3 Lectures on Black hole physic

- Basics, History
- Black hole soln's
- Basic Concepts, Classic theorems.
- General Relativity:

  Equivalence Principle

  - Weak E.P. $m_i = m_g$
  - Einstein E.P. (free fall frame) — local / locally — non-gravitating is described by Special Rel.

- Strong E.P.
- Mathematically: $(M, g_{\mu\nu})$
  - geometrization
  - Diffeomorphism invariance.
  - Probes: no back reaction → Geodesic

- Fields → field theory in curved Spacetime

- $G_{\mu\nu} = 8\pi G_N T_{\mu\nu}(g; \tilde{\Phi})$

$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R + \Lambda g_{\mu\nu}$

$I = I_{grav.} + I_{matt.}$

$I_{grav.} = \frac{1}{16\pi G_N} \int d^4x \sqrt{-g} (R - 2\Lambda)$

$I_{matt} = \int d^4x \sqrt{-g} \mathcal{L}_{matt.}$

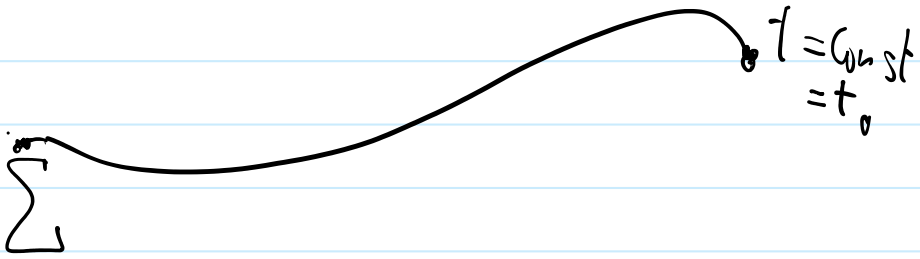
$\frac{1}{\sqrt{-g}} \frac{\delta I}{\delta g^{\mu\nu}} = 0$

$T_{\mu\nu} := \frac{-2}{\sqrt{-g}} \frac{\delta \mathcal{L}_{IH.}}{\delta g^{\mu\nu}}$

- Background independence

- Cauchy Problem

$t > t_0$



- History:

Black hole 1960s
J. Wheeler

1915 – 1960s Prehistory

1915-16 Sch'd static
Spherically Sym.
"Coordinate Singularity"

1937

1917 R. N.

- 1960s: . Kerr 1965 Stationary
. Horizon
. Causal Structure
- Observations X-ray astronomy
Pulsar

Cosmic Censorship Conjecture

- TOV stellar Evolution

1970s :

Theoretical:

- Thermodynamics in presence of horizon

Entropy

+ 2nd Law → Horizons should have entropy + Whole ~~Thermodyn.~~
+ Ein. E.P.

- Hawking : Ein. E.P. + Q.M.

Horizon is not a one-way ~~surface.~~

Ray-tracing

→ Radiate out.

Blackbody radiation

- Dynamical Formation of horizon

  - Evaporate

    - Information problem!

1980s: Observational