

ISSUES IN GRAVITY WITH DYNAMICAL TORSION

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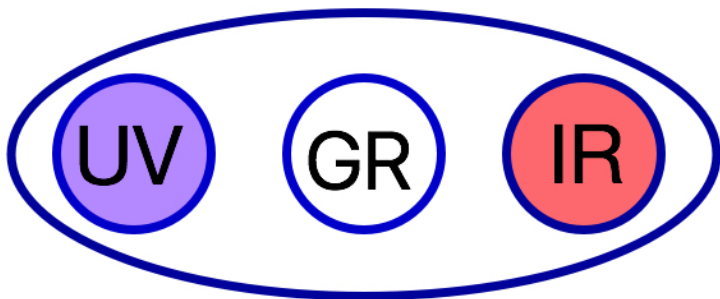
INFRARED modification of GR

Motivation:

- solve cosmological problems
- create checkable alternative to GR
- find something more than GR







SOMETHING BEAUTIFUL



INFRARED modification of GR

Function:

- solve cosmological problems
- create checkable alternative to GR
- find something more than GR

Why modifications can die

- fail Solar System/Astrophysical tests
- **sick fields** - ghosts, tachyons, instabilities

Sick fields:

Flat background: good spectrum

Curved background: sick fields

Dynamical torsion gravity:

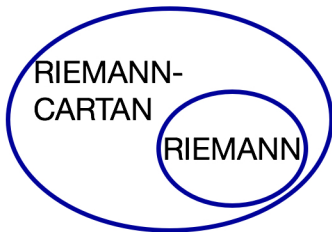
- natural GR generalization
- beautiful
- not forbidden
- nice features

Torsion T_{ijk} :

- antisymmetric part of affine connection

$$T_{ijk} = \Gamma_{jk}^i - \Gamma_{kj}^i$$

- Riemann-Cartan geometry



- save Equivalence Principle

Dynamical torsion gravity

2 independent variables:

tetrad (metric) + affine connection Γ
(not Christoffel)

Objects:

Curvature $F_{ijkl}(\Gamma)$ + Torsion T_{ijk}

10
parameters

$$L = F + F \dots F \dots + T \dots T \dots$$

Gauge theory with Poincare group and dynamical gauge field

Interesting consequences:

- Newtonian potential: $\frac{1}{r} + \frac{e^{-ar}}{r}$
- torsion is generated without its sources
- flat space solution
- self-accelerating cosmological solution without a cosmological constant

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FLAT SPACE SOLUTION:

massless graviton + massive graviton + massive pseudoscalar

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COSMOLOGICAL SOLUTIONS:

- TORSIONLESS, WITH COSMOLOGICAL CONSTANT
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- TORSIONFULL, WITHOUT COSMOLOGICAL CONSTANT **(SELF-ACCELERATION)**
gradient insabilities :(

Gradient instabilities:

$$\omega \sim k \sim \lambda^{-1}$$

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COSMOLOGICAL SOLUTIONS:

- TORSIONLESS, WITH COSMOLOGICAL CONSTANT
massless graviton + massive graviton + massive pseudoscalar
- TORSIONFULL, WITHOUT COSMOLOGICAL CONSTANT (**SELF-ACCELERATION**)
gradient instabilities :(
BUT THE NUMBER OF DOF IS THE SAME!!

Future of this theory:

- check the full 10-param Lagrangian
- stability on a general curved background

More details:

ArXiv:

0905.3732 , 1606.02565 , 1705.00856, 1711.03718 ,
1804.09215

For theoretical basis:

- 1 M. Blagojevic, "Gravitation and gauge symmetries"
- 2 K. Hayashi , T. Shirafuji , "Gravity From Poincare Gauge Theory of the Fundamental Particles"
- 3 E. Sezgin, "Class of Ghost Free Gravity Lagrangians With Massive or Massless Propagating Torsion"