INTEROFFICE MEMORANDUM

TO: B. BARISH

FROM: L. S. FINN

SUBJECT: GWIC MEETING REPORT

DATE: 9/26/01

In attendance

- ACIGA: McClelland
- ALLEGRO: Hamilton
- AURIGA: Cerdonio
- EXPLORER/NAUTILUS: Coccia
- GEO: Danzmann, Schutz
- LIGO: Barish, Lazzarini, Sanders
- LISA: Prince, Vitale
- NIOBE: Blair
- TAMA: Fujimoto
- VIRGO: Brillet, Giazotto
- Theory Representative: Will
- Executive Secretary: Finn
- Visitors: Aguiar, Collins, Frossati

The 2001 GWIC meeting was held on 8 July 2001 in Perth, Australia, immediately prior to the start of the Fourth Amaldi Meeting on Gravitational Waves and Their Detection.

Detector Progress Report

Two dominant themes emerged in the reports of the different projects: the first was great strides forward in commissioning activities or operating instrument sensitivities, and the second was vastly increased inter-project cooperation and collaboration.

In the last year ALLEGRO has moved to a new building and a new laboratory on the Louisiana State University campus. The detector is sealed in its dewar and, at the time of the meeting, is being cooled. In moving to the new building the detector platform was placed on air-bearings, allowing it to be periodically lifted and rotated to a different orientation. In this way ALLEGRO can be aligned to have different relative orientations with respect to LIGO and the other acoustic detectors. Since the sensitivity of a detector pair to a gravitational wave background depends on their relative orientation, this ability to rotate allows the creation of a "lock-in amplifier", increasing the sensitivity of the ALLEGRO/LLO detector pair to a stochastic background. ALLEGRO intends to carryout a coincidence run with LIGO at the time of LIGO's E6 engineering run. Toward this end, ALLEGRO is converting their data acquisition system to generate data in the LIGO/VIRGO developed FRAME format.

AURIGA suffered a cryogenic failure just after last 1999 Amaldi meeting. That failure has been repaired. During the downtime, the AURIGA team took the opportunity to perform a significant upgrade on their suspension, transducer and

transducer read-out. The new transducer is a double squid device, available commercially, and with a measured noise of less than 200 $h/2\pi$. With the new readout and new transducer, the AURIGA detector will have a 40 Hz bandwidth: nearly a two order of magnitude increase over previous cryogenic detector bandwidths. The overall sensitivity of AURIGA, taking into account the new bandwidth and decreased effective noise temperature, will correspond to a strain of 5e-20 in a 1 ms burst. AURIGA is also experimenting with a Fabrey-Perot read-out scheme, with a working prototype attached to a room temperature acoustic detector. Finally, the AURIGA detector data acquisition is transitioning to deliver data in FRAMES.

EXPLORER and NAUTILUS are both running regularly and well. The EXPLORER transducer has changed from a mushroom to a rosette design, leading to a significant improvement in detector bandwidth: the EXPLORER bandwidth is now 30 Hz, as opposed to the previous 1 Hz, with a peak strain sensitivity of 2e-21/sqrt(Hz). While improvements are being made and tested regularly on EXPLORER, the NAUTILUS strategy is operate with the maximum possible duty cycle. Currently, NAUTILUS is operating 82% of the time with an effective temperature less than 10 mK, and 61% of the time with an effective temperature less than 5 mK. It is planned to warm NAUTILUS and install a new rosette transducer of the design tested on EXPLORER. The Roma group has also submitted a proposal for a large, 3y program to the EU. This new proposal, ARGOS (Activity and Research for Gravitational –wave ObservatorieS) would fund several post-doc positions. Results of the competition are expected by the end of the year. .

NIOBE has spent the last several years warm while a number of improvements in the cryogenics, readout and amplifiers, and the addition of a cosmic-ray monitoring system about the antenna. The bar was cooled in February, though it became warm again after a recent power failure. It is currently being cooled again, and is at liquid nitrogen temperatures at the time of the GWIC meeting. The dominant noise source, previously the amplifier, is oscillator phase noise. (The amplifier noise has now been demonstrated to be $10h/2\pi$ both inside and outside the antenna.) There continues to be extensive cooperation between the Perth and Roma groups, with the Roma group contributing personnel to assist with data acquisition and analysis. Funding is currently difficult in Australia. Last years continuing proposal for NIOBE went unfounded. While two more proposals are currently submitted, and there remains funding to continue to operate NIOBE for its present run, a view is developing that independent detector technologies should not be simultaneously funded. Additionally, ARC is reviewing its policy of allowing senior investigators to serve on multiple awards. For projects that require multiple awards in order to proceed, this is a very dangerous situation

In the last year ACIGA christened the Gingin high-power research facility. The focus of work at Gingin is on cavities and interferometers under high power (on order 1MW circulating). The Gingin facility has been established as a facility of the US LIGO Scientific Collaboration, with an advisory board chaired by Jordan Camp. ARC is providing funding for Gingin, with LIGO, and also VIRGO, providing in-kind support. A second aspect of collaboration, between ACIGA and the Japanese LCGT project, is being explored, with a personnel exchange between the University of Western Australia and Kuroda's group, with a focus on removing thermal energy from mirrors. The Adelaide component of the ACIGA group already has strong collaboration with TAMA 300. The ACIGA program suffers from the same, difficult funding situation as the NIOBE program. There is no directly funded ACIGA program: instead, funding is

provided through several separate awards, each funding a particular part of the ACIGA program. This funding mechanism makes overall coordination and supervision difficult, since each award is to a different chief investigators (since ARC doesn't want to support too many awards under single investigator.) and each proposal must be justified on its own merits, without reference to its role in the larger context of a single project

GEO has installed its first two monolithically suspended mirrors. All the optics, except for a signal recycling mirror, are now in place, although not all the optics are the final optics. With all but the signal recycling mirror in place, GEO will attempt to operate as a power recycled interferometer within the next several weeks. GEO will attempt to operate in coincidence with LIGO during the LIGO E6 engineering run. Following that run, GEO will shutdown to install the remainder of its final optics, including signal recycling mirror, and begin commissioning in its final configuration.

During the last year LIGO: completed the installation of all detector hardware and optics and entered its commissioning phase. At present, commissioning with high power is underway. The LHO 2K mode cleaner has been tested at full power, and the LLO commissioning is going quickly, as the lessons learned at LHO are folded-in to the commissioning plans for the LLO detector. The LHO 4K detector commissioning has also begun. LIGO has also planned a series of engineering runs that represent steps toward full operation. Four engineering runs have already taken place, and at least two more are planned in some detail. Additional engineering runs beyond these will take place, but have not been planned in detail. The first attempt to run all three LIGO interferometers in triple coincidence will take place during the E6: run, which will also be taken as an opportunity to exercise the entire data analysis chain. The year 2001 completes the LIGO construction and early operations. In December 2000 LIGO submitted a proposal for funding of LIGO operations, science and R&D in 2002–6. This proposal represented a substantial increase over the previous operations and R&D budget, and LIGO was awarded most of what was requested. The submitted budget includes support of the LSC program in observational science and analysis, as well as advanced detector development. The current plan is that the first new LIGO detectors be installed in 2006, after accumulating at least one year (integrated) of data in triple coincidence at the first generation LIGO design sensitivity. This plan requires construction approval in FY2004.. Budgetary pressures in the United States may delay all new NSF starts by one year, which may affect these plans. LIGO is proceeding ahead while paying close attention to this process. LIGO has developed close collaborations with several other projects: with TAMA, on seismic isolation, thermal noise and optical modeling; with ACIGA, on lasers and high power cavities; with GEO on all aspects of advanced detector research and development and data analysis, including a full-partnership MoU addressing data sharing and analysis; and with VIRGO, on coating development.

A new gravitational wave detector research and development program has been initiated in Japan, covering the years 2002–5. It includes continuation of TAMA activities (improvements and observations) and research and development in laser, optics, cryogenics, resonant sideband extraction and other optical modeling for the Large Cryogenic Gravitational-wave Telescope (LCGT). The PIs of this new program are Fujimoto (NAO) and Kuroda (ICRR). Substantial progress has been made in stable operation of the TAMA detector: during a test run in June the detector was continuously locked for more than 24h during a week-day. A two-month test run is scheduled August and September 2001, with a target of 1000h integrated data at a sensitivity of $2 \times 10^{-}$

^{21}/sqrt(Hz) at 300 Hz. TAMA/LCGT representation on GWIC over the next several years will be Fujimoto and Tsubono.

VIRGO construction is nearly complete and expected to end soon. The VIRGO North Tunnel has been completed, 1200m of the north tube assembled, welded and installed. The first 300m are under vacuum, with no detected leaks and good unbaked vacuum. The west tunnel is almost complete: 3000m done but not yet covered. Progress has also been made in commissioning, which is underway in parallel with construction: the output mode cleaner is locked on dark fringe. The first VIRGO science run is planned to start at beginning 2003. Currently, VIRGO is being operated 5d/wk in two shifts of 12h each; in September this will transition to 6d/wk operation with two 8h shifts. Operation of machines in shifts, 5d/w in 12h shifts. A VIRGO shift involves 7 leaders for each of the seven major subsystems, plus at least one novice in training per subsystem, for a total of 10-15 per shift. Novices are indoctrinated for a period of 1.5m before becoming experts.

France and Italy have formed the EGO consortium to promote gravitational wave detection research in Europe, and VIRGO has been placed under the umbrella of the consortium. Under this new arrangement, financial support: for construction and infrastructure, including the computing facilities and, is provided by EGO, while VIRGO remains as a scientific collaboration with funding from INFN and CNRS. Important steps have been undertaken to extend VIRGOs collaboration with other projects, especially in the area of data analysis where VIRGOs goal is that LIGO and VIRGO operated as a single machine. As VIRGO construction nears completion, research and development on advance detectors is being renewed. The initial scope and budget associated with these activities is still under discussion. A new goal is to extend the VIRGO collaboration by including other research groups.

The European Space Agency and NASA have formally joined into a collaboration to build and deploy the Laser Interferometer Space Antenna (LISA) in the 2011 time-frame. The ESA budget for LISA is 185M Euros, plus additional national contributions. The NASA budget is contingent on a NASA/ESA agreement on costing, which will be required before a NASA budget can be submitted to the United States Congress in Spring 2002.. NASA and ESA have established a LISA International Science Team, with balanced representation from Europe and the United States. The LIST, which has a 3y lifespan, will advise the project on LISA's scientific goals. The LIST has approximately 10 members, but will involve the broader scientific community through the formation of working groups beyond the LIST. LISA is now committed to technology demonstration on SMART-2 , focusing on inertial sensors, charge management, thrusters, drag-free control, and laser technology. The SMART-2 preliminary design review is in July 2002, with an August 2006 launch and the LISA technology demonstration lasting for 1y beginning October 2006. The next major ESA approval milestone is in 2004 when it moves to pre-phase B status. In United States, a technology demonstration mission for the DRS (disturbance reduction system) has been developed. This mission has baselined SMART-2, but is also looking at other launch vehicles. The first critical milestone is in December 2001, when a single mission concept is selected from among four proposals, including DRS. Following the NASA/ESA collaborative agreement on the LISA mission, Prince, Schutz, Stebbins, and Vitale will represent LISA on GWIC.

New and Proposed Projects

GWIC heard reports on several new and proposed gravitational wave detector projects. In Brazil a prototype spherical cryogenic acoustic detector (Schenberg) prototype has been funded for construction in Sao Paulo. The final detector will operate in the 3.0–3.4KHz range. The project is oriented about cryogenics, transducers and vibration isolation. Nominally funded for two years, the project is divided into two phases: a technology demonstrator phase and a detector phase. Building construction is underway and the project has taken possession of and measured the resonances of the spherical detector mass. Schenberg is being developed in close collaboration with the Roma and MiniGrail groups.

MiniGRAIL - a 65cm, 1150Kg spherical CuAl cryogenic acoustic detector - has achieved its first cool-down. Current project goals are to speed the warm/cool cycle and, consequently, the development cycle time. The current sphere has a poor Q, owing to a problem in the fabrication process.

A third spherical detector prototype is being developed by LNF and Roma-2: SFERA is designed both to test suggestions regarding the anomalously strong excitations of the NAUTILUS bar detector to 20% of the detected cosmic ray events, and to investigate the associated limitations on the sensitivity of acoustic gravitational wave detectors. Assembly, commissioning and calibration will take place in 2002; in 2003, the detector will be moved to its permanent home and operations will commence.

Finally, Cerdonio discussed a dual-sphere wideband acoustic detector concept: two concentric, freely suspended spheres, with two different sets of resonant frequencies, and instrumented with Fabrey-Perot cavity readouts measuring the separation between the spheres. This detector will have a flat response between the two resonant frequencies. Current work is focusing on understanding the thermal noise in the suspensions, internal modes, and mirror coatings on FP readout, and on fabrication problems. Once these problems are sufficiently well understood (which is expected to take approximately two years) a decision will be made as to whether propose for funding.

Nominating Committee Report:

The GWIC Nominating Committee (Cerdonio, Sanders, Brillet) noted that two years, the nominal term of a GWIC chair, is too short a period and proposed that Barish serve again as chair for a second two-year term, and that Finn continue as Secretary. This proposal was accepted unanimously by GWIC in a secret ballot.

IUPAP/PaNAGIC

GWIC heard a brief report on the role of PaNAGIC, which has adopted GWIC as a sub-committee, in IUPAP. A recent change in the role of PaNAGIC in IUPAP has made it a special working group, which exists outside of IUPAP's Commission structure. Other special working groups include the International Committee on Future Accelerators, Working Group on Communication in Physics, Working Group on Facilities for Condensed Matter Physics, and the Working Group on Women in Physics.

Global Detector Arrays

GWIC heard a brief report by ACIGA describing on-going work on the sensitivity of global detector arrays and the effectiveness of a southern hemisphere This initial work focused on the relative sensitivity of optimal detector positioning on the means of combining the multiple detectors into a network. Without referring to the absolute efficiency or sensitivity of either method, the relative efficiency of a detector network is more sensitive to relative position and orientation when observations are combined using event-based coincidence then when the observations are combined coherently, as in aperture synthesis.

The IGEC is continuing to exchange data, under an updated protocol, which increases the information associated with each event. A new coincidence analysis method is also being studied, which should improve the reported event rate upper limits. They anticipate reporting improved results at the 2001 GWDAW meeting in Trento.

Meetings

- The 2001 Amaldi Meeting has 190 registrants, with 41 from Italy and 32 from the United States. The overall budget for the meeting is 56.5K$US and is balanced. The meeting proceedings will be published in a special issue of Classical and Quantum Gravity; however, unlike other special conference proceedings volumes, these proceedings will be refereed through the normal CQG reviewing process.

- GWDAW'01 will be held December 13–15 in Trento, Italy. There will be no proceedings. The registration fee is expected to be 100$US and will include a banquet dinner and meeting refreshments. The future direction of the GWDAW meetings is uncertain as the ground-based detector projects transition from prototypes and development activities to real science analyses: intermediate analysis results are typically not discussed outside of the relevant scientific collaborations, and these meetings are not the appropriate venue for announcing new analysis results.

- The Aspen meeting series fills the advanced detector design niche. GWIC had agreed to hold this meeting every third year at a European site. Two years previously the meeting was held in conjunction with the Moriond meeting; however, these two different meetings have very different cultures and neither was served well by the combination. The next meeting will be held May 19–26, 2002 in a conference facility on Elba.

- A workshop focusing on Gravitational Wave Phenomenology – the interface between experimental gravitational wave detection, astrophysics theory and relativity theory – will be held November 6–8 in the United States at Penn State. This meeting is associated with the kick-off of a major United States initiative to build a gravitational wave phenomenology community, which will serve the role for this community that the high energy physics phenomenology community fills in high energy physics research.

- The Fourth International LISA Symposium will be held 19–24 July 2002 at Penn State.

- The Australasian society for GRG is bidding for next GR meeting (GR17).

- COSPAR will meet next in Texas in July 2002. It is expected to attract 10,000 people.

- The TAUP meeting, at Gran Sasso, will host a PaNAGIC meeting and have a special session on gravitational waves.

- The next Marcel Grossman Meeting will be held in 2003 in Rio de Janeiro.

- The gravitational wave detection community currently focuses on two large meetings, which take place in alternate years: the Amaldi meeting and the LISA Symposium. Every third year there is thus a collision between one of these large meetings and the GR Society meeting. GWIC discussed scheduling the LISA and Amaldi meetings every third year, if the organizers of the GR Society would agree to accommodate a larger experimental gravitational wave detection program as part of the Society meeting. As part of this proposal, the Amaldi meeting, which has tended to focus principally on ground-based detectors, and the LISA Symposium, which has tended to focus principally on space-based detectors, would each become less parochial and more balanced in their focus on gravitational wave detection generally. Will was asked to bring this proposal to the GR Society and report back to GWIC.

- Bradaschia proposed that the 2003 Amaldi Meeting be held in Pisa, Italy, in late June or early July. Two possible sites were proposed: downtown Pisa downtown or at a seaside conference center. Either would be able to handle the expected number of delegates. The total cost per delegate would be the same at each. After a brief discussion GWIC accepted the Pisa seaside conference center proposal.

Collaborative Data Analysis

GEO and LIGO have recently signed a far-reaching Memorandum of Understanding, agreeing to a full and reciprocal sharing of data and analysis between the two collaborations. This MoU effectively establishes a complete partnership between the two experiments in areas of data taking and analysis, with each experiment agreeing distribute, analyze and ensure the security of the data of each as if it were there own data. The sharing arrangement is complete and covers epochs when only one experiment may be running. Dissemination of results requires permission of both Lab Director and GEO PI for data analysis.

Lazzarini reported on progress made by the GWIC working group on collaborative analysis, which has focused on setting up the automated exchange of PEM data. An automated exchange, involving LIGO and VIRGO and focusing on magnetometers, seismometers and power-main monitors has been underway since early June; GEO expects to join this exchange as soon as their environmental monitors are available in

FRAME data format. GWIC proposed that the next step should be the analysis of the exchanged data for long baseline (i.e., inter-continental) correlations, which might affect the coincidence rate among the different detectors.

Next Meeting

The next GWIC meeting will be held in conjunction with the Fourth International LISA Symposium, 19-24 July 2002 at Penn State