Is String Theory Useful?

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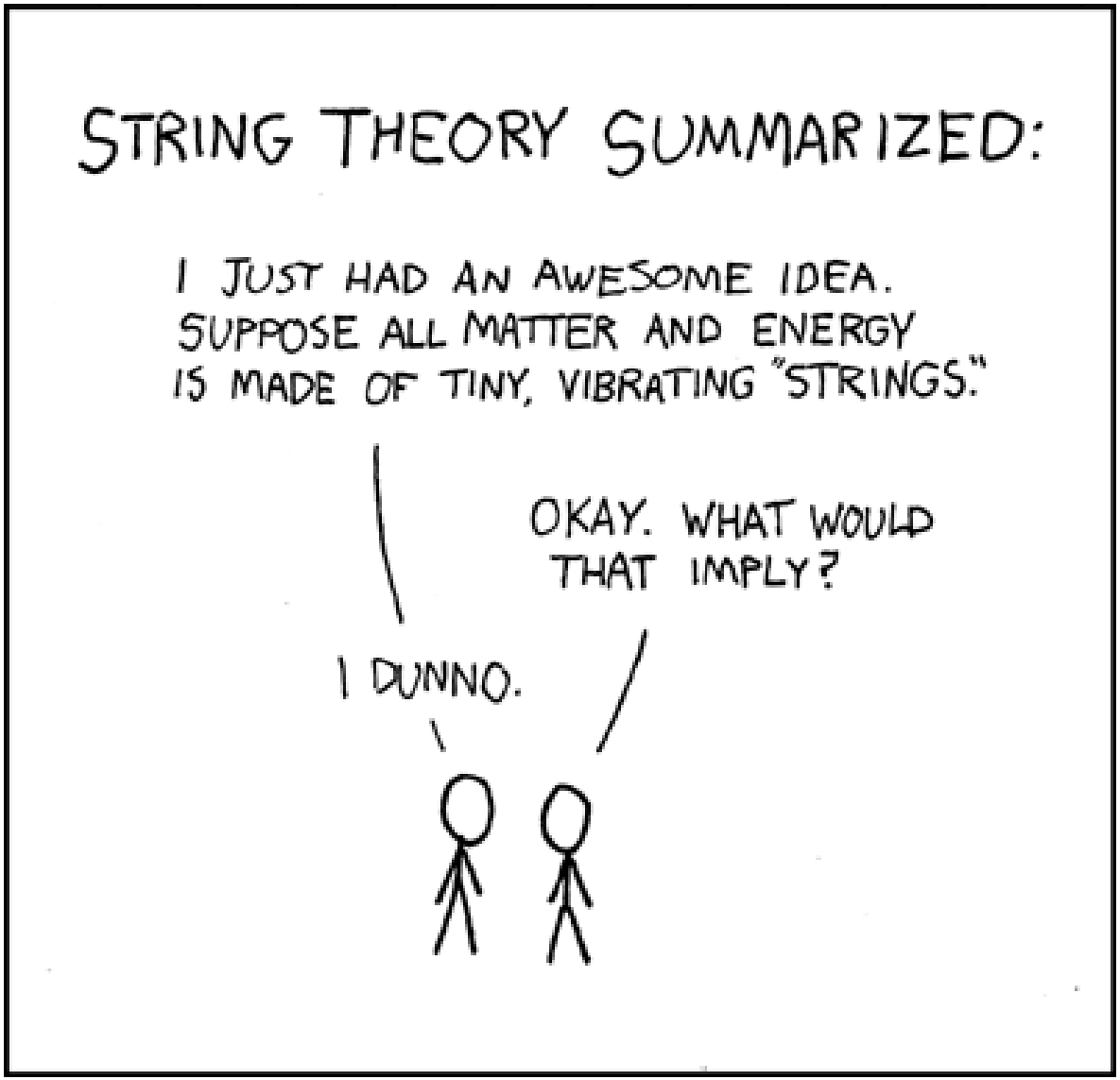
String Theory


STRING THEORY SUMMARIZED:
I JUST HAD AN AWESOME IDEA. SUPPOSE ALL MATTER AND ENERGY IS MADE OF TINY, VIBRATING "STRINGS."
OKAY. WHAT WOULD THAT IMPLY?
I DUNNO.

xkcd.com

Some Hard Problems in Physics

What Physicists Understand

Particles that don’t interact

(or interact only very weakly)

What Physicists Understand

"Physics is that subset of human experience which can be reduced to coupled harmonic oscillators"

Michael Peskin

What Physicists don't Understand

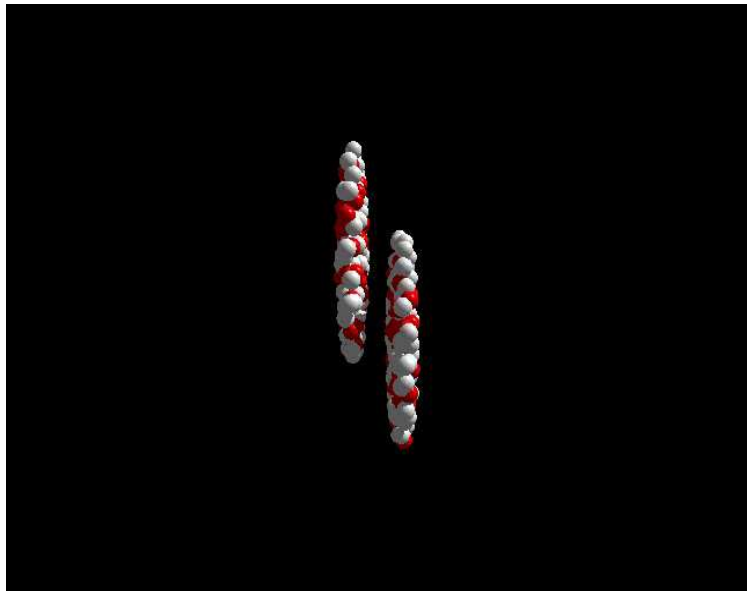
Pretty Much Everything Else

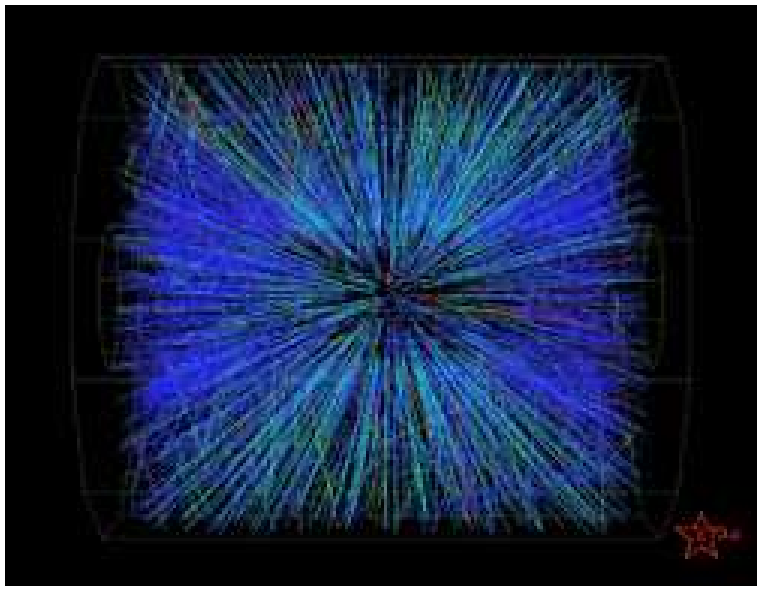
(Particles whose interactions are not small)

How to Proceed…

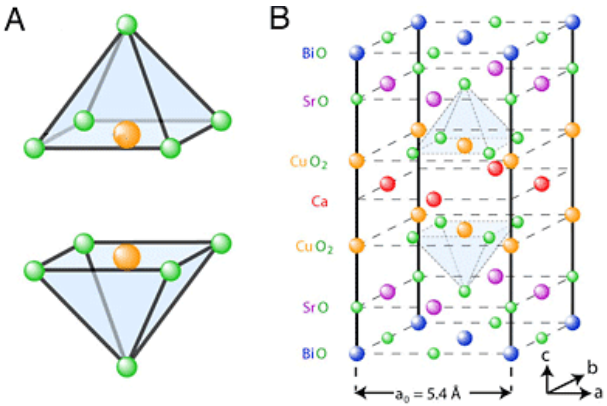
But sometimes this isn't possible…

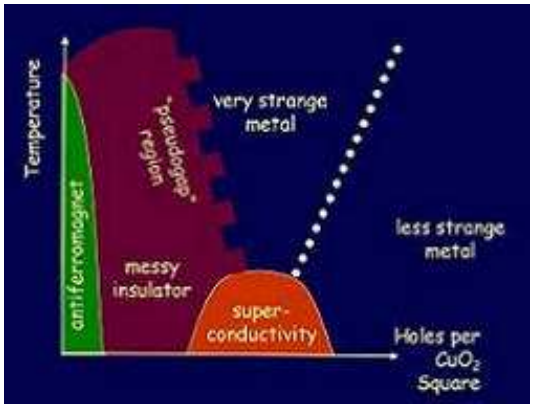
The Quark-Gluon Plasma

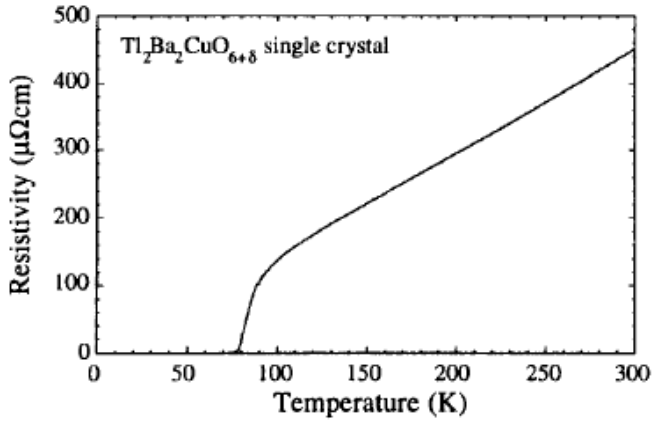




High Temperature Superconductors

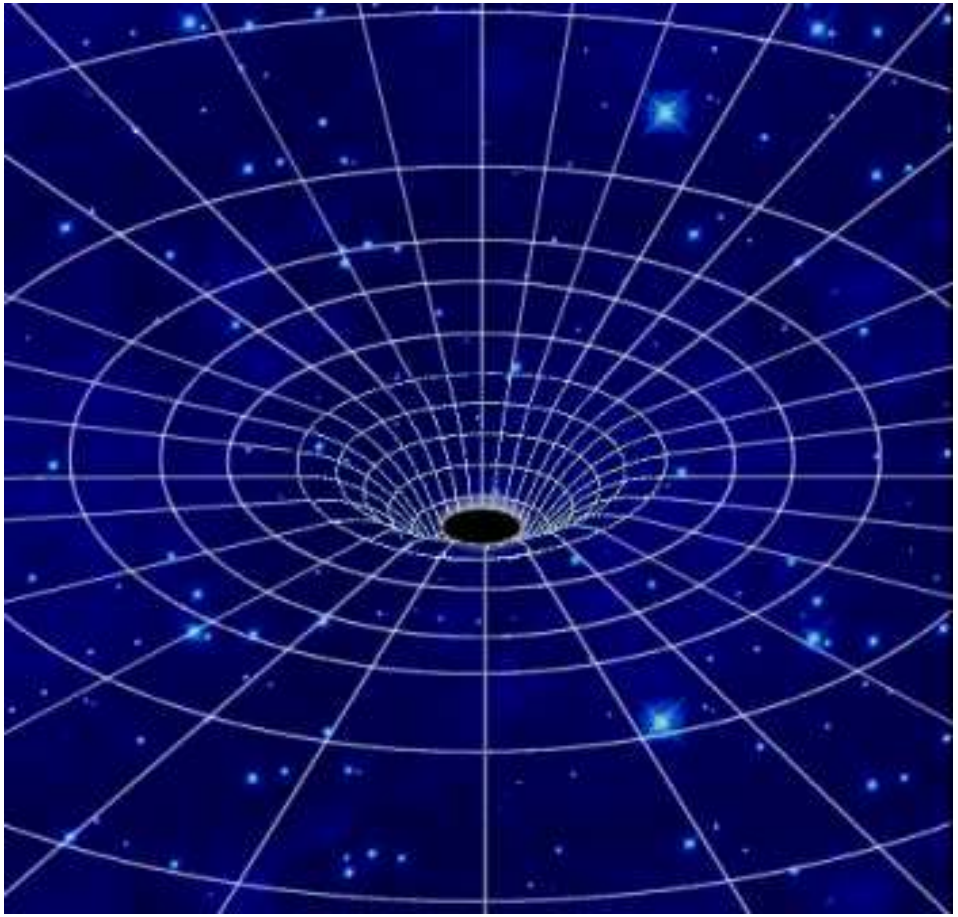






A New Tool

Help from a Surprising Place



Black Hole Entropy

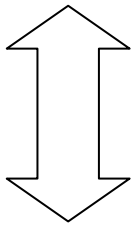
$$S_{BH} = \frac{A}{4}$$

Implication

We are all two dimensional holograms

Putting this to work

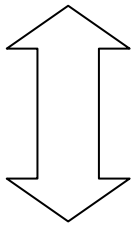
Gravity in d dimensions



Strongly interacting matter
in (d-1) dimensions

Putting this to work

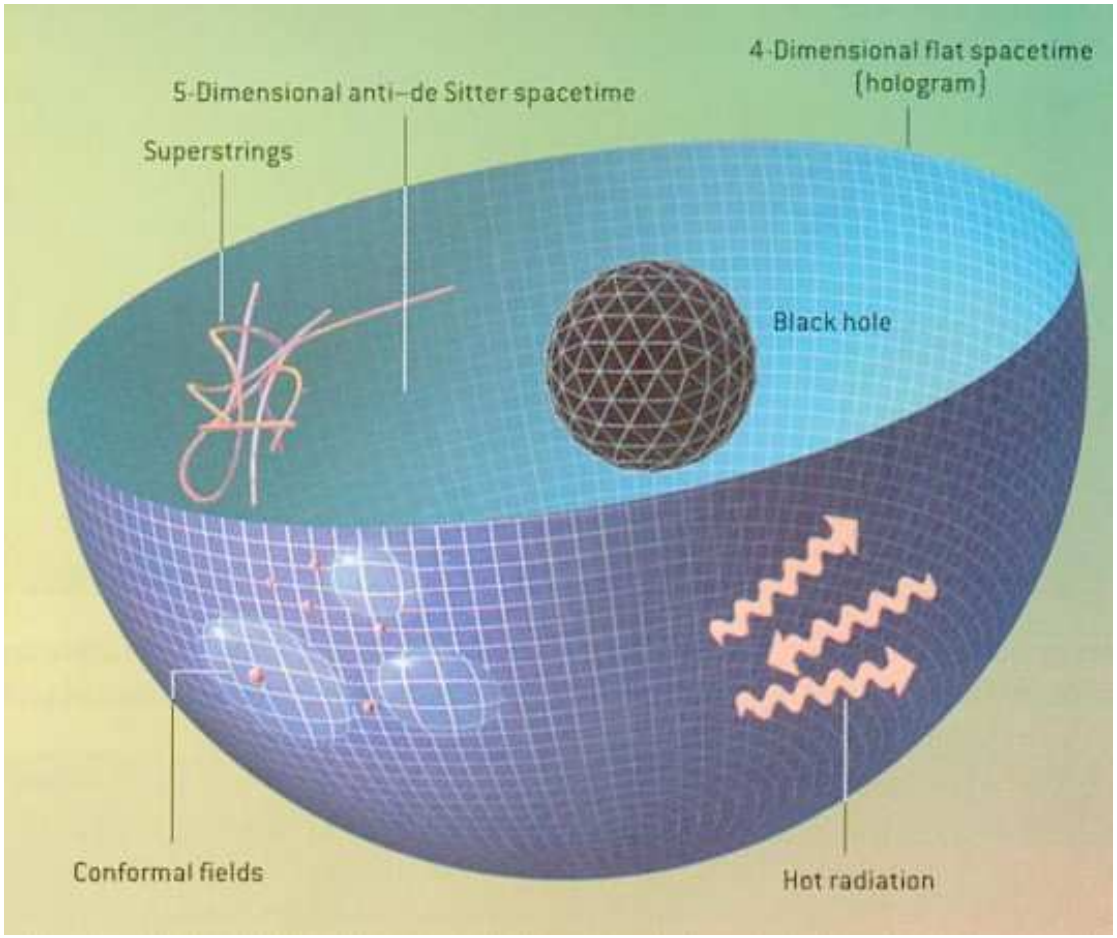
Strongly interacting matter
in (d-1) dimensions



Gravity in d dimensions

The AdS/CFT Correspondence

(a.k.a gauge/gravity duality)

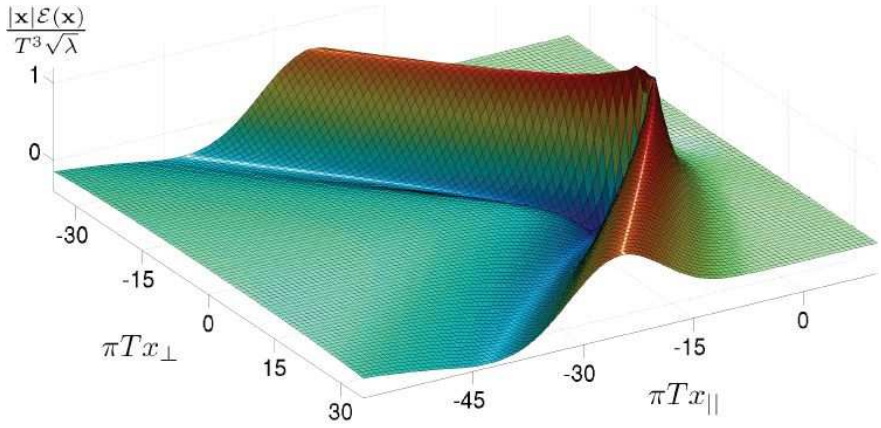


So is string theory useful?

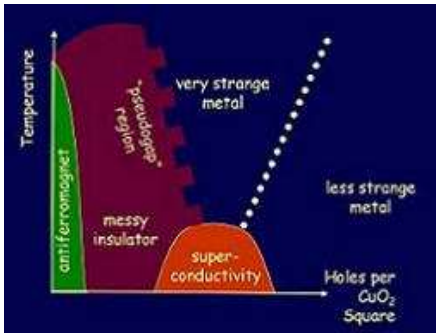
Prelimary Success: Quark-Gluon Plasma

- Viscosity: $\frac{\eta}{s} = \frac{1}{4\pi}$

- Jet Quenching:



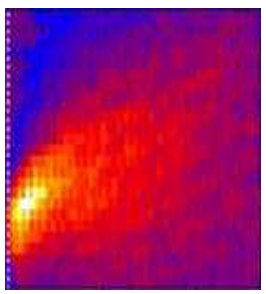
Pre-Prelimary Success: Non-Fermi Liquids

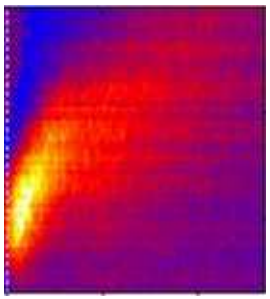


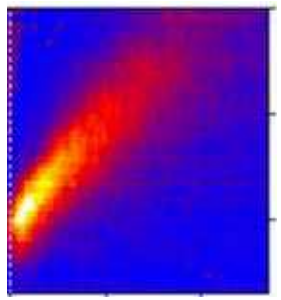
under doped

optimally doped

over doped

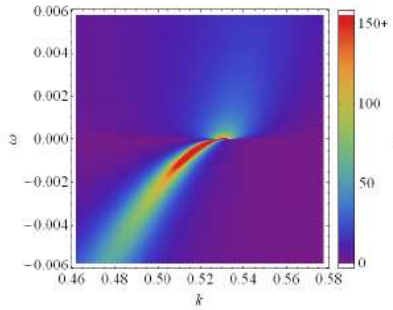


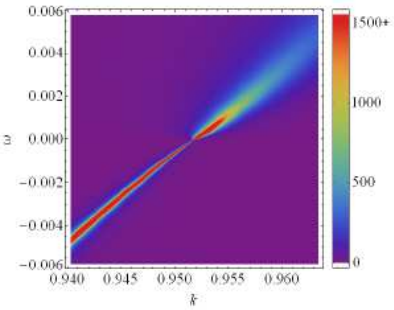


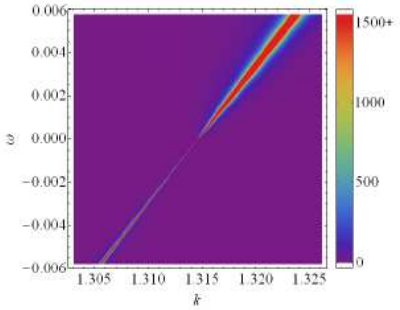


energy

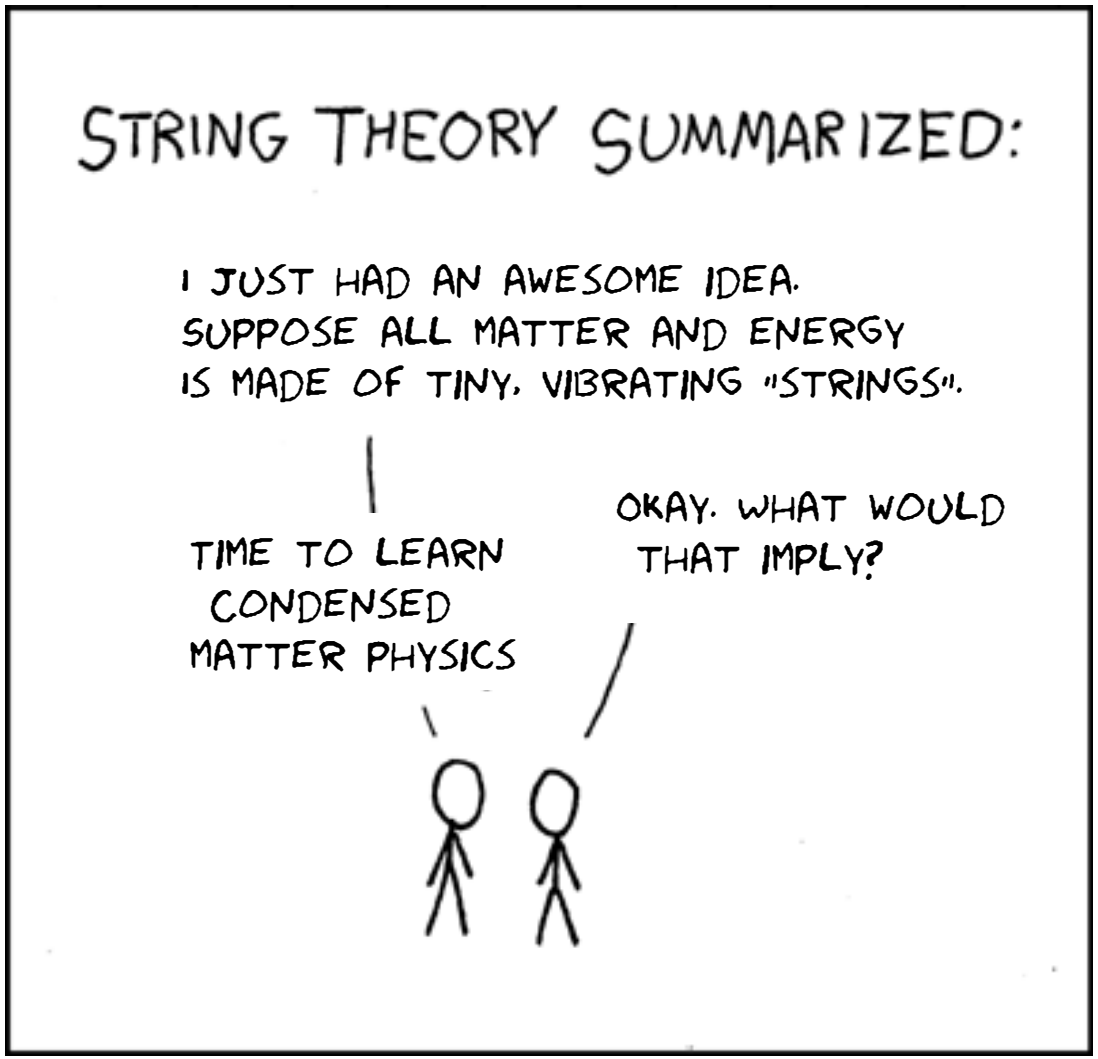
momentum







The Future


STRING THEORY SUMMARIZED:
I JUST HAD AN AWESOME IDEA. SUPPOSE ALL MATTER AND ENERGY IS MADE OF TINY, VIBRATING "STRINGS".
TIME TO LEARN CONDENSED MATTER PHYSICS
OKAY. WHAT WOULD THAT IMPLY?