Currently, three members of GWIC also serve on PaNAGIC (Hough, Coccia and Fujimoto). Our relationship to IUPAP and PaNAGIC also serves as a formal link to the International Society for General Relativity and Gravitation (GRG) which is an Affiliated Commission (AC-2) of IUPAP.

GWIC will report on its activities to PaNAGIC at the PaNAGIC's next meeting (held at the TAUP conference in Japan in mid-September). With the recent progress toward bringing about international collaboration and the other activities, the GWIC report should be well-received. PaNAGIC must make a presentation to IUPAP in 2008 to renew its mandate from IUPAP, and the GWIC activities should be a large part of their case for renewal.

2. Report on GWIC Thesis Prize

2.1. Competition for 2007

Stan reported on the selection of the 2007 winner. Nine nominations were received. The nominations spanned 7 countries and include two theses from outside the GWIC member projects, indicating that the Prize is getting increasing visibility. The selection committee was very impressed with the high quality of the theses.

The 2007 Thesis Prize is awarded to Keisuke Goda (MIT) for his thesis "Development of Techniques for Quantum-Enhanced Laser-Interferometric Gravitational-Wave Detectors." Unfortunately, Goda cannot attend the LISA Symposium to receive his award, but an announcement will be made at that meeting.

2.2. Plans for 2008

The process for 2007 (announcements, deadlines, etc.) seemed reasonably successful, so the 2008 competition will follow this pattern. The four members of the selection committee who were appointed this year will be asked to serve another term and the four that have already served two years will be replaced. GWIC members will be asked for suggestions for new committee members later this year via email. The 2008 Prize will be awarded at the Amaldi8 meeting in New York City.

3. Reports from Projects

3.1. AURIGA/DUAL:

The Auriga website is <http://www.auriga.inl.infn.it/>. Highlights include:

- runs “continuously” with minimal attendance
- data quality traceable at all times on website
- all data archived and preserved [GPS time]
- ready for any analysis upon “trigger”
- trying coincidences with LVD triggers
- IGEC will continue
- demonstrated “cold damping” of modes to about 100 μ K (Phys Rev Letters in press)
- *will be phased out as gw detector as soon as enhanced LIGO/Virgo will be on the air*
- will then consider options to perform precision measurements on quantum limits and/or tests of relativistic gravity [Trento SQUID noise below 10 quanta]

The Dual Website is <http://www.dual.inl.infn.it/>. Highlights include:

- encouraging results on materials, bonding, configurations, antenna pattern
- show stopper from thermal noise of mirrors coating low mechanical Q: the expected 1–4 kHz sensitivity is comparable to that of broadband advanced ifos
- *will complete study in 1y and put in stand-by [not in a position to start research on coatings...]*

3.2. EXPLORER/NAUTILUS:

The ROG Collaboration website is <http://www.lnf.infn.it/esperimenti/rog/>

- both detectors run “continuously” with minimal attendance
- data quality traceable at all times on website
- all data archived and preserved [GPS time]
- ready for any analysis upon “trigger”
- IGEC will continue
- study of the effect of cosmic rays both on Explorer and Nautilus
- a dedicated experiment (RAP, <http://www.lnf.infn.it/esperimenti/rap/>) is being performed on the Frascati electron beam with cryogenic resonant bars of various material

- development of algorithms for correlating the output of GW detectors in correspondence of astrophysical triggers
- both will be phased out as GW detectors as soon as enhanced LIGO/Virgo will be on the air

3.3. GEO

GEO has been running as part of Astrowatch since October 2007 with > 80% duty cycle, and only minor, low-risk commissioning being undertaken.

Upgrading to GEO HF with improved high frequency performance will commence in Spring 2009. One of the aims of GEO HF will be the demonstration of stable reliable interferometer operation with the use of squeezed light techniques.

A new prototype system is being built up in Hannover to allow the investigation of a range of potential detector upgrades.

3.4. LIGO:

LIGO ended its S5 Science Run at the end of September 2007. Installation of a set of minor upgrades for LIGO's two 4km interferometers, called Enhanced LIGO, started shortly thereafter. Work is progressing well and Enhanced LIGO is still on track for operation in early 2009.

The 2 km interferometer has been kept intact, and is being operated by a team of graduate students in "Astrowatch" mode, during nights and weekends. This effort started in January and will continue until Enhanced LIGO is operational.

Two important LIGO funding decisions were made by NSF this year. The award for Advanced LIGO was approved by the National Science Foundation and the funding started April 1. At the same time, the NSF awarded Caltech and MIT the grant to operate the LIGO Laboratory for a 5 year period beginning 1 October 2008.

One of the issues which the National Science Board in conjunction with the funding of Advanced LIGO and the LIGO Lab operation was the issue of public release of LIGO data. The NSF is moving increasingly toward a requirement for all NSF funded activities to make their data available after a reasonable period of time. The LIGO Lab is beginning to study how to respond to NSF on this issue. The existence of inter-project agreements governing data-sharing will necessitate getting the input from other GWIC members.

3.5. LISA:

3.5.1. United States/NASA:

No report.

3.5.2. Europe/ESA:

No report.

3.6. TAMA/LCGT/CLIO/DECIGO:

TAMA300

After the shaking down and tuning of the SAS, the power recycled operation of TAMA300 has been recovered. Sensitivity improvement up to 200Hz was confirmed although further tuning of the interferometer system is needed for the higher frequency band. The proposal for enhancement by introducing an RSE configuration was recently approved.

LCGT

The budget request for the construction of LCGT has been submitted to the University of Tokyo and it is recommended by a review panel of the University to be included in the request file for the next financial year (begins in April, 2009) to the Ministry of Education, Sport, Culture, Science and Technology by this June. The frame work of the approval and recommendation of such a big basic science project in universities as LCGT has been missing in these three years (2005-2007) but the Science Council of Japan published a report of the necessity last year to the Ministry. Our request is being processed according to this proposed frame work. With the strong support of GWIC, the Ministry is taking a positive attitude for LCGT this year.

DECIGO

DECIGO pathfinder (DPF) has been selected as one of the five important mission candidates for the small science satellite series run by JAXA/ISAS. They plan to launch three missions during five years starting from 2011, and other mission has been already selected as the first mission. We have been doing R&D to demonstrate the availability of technologies required for DPF and plan to submit a Phase-A proposal at the end of this year, and then the selection for the 2nd and 3rd mission will be made.

3.7. Virgo:

The commissioning period that started in 2007 after the first Virgo Science run was very fruitful. Work concentrated on length and angular sensing and control at low frequency and on reducing the effects of environmental noise. Magnetic coupling to the mirrors and diffused light effects were strongly reduced. This allowed to lower noise at low and intermediate frequency bringing the actual sensitivity near design. The averaged BNS horizon achieved was above 6 Mpc and the sensitivity in the band 10-40 Hz is unprecedented.

The commissioning activity was interrupted on May 5 due to the breaking of a viewport during evacuation of the North End Tower after an intervention on the NE mirror magnets. Nobody was hurt but the mirror got damaged by the viewport debris. The large valve at the end of the 3km North arm was closed

limiting damage to the tower only. An investigation of the cause of this failure is in progress. The shutdown for Virgo+ planned for the end of May was anticipated and thanks to an extraordinary effort in producing a new NE mirror it is expected to restart with Virgo+ commissioning in the early fall, as planned to start the second Virgo Science Run (VSR2) around mid 2009.

The preparation for the discussion of Advanced Virgo by the funding agencies is progressing. First expenditure is expected for 2009.

3.8. ACIGA:

International and National Advisory Committees were convened to advise on how to advance the cause for a second generation (2G) interferometer in Australia, AIGO. These committees recommended the development of a roadmap. Based on the assumption that 2G facilities have a limited lifetime (7 to 10 years) any new 2G facility needed to be operational by 2016-17 to be a significant contributor to a global network. This then leads to the need for construction funding to begin by 2010, 2011 - the window of opportunity. In order to build a 2G facility on such a fast timescale from a greenfield site, the Roadmap recommends copying an already fully designed 2G instrument - AdvLIGO. AdvLIGO was supportive and the NSF raised no objections. Our goal is to be prepared and ready if our new government calls for submission for major research facilities.

However, the assumption above rests on the recommendations of the Global roadmap being prepared by GWIC. It may be the 2G facilities have a major role in a 3G network, giving them a much longer lifetime..

3.9. Spheres/miniGRAIL:

No report

4. Pulsar timing for GW detection (Andrea Lommen, Andrea Possenti)

Presentations on the current of gravitational wave searches using pulsar timing, and descriptions of the three collaborations currently active in this area were made by Andrea Lommen (Appendix C) and Andrea Possenti (Appendix D). Progress in identifying new, very stable pulsars and in improving the timing accuracies has been impressive over the past few years, and in the next few years, the detection of a stochastic background and/or a supermassive inspiral/merger signal are quite plausible.

There are three international collaborations, each with its own governance and rules of operation. The three are beginning to discuss closer collaborations among themselves, with a meeting schedule at Arecibo August 1-2. There was a discussion of possible ways for this community to engage with GWIC, and the two presenters indicate that although they could not speak for their collaborations without further consultation, they thought that the timing community would like to be a part of GWIC.

5. The Einstein Telescope (Jacques Colas)

Jacques Colas made a brief presentation on the Einstein Telescope (ET). This presentation is reproduced in Appendix E. ET is a design study for a third generation ground-based interferometric detector.

The funding for the ET design Study comes from the European Commission through its FP7 and ILIAS programs. The design team involves a broad group of GEO and Virgo scientists. EGO will act to coordinate the ET activities. They are currently establishing the executive board and the science team.

6. Meeting Reports:

6.1. Amaldi8 Meeting

Szabi Marka reported on the planning for the Amaldi8 meeting, to be held at Columbia University, June 21-26, 2009 (see Appendix F for a copy of his presentation).

GWIC generally approved of the plans. Some note was taken that the current schedule has two parallel sessions. It was pointed out that this had never been done before in the Amaldi series. Szabi responded that he was expecting a large attendance, and want to be able to accommodate more oral presentations. He also indicated that the schedule could be altered to respond to actual requests for talks.

Szabi highlighted the plans to hold a series of "Wake-up Lectures". These would be typically local speakers talking on areas of physics outside of gravitational waves, but with some relevance. The general concensus was that this sounded valuable.

The final discussion was about proceedings. Here GWIC recommended to follow the model established at Amaldi7 (Plenary talks and selected contributed talks to CQG, with other contributed talks to the *Journal of Physics: Conference Series*).

Szabi suggested that the GW community should gain ownership of the address www.amaldi.org, which can then be used as an entrypoint for past and future Amaldi meetings. Szabi subsequently secured this name and has posted a simple page providing links to the Amaldi series.

Action Item: GWIC expressed its intention to serve as the Scientific Organizing Committee for the Amaldi meeting. Consequently it needs to identify plenary speakers and topic, and session conveners at the earliest possible time, and provide those names to the Local Organizing Committee. .

6.2. LISA Symposium:

Alberto Lobo was unable to attend the GWIC meeting, but Stan walked us through a presentation sent by Alberto on the preparation and plans for the LISA Symposium to be held in Barcelona June 16-20, 2008. (His presentation is

attached in Appendix G.)

The principal remaining question concerns the Proceedings. CQG has not yet made a final decision about publishing them. If they decline, then Lobo intends to use *Journal of Physics: Conference Series*. There was some discussion about whether there was sufficient value in *JoP Conference Series* to motivate speakers to write up their talks, but no better plan emerged.

6.3. GWDAAW:

GWDAAW13 will be held 19-22 January 2009 in San Juan, Puerto Rico. The shift of the date to January will reduce the conflict with other December meetings (notably, the LSC-Virgo Collaboration meeting and the Texas Symposium), but may have an effect on attendance.

6.4. GWADW:

The GW Advanced Detector Workshop (commonly known as the Aspen meeting) which had just been held at Elba was discussed. Many of the GWIC members had attended this workshop and the consensus was that it had been very productive. The beginning of the ET design Study seems to have generated new interest in the longer term future of detector technology. After a couple of times of more widely spaced meeting, many felt that it was time to shift the GWADW series back to an annual one.

A suggestion was made that since the ultimate goal is a global network that it might help foster interest more broadly if the GWADW meeting could be hosted in different regions from year to year. In keeping with this goal, GWIC recommended that a venue in the US for May 2009 be investigated.

7. GWIC Roadmap report (Jay Marx)

Jay Marx presented the status of the GWIC roadmap which he and his committee are preparing (see Appendix H for a copy of his presentation). The target is to complete it by the fall.

There was some discussion of the Roadmap. A key point was that GWIC emphasized need for buy-in from community and several suggestions were made about how to get this. These included more active solicitation of input from the community, and asking for a few carefully suggested readers to comment on it when it is in an advanced state.

A final topic that was raised was how to increase the role of GWIC in helping coordinate the world-wide activity. ICFA plays such a role in international accelerator planning (particularly for the ILC), with essentially the same "legal" status as GWIC. The question is how does it get its authority. This will likely be a discussion topic for the future.

8. Closed Session: Discussion of new members

GWIC met in executive session to discuss the presentations on Pulsar Timing and the Einstein Telescope. The following two action items resulted from this meeting:

Action Item: The three pulsar timing collaborations will be asked to propose how they should be represented in GWIC. The pulsar timing community is holding an international meeting at Arecibo August 1-2, and this would be a natural venue for them to discuss this question.

Action Item: The Einstein Telescope project would be invited to join GWIC as a "small" member project, i.e., entitled to one representative. The Einstein Telescope project team will be asked to identify one of the members of its leadership team to serve as its representative on GWIC.

9. Next GWIC Meeting:

There was a brief discussion of the date/venue for the next meeting. The logical date seems to be Sunday, June 21, 2009, the day before the Amaldi8 meeting in New York City. This date will be confirmed with the Amaldi8 organizers and confirmed with the GWIC membership via email.

The meeting was then adjourned.

Appendix A

Agenda

- 9:00 Welcome and introductions
- 9:05 Report from the chair
including: actions after last meeting, PaNAGIC, etc
- 9:20 Report on GWIC Thesis Prize (update by stan)
- 9:30 Reports from the Projects
very brief, no slides, please tell about project/agency plans and submit a prepared statement for the minutes
- 10:00 Collaborative R&D projects: review of collaborative activities in technologies and data analysis
- coffee break**
- 10:40 Meeting report: Amaldi8 (Szabi Marka)
- 10:50 Einstein Telescope Project (Jacques Colas)
- 11:20 Pulsar Timing (Andrea Lommen, Andrea Possenti)
Pulsar timing science and status
Pulsar timing projects and collaborations
Relationship to GW community
- 12:10 Closed session: Discussion of possible new members
- 12:40 **Lunch**
- 13:40 Meetings: Short reports
LISA Symposium
GWADW ('Aspen')
- 14:00 GWIC Roadmap (Jay Marx)
Report
Discussion
- 16:00 Closed session (if needed)
- 16:30 Wrap-up, any other business; date of next meeting
- 17:00 Adjourn

GWIC

May 19, 2008

Appendix B

Report on PaNAGIC Activities

Eugenio Coccia

PaNAGIC Report to IUPAP Council and Commission Chairs

August 31, 2007

PaNAGIC (Particle and Nuclear Astrophysics and Gravitational International Committee) is a Working Group (WG4) of IUPAP. It 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 mandate was extended twice by the IUPAP General Assembly in October 2002 (Berlin) and October 2005 (Cape Town). PaNAGIC reports to Commissions C4, C11, C12 and C19, with a primary relation to C4 and a connection to AC2. The Committee has 16 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 is included below. This brief report covers the activities of PaNAGIC for the last year and a half.

PaNAGIC current 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. This brief report covers the activities of PaNAGIC since the renewal of its mandate by the GA in October 2005.

The committee generally meets once per year, during the International Neutrino Conference series (even years) and during the TAUP (Topics on Astroparticle and Underground Physics) Conferences (odd years). It met in Santa Fe (USA) in June 2006 during the Neutrino Conference, and will meet in Sendai (Japan) in September of 2007 during the TAUP Conference. It also held a phone-meeting in the spring of 2006.

One of the major activities of PaNAGIC was the promotion of the TAUP workshops (which had been taking place for a number of years in Italy and Spain) to a worldwide event, sponsored by IUPAP as a "class B" Conference. 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. The latest edition in Zaragoza, Spain, in September of 2005, was attended by 270 people and a high attendance is also expected for the coming edition in Sendai, Japan. PaNAGIC members help in the organization of the Conference, some by being part of the TAUP Steering Committee and others by taking part in the International Advisory Committee. Starting in Sendai it will become customary that the Panagic Chair gives a brief report of its activities to the TAUP Conference.

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. On this respect PaNAGIC also appoints or seeks advice from panels and committees for particular sub-fields when this is considered useful for carrying out its tasks. Particularly

important is the GWIC (Gravitational Wave International Committee) Committee, which was an existing body, created by the initiative of the community of researchers in gravitational waves. GWIC asked to be associated to PaNAGIC and this was favorably considered.

GWIC recommended that the existing Edoardo Amaldi Conference series became the main forum for gravitational waves research, something that is now happening. This biannual Amaldi Conference also has IUPAP support and sponsorship as “class B” conference and its location rotates internationally. GWIC also oversees the organization of two annual workshops on its field of interest and helps coordinating activities toward a possibly global network of detectors, which would make use of GRID distributed computing for data analysis. Initial results from “bar” and “interferometer” networks are already published.

PaNAGIC future activities

In addition to continuing with the co-organization of TAUP and Amaldi Conferences (the latest through GWIC) PaNAGIC is considering two large actions:

1) Ever since the establishment of the Committee it was recognized that a high- level comprehensive school (or schools) in the field of particle astrophysics would be of major importance to help in the development of a common culture in this field, world-wide. A successful school is already taking place in Europe, notably the ISAAP (International Schools on AstroParticle Physics) School, recognized by some universities as part of their doctoral program. Discussions are now formally taking place between PaNAGIC and the ISAAP organizers to make the school world-wide, either by moving it outside Europe in some years or by organizing several regional schools with the same format.

2) "Regional Road-maps" of the field of Astroparticle Physics are also being prepared. In particular in Europe, the ApPECC road-map is about to be completed. An action where PaNAGIC can help is in the coordination of the different road-maps. There is a real need for this coordination, given that most large experiments involve the world-wide community. How to initiate this coordination will be discussed in Sendai.

Membership of PaNAGIC

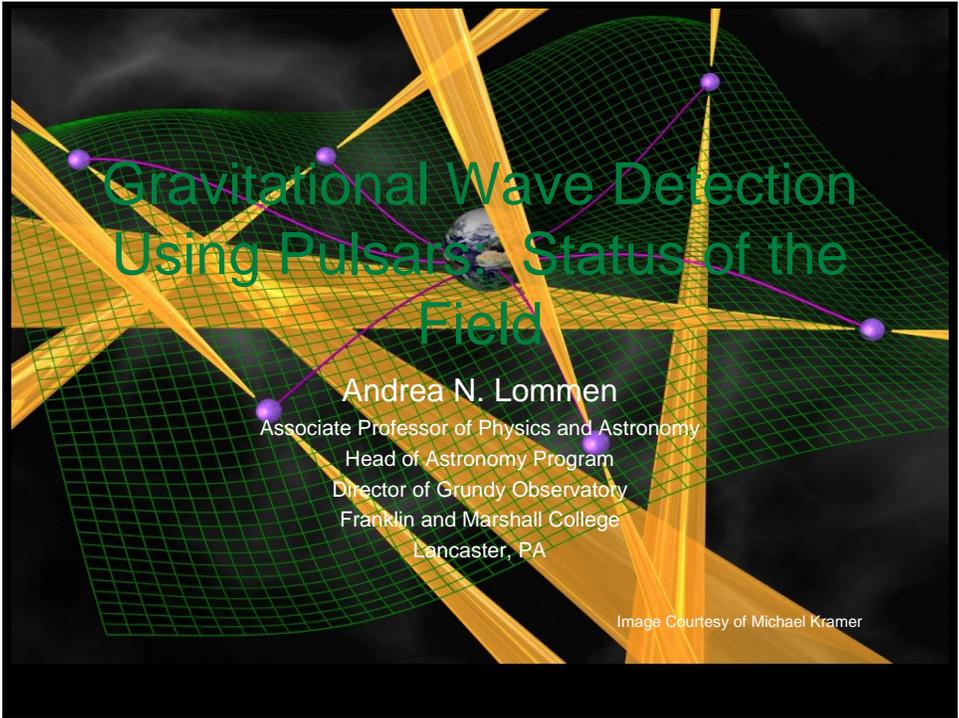
The present membership in PaNAGIC is the following (the nationality, starting date and IUPAP Commission membership, when applicable, are given in parenthesis):

Leonid Berzukov (Russia, 2007), Johannes Blümer (Germany; 2003); Eugenio Coccia (Italy, 2007), Enrique Fernandez (Spain, 2000; Chair since 2005), Victoria Fonseca (Spain, 2004), Joshua Frieman (USA, 2003), Masa-Katsu Fujimoto (Japan, 2004), Rohini Godbole (India, 2004, C-11), James Hough (UK, 2007; GWIC), Takaaki Kajita (Japan, 2003), Stavros Katsanevas (France, 2004), Paolo Lipari (Italy, 2004, C-4), Angela Olinto (USA, 2004), David Sinclair (Canada, 2004), Steve Ritz (USA, 2003, C-19), Michael Wiescher (USA, 2004, C-12).

Appendix C:

Gravitational Wave Detection Using Pulsars: Status of the Field

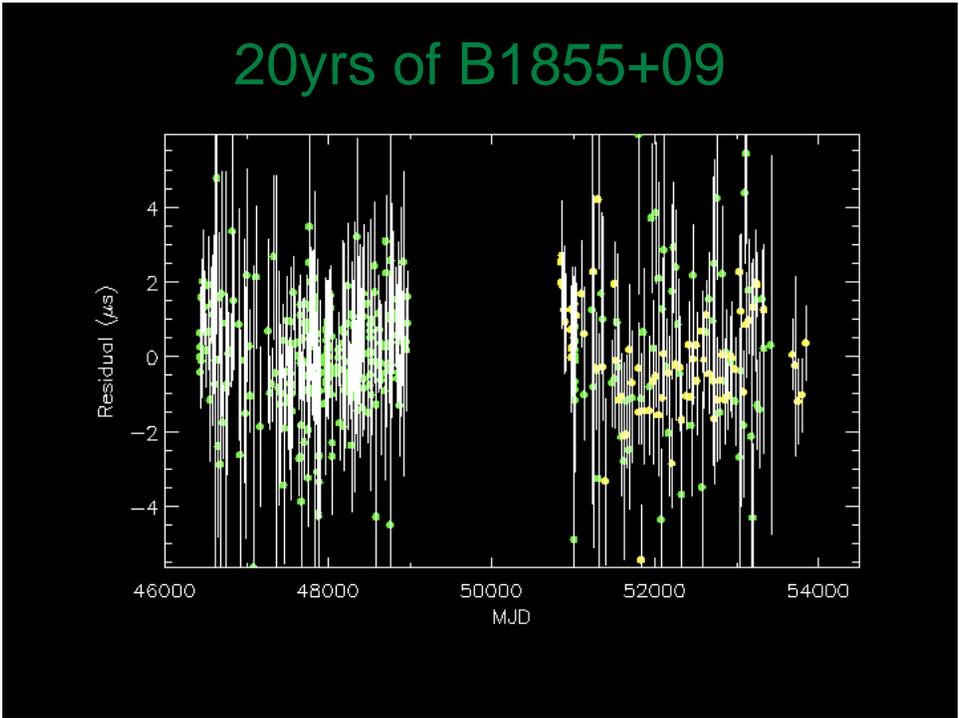
Andrea Lommen

A 3D visualization of spacetime curvature. A green grid represents the fabric of spacetime, which is distorted by a massive object (Earth) in the center. Several purple spheres are connected by lines, representing the paths of pulsars. The title "Gravitational Wave Detection Using Pulsars: Status of the Field" is written in green text across the top. The presenter's name and affiliation are listed in white text in the center.

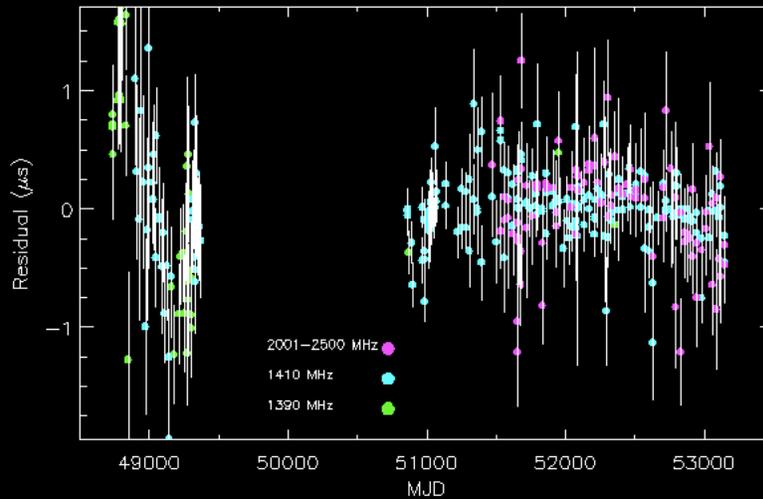
Gravitational Wave Detection
Using Pulsars: Status of the
Field

Andrea N. Lommen
Associate Professor of Physics and Astronomy
Head of Astronomy Program
Director of Grundy Observatory
Franklin and Marshall College
Lancaster, PA

Image Courtesy of Michael Kramer



PSR J1713+0747 over 12 years



Rms and dataspan are the currency of the field

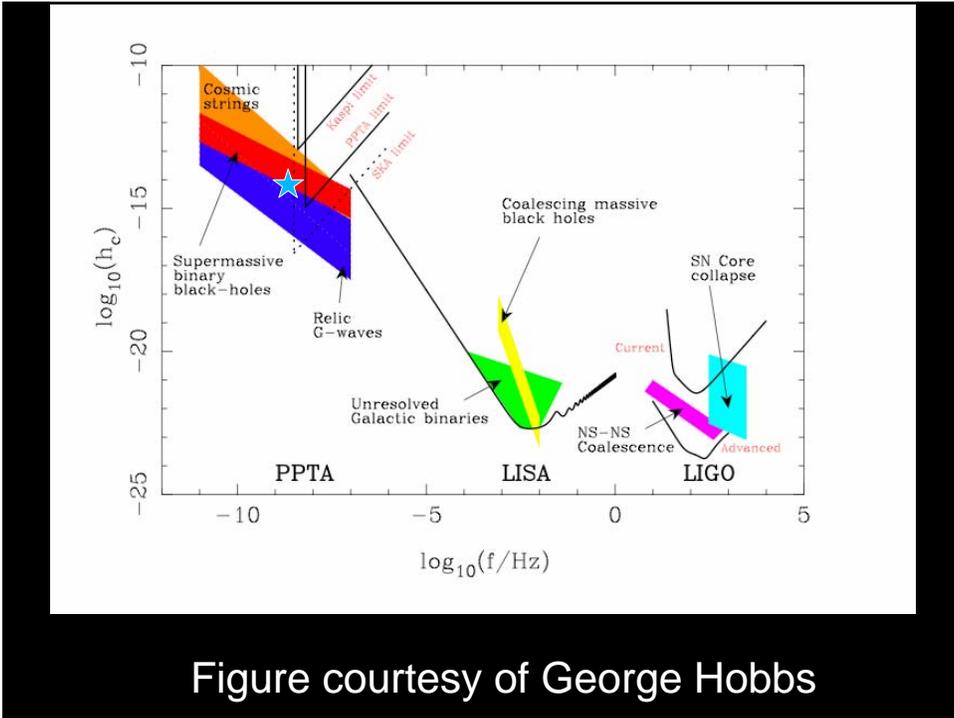
$$\Omega_{\text{gw}}(f) = \frac{2}{3} \frac{\pi^2}{H_0^2} f^2 h_c(f)^2$$

$$f_{\text{min}} = \frac{1}{\text{dataspan}}$$

$$h_c(f_{\text{min}}) \leq \frac{\text{rms}}{\text{dataspan}}$$

$$\Omega_{\text{gw}}(f) \leq \frac{\text{rms}^2}{\text{dataspan}^4}$$

← From Jenet, Hobbs, van Straten, Manchester, Bailes, Verbiest, Edwards, Hotan, Sarkissian & Ord (2006)



Current and Future Limits on the Stochastic GW Background

- Current limit: $\Omega_{\text{gw}}(1/8 \text{ yr}) \sim 2 \times 10^{-8}$ (Jenet et al. 2006)
- For full PPTA (100ns, 5 yr): $\sim 10^{-10}$
- Currently consistent with all SMBH evolutionary models (e.g., Jaffe & Backer 2003; Wyithe & Loeb 2003, Enoki et al. 2004)
- If no detection with full PPTA, all current models ruled out
- Already limiting tension in cosmic strings (Grishchuk 2005; Damour & Vilenkin 2005)

PPTA

Pulsars: Recent Results using PDFB2

- Two pulsars with rms timing residuals < 100 ns, seven < 500 ns, eleven < 1 μ s, all < 2.6 μ s
- Best results on J0437-4715 (52 ns) and J1909-3744 (97 ns)

Name	Period (ms)	DM (cm ³ pc)	Orbital period (d)	Rms Residual (μ s)
J0437-4715	5.757	2.65	5.74	0.05
J0613-0200	3.062	38.78	1.20	0.69
J0711-6830	5.491	18.41	-	1.26
J1022+1001	16.453	10.25	7.81	1.03
J1024-0719	5.162	6.49	-	1.01
J1045-4509	7.474	58.15	4.08	1.51
J1600-3053	3.598	52.19	14.34	0.41
J1603-7202	14.842	38.05	6.31	0.92
J1643-1224	4.622	62.41	147.02	1.00
J1713+0747	4.570	15.99	67.83	0.16
J1730-2304	8.123	9.61	-	1.34
J1732-5049	5.313	56.84	5.26	1.34
J1744-1134	4.075	3.14	-	0.36
J1824-2452	3.054	119.86	-	1.66
J1857+0943	5.362	13.31	12.33	0.72
J1909-3744	2.947	10.39	1.53	0.10
J1939+2134	1.558	71.04	-	0.13
J2124-3358	4.931	4.62	-	2.66
J2129-5721	3.726	31.85	6.63	1.57
J2145-0750	16.052	9.00	6.84	0.46

NANOGrav data sets

Arecibo:

7 pulsars

5-20 years of data on each

About 1 microsecond RMS

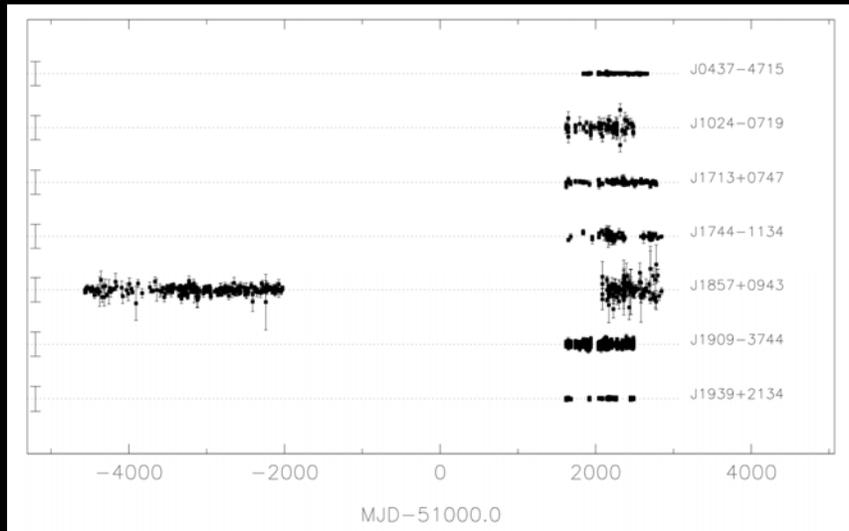
Every 2, then 4, then 6 weeks.

Greenbank:

Another dozen pulsars

2 years of data on each

Once a month



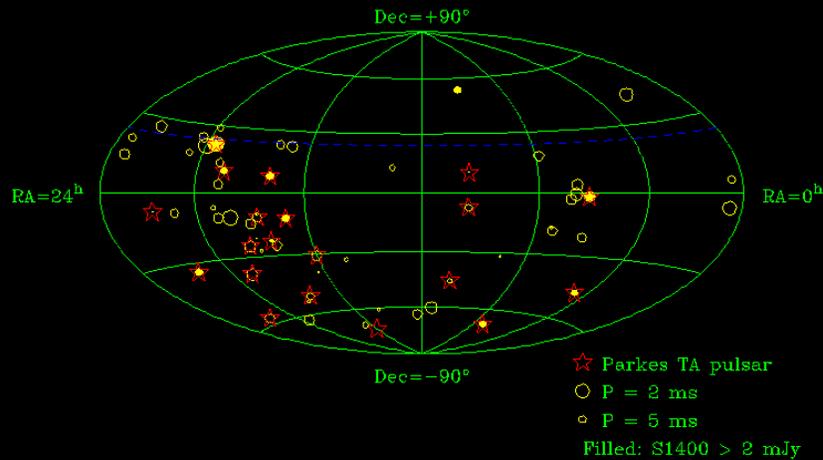
The PPTA Project: Goals

- To detect gravitational waves of astrophysical origin
- To establish a pulsar-based timescale and to investigate irregularities in terrestrial timescales
- To improve on the Solar System ephemeris used for barycentric correction

To achieve these goals we need ~weekly observations of ~20 MSPs over at least five years with TOA precisions of ~100 ns for ~10 pulsars and < 1 μs for rest

- Modelling and detection algorithms for GW signals
- Measurement and correction for interstellar and Solar System propagation effects
- Implementation of radio-frequency interference mitigation techniques

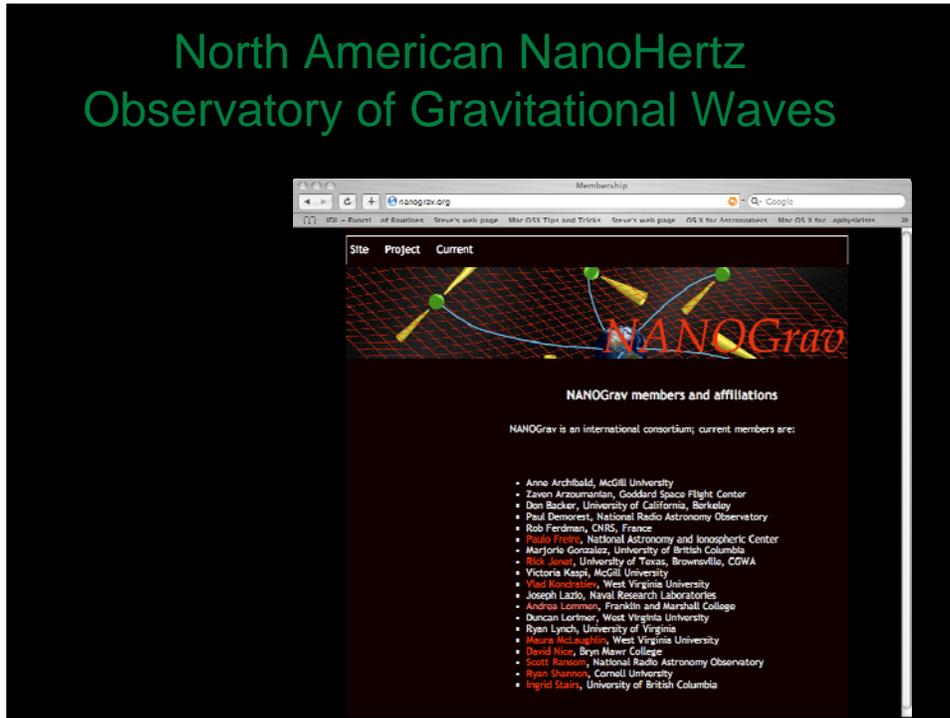
Sky Distribution of Millisecond Pulsars $P < 20$ ms and not in globular clusters



Recent Developments

- Processing database
 - Improved efficiency for pipeline processing
 - Easier access to intermediate processing steps
- Digital Filterbank (PDFB2/3) development
 - 1 GHz bandwidth
 - Real-time radio frequency interference rejection
 - PDFB2 commissioned in March 2007, PDFB3 in February 2008
- ATNF-Parkes-Swinburne Recorder (APSR) development
 - Coherent dedispersion of bandwidths up to 1 GHz
 - Uses PDFB3 as a front-end processor
 - Currently being commissioned
- GW simulations, detection algorithms and implications
 - TEMPO2, galaxy evolution studies
- International collaboration
 - Present: EPTA, NANOGrav; future: CPTA

North American NanoHertz Observatory of Gravitational Waves



The Parkes Pulsar Timing Array Project

Collaborators:

- Australia Telescope National Facility, CSIRO, Sydney
Dick Manchester, George Hobbs, David Champion, John Sarkissian, John Reynolds, Mike Kesteven, Grant Hampson, Andrew Brown, David Smith, Jonathan Khoo, (Russell Edwards)
- Swinburne University of Technology, Melbourne
Matthew Bailes, Ramesh Bhat, Willem van Straten, Joris Verbiest, Sarah Burke, Andrew Jameson
- University of Texas, Brownsville
Rick Jenet
- Franklin & Marshall College, Lancaster
Andrea Lommen
- University of Sydney, Sydney
Daniel Yardley
- National Observatories of China, Beijing
Johnny Wen
- Peking University, Beijing
Kejia Lee
- Southwest University, Chongqing
Xiaopeng You
- Curtin University, Perth
Aidan Hotan



The EPTA: partners

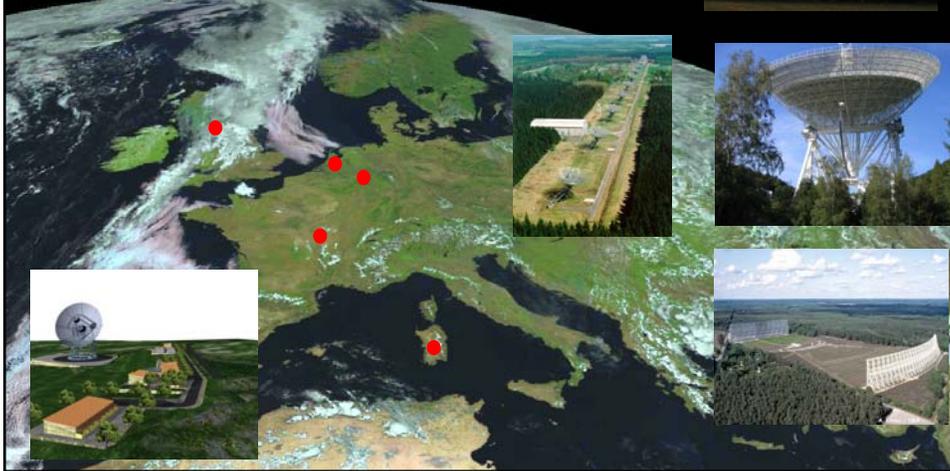
University of Manchester, JBO, UK

ASTRON, NL

Max-Planck Institut für Radioastronomie, GER

Nancay Observatory, FR

INAF Osservatorio Astronomico di Cagliari, IT



Summary

- Pulsar timing can and has ruled out individual systems by considering the effects of the gravitational waves those systems would produce.
- Burst detection is possible and makes the PTA a directional detector.
- With our current sensitivity we are limiting cosmic string tensions and just barely permitting all SMBH evolutionary models.
- Additional sensitivity will come from more pulsars, better sky coverage, lower rms, and longer dataspans.

Appendix D:

EPTA : the European Pulsar Timing Array

Andrea Possenti

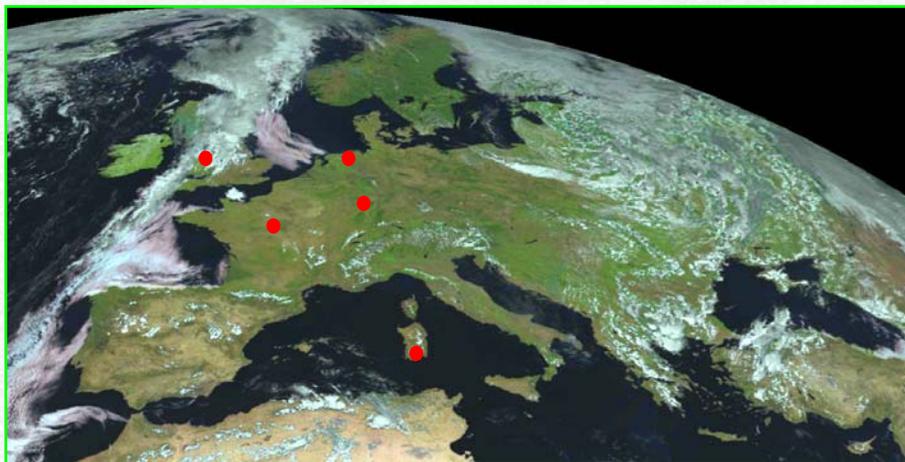
GWIC MEETING
VIRGO – Cascina - 19 May 2008

EPTA : the European Pulsar Timing Array

Andrea Possenti



The EPTA : the partner institutions



University of Manchester, JBO, **UK**

Nancay Observatory, **FR**

INAF Osservatorio Astronomico di Cagliari, **IT**
Max-Planck Institut fur Radioastronomie, **GER**

ASTRON, **NL**



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : the people

- **MPIfR:** Axel Jessner, Kosmas Lazarides, (Anton Zensus)
- **ASTRON:** Van den Leeuwen, Gemma Janssen
- **Un. of Manchester:** Michael Kramer, Andrew Lyne, Ben Stappers, Mark Purver, (Liu Kuo), Chris Jordan
- **Obs de Nancy:** Ismael Cognard, Gilles Theureau, Rob Ferdman, Alessandro Corongiu, Gregory Desvignes
- **INAF-Oss, di Cagliari:** Nichi D'Amico, Andrea Possenti, Marta Burgay, Maura Pilia
- plus engineers at all observatories



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : where it comes from

- Based on a long and fruitful collaboration dating back in early nineties
- Supported in the past by various EU programmes (TMA, FP6)



2005 Descartes
Prize of the
European Union
for collaborative
research



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : some relevant dates

- **Memorandum of Understanding (MoU) signed in January 2006 and Nancay joined in October 2006 with MoU signed in December 2006**
- **Students involved at all observatories since mid 2007**
- **Constituting workshop in October 2006 in Paris**
- **Second workshop in May 2007 in Cagliari**
- **Third workshop in January 2008 in Bad Honnef**



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : how it works

- **Coordinated source lists and partly-coordinated observing sessions**
- **Time Of Arrivals (TOAs) (and later raw data) shared among partners**
- **Access for every partner to set-up WIKI page**
- **Library of common synthetic multi-frequency templates (based on excellent experience with double pulsar timing)**
- **Open to international collaboration (sharing TOAs for joint goals)**
- **MoU with PPTA in preparation; hope to reach similar agreement with NANOGrav**



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : strong advantages (I)

➤ Unique feature of European astronomy: the availability of 4 (and soon 5) 100-m class radio-telescopes:

- Effelsberg (100 m)
- Westerbork (96 m)
- Nancay (92 m)
- Lovell (76 m)
- Sardinia (64 m)



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : the telescopes



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : strong advantages (I)

- Unique feature of European astronomy: the availability of **4 (and soon 5) 100-m class radio-telescopes**:
 - Effelsberg (100 m)
 - Westerbork (96 m)
 - Nancay (92 m)
 - Lovell (76 m)
 - Sardinia (64 m)
- All telescopes have **active timing programs**, allowing to collect a significantly larger (wrt other collaborations) number of TOAs
- Commensurate scheduling will offer a **better binary and yearly phase coverage**



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : strong advantages (II)

- **Wide range of observing frequencies**, allowing to combine various data sets and creating dense multi-frequency samples of TOAs
- **Simultaneous same frequency observations can be used in order to check polarisation calibration and overall timing offsets**
- Comparing the observation at various sites, telescope, instrumentation or observatory clock-based **errors on the TOAs can also be quickly identified and corrected**



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : the time devoted to pulsar obs

Telescope	Frequency (MHz)	Bandwidth (MHz)	T_{sys} (K)	Occurrence
Effelsberg	860	40	60	15%
	1400	100	20-25	
	2700	80	20-25	
	4900	500	30	
Jodrell Bank	8400	1200	30	70%
	1400	100	25	
	6000	500	25	
Nancay	1000-3500	128	35	44%
		328	60	120
WSRT	1100-1800	80	75	
		160	27	
		160	30	
		160	30	
		160	30	
Sardinia	300/1400	100/500	25	? 30-40% ?
		500	25	
		500	25	

In addition to regular timing, it is planned to perform simultaneous sessions at the same or different frequencies.



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : publication score

Papers using EPTA data. Published/submitted/in preparation.

published papers

- * [Chandra and RXTE studies of the X-ray/gamma-ray MSP J0218+4232](#)
L. Kuiper, W. Hermsen and B.W. Stappers, AdSpR 2004, 33, 507
- * [The phase of the radio and X-ray pulses of PSR B1937+21](#)
G. Cusumano, W. Hermsen, M. Kramer et. al., NuPhS 2004, 132, 596
- * [The European Pulsar Timing Array](#)
B.W. Stappers, M. Kramer, A. Lyne et al., ChJAA 2006, 6, 298
- * [30 Glitches in slow pulsars](#)
G.H. Janssen and B.W. Stappers, A&A 2006, 457, 611
- * [The binary pulsar J1811-1736: evidence of a low amplitude supernova kick](#)
A. Corongiu, M. Kramer, B.W. Stappers et al. A&A 2007, 462, 703
- [PuMa-II: A wide band pulsar machine for the WSRT](#)
R. Karuppusamy, B.W. Stappers and W. van Straten, PASP 2008, 120, 191

submitted papers

- * [EPTA timing of PSR J1518+4904](#)
G.H. Janssen, B.W. Stappers, M. Kramer et al, 2008, submitted to A&A

+ other 7 papers in preparation and due in 2008



GWIC meeting – 19 May 2008

"The European Pulsar Timing Array"

The EPTA : example of ToA uncertainties (μ s)

Pulsar	WSRT	Nancay	Effelsberg
PSR0034-0534	4.9	4.5	
PSR0218-4232	8.0		14.4
PSR0613-0200	2.6	1.4	5.6
PSR0621+1002	7.5	6.0	10.0
PSR1012+5307	1.4		2.9
PSR1022+1001	0.7		2.1
PSR1640+2224	4.1		3.1
PSR1713+0747	0.85	0.5	0.6
PSR1821-24	2.2	0.9	
PSR1855+09	2.0	2.5	(3.0)
PSR1937+21	1.3	0.3	0.9
PSR2145-0750	2.7	1.8	4.0

- Results for uncleaned data
- “Soon” improved hardware (PDFB3) at Effelsberg and Sardinia
- Longer term goal: **joint & identical european pulsar backend**

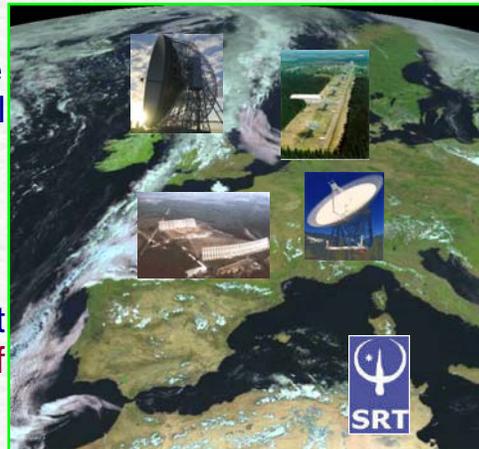


GWIC meeting – 19 May 2008

“The European Pulsar Timing Array”

LEAP : Large European Array for Pulsars

- ✓ To achieve even better sensitivity to GWs we are planning on combining all the telescopes “coherently”
- ✓ That gives a telescope with a **sensitivity equivalent to Arecibo**, but able to see **much more of the sky**
- ✓ It will test limits of **sensitivity and pulse jitter**



It also provides excellent tests of SKA-like pulsar observing



GWIC meeting – 19 May 2008

“The European Pulsar Timing Array”

GWIC

May 19, 2008

Appendix E:

The Einstein Telescope

Jacques Colas



ET: Einstein Telescope

Jacques COLAS
Based on presentation by
Michele Punturo
At GWADW 2008

19 May 2008 GWIC meeting 1

What's beyond?

- Second generation detectors:
 - Will permit the detection of Gravitational Waves (GW)
 - Will just open the era of the GW astronomy
 - Will be the “core business” of the next decade in experimental GW research
- But could we look beyond?
 - Precision GW astronomy needs high SNR to determine the parameters of the astrophysical process
 - Interesting phenomena involves massive bodies that requires low frequency sensitivity in GW detectors
 - We need to think to 3rd generation GW detectors

19 May 2008 GWIC meeting 2

Possible objectives

From detection and initial GW astronomy to precision GW astronomy

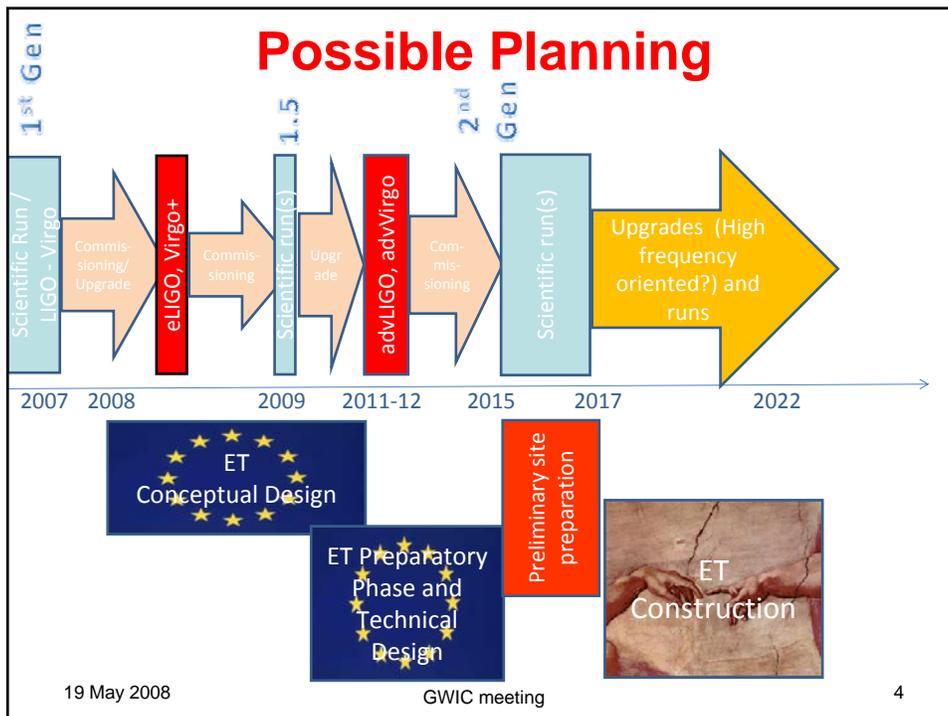
- **Fundamental Physics:** Test general relativity in the strongly non-linear regime
 - Initial and advanced detectors won't have the sensitivity required to test strong field GR (too low SNR)
 - Most tests are currently quoted in the context of LISA, but in a different frequency range
 - We need to have good enough SNR for rare BBH mergers which will enable strong-field test of GR
- **Black hole physics:**
 - What is the end state of a gravitational collapse?
- **Astrophysics:** Take a census of binary neutron stars in the high red-shift Universe
 - Adv VIRGO/LIGO might confirm BNS mergers, possibly provide links to γ -ray bursts
 - 3rd generation GW detectors should do much more: see different classes of sources (NS-NS, NS-BH) and contribute to resolve the enigma in the variety of γ -ray bursts

19 May 2008

GWIC meeting

3

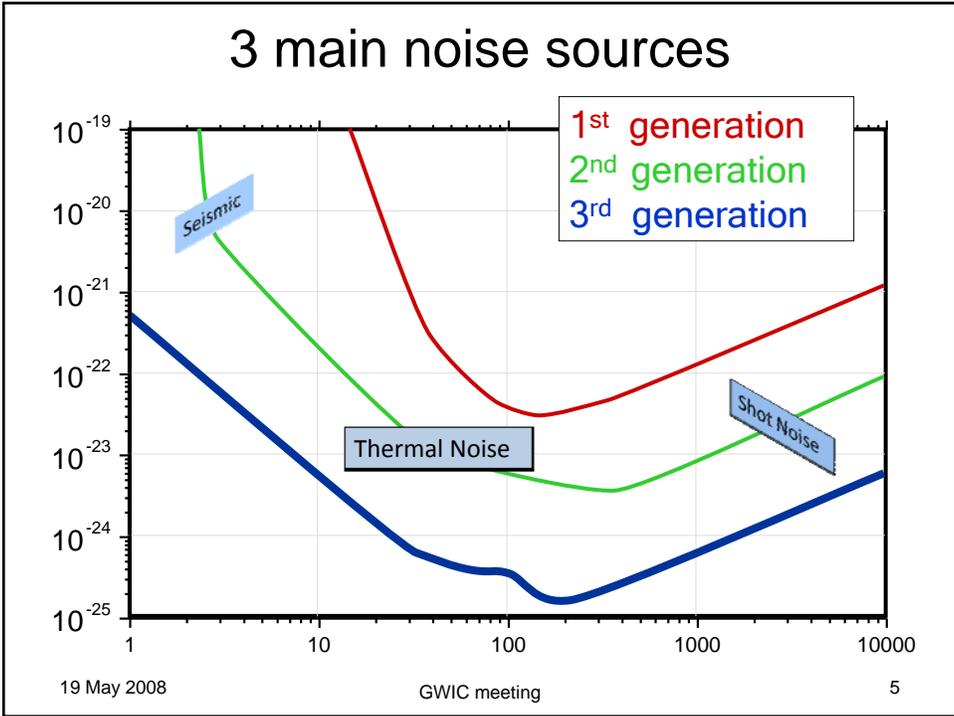
Possible Planning



19 May 2008

GWIC meeting

4



ET: Participants

Participant no.	Participant organization name	Country
1	European Gravitational Observatory	Italy-France
2	Istituto Nazionale di Fisica Nucleare	Italy
3	Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., acting through Max-Planck-Institut für Gravitationsphysik	Germany
4	Centre National de la Recherche Scientifique	France
5	University of Birmingham	United Kingdom
6	University of Glasgow	United Kingdom
7	NIKHEF	The Netherlands
8	Cardiff University	United Kingdom

19 May 2008 GWIC meeting 6



Status of the project



- We are concluding the administrative phase
 - Consortium agreement signed by all the institutions
 - Grant agreement between EGO and EU to be signed soon
- Official start-up date is the 5th of May 2008
 - First Executive Board meeting on May 13
- A budget of 3M€ for 38Months of activity
 - Main costs: man power and travels

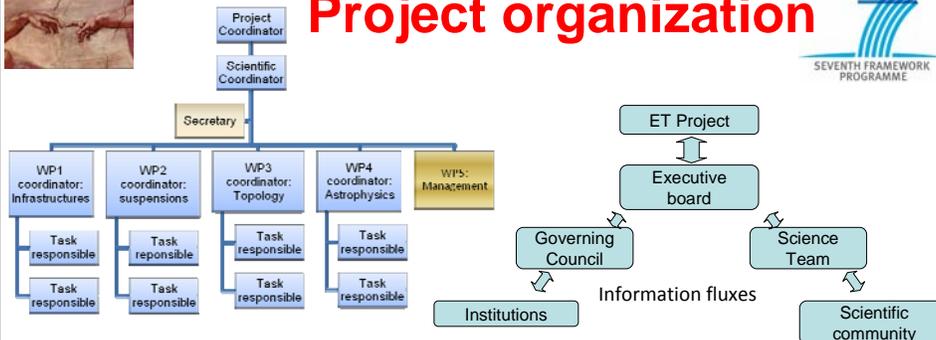
19 May 2008

GWADW, La Riedola, May 2008
GWIC meeting

7



Project organization



- Project organization driven by “Physics”:
 - Nominated scientific coordinators : M. Punturo, H. Lück (deputy)
 - 4 working groups for the major technical and scientific issues
 - WP1: Infrastructures J. Van den Brand
 - WP2: Suspension & Cryogenics P. Rapagnani
 - WP3: Topology & Optical layout A. Freise
 - WP4: Astrophysical and computing issues B. Sathyaprakash
 - Project coordinator : EGO

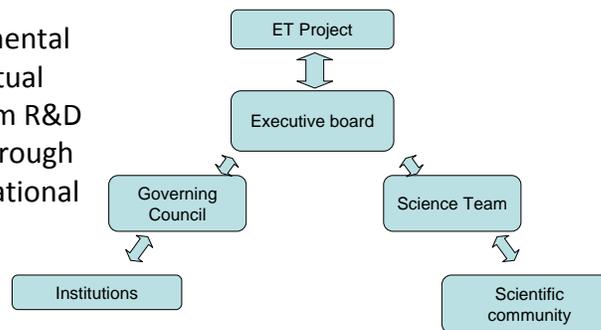
19 May 2008

GWIC meeting

8

WG & Science Team

- ET is an emerging facility for the whole Europe and contributions should not be limited to the founding team/institutions
- In the structure the special body “Science Team” permits the exchange with a larger Scientific Community
- Additional and fundamental support to the conceptual design must arrive from R&D activities supported through other European and national funding schemes



19 May 2008

GWIC meeting

9

Appendix F:
Amaldi 8 Preparations
Szabi Marka

Amaldi8 Progress Report



for Zsuzsa Marka



 **COLUMBIA UNIVERSITY**
IN THE CITY OF NEW YORK



Tentative Schedule

June 21, Sunday		Registration and Reception
June 22, Monday	9:00 AM - 12:00 PM 2:00 PM - 5:00 PM	Plenary Sessions Plenary Sessions
June 23, Tuesday	9:00 AM - 12:00 PM 2:00 PM - 5:00 PM evening	Plenary Sessions Parallel Sessions Public lecture
June 24, Wednesday	9:00 AM - 1:00 PM afternoon/evening	Plenary Sessions social events, banquet
June 25, Thursday	9:00 AM - 12:00 PM 2:00 PM - 4:30 PM late afternoon	Plenary Sessions Parallel Sessions Poster Session
June 26, Friday	9:00 AM - 12:00 PM 2:00 PM - 5:00 PM	Plenary Sessions Plenary Sessions
June 27, Saturday		Departures

"Wake up lecture" series for the mornings (e.g. 8:30-9:00am)
- local speaker (physics from dark matter searches, through cosmology, to neutrino/particle physics)

Checklist : 13 months before the conference (current)

- ✓ IUPAP proposal submitted: 12,000 USD (decision in October)
- ✓ Webpage purchased: <http://www.amaldi8.org/>
- ✓ Inquired about possible NSF funding, start proposal preparation
- ✓ Accommodation list preparation and reservation is ongoing
 - ✓ Columbia affiliated room selection under way (dorm and guest room)
 - ✓ Selecting other NYC hotel sites
- ✓ Conference room selection and reservation request is being negotiated at Columbia University
- ✓ Preparation of database of potential participants and contact points for conference posters, announcements and email circulars
- ✓ Reservation for conference dinner ongoing
- ✓ Reservation for Public event ongoing

Location

–Initial conference room selection request was discussed with the Scheduling Division of the Office of the Registrar (plenary section conference room and poster session room reservation can be finalized in January 2009, when have first estimate on number of attendees)

- Altschul Auditorium (402)
- Pupin Hall (up to 272)
- Havemeyer Hall (up to 339)
- Lerner Hall (up to 1500)

–Public event: Lerner Hall Auditorium (up to 1500) is available

–Poster session: Lerner Hall Auditorium or Lobby is available

Room charge (for Lerner Hall and some of the lecture rooms)

Security charge (for Public event it is a must)

Facility charge

Equipment charge





Accommodation:

- On campus accommodation details for the conference will be finalized in our *June meeting with Columbia University Guest & Conference Housing Office* from suite-style settings to private, single rooms
- Columbia's guest accommodation facility and Columbia affiliated institutions (International House, Teachers College - Whittier Hall, Union Theological Seminary)
- Off-Columbia hotels (will choose ~3 along #1 subway line, one of them will be in downtown)

Food: reception(1st day), small breakfasts, two additional (mid morning and mid afternoon) coffee breaks

- *Columbia Catering (University Event Management Office) – under discussion*
- Local companies (FreshDirect, an internet-based company)
- Local restaurant spectrum around the university is very wide (over 50 restaurants)



Conference Organization:

- Anticipate nominally ~350 attendees
- IUPAP Proposal submitted (decision in October), IUPAP US representative notified
- Science scope/program
 - GWIC and expert scientific advisors
 - Local Organizing Committee

Focus:

- research and development of ground (bar, lfo,...) and space based detectors
- results from already collected data (S5, VSR1,..., S6 (?), ...)
- connection of gravitational wave science to other fields of astrophysics and astronomy
- ...

We plan to send out first announcement next month (~1 year before conference), we welcome input from GWIC

- Local Organizing Committee:
Szabolcs Márka, chair (Columbia)
Lam Hui, David Helfand, Kristen Menou, Zoltan Haiman (Columbia), Janna Levin (Barnard), Zsuzsa Márka (Columbia)
Peter Saulson (Syracuse), Alessandra Buonanno and Peter Shawhan (Maryland), Erik Katsavounidis (MIT),
Laura Cadonati (UMass), Deirdre Shoemaker (PennState), Jolien Creighton (Wisconsin), Syd Meshkov (Caltech)

Kimio Tsubono (Tokyo), Martin Hewitson (AEI), Ik Siong Heng (Glasgow), Patrick Sutton(Cardiff)
additional members pending from France, Italy and Australia

Public Lecture: (at Lerner Hall auditorium at the University)

- Very likely a high profile outreach event.
- The City has a significant population of science enthusiasts.
- Reach local educational institutions.
- Existing good connections with local high schools.



Social Event/ Conference Dinner:

- Preferred location: American Museum of Natural History (can also host the banquet)** - currently discussing possibility of reduced price based on Columbia affiliation
- Other possibilities (e.g. cruise and dinner on World Yacht around Manhattan)
- Several other possible locations for banquet (e.g. Terrace in the Sky, next to Columbia)

Organized event possibilities for spouses (one of these):

- Museum trips (Guggenheim, MoMA, Metropolitan etc.)
- Top of the Rockefeller Center (best view of Manhattan)
- Manhattan sightseeing bus tour on a double-decker
- Afternoon Theatre show or concert
- Trip to Ellis Island/Statue of Liberty

Checklist : 11 months before the conference (July 2008)

- Local organizing committee telecon to **propose program (sessions) to GWIC => Send out first announcement circular via email and mail**
- Select and contact session conveners
- Public speaker selection (finalizing)
- Set proceedings format (page limits, instructions etc) with publishers (initial contact to CQG was already made)
- Prepare abstract preparation instructions (format, length etc)
- Start conference poster preparation (dates, location, website, contact, committees, topics, sponsors ?)
- Notify conference listings (SPIRES, etc.)
- Make list and start contacting possible sponsors for conference
- **Event coordination meeting with Columbia physics department administrators; creation of university account for conference expenses**
- Select company for web registration/payment process for the conference
- Update website with new information
- **Finalize accommodation list (June meeting with Columbia University Guest & Conference Housing Office personnel)**
- Finalize conference reception place (likely at Columbia on June 21, 2009) and get quotes on catering possibilities

Checklist : 9 months before the conference (Sept. 2008)

- Select social event possibilities and companion programs
- Select the caterer for conference breakfasts and coffee breaks
- Select printing facility for conference posters
- Conference backpack and other freebee options finalized
- Review existing and continue identifying possible sponsors
- Select room, date(s) for sponsor exhibition
- Update website (transportation information, information on additional hotels, dining guide in the university area, NYC information)
- Decision on registration forms, abstract submission procedures
- **Finalize plenary and parallel session lengths (how many talks?, what lengths?)**
- **LOC telecon, assign various jobs to LOC members**
- Confirm session chairs
- Confirm public speaker
- Computer needs: disk space for archiving conference presentation files
- Decide on and reserve equipments: projectors, video conferencing? (provided by Columbia)

7 months

Subset for the future...

- Finalize and print poster
- Finalize website (registration, abstract submission, accommodation options, proceedings instructions etc.)
- Assess expected number of participants: Final decision on conference fee

6 months

- Mail conference poster
- Email second announcement
- **Start of registration, and abstract submission**
- LOC meeting (invited speakers?)

4 months

- Email 3rd announcement

2.5 months (April 5)

- **Early registration deadline**
- LOC/SOC telecon: selection of plenary talks, parallel vs. poster selections
- Decision on sponsoring travel/conference registration for selected student/international attendees (provided that outside funds are available for this purpose)

1.5 months (May 4 2009)

- **Late registration deadline**
- Weekly/biweekly LOC/SOC meetings, set final program

AFTER

- 2 months after: Final budget assessment
Selection for CQG/JPC proceeding submissions
- 4 months after :Proceedings deadline

GWIC

May 19, 2008

Appendix G:

LISA Symposium 2008

Alberto Lobo



7th International LISA Symposium Barcelona, Spain, 16-20 June 2008

Organisation update as of 19-May-2008



**7TH INTERNATIONAL
LISA SYMPOSIUM**
ON THE LASER INTERFEROMETER SPACE ANTENNA (LISA)
AND THE NEW SCIENCE OF GRAVITATIONAL WAVE ASTRONOMY

BARCELONA - SPAIN
16 - 20 JUNE 2008

Science Organising Committee:
P. Baret (VPI)
M. Cantamano (I. Physikalisches Institut)
K. Danzmann (NASA/JPL, Hannover)
M. Doornik (I. Physikalisches Institut)
J. Hough (I. Physikalisches Institut)
D. Jarancho (IEEC)
P. Marzari (I. Physikalisches Institut)
A. Lobo (IEEC/CSIC/IEEC, chair)
Y. Mittleman (I. Physikalisches Institut)
B. Schutz (I. Physikalisches Institut)
T. Sponholz (I. Physikalisches Institut, London)
J. Van der Bruggen (I. Physikalisches Institut)
S. Vitell (I. Physikalisches Institut)
P. Bender (I. Physikalisches Institut)
S. Buchhorn (I. Physikalisches Institut)
J. Conrath (NASA/JPL/CSIC)
K. Crowder (I. Physikalisches Institut)
C. Cutler (NASA/JPL)
S. Fairhead (I. Physikalisches Institut)
J. Garofalo (I. Physikalisches Institut)
C. Hooley (I. Physikalisches Institut)
S. Hughes (I. Physikalisches Institut)
P. Inigo (I. Physikalisches Institut)
T. Prince (NASA/JPL)
S. Prasad (I. Physikalisches Institut)
D. Richardson (I. Physikalisches Institut)
T. Shaddock (NASA/JPL/CSIC)
K. Thorne (I. Physikalisches Institut)
R. Barstow (Stanford U.)
E. Cocchi (I. Physikalisches Institut)
C. Sopuerta (IEEC/CSIC/IEEC)
E. Castellani (I. Physikalisches Institut)
S. Kawamura (I. Physikalisches Institut)
J. Marzari (I. Physikalisches Institut)
S. Morikawa (NASA/JPL/CSIC)
B. Mours (I. Physikalisches Institut)
C. Neunert (I. Physikalisches Institut)
E. Vestergaard (I. Physikalisches Institut)
C. Will (I. Physikalisches Institut)

Local Organising Committee:
A. Barón (IEEC)
P. Calvo (IEEC/CSIC/IEEC)
C. Sopuerta (IEEC/CSIC/IEEC)
J. Lobo (IEEC/CSIC/IEEC, chair)
A. Lobo (IEEC/CSIC/IEEC)
M. Muñoz (IEEC/CSIC/IEEC)
P. Muñoz (IEEC)
M. Villaverde (IEEC/CSIC/IEEC)
J. Sanjaume (IEEC/CSIC/IEEC)

Logos: ESA, NASA, IEEC, SER, IFFA, etc.

http://www.ieec.cat/research/LISA_Symposium

**Official
Symposium
Poster**

*Selected in a
contest, with
18 proposals
received (see
web-page)*



Venue

IEEC



Pisa 19-v-2008

The LISA #7 LOC

3



Venue

IEEC

COSMOCAIXA
BARCELONA



<http://portal1.lacaixa.es/Docs/Chan/99/3-99-10-10000001.html>

Pisa 19-v-2008

The LISA #7 LOC

4



Facilities

IEEC

Room name Seats

Auditori	320
Agora	220
Alfa	55
Beta	55
Gamma	65
Omega	81
Additional #1	75
Additional #2	30

These rooms are fully equipped with audio/video utilities.

There is a *Wifi* link covering all the Symposium area .

An additional VIP lounge is available

Pisa 19-v-2008

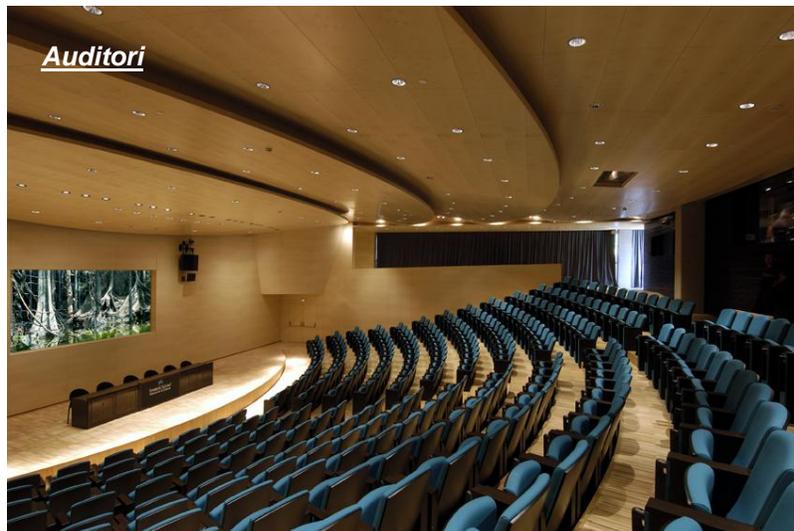
The LISA #7 LOC

5



Facilities

IEEC



Pisa 19-v-2008

The LISA #7 LOC

6

Web-page

IEEC

Pisa 19-v-2008 The LISA #7 LOC 7

Web-page

IEEC

CSIC

Functionalities:

- General information
- Information on venue and access directives
- Information on Committees
- Symposium Programme –updated as required
- Registration and abstract submission on-line
- Dynamically updated list of participants
- Accommodation directives and hints
- More...
 - GWIC Prize
 - Poster Gallery
 - Social events
 - ...

Site: http://www.ice.cat/research/LISA_Symposium/

Pisa 19-v-2008 The LISA #7 LOC 8



Symposium Committees

IEEC

SOC

Pierre Binetruy	Massimo Cerdonio
Karsten Danzmann	Mike Cruise
Jim Hough	Oliver Jennrich
Philippe Jetzer	Alberto Lobo (chair)
Yannick Mellier	Bernard Schutz
Tim Sumner	Jean-Yves Vinet
Stefano Vitale	Peter Bender
Sasha Buchman	Joan Centrella
Neil Cornish	Curt Cutler
Sam Finn	Jens Gundlach
Craig Hogan	Scott Hughes
Piero Madau	Tom Prince
Sterl Phinney	Doug Richstone
Tuck Stebbins	Kip Thorne
Roger Blandford	Eugenio Coccia
Carlos F. Sopuerta	Enrique Garcia-Berro
Seiji Kawamura	Jay Marx
Stephen Merkowitz	Benoit Mours
Gijs Nelemans	Enric Verdaguer
Clifford M. Will	

LOC

Anna Bertolín
 Priscilla Cañizares
 Carlos F. Sopuerta
 Ivan Lloro (chair)
 Alberto Lobo
 Nacho Mateos
 Pilar Montes
 Miquel Nofrarias
 Juan Ramos-Castro
 Josep Sanjuán

Pisa 19-v-2008

The LISA #7 LOC

9



Programme structure

IEEC

- *Morning sessions*: 2 (40 min) + 4 (25 min) invited plenaries
- *Afternoon sessions*: Two parallel sessions (3 hours)
- *Poster session*: Wednesday before lunch (~2 hours)
- *Public Talk*: **Cliff Will**, on BHs and GWs (Thursday evening)

Numerics:

- **31** plenary talks
- **10** parallel sessions (convenors now working on them)
- **138** abstracts received (in addition to plenaries)
- **217** registered delegates

Pisa 19-v-2008

The LISA #7 LOC

10



Finance

Supporting entities:



ESA



AEI



Spanish Ministry of Education



Spanish Nat. Res. Council



Host Institution



Regional Government



Spanish Society of GRG



Polytech. Univ. of Catalonia



Univ. of Barcelona



HEP Institute Barcelona



La Caixa

Delegate fee: **310 euro (370 euro after May 4th)**

Status: we expect to balance all Symposium expenses



Other activities/actions

Grant programme: estimated 12,000 euro

Proceedings:

- still waiting for CQG response, expected end of May
- alternative: *Journal of Physics Conference Series*

Social activities:

- Welcome reception, Sunday 15 evening
- Social dinner, Thursday 19 evening
[\(http://www.ice.cat/research/LISA_Symposium/more/social_events/\)](http://www.ice.cat/research/LISA_Symposium/more/social_events/)

GWIC

May 19, 2008

Appendix H:

GWIC Roadmap

Jay Marx

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The GWIC Roadmap

Talk at GWIC meeting

May 19, 2008

Jay Marx for GWIC Roadmap Committee

G080307-00A

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

This is a status report

- The Roadmap is a work in progress
- Will not present much of the material I presented at Elba--most people here heard that talk
- In this talk will focus on-
 - Plans for completing the Roadmap
 - Questions for GWIC to consider about what to do with the Roadmap and related issues

G080307-00A

GWIC Roadmap--Elba Workshop

2

Goals of GWIC Roadmap

- Develop a strategic plan that lays out the excitement of the field, the potential great discoveries, and the facilities and resources needed to reach that potential
 - Broadly cover--ground-based, space-based, including pulsar timing, CMB polarization, etc.,
- A plan that global GW community can rally around and advocate
- A plan to excite and influence scientists from other fields and funders about great opportunities in field, its potential impact, and possible synergy with other sciences
- Show funders that we have a realistic and coherent science-driven plan for the development of the field (e.g. we have our heads screwed on right)

Some constraints/subtleties

- Pre-existing community/government expectations for existing/proposed projects
 - Expectations our community has raised for future projects
 - don't undercut visions already articulated
 - Keeping the fine line between optimism and realism-- maintaining the credibility of the Roadmap
- Other Roadmaps that speak about GW--
 - e.g. ASPERA which has GW part of astrophysics
 - Astronet Roadmap
 - Avoid problem of conflicting strategies, plans, etc

Big picture of Roadmap status

- Many meetings of Roadmap committee
- Report outline drafted
- Active subgroups focusing on science opportunities, ground & space-based developments, impacts of other fields.
- Gathering input & advice from within field, from neighboring sciences, from funding agencies.....

Working subgroups

- Set up as mechanism to get much of the work done
- Each has a well defined topic and charge--
- e.g. subgroup 5 charge---lay out a science-driven strategy for the space-based experimental and the theoretical and numerical capabilities and developments needed to address the anticipated scientific opportunities for the next few decades.
- Members-- ~3 from Roadmap committee;
- Subgroups have interacted with other people in field for information gathering and help
- Evolving subgroup reports are discussed with full committee at meetings, distributed to full committee for comments
- Each subgroup report will form the basis of a key chapter in the roadmap report as indicated in outline of report

Outline of report

1. **Executive summary** including major conclusions and recommendations
2. **Introduction**---what is GWIC, why a roadmap, this committee, members, process
3. **Introduction to Gravitational Wave Science**—general tutorial level (subgroup 1)
4. **Scientific opportunities** in GW science now and in the next several decades (subgroup 2)
5. **Current state of the field** (subgroup 3)
6. **The future of the field in response to anticipated scientific opportunities—on the ground** (subgroup 4)
7. **The future of the field in response to anticipated scientific opportunities—in space** (subgroup 5)
8. **Impact of GW science on other sciences** (subgroup 6)
9. **The Roadmap**----concise way to represent how field can develop, what should happen when, decision points, off-ramps, etc. with text to explain
10. **Recommendations** to guide the development of the field- (developed by whole committee)
11. **Conclusions**

“Wise people” thus far

- Barry Barish
- Rai Weiss
- Peter Bender
- Eugenio Coccia
- Bernie Schutz
- Adalberto Giazotto
- Craig Hogan
- Annelia Sargent

Representatives of funding agencies-- have met with us

Meetings with full Roadmap Committee

- National Science Foundation (US) --Beverly Berger--
- INFN (Italy) --Benedetto D'Ettorre--
- CNRS (France) --Stavros Katsenevas--
- STFC (UK) --John Womersley--

Meeting with individual committee members

- Japan- Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- Australian Research Council

Others contacted

- e.g. NASA, ESA--- no response yet

Community input

- Essential part of process but not yet high level of input (to say the least)
- What have we done so far?
- Had a session at LSC/Virgo Collaboration meeting in October 2007
- Talk at Elba Workshop-- May 2008
- Talk at LISA Symposium-- June 2008
- Letter to community inviting input, ideas, comments, etc.-
wiki set up for e-mails from community--
gwicpoll@ligo.caltech.edu
 - minimal response (1 letter)
- Why is it so hard to get members of our community to express themselves about the Roadmap?? (my view-P5)
 - GWIC/Committee must try to find ways to improve this.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The road to the Roadmap-- completing the job

G080307-00A

GWIC Roadmap--Elba Workshop

11

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Key step

- Developing overall strategic vision for field on the ground and in space
- The strategic view is the backbone on which the Roadmap is built
- Been actively working on this at/since the March face-to-face meeting

G080307-00A

GWIC Roadmap--Elba Workshop

12

Examples of **strategic** considerations

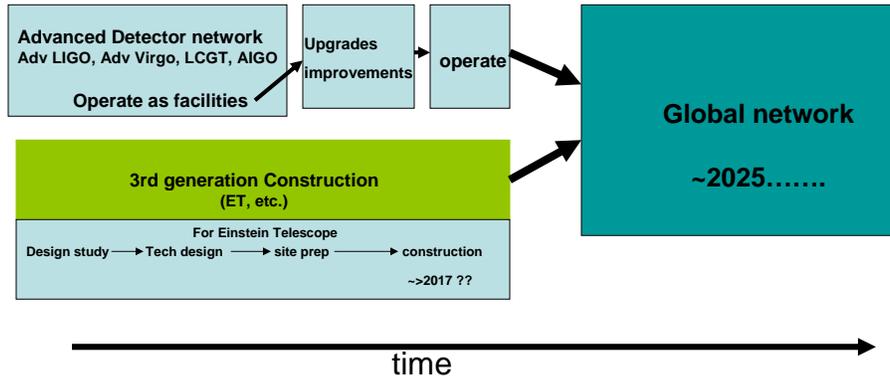
- **Discovery** will change the strategic landscape-- when?
 - optimistic (2010) or pessimistic (>~2014)? Impacts roadmap
- **Strategic questions---ground-based**
 - 2nd generation (aka Advanced detectors)-- how to complete the global array in a timely way (LCGT, AIGO)? What is timely?-- lifetime of Advanced detectors

Examples of **strategic** considerations

- Role of Advanced Detectors in 3rd generation (ET, et al) era?
 - View as facilities that keep improving so long life?
 - Long term- unified global network with Advanced Detectors to complement 3rd generation?
- 3rd generation- focus on low freq or broadband? how many instruments, sites? Where, when, how? Etc. etc.
 - Configuration of ET-- 1000 flowers are blooming
 - When will configuration be set?--key Roadmap lynchpin

The emerging vision on the earth

Global network = “evolved” advanced detectors + 3rd Generation



G080307-00A

GWIC Roadmap--Elba Workshop

15

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

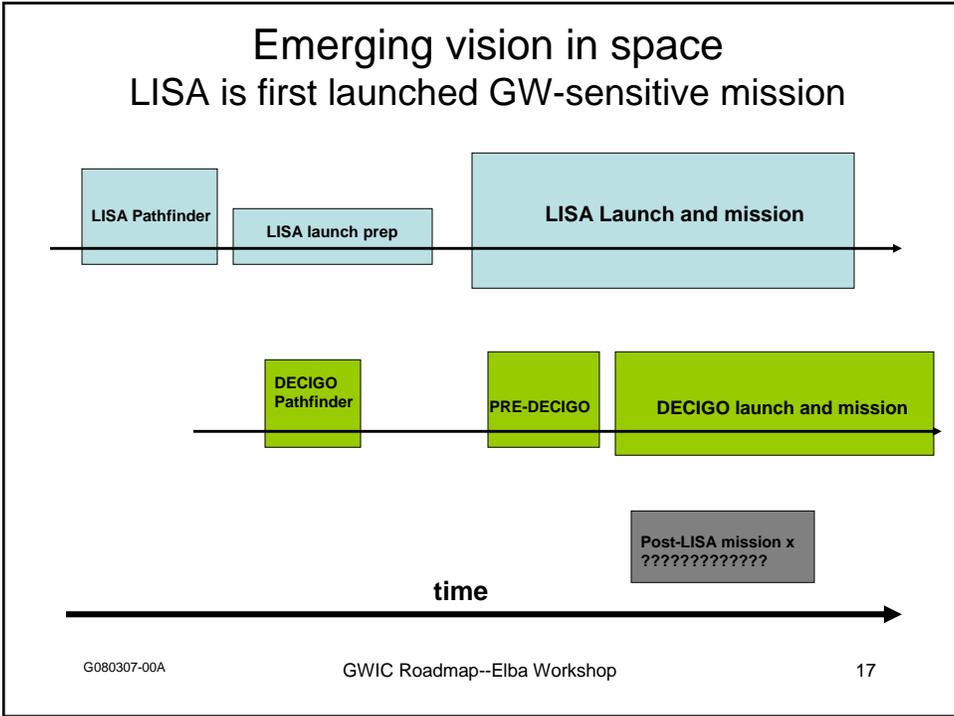
Strategic questions- space-based

- Should the Roadmap focus on LISA as the first-to-launch scientific mission?
 - Importance of LISA pathfinder on Roadmap?
 - When is the launch for LISA? (projected 2018)
 - “technical flights” before LISA launch in preparation for post-LISA missions-- give importance on Roadmap?
 - e.g. DECIGO pathfinder
- After LISA
 - Mission(s) with complementary scientific goals (e.g. DECIGO, ????)
 - Timing of science mission(s) wrt LISA
 - Should/could LISA data impact choice or will this just cause delay and missed opportunities

G080307-00A

GWIC Roadmap--Elba Workshop

16



QuickTime™ and a TIFF (uncompressed) decompressor are needed to see this picture.

Other approaches- strategic?

- e.g. pulsar timing, CMB polarization
- Can/should these be considered by roadmap in a strategic sense?
 - Could these approaches impact what the interferometer community does? And visa versa
 - How should the Roadmap address these to be helpful?

G080307-00A GWIC Roadmap--Elba Workshop 18

Completing the job after Elba

- More input from wise people outside GW community?
- From GW community!!!!!!!!!!!!
- More committee discussion (e-mail, telecoms, etc.) about recommendations, key strategies, etc. so we have consensus
- Complete writing report draft chapters
 - Goal--complete by July 1
- Editorial group will merge all draft chapters into full report draft. And get ok from committee membership
 - Goal complete by August 1
- Draft report will be distributed to key members of our community to get feedback. Then final discussions of report and signoff by full committee.
 - **Goal- present final report to GWIC-- Fall 2008**

What happens after the Roadmap is complete?

- What does GWIC do with the Roadmap to promote the goals of the field?
- Other issues for GWIC raised by roadmap process

After report is submitted to GWIC-- mechanics-the easy part

- GWIC should evaluation and approval (bless) the report-- to give it a good pedigree
- After ok, how to publish, distribute—the mechanics---\$\$\$?

Serious questions for GWIC discussion

1. What will GWIC do with roadmap after it is submitted
 - what is desired impact?-
 - Promote global planning in our field ?
 - Excite scientists in other fields?
 - Influence funding agencies and politicians?
 - Influence the public?
 - how to make it happen?
 - market roadmap, how, to whom
 - e.g. can the Roadmap become a template for international planning even in context of regional or local interests
2. How to get community acceptance, ownership, advocacy?
VERY IMPORTANT, in my view!!!
If not, Roadmap is just a piece of paper.

Questions raised by the roadmap process

1. What can GWIC do to encourage better interaction and integration with other communities (e.g. astronomy...)-- people to meetings, where our publications go in achieves, more talks at university astronomy colloquia,.....

2. Is there a role for GWIC in global planning for Generation 3?
 - To help coordinate the evolution of the conceptual planning for 3rd generation *in a way that involves the global community and aims at an optimized global network*
 - Analogous to role of ICFA--we should strive to be as influential and *this is our opportunity*
 - e.g. a steering committee analogous to ILC steering committee structure set up via GDE through ICFA

More for GWIC consideration

- Another longer term (sort of) issue that needs cross-project/region coordination---public sharing of data
 - With networks comes question of who “owns data and who decides how this is handled
 - Another ideal role for GWIC---an GWIC sponsored group to study the question and recommend what might work in the network/multi-region context

- After this Roadmap exercise--are we done? Keeping the roadmap alive as time passes—a living document? periodic updates?
 - If we make good use of this Roadmap, I’d suggest revisiting it every 3 years or if a big change occurs.
 - If it is just an exercise in killing trees.....forget it.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Final thoughts

For the roadmap to have a significant positive impact on the opportunities for the field--

1. Our community must own and endorse it--
Must find how to get more input so more buy-in
2. It must successfully speak to, impress and excite scientists in neighboring fields and the funding agencies
3. GWIC must carefully consider how to make the best use of the roadmap to get the message out in the right form to the right people at the right time.

For GWIC-- Opportunity to play in the big leagues--- play role of ICFA development of Generation 3 network requires this and is the opportunity for GWIC to “get on the map”

Backup slides

GWIC Roadmap --membership

- **Representing**
 - Space and ground-based community
 - Major projects, world-wide
 - Asia, Europe, US, Australia
 - Astrophysics, instrument science
 - Theory, experiment
- **Committee members**
 - Karsten Danzmann
 - Jim Hough (ex-officio)
 - Kazuaki Kuroda
 - Jay Marx (chair)
 - David McClelland
 - Benoit Mours
 - Sterl Phinney
 - Sheila Rowan
 - Flavio Vetrano
 - Stefano Vitale
 - Stan Whitcomb
 - Cliff Will

G080307-00A

GWIC Roadmap--Elba Workshop

27

On the ground- **When a discovery?**

Discovery would change the landscape- the big strategic lynchpin

- Early discovery means big increase in opportunities to gain resources from governments and increase in manpower, faculties
- Could accelerate the timescale for ambitious projects
- For planning purposes-- when assume discovery (~2010 or ~2014)? How to take account of discovery earlier or later

G080307-00A

GWIC Roadmap--Elba Workshop

28

On the ground-- completing the 2nd generation network?

- Advanced LIGO and Advanced Virgo begin science ~2014 and operate for ~ a decade
- Opportunities exist to complete world-wide array during this decade
- Instruments in Japan (LIGO) and Australia (AIGO) to complete tetrahedron---
 - Online soon enough to overlap AdL & AdV?
 - Would like them online by 2016 or so
 - This is the plan but will resources be provided soon enough?
 - How can international community contribute?

On the ground-- Role of 2nd generation in 3rd generation era

- When 3rd generation (e.g. ET) operating
- Is there a scientific value to “ultimate” LIGO and Virgo using existing sites and infrastructure or move to generation 3
 - “ultimate”= Major upgrades to Advanced LIGO and Advanced Virgo that significantly increase performance at a modest cost (i.e. tens of millions of \$) at current sites with current infrastructure
 - Complementary information for generation 3? e.g. high frequency domain
- Or focus on generation 3

On the ground- the 3rd generation

- Goal- Reach 1 Hz and below- go underground
- How many sites (an array?- stochastic, polarization, pointing) Where? When? How?
 - Europe--ET- When could/will construction start;
 - impacts intermediate plans- (time between AdV + GEOHF and ET)
 - When would it be realistic to imagine a US facility given investment in Advanced LIGO
 - Other elements of a 3rd generation global array?
 - How to optimize *overall* 3rd generation science capabilities if instruments designed, sited, built based on regional opportunities, constraints, taste, etc.
- Are there any other niche approaches that could contribute good complementary science in this era?

Initiation of GWIC Roadmap

- At GWIC meeting held in Sydney, July 2007
- GWIC members voted to initiate the Roadmap and charge the Roadmap committee to carry out the task

Another issue- perhaps

- My personal view ---several 3rd generation facilities (ET and one in US) will not be funded in parallel. Will need international collaboration and resources to build in each regional in turn. If so.....
 - How and when to bring together potential resource providers from the various regions and plan for internationalization of support Generation 3.
 - Seems like GWIC is a possible broker/vehicle for this-- how?
 - Study other examples for good and bad, applicable or not
 - e.g. ILC, ITER, SKA.....

What is a Roadmap?

- A way to show the path from “here” to “there”
 - “here” is now
 - “there” is a set of goals for the field many years from now
- A Roadmap can have several paths to the goal;
- Branch points and off ramps---
 - places along the way where things can/do change
 - strategic decision points; new scientific information, etc.
 - And so can change the path to take account of a new reality

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

An Example--Elba meeting

**GWIC Roadmap Committee meeting. Elba- May 13-15,
2008**

**May 13—1:30 pm – 4:30 pm--Input from funding
agencies**

May 14—7:30 pm—10 PM—Input from “wise people”

May 15-- 7 pm to 11 pm – Committee business

G080307-00A

GWIC Roadmap--Elba Workshop

35

GWIC and the Roadmap

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

About GWIC and the Roadmap---

G080307-00A

GWIC Roadmap--Elba Workshop

37

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

About the Gravitational Wave International Committee (GWIC)

- GWIC, the Gravitational Wave International Committee, 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.
- It is affiliated with the International Union of Pure and Applied Physics as a sub-committee of IUPAP's Particle and Nuclear Astrophysics and Gravitation International Committee.

G080307-00A

GWIC Roadmap--Elba Workshop

38

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

GWIC's Goals: Roadmap supports many of these

- **Promote international cooperation** in all phases of construction and exploitation of gravitational-wave detectors;
- **Coordinate and support long-range planning** for new instrument proposals, or proposals for instrument upgrades;
- **Promote** the development of gravitational-wave detection as an astronomical tool, exploiting especially the potential for coincident detection of gravitational-waves and other fields (photons, cosmic-rays, neutrinos);
- Organize regular, world-inclusive meetings and workshops for the study of problems related to the development of exploitation of new or enhanced gravitational-wave detectors, and foster research and development of new technology;
- Represent the gravitational-wave detection community internationally, **acting as its advocate**;
- Provide a forum for the laboratory directors to regularly meet, discuss, and plan jointly the operations and direction of their laboratories and experimental gravitational-wave physics generally.