What the f*ck did Tom spend six and a half years of his life studying?

Tom

A nicely typeset and extremely sarcastic zine attempting to explain what the f*ck is going on.

Vocabulary

We make up a lot of fancy words to mean a lot of things.

matter the junk that makes stuff up

dark cannot be seen with our telescopes

law an idea that is right in like... most of our experiments

model a collection of laws and their mathematical formulae

particle a little piece of junk

QFT a neat bit a "math" where we pretend that infinite-dimensional integration makes any kind of sense and which models our data extremely well (what the f*ck)

All the junk we see is made up of elementary particles that interact with each other by exchanging other particles. It's complicated and we don't know why it's like this! 😬

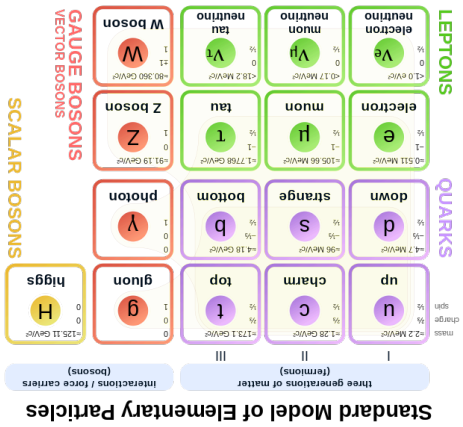

Figure 4: All the junk we know about with their fancy names.

Dark Matter

There's a bunch of junk (matter) we can't see with our telescopes (dark).

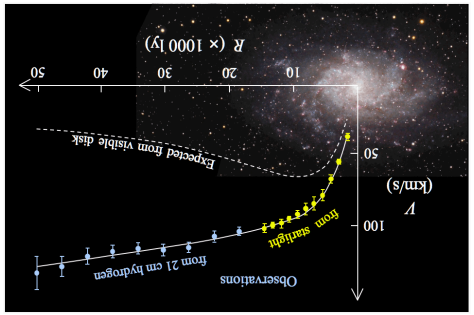

Figure 3: Shout out to ya girl Vera Rubin for making the first (replicable) observation of these galactic rotation curves!

We know its there because the junk we can see moves faster than it would without extra gravity (from extra junk).

There are also a bunch of other reasons, galactic rotation curves were just the first evidence. There's also the bullet cluster data, gravitational lensing, baryonic acoustic oscillation measurements of the cosmic microwave background, and others with even more wacky and fun made up names!

Experiments

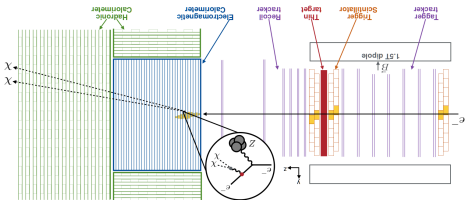

Figure 1: Electron loses energy to nothing we can see? That's Dark Matter.

Everyone knows that X is a cooler letter than E, so we decided to have X be the letter in the acronym representing the word experiment.

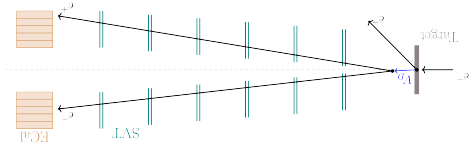

Figure 2: Electron and Positron appear out of nowhere? Dark Matter you silly goose.

So... How'd it go?

1. I learned a lot.
2. I made a lot of friends.
3. I've had a lot of fun

(We did not find Dark Matter.)

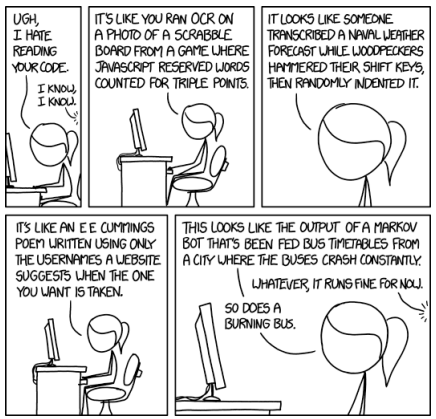

Figure 5: XKCD #1695: I've also learned I am very passionate about code quality although I try to be kinder than the reviewer here.

Software

Math is hard.

(And quantum shit is inherently random.)

So we, as a field, write code to do all of the hard calculations and sample from these underlying physical distributions (simulate), mimic our physical detectors (emulate), and interpret these measurements in more understandable ways (reconstruct).

I've spent my PhD career mostly focused on writing, testing, and improving these software packages.

Follow me on GitHub 😜 tomeichlersmith

Learn More

Wikipedia: Dark Matter

Quanta: Dogged Dark Matter Hunters

Online High-Res Copy: z.umn.edu/tom-phd-zine

Full Thesis: z.umn.edu/tom-phd-thesis

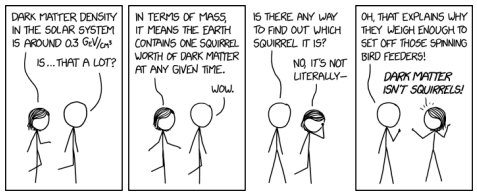

Figure 6: XKCD #2186: Sometimes our analogies get out of hand.

With Sincerity...

I've genuinely learned a lot and would enjoy lecturing on this topic with anyone interested in learning more.

Follow up questions are welcome!