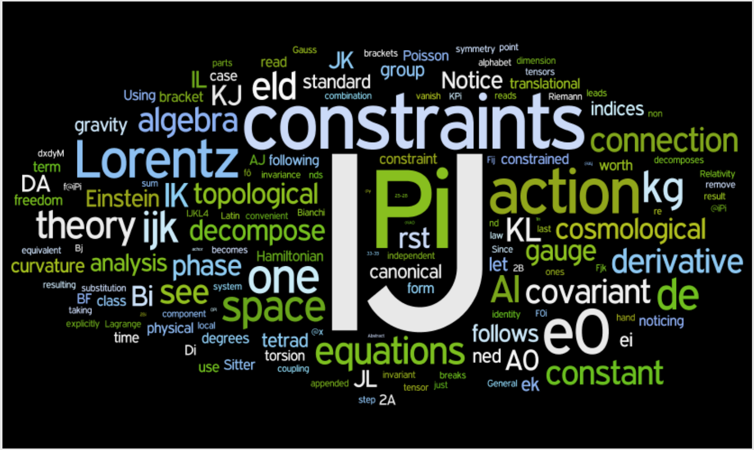
Remigiusz Durka



Supervisor: prof. Jerzy Kowalski-Glikman

My PhD Report

Time elapsed: 626 days

Conferences this year: 2

- Cracow (QG^2)
- Triest (ICTP)

Classes this year:

- Useful Programs

Web pages:

- www.ift.uni.wroc.pl/~rdurka/blog
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XXV Max Born Symposium

- Secretary of the "The Planck Scale" Conference

Papers in progress: 2

- Hamiltonian analysis of constrained BF gravity
- Supersymmetric BF theory

Co-authors:

- prof. Jerzy Kowalski-Glikman
- mgr Michal Szczachor

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Alternative formulation of General Relativity in language of p-forms

New variables of GR:

- e^i_μ tetrad (not metric $g_{\mu\nu}$)
- ω^{ij}_μ $so(3,1)$ connection

$$F^{IJ} = dA^{IJ} + A^{IK} \wedge A_K{}^J$$

Together as $so(4,1)$-connection:

$$A^{IJ}_\mu \rightarrow \begin{cases} A^{ij}_\mu = \omega^{ij}_\mu \\ A^{i5}_\mu = \frac{1}{2\ell} e^i_\mu \end{cases}$$

- Action in MacDowell and Mansouri formulation (with gauge symmetry breaking from $SO(4,1)$ to $SO(3,1)$:

$$S = \int_{\mathcal{M}} \left(B_{\mu\nu IJ} F^{IJ}_{\rho\sigma} - \frac{\beta}{2} B_{\mu\nu IJ} B^{IJ}_{\rho\sigma} - \frac{\alpha}{4} \epsilon_{IJKL} B^{IJ}_{\mu\nu} B^{KL}_{\rho\sigma} \right) \epsilon^{\mu\nu\rho\sigma} d^4 x$$

(which is not more than constrained BF theory) reduces to:

- Action of GR with cosmological constant Λ and Immirzi parameter γ:

$$S = -\frac{1}{2G} \int \left((R^{ij} \wedge e^k \wedge e^l + \frac{\Lambda}{6} e^i \wedge e^j \wedge e^k \wedge e^l) \epsilon_{ijkl} - \frac{2}{\gamma} R^{ij} \wedge e_i \wedge e_j \right)$$

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Transition from Lagrange to the Hamiltonian formalism

$$\mathcal{L}(q,\dot{q}) \rightarrow \mathcal{H}(q,p) = \sum p_i \dot{q}^i - \mathcal{L} + \lambda\phi \qquad p_i \equiv \frac{\delta \mathcal{L}}{\delta \dot{q}_i} \qquad \{q^i, p_j\} = \delta^i_j$$

Hamiltonian analysis of constrained *BF* gravity

- Due to constraints in the theory there are always problems with that procedure.

"Why even bother?"

- linear dependencies in momentum in constraints and equations which is nice feature in quantization
- more wide framework dealing with:
  - torsion
  - coupling spinors to relativity.
- formulation is close to formulation of Yang-Mills theories.

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Academic year 2008/2009