

Dark Sectors of the Universe

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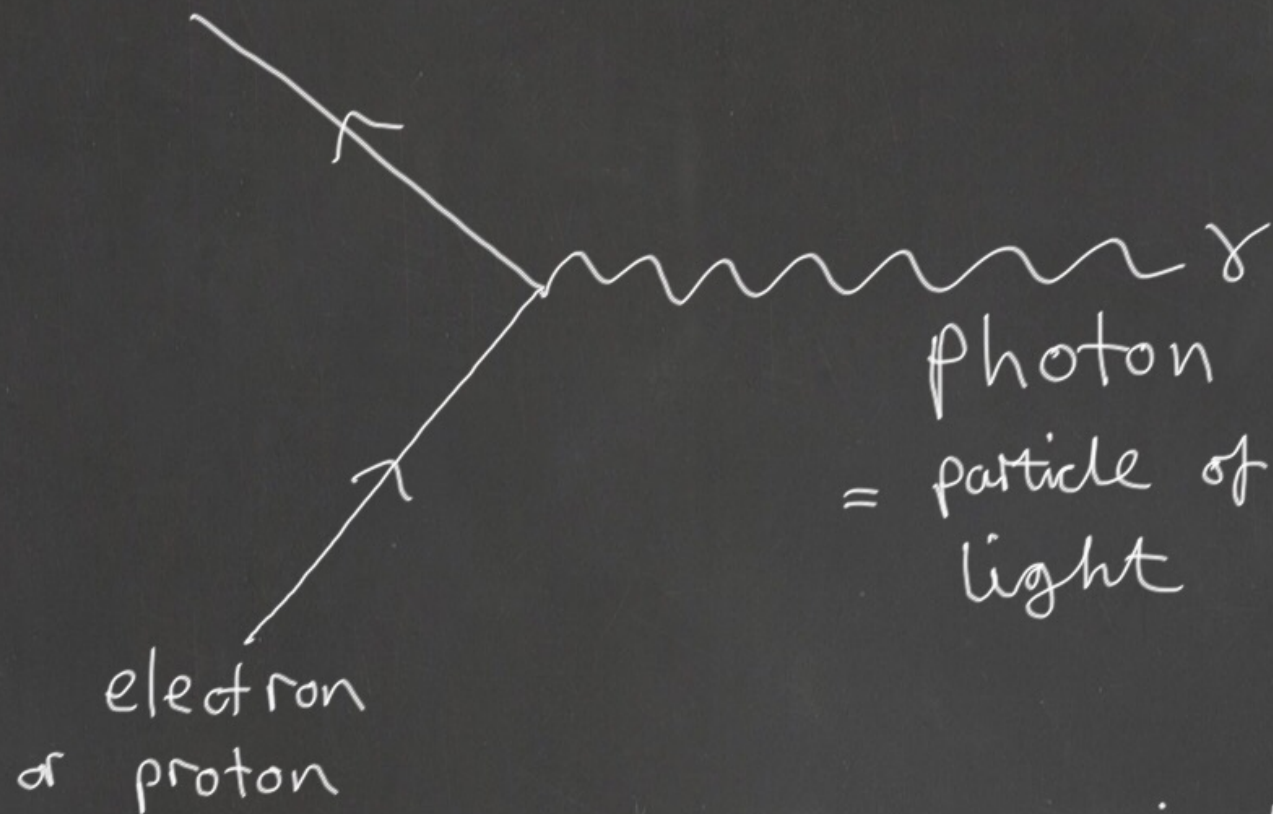
• What is "Dark"?

• What does fundamental theory (e.g. superstring theory) say about dark sectors?

• Do dark sectors exist in our Universe?

"Dark" objects are almost
literally objects which we can't
see.

How do we see.....

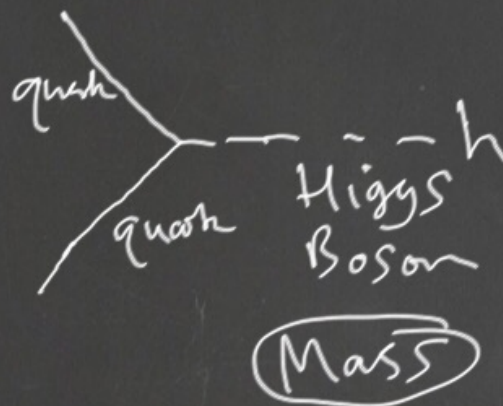
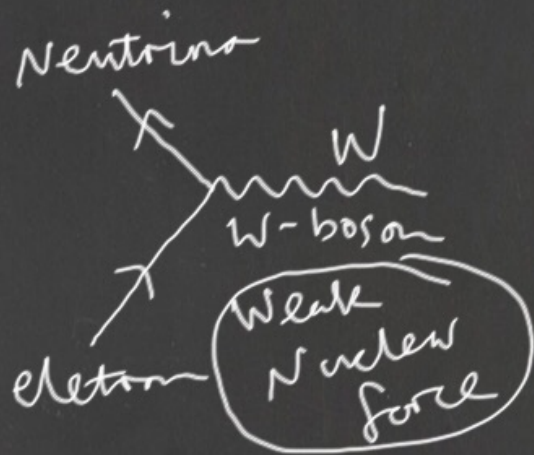
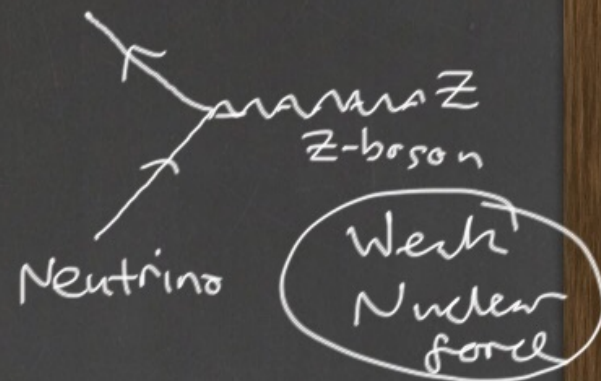
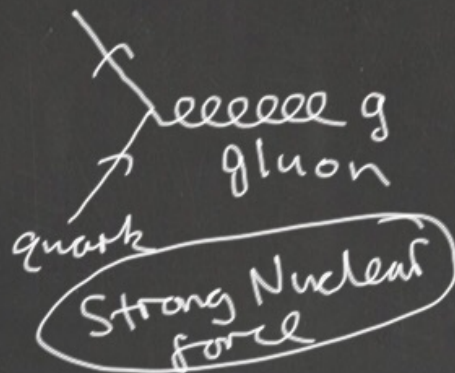
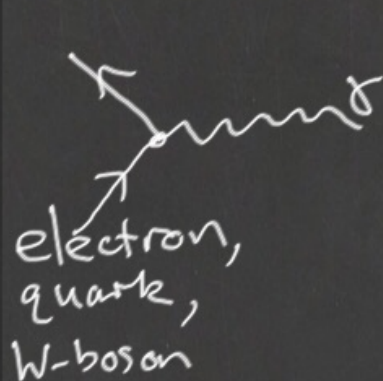


EVERYTHING you've ever seen is based
on this basic image (= "Feynman vertex")

All observed optical, electrical,
electromagnetic phenomena
are based on that
Feynman vertex.

Beyond Electromagnetism there
are other forces and
particles.....

STANDARD MODEL OF PARTICLES

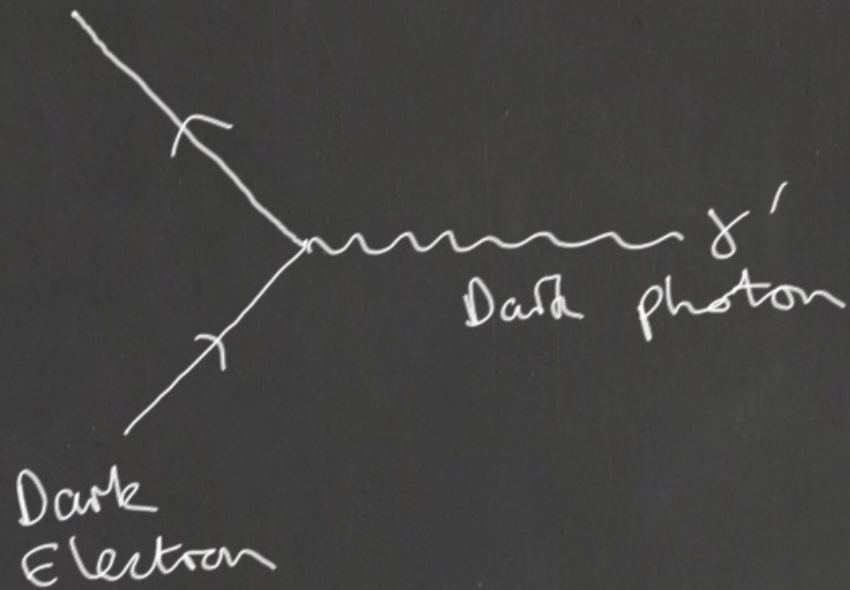


Different forces are associated
with different types of
"photons":

Electromagnetism	$\longleftrightarrow$	Photon
Strong Nuclear force	$\longleftrightarrow$	gluon
Weak " "	$\longleftrightarrow$	$W^\pm, Z$ boson

We know these particles exist
because we have produced them
and interacted with them eg
at CERN.

But what if there are
"photons" and matter particles
which interact ONLY amongst
THEMSELVES and NOT electrons, quarks
etc ???



Mathematically, there is
no reason why not.
Also philosophically.

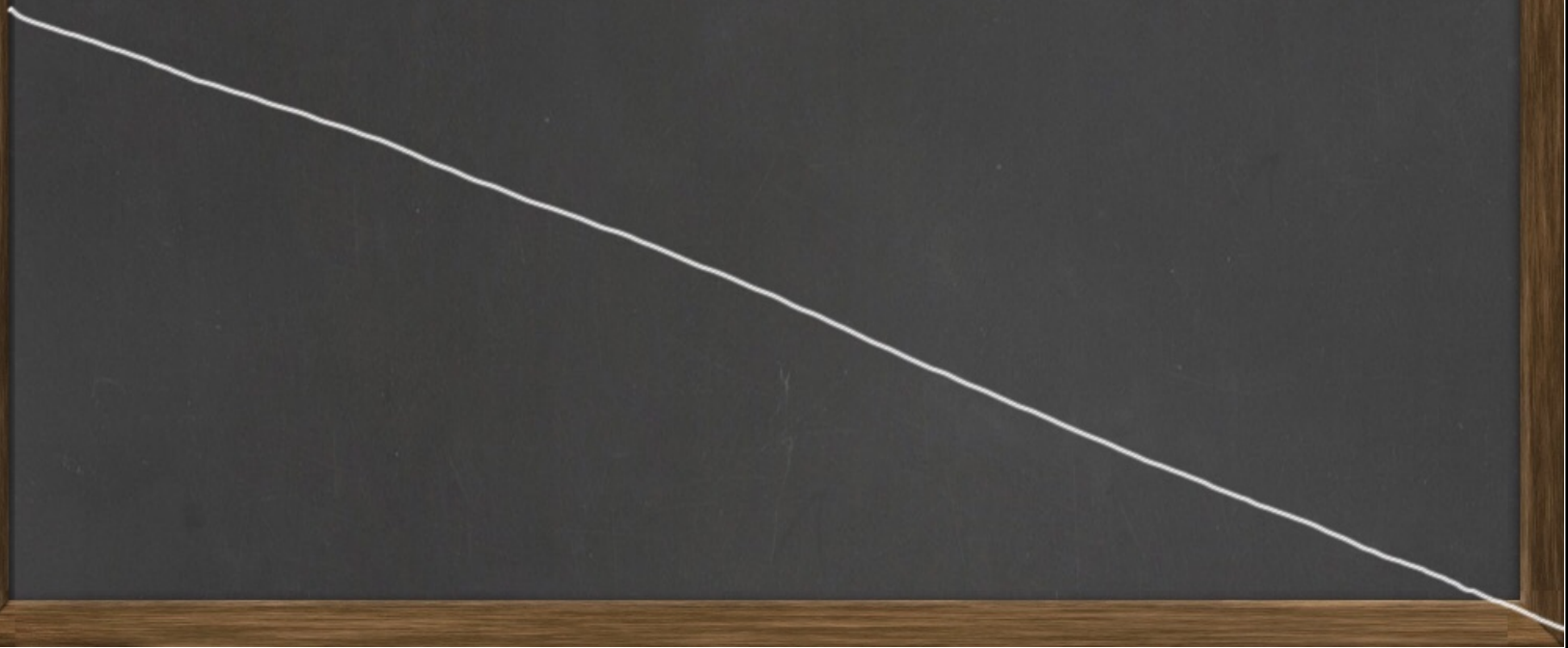
How many dimensions of space
are there?

We are sure the answer is
at least three:



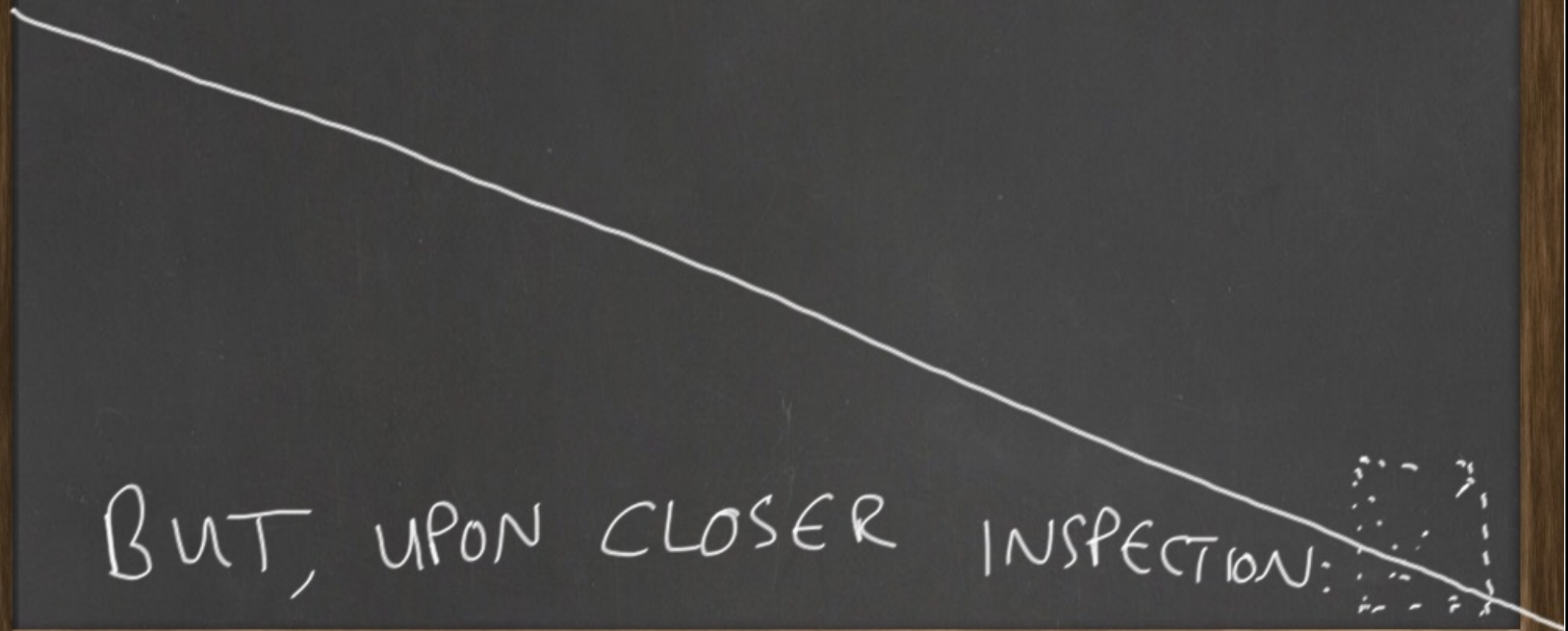
How do we know?

This line looks
ONE-DIMENSIONAL:

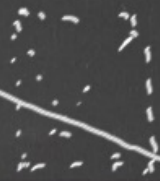


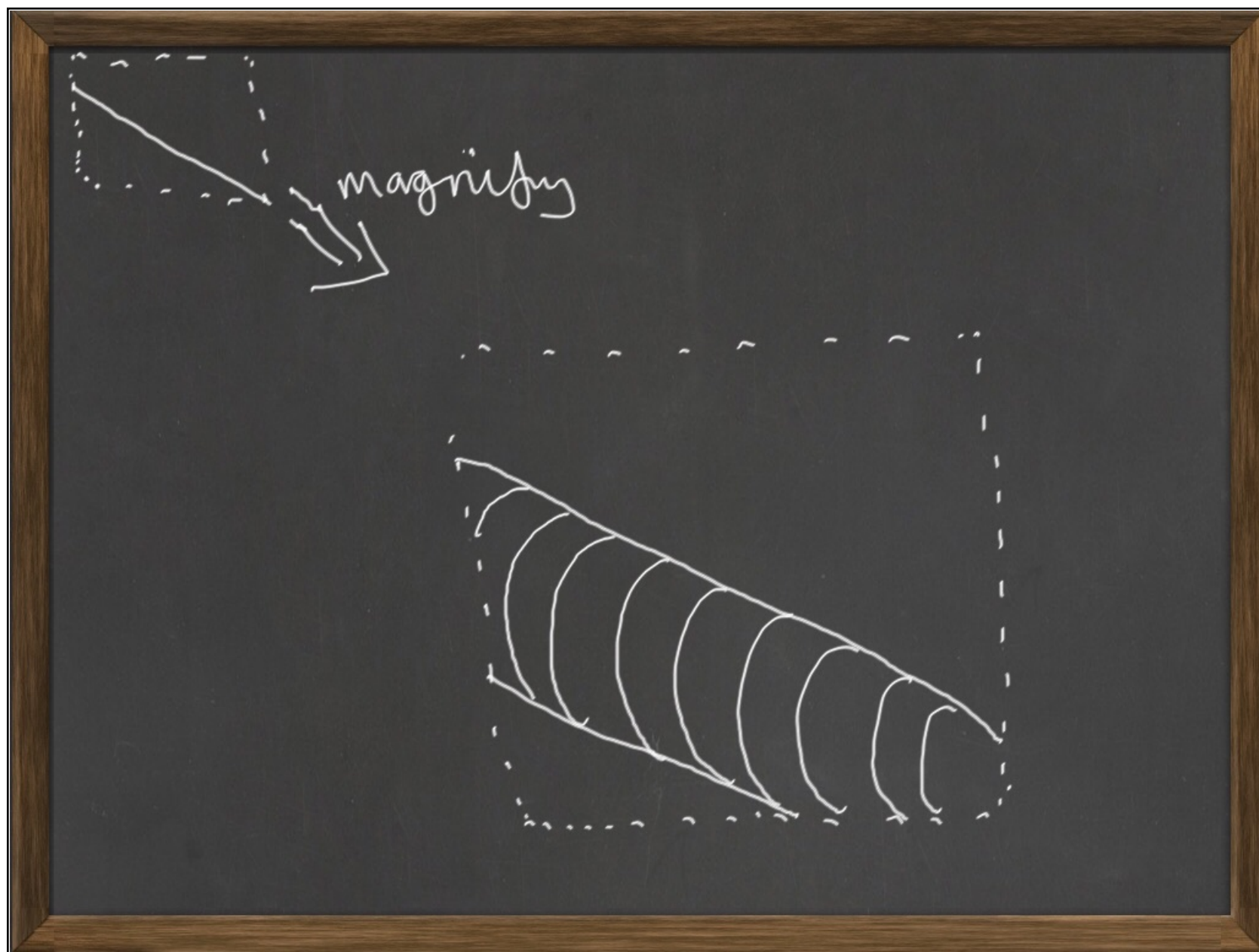
How do we know?

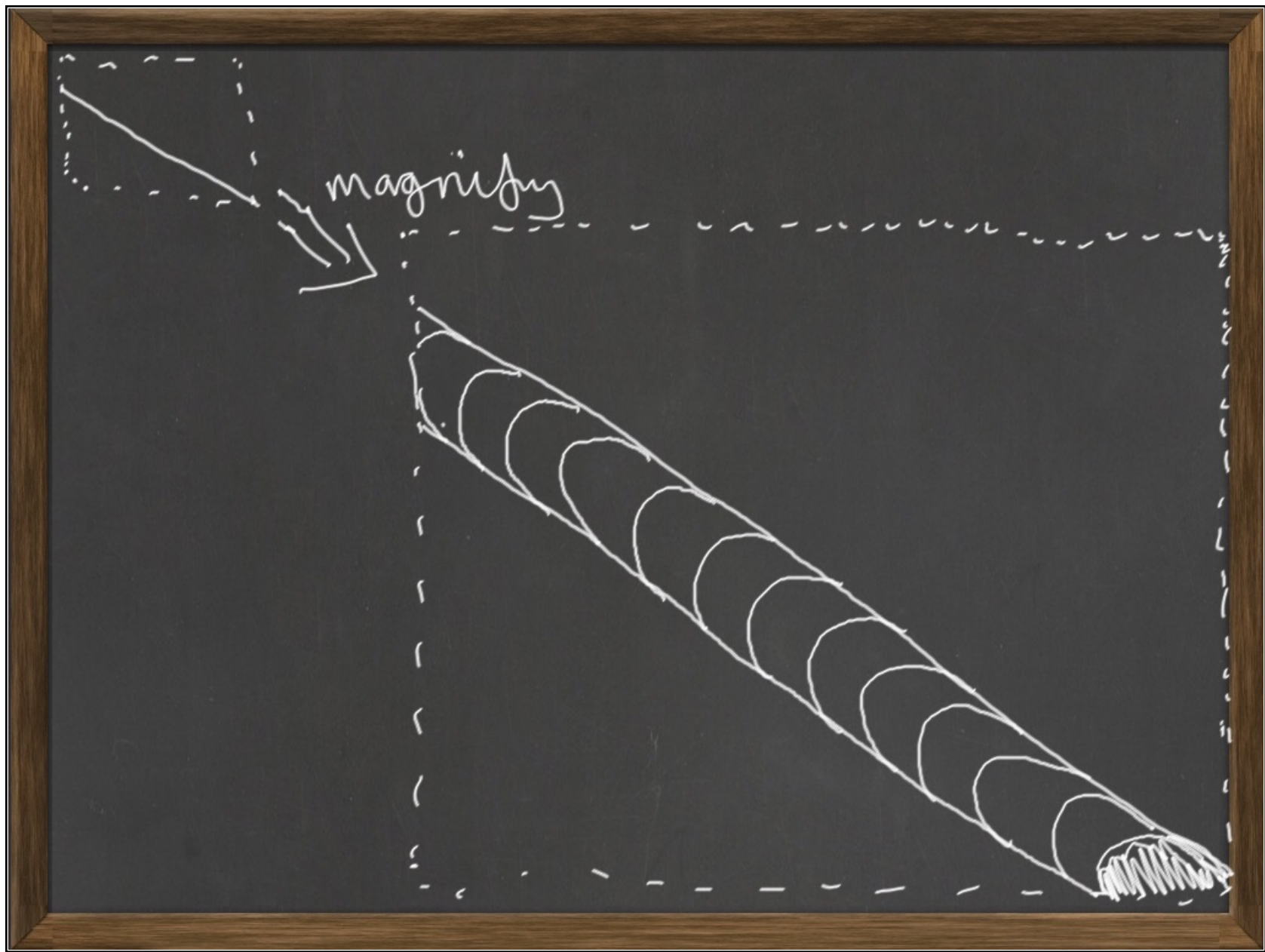
This line looks
ONE-DIMENSIONAL:



BUT, UPON CLOSER INSPECTION:







So there could be many
"EXTRA" DIMENSIONS all
around us, but they are
so relatively tiny that
we haven't seen them
yet.

Superstring / M theory
predicts both :
Dark sectors of particles
and
Extra Dimensions

Remarkably, many different observations and measurements demonstrate that the Universe is "dominated" by Dark matter and Energy.

Discovering its detailed properties will be a tremendous leap in knowledge and open doors to the Dark Sectors.