

When I first started preparing for this talk, I ^{4/5} was prepared to make a long list of historical feuds that had occurred between physicists and the church. For some reason I had the idea stuck in my head that Galileo was sentenced to death ~~for promoting that the~~ by the church for promoting the idea that the Earth wasn't at the center of the universe. A quick google informed me that there was ~~a certainly~~ persecution from the church, ~~but this~~ and it did take them ~~some~~ several hundred years to apologize for it, but ~~this type of~~ ^{historically,} persecution ~~was~~ ^{Galileo's} was the exception, rather than the rule.

~~I~~ I'm thankful that this has been my experience while studying physics as well. ~~I~~ I've never been attacked for being a bad scientist because of my beliefs, and I think the only time people have commented on the intersection of science and faith have been from my ~~data~~ days of having an online ~~at~~ dating profile when it was more than once noted as a positive attribute.

For myself, I feel ~~as though~~ that science and faith, are tools for ~~answering~~ ^{two} exploring two very different sorts of questions. If you want to know what the width of an atom is, you reach for a textbook, while if you want to know how you should live your life and treat others, reach for the bible. While this is generally my perspective, I can't help but think of studying physics as

~~Uncertainty~~ studying God's creation, so if you'll let ^{me}, I'll treat this as a sort of mini physics ^{2/5} lesson.

Our text for this Sunday

I chose our text for this Sunday because I wanted to draw a connection between quantum physics and the bible, which might seem like a bit of a stretch. You might be uncertain how I could make that kind of connection, but if you are thinking that you're already on the right track because uncertainty is the connecting idea. ~~We're going to~~ The path to get there is going to dwell in ~~this~~ ~~are~~ the ~~quantum~~ quantum physics side for a lot longer than it does on the bible side, but I hope you'll forgive me, as I'm more familiar with the works of God than the word of God.

~~So~~ let's start with Physics. What is physics? It's the study of how the world works. ~~If~~ ~~if~~ you've ever had a question of how something works. ~~It's~~ a discipline that's best suited for people who can't stop asking "why." Even if you for "squishy" science dealing with living things, think the answer to your question lies in biology or chemistry, the truth is you've just stopped asking questions too early. If you keep going, you'll hit physics. Now I'm hearing some ~~rumblings~~ from the back, from people "in the know" who are saying, "What about math?" Isn't math the ^{purest} of the ^{most} rigorous ^{to} the bedrock scientific disciplines? It is true that math is more rigorous, but math is the study

The subfield of physics that I study is called atomic physics, where we investigate the properties and behaviors of the smallest building block of matter, atoms, and the parts that atoms are ~~but~~ made of.

If we go back to the 1900s, and listen to some of the discussions about physics we would have heard things like, "Well, looks like we're done here." "Everything seems to be figured out." "Want to ~~decrease~~ ^{reduce} the uncertainty by another factor of 10?" People thought that physics would just be a game of measuring values to higher and higher precision.

Then came quantum mechanics. We found out that ~~matter~~ the smallest particle wasn't an atom, and there were subatomic particles. And as we studied these particles, we found they behaved strangely, that is different than our ~~normal~~ ^{everyday} experiences. There are a number of fun subjects to talk about ~~in physics~~ ^{in how things are different} but to keep ~~this~~ my time under 20 minutes, we're going to just talk about the uncertainty principle.

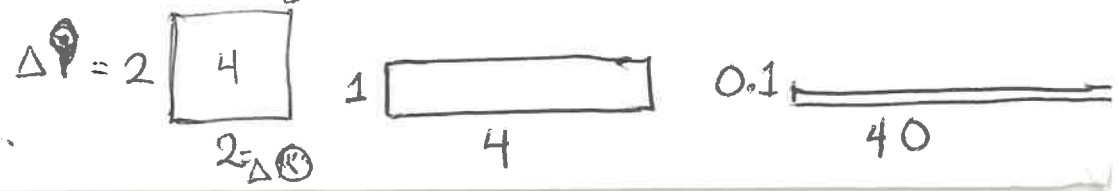
$$(\Delta x)(\Delta p) \geq \frac{\hbar}{2}$$

This is an axiom of quantum mechanics. It says that ~~for~~ certain things that we want to measure are incompatible with one another, and we can't measure both to an arbitrarily high precision. ~~The~~ ^{most} ~~common~~ ^{values} example is ~~position~~ ^{location (x)} and momentum (p).

If we multiply those two uncertainties together ~~the~~ the number, which could represent our overall uncertainty, ~~will be~~ cannot be smaller than some number.

$$(\Delta p)(\Delta x) \geq 4$$


↑ ↑ ↑
 width height Area of square



~~Now~~ Now I know equations can be intimidating, so I'm going to try to make this easier to understand.

Okay, now to make the ^{quantum} leap back to our bible ^{4/5} story, we just need to take two more steps.

1. Uncertainty principle applies to other variables, and for our story we make use of the variables energy + time.

Δt 

over very short time scales, ΔE the energy in a system can ~~fluctuate~~ have a very large uncertainty

2. ~~Another~~ The most recognizable equation from Einstein himself

$$E = mc^2$$

Δt 

This actually happens all the time in the universe. Tiny pieces of mass pop into existence and disappear. So in theory, it's possible for all the subatomic particles needed to make a loaf of bread could simultaneously pop into existence, making feeding the 4,000 possible.

Possible... but very improbable. I don't think this is actually how Jesus fed the 4,000. It's more inspiring to me as a social miracle, that Jesus changed people's hearts and caused them to share what they had with others.

My takeaway message is this: Sometimes you might be concerned because you have a little (or a lot) of uncertainty in your life. But when God designed the world she did it in such a way that uncertainty will

5/5
always be present. ~~and can never be.~~
Just follow the example of the disciples and
recognize that uncertainty, but trust that Jesus
can carry you through it.