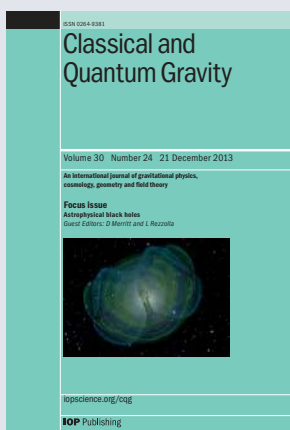# Classical and Quantum Gravity

Highlights of 2012–2013

IMPACT FACTOR

3.562[*]

*As listed in the 2012 ISI Journal
Citation Reports®*

It is my pleasure to present this year's *Classical and Quantum Gravity* (CQG) Highlights. The Editorial Board has chosen these articles as a selection of the highest quality work published in CQG in the last year. Congratulations to all the featured authors on their excellent work!

An exciting recent development on the journal is the introduction of CQG+. This is a companion website that makes CQG's high-quality content accessible to all of the gravitational physics community in a more informal setting. Among other features, the website includes commentaries on recent articles written by authors and referees. You can follow CQG+ at **cqgplus.com**.

We were very happy to see this year's IOP Gravitational Physics Group's Thesis Prize, sponsored by CQG, awarded to Anna Heffernan for her work on the self-force problem in gravitational physics. Anna completed her thesis at University College Dublin under the supervision of Professor Adrian Ottewill.

With CQG's impact factor at an all-time high of 3.562 there has never been a better time to publish in the journal. I invite you to submit your next paper to CQG and I hope to see it featured on CQG+.

Clifford M Will
Editor-in-Chief

Black holes

Black hole uniqueness theorems in higher dimensional spacetimes

TOPICAL REVIEW

Stefan Hollands and Akihiro Ishibashi
2012 *Class. Quantum Grav.* **29** 163001

"A comprehensive and very well presented treatment of a topic of great current interest." **Comment from Editorial Board**

Gravitational turbulent instability of anti-de Sitter space

INVITED ARTICLE

Óscar J C Dias, Gary T Horowitz and Jorge E Santos
2012 *Class. Quantum Grav.* **29** 194002

"An important result that could trigger further development in this field." **Comment from Editorial Board**

A note on instabilities of extremal black holes under scalar perturbations from afar

Stefanos Aretakis
2013 *Class. Quantum Grav.* **30** 095010

"A lovely paper proving that instabilities of extreme horizons can be triggered by initial data supported far from the horizon." **Comment from Editorial Board**
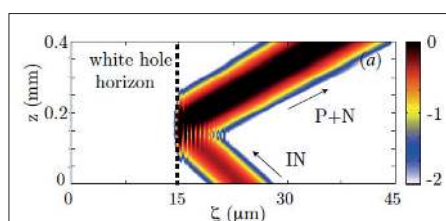
Optical black hole lasers

INVITED ARTICLE

Daniele Faccio, Tal Arane, Marco Lamperti and Ulf Leonhardt
2012 *Class. Quantum Grav.* **29** 224009

"Advances the field of analogue gravity in new directions."
Comment from Editorial Board

Numerical simulation of the interaction of a laser pulse with a white hole horizon: Amplitude profile, in logarithmic scale, of the laser pulse reflecting on the horizon (dashed line).
IN = input, P = positive,
N = negative, denote modes.

Tidal acceleration of black holes and superradiance

Vitor Cardoso and Paolo Pani

2013 *Class. Quantum Grav.* **30** 045011

"An engaging paper on the connection between tidal acceleration and superradiance." **Comment from Editorial Board**

Proof of the area–angular momentum–charge inequality for axisymmetric black holes

María E Gabach Clement, José Luis Jaramillo and Martín Reiris

2013 *Class. Quantum Grav.* **30** 065017

"Addresses the important issue of geometric inequalities motivated by black holes and thermodynamics." **Comment from Editorial Board**
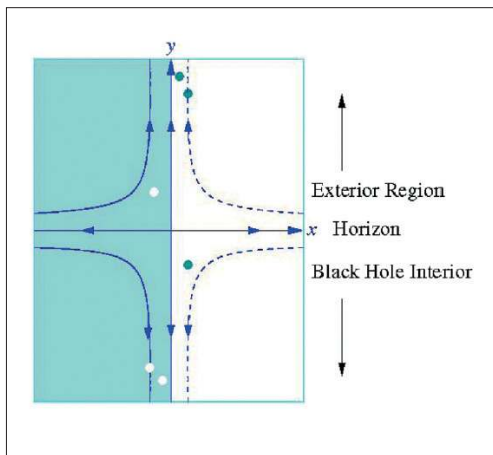
An analogue of Hawking radiation in the quantum Hall effect

Michael Stone

2013 *Class. Quantum Grav.* **30** 085003

"Presents another experimental context for the Hawking effect." **Comment from Editorial Board**

The two-dimensional electron gas (2DEG) black-hole analogue. The shaded region is the 2DEG. The lines indicate the semiclassical electron orbits (dashed when mostly unoccupied). The low energy excitations near the boundary at $x = 0$ constitute the quantum system in which we will find Hawking radiation. This radiation is illustrated by three correlated pairs of electrons and holes moving in opposite directions inside and outside the black hole.

Formation of photon spheres in boson stars with a nonminimally coupled field

D Horvat, S Ilijić, A Kirin and Z Narančić

2013 *Class. Quantum Grav.* **30** 095014

"An interesting and inspiring result." **Comment from Editorial Board**

Astrophysical Black Holes

FOCUS ISSUE

**Guest Editors: David Merritt and Luciano Rezzolla**

Black holes are now seen as an inevitable consequence of the evolution of massive stars, and the existence of supermassive black holes at the centres of galaxies is also a default assumption given the existence of tight scaling relations between black hole mass and galaxy properties. The close connection between black holes and galaxies implies that binary supermassive black holes should form and coalesce during galaxy mergers; and the detection of the merger of stellar-mass black holes is eagerly awaited by the detectors presently under construction. For this focus issue of *Classical and Quantum Gravity*, thirteen prominent researchers have been asked to summarize recent developments in the observational and theoretical understanding of black holes, both stellar-mass and supermassive. The context is astrophysical; that is: how black holes form in, and interact with, their stellar and galactic environments, and the observational consequences of that interaction.

Read the articles in this focus issue in CQG Volume 30 Issue 24

Rising impact factor

CQG's consistently rising impact factor reflects the continuing increase in article quality.
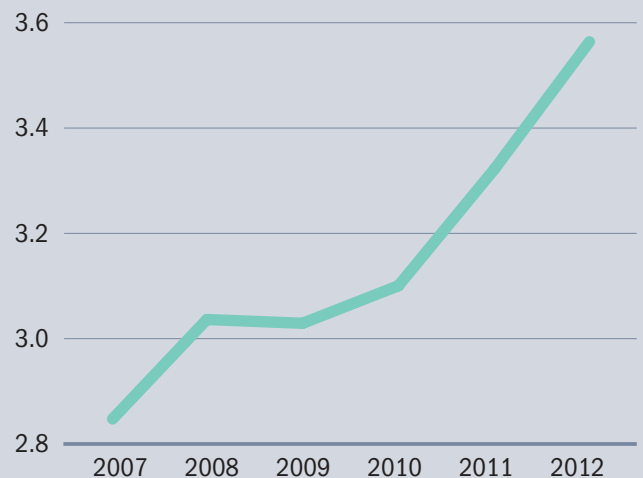
Gravitational radiation

Next-to-next-to-leading order spin–orbit effects in the near-zone metric and precession equations of compact binaries

Alejandro Bohé, Sylvain Marsat, Guillaume Faye and Luc Blanchet
2013 *Class. Quantum Grav.* **30** 075017

"A detailed overview of the motion of compact binaries with spin."
Comment from Editorial Board

The electromagnetic Christodoulou memory effect and its application to neutron star binary mergers

Lydia Bieri, PoNing Chen and Shing-Tung Yau
2012 *Class. Quantum Grav.* **29** 215003

"A beautiful presentation of mathematical results about a subtle gravitational wave effect." **Comment from Editorial Board**

Low-frequency gravitational-wave science with eLISA/NGO

INVITED ARTICLE

Pau Amaro-Seoane *et al*
2012 *Class. Quantum Grav.* **29** 124016

"Even after the long-planned LISA mission was discontinued, the dream of gravitational wave detection in space lives on. This article provides a broad view of the rich science that can still be done with the more affordable eLISA mission." **Comment from Editorial Board**

Detector configuration of KAGRA–the Japanese cryogenic gravitational-wave detector

INVITED ARTICLE

Kentaro Somiya (for the KAGRA Collaboration)
2012 *Class. Quantum Grav.* **29** 124007

"Summarizes the characteristics of KAGRA in a clear and engaging manner."
Comment from Editorial Board

Update on quadruple suspension design for Advanced LIGO

S M Aston *et al*
2012 *Class. Quantum Grav.* **29** 235004

"A complete review of the Advanced LIGO suspension system which is a key element for reaching the design sensitivity." **Comment from Editorial Board**

Photograph of one of the first production quadruple suspension systems ready for installation in aLIGO.

Pulsar Timing Arrays

FOCUS ISSUE

Guest Editors: M A Bizouard, F Jenet, R Price and C M Will

Gravitational-wave detection via a pulsar timing array (PTA) is now entering the realm of practicality. This focus issue includes an overview of the field and articles describing the various detection efforts that are currently underway. Other articles in the issue discuss the potential for astrophysics and tests of general relativity using PTAs.

↻ Read the articles in this focus issue in CQG Volume 30 Issue 22

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

Did you know?
All of the articles featured in this brochure are free to read on the CQG website until 31 December 2014. Visit iopscience.org/cqg for more information

Experimental gravity

New tests of local Lorentz invariance of gravity with small-eccentricity binary pulsars

Lijing Shao and Norbert Wex
2012 *Class. Quantum Grav.* **29** 215018

"A novel combination of pulsar timing and white dwarf spectroscopy to put a tight bound on violations of Lorentz invariance."
Comment from Editorial Board

Experimental test of higher-order Laguerre–Gauss modes in the 10 m Glasgow prototype interferometer

B Sorazu *et al*
2013 *Class. Quantum Grav.* **30** 035004

"First tests with a full-scale gravitational wave detector (10 m Glasgow prototype) of the use of higher order Laguerre–Gauss beams to reduce the coating thermal noise for future gravitational wave detectors. Important conclusions about mode matching and mirror astigmatism requirements are shown." **Comment from Editorial Board**

Tests of Lorentz invariance: a 2013 update

TOPICAL REVIEW

S Liberati
2013 *Class. Quantum Grav.* **30** 133001

"A very much needed and complete review of a rapidly developing field of research." **Comment from Editorial Board**
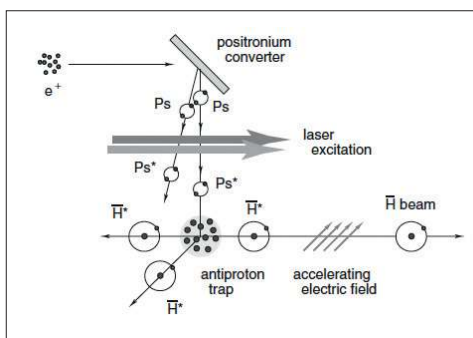
Exploring the WEP with a pulsed cold beam of antihydrogen

INVITED ARTICLE

M Doser *et al*
2012 *Class. Quantum Grav.* **29** 184009

"Description of the first experiment ever to test the Weak Equivalence Principle with antimatter using the antiproton decelerator at CERN."
Comment from Editorial Board

Proposed method for the production of a pulsed beam of cold $\overline{H}$ atoms.

Torsion-balance tests of the weak equivalence principle
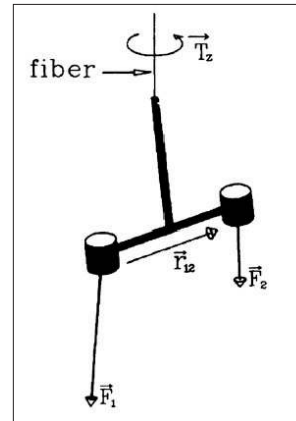
INVITED ARTICLE

T A Wagner, S Schlamminger, J H Gundlach and E G Adelberger
2012 *Class. Quantum Grav.* **29** 184002

"A clear review of the state-of-the-art of testing the equivalence principle with exquisitely sensitive laboratory measurements, and the impact of the limits on models of non-standard interactions and dark matter."
Comment from Editorial Board

Operating principle of the Eötvös torsion balance. This idealized balance consists of two test bodies attached to a rigid, massless frame that is supported by a perfectly flexible torsion fiber. F_1 and F_2 denote the external forces on the test bodies. The torque about the fiber axis is $T_z = (F_1 \times F_2 \times r_{12})/ | F_1 + F_2 |$. The signal is the change in T_z when the instrument is rotated about the fiber axis so that the component of r_{12} along the direction of $F_1 \times F_2$ changes sign.

Phases and relativity in atomic gravimetry

M-T Jaekel, B Lamine and S Reynaud
2013 *Class. Quantum Grav.* **30** 065006

"Theoretical physics in atom interferometry: a new emerging experimental interface between gravity and quantum mechanics."
Comment from Editorial Board

IOP Gravitational Physics Group Thesis Prize

The Gravitational Physics Group (GPG) Thesis 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 Britgrav meeting organised by the GPG.

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

This year's prize was awarded to **Anna Heffernan** for her *"eloquently written thesis on the self-force problem in gravitational physics, and for her detailed calculation of the singular component of the divergent fields that arise"*. Anna obtained her PhD from University College Dublin under the supervision of Professor Adrian Ottewill.

Bangalore Sathyaprakash
Chair
Gravitational Physics Group

Mathematical relativity

On algebraically special vacuum spacetimes in five dimensions

Harvey S Reall, Alexander A H Graham and Carl P Turner
2013 *Class. Quantum Grav.* **30** 055004

"A very nicely written and interesting paper which utilizes rigorous mathematical techniques developed in 4D general relativity to study higher dimensional (vacuum exact) black hole solutions which are of great interest in contemporary theoretical physics." **Comment from Editorial Board**

Scaling up the extrinsic curvature in asymptotically flat gravitational initial data: generating trapped surfaces

Shan Bai and Niall Ó Murchadha
2013 *Class. Quantum Grav.* **30** 025013

"A very interesting result on what happens to initial data when extrinsic curvature gets large." **Comment from Editorial Board**

On the geodesic incompleteness of spacetimes containing marginally (outer) trapped surfaces

I P Costa e Silva
2012 *Class. Quantum Grav.* **29** 235008

"Well-written paper presenting interesting results on singularity theorems for spacetimes containing marginally (outer) trapped surfaces under causality conditions weaker than global hyperbolicity. Particularly useful given the essentially self-contained character of the presentation." **Comment from Editorial Board**

Local metrics admitting a principal Killing–Yano tensor with torsion

Tsuyoshi Houri, David Kubizňák, Claude M Warnick and Yukinori Yasui
2012 *Class. Quantum Grav.* **29** 165001

"Hidden symmetries are a surprising feature of black hole spacetimes. As this article shows, they are a valuable tool in classifying spacetimes and may lead to the discovery of new classes of solutions of Einstein's equations." **Comment from Editorial Board**

Intrinsic time gravity and the Lichnerowicz–York equation

Niall Ó Murchadha, Chopin Soo and Hoi-Lai Yu
2013 *Class. Quantum Grav.* **30** 095016

"On choosing an intrinsic time as slicing condition in GR, a remarkably simple explicit reduced Hamiltonian emerges." **Comment from Editorial Board**

Strong lensing, plane gravitational waves and transient flashes

Abraham I Harte
2013 *Class. Quantum Grav.* **30** 075011

"A systematic and comprehensive approach to a novel research area." **Comment from Editorial Board**

Parametrized post-Newtonian virial theorem

Mahmood Roshan
2012 *Class. Quantum Grav.* **29** 215001

"A derivation of the fundamental virial theorem in the parametrized PPN formalism. It may open the door for very simple checks of different theories of gravitation in the solar and other astrophysical systems with weak gravitational fields." **Comment from Editorial Board**

Quasilocal conservation laws: why we need them

Paul L McGrath, Richard J Epp and Robert B Mann
2012 *Class. Quantum Grav.* **29** 215012

"Provides some penetrating insights into one of the most fundamental unresolved problems in theoretical gravitational physics." **Comment from Editorial Board**

On the convexity of relativistic hydrodynamics

José M Ibáñez, Isabel Cordero-Carrión, José M Martí and Juan A Miralles
2013 *Class. Quantum Grav.* **30** 057002

"A useful remark on an important property of relativistic fluids." **Comment from Editorial Board**

Quantum gravity

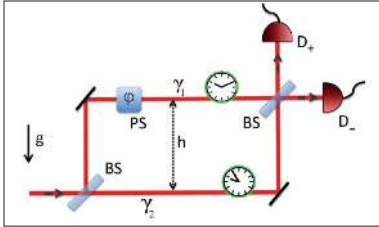## General relativistic effects in quantum interference of photons

Magdalena Zych *et al*

2012 *Class. Quantum Grav.* **29** 224010

"Presents a new and interesting extension of an experimental test of quantum interference sensitive to gravitational effects." **Comment from Editorial Board**

A Mach–Zehnder interferometer to measure the effect of general relativistic time dilation on a wavefunction of a single quantum system. The setup is placed in a homogeneous gravitational field (g) and it consists of two beam splitters (BS), two detectors D± and the phase shifter (PS) which gives a controllable phase difference φ between the two trajectories γ1 and γ2. The separation between the paths in the direction of the field is h. If the quantum particle that travels in superposition keeps track of time along its path, the visibility of the interference will be reduced since the which-way information becomes accessible due to the time dilation between the paths.

Asymptotics of spinfoam amplitude on simplicial manifold: Lorentzian theory

Muxin Han and Mingyi Zhang

2013 *Class. Quantum Grav.* **30** 165012

"A complete analysis of the classical limit of loop quantum gravity." **Comment from Editorial Board**

New variables for classical and quantum gravity in all dimensions: I. Hamiltonian analysis

N Bodendorfer, T Thiemann and A Thurn

2013 *Class. Quantum Grav.* **30** 045001

"Opens a novel avenue for generalization of loop quantum gravity techniques to higher dimensional spacetimes." **Comment from Editorial Board**

Higher Spins and Holography

Guest Editors: Per Kraus and Simon F Ross

Higher spin gravity has gained broader appeal in recent years due to its appearance in the AdS/CFT correspondence. In three and four spacetime dimensions, there exist duality proposals linking higher spin gravity theories to specific conformal field theories living in two and three dimensions respectively. The enlarged symmetry algebra of the conformal field theories renders them exactly soluble, which makes them excellent laboratories for understanding in detail the holographic mechanism behind AdS/CFT duality.

Quantum cosmology

Cosmological quantum entanglement

Eduardo Martín-Martínez and Nicolas C Menicucci

2012 *Class. Quantum Grav.* **29** 224003

"Comprehensive review of an important foundational question for early universe cosmology." **Comment from Editorial Board**

Quantum cosmology: effective theory

Martin Bojowald

2012 *Class. Quantum Grav.* **29** 213001

"A key quantum cosmology review article which discusses important questions as well as pertinent analogies and suggestions." **Comment from Editorial Board**

The pre-inflationary dynamics of loop quantum cosmology: confronting quantum gravity with observations

Ivan Agullo, Abhay Ashtekar and William Nelson

2013 *Class. Quantum Grav.* **30** 085014

"An important and rigorous work on extracting reliable physical predictions for cosmological perturbations in the epoch before inflation in loop quantum cosmology." **Comment from Editorial Board**

Embedding loop quantum cosmology without piecewise linearity

Jonathan Engle

2013 *Class. Quantum Grav.* **30** 085001

"Provides important insights on the relationship between loop quantum gravity and loop quantum cosmology." **Comment from Editorial Board**

Scalars and Gravity

Guest Editor: David Langlois

This issue presents several active directions of research where the interplay between scalar fields and gravity is essential. It includes articles on a range of topics including inflationary models based on scalar fields, quintessence, chameleon fields, and generalized Galileon theories.

Cosmology

A gravitational entropy proposal

Timothy Clifton, George F R Ellis and Reza Tavakol

2013 *Class. Quantum Grav.* **30** 125009

"An interesting and potentially important proposal for ascribing entropy to a gravitational field." **Comment from Editorial Board**

Cosmological solutions of massive gravity on de Sitter

FTC

David Langlois and Atsushi Naruko

2012 *Class. Quantum Grav.* **29** 202001

"A very timely and important result in ghost-free massive gravity." **Comment from Editorial Board**

Phantom crossing and quintessence limit in extended nonlinear massive gravity

Emmanuel N Saridakis

2013 *Class. Quantum Grav.* **30** 075003

"There is a growing interest in the cosmological implications of nonlinear massive gravity. In this paper the author considered a model with scalar-field dependent graviton mass and showed that this model can lead to rich cosmological phenomenology." **Comment from Editorial Board**

Massive Gravity

FOCUS ISSUE

Guest Editor: Shinji Mukohyama

The concept of mass has been central in many areas of physics. Gravitation is not an exception, and it has been one of the long-standing questions whether the graviton, a spin-2 particle that mediates gravity, can have a non-vanishing mass or not. This question is relevant from not only theoretical but also phenomenological viewpoints, since a nonzero graviton mass may lead to late-time acceleration of the universe and thus may be considered as an alternative to dark energy. The aim of the focus issue is to highlight some of the recent developments in massive gravity and their phenomenological implications.

Read the articles in this focus issue in CQG Volume 30 Issue 18

Numerical relativity

A numerical approach to finding general stationary vacuum black holes

Alexander Adam, Sam Kitchen and Toby Wiseman

2012 *Class. Quantum Grav.* **29** 165002

"A robust numerical method to find black hole solutions in various dimensions." **Comment from Editorial Board**
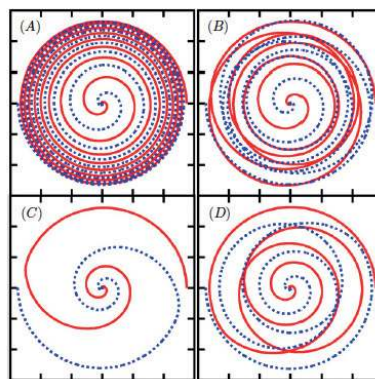
Late inspiral and merger of binary black holes in scalar–tensor theories of gravity

FTC

James Healy *et al*

2012 *Class. Quantum Grav.* **29** 232002

"The first steps toward verifying whether binary black holes shed their scalar hair even in the strong gravity regime." **Comment from Editorial Board**

Trajectories of the black holes when viewed from the Einstein frame.

The Bergmann-Wheeler Thesis Prize

This prize, sponsored by Classical and Quantum Gravity, is awarded by the International Society on General Relativity and Gravitation (ISGRG) every three years for the best PhD thesis in quantum gravity. The winner of the prize will receive $1800 and a certificate. Nominations can be made at any time. Full guidelines can be found at **isgrg.org**.

The last two winners of the prize were:
2010 **Victor Taveras**, thesis institution: Pennsylvania State University
2013 **Aron C Wall**, thesis institution: University of Maryland

Gary Horowitz
President
International Society on General Relativity and Gravitation

Strings, branes, supergravity and gauge theory

Constraining conformal field theories with a slightly broken higher spin symmetry

INVITED ARTICLE

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

"An impressive set of results that significantly advances our understanding of holography for Vasiliev's higher spin generalizations of gravity."
Comment from Editorial Board

Chern–Simons forms in gravitation theories

TOPICAL REVIEW

Jorge Zanelli
2012 *Class. Quantum Grav.* **29** 133001

"A very high quality review covering a broad scope."
Comment from Editorial Board

Entanglement entropy from a holographic viewpoint

TOPICAL REVIEW

Tadashi Takayanagi
2012 *Class. Quantum Grav.* **29** 153001

"Entanglement entropy is the main tool used to get a quantum mechanical interpretation of gravitational entropy. According to the AdS/CFT correspondence it should have a holographic origin and recently there has been a lot of activity in this area. This paper presents a review on recent issues about holographic entanglement entropy in a very comprehensible way."
Comment from Editorial Board

Forthcoming Focus Issues

2014
- Entanglement Entropy
- Galactic Centres
- Advanced Gravitational Wave Detectors
- Relativistic Effects in Cosmology

2015
- Planck Experiment
- Milestones of General Relativity

On the nonlinear stability of asymptotically anti-de Sitter solutions

Óscar J C Dias, Gary T Horowitz, Don Marolf and Jorge E Santos
2012 *Class. Quantum Grav.* **29** 235019

"Striking result showing that the recently-uncovered nonlinear instability of AdS is a special property of pure AdS not shared by many asymptotically AdS spacetimes." **Comment from Editorial Board**

The gravity dual of a density matrix

Bartłomiej Czech, Joanna L Karczmarek, Fernando Nogueira and Mark Van Raamsdonk
2012 *Class. Quantum Grav.* **29** 155009

"Explores the reconstruction of the bulk spacetime in AdS/CFT from information about subregions in the boundary."
Comment from Editorial Board

Thermal correlators in holographic models with Lifshitz scaling

INVITED ARTICLE

Ville Keränen and Larus Thorlacius
2012 *Class. Quantum Grav.* **29** 194009

"Some quantum critical systems in low dimensions can have a description in terms of holographic models and many interesting results have been obtained in this way. Incorporating Lifshitz scaling is an important advance and this paper shows how to obtain thermal correlators in a number of interesting situations." **Comment from Editorial Board**

Percentage of articles rated high quality by referees

There has been a significant rise in top-quality articles in recent years. Many of these articles are featured in journal promotions such as IOP Select.