

What is the gravitational S -matrix?

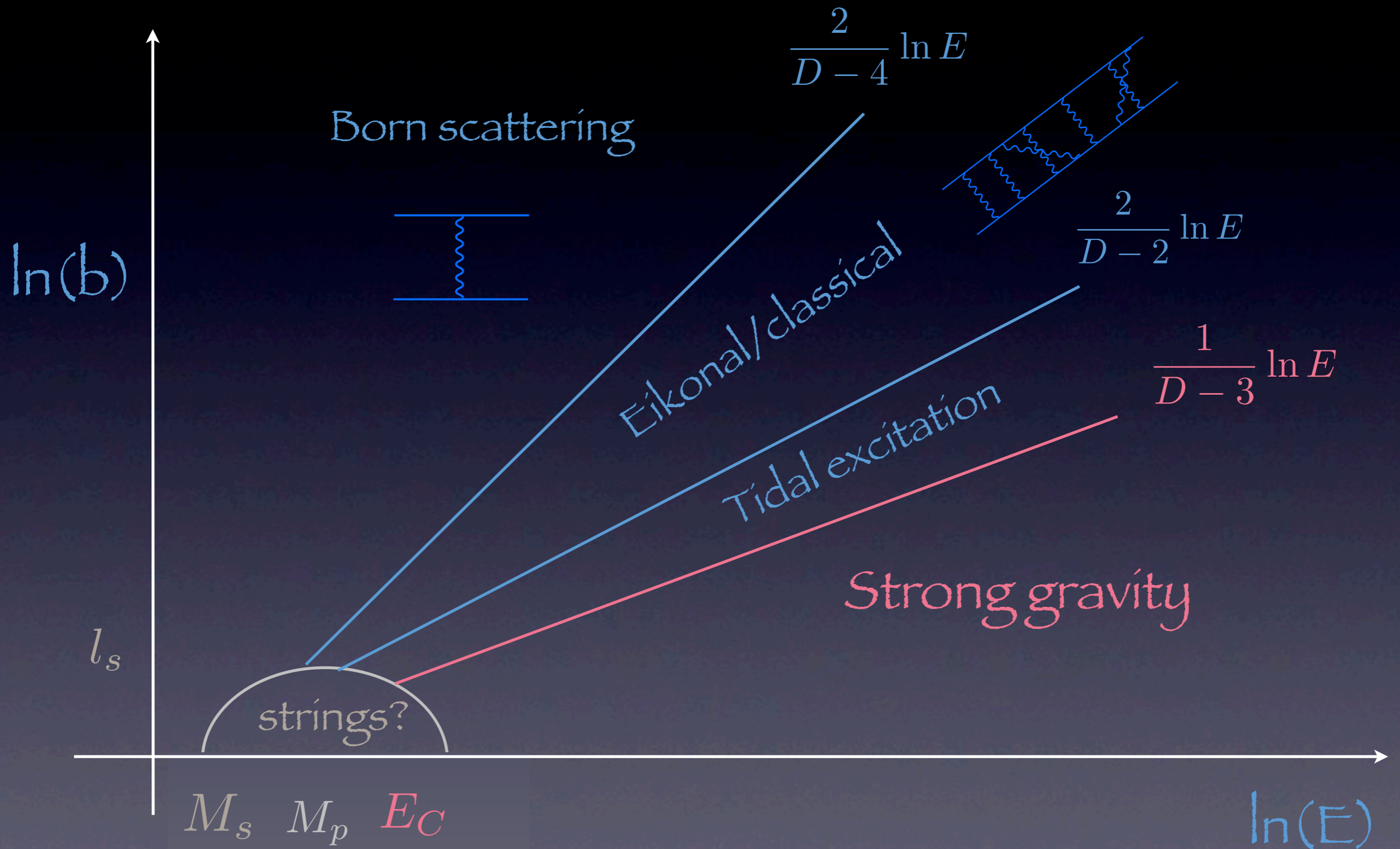
(Does it exist?)

$$E \gg M_D$$

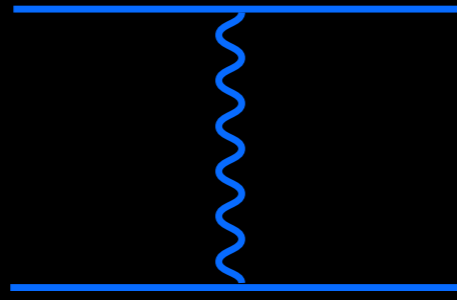
$$M_D \sim 10^{19} \text{ GeV, or } 1 \text{ TeV}$$

a very important question of principle

Regimes:



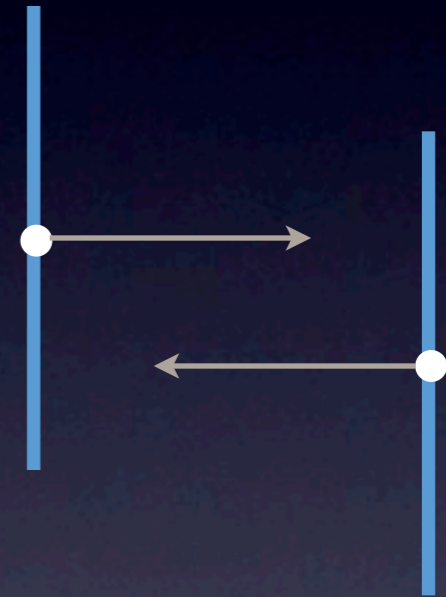
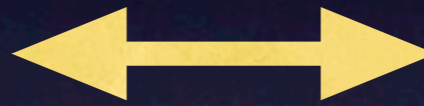
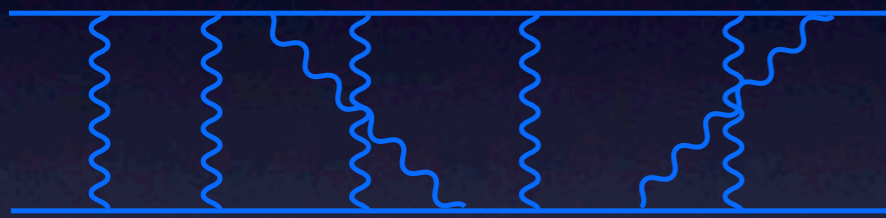
1) Born



$$T_{tree} = -8\pi G_D s^2 / t$$

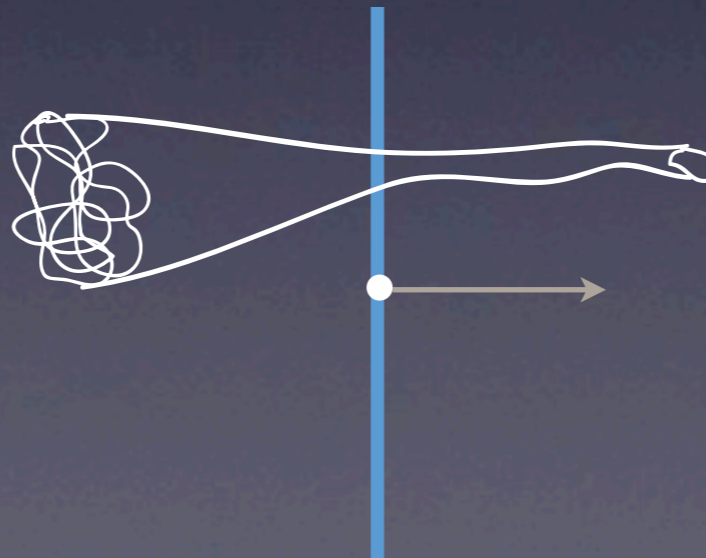
2) Eikonal/classical

~ earth-moon



3) Tidal

e.g.



soft brems, ...

For $b \gg R_S(E) \sim E^{1/(D-3)}$

- nice match diagrammatics-semiclassical
- thus, provisional understanding of features of S
- wish to improve: radiation, structure of pert. thy, etc.

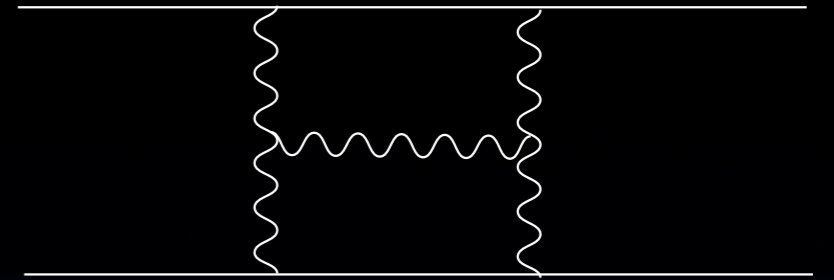
For $b \lesssim R_S(E) \sim E^{1/(D-3)}$

- perturbation theory fails

- semiclassically, unitarity fails (black hole-Hawking)

- information paradox

- new principles needed



unitarization: a guide to what is missing in QG?

(compare classical H stability)

Investigate:

- understand divergence at $b \sim R(E)$

- strings relevant? (not clearly)

(w/Gary, Penedones;
Maharana, Gross)

- properties of S-matrix

(w/Srednicki, Porto)

unitarity; analyticity, ~~polynomiality~~; crossing (?)

basic features of gravity (eik., BHs, ...)

~~locality~~ causality/consistency

- "inside" description: approximately local

observables

(w/Marolf, Hartle, Gary...)

- connections w/Q. cosmology: dS, etc.

- infer basic principles ...

Other current interests:

What will we see at LHC (what is hierarchy really telling us)

How will we see it?

and, necessities:

“accelerator safety”