

CURRICULUM VITAE

I. General data

I.1. Biographical data

Family name and first name: BĂBĂLÎC ELENA-MIRELA

Date and place of birth: 19.06.1979, Craiova, Dolj county

I.2. High School

During 1994-1998 I was enrolled at the “Nicolae Titulescu” High School in Craiova, mathematics-physics profile. In June 1998 I graduated from the same institution by passing the final exam.

I.3. Academic studies

During 1998-2002 I was enrolled at the Faculty of Sciences, Physics section, University of Craiova. I passed the final exam at the same faculty in June 2002.

I.4. Mastership studies

In 2002 I was admitted at the mastership programme “Quantum Field Theory”, organized by the Faculty of Sciences, University of Craiova. I graduated this programme in June 2003, after defending my dissertation thesis.

I.5. Ph.D. studies

Beginning with October 2003 I am a Ph.D. student in Physics at the University of Craiova.

I.6. Doctoral stages

During the period 1 September 2007–30 August 2008 I was granted an Early-Stage-Researcher (ESR) position in “The European Superstring Theory Network”, contract no. MRTN-CT-2004-512194 within the Sixth Framework Programme (FP6), at Chalmers University of Technology in Göteborg, Sweden. The aim of this doctoral stage was to connect myself to the present researches from the subdomain of supersymmetric theories such as superstring and supermembrane.

I.7. Professional experience

Beginning with 15 June 2009 I am employed as a Research Assistant at the Department of Theoretical Physics from the “Horia Hulubei” National R&D Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest. This position is financed from the research grant 464/2009, programme IDEI of C.N.C.S.I.S.

II. Scientific activity

II.1. Approached problems

The main topic approached is Quantum Field Theory, with emphasis on the Becchi-Rouet-Stora-Tyutin (BRST) quantization of gauge theories. The secondary topic is Superstring and Supermembrane Theory. Within these topics, I investigated the following subjects:

1. the analysis of interactions in a particular class of topological BF models in $D = 2$ dimensions;
2. the construction of couplings in $D \geq 5$ dimensions between a massless tensor field with mixed symmetry $(3, 1)$ and one with the mixed symmetry of the Riemann tensor;
3. the analysis of interactions between two different collections of massless tensor fields with mixed symmetries $(3, 1)$ and $(2, 2)$, also in $D \geq 5$ dimensions;
4. the study of the correlation between the BRST charges obtained in the pure spinor and kappa-symmetric formulations of the superparticle and respectively the supermembrane in $D = 11$ dimensions.

II.2. Main results

- Under the hypotheses of analyticity of deformations in the coupling constant, space-time locality, Lorentz covariance, Poincaré invariance, and the preservation of the number of derivatives on each field, we obtain that: a) there exist consistent couplings in a class of topological BF theories in $D = 2$ dimensions with the field spectrum consisting of a vector field and a tensor field of degree two, which appear only at order one in the coupling constant; b) the interaction vertices are

quadratic in the tensor fields of degree two and depend on the vector field through a Poisson two-tensor field; c) the PT invariance of the deformed action is broken; d) the gauge transformations for both types of fields are deformed; e) the deformed generating set of gauge transformations remains irreducible; f) the gauge algebra associated with the deformed generating set is open, unlike that of the free model, which is Abelian.

- Under the same hypotheses like in the above we find consistent couplings that can be added between a massless tensor field with mixed symmetry $(3, 1)$ and one with mixed symmetry $(2, 2)$, which deform the free action and its gauge transformations, but only in $D = 6$ space-time dimensions. In other words, there exist non-trivial couplings between the dual formulation of linearized gravity in $D = 6$ and a tensor field with the mixed symmetry of the Riemann tensor. The main results obtained can be synthesized in: g) the deformed Lagrangian action contains only mixing-component terms at order one and two in the deformation parameter; h) both the gauge transformations and first-order reducibility functions associated with the tensor field with the mixed symmetry $(3, 1)$ are modified, while the tensor field with the mixed symmetry $(2, 2)$ is rigid under the deformation procedure at the level of gauge symmetries as well as to that of reducibility; i) the gauge algebra and the structure of the second-order reducibility are conserved with respect to the free limit; j) imposing the supplementary hypothesis of PT invariance on the deformed theory eliminates the above mentioned couplings.
- Under same hypotheses the self-interactions in a collection of massless tensor fields with mixed symmetry $(3, 1)$, the self-interactions in a collection of massless tensor fields with the mixed symmetry of the Riemann tensor as well as the cross-couplings between these collections are studied. Related to self-interactions, some ‘no-go’ results for each type of tensor fields, which generalize the results obtained in the literature for a single tensor field with mixed symmetry $(3, 1)$ and respectively for a a single tensor field with the mixed symmetry of the Riemann tensor, are proven. Regarding the cross-couplings between the two collections of tensor fields, it is shown that: k) they exist only in $D = 6$ space-time dimensions; l) the Lagrangian action of the interacting the-

ory contains only mixing-component terms at order one and two in the deformation parameter; m) concerning the cross-couplings among different fields with the mixed symmetry of the Riemann tensor, their existence is dictated by the properties of the metric tensor in the inner space of collection indices, $\hat{k} = (k_{ab})$ — if \hat{k} is positive-definite, then there appear no cross-couplings among different fields with the mixed symmetry $(2, 2)$, while for an indefinite \hat{k} such cross-couplings are allowed; n) both the gauge transformations and first-order reducibility functions associated with the tensor fields with the mixed symmetry $(3, 1)$ are modified, while the tensor fields with the mixed symmetry $(2, 2)$ are rigid under the deformation procedure; o) the gauge algebra and the structure of the second-order reducibility are conserved with respect to the free limit.

- We attempt to establish a connection (possibly equivalence) between the κ -symmetric and pure spinor formulations for the supermembrane in eleven dimensions. We start from the pure spinor approach recently developed for quantizing the superstring in ten dimensions, which is applied along the same line initially to the superparticle in eleven dimensions and afterwards to the more complicated case of the supermembrane in eleven dimensions. We notice that: p) the “BRST charge” for the superparticle in the pure spinor formalism is equivalent to the BRST charge in the κ -symmetric formalism; q) it is possible to reinstate the reparameterization constraints in the pure-spinor formulation of the supermembrane by introducing a non-minimal sector and performing a similarity transformation; r) the resulting “BRST charge” is then of conventional type and is argued to be (related to) the BRST charge of the κ -symmetric supermembrane in a formulation where all second class constraints are ‘gauge unfixed’ to first class constraints; s) we encounter a natural candidate for a (non-covariant) supermembrane analogue of the superstring b -ghost.

III. Selected papers

1. E. M. Băbălîc, C. C. Ciobîrcă, E. M. Cioroianu, I. Negru, S. C. Săraru, Two dimensional interactions in a class of tensor gauge fields from local BRST cohomology, Acta. Phys. Polon. **B34** (2003) 2673–2682
2. E. M. Băbălîc, Niclas Wyllard, Towards relating the kappa-symmetric

and pure-spinor versions of the supermembrane, *JHEP* **0810** (2008) 059 (15 pag.)

3. C. Bizdadea, S. O. Saliu, E. M. Băbălîc, Selfinteractions in collections of massless tensor fields with the mixed symmetry (3,1) and (2,2), *Physics AUC* **19**, part I (2009) 1–21

4. C. Bizdadea, E. M. Cioroianu, S. O. Saliu, E. M. Băbălîc, Dual linearized gravity in $D = 6$ coupled to a purely spin-two field of mixed symmetry (2, 2), accepted for publication in *Fortschr. Phys.*

5. C. Bizdadea, E. M. Cioroianu, S. O. Saliu, E. M. Băbălîc, Yes-go cross-couplings in collections of tensor fields with mixed symmetries of the type (3, 1) and (2, 2), accepted for publication in *Int. J. Mod. Phys. A*

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Elena-Mirela BĂBĂLÎC