



**Attachment DAT to the
Memorandum of Understanding LIGO-M050292-00
between the Caltech Relativity Group (CaRT)
and the
Laser Interferometer Gravitational Wave Observatory (LIGO)
For The Period
August 15, 2007 - August 14, 2008**

This Attachment DAT to the Memorandum of Understanding LIGO-M050292-00 defines the role of the Caltech Relativity Group (CaRT) as a Member of the LIGO Scientific Collaboration (LSC). In particular, it addresses data analysis activities in support of the initial LIGO interferometers. The period of performance for the activities in this Attachment is from August 15, 2007 - August 14, 2008.

1. Collaboration

Together, the LIGO Laboratory and the LIGO Scientific Collaboration (LSC) are responsible for implementing and exploiting the initial LIGO detector through its science data runs. The LSC has organized the data analysis effort into search groups which coordinate analysis, review, and publication on behalf of the collaboration. LSC groups are encouraged to participate in one or more of these groups.

MOU Attachment DAT defines the contributions of each participating group to the data analysis development groups.

2. Participation

During the period August 15, 2007 - August 14, 2008, the members of CaRT will participate in the analysis of initial LIGO data in the following areas:

a. Binary Inspirals

1. PBCV, i.e. PTF Template Families

Chen and Vallisneri (CaRT), in collaboration with Brown (SUERG) and Pan (UMD) will continue to supervise Diego Fazi's implementation of the PTF search for spinning BH/NS binaries in S5 data. Fazi will test the PTF algorithm on S5 data using a "kludge" template bank based on extending existing non-spinning template banks with the relevant spin parameters. By exploring the behavior of the PTF filter and the standard non-spinning inspiral filter, Fazi will determine how best the PTF filter can be used in the inspiral search pipeline (as a stand-alone search or as a hierarchical follow-up to a non-spinning template bank). Pan, Brown, Chen and Vallisneri

will develop appropriate metric based template banks that can be used in the PTF search. Using the techniques developed, Fazi will search the S5 data for spinning BH/NS binaries.

2. Stochastic Methods for Template Placement

Vallisneri will continue work on stochastic/mesh-refinement template placement methods. He will be helped by incoming JPL postdoc Gian Mario Manca, who has expertise in statistical-physics Monte Carlo (Manca is not in the LSC, but this technical work has applications to LISA as well as LIGO, and no LIGO data or LSC-restricted information will be used.)

3. Data Analysis Techniques and Accuracy for IMRIs (Intermediate Mass Ratio Inspirals)

Drasco and perhaps other members of CaRT will work with Brown (SUERG) to develop a Teukolsky-based, discrete template family for Advanced-LIGO searches for IMRI waves and to begin implementation of an IMRI search algorithm. They will also work to improve the estimates of parameter estimation accuracy for these sources. This work will be based on ideas laid out in our paper gr-qc/0612060.

4. Numerical-Relativity-based inspiral template bank

Chen and other members of CaRT will generate, and lay foundations for generating, discrete template families for binary black-hole inspiral, based on numerical relativity simulations. Initially this will be a continuation of Chen's current collaboration with Ajith (AEI) on construction of an "interpolation template bank", which has high matches with hybrid waveforms built from PN expansions and numerical relativity, for quadrupole waves from nonspinning black-hole binaries in circular orbits — based on numerical waveforms from Jena. We expect this to transition into a collaboration between CaRT (Chen et al), Brown's group (SUERG) and the Caltech/Cornell numerical relativity group, relying on Caltech/Cornell numerical waveforms (which have much higher accuracy than Jena due to using pseudo-spectral methods rather than finite-difference techniques).

b. Bursts

1. Multidetector Pipeline for Unknown Bursts

Yanbei Chen and **Linqing Wen** will work on a multi-detector, coherent pipeline for unknown bursts.

c. Stochastic

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d. Continuous

1. LAL Barycenter Routines

There is a 2-3 microsecond discrepancy between LALBarycenter and TEMPO (the standard radio pulsar timing code). **Cutler** understands the reason for about half of that (failure to include the day/night variation in the velocity of the Earth's surface when computing the time dilation, as well as an approximate treatment of variations in the Earth's spindown rate), but does not understand the rest. Cutler will try

to figure out the cause of the extra (small, nagging) discrepancy; if he can, and it is easy to fix, he will modify the LALBarycenter code.

e. Other Contributions

Not Applicable

3. Resource Sharing

The LIGO Laboratory will contribute resources including allocation of appropriate scientific and engineering personnel, research facilities, and funding in support of the effort in Item No. 2, as indicated below.

- a. Research accommodations for CaRT group members while on LIGO research assignment at any LIGO Laboratory site.

Not Applicable

- b. Access to LIGO data through established LSC channels in support of this work.

Not Applicable

4. Coordination and Reporting

CaRT will perform research within the structures established by the LIGO Laboratory and the LSC where appropriate.

In particular, with reference to activities described above:

2a will be carried out within the LSC Inspiral Search Group.

2b will be carried out within the LSC Burst Search Group.

2c will be carried out within the LSC Stochastic Search Group.

2d will be carried out within the LSC Continuous Waves search Group.

This includes keeping the Group leaders informed of activities and plans, reporting to the group at meetings and telecons, and through technical documents submitted to the LIGO Document Control Center.

In addition, an annual report will be submitted with the update to this Attachment, giving a summary status on research by topic as indicated in Item No. 2, including progress against the milestones if any, significant accomplishments such as new insights/discoveries or publications, issues of concern if any, and an indication of invested time.

This Attachment will be updated at least annually with a plan of activities for the succeeding one-year period. These documents will be due one month before the close of the period of performance under this Attachment.

5. Computer Code

All computer code delivered to the LSC under this Attachment must be developed in consultation with the LSC Data Analysis Software Working Group (DASWG) and archived, documented and reviewed as determined by that group.



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