SD without GR

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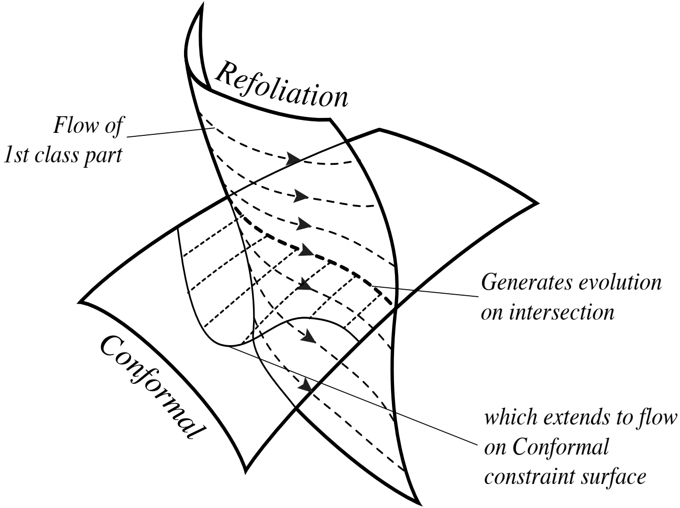
Shape dynamics and the intersection surface



What is the most general gravitational intersection theory?

Fine-print:

- Has to be first class wrt diffeomorphisms.
- Contain two propagating degrees of freedom.
- Up to second order in momenta.
- Optional: regular single connected component.

Answer:

$$aR + \frac{\sigma^{ab}\sigma_{ab}}{\sqrt{g}} + \left(\frac{3}{8}\tau^2 + c\tau + 2\Lambda\right) = 0$$

(could have e.g. τ_i for different components)

For comparison

$$aR + \frac{\sigma^{ab}\sigma_{ab}}{g} + (\frac{3}{8}\tau^2 + c\tau - 2\Lambda) = 0 \qquad (1)$$

Almost intersection of ADM and $\pi - \tau\sqrt{g} = 0$ surface:

$$R + \frac{\sigma^{ab}\sigma_{ab}}{g} + (\frac{3}{8}\tau^2 - 2\Lambda) = 0 \qquad (2)$$

Can find a canonical transformation such that (1) $\rightarrow$ (2).
Only effect is that Λ absorbs c:

$$\Lambda \rightarrow \Lambda + 3c^2$$

Weakening the requirements

What if the Hamiltonian constraint closes only at the intersection surface?

No duality.

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What if the Hamiltonian constraint closes only at the intersection surface?

No duality. Do we have such an example? Yes:

- $aR\sqrt{g} + \frac{\pi^{ab}\pi_{ab} + b\pi^2}{\sqrt{g}} + (f(V)\pi + 2\Lambda\sqrt{g}) = 0$

Closes only on $\pi/\sqrt{g} = cte$.

Canonical transformation with $b = -1/2$ goes to ADM Hamiltonian with:

$$\Lambda \to \Lambda + 3f^2(V)$$

Case with $b \neq -1/2$ not yet studied (Horava).

The (modified) LY equation

What about the "gauge-unfixed" version? Usual LY equation:

$$\phi^{-12}\pi^{ab}_{TT}\pi^{TT}_{ab} - \frac{2}{3}\tau^2 + 2\Lambda - \phi^{-4}R + 8\phi^{-5}\nabla^2\phi = 0$$

Both alternatives have almost same form as this, but criteria for solvability is given by:

$$(b - \frac{1}{6})\tau^2 + 2\Lambda < 0$$

Then one obtains well-defined theory with SD symmetries. (non-local Hamiltonian, or smearing N_o)

No dual theory with refoliation invariance.

Are there signatures?

Neutrinos and Ashtekar connection:

Got a volume-dependent cosmological constant. But also relation between extrinsic curvature and momenta disrupted:

$$\pi_{ab} = K_{ab} - K g_{ab} - \frac{1}{2} g_{ab} f(V)$$

Ashtekar connection in chiral spinor dynamics differs from self-dual connection by torsion:

$$A^i_a = \omega^i_a - \frac{i}{2} e^i_a f(V)$$

(this is all for $b = 0$)

Many open questions

- More signatures?
- What about for a variable DeWitt parameter?
- Variable speed of light?
- Canonical transformations?
- RG flow acting on cosmological constant and DeWitt parameter? (Horava)

  or better: RG flow on space of “local gauge-fixings” of conformal symmetry, which leave 2 physical dofs?

  More room than purely conformal diffeo invariants.