Strings, branes, supergravity and gauge theory

Quantum supersymmetric cosmology and its hidden Kac-Moody structure

T Damour and P Spindel
2013 Class. Quantum Grav. 30 162001
“This is an elegant paper, where ingredients such as supersymmetry, group theory, fundamental physics, the early universe and lateral comments to other areas come together in a highly technical article that is brief but very informative. This work shows how quantum cosmology without supersymmetry cannot be ignored.” Comment from Editorial Board

Double field theory: a pedagogical review

Gerardo Aldazabal, Diego Marqués and Carmen Núñez
2013 Class. Quantum Grav. 30 163001
“Double field theory is a field theory formulated in a configuration space with twice the number of coordinates which incorporates T-duality in a natural way. It is a growing area of research and this paper provides a timely review from the basics of DFT until recent topics like its connection with gauged supergravity theories and flux compactifications. It is written in a very clear way and it is very useful for beginners as well as experienced researchers in the area.” Comment from Editorial Board

Constraining conformal field theories with a slightly broken higher spin symmetry

Juan Maldacena and Alexander Zhiboedov
2013 Class. Quantum Grav. 30 L04003
“Determines the leading form of the correlation functions in the CFT dual for a large class of higher spin theories, using only very general properties of the theory. The resulting form of the correlation functions is highly constrained. These universal results will play an important part in the development of holographic duality for higher spin.” Comment from Editorial Board

Holography without strings?

Donald Marolf
2014 Class. Quantum Grav. 31 015008
“Emphasizes the role of the gravitational Gauss law constraint and entanglement in the bulk in holography. The discussion of Reeh-Schlieder sheds an interesting new light on the reconstruction of bulk observables from boundary correlators.” Comment from Editorial Board

Relativistic effects in cosmology

Guest Editors Kazuya Koyama
Upcoming galaxy surveys will probe the large-scale structures of the Universe on ever larger scales with ever greater precision. These surveys also probe galaxies at higher redshifts when the Hubble scale is smaller and general relativistic (GR) effects become more important. This focus issue contains a selection of articles by the authors who pioneered the development in gauged supergravity theories and flux compactifications. It is written in a very clear way and it is very useful for both beginners and as experienced researchers in the area.” Comment from Editorial Board

Submissions to CQG (papers)
More popular than ever, CQG experienced a record number of regular paper submissions in 2014.

- 1000 submissions in 2006
- 950 submissions in 2007
- 900 submissions in 2008
- 850 submissions in 2009
- 800 submissions in 2010
- 750 submissions in 2011
- 700 submissions in 2012
- 650 submissions in 2013
- 700 submissions in 2014

Focused Issues
- Strings, branes, supergravity and gauge theory
- Quantum supersymmetric cosmology and its hidden Kac-Moody structure
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The Bergmann-Wheeler Thesis Prize
This prize, sponsored by Classical and Quantum Gravity, is awarded every three years by the International Society on General Relativity and Gravitation (ISGRG) for the best PhD thesis in quantum gravity. It is named after 2 great pioneers of quantum gravity: Jürgen Bergmann and Peter Bergmann. The winner of the prize will receive $1800 and a certificate. The next prize will be awarded at the GR21 meeting in New York City in 2016. To be considered, nominations must be received by 30 September 2015. Guidelines for the nomination are available at http://www.qg.org
Past recipients are:
2013 Aron C Wall, thesis institution: University of Maryland
2010 Victor Tassis, thesis institution: Pennsylvania State University
Gary Horowitz
President, International Society on General Relativity and Gravitation

Welcome to the 2015 CQG Highlights brochure, featuring some of the best papers published during the last 12 months, as selected by our Editorial Board.
As the centenary of Albert Einstein’s discovery of general relativity, 2015 will be an exciting year for the CQG community. To mark this occasion, CQG will publish a special issue of the journal entitled ‘Milestones of General Relativity’, which will review some of the most important developments in the history of gravitational physics. You can also watch for the full scientific output of the Gravity Probe B mission, which will appear in CQG in 2015.
The last 12 months have been very eventful for the journal. CQG’s new companion website, CQG+ (at cagplus.com) has generated some considerable interest. Papers featured on CQG+ are among the most read in the journal. It’s a great place to learn about your peers in the community and their work in an informal setting. CQG+ has also published movie reviews, interviews, details of prizes sponsored by CQG and other news. Go to CQG+ and follow the site to receive instant notifications of this new and varied content.
CQG made the headlines this year with the publication of a paper co-written by Kip Thorne and the visual effects team who worked on Christopher Nolan’s Interstellar. The paper describes how the images of Interstellar’s black hole was created, and is freely available to read in CQG. Interstellar went on to win an Oscar® for best visual effects.
Clifford M Will
Editor-in-Chief, Classical and Quantum Gravity
Black holes

Instability of black holes in massive gravity

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Aarón Wall
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"This paper shows the kind of structures need to provide a discrete and causal model of quantum gravity. " Comment from Editorial Board

The Renormalisation group and Weyl Invariance

A Codello, G D’Odorico, C Pagani and R Percacci
2013 Class. Quantum Grav. 30 115015

"This paper gives a modern particle physics interpretation of a very classical geometrical idea due to Hermann Weyl. While Weyl’s idea in its original form was not experimentally viable, it led to modern gauge theories. This paper looks at the matter from the modern perspective of the renormalisation group and trace anomalies." Comment from Editorial Board

A gravitational entropy proposal

Timothy Clifton, George R Ellis and Reza Tavakoli
2013 Class. Quantum Grav. 30 1250095

"This paper proposes a new definition of gravitational entropy based on the Bel-Robinson tensor that could be applicable to cosmological settings. Further study will be required to determine how viable this proposal is, but it merits serious consideration since it connects black hole entropy to a broader definition of entropy of a gravitational field." Comment from Editorial Board

The generator of spatial diffeomorphisms in the Koslowski–Sahlmann representation

Madhavan Varadarajan
2013 Class. Quantum Grav. 30 175017

"This article addresses the issue of constructing diffeomorphism constraint operator in the Koslowski-Sahlmann representation in loop quantum gravity. This work shows that difficulties associated with the construction of diffeomorphism constraint operator using holonomy and flux operators can be overcome by identifying new background exponential operators. A rigorous construction of the diffeomorphism constraint is provided in the enlarged holonomy-flux background exponential algebra. The construction is potentially very useful in gaining important insights on the emergence of smooth classical geometries from the quantum geometry." Comment from Editorial Board

Hamiltonian treatment of linear field theories in the presence of boundaries: a geometric approach

Fernando Barbero G, Jorge Prieto, Eduardo J Villasenor
2014 Class. Quantum Grav. 31 045021

"This paper presents a rigorous treatment of the scalar and electromagnetic fields in the presence of boundaries in the Hamiltonian framework. The work is based on the implementation of the geometric constraint algorithm of Gicay, Reuter and Vides. The geometric approach implemented in this paper provides important insights on the role of the boundaries and identification of the physical degrees of freedom." Comment from Editorial Board

Entanglement and quantum gravity

Guest Editors: Eugenio Bianchi and Carlo Rovelli

Quantum gravity alone is not the only major theoretical open problem in fundamental physics: gravity, quantum theory and thermodynamics form a trinity, whose full interconnections we have definitely not yet understood. As soon as quantum effects appear in a curved spacetime, thermal aspects appear to be unavoidable. Combining thermodynamics and (full) gravity might turn out to be even more crucial than understanding the quantum aspects of the gravitational field alone. In recent years, it has become increasingly clear that entanglement entropy is a central ingredient for the synthesis we are seeking.

Recent years have seen a flourishing of interest in the role that entanglement entropy plays in the physics of spacetime. Insights have been obtained into the role of entanglement for the entropy for black hole thermodynamics, and new ideas have been explored connecting entanglement to holography, wormholes, to the structure itself of semiclassical spacetime and others. This special issue collects a number of articles on this topic, offering a partial overview of these new developments.

Focus issues can be found at lpsciences.org/0264-9381/page/Focus issues

Did you know?
All of the articles featured in this brochure are free to read on the CQG website until 31 December 2015. Visit lpsciences.org/cqg for more information
Cosmology

Multiversality
F Wilczek
2013 Class. Quantum Grav. 30 193001
“The cosmological multiverse, which is suggested in current fundamental theories of physics, has been much discussed in the recent scientific literature, often with a more philosophical bent. Wilczek presents a very readable and informative topical review on the theoretical and empirical motivations of the cosmological multiverse, and its potential “disruptive implications for the traditional program of fundamental physics”. In particular he focuses on the firmly rooted and plausible inflationary axion cosmological paradigm, and discusses its possible testable phenomenological consequences. “Comment from Editorial Board

Inflationary attractors and their measures
Alejandro Corichi and David Sloan
2014 Class. Quantum Grav. 31 062001
“An insightful work on the measure problem in the inflationary models which gives significant insights on the probability for inflation to occur. This paper addresses some of the misconceptions in the literature. Conclusions from this work are significant to understand the naturalness of inflation in different frameworks describing the very early universe.” Comment from Editorial Board

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Mikołaj Korzynski
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Numerical relativity
Massive disc formation in the tidal disruption of a neutron star by a nearly extremal black hole
Geoffrey Lovelace, Matthew D Duce, Francois Foucart, Lawrence E Kidder, Harald P Pfeiffer, Mark A Scheel and Béla Szilágyi
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“A catalogue of gravitational waveforms from black-hole binaries is generated using different numerical codes and compared with analytical waveform models. The comparison highlights where further improvements of the models are required and more numerical waveforms are needed for calibration. An overview of the numerical ingredients used in numerical relativity is given and the article provides standards for the analysis of the waveforms.” Comment from Editorial Board

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H-O Kreiss and J Winicour
2014 Class. Quantum Grav. 31 065004
“Interesting progress in identifying local geometric data on a timelike boundary guaranteeing a well-posedness result for the initial-boundary value problem for the Einstein field equations.” Comment from Editorial Board

Did you know?
CQG has an Advisory Panel of around 50 senior authors who support the Editorial Board in maintaining the rigour and speed of peer review

Higher-dimensional gravity and other theories of gravity

Time delays across saddles as a test of modified gravity
Jaco Magrebe and Ali Mozaffari
2013 Class. Quantum Grav. 30 092002
“This paper presents novel ways to test Modified Newtonian Dynamics using the time delay effects at the saddle points of the gravitation potential where the Newtonian force vanishes and modifications to Newton gravity are maximised in these theories. Experiments using Lunar Laser Ranging and Very Large Baseline Interferometry are discussed.” Comment from Editorial Board

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Claudia de Rham, Andrew Matas and Andrew J Tolley
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A new limit on local Lorentz invariance violation of gravity from solitary pulsars

Lijing Shao, R Nicolas Caballero, Michael Kramer, Norbert Wex, David J Champion and Axel Jessner
2013 Class. Quantum Grav. 30 165019

“A new method to compute the travel time of a photon in terms of the spatial orders of magnitude over solar-system bounds, and shows once again that limit any precession produced by a ‘Whitehead’ term in the post-Newtonian terms when emitter and receiver are in conjunction is confirmed. These are necessary to determine the post-Newtonian parameter gamma with precision better by a factor 100 than had been achieved in the solar system.” Comment from Editorial Board

The stochastic background: scaling laws and time to detection for pulsar timing arrays

Xavier Siemens, Justin Ellis, Frederik Jonet and Joseph B Romans
2013 Class. Quantum Grav. 30 124205

“A detailed analysis of how a stochastic gravitational wave signal can be extracted from pulsar timing data, pointing the way to a preferred strategy, and projecting when a signal may finally emerge from the noise.” Comment from Editorial Board

Method to reduce excess noise of a detuned cavity for application in KAGRA

Shinichiro Ueda, Naoya Saito, Daniel Friedelich, Yotsubi Aso and Kentaro Somiya (for the KAGRA collaboration)
2014 Class. Quantum Grav. 31 195003

“Discusses, with admirable clarity, the technical issues associated with detuning signal recycling cavities in gravitational wave detectors. By showing how technical noise can be reduced, it confirms the promise of using detuning to shape the frequency response of advanced detectors.” Comment from Editorial Board

Increasing LIGO sensitivity by feedforward subtraction of auxiliary length control noise

Grant David Meadors, Keita Kawabe and Keith Riles
2014 Class. Quantum Grav. 31 150514

“A very important result with real LIGO data that shows how the Michelson length control noise can be subtracted from the gravitational strain h(t) using simple feedforward subtraction methods. If used, this will especially improve the advanced detectors’ sensitivity in their most sensitive frequency band where control noises may be contributing to the overall noise floor.” Comment from Editorial Board

Advanced interferometric gravitational wave detectors

Guest Editors: Peter Shawhan and Mario-Antonio Blizzard

The quest to detect gravitational waves directly has accelerated in the past decade with the successful operation of a first generation of large interferometric detectors. The lessons learned from the first generation detectors led to the design of advanced detectors which are now being constructed and commissioned and will soon begin collecting data. Higher laser power, sophisticated mirror suspensions and numerous other improvements will extend the distance reach of the detectors by an order of magnitude and finally record the tiny gravitational-wave signals traversing Earth. This special issue examines the advanced techniques and detectors currently being assembled, tested and prepared.

Focus issues can be found at iopscience.org/0264-9381/page.Focus issues

Mathematical relativity

Momentum in general relativity: local versus quasilocal conservation laws

Richard J Epp, Paul L McGrath and Robert B Mann
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“This well-written paper continues a worthwhile investigation into relativistic conservation laws in conjunction with the authors’ notion of a ‘rigid quasilocal frame’. This paper represents the state of the art in this area of relativity.” Comment from Editorial Board

The Lichnerowicz equation on compact manifolds with boundary

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Non-CMC solutions of the Einstein constraint equations on asymptotically Euclidean manifolds

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“This article solves an open problem and has potential future applications for the construction of binary black hole initial data with non trivial/linear momentum. This article is recommended for both mathematical and numerical relativists.” Comment from Editorial Board

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“This is a technical paper. It is known that gravitational double layers, unlike their classical electromagnetic counterparts, do not occur in general relativity (and are usually assumed to be unphysical). However, this paper clearly demonstrates (using the mathematical properties of thin shells) that double layers do exist in some alternative, modified gravitational theories (e.g. quadratic FR1 theories).” Comment from Editorial Board

Axisymmetric constant mean curvature slices in the Kerr spacetime

David Schlinkel, Rodrigo Panioso Macedo and Marcus Amaro
2014 Class. Quantum Grav. 31 075017

“This work will have applications in numerical relativity simulations and is of general interest in further understanding the Kerr solution.” Comment from Editorial Board

IOP Gravitational Physics Group Thesis Prize

The Gravitational Physics Group (GPG) Prize, sponsored by Classical and Quantum Gravity, is awarded for excellence in postgraduate research and communication skills in gravitational physics. The winner receives £500, and is invited to speak at the annual Braginsk meeting organised by the EPL.

Further information about the prize and the nomination procedure can be found on the IOPG website: gp.iop.org

This year’s winner of the prize was Dr Patricia Schmidt for her thesis “Studying and Modelling the Complete Gravitational-Wave Signal from Precessing Black Hole Binaries”, completed at Cardiff University under the supervision of Mark Hannam.

Bangalore Sathyaprakash
Chair
Gravitational Physics Group

Classical and Quantum Gravity Highlights 2013–2014

IOPscience.org/IQG

Classical and Quantum Gravity Highlights 2013–2014

IOPscience.org/IQG
Experimental Gravity

How gravitational-wave observations can shape the gamma-ray burst paradigm

I. Baraus, P. Brady and S. Márka
2013 Class. Quantum Grav. 30 123001

“A comprehensive review interrelating the astrophysical processes and gravitational-wave emission mechanisms of binary coalescences and other likely GRB progenitors. Outlines observing strategies and the many things that can potentially be deduced from gravitational-wave observations of these events.” Comment from Editorial Board

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“Continuing a program of using millisecond pulsars to reach ever tighter limits on post-Newtonian parameters, Shao and colleagues have constrained a preferred frame parameter better by a factor 100 than had been achieved in the solar system.” Comment from Editorial Board

New limits on the violation of local position invariance of gravity

Lijing Shao and Norbert Wex
2013 Class. Quantum Grav. 30 165020

“This paper presents observations of very stable, isolated millisecond pulsars to limit any precession produced by a ‘Whitehead’ term in the post-Newtonian metric. The limit on the Whitehead’s PPN parameter is an improvement by 6 orders of magnitude over solar-system bounds, and shows once again that Whitehead’s theory of gravity is well and truly dead.” Comment from Editorial Board

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Conformal Carroll groups and BFS symmetry

C. Duval, G. W. Gibbons and P. A. Horvathy
2014 Class. Quantum Grav. 31 092001

“Demonstrates a new relation between the BFS group (the asymptotic symmetry group of an asymptotically flat spacetime) and a group arising from the Plecsir group in the limit of vanishing speed of light. May have important implications for recent work on the application of the BFS group to scattering amplitudes.” Comment from Editorial Board
Discrete Newtonian Cosmology

G Gibbons and G Ellis
2014 Class. Quantum Grav. 31 025003

"Normally in astrophysical cosmology it is assumed that Newtonian theory adequately describes the formation of large scale structure. In this paper the authors clearly lay down a rigorous and self consistent pedagogical foundation for a purely Newtonian theory of cosmology, valid at scales small compared cosmological scales. They are thus able to justify the usual assumptions behind the elementary standard spatially homogeneous and isotropic Raychaudhuri and Friedmann equations without making any fluid dynamic or continuum approximations." Comment from Editorial Board

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"This paper shows the kind of structures need to provide a discrete and causal model of quantum gravity." Comment from Editorial Board

The Renormalisation group and Weyl Invariance
A Codelli, G D’Odorico, C Pagani and R Percacci
2013 Class. Quantum Grav. 30 115015

"This paper gives a modern particle physics interpretation of a very classical geometric idea due to Hermann Weyl. While Weyl’s idea in its original form was not experimentally viable, it led to modern gauge theories. This paper looks at the matter from the modern perspective of the renormalisation group and trace anomalies." Comment from Editorial Board

A gravitational entropy proposal
Timothy Clifton, George F R Ellis and Reza Tavakoli
2013 Class. Quantum Grav. 30 1250095

"This paper proposes a new definition of gravitational entropy based on the Bel-Robinson tensor that could be applicable to cosmological settings. Further study will be required to determine how viable this proposal is, but it merits serious consideration since it connects black hole entropy to a broader definition of entropy of a gravitational field." Comment from Editorial Board

The generator of spatial diffeomorphisms in the Koslowski–Sahlmann representation
Madhavan Varadarajan
2013 Class. Quantum Grav. 30 175017

"This paper addresses the issue of constructing diffeomorphism constraint operator in the Koslowski-Sahlmann representation in loop quantum gravity. This work shows that difficulties associated with the construction of diffeomorphism constraint operator using holonomy and flux operators can be overcome by identifying new background exponential operators. A rigorous construction of the diffeomorphism constraint is provided in the enlarged holonomy-flux background exponential algebra. The construction is potentially very useful in gaining important insights on the emergence of smooth classical geometries from the quantum geometry." Comment from Editorial Board

Hamiltonian treatment of linear field theories in the presence of boundaries: a geometric approach
Fernando Barbero G, Jorge Prieto, Eduardo J Villasenor
2014 Class. Quantum Grav. 31 045021

"This paper presents a rigorous treatment of the scalar and electromagnetic fields in the presence of boundaries in the Hamiltonian framework. The work is based on the implementation of the geometric constraint algorithm of Goela, Heer and Vinko. The geometric approach implemented in this paper provides important insights on the role of the boundaries and identification of the physical degrees of freedom." Comment from Editorial Board

Entanglement and quantum gravity

Guest Editors: Eugenio Bianchi and Carlo Rovelli
Quantum gravity alone is not the only major theoretical open problem in fundamental physics: gravity, quantum theory and thermodynamics form a triad, whose full interconnections we have definitely not yet understood. As soon as quantum effects appear in a curved spacetime, thermal aspects appear to be unavoidable. Combining thermodynamics and (full) gravity might turn out to be even more crucial than understanding the quantum aspects of the gravitational field alone. In recent years, it has become increasingly clear that entanglement entropy is a central ingredient for the synthesis we are seeking.

Recent years have seen a flourishing of interest in the role that entanglement entropy plays in the physics of spacetime. Insights have been obtained into the role of entanglement for the entropy for black hole thermodynamics, and new ideas have been explored connecting entanglement to holography, wormholes, to the structure itself of semiclassical spacetime and others. This special issue collects a number of articles on this topic, offering a partial overview of these new developments.

Focus issues can be found at

Focus issues can be found at lopsscience.org/0264-9381/page/Focus issues

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Strings, branes, supergravity and gauge theory

Quantum supersymmetric cosmology and its hidden Kac-Moody structure

T Damour and P Spindel
2013 Class. Quantum Grav. 30 162001

"This is an elegant paper, where ingredients such as supersymmetry, group theory, fundamental physics, the early universe and lateral comments to other areas come together in a highly technical article that is brief but very informative. This work shows how quantum cosmology without supersymmetry cannot be ignored." Comment from Editorial Board

Double field theory: a pedagogical review

Gerardo Aldazabal, Diego Marqués and Carmen Núñez
2013 Class. Quantum Grav. 30 163001

"Double field theory is a field theory formulated in a configuration space with twice the number of coordinates which incorporates T-duality in a natural way. It is a growing area of research and this paper provides a timely review from the basics of DFT until recent topics like its connection with gauged supergravity theories and flux compactifications. It is written in a very clear way and it is very useful for beginners as well as experienced researchers in the area." Comment from Editorial Board

Constraining conformal field theories with a slightly broken higher spin symmetry

Juan Maldacena and Alexander Zhiboedov
2013 Class. Quantum Grav. 30 104003

"Determines the leading form of the correlation functions in the CFT dual for a large class of higher spin theories, using only very general properties of the theory. The resulting form of the correlation functions is highly constrained. These universal results will likely play an important part in the development of holographic duality for higher spin." Comment from Editorial Board

Holography without strings?

Donald Marolf
2014 Class. Quantum Grav. 31 015008

"Emphasizes the role of the gravitational Gauss law constraint and entanglement in the bulk in holography. The discussion of Reeh-Schlieder sheds an interesting new light on the reconstruction of bulk observables from boundary correlators." Comment from Editorial Board

Relativistic effects in cosmology

Guest Editors Kazuya Koyama

Upcoming galaxy surveys will probe the large-scale structures of the Universe on ever larger scales with ever greater precision. These surveys also probe galaxies at higher redshifts when the Hubble scale is smaller and general relativistic (GR) effects become more important. This focus issue contains a selection of articles by the authors who pioneered the development in our understanding of general relativistic effects in cosmological observations.

Focus issues can be found at iopscience.org/0264-9381/page/Focus Issues

Classical and Quantum Gravity Highlights of 2013–2014

Welcome to the 2015 CQG Highlights brochure, featuring some of the best papers published during the last 12 months, as selected by our Editorial Board.

As the centenary of Albert Einstein’s discovery of general relativity, 2015 will be an exciting year for the CQG community. To mark this occasion, CQG will publish a special issue of the journal entitled ‘Milestones of General Relativity’, which will review some of the most important developments in the history of gravitational physics. You can also watch for the full scientific output of the Gravity Probe B mission, which will appear in CQG in 2015.

The last 12 months have been very eventful for the journal. CQG+ (at cqplus.com) has generated some considerable interest. Papers featured on CQG+ are among the most read in the journal. It’s a great place to learn about your peers in the community and their work in an informal setting. CQG+ has also published movie reviews, interviews, details of prizes sponsored by CQG and other news. Go to CQG+ and follow the site to receive instant notifications of this new and varied content.

CQG made the headlines this year with the publication of a paper co-written by Kip Thorne and the visual effects team who worked on Christopher Nolan’s Interstellar. The paper details how the images of Interstellar’s black hole was created, and is freely available to read in CQG. Interstellar went on to win an Oscar® for best visual effects.

Clifford M Will
Editor-in-Chief, Classical and Quantum Gravity

The Bergmann-Wheeler Thesis Prize

This prize, sponsored by Classical and Quantum Gravity, is awarded every three years by the International Society on General Relativity and Gravitation (ISGRI) for the best PhD thesis in quantum gravity. It is named after 2 great pioneers of quantum gravity, John Wheeler and Peter Bergmann. The winner of the prize will receive $1800 and a certificate. The next prize will be awarded at the GR21 meeting in New York City in 2016. To be considered, nominations must be received by 30 September 2015. Guidelines for the nomination are available at isgrg.org

Past recipients are:
2013 Aron C Wall, thesis institution: University of Maryland
2010 Victor Toews, thesis institution: Pennsylvania State University
2007 Gary Horowitz, thesis institution: Stanford University

Gary Horowitz
President, International Society on General Relativity and Gravitation