16th PACIFIC COAST GRAVITY MEETING

Program

This schedule is susceptible of modifications. Please make sure when your talk is scheduled to be given, but always be present in the lecture hall before the time it is scheduled for. If a speaker does not show up, the next talks will be shifted forward.
Coffee and pastries are available each morning from 8:30 in East Bridge 110.

Friday, March 24, 2000

Time	Speaker	Affiliation	Title
9:00 - 9:15	**Lior Burko**	Caltech	Welcome and openning remarks
9:15 - 9:30	**Arthur E. Fischer** and Vincent Moncrief	UC Santa Cruz	Convergence and Collapse for the Reduced Einstein Equations
9:30 - 9:45	Ian Anderson, Mark Fels, and **Charles Torre**	Utah State University	101 Spacetimes with Symmetry
9:45 - 10:00	**Eduardo Guendelman**	Ben Gurion University, Beer Sheva, Israel	Scale invariance, induced gravity and the vacuum energy of the present universe
10:00 - 10:15	**Richard Trejos**	Hill AFB, Ogden Utah	Gravity
10:15 - 11:00	**Coffee break**	---	Refreshments are served in East Bridge 110
11:00 - 11:15	**Shane L. Larson**	Jet Propulsion Laboratory/Montana State University	Low frequency gravitational waves from the galactic center
11:15 - 11:30	**Marc Kamionkowski**	Theoretical Astrophysics, Caltech	Detection of Gravitational Waves from Inflation
11:30 - 11:45	**Lee Lindblom**	Theoretical Astrophysics, Caltech	The r-mode instability in old-cold neutron stars

11:45 - 12:00	**Greg Ushomirsky**	Theoretical Astrophysics, Caltech	Gravitational Waves from Low-Mass X-ray Binaries
12:00 - 12:15	**Jeremy S. Heyl**	Theoretical Astrophysics, Caltech	Gravitational Radiation from Strongly Magnetized White Dwarfs
12:15 - 12:30	**Josh Routzahn**	Montana State University	Low Frequency Gravitational Waves from White Dwarf MACHO Binaries
12:30 - 14:15	**Lunch break**	---	---
14:15 - 14:30	**Peter Diener**	Theoretical Astrophysics, Caltech	Relativistic Tidal Interaction of Stars with a Rotating Black Hole
14:30 - 14:45	**Warner A. Miller** and Pablo Laguna	Los Alamos National Laboratory	Constant Crunch Surfaces for Black Hole Simulations
14:45 - 15:00	**Robert Bartnik**	University of Canberra	High accuracy numerical black hole simulation
15:00 - 15:15	**Michael Holst** and David Bernstein	Department of Mathematics, UC San Diego	Some existence, uniqueness, and approximation results for the initial value problem
15:15 - 15:30	**David Bernstein** and Michael Holst	Department of Mathematics, UC San Diego	Adaptive finite element solution of the initial value problem: A few illustrative examples
15:30 - 15:45	**Walter Landry**	University of Utah	A General Method for the Binary Black Hole Initial Value Problem
15:45 - 16:00	**Kashif Alvi**	Theoretical Astrophysics, Caltech	An approximate binary-black-hole metric
16:00 - 16:15	**Kip S. Thorne**	Theoretical Astrophysics, Caltech	QND Interferometers for LIGO-III
16:15 - 16:45	**Coffee break**	---	Refreshments are served in East Bridge 110
16:45 - 17:00	**Erez M. Yahalomi**	Technion - Israel Institute of Technology	Extension of the equivalence of acceleration to gravitation obtains a way of finding the big bang location
17:00 - 17:15	**Alessandra Buonanno**	Theoretical Astrophyics, Caltech	Binary black hole coalescences: transition from inspiral to plunge
17:15 - 17:30	**Marc Favata**	Theoretical Astrophyics, Caltech	Energy Localization Invariance of Tidal Work
17:30 - 17:45	**Frank Estabrook**, John Armstrong and Massimo Tinto	Jet Propulsion Laboratory	Time Delay Interferometry for LISA
17:45 - 18:00	**Gopakumar Achamveedu**	Washington University in St. Louis	Constructing search templates for inspiraling binaries in eccentric orbits
18:30 - >	**Supper party**	---	BRING YOUR SWIMMING SUIT

Saturday, March 25, 2000

Time	Speaker	Affiliation	Title
9:00 - 9:15	**Kimberly C. B. New**, Joan M. Centrella, and Joel E. Tohline	Los Alamos National Laboratory	Gravitational Waves from Long-Duration Simulations of the Dynamical Bar Instability
9:15 - 9:30	Zeferino Andrade and **Richard H. Price**	Department of Physics, University of Utah	Gravitational Waves from Neutron Stars: Is a Relativistic Analysis Necessary?
9:30 - 9:45	**Scott Hughes**	Theoretical Astrophysics, Caltech	Radiative evolution of strong field, circular orbits of extreme mass ratio binaries
9:45 - 10:00	**Lior M. Burko**	Theoretical Astrophysics, Caltech	Calculation of self forces using a mode-sum regularization prescription
10:00 - 10:15	**Michele Vallisneri**	Theoretical Astrophysics, Caltech	Prospects for gravitational-wave observations of neutron-star tidal disruption in neutron-star/black-hole binaries
10:15 - 10:30	**Yuk-Tung Liu**	Theoretical Astrophysics, Caltech	Accretion Induced Collapse of Rapidly Rotating White Dwarfs
10:30 - 11:00	**Coffee break**	---	Refreshments are served in East Bridge 110
11:00 - 11:15	**Geoffrey Kagel**	University of California, Irvine	The Bianchi Identities in Regge Calculus
11:15 - 11:30	**Tevian Dray** and Corinne A. Manogue	Oregon State University	Quaternionic Spin
11:30 - 11:45	**Frederick D. Elston**	Embry-Riddle University	A possible Lagrangian form-invariance for the gravitational effects of electromagnetic fields
11:45 - 12:00	**Daniel Holz**	ITP, UC Santa Barbara	Probing dark matter through lensing of supernovae
12:00 - 12:15	**Veronika Hubeny**	UC Santa Barbara	Quasinormal modes of Schwarzschild-AdS black holes and their relevance for gauge theories
12:15 - 12:30	**Homer Ellis**	University of Colorado at Boulder	A Universe of Spinning Spheres
12:30 - 14:00	**Lunch break**	---	---
14:00 - 14:15	**Eric A. Minassian**	Department of Physics, UC Davis	Spacetime Singularities in 2+1 Dimensional Quantum Gravity
14:15 - 14:30	**Thomas Helliwell** and Deborah Konkowski	Harvey Mudd College	Quantum singularity in a screw-dislocated spacetime

14:30 - 14:45	**Sharmanthie Fernando**	University of Cincinnati	The Structure of the source modified WZW theory
14:45 - 15:00	**Petr Hajicek**	University of Berne	Embedding variables in canonical theory of generally covariant systems
15:00 - 15:15	**Herbert W. Hamber**	University of California, Irvine	Simplicial Quantum Gravity on a Custom-Built Parallel Supercomputer
15:15 - 15:30	**Ioannis Kouletsis**	University of Utah	Spacetime History Hamiltonian Formalism And Implementation Of Spacetime Diffeomorphisms As Symplectomorphisms
15:30 - 15:45	**Chris Vuille**	Embry-Riddle Aeronautical University	Natural Strings in General Relativity
15:45 - 16:00	**Kristin Schleich**	University of British Columbia	Does Small Scale Topology have Quantum Hair?
16:00 - 16:30	**Coffee break**	---	Refreshments are served in East Bridge 110
16:30 - 16:45	**Don Witt**	University of British Columbia	Topological Censorship and the ADS/CFT Correspondence
16:45 - 17:00	**William A. Hiscock**	Montana State University	Do semiclassical zero temperature black holes exist?
17:00 - 17:15	**Leonard S. Abrams**	---	A new model for spacetime
17:15 - 17:30	**Closing remarks and awarding of the Bell Prize**	---	---

When a talk is authored by more than one author, the speaker's name is in boldfaced font. The affiliation is that of the speaker.

Leonard S. Abrams
A new model for spacetime

An incomplete spacetime does not represent a unique universe, but instead corresponds to a family of universes, one for each distinct boundary compatible with it. Thus for universes having incomplete spacetimes the appropriate model therefor is not (M,g), but (M,g,B), where B denotes the boundary attached to (M,g). This requires modification of the concept of equivalence.

Gopakumar Achamveedu, Washington University in St. Louis
Constructing search templates for inspiraling binaries in eccentric orbits

We present second post-Newtonian corrections to the two independent `plus' and `cross' polarization waveforms associated with non-spinning compact binaries in `eccentric' orbit. We perform spectral analysis on these waveforms and investigate the influence of orbital elements on the spectrum. This work is done in collaboration with Bala R. Iyer.

Kashif Alvi (*), Theoretical Astrophysics, Caltech
An approximate binary-black-hole metric

An approximate solution to Einstein's equations representing two widely-separated non-rotating black holes in a circular orbit is constructed by matching a post-Newtonian metric to two perturbed Schwarzschild metrics. The spacetime metric is presented in a single coordinate system valid up to the apparent horizons of the black holes. This metric could be useful in numerical simulations of binary black holes. Initial data extracted from this metric have the advantages of being linked to the early inspiral phase of the binary system, and of not containing spurious gravitational waves.

Ian Anderson, Mark Fels, and **Charles Torre**, Utah State University
101 Spacetimes with Symmetry

Petrov has given a classification of spacetimes based upon their isometry groups. In this talk I will describe an ongoing project at Utah State University that further develops and applies Petrov's results. This work includes, for each of the approximately 100 symmetry classes, a classification of the isometry algebra, isotropy subalgebras and linear isotropy representations; computation of all invariant scalar fields, vector fields, 1-forms, metrics and curvature tensors; computation of the maximal subgroup of the spacetime diffeomorphism group which preserves the symmetry class; expression of the Einstein tensor in terms of scalar zeroth-order invariants and their invariant derivatives; verification of the principle of symmetric criticality; compilation of symmetry-reduced Noether identities and conservation laws; software to compute all this; web-based access to these results; and anything else you can think of.

Robert Bartnik, University of Canberra, Australia
High accuracy numerical black hole simulation

Andrew Norton and I have constructed a numerical code which models arbitrary gravitational waves interacting with a single black hole, to rather high accuracy. The code is based on an outgoing null coordinate and a quasi-spherical radial foliation condition, and makes extensive use of edth and spin-weighted spherical harmonics. The algorithms are described in gr-qc/9904045, and interactive access to the data is available through http://gular.canberra.edu.au/relativity.html. As an application we have constructed a spacetime for which the peeling conjecture about the behaviour of the Weyl spinors, fails: $r^4\Psi_0$ has a nonzero limit at future null infinity.

David Bernstein and Michael Holst, Department of Mathematics, UC San Diego
Adaptive finite element solution of the initial value problem: A few illustrative examples

We describe a computer program called Manifold Code (MC) for solving the fully coupled constraint system arising from the 3+1 conformal decomposition formalism. MC is a finite element code which uses a posteriori error estimation, adaptive simplex subdivision, algebraic multilevel methods, global inexact Newton methods, and numerical continuation methods for the highly efficient and accurate solution of coupled elliptic systems on 2- and 3-manifolds. We illustrate the use of MC by generating initial data for several different types of black hole spacetimes, including a two hole collision and a time symmetric single hole/gravitational wave collision. We also describe a novel approach to generating highly adapted unstructured tetrahedral meshes around one or two compact objects having axial symmetry.

Alessandra Buonanno, Caltech
Binary black hole coalescences: transition from inspiral to plunge

Combining recent techniques giving non-perturbative re-summed estimates of the damping and conservative parts of the two-body dynamics, we shall describe the transition between the adiabatic phase and the plunge, in coalescing binary black-holes with comparable masses, moving on quasi-circular orbits. (This talk is based on works developed with T. Damour)

Lior M. Burko, Theoretical Astrophysics, Caltech
Calculation of self forces using a mode-sum regularization prescription

I will review the status and the results which have recently been obtained for the calculations of self forces (a.k.a radiation reaction forces) acting on particles in curved spacetime using a mode-sum regularization prescription. In particular, I will describe results for a scalar particle in circular orbit around a black hole, for static charges inside and outside a spherical massive shell, and for charges falling radially into a black hole.

Peter Diener, Theoretical Astrophysics, Caltech
Relativistic Tidal Interaction of Stars with a Rotating Black Hole

I will present results from the numerical simulation of the tidal interaction of n=1.5 polytropic stars on parabolic orbits with a massive rotating black hole. In the simulations the general relativistic tidal potential for the Kerr metric was used to evaluate tidal forces exerted on a star and the hydrodynamic response of a star to these forces was treated in the Newtonian approximation using a three-dimensional, Eulerian, PPM hydrodynamical code. For different orbital and stellar parameters we computed the energy transfer, angular momentum transfer into the star, and the mass lost by the star during the interaction. >From the simulations it is found, that the complicated dependence of mass loss and the energy and angular momentum transfer on the orbital and stellar parameters can be factorized by introducing a single dimensionless parameter that is proportional to the integral of the square of the trace of the tidal tensor along the stellar trajectory. This result allows one to easily determine the outcome of the tidal interaction for every possible combination of the orbital and stellar parameters.

Tevian Dray and Corinne A. Manogue, Oregon State University
Quaternionic Spin

We consider the standard notion of spin in the nonstandard context of quaternionic (and octonionic) matrices. This leads to several inequivalent formulations, including one for which the standard spin eigenstates are in fact simultaneous eigenvectors of all 3 spin operators. This latter approach is the one which arises naturally in our octonionic dimensional reduction scheme, which reduces 10 spacetime dimensions to 4 through the choice of a preferred complex subalgebra.

Homer Ellis, University of Colorado at Boulder
A Universe of Spinning Spheres

If M is a geodesically complete Riemannian 3-space, the set of all 2-spheres in M is a four-manifold S(M), diffeomorphic to R x M. An elementary geometric construction produces on S(M) a space-time metric that reduces to the de Sitter metric when M is Euclidean 3-space (http://xxx.lanl.gov/abs/gr-qc/0003024). Geodesics of this metric are one-parameter families of 2-spheres of M whose centers track along geodesics of M. The set of all "rotationally distinguished" 2-spheres in M is a seven-dimensional manifold RDS(M), diffeomorphic to R x M x SO(3). A generalization of the earlier construction produces on RDS(M) a quartic Finsler arclength differential dT, which has embedded in it the earlier, de Sitter-like metric. Geodesics of dT are one-parameter families of spinning 2-spheres of M. When M is Euclidean 3-space, these geodesics can be fully described. Among the interesting phenomena they exhibit are (1) helical motion with spin vector precession about the helical axis, (2) separation of spin states into two classes ("up" and "down"), and (3) locking of velocity vector and spin vector into parallelism or antiparallelism when the motion is at the speed of light.

Frederick D. Elston, Embry-Riddle University
A possible Lagrangian form-invariance for the gravitational effects of electromagnetic fields

The ambiguities in the classical expressions for the electromagnetic energy density u and Poynting vector S are made the basis for a Lagrangian form-invariance. Alternative expressions for u and S are used to create alternative Lagrangians which become identical to a "standard" Lagrangian when appropriate "gauge" fields (the affine connections of the gravitational field) are introduced. This identity yields field equations for the affine connections without the necessity of a separate Lagrangian for the gravitational field. An example of this approach is provided in the special case of electrostatics.

Frank Estabrook, John Armstrong and Massimo Tinto, Jet Propulsion Laboratory
Time Delay Interferometry for LISA

LISA is a proposed three-spacecraft constellation to detect and study low-frequency gravitational radiation with excellent (~10^{-23}, in a one year integration) sensitivity. LISA will use coherent laser beams exchanged between three (almost) inertial spacecraft with separations of about .03 A.U. The main experimental problems are to cancel, very precisely, the laser phase noises and the non-inertial motions of the spacecraft and their optical benches in order to achieve the desired GW sensitivity. The baseline configuration is an unequal-arm-length Michelson interferometer, using transponders at each of the "corner masses". If, however, there is no transponding or other phase locking of the lasers, each spacecraft can use its laser as a local oscillator and six data streams are recorded. If drag-free control is used, twelve data streams can be recorded. With suitable delays, these data can be combined so as to eliminate all laser phase noise and Doppler shifts due to spacecraft motions. Doppler shifts resulting from passing gravitational wave are replicated six, eight or more times in the reduced data.

Marc Favata (*), Theoretical Astrophysics, Caltech
Energy Localization Invariance of Tidal Work

We examine a problem with computing the tidal work that a general relativistic (electric-type) external tidal field does on an isolated body with an evolving quadrupole moment. Thorne has proposed the following question: since the gravitational interaction energy between the external tidal field and the isolated body's quadrupole moment is ambiguously defined, is the formula for the tidal work also ambiguously defined? We demonstrate that the answer to this question is no. The formula for the tidal work is independent of how one chooses to localize gravitational energy in general relativity. This is proved by explicitly calculating the tidal work using various gravitational energy-momentum pseudotensors (Einstein, Landau-Lifshitz, Moller) as well as Bergmann's conserved quantities.

Arthur E. Fischer and Vincent Moncrief, UC Santa Cruz
Convergence and Collapse for the Reduced Einstein Equations

The future time evolution of a curvature-bounded non-singular sigma solution of the reduced Einstein equations on a closed 3-manifold M of negative Yamabe type is studied. Using recently developed methods of comparison geometry, it is shown that the base integral curve of geometries of any such solution must either (1) converge (up to isometry) to a hyperbolic metric, (2) volume collapse as a graph manifold, (3) volume collapse with bounded diameter as a Seifert-fibered or Sol manifold, or (4) weakly collapse as cusps develop. These four cases are controlled by the sign of the sigma constant of M, either negative or zero, and by whether the diameters of the base integral curve are bounded or unbounded. Through this approach, we show how the reduced Einstein equations provide a system of hyperbolic evolution equations that can be used to study the geometrization of 3-manifolds.

Sharmanthie Fernando, University of Cincinnati
The Structure of the source modified WZW theory

In 2+1 dimensions, the Chern-Simons Gauge theory on a manfold with a boundary is known to lead to a WZW theory at the boundary. When a source chracterized by the Cartan subalgebra of the gauge group is coupled to the Chern-Simons theory, the corresponding WZW theory is modified. We study the consequences of this modification on the corresponding Kac-Moody algebra and Virasoro algebras. We hope to apply these developments to understand the entropy of the black hole in 2+1 dimensions.

Eduardo Guendelman, Ben Gurion University, Beer Sheva, Israel
Scale invariance, induced gravity and the vacuum energy of the present universe

The possibility of mass in the context of scale-invariant, generally covariant theories, is discussed. Scale invariance is considered in the context of a gravitational theory where the action, in the first order formalism, is of the form $S = \int L_{1} \Phi d^4x$ + $\int L_{2}\sqrt{-g}d^4x$ where Φ is a density built out of degrees of freedom independent of the metric. For global scale invariance, a "dilaton" ϕ has to be introduced, with non-trivial potentials $V(\phi)$ = $f_{1}e^{\alpha\phi}$ in L_1 and $U(\phi)$ = $f_{2}e^{2\alpha\phi}$ in L_2. This leads to non-trivial mass generation and a potential for ϕ which is interesting for inflation. The model after ssb can be connected to the induced gravity model of Zee, which is a successful model of inflation. Models of the present universe and a natural transition from inflation to a slowly accelerated universe at late times are discussed.

Petr Hajicek, University of Berne
Embedding variables in canonical theory of generally covariant systems

Covariant gauge fixings and background manifolds are defined for models with dynamical spacetimes. Transformation from ADM variables to embedding variables is shown to exist. New formalism, not strictly equivalent to ADM one results, diffeomorphism group acts on the phase space, singularities of constrait surface are removed. The background manifold helps to show, in an application to thin shell model, that the quantum dynamics is unitary and that pairs of transient black and white holes are created rather than a real black hole.

Herbert W. Hamber , University of California, Irvine
Simplicial Quantum Gravity on a Custom-Built Parallel Supercomputer

The talk will cover the physics goals of the machine and its properties, as well as recent results for the phase diagram of quantum gravity, a determination of the gravitational scaling dimensions, and related physical correlation functions.

Thomas Helliwell and Deborah Konkowski, Harvey Mudd College
Quantum singularity in a screw-dislocated spacetime

Using a definition of quantum singularities in static spacetimes due to Horowitz and Marolf, it is found that a screw-dislocated spacetime possessing a classical quasiregular singularity is also quantum-mechanically singular, in that the time evolution of an initial wave function is not unique.

Jeremy S. Heyl, Theoretical Astrophysics, Caltech
Gravitational Radiation from Strongly Magnetized White Dwarfs

The magnetic fields of white dwarfs distort their shape generating an anisotropic moment of inertia. A magnetized white dwarf which rotates obliquely relative to the symmetry axis has a mass quadrupole moment which varies in time, so it will emit gravitational radiation. LISA may be able to detect the gravitational waves from two nearby, quickly rotating white dwarfs.

William A. Hiscock, Montana State University
Do semiclassical zero temperature black holes exist?

The semiclassical Einstein equations are solved to first order for the case of a Reissner-Nordstrom black hole perturbed by the vacuum stress-energy of quantized free fields. Massless and massive fields of spin 0, 1/2, and 1 are considered. We show that in all physically realistic cases, macroscopic zero temperature black hole solutions do not exist. Any static zero temperature semiclassical black hole solutions must then be microscopic and isolated in the space of solutions; they do not join smoothly onto the classical extreme Reissner-Nordstom solution in the limit of large mass or small $\hbar$.

Michael Holst and David Bernstein, Department of Mathematics, UC San Diego
Some existence, uniqueness, and approximation results for the initial value problem

In this talk we derive weak formulations of the coupled elliptic system arising in the York conformal decomposition of the initial value problem. Under minimal smoothness assumptions on the data and domain, we establish that weak formulations of the momentum and Hamiltonian constraints on connected compact Riemannian manifolds with Lipschitz boundaries are well-posed using Riesz-Schauder theory and convex analysis. The proof technique allows for some degree of negative conformal scalar curvature. We also establish some related approximation results which can be used to adaptively build extremely accurate numerical solutions. We finish by briefly outlining the implementation of the approximation techniques in the adaptive finite element software package "MC", which is designed to adaptively solve general nonlinear systems of tensor equations on manifolds.

Daniel Holz, ITP, UC Santa Brabara
Probing dark matter through lensing of supernovae

Gravitational lensing affects the observed magnification probability distribution of high redshift supernovae. The precise form of the lensing is a sensitive function of the matter distribution function. By observing sufficient numbers of supernovae it is possible to measure the form of the lensing, and thereby infer fundamental properties of the dark matter.

Veronika Hubeny (*), UC Santa Brabara
Quasinormal modes of Schwarzschild-AdS black holes and their relevance for gauge theories

We investigate the decay of a scalar field outside a Schwarzschild anti de Sitter black hole. This is determined by computing the complex frequencies associated with quasinormal modes. There are qualitative differences from the asymptotically flat case, even in the limit of small black holes. In particular, the decay is always exponential - there are no power law tails at late times. In terms of the recently proposed AdS/CFT correspondence in string theory (which I will briefly review), a large black hole corresponds to an approximately thermal state in conformal field theory, and the decay of the scalar field corresponds to the decay of a perturbation of this state. Thus one obtains the timescale for the approach to thermal equilibrium in a strongly coupled field theory.

Scott Hughes, Theoretical Astrophysics, Caltech
Radiative evolution of strong field, circular orbits of extreme mass ratio binaries

Using a "radiation reaction without radiation reaction forces" formalism (based on the frequency domain Teukolsky equation), I study the evolution of the orbits of small (10 solar mass or smaller) black holes around large (10^6 solar mass or larger) black holes. I focus on orbits in the very strong field. These results may impact measurements to be made by LISA.

Geoffrey Kagel (*), University of California, Irvine
The Bianchi Identities in Regge Calculus

I will discuss an explicit general formulation of the Bianchi Identities in Regge Calculus.

Marc Kamionkowski, Theoretical Astrophysics, Caltech
Detection of Gravitational Waves from Inflation

Inflation predicts the existence of a gravitational-wave background. I will explain how these gravitational waves can be detected by mapping the polarization of the cosmic microwave background.

Ioannis Kouletsis, University of Utah,
Spacetime History Hamiltonian Formalism And Implementation Of Spacetime Diffeomorphisms As Symplectomorphisms

In the standard approach to canonical quantization, the fields depend on the fixed foliation of Spacetime into equal-time hypersurfaces. Upon quantization, the invariances of the original spacetime theory are either lost or cannot be traced down explicitly, and the theory is subject to the so-called problem of time in quantum gravity. In the present approach, the canonical variables and the phase space of the theory are defined on Spacetime rather than on an equal-time hypersurface; i.e., they are defined on the space of classical Spacetime Histories. The resulting canonical framework is explicitly invariant under

Diffeomorphisms of Spacetime, while the latter are implemented canonically in the theory, as symplectomorphisms. The ultimate aim of this program is a Spacetime invariant quantum theory of gravity, in the context of the consistent histories approach to quantum theory.

Walter Landry, University of Utah
A General Method for the Binary Black Hole Initial Value Problem

Previous work with the close-limit approach to coalescing black holes only explored non-rotating spacetimes. The principle difficulty was in solving the initial value problem in a way such that, as the two holes got arbitrarily close together, the answer reduced to a single, time-independent, spinning hole. We present a method that overcomes this difficulty and can reduce to a wide class of spacetimes as the separation goes to zero. We also present some numerical results for various separations.

Shane L. Larson, Jet Propulsion Laboratory/Montana State University
Low frequency gravitational waves from the galactic center

The most recent observations of the "S0" family of stars near Sgr A* suggest these stars are on highly elliptical orbits with close approaches to the black hole at the center of the Milky Way. We examine the gravitational wave signal during the close passes and the implications of these stars as sources for LISA.

Lee Lindblom, Theoretical Astrophysics, Caltech
The r-mode instability in old-cold neutron stars

The gravitational radiation instability in the r-modes is damped by several important dissipative mechanisms that are unique to old-cold neutron stars. Recent analysis of the dissipation due to superfluid "mutual friction" and to core-crust "rubbing" will be briefly described. The implications of these results for the stability of old-cold neutron stars will be discussed.

Yuk-Tung Liu (*), Theoretical Astrophysics, Caltech
Accretion Induced Collapse of Rapidly Rotating White Dwarfs

An equilibrium model for the accretion induced collapse of a rapidly rotating white dwarf is constructed. This collapsed compact object is likely to be unstable against non-axissymmetric perturbations and so is a potentially strong source of gravitational radiation.

Warner A. Miller and Pablo Laguna, Los Alamos National Laboratory
Constant Crunch Surfaces for Black Hole Simulations

We are currently reinvestigating the use of Tr(K)=constant surfaces as a possible foliation in the numerical simulation of black holes to support the gravity wave interferometers (LIGO). Preliminary indications suggest that families of such surfaces (1) avoid singularities and may avoid the need to excise the apparent horizons, (2) are asymptotically null aiding in gravity wave extraction, (3) cover the spacetime, and (4) appear to have manageable "grid stretching" properties. Numerical investigations into their utility are currently underway.

Eric A. Minassian (*), Department of Physics, University of California, Davis
Spacetime Singularities in 2+1 Dimensional Quantum Gravity

The effects of quantization of spacetime on black hole and big bang/big crunch type singularities can be studied using new tools and models from 2+1 dimensional quantum gravity. We investigate effects of quantization of spacetime on singularities of the 2+1 dimensional BTZ black hole and the 2+1 dimensional torus universe. Hosoya has considered the BTZ black hole, and using a "quantum generalized affine parameter" (QGAP), has shown that, for some specific paths, quantum effects "smear" the singularity. Using gaussian wave functions as generic wave functions, we show that for both BTZ black hole and the torus universe, there are families of paths that still reach the singularities with a finite QGAP, suggesting that singularities persist in quantum gravity. More realistic calculations, using modular invariant wave functions of Carlip and Nelson for the torus universe, offer further support for this conclusion.

Kimberly C. B. New, Joan M. Centrella, and Joel E. Tohline, Los Alamos National Laboratory
Gravitational Waves from Long-Duration Simulations of the Dynamical Bar Instability

Compact astrophysical objects that rotate rapidly may encounter the dynamical "bar-instability." The bar-like deformation induced by this rotational instability causes the object to become a potentially strong source of gravitational radiation. We have carried out a set of long-duration simulations of the bar-instability with two Eulerian hydrodynamics codes. Our results indicate that the remnant of this instability is a persistent bar-like structure that emits a long-lived gravitational radiation signal.

Zeferino Andrade and **Richard H. Price**, Department of Physics, University of Utah
Gravitational Waves from Neutron Stars; Is a Relativistic Analysis Necessary?

The existence of w modes for compact neutron stars demonstrates that some neutron star physics is missed in a Newtonian analysis, but is this a matter of principle, or of serious concern in source calculations? We show that mass motions in a shell can be used to drive oscillations of a neutron star, allowing a comparison of Newtonian and relativistic predictions. For a constant density equation of state we find that Newtonian calculations suffice.

Josh Routzahn (*), Montana State University
Low Frequency Gravitational Waves from White Dwarf MACHO Binaries

We examine the possibility that the Galatic halo MACHOs are half solar mass white dwarfs, and calculate the contribution of halo white dwarf binaries to the low frequency gravitational wave background. The contribution from halo white dwarfs is found to be approximately 15 times stronger than the expected Galactic disk binary component, and could dominate the stochastic background for LISA.

Kristin Schleich, University of British Columbia
Does Small Scale Topology have Quantum Hair?

Topological censorship theorems unequivocably demonstrate that small scale topology is shrouded from outside observers in classical spacetimes. However, recent results hint that vacuum states for RP3 Schwarzchild and RP3 de Sitter spacetimes exhibit correlations not present in the vacuum states for their S3 counterparts. What do these results mean for quantum versions of topological censorship? This talk will discuss these issues in the context of possible generalizations of topological censorship to quantum fields in curved spacetimes.

Kip S. Thorne, Theoretical Astrophysics, Caltech
QND Interferometers for LIGO-III

LIGO-II interferometers (ca. 2006-2008) will operate at or near the standard quantum limit (SQL); and LIGO-III interferometers (ca. 2010 --) will need to operate below the SQL. This must be done by some form of "quantum nondemolition" (QND) technology. Thorne will describe a set of possible designs for such interferometers and their predicted performance. These designs (developed by Jeff Kimble, Yuri Levin, Andrei Matsko, Sergei Vyatchanin, and Thorne) rely on correlations that exist between photon shot noise and radiation pressure noise in any interferometer.

Richard Trejos, Hill AFB, Ogden Utah
Gravity

Explanation and calculation of how gravitational energy works with the electro-magnetic energy of space and matter. This calculation will build upon Einstein's work with Special Relativity (E=mc^2), deducing a force from this equation that will link the gravitational and magnetic constants together-results are units of acceleration. It is these two energies/forces that cause the curvature of space or force of acceleration we know as gravity.

Greg Ushomirsky, Theoretical Astrophysics, Caltech
Gravitational Waves from Low-Mass X-ray Binaries

I will summarize observations of the spin periods of rapidly accreting neutron stars. If gravitational radiation is responsible for balancing the accretion torque at the observed spin frequencies of ~300 Hz, then the brightest of these systems make excellent gravitational wave sources for LIGO-II and beyond. In addition, I will review the recent theoretical progress on gravitational wave emission mechanisms for these systems: mass quadrupole radiation from deformed neutron star crusts and current quadrupole radiation from r-mode pulsations in neutron star cores.

Michele Vallisneri (*), Theoretical Astrophysics, Caltech
Prospects for gravitational-wave observations of neutron-star tidal disruption in neutron-star/black-hole binaries

The equation of state of the bulk nuclear matter inside a neutron star (NS) is still poorly understood. Thorne has conjectured that insights into the equation of state might come from measurements of the gravitational waveforms emitted by merging NS/NS binaries and/or tidally disrupting NS's in neutron-star/black-hole (NS/BH) binaries. More recently, Newtonian models of NS/NS mergers have given strong evidence that the merger waves do carry equation-of-state information, but for NS/NS are emitted at frequencies (of order 1400-2800 Hz) that are too high for measurement by LIGO-type gravity-wave interferometers. We show that the prospects for NS/BH measurements are much brighter.

Chris Vuille, Embry-Riddle Aeronautical University
Natural Strings in General Relativity

Schrodinger's equation is generalized to an arbitrary four manifold by direct generalization of the differential operators followed by standard operator replacement. The resulting fourth order equation appears to describe objects that could be interpreted as propagating strings. Some approximate solutions, yielding eigenfunctions and mass spectra corresponding to a given stress energy, are presented.

Erez M. Yahalomi (*), Technion - Israel Institute of Technology
Extension of the equivalence of acceleration to gravitation obtains a way of finding the big bang location

As it is known Einstein used the Lorentz transformations in his special theory of relativity by denying the existence of a privileged frame. Lorentz , Ives , Builder , Caruso and Marinov obtained the Lorentz transformations by affirming the existence of a privileged frame. When trying to explain the existence of a privileged inertial reference frame they came with indefinite explanations like motion with respect to distant matter or the existence of ether. We present a definite mathematically formulated explanation for the distinction of a privileged inertial frame and the cause of special relativistic effects. We find that special relativistic effects occur only in frames that accelerated to reach the uniform velocity in which they are moving at the time of the measurement. We obtained symmetry breaking in special relativity. There is only one set of relativistic equations for systems with velocity v. There is no second set of relativistic equations for exchanging the frame of reference with the inertial frame and considering it to have velocity v. The frame, which did not accelerate, and its velocity is viewed to be- v by viewing from the other frame, is the privileged inertial frame. The integration of acceleration over time until reaching the uniform velocity turns out to be the source of all the special relativity effects. The equations for space-time, mass, energy, length and charge density are presented. This phenomenon complements the explanation for the twins' paradox. This approach to the theory of special relativity is similar to the general relativity theory where the relativistic effects are determined absolutely by potentials. It extends the equivalence principle, which state that acceleration equivalent to gravitation. A universal inertial frame is obtained. It implies that in a proper direction there is a range of velocities in which the time rate of a moving frame can increase, and the magnitude of mass can decrease. An experiment based on the rate's measurement of atomic clock as we described could discover the speed and the direction the Earth moves compared to the Universe before the Big Bang, which is considering as the Universal Inertial Frame.

Don Witt, University of British Columbia
Topological Censorship and the ADS/CFT Correspondence

Recently, the ADS/CFT correspondence conjecture has proposed that supergravity in an asymptotically anti-de Sitter spacetime, the low energy limit of certain D-brane configurations, corresponds to a conformal field theory on the boundary of this spacetime in the large N limit. This talk describe how topological censorship, a proven property of a general class of asymptotically anti-de Sitter spacetimes, characterizes the relationship of the topology of the boundary to that of the spacetime interior to it in arbitrary dimensions. In particular a simple corollary of topological censorship is that anyasymptotically anti-de Sitter spacetime with a disconnected boundary necessarily contains black hole horizons which screen the boundary components from each other. This corollary may be viewed as a Lorentzian analog of the Witten and Yau result but is independent of the scalar curvature of $\scri$. Furthermore, in $n+1$ spacetime dimensions with $n>1$, spatial hypersurfaces corresponding to Cauchy surfaces for these spacetimes cannot contain any wormholes or other compact, non-simply connected topological structures. For the case of $n=2$, these constraints are sufficient to limit the topology of these hypersurfaces to either B^2 or $I\times S^1$.

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16th PACIFIC COAST GRAVITY MEETING

Participants and Talk Titles (partial list)

List of speakers and titles

Speaker	E-mail	Affiliation	Title
Leonard S. Abrams	lsabrams@mindspring.com	---	A new model for spacetime
Gopakumar Achamveedu	gopu@wugrav.wustl.edu	Washington University in St. Louis	Constructing search templates for inspiraling binaries in eccentric orbits
Kashif Alvi (*)	kashif@newman.tapir.caltech.edu	Theoretical Astrophysics, Caltech	An approximate binary-black-hole metric
Ian Anderson, Mark Fels, and **Charles Torre**	TORRE@cc.usu.edu	Utah State University	101 Spacetimes with Symmetry
Robert Bartnik	bartnik@ise.canberra.edu.au	University of Canberra	High accuracy numerical black hole simulation
David Bernstein and Michael Holst	mholst@math.ucsd.edu	Department of Mathematics, UC San Diego	Adaptive finite element solution of the initial value problem: A few illustrative examples
Alessandra Buonanno	buonanno@newman.tapir.caltech.edu	Theoretical Astrophyics, Caltech	Binary black hole coalescences: transition from inspiral to plunge
Peter Diener	peter@tapir.caltech.edu	Theoretical Astrophysics, Caltech	Relativistic Tidal Interaction of Stars with a Rotating Black Hole

Tevian Dray and Corinne A. Manogue	tevian@math.orst.edu	Oregon State University	Quaternionic Spin
Homer Ellis	ellis@euclid.Colorado.EDU	University of Colorado at Boulder	A Universe of Spinning Spheres
Frederick D. Elston	elstonf@cts.db.erau.edu	Physical Sciences Department, Embry-Riddle University	A possible Lagrangian form-invariance for the gravitational effects of electromagnetic fields
Frank Estabrook, John Armstrong and Massimo Tinto	frank@bottom.jpl.nasa.gov	Jet Propulsion Laboratory	Time Delay Interferometry for LISA
Sharmanthie Fernando	fernando@physics.uc.edu	University of Cincinnati	The Structure of the source modified WZW theory
Arthur E. Fischer and Vincent Moncrief	aef@cats.UCSC.EDU	UC Santa Cruz	Convergence and Collapse for the Reduced Einstein Equations
Eduardo Guendelman	guendel@bgumail.bgu.ac.il	Ben Gurion University, Beer Sheva, Israel	Scale invariance, induced gravity and the vacuum energy of the present universe
Petr Hajicek	hajicek@physics.utah.edu	University of Berne	Embedding variables in canonical theory of generally covariant systems
Herbert W. Hamber	hhamber@uci.edu	University of California, Irvine	Simplicial Quantum Gravity on a Custom-Built Parallel Supercomputer
Thomas Helliwell	helliwell@hmc.edu	Harvey Mudd College	Quantum singularity in a screw-dislocated spacetime
Jeremy S. Heyl	jsheyl@tapir.caltech.edu	Theoretical Astrophysics, Caltech	Gravitational Radiation from Strongly Magnetized White Dwarfs
William A. Hiscock	hiscock@physics.montana.edu	Montana State University	Do semiclassical zero temperature black holes exist?
Michael Holst and David Bernstein	mholst@math.ucsd.edu	Department of Mathematics, UC San Diego	Some existence, uniqueness, and approximation results for the initial value problem

Daniel Holz	deholz@itp.ucsb.edu	ITP, UC Santa Barbara	Probing dark matter through lensing of supernovae
Veronika Hubeny (*)	veronika@cosmic.physics.ucsb.edu	UC Santa Barbara	Quasinormal modes of Schwarzschild-AdS black holes and their relevance for gauge theories
Scott Hughes	hughes@newman.tapir.caltech.edu	Theoretical Astrophyics, Caltech	Radiative evolution of strong field, circular orbits of extreme mass ratio binaries
Geoffrey Kagel (*)	gkagel@ea.oac.uci.edu	University of California, Irvine	The Bianchi Identities in Regge Calculus
Marc Kamionkowski	kamion@tapir.caltech.edu	Theoretical Astrophysics, Caltech	Detection of Gravitational Waves from Inflation
Pavel Korobkov (*)	paul@sai.msu.ru	Sternberg Astronomical Institute, Moscow State University	LISA detection of gravitational waves produced by the solar g-modes oscillations
Valery M. Koryukin	koryukin@mpicnit.mari.su	Mari State Technical University, Yoshkar-Ola, Russia	Neutrinos of Universe and Induced Gravitation
Ioannis Kouletsis	kouletsi@physics.utah.edu	University of Utah	Spacetime History Hamiltonian Formalism And Implementation Of Spacetime Diffeomorphisms As Symplectomorphisms
Walter Landry	landry@physics.utah.edu	University of Utah	A General Method for the Binary Black Hole Initial Value Problem
Shane L. Larson	shane@orion.physics.montana.edu	Jet Propulsion Laboratory/Montana State University	Low frequency gravitational waves from the galactic center
Lee Lindblom	lindblom@tapir.caltech.edu	Theoretical Astrophysics, Caltech	The r-mode instability in old-cold neutron stars
Yuk-Tung Liu (*)	ytliu@its.caltech.edu	Theoretical Astrophysics, Caltech	Accretion Induced Collapse of Rapidly Rotating White Dwarfs
Warner A. Miller and Pablo Laguna	wam@lanl.gov	Los Alamos National Laboratory	Constant Crunch Surfaces for Black Hole Simulations
Eric A. Minassian (*)	eminassi@landau.ucdavis.edu	Department of Physics, UC Davis	Spacetime Singularities in 2+1 Dimensional Quantum Gravity

Kimberly C. B. New, Joan M. Centrella, and Joel E. Tohline	knew@lanl.gov	Los Alamos National Laboratory	Gravitational Waves from Long-Duration Simulations of the Dynamical Bar Instability
Zeferino Andrade and **Richard H. Price**	rprice@physics.utah.edu	Department of Physics, University of Utah	Gravitational Waves from Neutron Stars; Is a Relativistic Analysis Necessary?
Josh Routzahn (*)	routzahn@physics.montana.edu	Montana State University	Low Frequency Gravitational Waves from White Dwarf MACHO Binaries
Kristin Schleich	schleich@physics.ubc.ca	University of British Columbia	Does Small Scale Topology have Quantum Hair?
Kip S. Thorne	kip@tapir.caltech.edu	Theoretical Astrophysics, Caltech	QND Interferometers for LIGO-III
Richard Trejos	Rich.Trejos@Hill.af.mil	Hill AFB, Ogden Utah	Gravity
Greg Ushomirsky	gregus@tapir.caltech.edu	Theoretical Astrophysics, Caltech	Gravitational Waves from Low-Mass X-ray Binaries
Michele Vallisneri (*)	vallis@caltech.edu	Theoretical Astrophysics, Caltech	Prospects for gravitational-wave observations of neutron-star tidal disruption in neutron-star/black-hole binaries
Chris Vuille	vuille@fl.freei.net	Embry-Riddle Aeronautical University	Natural Strings in General Relativity
Erez M. Yahalomi (*)	cherez@techunix.technion.ac.il	Technion - Israel Institute of Technology	Extension of the equivalence of acceleration to gravitation obtains a way of finding the big bang location
Don Witt	schleich@physics.ubc.ca	University of British Columbia	Topological Censorship and the ADS/CFT Correspondence

* speakers who are students, and therefore eligible for the Bell Prize.
When a talk is authored by more than one author, the speaker's name is in boldfaced font. The affiliation is that of the speaker. The list is in alphabetical order.

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16th PACIFIC COAST GRAVITY MEETING

California Institute of Technology
Pasadena, California
March 24-25, 2000

Jump to: Announcement - Schedule - Venue - Lodging - Bell Prize - Party - Parking - Further Resources

The registration deadline is March 13, 2000

Announcement

The 16th Pacific Coast Gravity Meeting will be held at the California Institute of Technology, on March 24th and 25th, 2000. As in previous years, this will be an open meeting. All interested researchers and students in all areas of gravitational physics---classical and quantum, theory and experiment---are invited. Because this is a regional meeting, many participants will be from the Western United States, but all are welcome.

The meeting will follow the standard, very informal, format of previous PCGMs. There will be no plenary talks. Instead, all participants, especially postdocs and graduate students, are invited to contribute talks on their current research. Unless we are overwhelmed with speakers, we will allot equal time to everyone who requests to speak, and we will not have parallel sessions. Based on previous experience, we anticipate that each talk will be between 10 to 15 minutes long.

There will be no registration fee, and the organizers cannot provide financial support for any participants. Refreshments will be provided at coffee breaks, but meals will be the responsibility of individual participants. Many restaurants can be found within walking distance from Campus.

Schedule

The schedule of the meeting, including links to the abstracts of all talks is available. A list of participants, including e-mail addresses, is available here .

Venue

All talks will be held at East Bridge 201, Caltech.

Lodging

Each participant should take care of his/her own reservations. A list of nearby hotels, phone numbers and prices can be found here.

Bell Prize

A prize of $100 will be awarded for the best talk by a student at the meeting. The prize is named after Jocelyn Bell Burnell who discovered radio pulsars while a graduate student.

Party

On Friday evening, March 24 there will be a party for all participants (including buffet supper) at the home of Kip Thorne and Carolee Winstein: 1462 Rutherford Drive, Pasadena. Please bring your swimming suits if you want to cavort in the jaccuzi, pool, or steam sauna. Bring light jackets if you want to sit around the fire pit and watch the cavorting. Driving directions from Caltech are available here .

Note about parking

You may park your car in undesignated parking places in the Caltech parking lots. You shouldn't have problems in finding a parking place early on Friday morning and throughout Saturday.
Parking in the streets arround Caltech is usually free, but limited to 2 hours. This time limit is strictly enforced by the Pasadena Police Department.
The Athenaeum parking is for Athenaeum guests only.

Further resources:

- California Institute of Technology
- Caltech Theoretical Astrophysics and Relativity Group

- Zoomable map of the Caltech campus.

For more information, contact Lior Burko (*burko@tapir.caltech.edu*).

Last update: March 18, 2000