

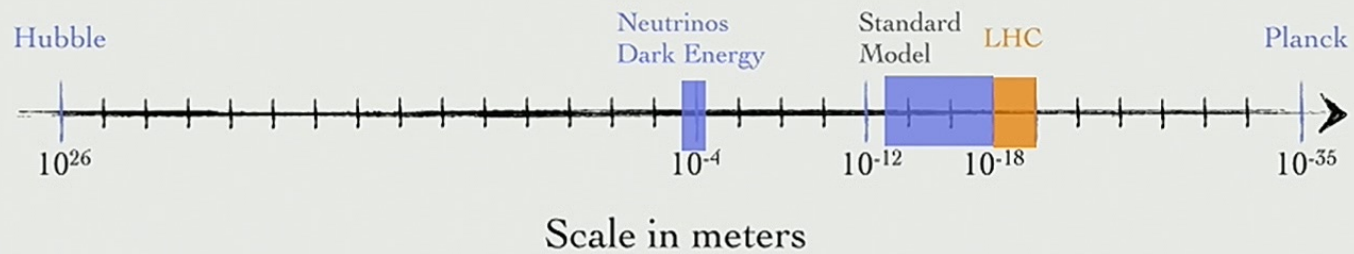
Title: Experiments Big and Small

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URL: <http://pirsa.org/15060038>

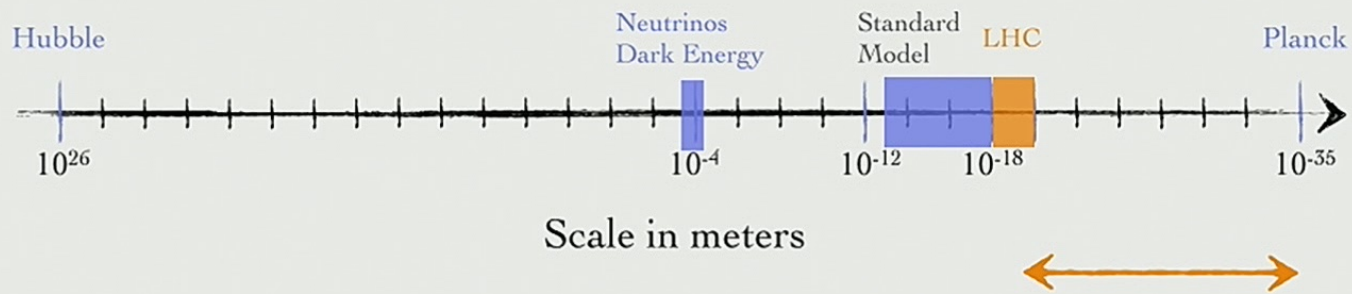
Abstract: I will discuss explorations of fundamental physics via the LHC, as well as smaller experiments which will play a leading role in the future.

# EXPERIMENTS BIG AND SMALL



Savas Dimopoulos  
Stanford University

# The Scales in our Universe

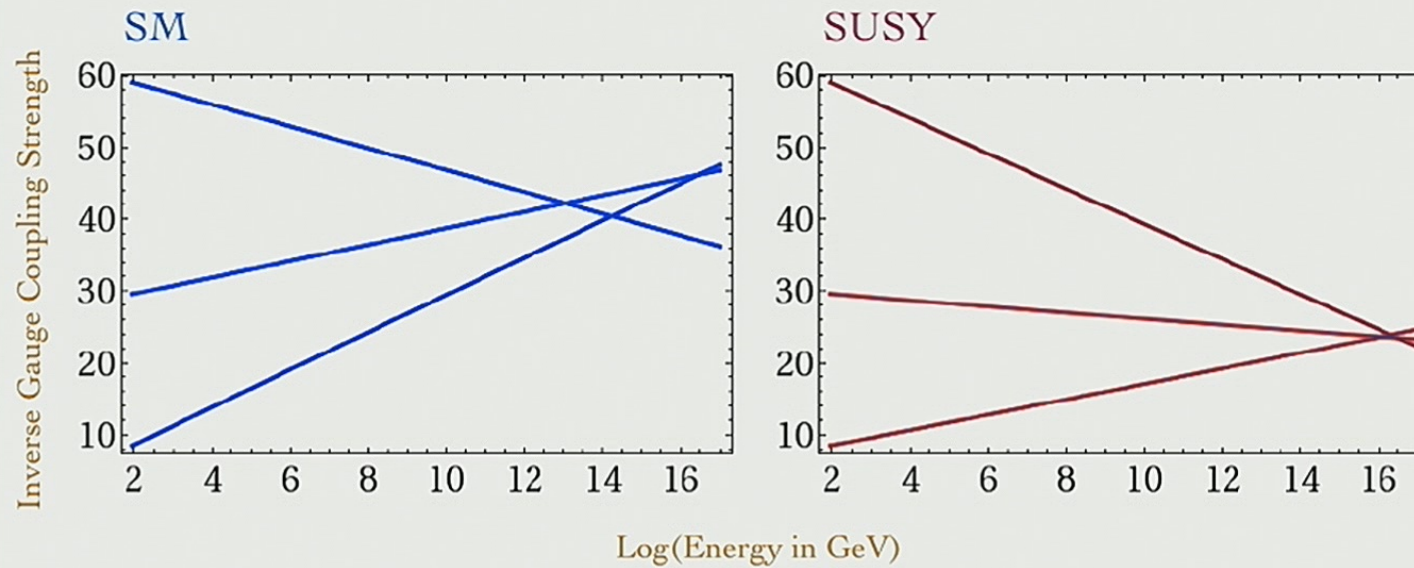


The **Hierarchy Problem**  
Why is Gravity so **weak**?

## Mechanisms to keep scales apart

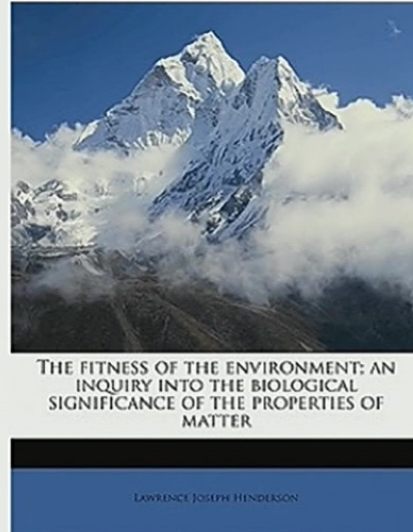
- Fine-Tuning
- Natural
- Environmental
- Historical

# Why Supersymmetry?



Gauge Coupling running at two loops

# The Environmental Approach



*"the whole evolutionary process, both  
cosmic and organic, is one, and ... the  
universe in its very essence is **biocentric**"*

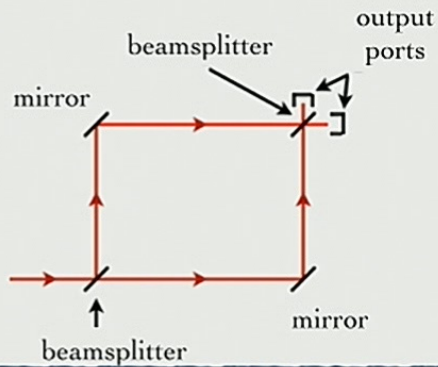
L. J. Henderson

# How Do You Probe The Low Energy Frontier?

- Cantilever experiments
- LIGO/Advanced LIGO
- Electromagnetic Cavities
- Atom Interferometry
- Optomechanical Oscillators
- Precision Magnetometry
- New Forces-New dimensions
- Gravitational Waves
- Axions - Photons
- Gravitational Waves
- New Forces and Gravitational Waves
- Axion(s)

# Light vs Atom Interferometry

## LIGHT



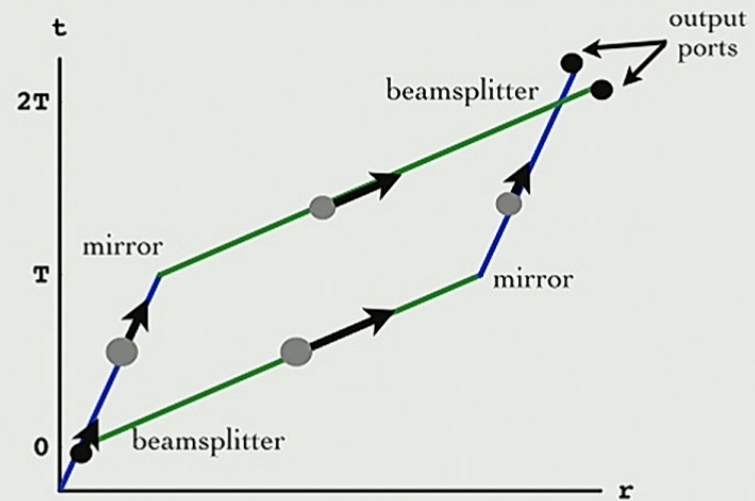
accuracy of measurement

$$\frac{\delta L}{L} \approx \frac{\lambda}{L} \times \text{phase resolution}$$

## ATOMS

For atoms  $T \sim 1$  sec

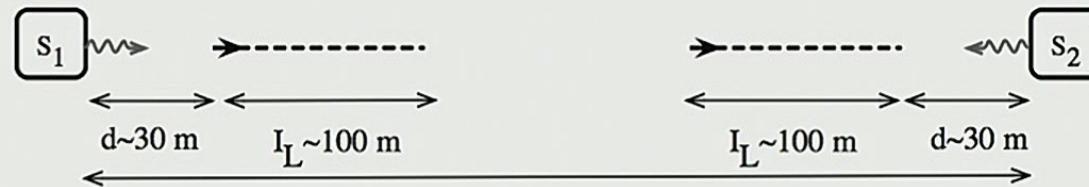
$\Rightarrow L = cT \sim \text{Earth-Moon distance!}$





# Gravitational Wave Detection with Atom Interferometry

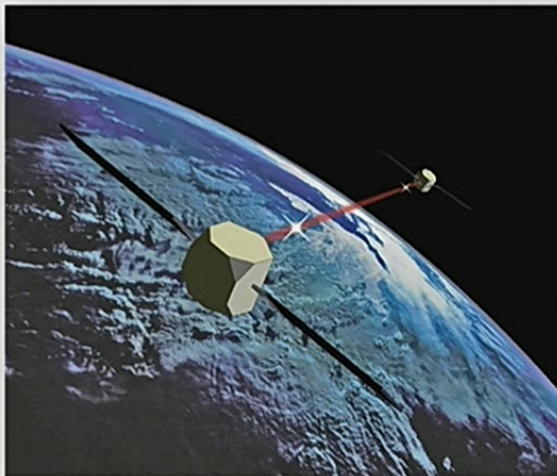
SD, Graham, Hogan, Kasevich, Rajendran  
2008



$L \sim 1000$  km

Physical Distances between atoms oscillate with the GW amplitude:

$$L = L_0(1 + h \cos(\omega t))$$



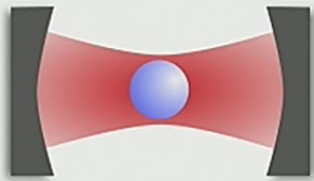
- Currently funded by NASA NIAC grant (NASA Innovative Advanced Concepts)

- MIGA - Philip Bouyer: Ground based GW detector in Bordeaux

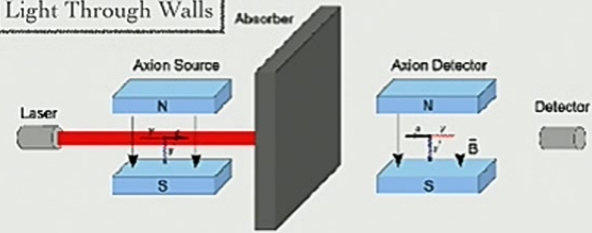


# Scattered Experiments

Optically Levitated Objects



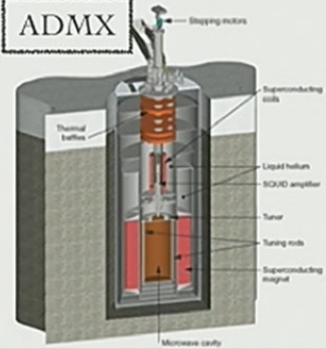
Light Through Walls



Atom Interferometry



ADMX



Cantilever Experiments

