Research directions in the University of Valencia

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Hawking radiation and the Planck scale.

QFT + GR $\Rightarrow$ black holes emit thermal radiation. But the derivation seems to invoke Planck-scale physics.

Would the microscopic structure of string theory, which agrees with Hawking results at small frequencies, leave an imprint in the emission rate?

Current investigation: the contribution of the ultrashort distances to the Planckian spectrum is negligible up to frequencies two orders above Hawking's temperature for astrophysical black holes.

Only at high emission frequencies an underlying quantum theory of gravity could potentially predict significant deviations from Hawking's result.

Agullò, Navarro-Salas, Olmo, Parker

Black hole evaporation and holography.

Hawking discovery prompted new, deep questions:

- what is the time evolution of a black hole?
- What is its endpoint?
- Is information lost during the evaporation?

String theory can be used to tackle these problems: AdS/CFT on RS2 braneworlds leads to the holographic conjecture: *'classical 5D brane localized black holes are dual to 4D quantum corrected black holes'*.

Emparan, Fabbri, Kaloper

Investigations:

(Static) classical (5D) vs. quantum (4D) correction to the Newtonian potential; zero temperature quantum corrections to the horizon.

Time dependent case: we are studying ways to check the existence of Hawking radiation in these scenarios.

Anderson, Balbinot, Fabbri, Farese, Navarro-Salas, Olmo, Procopio, Sanchis-Alepuz

A search for the fundamental d.o.f. of M–theory (BPS preons).

BPS preons =BPS states preserving all supersymmetries but one, $|BPS\ preon>=|\frac{31}{32}\ BPS>$ are hypothetical constituents of M-theory **[I.A. Bandos, J.A. de Azcárraga, J.M. Izquierdo, J. Lukierski (Wroclaw), 2001]** because all M-theory BPS states can be considered as composites of BPS preons.

♦ k/32 susy BPS state ⇔ (32-k) preons,

$$|\frac{k}{32}\ BPS>=\underbrace{|BPS\ preon>\otimes\ldots\otimes|BPS\ preon>}_{\tilde{n}=(32-k)}$$

♦ Completely susy BPS states ⇔ no preons,
$|32/32\ BPS>=$ 'vacua for vacua'
♦ fully non-susy state ⇔ 32 independent preons. max. number ⇔ 'most complicated'

Supergravity solutions with the properties of preons - 31/32 susy- are not known and even *have been proved to be absent in 'free', 'classical' supergravity*, but for the supergravity with quantum (stringy, α') corrections the question is still open. **I.A. Bandos, J.A. de Azcàrraga, M. Picòn (Padova), O. Varela (Imperial College)**
Moreover, such a *preon conspiracy* is not a problem for the preon conjecture (as impossibility to observe a free quark is not a problem for quantum chromodynamics).

The same notion of preons applies also to an arbitrary spacetime dimension and in D=4, 6, 10:

BPS preon = free conformal higher spin theory.

Definition of preon $\underbrace{\equiv}_{\Uparrow}$ equations for higher spin fields

in coordinate representation in 'tensorial superspace'
$(X^{\alpha\beta}, \theta^{\alpha}) \quad (= (x^m, y^{[mn]}, \theta^{\alpha})$ in D=4)

I.A. Bandos, J.A. de Azcárraga, J. Lukierski, D. Sorokin, P. Pasti and M. Tonin (Padova), X. Bekaert, M. Tsulaia

Brane dynamics.

Another collaboration with the (**Padova**) node (Valencia-Padova-Kharkov collaboration) is being carried out in the field of D-brane dynamics in particular in the framework of the so-called superembedding approach **[I. Bandos, P. Pasti, D. Sorokin, M. Tonin, D.V. Volkov]**.

Superembedding approach for the newly discovered **(by Groningen group)** Q7 branes is under study by **[I.A. Bandos, D. Sorokin, P. Howe, L. Wulff]**:

Lagrangian description of supergravity–superbrane interaction. Complete but gauge fixed action
[I.A. Bandos, J.A. de Azcárraga, J.M. Izquierdo, J. Lukierski]

$$\boxed{S_{SUGRA}(e^a_\mu(x), \psi^\alpha_\mu(x), A_3(x)) + S_{M2}(E^a_M(Z), A_3(Z))|_{\theta(\tau,\vec{\sigma})=0}}$$

Superalgebras

Expansions of superalgerbas= new method of obtaining superalgebras from the given one.
[J.A. de Azcárraga, J.M. Izquierdo, M. Picón, O. Varela]

Supergravity with tensors.

Tensors appear naturally in M–theory and string theory compactifications.

Usually (in D=4,5) the tensors are Hodge dualized to scalars or vectors, but this is not always possible if the compactification is performed in the presence of fluxes.

$$\Downarrow$$

study of the deformations of 4– and 5–dimensional supergravity.

R. D'Auria, L. Andrianopoli, L. Sommovigo

Politecnico di Torino

Geometry of supersymmetry.

The geometry of the space of the scalars in supersymmetric theories and supergravity is crucial to determine properties of solutions, and to choose realistic models. The interest is mainly on special geometry (N=2) in $D=5,4$. Although widely treated in the literature, some global aspects are still unknown (and surprising). The most promising application of this study is to make the transition to the quantum moduli space, using the techniques of *deformations* or *non commutative geometry*.

S. Ferrara, M. A. Lledó, O. Maciá, J. A. Rodríguez, A. Van Proeyen, V. S. Varadarajan

Leuven, Frascati

Supergeometry.

Supergeometry has lately attracted some attention among the mathematicians and we have now points of view inherited from algebraic geometry that can be used in physics. In this framework super conformal symmetry in higher dimensions in its classical and quantum versions is studied.

D. Cervantes, R. Fioresi, M. A. Lledó

Other subjects.

Geometric torsion in gravity, a new point of view for topological properties of solutions.

L. Andrianopoli, M. A. Lledó, L. Sommovigo

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Deformations and contractions of symmetric spaces modelling transitions among different regimes of sigma models.

F. Aláez, M. A. Lledó, M. Petropoulos

École Polythechnic