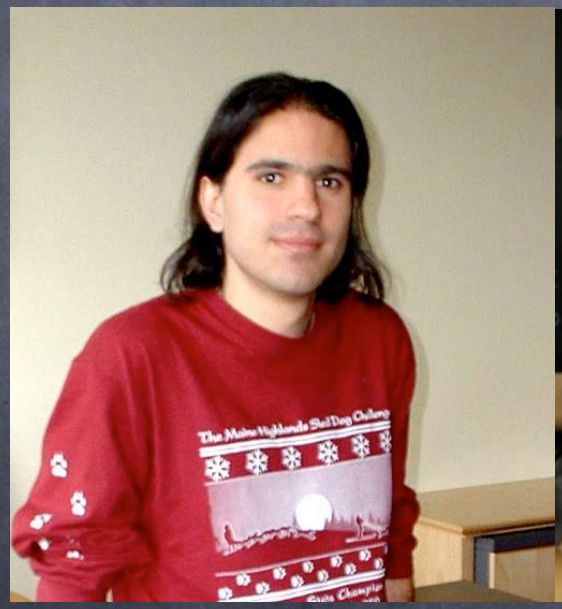
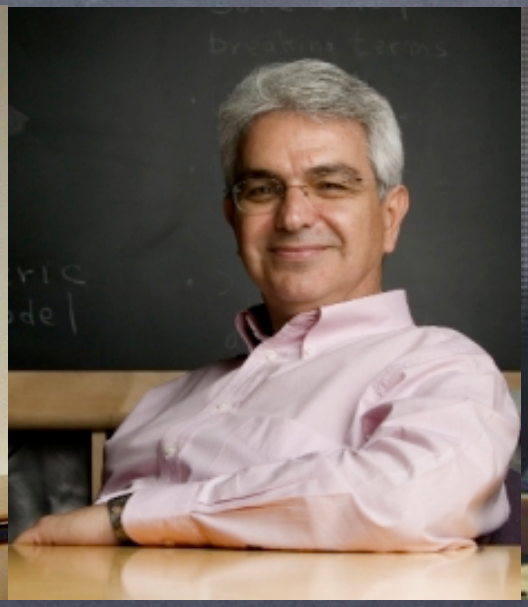
Chapter 19:
Large Extra Dimensions

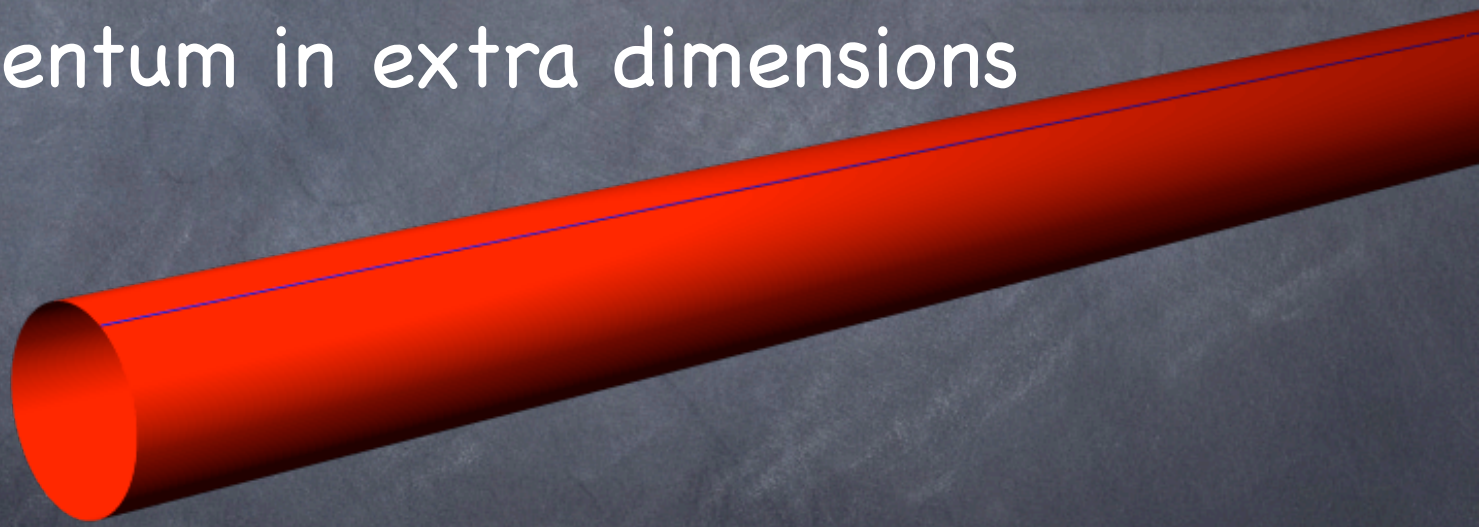
Arkani-Hamed, Dimopoulos, Dvali



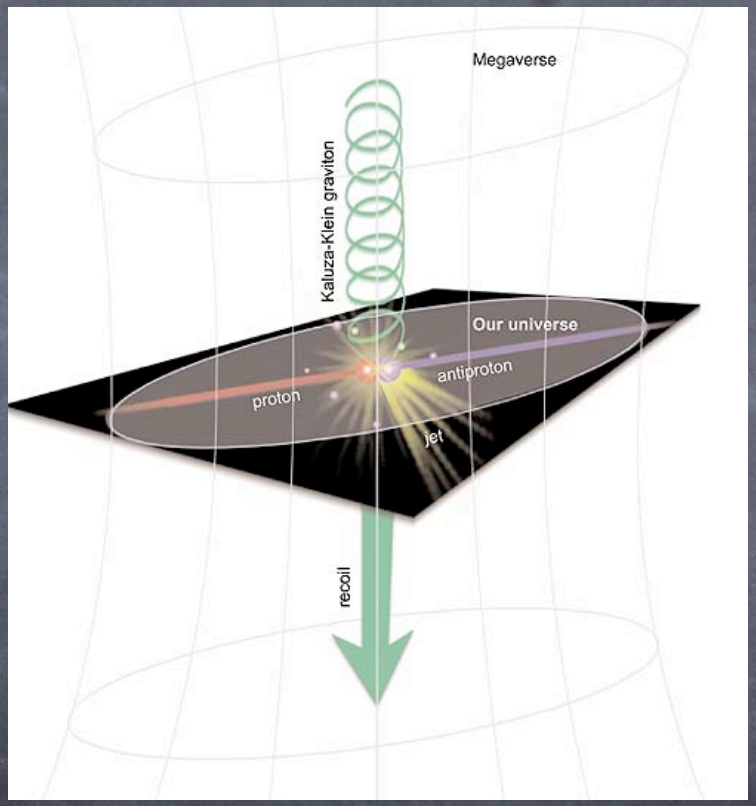



ADD: Stuck on a Brane

quarks and leptons have no momentum in extra dimensions



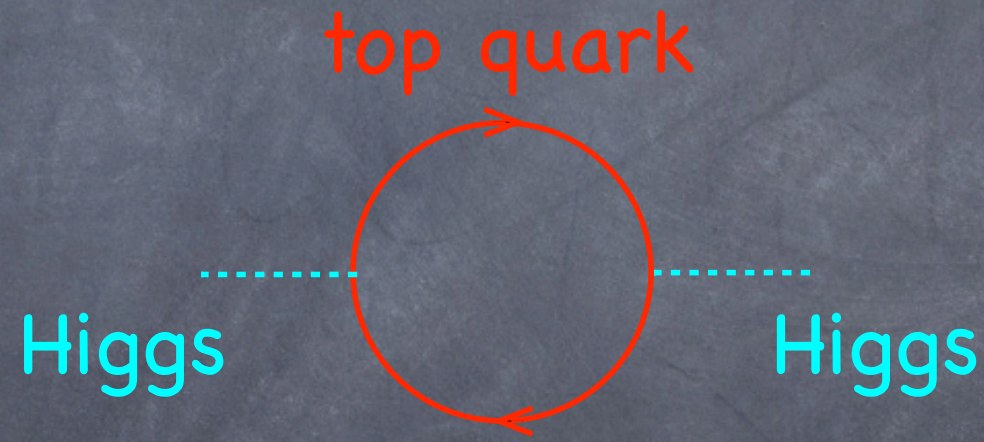
ADD: Gravity Leaks



$$M_{string} \sim M_{weak} = 1\mathrm{TeV}$$

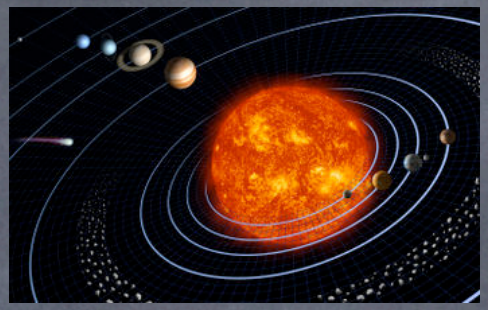
$$G_N = \frac{1}{M_{Planck}^2} \ll \frac{1}{M_{string}^2}$$

Hierarchy Rephrased



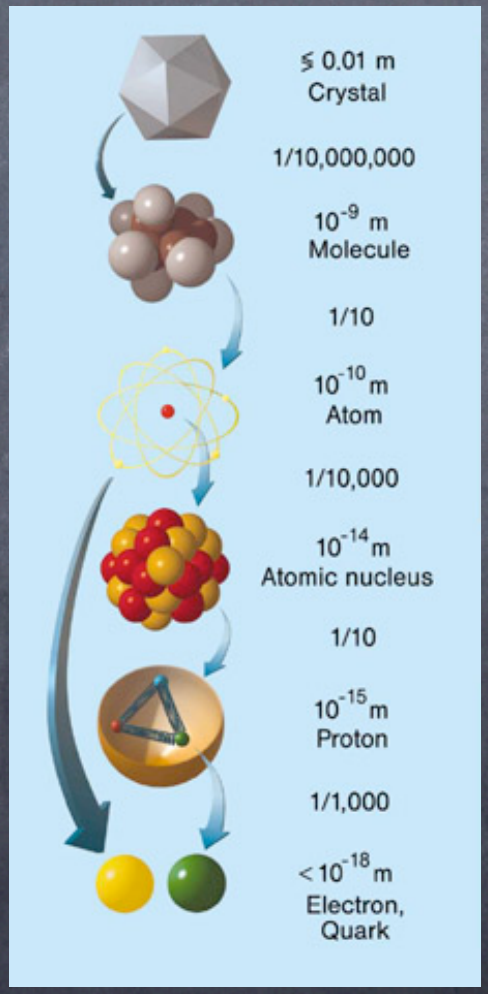
$$M_{Higgs} \sim M_{string}$$

Sizes of n Extra Dimensions



$$n = 1, R = 10^{11}\mathrm{m}$$

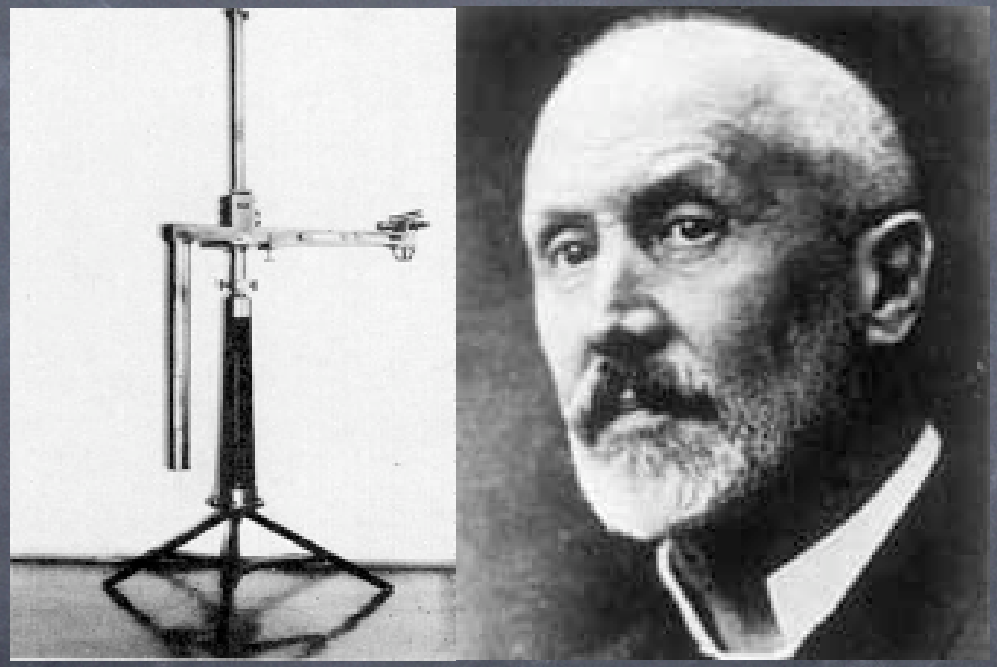
Gravity is 3+n dimensional for for distances smaller than R



$$n = 2, R = 0.1\mathrm{mm}$$
$$n = 3, R = 10^{-9}\mathrm{m}$$

$$n = 4, R = 10^{-12}\mathrm{m}$$
$$n = 6, R = 10^{-14}\mathrm{m}$$

Baron von Eotvos

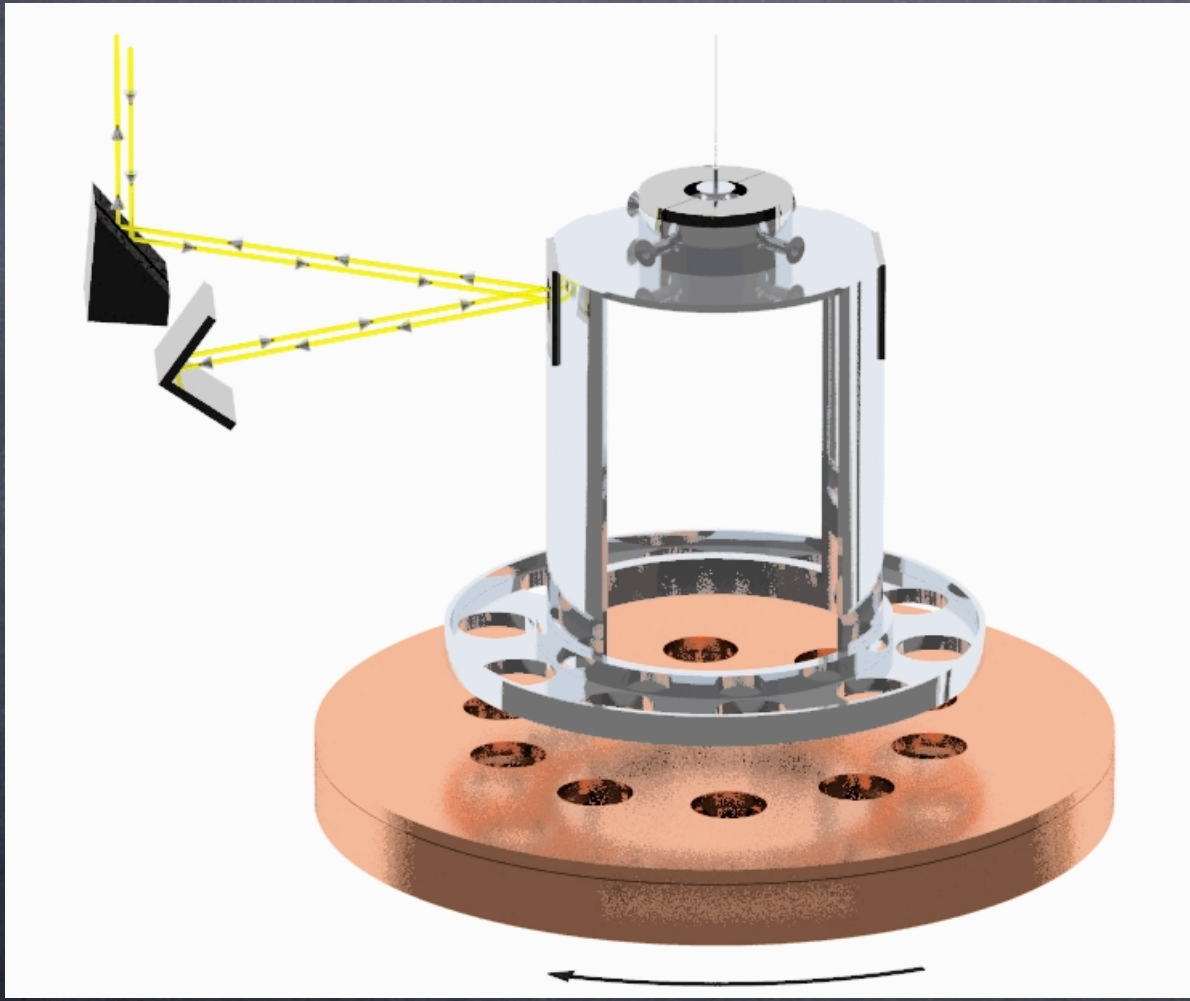


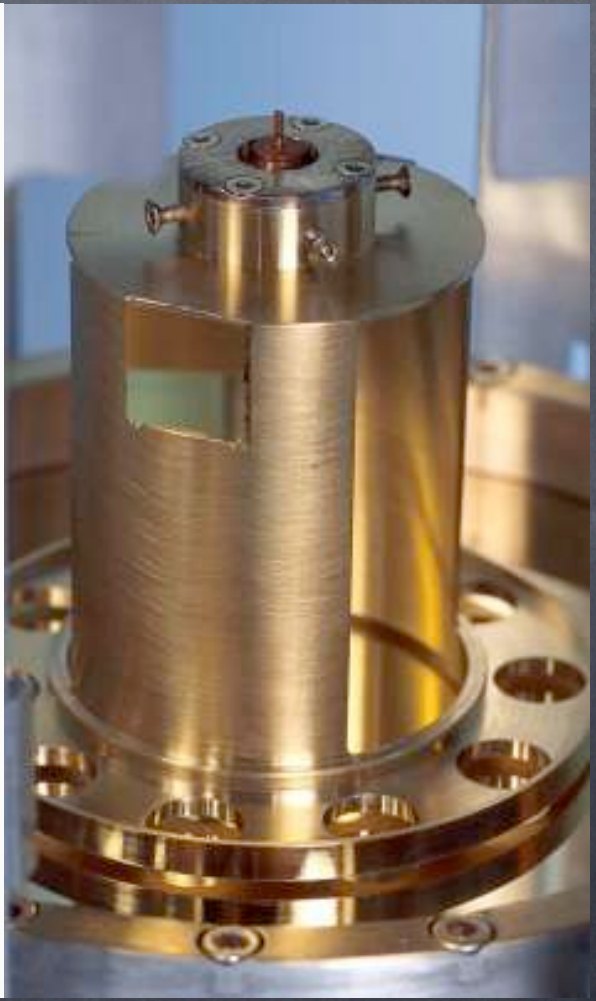
tested Equivalence Principle
with torsion balance to
5 parts in a billion

Adelberger, Heckel

tested gravity
with torsion balance to
a fraction of a millimeter

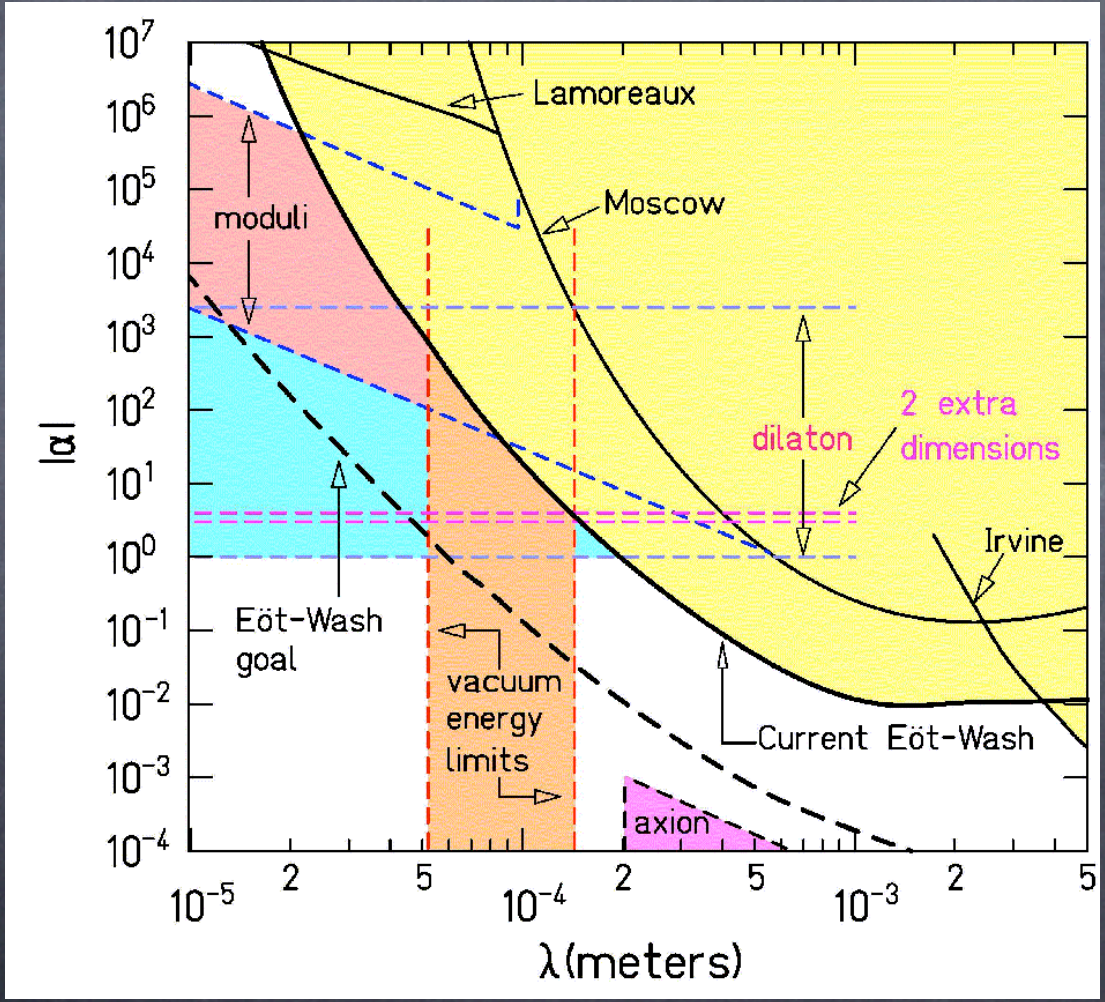
Torsion Pendulum



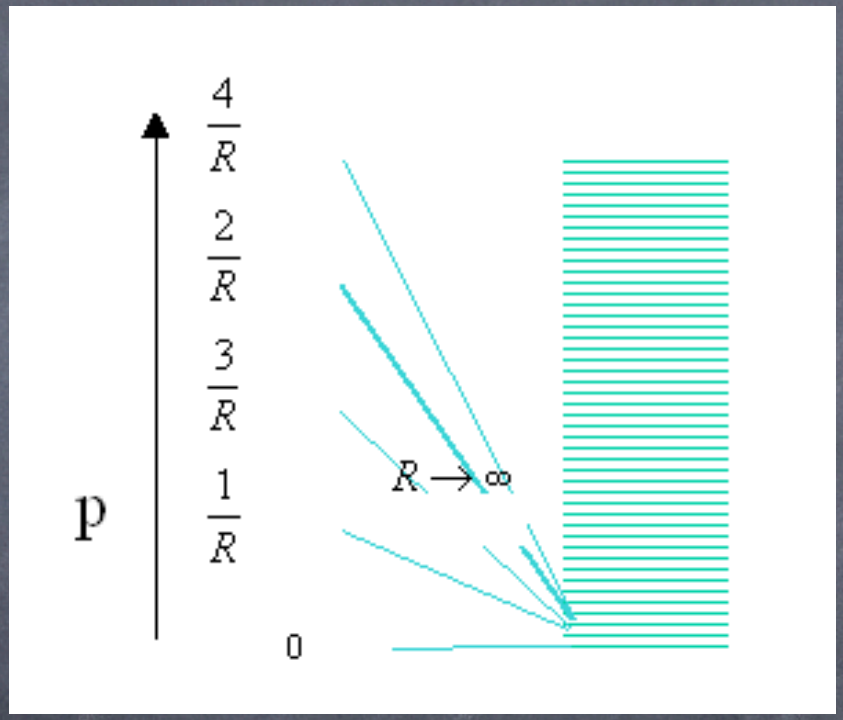


Eot-Wash

Torsion Pendulum Limits



ADD: KK Gravitons

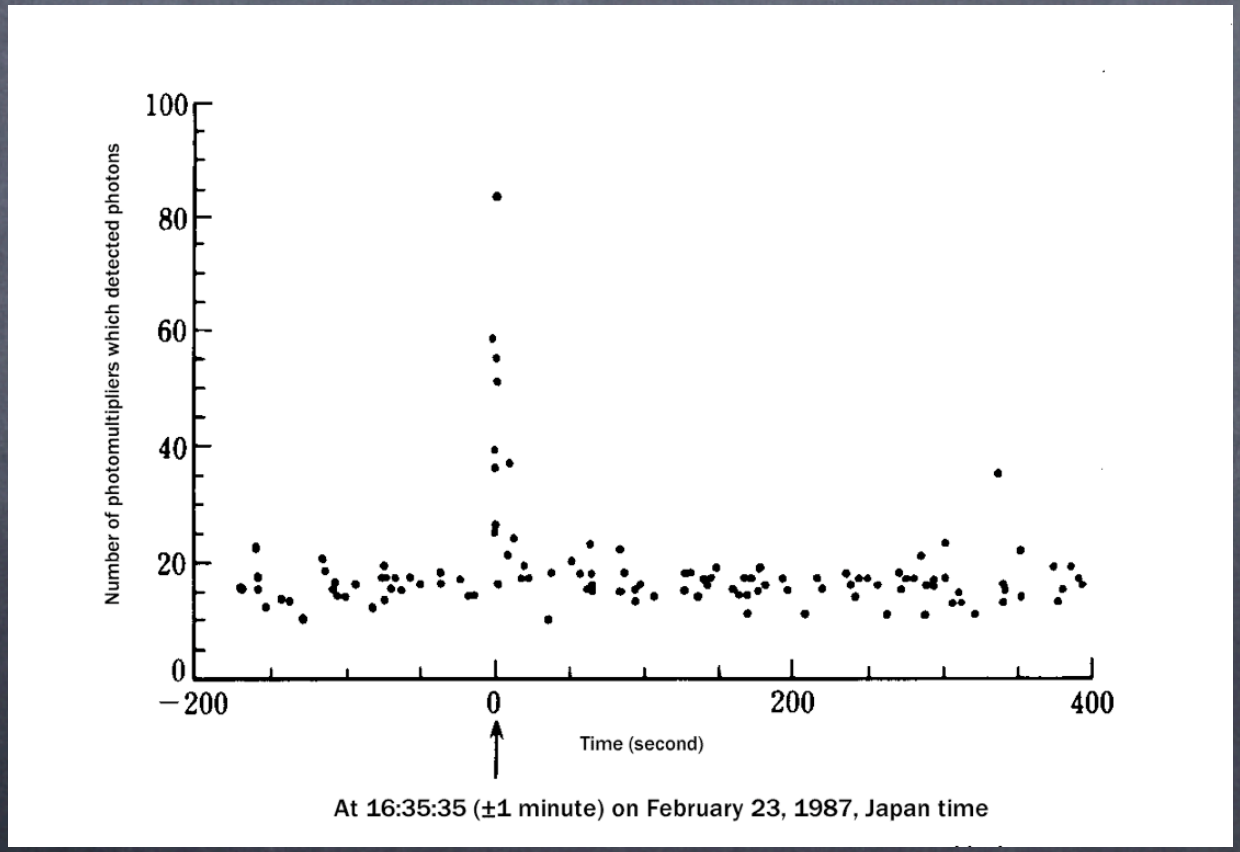


KK gravitons extremely light
lots of them
change Supernova cooling

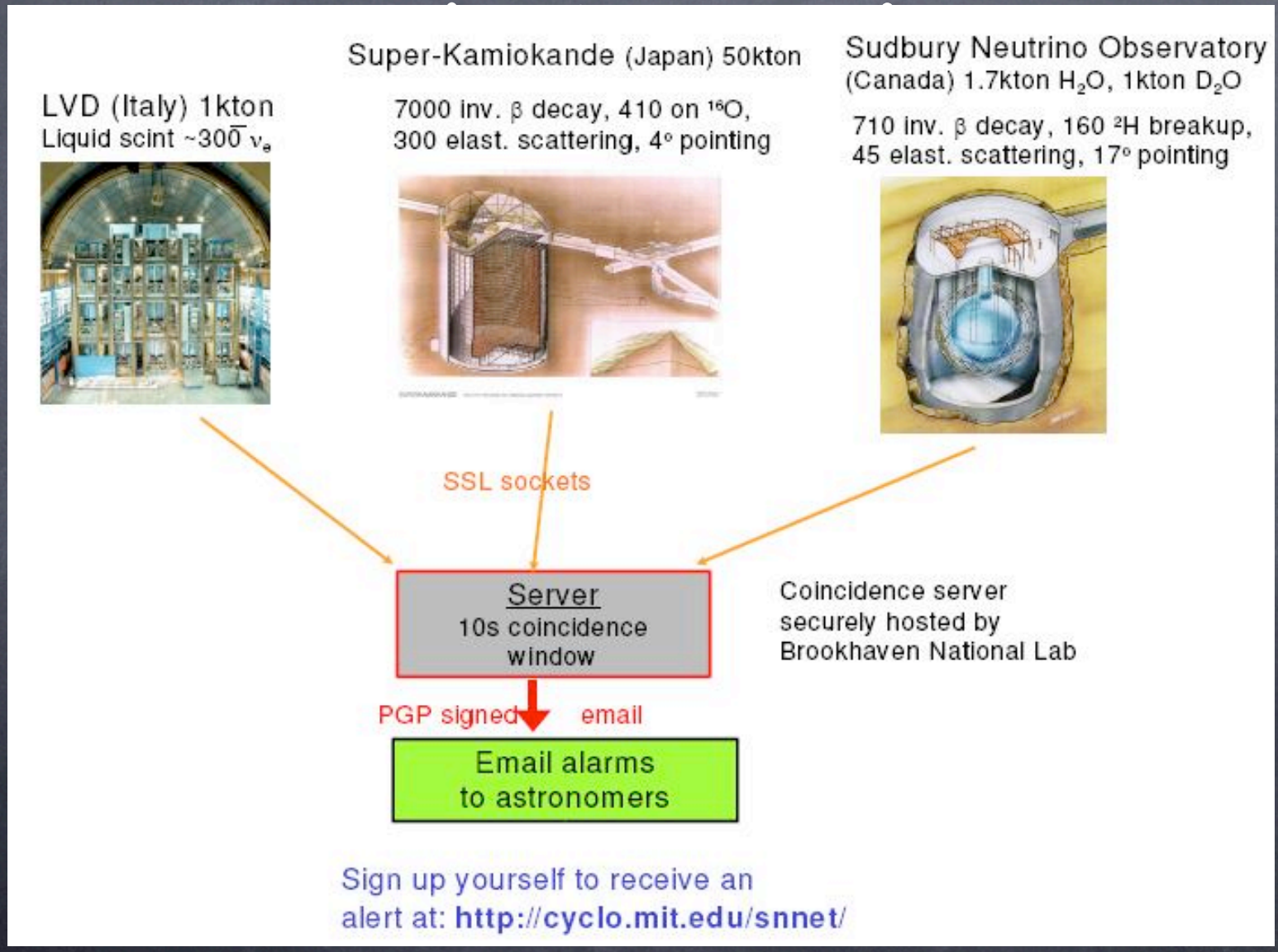
Supernovae Emit Neutrinos

(except Type IA)

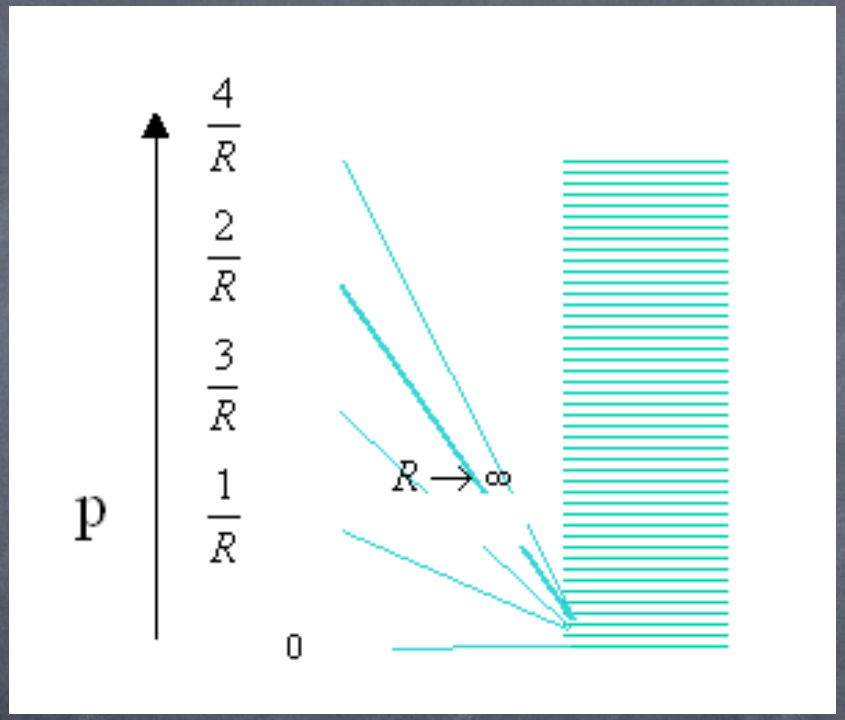
Supernova Neutrinos



Supernova Neutrino

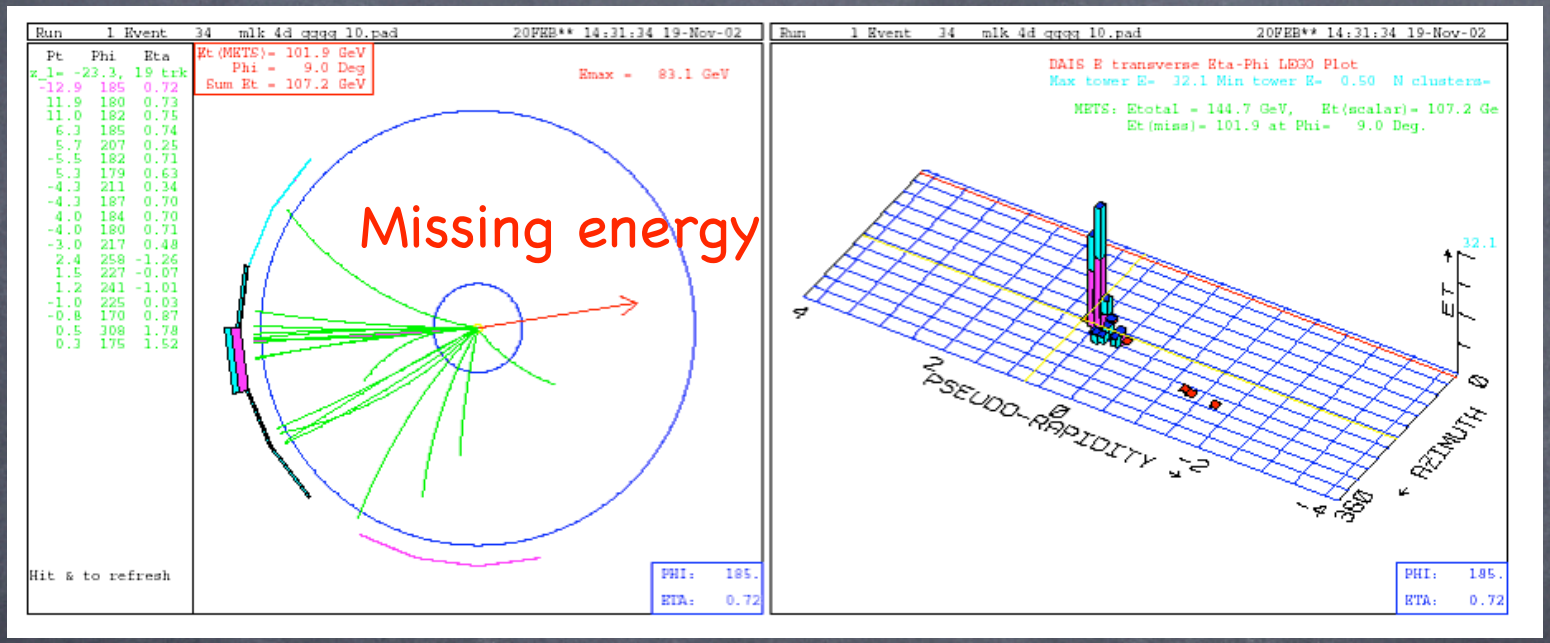


KK Gravitons at LHC



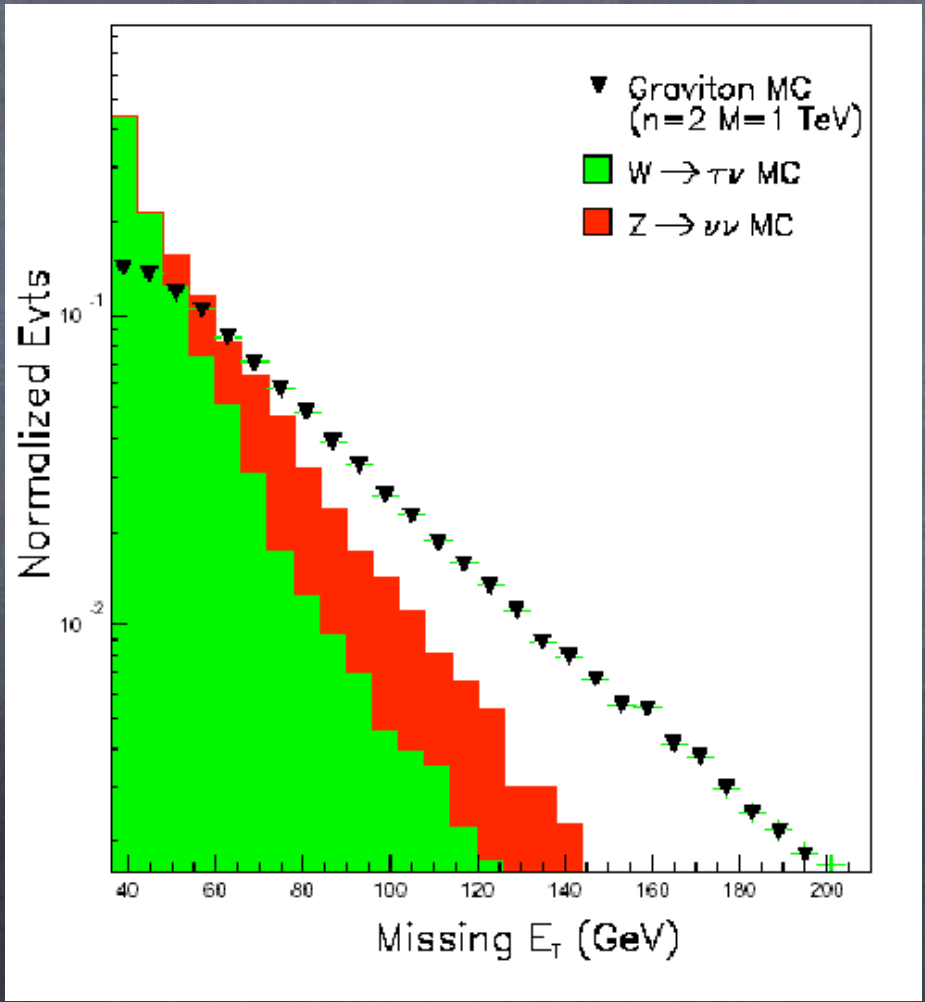
at TeV KK gravitons
add up to strong
extra dimensional gravity

KK Gravitons at LHC

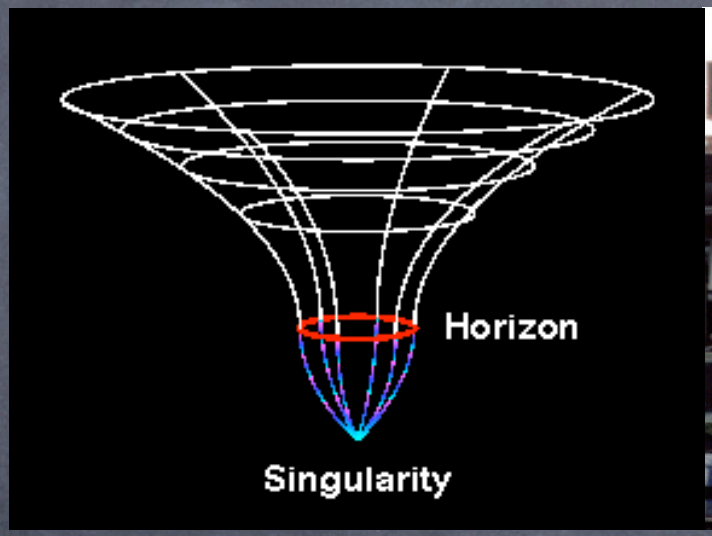


KK gravitons extremely light
lots of them
produced at colliders

KK Gravitons at LHC

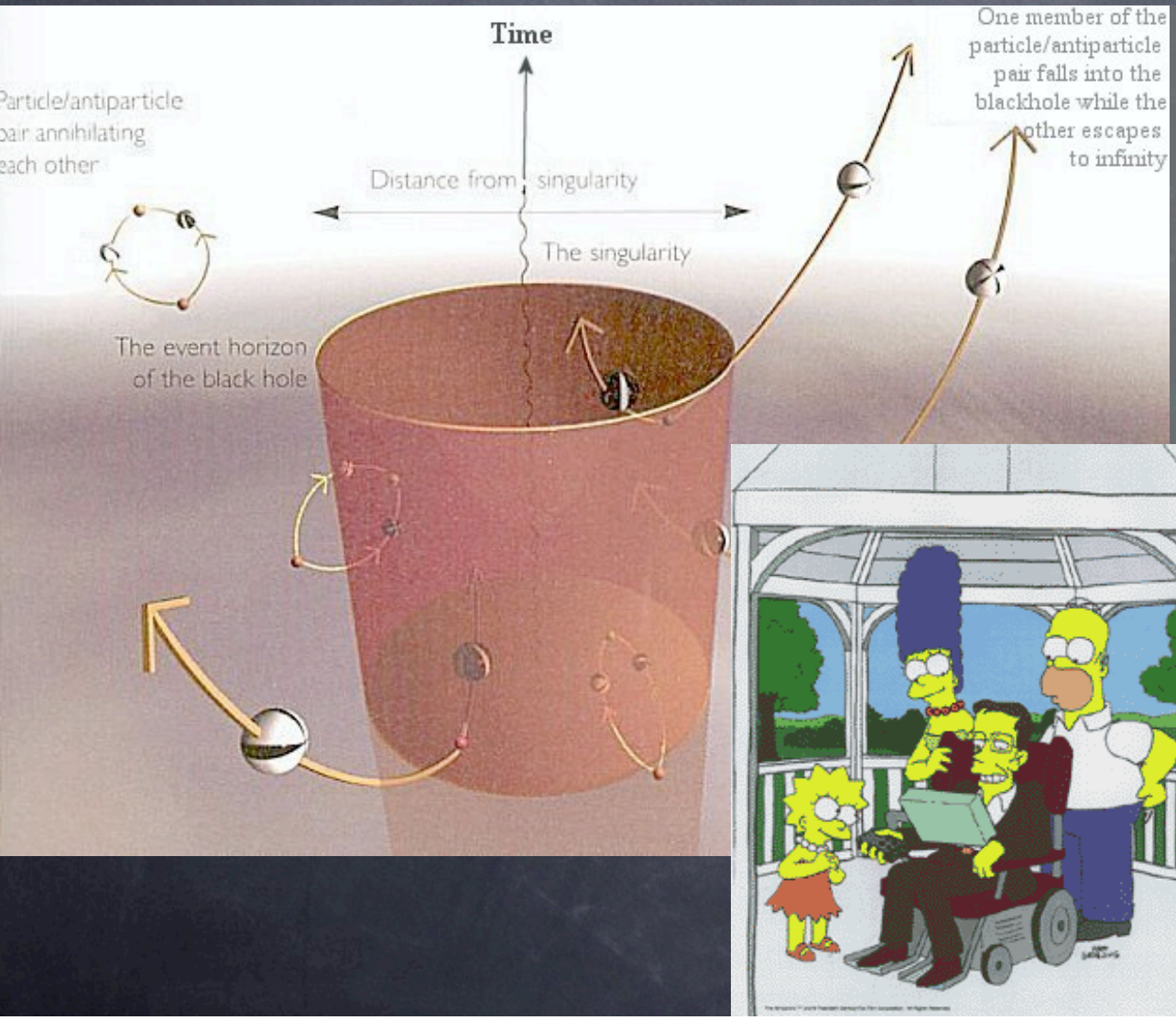


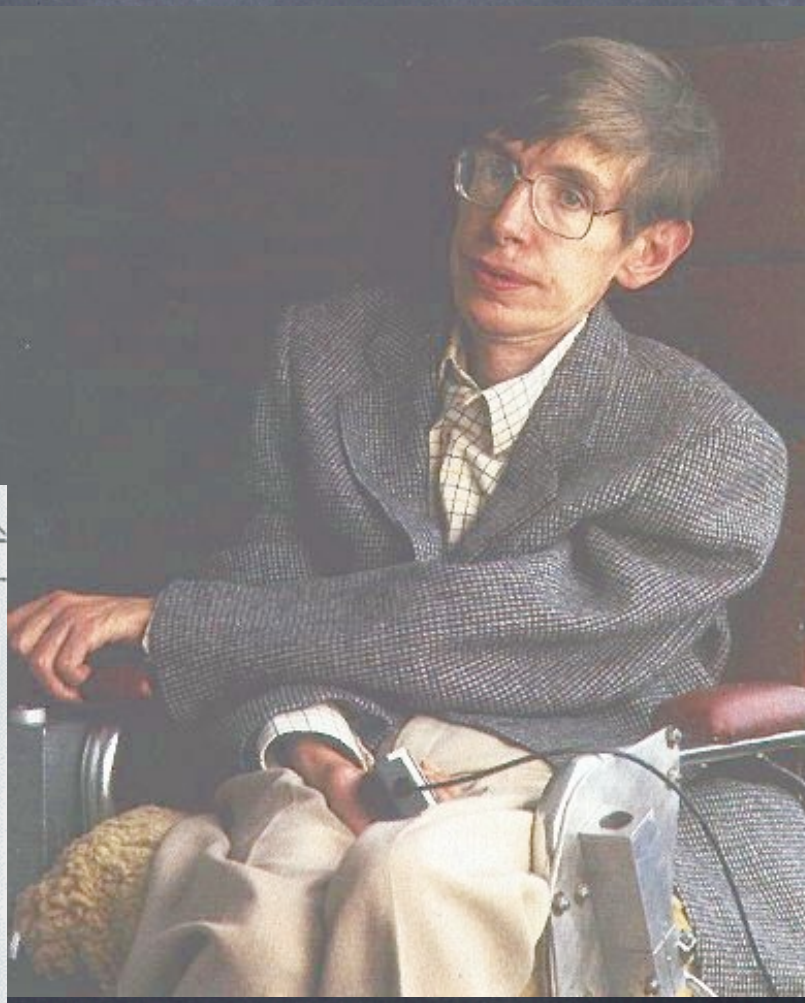
Black Holes at LHC



at TeV KK gravitons
add up to strong
extra dimensional gravity

Hawking Radiation





Black Holes at LHC