Curriculum Vitæ

Georgios KOFINAS

- **Date and place of birth** 28th of December 1970 in Athens-Greece
- **Title** Dr
- **Nationality** Greek
- **Marital Status** Single
- **Professional address** University of the Aegean
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Higher Education :

- **1996 - May 1999** Ph.D. degree at the University of Athens, Physics Department, Athens, Greece. Thesis title: "Relativistic Classical and Quantum Cosmology". Supervisor Ass. Prof. T. Christodoulakis.
  Honourable mention with congratulations from the jury.
- **1993 - 1995** M.Sc. degree in Theoretical Physics at the University of Alberta, Physics Department, Edmonton, Canada. Thesis title: "Bianchi-IX Universe in Euclidean Quantum Cosmology". Supervisor Professor D.N. Page.
- **1988 - 1992** Diploma in Physics at the University of Athens, Greece.
  Class of qualification 8.9/10 (Honours).
- **1988** High School graduation (19.5/20.0). Entry examination to the University of Athens, Physics Department.

Professional Career :

- **12/13 -** Lecturer, University of the Aegean, Department of Information and Communication Systems Engineering.
- **09/12 - 12/12** Visiting Professor, University of Cyprus, Department of Physics, Nicosia (courses taught: Statistical Physics, Physics for chemists, Quantum Field Theory II).
- **10/11 - 12/13** Visiting Professor, University of the Aegean, Department of Information and Communication Systems Engineering (courses taught: Calculus, Physics I - mechanics, Physics II - electromagnetism, Linear Algebra, graduate Cosmology).
- **10/10** Elected Lecturer (to be appointed by Ministry), University of the Aegean, Department of Information and Communication Systems Engineering.
- **09/06 - 09/11** Visiting Professor, University of Crete, Physics Department, Heraklion, Greece (courses taught: Cosmology, General Relativity, graduate Classical Mechanics, Partial Differential Equations, Linear Algebra).
- **06/04 - 06/06** Postdoctoral research at the Universitat de Barcelona, Departament de Física Fonamental, Barcelona, Spain
- **10/02 - 01/04** Postdoctoral research at the Centro de Estudios Cientificos (CECS), Valdivia, Chile.
- **01/02 - 09/02** Postdoctoral research and teaching of the Cosmology course at the University of Crete, Physics Department, Heraklion, Greece.
- **01/01 - 12/01** Postdoctoral research at the University of Athens, Physics Department, Athens, Greece.
- **05/99 - 11/00** Military service in the Greek army.
- **1993 - 1995** Teaching Assistantship at the University of Alberta, Physics Department.

Fellowships - Distinctions :

- Marie Curie Intra-European Fellowship for postdoctoral research.
- Fellowship from the Hellenic Research Foundation during Ph.D. studies.
- Fellowship from the Lilian Voudouri Foundation during the M.Sc. studies.
- University of Athens Fellowships during undergraduate studies.
- Honours during Higher Education.

Additional Pieces of Information :

- Languages : Greek (native), English (fluent), French, Spanish (elementary).

Research Interests :

- Classical gravity, Alternative gravity theories, Gravity of higher dimensions, Black holes, Gravitational radiation.
- Cosmology, Braneworld cosmology, String cosmology.

- Canonical approach of quantum gravity and quantum cosmology.
- Biological Physics.

Publications :

1. T. Christodoulakis, G. Kofinas, E. Korfiatis and A. Paschos, *Wave functions for the general Type II Cosmology*, Phys. Lett. **390B** (1997) 55.

2. T. Christodoulakis, G. Kofinas, E. Korfiatis and A. Paschos, *Normalizable wave functions for the general Type V Cosmology*, Phys. Lett. **419B** (1998) 30.

3. T. Christodoulakis, G. Kofinas and V. Zarikas, *The untilted diffuse matter Bianchi V Universe*, Phys. Lett. **275A** (2000) 180 [gr-qc/9907104].

4. T. Christodoulakis, G. Kofinas, E. Korfiatis, G.O. Papadopoulos and A. Paschos, *Time-dependent Automorphism Inducing Diffeomorphisms in vacuum Bianchi Cosmologies and the complete closed form solutions for Type II and V*, J. Math. Phys. **42** (2001) 3580 [gr-qc/0008050].

5. T. Christodoulakis, G. Kofinas and G.O. Papadopoulos, *Conditional symmetries and phase space reduction towards G.C.T. invariant wave functions for the Class A Bianchi Type VI and VII vacuum Cosmologies*, Phys. Lett. **B514** (2001) 149 [gr-qc/0101103].

6. G. Kofinas, *New perspectives on moving domain walls in* $(A)dS_5$ *space*, Nucl. Phys. **B622** (2002) 347 [hep-th/0103045].

7. G. Kofinas, *General brane Cosmology with* ${}^{(4)}R$ *term in* $(A)dS_5$ *or Minkowski bulk*, JHEP **0108** (2001) 034 [hep-th/0108013].

8. G. Kofinas, E. Papantonopoulos and I. Pappa, *Spherically symmetric braneworld solutions with* ${}^{(4)}R$ *term in the bulk*, Phys. Rev. **D66** (2002) 104014 [hep-th/0112019].

9. E. Kiritsis, G. Kofinas, N. Tetradis, T.N. Tomaras and V. Zarikas, *Cosmological evolution with brane-bulk energy exchange*, JHEP **0302** (2003) 035 [hep-th/0207060].

10. G. Kofinas, E. Papantonopoulos and V. Zamarias, *Black hole solutions in braneworlds with induced gravity*, Phys. Rev. **D66** (2002) 104028 [hep-th/0208207].

11. G. Kofinas, E. Papantonopoulos and V. Zamarias, *Black holes on the brane with induced gravity*, Astrophys. Space Sci. **283** (2003) 685, talk presented at the JENAM 2002 workshop on varying fundamental constants, Porto, September 2002 [hep-th/0210006].

12. G. Kofinas, R. Maartens and E. Papantonopoulos, *Brane cosmology with curvature corrections*, JHEP **10** (2003) 066 [hep-th/0307138].

13. G. Kofinas and E. Papantonopoulos, *Gravitational collapse in braneworld models with curvature corrections*, JCAP **0412** (2004) 011 [gr-qc/0401047].

14. A. Kehagias and G. Kofinas, *Cosmology with exponential potentials*, Class. Quant. Grav. **21** (2004) 3871 [gr-qc/0402059].

15. G. Kofinas, *Conservation equation on braneworld in six dimensions*, Class. Quant. Grav. **22** (2005) L47 [hep-th/0412299].

16. G. Kofinas, *On braneworld cosmologies from six dimensions, and absence thereof*, Phys. Lett. **B633** (2006) 141 [hep-th/0506035].

17. G. Kofinas, G. Panotopoulos and T.N. Tomaras, *Brane-bulk energy exchange: a model with the present universe as a global attractor*, JHEP **0601** (2006) 107 [hep-th/0510207].

18. G. Kofinas and R. Olea, *Vacuum energy in Einstein-Gauss-Bonnet AdS gravity*, Phys. Rev. **D74** (2006) 084035 [hep-th/0606253].

19. G. Kofinas and T.N. Tomaras, *Gravitating defects of codimension-two*, Class. Quantum Grav. **24** (2007) 5861 [hep-th/0702010].

20. G. Kofinas and R. Olea, *Universal regularization prescription for Lovelock AdS gravity*, JHEP **11** (2007) 069 [hep-th/0708.0782].

21. D.V. Gal'tsov, G. Kofinas, P. Spirin and T.N. Tomaras, *Classical ultra-relativistic scattering in ADD*, JHEP **05** (2009) 074 [hep-ph/0903.3019].

22. E. Kiritsis, G. Kofinas, *Hořava-Lifshitz Cosmology*, Nucl. Phys. **B821** (2009) 467 [hep-th/0904.1334].

23. C. Charmousis, G. Kofinas and A. Papazoglou, *The consistency of codimension-2 braneworlds and their cosmology*, JCAP **1001** (2010) 022 [hep-th/0907.1640].

24. D.V. Gal'tsov, G. Kofinas, P. Spirin and T.N. Tomaras, *Transplanckian bremsstra hlung and black hole production*, Phys. Lett. **B683** (2010) 331 [hep-ph/0908.0675].

25. E. Kiritsis, G. Kofinas, *On Hořava-Lifshitz "Black holes"*, JHEP **01** (2010) 122 [hep-th/0910.5487].

26. D.V. Gal'tsov, G. Kofinas, P. Spirin and T.N. Tomaras, *Scalar ultrarelativistic bremsstrahlung in extra dimensions*, JHEP **05** (2010) 055 [hep-th/1003.2982].

27. G. Kofinas, V. Zarikas, *A solution of the coincidence problem based on the recent galactic core black hole energy density increase*, The European Physical Journal C **73** (2013) 2379 [hep-th/1107.2602].

28. G. Kofinas, M. Heraklidou, *Self-gravitating branes again*, hep-th/1309.0674.

29. G. Kofinas, V. Zarikas, *Five-dimensional braneworld with gravitating Nambu-Goto matching conditions*, to appear.

30. G. Kofinas, E. Saridakis and J.-Q. Xia, *Observational constraints of the 5-dimensional braneworld cosmology with gravitating Nambu-Goto matching conditions*, to appear.

Selected Talks and Seminars :

- **September 2013:** Speaker at the *7nd Aegean Summer School on Cosmology*, Paros, Greece. Title of the talk: *Alternative matching conditions for gravitating defects.*
- **November 2010:** Seminar given at the University of the Aegean, Department of Information and Communication Systems Engineering, Samos, Greece. Title of the seminar: *Ultrarelativistic gravitational bremsstrahlung in ADD.*
- **October 2010:** Seminar given at the AstroParticle and Cosmology (APC) Laboratory, University of Paris 7, Paris, France. Title of the seminar: *Gravitational bremsstrahlung in transplanckian collisions.*
- **September 2010:** Speaker at the *Crete Conference on Gauge Theories and the Structure of Spacetime*, Kolymbari, Orthodox Academy of Crete. Title of the talk: *Gravitational bremsstrahlung in transplanckian scattering.*
- **June 2010:** Seminar given at the Ben-Gurion University, Department of Physics, Beer-Sheva, Israel. Title of the seminar: *Ultrarelativistic gravitational bremsstrahlung in ADD.*
- **June 2010:** Speaker at the 14th Conference on *Recent Developments in Relativity*, University of Ioannina, Physics Department, Ioannina, Greece. Title of the talk: *Ultrarelativistic gravitational bremsstrahlung in ADD.*
- **June 2009:** Speaker at the *Fifth Crete Regional Meeting in String Theory*, Kolymbari, Orthodox Academy of Crete. Title of the talk: *Black-holes in non-relativistic gravity.*
- **January 2006:** Seminar given at the University of Barcelona, Barcelona, Spain. Title of the seminar: *Higher codimensional braneworlds.*
- **September 2005:** Speaker at the *3rd Aegean Summer School on Cosmology*, Chios, Greece. Title of the talk: *On braneworld cosmologies from six dimensions.*
- **September 2003:** Speaker at the *2nd Aegean Summer School on Cosmology*, Syros, Greece. Title of the talk: *Brane cosmology with curvature corrections.*
- **November 2002:** Lectures given at the Centro de Estudios Cientificos, Valdivia, Chile. Title: *Introduction to the Braneworlds.*
- **June 2002:** Speaker at the 10th Conference on *Recent Developments in Relativity*, University of Thessaloniki, Physics Department, Chalkidiki, Greece. Title of the talk: *Braneworlds with induced gravity.*
- **May 2002:** Seminars given at the University of Crete, Physics Department. Title of the seminars: *The induced gravity scenario on the braneworld.*
- **August 2000:** Speaker at the 9th Conference on *Recent Developments in Relativity*, University of Ioannina, Physics Department, Ioannina, Greece. Title of the talk: *Temperature anisotropy in Bianchi type V cosmology.*

- **October 1996:** Speaker at the 7th Conference on *Recent Developments in Relativity*, University of Athens, Physics Department, Athens, Greece. Title of the talk: *Bianchi-IX universe in Euclidean quantum cosmology.*

Participation to Conferences :

- **April 2010:** *Workshop on Cosmology*, Physics Department, University of Crete, Heraklion.
- **May 2009:** *Workshop on applications of AdS/CFT to condensed matter problems*, Foundation for Research and Technology, Heraklion.
- **September 2008:** *4th Young Researchers Workshop of the European Superstring Theory Network*, Agia Napa, Cyprus.
- **July 2007:** *Workshop on Cosmology and Strings*, Miramare-Trieste, Italy.
- **June 2006:** 12th Hellenic Conference on *Recent Developments in Relativity*, University of Athens, Physics Department, Nafplio, Greece.
- **September 2005:** *3rd Aegean Summer School on Cosmology*, Chios, Greece.
- **September 2005:** XXVIII Spanish Relativity Meeting 2005, *A Century of Relativity Physics*, Oviedo, Asturias, Spain.
- **July 2005:** Albert Einstein Century International Conference, Palais de l' Unesco, Paris, France.
- **April 2005:** String Cosmology Conference, Department of Theoretical Physics, Uppsala Universitet, Uppsala, Sweden.
- **March 2005:** Winter School on Modern Trends in Supersymmetric Mechanics, INFN-Laboratori Nazionali di Frascati, Frascati, Italy.
- **September 2004:** XXVII Spanish Relativity Meeting 2004, *Beyond General Relativity*, La Cristalera, Miraflores de la Sierra, Madrid, Spain.
- **September 2003:** *2nd Aegean Summer School on Cosmology*, Syros, Greece.
- **October 2002:** Mini-workshop organized by the Universidad de Santiago de Chile on *Integrable Systems*, Santiago, Chile.
- **June 2002:** 10th Hellenic Conference on *Recent Developments in Relativity*, University of Thessaloniki, Physics Department, Chalkidiki, Greece.
- **April 2002:** *HEP 2002*, University of Patras, Physics Department, Patras, Greece.
- **September 2001:** *1st Aegean Summer School on Cosmology*, Samos, Greece.
- **June 2001:** *Crete Regional Meeting on String Theory*, Orthodox Academy of Crete, Kolymbari, Greece.

- **April 2001:** *HEP 2001*, University of Crete, Physics Department, Heraklion, Greece.
- **April 2001:** *2nd Hellenic Cosmology Workshop*, National Observatory of Athens, Penteli, Athens, Greece.
- **September 2000:** *Particle Physics and Gravitation*, Euroconference on Quantum Fields and Strings, Crete, Greece.
- **August 2000:** 9th Hellenic Conference on *Recent Developments in Relativity*, University of Ioannina, Physics Department, Ioannina, Greece.
- **September 1998:** 2nd Samos Meeting on *Cosmology, Geometry and Relativity*, Pythagoreon, Samos, Greece.
- **August 1998:** 8th Hellenic Conference on *Recent Developments in Relativity*, University of the Aegean, Department of Mathematics, Karlovassi, Greece.
- **October 1996:** 7th Hellenic Conference on *Recent Developments in Relativity*, University of Athens, Physics Department, Athens, Greece.

Other Scientific Activities :

- Member of the Organizing Committee of the 7th Hellenic Conference on *Recent Developments in Relativity*, October 1996, Athens, Greece.
- Member of the Organizing Committee of the *Fifth Crete Regional Meeting in String Theory*, June 2009, Kolymbari, Orthodox Academy of Crete.
- Member of the Organizing Committee of the *Crete Workshop on the Frontiers of Cosmology*, April 2010, Crete Center of Theoretical Physics, Heraklion.
- Member of the Organizing Committee of the *Crete Conference on Gauge Theories and the Structure of Spacetime*, September 2010, Kolymbari, Orthodox Academy of Crete.
- Referee for *Physical Review D, JCAP, European Journal of Physics, Classical and Quantum Gravity, Nuclear Physics B.*
- Main supervisor of the master's thesis of M. Heraklidou, Physics Department, University of Crete, Title: A study of codimension-2 gravitational defects with Gauss-Bonnet action.
- Co-supervisor of the Ph.d dissertation of N. Nomikos, Department of Information and Communication Systems Engineering, University of the Aegean, Title: Theoretical gravity and cosmology.

Names for recommendation letters :

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Outline of research activity :

The research I have been carrying out up to date refers to the areas of quantum cosmology, classical cosmology, to cosmological models and black hole solutions coming from higher dimensions according to the braneworld or string-like paradigm, to topics of gravity in asymptotically Anti-de

Sitter spaces connected to the AdS/CFT correspondence of high energy physics, with the problem of gravitational radiation from the scattering of particles in the presence of extra dimensions and the non-relativistic Horăva-Lifshitz gravity. The total number of citations that my published work has taken is more than 1000.

As a M.Sc. student, I dealt, under the instruction of my supervisor, with the path-integral approximation of quantum-cosmology, applied to a particular homogeneous and anisotropic model (Bianchi type-IX). Approximate instanton solutions close to the boundaries (NUT-Bolt) were derived for vacuum or including scalar fields, and they were used for numerical integration of the system and for drawing sketches of peak-shaped wave functions of the universe according to the Hartle-Hawking proposal.

In the group of papers [1, 2, 4, 5], we have adopted a way of canonically quantizing the most general anisotropic cosmological models, without any restrictions on the form of the metric, or any gauge choice, by exploiting the information carried by the linear constraints. Furthermore, the role played by the automorphism group at the classical level in simplifying the Einstein equations, and at the quantum in reducing the Wheeler-De Witt equation to its true degrees of freedom, was investigated. In [3], we investigated the relationship of the CMB anisotropy to a possible primordial global anisotropy for a particular Bianchi-type universe. The computations of the CMB spectrum have the value that can be contracted with the accurate and recent CMB data and allow for testing the available theories of the early universe. In [6], I found in the braneworld context a 5-dimensional bulk metric solution, depending on both the time and the extra coordinate, and is dynamically interacting with a moving domain wall. After the general formulation was established, the 3-universe cosmological evolution was obtained and found to possess non-singular characteristics, although the corresponding 5-dimensional characteristics appear singular. In [7], the generic dynamics which is induced on the braneworld in the induced gravity scenario was found. Although the intrinsic curvature term is geometrical in nature, and thus, induces additional geometrical terms on the brane equations beyond the Einstein one, it was shown that the induced braneworld dynamics resembles the Einstein dynamics with a well-defined modified energy-momentum tensor. This way, the methods of standard General Relativity can be used for deriving new braneworld solutions. Indeed, four-dimensional black hole solutions were obtained in [8, 10] which are generalizations of the four-dimensional Schwarzschild-$(A)dS$ spacetime. Some of these solutions are interesting from the astrophysical data viewpoint, as they give long-distance (galactic scale) modifications of gravity. In [9], we explored a novel mechanism of energy exchange (outflow/influx) between brane and bulk, due to particle physics processes, which supplies a variety of cosmological perspectives. The most significant is the possibility of associating an accelerating era of the universe to this mechanism; this could be relevant to the old inflationary regime, as well as to the today small acceleration era. In [12], the cosmology of the Randall-Sundrum braneworld was studied when two curvature correction terms are added in the action: the five-dimensional Gauss-Bonnet curvature term, and the the four-dimensional scalar curvature from induced gravity on the brane. As a result, the infinite-density big bang singularity is removed, while the curvature can still diverge for some parameter values. Additionally, a radiation brane can undergoe accelerated expansion near the minimal scale factor, without an inflaton field or negative pressures. In [13], the collapse of a homogenous braneworld dust cloud was studied in the context of the various braneworld scenarios, namely, the induced-gravity, the Gauss-Bonnet, and the combined induced-gravity and Gauss-Bonnet. It was found that in accordance to the Randall-Sundrum model, and contrary to

four-dimensional general relativity, the exterior spacetime on the brane is always non-static. In [14], the dynamics of a spatially flat Robertson-Walker universe filled with a classical minimally coupled scalar field of exponential potential plus pressureless baryonic matter was studied in the context of general relativity. This system was reduced to a first-order ordinary differential equation, providing in general direct evidence of the passage into acceleration during the evolution, and setting bounds on the parameter of the exponent of the potential. Additionally, for the almost cosmological constant case, as well as for late times, general solutions were found. In the group of papers [15, 16], (thin) braneworlds with conical singularities were considered in six-dimensional Einstein-Gauss-Bonnet gravity, as it is known that in such dimensions the Gauss-Bonnet term is necessary for including non-trivial matter on the brane. The energy-momentum of the brane was shown to be always conserved, independently of any regular bulk energy-momentum tensor, contrary to the situation of the five-dimensional case. Furthermore, for a bulk cosmological constant, it was shown that the model for axially symmetric bulks does not possess isotropic braneworld cosmological solutions. In [17], the role of brane-bulk energy exchange and of an induced gravity term on a braneworld of negative tension and vanishing effective cosmological constant was studied. It was shown that a unique global attractor which can realize our present universe exists for a wide range of the parameters of the model. Moreover, during the evolution, the parameter of the equation of state for the dark energy crosses the cosmological constant value -1 to smaller values.

Beyond the relevant success against current observational data of the 5-dimensional cosmological scenarios as alternatives to the standard model, the difficulty has now accumulated at the nonlocal character of the gravitational brane-bulk interaction as seen from the brane viewpoint. Therefore, a significant open problem for astrophysics and cosmology would be to find the simplest realistic solution (or approximation to it) of an astrophysical black hole on the brane, and settle the questions about its staticity, Hawking radiation and horizon; moreover, it is a key open question to investigate the distinguishing signals of the cosmological perturbations on all scales and computing the anisotropies and large-scale structures at the level beyond the commonly used maximal symmetry. Generalizing such models to various directions, e.g. by adding brane/bulk scalars, curvature corrections, supersymmetry, is necessary to make them more realistic and explore aspects of higher-dimensions not probed by simpler models. E.g., the difficulty of stability of Horava-Witten spacetimes with two branes of opposite tension has been recently resolved assuming the unbroken supersymmetry of the theory; the study of such stability with supersymmetry unbroken in the bulk, but softly broken on the brane would be interesting. Finding four-dimensional braneworld solutions which are generalizations of the Schwarzschild solution arising from some higher curvature corrected 5-dimensional gravity and study its thermodynamics is also interesting and necessary from the phenomenological point of view and has not been done. Another interesting line of activity could be the study, through explicit solutions, of the mechanism of energy influx/outflow between brane and bulk due to scalar fields in the bulk and on the brane. Under the prism of the AdS/CFT correspondence, the treatment of scalar fields becomes more significant, and the study of the holographic dual will provide a more controllable picture of such exchange mechanisms. It seems that one of the hottest topics today in cosmology is how far it is possible the parameter of the equation of state for the dark energy can mimic a value which is smaller than -1. I plan to investigate further models which offer such a possibility, and in particular, models which arise from an interaction between brane and bulk (these could in principle solve also the coincidence problem in cosmology by realizing the present universe as being close to a late-time

fixed point of the evolution).

A new perspective arises from a recent proposal for understanding the smallness of the vacuum energy within the framework of 6-dimensional gravity or supergravity: a codimension-two object induces a conical singularity, and a cancelation occurring between the brane tension and the bulk gravitational degrees of freedom gives rise to a vanishing effective cosmological constant. However, it is known that six-dimensional Einstein gravity cannot support a thin gravitating braneworld with a non-trivial matter different than a brane tension. One might try to modify the gravitational part of the action expecting to obtain consistent configurations, e.g. some consistent four-dimensional braneworld cosmology. One such proposal by including the six-dimensional Gauss-Bonnet term has been partially investigated, and bulks which are axially symmetric around the defect do not seem to support deviations from maximal symmetry on the brane. I would be interested in further investigation (formal development) of such sort of models, as well as investigating alternative matching conditions or more general bulk symmetry ansatzen lacking axial symmetry, or also study the linearization and stability around the maximally symmetric solutions. Maybe the inclusion of a bulk scalar (or dilatonic) will not only add degrees of freedom to the problem, but contributes to making the situation meaningful. In case a meaningful cosmology is found, the standard cornerstones in the area of physical cosmology have to be addressed, namely, the inflation, the primordial nucleosynthesis, the CMB, and the cosmological perturbations.

Another line of research I would be interested is working in the context of the string cosmological models (D-brane inflation, S-brane scenarios, cyclic, KKLT), in the investigation of the rich structure of the vacua solutions in moduli space revealed recently, the inclusion of realistic cosmological matter, and how a viable cosmological picture could be obtained.
I would also like to think how previous ideas found in the area of quantum cosmology could provide some new realizations in the context of string theory.

Abstracts of papers

1. T. Christodoulakis, G. Kofinas, E. Korfiatis and A. Paschos, *Wave functions for the general Type II Cosmology*, Phys. Lett. **390B** (1997) 55.
The quantization of the most general Type II geometry (having all six scale factors as well as the shift vector) is considered. The information carried by the linear constraints is used to reduce the initial Wheeler-De Witt equation (in six variables) to a final PDE in four variables. The full space of solutions to this equation is exhibited.

2. T. Christodoulakis, G. Kofinas, E. Korfiatis and . Paschos, *Isolation of the true degree of freeedom and normalizable wave functions for the general type V cosmology*, Phys. Lett. **419B** (1998) 30.
The quantization of the most general Type V geometry (with all six scale factors as well as the shift vector present) is considered. The information carried by the linear constraints is used to reduce the Wheeler-DeWitt equation (arising from a valid Hamiltonian found earlier), which initially included six variables, to a final PDE in three variables, getting rid of three redundant variables (gauge degrees of freedom). The full space of solutions to this equation is presented. In trying to interpret these wave functions, we are led through further consideration of the action of the automorphism group on the configuration space, to a final reduction to the one and only true degree of freedom, i.e. the only independent curvature invariant of the slice t=constant. Thus, a normalizable wave function in terms of the true degree of freedom is obtained.

3. T. Christodoulakis, G. Kofinas and V. Zarikas, *The general untilted diffuse matter Bianchi V universe*, Phys. Lett. **275A** (2000) 180 [gr-qc/9907104].
A diffuse matter filled Type V Universe is studied. The anisotropic behaviour, the distortion caused to the CMBR and the parameter region allowed by present cosmological bounds are examined. It is shown how the overall sky pattern of temperature anisotropies changes under a non-infinitesimal spatial coordinate transformation that preserves the Type V manifest homogeneity.

4. T. Christodoulakis, G. Kofinas, E. Korfiatis, G.O. Papadopoulos and A. Paschos, *Time dependent automorphism inducing diffeomorphisms and the complete closed form solutions of Bianchi types II and V vacuum cosmologies*, J. Math. Phys. **42** (2001) 3580 [gr-qc/0008050].
We investigate the set of spacetime general coordinate transformations (G.C.T.) which leave the line element of a generic Bianchi Type Geometry, quasi-form invariant; i.e. preserve manifest spatial Homogeneity. We find that these G.C.T.'s, induce special time-dependent automorphic changes, on the spatial scale factor matrix $\gamma_{\alpha\beta}(t)$ -along with corresponding changes on the lapse function $N(t)$ and the shift vector $N^{\alpha}(t)$. These changes, which are Bianchi Type dependent, form a group and are, in general, different from those induced by the group SAut(G) -advocated in earlier investigations as the relevant symmetry group-, they are used to simplify the form of the line element -and thus simplify Einstein's equations as well-, without losing generality. As far as this simplification procedure is concerned, the transformations found, are proved to be essentialy unique. For the case of Bianchi Types II

and V, where the most general solutions are known -Taub's and Joseph's, respectively-, it is explicitly verified that our transformations and only those, suffice to reduce the generic line element, to the previously known forms. It becomes thus possible, -for these Types- to give in closed form, the most general solution, containing all the necessary "gauge" freedom.

5. T. Christodoulakis, G. Kofinas and G.O. Papadopoulos, *Conditional symmetries and phase space reduction towards G.C.T. invariant wave functions for the Class A Bianchi Type VI and VII vacuum Cosmologies*, Phys. Lett. **B514** (2001) 149 [gr-qc/0101103].
The quantization of Class A Bianchi Type VI and VII geometries -with all six scale factors, as well as the lapse function and the shift vector present- is considered. A first reduction of the initial 6-dimensional configuration space is achieved by the usage of the information furnished by the quantum form of the linear constraints. Further reduction of the space in which the wave function -obeying the Wheeler-DeWitt equation- lives, is accomplished by revealing a classical integral of motion, tantamount to an extra symmetry of the corresponding classical Hamiltonian. This symmetry generator -member of a larger group- is linear in momenta and corresponds to G.C.T.s through the action of the automorphism group -especially through the action of the outer automorphism subgroup. Thus, a G.C.T. invariant wave function is found, which depends on one combination of the two curvature invariants –which uniquely and irreducibly characterizes the hypersurfaces t=const.

6. G. Kofinas, *New perspectives on moving domain walls in* $(A)dS_5$ *space*, Nucl. Phys. **B622** (2002) 347 [hep-th/0103045].
A new moving domain wall solution is obtained for a flat 3-universe. This consists of a bulk metric depending on both time and the extra coordinate, plus a dynamically interacting domain wall, admitted by the metric and inhabited by the three-universe. The matter contents are cosmological constants on the domain wall and the bulk. The bulk space is shown to be $(A)dS_5$. A remarkable fact concerning the three-universe is that its scale factor never vanishes, even though the corresponding scale factor of the bulk metric vanishes. The inclusion of a bulk scalar field is discussed, neglecting back-reaction. Its normalizability and the existence of a positive frequency or adiabatic bulk vacuum are shown.

7. G. Kofinas, *General brane Cosmology with* ${}^{(4)}R$ *term in* $(A)dS_5$ *or Minkowski bulk*, JHEP **0108** (2001) 034 [hep-th/0108013].
A general analysis of the induced brane dynamics is performed when the intrinsic curvature term is included in the action. Such a term is known to cause dramatic changes and is generically induced by quantum corrections coming from the bulk gravity and its coupling with matter living on the brane. The induced brane dynamics is shown to be the usual Einstein dynamics coupled to a well defined modified energy-momentum tensor. In cosmology, conventional general relativity revives for an initial era whose duration depends on the value of the five-dimensional Planck mass. Violations of energy conditions may be possible, as well as matter inhomogeneities on the brane in $(A)dS_5$ or Minkowski backgrounds. A new anisotropic cosmological solution is given in the above context. This solution, for a fine-tuned five-dimensional cosmological constant, exhibits an intermediate accelerating phase which is followed by an era corresponding to a 4D perfect fluid solution with no future horizons.

8. G. Kofinas, E. Papantonopoulos and I. Pappa, *Spherically symmetric braneworld*

solutions with ${}^{(4)}R$ *term in the bulk*, Phys. Rev. **D66** (2002) 104014 [hep-th/0112019].
An analysis of a spherically symmetric braneworld configuration is performed when the intrinsic curvature scalar is included in the bulk action; the vanishing of the electric part of the Weyl tensor is used as the boundary condition for the embedding of the brane in the bulk. All the solutions outside a static localized matter distribution are found; some of them are of the Schwarzschild-$(A)dS_4$ form. Two modified Oppenheimer-Volkoff interior solutions are also found; one is matched to a Schwarzschild-$(A)dS_4$ exterior, while the other does not. A non-universal gravitational constant arises, depending on the density of the considered object; however, the conventional limits of the Newton's constant are recovered. An upper bound of the order of TeV for the energy string scale is extracted from the known solar system measurements (experiments). On the contrary, in usual brane dynamics, this string scale is calculated to be larger than TeV.

9. E. Kiritsis, G. Kofinas, N. Tetradis, T.N. Tomaras and V. Zarikas, *Cosmological evolution with brane-bulk energy exchange*, JHEP **0302** (2003) 035 [hep-th/0207060].
The consequences on the brane cosmological evolution of energy exchange between the brane and the bulk are analysed in detail, in the context of a non-factorizable background geometry with vanishing effective cosmological constant on the brane. A rich variety of brane cosmologies is obtained, depending on the precise mechanism of energy transfer, on the equation of state of brane-matter and on the spatial topology. An accelerating era is generically a feature of our solutions. In the case of low-density flat universe more dark matter than in the conventional FRW picture is predicted. Spatially compact solutions were found to delay their recollapse.

10. G. Kofinas, E. Papantonopoulos and V. Zamarias, *Black hole solutions in braneworlds with induced gravity*, Phys. Rev. **D66** (2002) 104028 [hep-th/0208207].
We extent our previous study on spherically symmetric braneworld solutions with induced gravity, including non-local bulk effects. We find the most general static four-dimensional black hole solutions with $g_{tt} = -g_{rr}^{-1}$. They satisfy a closed system of equations on the brane and represent the strong-gravity corrections to the Schwarzschild-$(A)dS_4$ spacetime. These new solutions have extra terms which give extra attraction relative to the Newtonian-$(A)dS_4$ force; however, the conventional limits are easily obtained. These terms, when defined asymptotically, behave like AdS_4 in this regime, while when defined at infinitely short distances predict either an additional attractive Newtonian potential or an attractive potential which scales approximately as $\sqrt{r}$. One of the solutions found gives extra deflection of light compared to Newtonian deflection.

11. G. Kofinas, E. Papantonopoulos and V. Zamarias, *Black holes on the brane with induced gravity*, Astrophys. Space Sci. **283** (2003) 685, talk presented at the JENAM 2002 workshop on varying fundamental constants, Porto, September 2002 [hep-th/0210006].
An analysis of a spherically symmetric braneworld configuration is performed when the intrinsic curvature scalar is included in the bulk action. In the case when the electric part of the Weyl tensor is zero, all the exterior solutions are found; one of them is of the Schwarzschild-(A)dS(4) form, which is matched to a modified Oppenheimer-Volkoff interior solution. In the case when the electric part of the Weyl tensor is non zero, the exterior Schwarzschild-

(A)dS(4) black hole solution is modified receiving corrections from the non-local bulk effects. A non-universal gravitational constant arises, depending on the density of the considered object and the Newton's law is modified for small and large distances; however, the conventional limits are easily obtained.

12. G. Kofinas, R. Maartens and E. Papantonopoulos, *Brane cosmology with curvature corrections*, JHEP **10** (2003) 066 [hep-th/0307138].
We study the cosmology of the Randall-Sundrum brane-world where the Einstein-Hilbert action is modified by curvature correction terms: a four-dimensional scalar curvature from induced gravity on the brane, and a five-dimensional Gauss-Bonnet curvature term. The combined effect of these curvature corrections to the action removes the infinite-density big bang singularity, although the curvature can still diverge for some parameter values. A radiation brane undergoes accelerated expansion near the minimal scale factor, for a range of parameters. This acceleration is driven by the geometric effects, without an inflaton field or negative pressures. At late times, conventional cosmology is recovered.

13. G. Kofinas and E. Papantonopoulos, *Gravitational collapse in braneworld models with curvature corrections*, JCAP **0412** (2004) 011 [gr-qc/0401047].
We study the collapse of a homogeneous braneworld dust cloud in the context of the various curvature correction scenarios, namely, the induced-gravity, the Gauss-Bonnet, and the combined induced-gravity and Gauss-Bonnet. In accordance to the Randall-Sundrum model, and contrary to four-dimensional general relativity, we show in all cases that the exterior spacetime on the brane is non-static.

14. A. Kehagias and G. Kofinas, *Cosmology with exponential potentials*, Class. Quant. Grav. **21** (2004) 3871 [gr-qc/0402059].
We examine in the context of general relativity the dynamics of a spatially flat Robertson-Walker universe filled with a classical minimally coupled scalar field ϕ of exponential potential $V(\phi) \sim exp(-\mu\phi)$ plus pressureless baryonic matter. This system is reduced to a first-order ordinary differential equation for $\Omega_\phi(w_\phi)$ or $q(w_\phi)$, providing direct evidence on the acceleration/deceleration properties of the system. As a consequence, for positive potentials, passage into acceleration not at late times is generically a feature of the system for any value of μ, even when the late-times attractors are decelerating. Furthermore, the structure formation bound, together with the constraints $\Omega_{m0} \approx 0.25 - 0.3$, $-1 \leq w_{\phi 0} \leq -0.6$ provide, independently of initial conditions and other parameters, the necessary condition $0 < \mu < 1.6\sqrt{8\pi G_N}$, while the less conservative constraint $-1 \leq w_\phi \leq -0.93$ gives $0 < \mu < 0.7\sqrt{8\pi G_N}$. Special solutions are found to possess intervals of acceleration. For the almost cosmological constant case $w_\phi \approx -1$, the general relation $\Omega_\phi(w_\phi)$ is obtained. The generic (non-linearized) late-times solution of the system in the plane (w_ϕ, Ω_ϕ) or (w_ϕ, q) is also derived.

15. G. Kofinas, *Conservation equation on braneworld in six dimensions*, Class. Quant. Grav. **22** (2005) L47 [hep-th/0412299].
We study braneworlds in six-dimensional Einstein-Gauss-Bonnet gravity. The Gauss-Bonnet term is crucial for the equations to be well-posed in six dimensions when non-trivial matter on the brane is included (the also involved induced gravity term is not significant for

their structure), and the matching conditions of the braneworld are known. We show that the energy-momentum of the brane is always conserved, independently of any regular bulk energy-momentum tensor, contrary to the situation of the five-dimensional case.

16. G. Kofinas, *On braneworld cosmologies from six dimensions, and absence thereof*, Class. Quant. Grav. **21** (2004) 3871 [gr-qc/0402059].
We consider (thin) braneworlds with conical singularities in six-dimensional Einstein-Gauss-Bonnet gravity with a bulk cosmological constant. The Gauss-Bonnet term is necessary in six dimensions for including non-trivial brane matter. We show that this model for axially symmetric bulks does not possess isotropic braneworld cosmological solutions.

17. G. Kofinas, G. Panotopoulos and T.N. Tomaras, *Brane-bulk energy exchange: a model with the present universe as a global attractor*, JHEP **0601** (2006) 107 [hep-th/0510207].
The role of brane-bulk energy exchange and of an induced gravity term on a single braneworld of negative tension and vanishing effective cosmological constant is studied. It is shown that for the physically interesting cases of dust and radiation a unique global attractor which can realize our present universe (accelerating and $0 < \Omega_{m0} < 1$) exists for a wide range of the parameters of the model. For $\Omega_{m0} = 0.3$, independently of the other parameters, the model predicts that the equation of state for the dark energy today is $w_{DE,0} = -1.4$, while $\Omega_{m0} = 0.03$ leads to $w_{DE,0} = -1.03$. In addition, during its evolution, w_{DE} crosses the $w_{DE} = -1$ line to smaller values.

18. G. Kofinas and R. Olea, *Vacuum energy in Einstein-Gauss-Bonnet AdS gravity*, Phys. Rev. **D74** (2006) 084035 [hep-th/0606253].
A finite action principle for Einstein-Gauss-Bonnet anti−de Sitter gravity is achieved supplementing the bulk Lagrangian by a suitable boundary term, whose form substantially differs in odd and even dimensions. For even dimensions, this term is given by the boundary contribution in the Euler theorem with a coupling constant fixed demanding the spacetime to have constant (negative) curvature in the asymptotic region. For odd dimensions, the action is stationary under a boundary condition on the variation of the extrinsic curvature. A well-posed variational principle leads to an appropriate definition of energy and other conserved quantities using the Noether theorem, and to a correct description of black hole thermodynamics. In particular, this procedure assigns a nonzero energy to anti-de Sitter spacetime in all odd dimensions.

19. G. Kofinas and T.N. Tomaras, *Gravitating defects of codimension-two*, Class. Quantum Grav. **24** (2007) 5861 [hep-th/0702010].
Thin gravitating defects with conical singularities in higher codimensions and with generalized Israel matching conditions are known to be inconsistent for generic energy-momentum. A way to remove this inconsistency is proposed and is realized for an axially symmetric gravitating codimension-two defect in six dimensional Einstein gravity. By varying with respect to the brane embedding fields, alternative matching conditions are derived, which are generalizations of the Nambu-Goto equations of motion of the defect, consistent with bulk gravity. For a maximally symmetric defect the standard picture is recovered. The four-dimensional perfect fluid cosmology coincides with conventional FRW in the case of radiation, but for

dust it has $\rho^{4/3}$ instead of ρ. A four-dimensional black hole solution is presented having the Schwarzschild form with a short-distance correction r^{-2}.

20. G. Kofinas and R. Olea, *Universal regularization prescription for Lovelock AdS gravity*, JHEP **11** (2007) 069 [hep-th/0708.0782].
A definite form for the boundary term that produces the finiteness of both the conserved quantities and Euclidean action for any Lovelock gravity with AdS asymptotics is presented. This prescription merely tells even from odd bulk dimensions, regardless the particular theory considered, what is valid even for Einstein-Hilbert and Einstein-Gauss-Bonnet AdS gravity. The boundary term is a given polynomial of the boundary extrinsic and intrinsic curvatures (also referred to as Kounterterms series). Only the coupling constant of the boundary term changes accordingly, such that it always preserves a well-posed variational principle for boundary conditions suitable for asymptotically AdS spaces. The background-independent conserved charges associated to asymptotic symmetries are found. In odd bulk dimensions, this regularization produces a generalized formula for the vacuum energy in Lovelock AdS gravity. The standard entropy for asymptotically AdS black holes is recovered directly from the regularization of the Euclidean action, and not only from the first law of thermodynamics associated to the conserved quantities.

21. D. Gal'tsov, G. Kofinas, P. Spirin and T. Tomaras, *Classical ultra-relativistic scattering in ADD*, JHEP **0905** (2009) 074 [hep-ph/0903.3019].
The classical differential cross-section is calculated for high-energy small-angle gravitational scattering in the factorizable model with toroidal extra dimensions. The three main features of the classical computation are: (a) It involves summation over the infinite Kaluza-Klein towers but, contrary to the Born amplitude, it is finite with no need of an ultraviolet cutoff. (b) It is shown to correspond to the non-perturbative saddle-point approximation of the eikonal amplitude, obtained by the summation of an infinite number of ladder graphs of the quantum theory. (c) In the absence of extra dimensions it reproduces all previously known results.

22. E. Kiritsis and G. Kofinas, *Horava-Lifshitz Cosmology*, Nucl. Phys. **B821** (2009) 467 [hep-th/0904.1334]
The cosmological equations suggested by the non-relativistic renormalizable gravitational theory proposed by Hořava are considered. It is pointed out that the early universe cosmology has features that may give an alternative to inflation and the theory may be able to escape singularities.

23. C. Charmousis, G. Kofinas and A. Papazoglou, *The consistency of codimension-2 braneworlds and their cosmology*, JCAP **1001** (2010) 022 [hep-th/0907.1640].
We study axially symmetric codimension-2 cosmology for a distributional braneworld fueled by a localised four-dimensional perfect fluid, in a six-dimensional Lovelock theory. We argue that only the matching conditions (dubbed topological) where the extrinsic curvature on the brane has no jump describe a pure codimension-2 brane. If there is discontinuity in the extrinsic curvature on the brane, this induces inevitably codimension-1 distributional terms. We study these topological matching conditions, together with constraints from the bulk

equations evaluated at the brane position, for two cases of regularisation of the codimension-2 defect. First, for an arbitrary smooth regularisation of the defect and second for a ring regularisation which has a cusp in the angular part of the metric. For a cosmological ansatz, we see that in the first case the coupled system is not closed and requires input from the bulk equations away from the brane. The relevant bulk function, which is a time-dependent angular deficit, describes the energy exchange between the brane and the six-dimensional bulk spacetime. On the other hand, for the ring regularisation case, the system is closed and there is no leakage of energy in the bulk. We demonstrate that the full set of matching conditions and field equations evaluated at the brane position are consistent, correcting some previous claim in the literature which used rather restrictive assumptions for the form of geometrical quantities close to the codimension-2 brane. We analyse the modified Friedmann equation and we see that there are certain corrections coming from the non-zero extrinsic curvature on the brane. We establish the presence of geometric self-acceleration and a possible curvature domination wedged in between the period of matter and self-acceleration eras as signatures of codimension-2 cosmology.

24. D. Gal'tsov, G. Kofinas, P. Spirin and T. Tomaras, *Transplanckian bremsstrahlung and black hole production*, Phys. Lett. **B683** (2010) 331 [hep-ph/0908.0675].
Classical gravitational bremsstrahlung in particle collisions at transplanckian energies is studied in $\mathcal{M}_4 \times \mathcal{T}^d$. The radiation efficiency $\epsilon \equiv E_{\rm rad}/E_{\rm initial}$ is computed in terms of the Schwarzschild radius $r_S(\sqrt{s})$, the impact parameter b and the Lorentz factor $\gamma_{\rm cm}$ and found to be $\epsilon = C_d(r_S/b)^{3d+3}\gamma_{\rm cm}^{2d+1}$, larger than previous *estimates* by many powers of $\gamma_{\rm cm} \gg 1$. The cubic graviton vertex is consistently taken into account and the approximation is reliable for impact parameters in the range $r_S < b < b_c$, with b_c marking (for $d \neq 0$) the loss of the notion of classical trajectories. It follows that gravitational bremsstrahlung leads to extreme damping in transplanckian collisions and radiation reaction should be included in the analysis of black hole production. Furthermore, even if a black hole forms, its thermal Hawking radiation will be hardly distinguishable from the non-thermal radiation due to collisions with impact parameters larger than r_S.

25. E. Kiritsis and G. Kofinas, *On Hořava-Lifshitz 'Black Holes'*, JHEP **01** (2010) 122 [hep-th/0910.5487].
The most general spherically symmetric solution with zero shift is found in the non-projectable Hořava-Lifshitz class of theories with general coupling constants. It contains as special cases, spherically symmetric solutions found by other authors earlier. It is found that the generic solution has conventional (AdS, dS or flat) asymptotics with a universal 1/r tail. There are several special cases where the asymptotics differ, including the detailed balance choice of couplings. The conventional thermodynamics of this general class of solutions is established by calculating the energy, temperature and entropy. Although several of the solutions have conventional horizons, for particles with ultra-luminal dispersion relations such solutions appear to be horizonless.

26. D. Gal'tsov, G. Kofinas, P. Spirin and T. Tomaras, *Scalar ultrarelativistic bremsstrah- lung in extra dimensions*, JHEP **05** (2010) 055 [hep-th/1003.2982].
The emitted energy and the cross-section of classical scalar bremsstrahlung in massive particle

collisions in $D = 4 + d-$dimensional Minkowski space $\mathcal{M}_D$ as well as in the brane world $\mathcal{M}_4 \times \mathcal{T}^d$ is computed to leading ultra-relativistic order. The particles are taken to interact in the first case via the exchange of a bulk massless scalar field Φ and in the second with an additional massless scalar ϕ, confined together with the particles on the brane. Energy is emitted as Φ radiation in the bulk or ϕ radiation on the brane. In contrast to the quantum Born approximation, the classical result is unambiguous and valid in a kinematical region which is also specified. For $D = 4$ the results are in agreement with similar expressions in classical electrodynamics.

27. G. Kofinas and V. Zarikas, *A solution of the coincidence problem based on the recent galactic core black hole energy density increase*, The European Physical Journal C **73** (2013) 2379 [hep-th/1107.2602].
A mechanism capable to provide a natural solution to two major cosmological problems, i.e. the cosmic acceleration and the coincidence problem, is proposed. A specific brane-bulk energy exchange mechanism produces a total dark pressure, arising when adding all normal to the brane negative pressures in the interior of galactic core black holes. This astrophysically produced negative dark pressure explains cosmic acceleration and why the dark energy today is of the same order to the matter density for a wide range of the involved parameters. An exciting result of the analysis is that the recent rise of the galactic core black hole mass density causes the recent passage from cosmic deceleration to acceleration. Finally, it is worth mentioning that this work corrects a wide spread fallacy among brane cosmologists, i.e. that escaping gravitons result to positive dark pressure.

28. G. Kofinas and M. Heraklidou, *Self-gravitating branes again*, hep-th/1309.0674.
We raise on theoretical grounds the question of the physical relevance of Israel matching conditions and their generalizations to higher codimensions, the standard cornerstone of the braneworld and other membrane scenarios. Our reasoning is twofold: First, the incapability of the conventional matching conditions to accept the Nambu-Goto probe limit (even the geodesic limit of the Israel matching conditions is not acceptable since being the geodesic equation a kinematical fact it should be preserved for all gravitational theories or defects, which is not the case for these conditions). Second, in our D-dimensional spacetime (maybe D=4), classical defects of any possible codimension should be compatible. These matching conditions fail to accept codimension-2 and 3 defects for D=4 (which represents effectively the spacetime at certain length and energy scales) and most probably fail to accept high enough codimensional defects for any D since there is no high enough Lovelock density to support them. Here, we propose alternative matching conditions which seem to satisfy the previous criteria. Instead of varying the brane-bulk action with respect to the bulk metric at the brane position, we vary with respect to the brane embedding fields so that the gravitational back-reaction is included. For a codimension-2 brane in 6-dim EGB gravity we prove its consistency for an axially symmetric cosmological configuration. The cosmologies found have the LFRW behaviour and extra correction terms. For a radiation brane one solution avoids a cosmological singularity and undergoes accelerated expansion near the minimum scale factor. In the presence of an induced gravity term, there naturally appears in the theory the effective cosmological constant scale $\lambda/(M_6^4 r_c^2)$, which for a brane tension $\lambda \sim M_6^4$ (e.g. TeV^4) and $r_c \sim H_0^{-1}$ gives the observed value of the cosmological constant.

29. G. Kofinas and V. Zarikas, *Five-dimensional braneworld with gravitating Nambu-Goto matching conditions*, to appear
We continue the investigation of a recent proposal on alternative matching conditions for self-gravitating defects. The reasoning for this study is the need for consistency of the various codimension defects and the existence of a meaningful equation of motion at the probe limit, things that seem to lack from the standard approach. These matching conditions arise by varying the brane-bulk action with respect to the brane embedding fields (and not with respect to the bulk metric at the brane position) in a way that takes into account the gravitational back-reaction of the brane to the bulk. They always possess a Nambu-Goto probe limit and any codimension defect is seemingly consistent for any second order bulk gravity theory. Here, we consider in detail the case of a codimension-1 brane in five-dimensional Einstein gravity, derive the generic alternative junction conditions and find the Z_2-symmetric braneworld cosmology, as well as its bulk extension which is not AdS_5. Compared to the standard braneworld cosmology, the new one has an extra integration constant which accounts for the today matter and dark energy contents, therefore, there is more freedom for accommodating the observed cosmic features. One branch of the solution possesses the asymptotic linearized LFRW regime. We have constrained the parameters so that to have a recent passage from a long deceleration era to a small today acceleration epoch and we have computed the time-varying dark energy equation of state and the age of the universe. For a range of the parameters it is possible for the presented cosmology to provide a large acceleration in the high energy regime.

30. G. Kofinas, E. Saridakis and J.-Q. Xia, *Observational constraints of the 5-dimensional braneworld cosmology with gravitating Nambu-Goto matching conditions*, to appear.