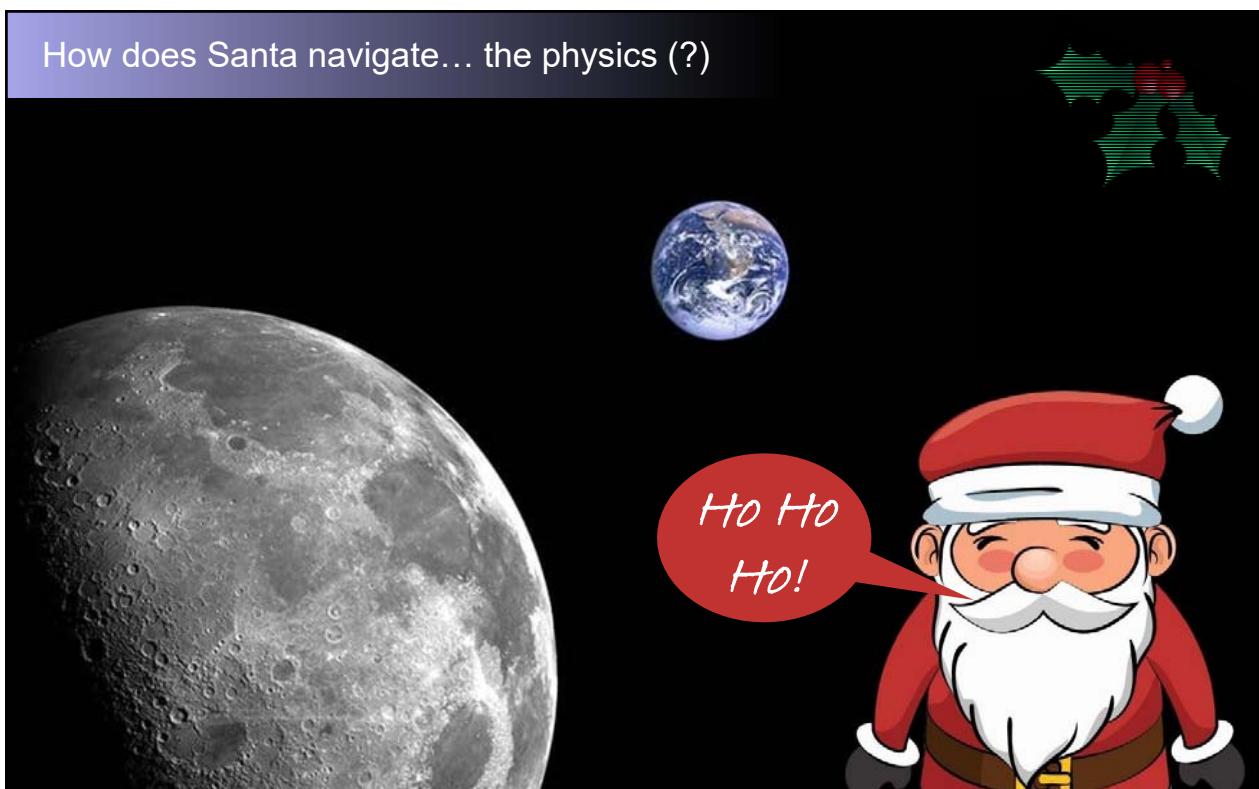


How does Santa navigate... the physics (?)



Santa Claus – the bare facts

- Santa is a portly gentleman who is old but doesn't seem to age
- He lives at the North Pole
- He has a **huge** delivery list...
...which he covers in one night



*So, how **does** he do that...
...and obey the laws of physics?*



Santa Claus and the laws of Physics

Special Relativity

- Nothing moves faster than the speed of light, c
- The faster he drives (closer to c):
 - the more distances shorten (for him)
 - the more slowly his time passes for us so he ages more slowly... (in our world)

...and the more massive he becomes!

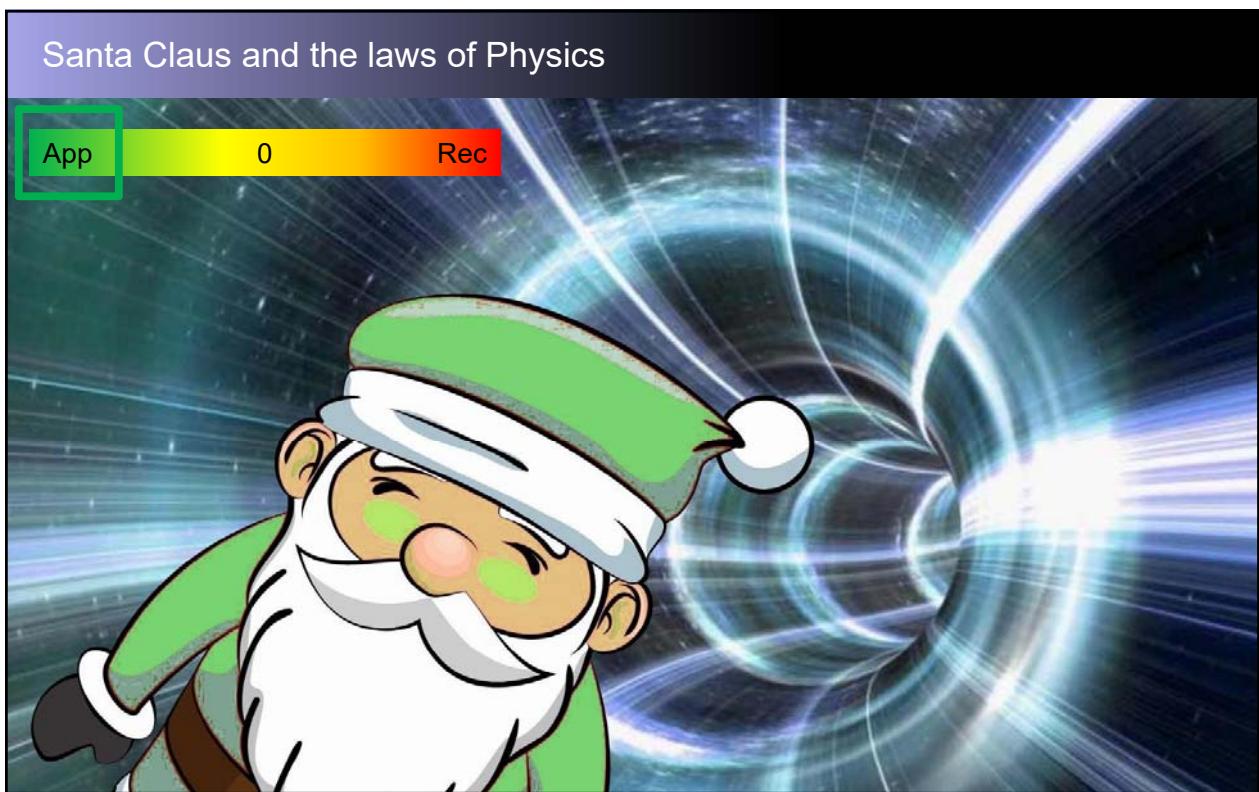
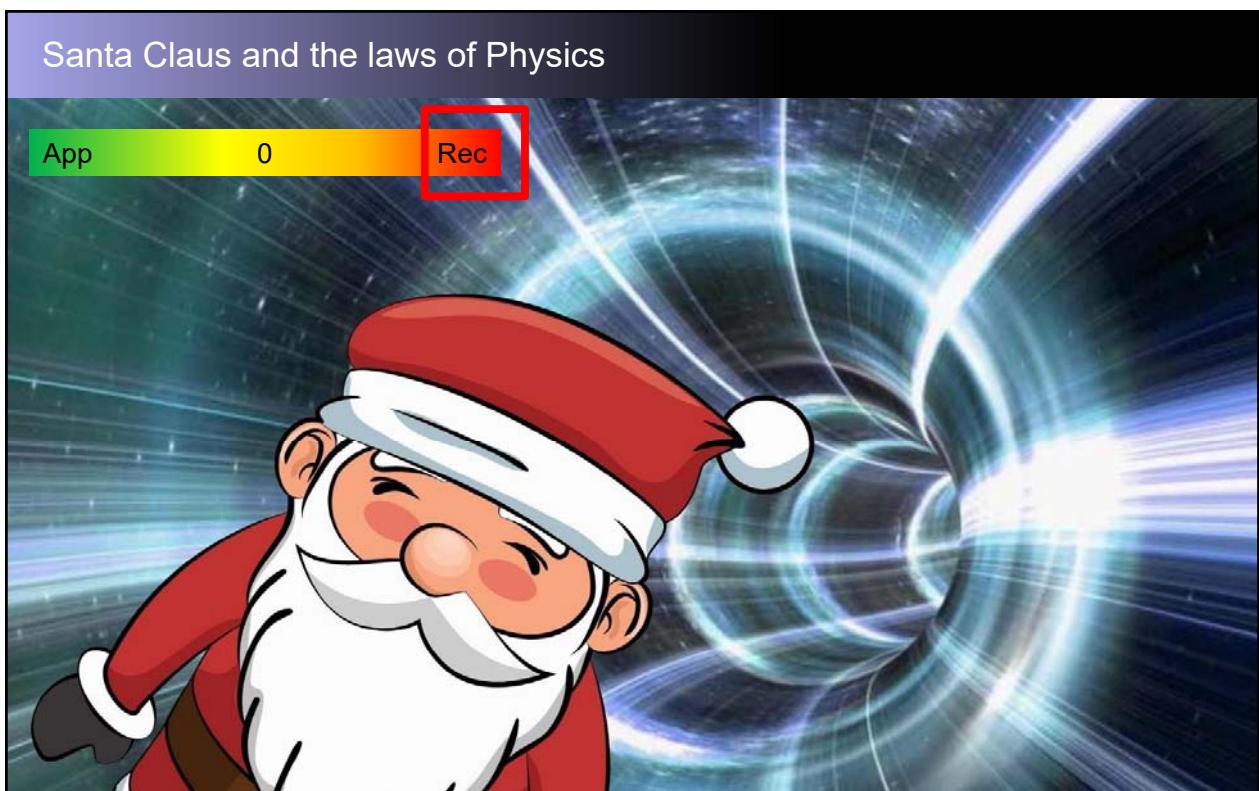
$$E=mc^2$$



The colour of his coat

Is it **red**, or is it **green**?



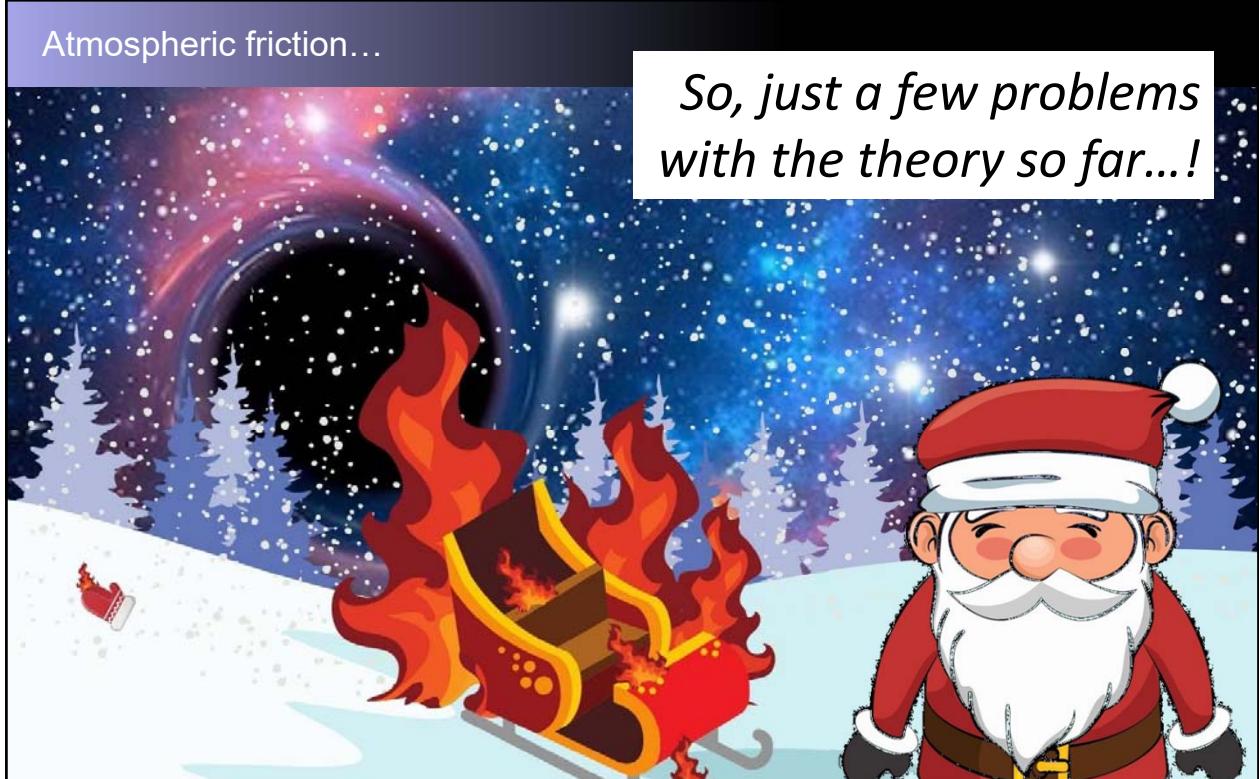


Santa Claus and the laws of Physics



Atmospheric friction...

*So, just a few problems
with the theory so far...!*



Evidence for Santa's existence...

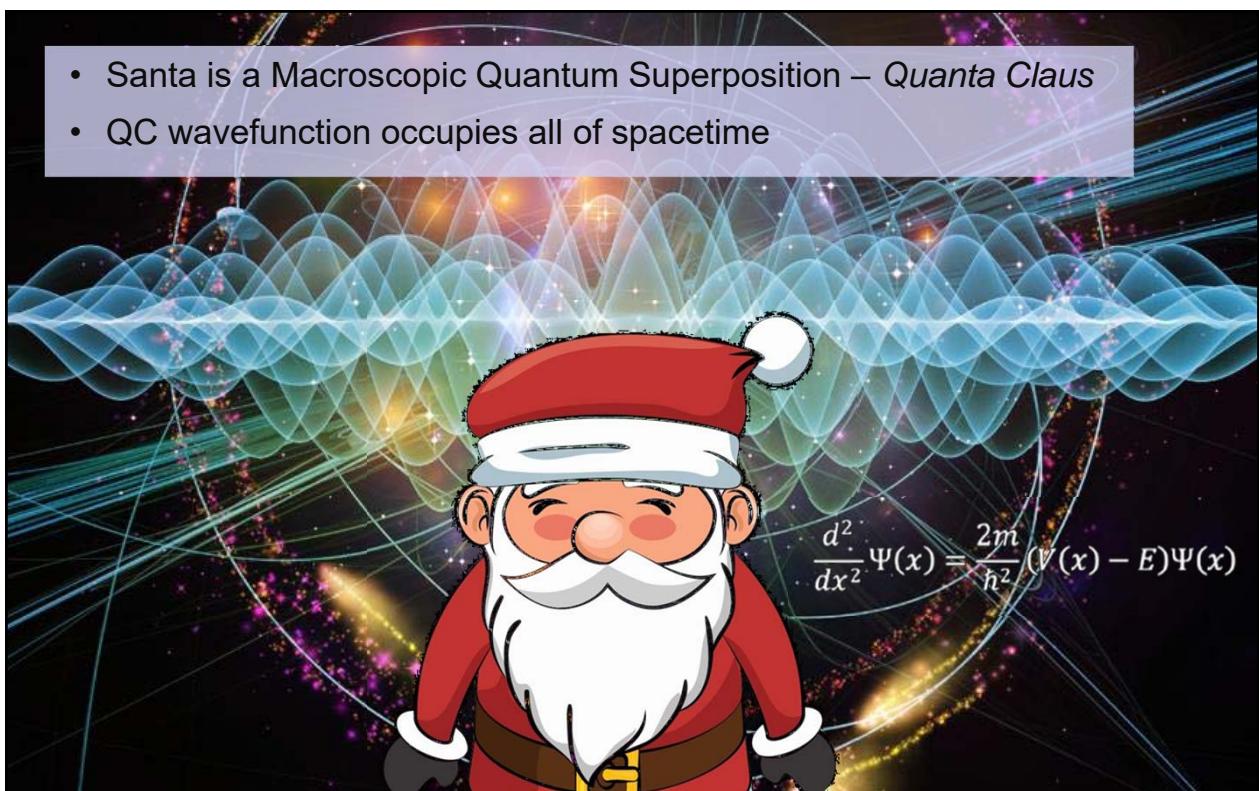
Have you *seen* Santa?
Is he real?



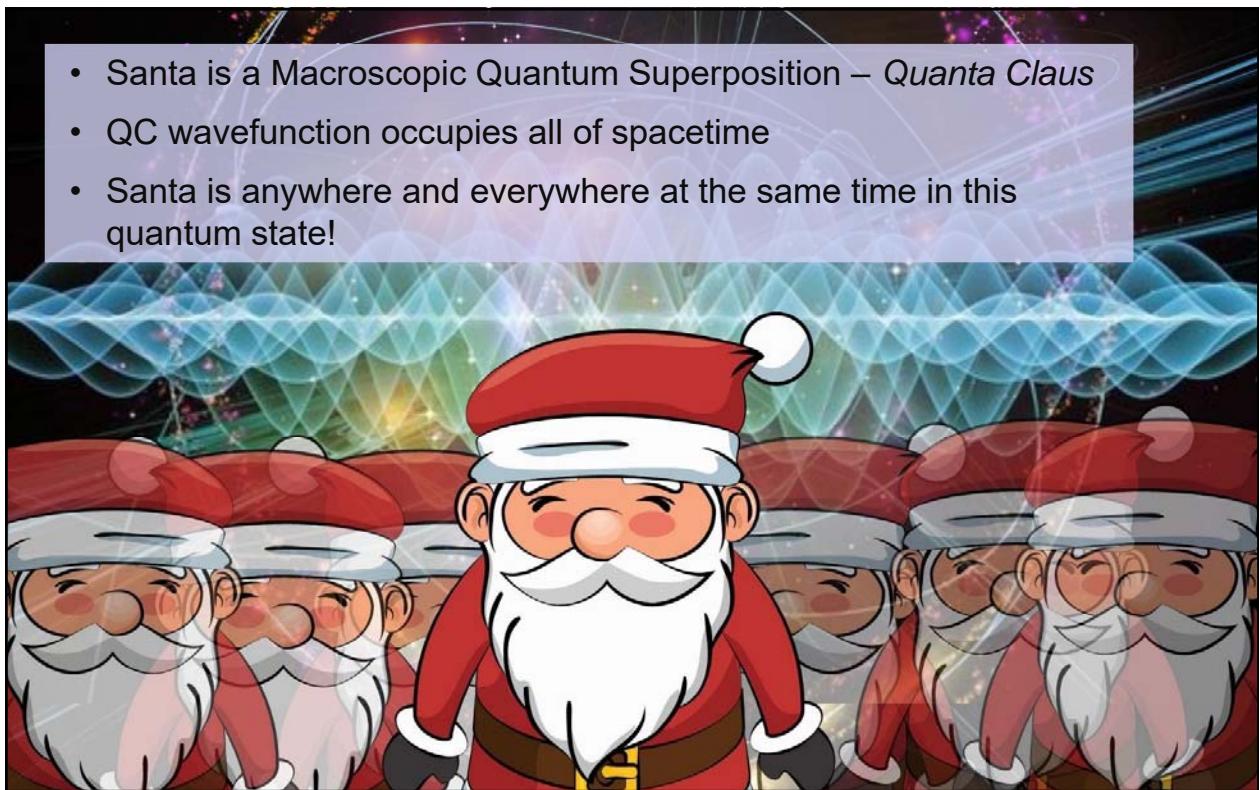
What about...Quantum Physics?



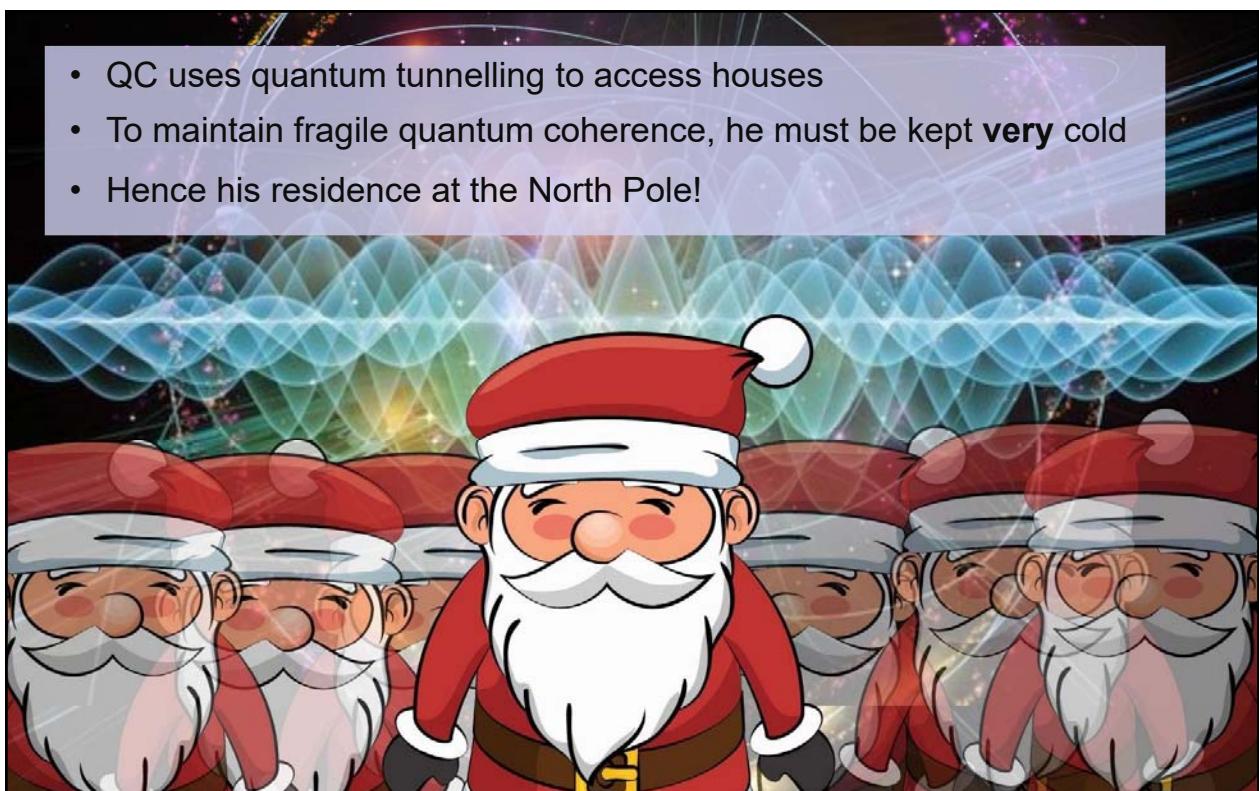
- Santa is a Macroscopic Quantum Superposition – *Quanta Claus*
- QC wavefunction occupies all of spacetime



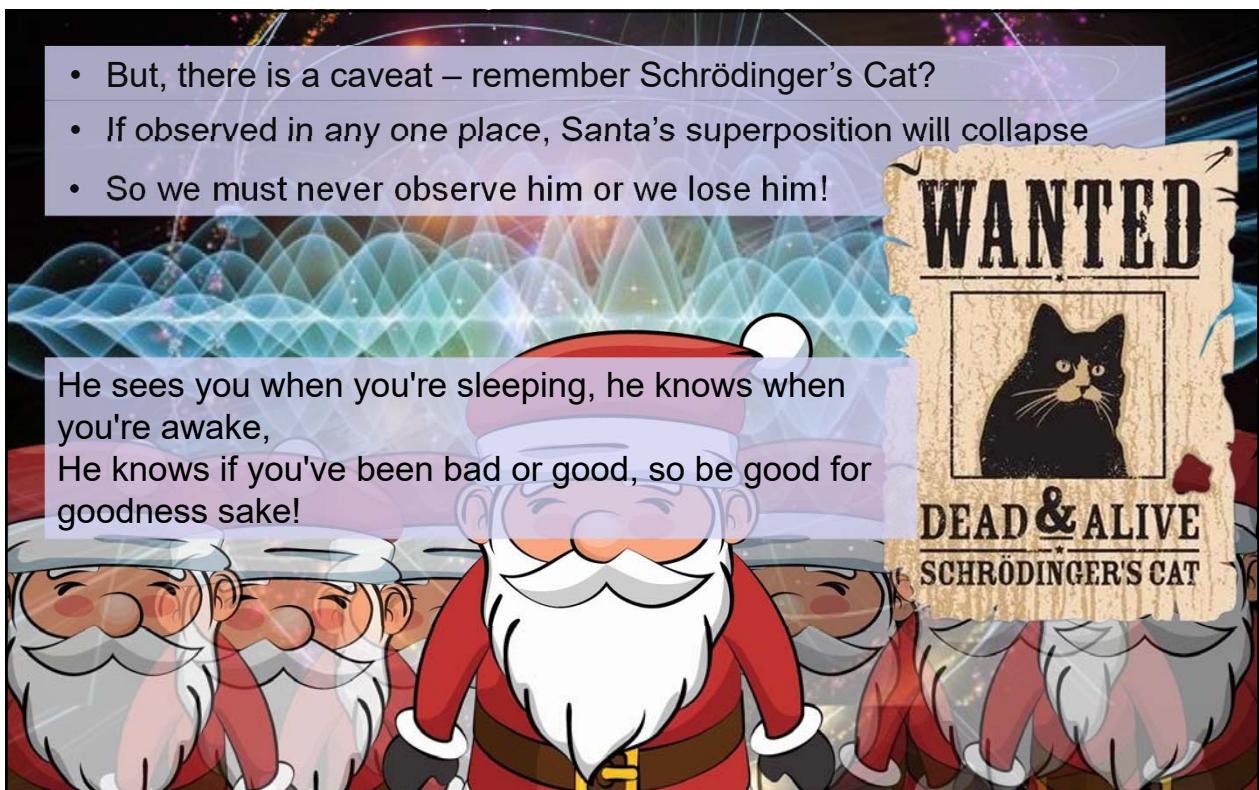
- Santa is a Macroscopic Quantum Superposition – *Quanta Claus*
- QC wavefunction occupies all of spacetime
- Santa is anywhere and everywhere at the same time in this quantum state!



- QC uses quantum tunnelling to access houses
- To maintain fragile quantum coherence, he must be kept **very** cold
- Hence his residence at the North Pole!



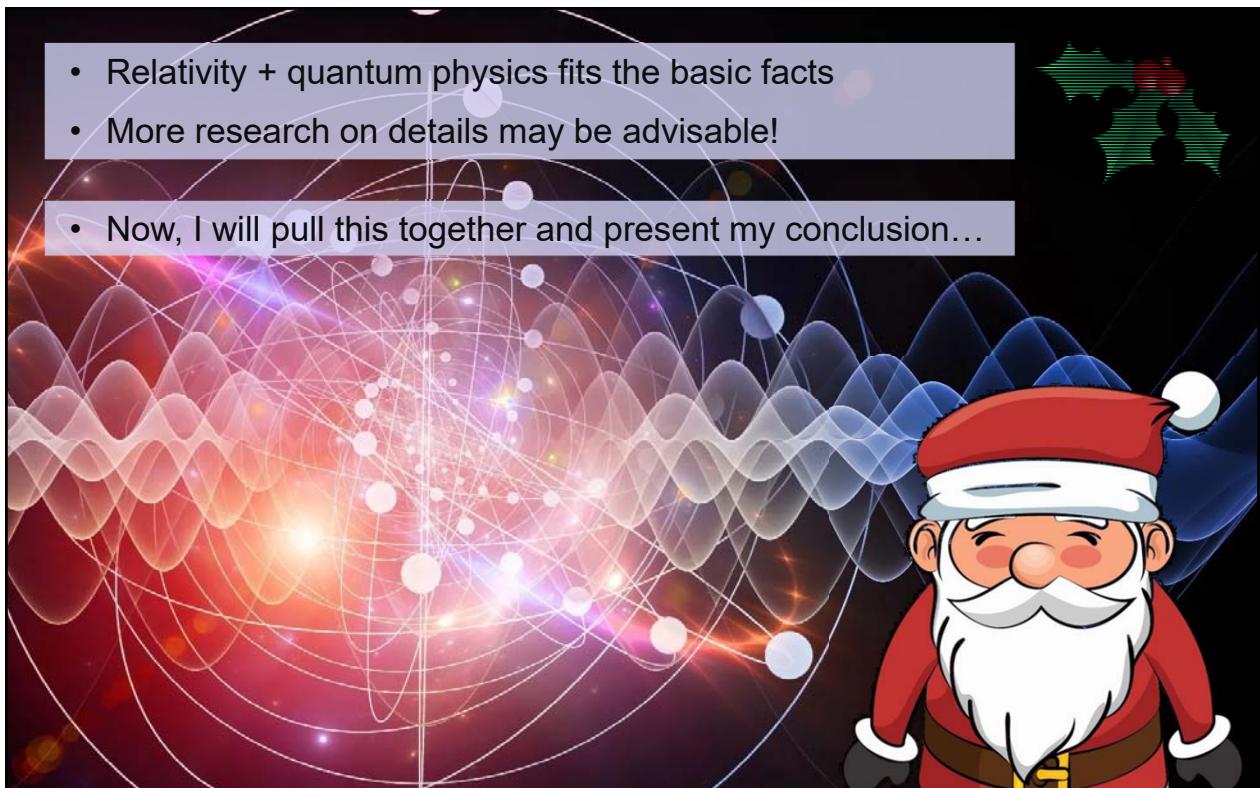
- But, there is a caveat – remember Schrödinger's Cat?
- If observed in any one place, Santa's superposition will collapse
- So we must never observe him or we lose him!



He sees you when you're sleeping, he knows when you're awake,
He knows if you've been bad or good, so be good for goodness sake!

- Relativity + quantum physics fits the basic facts
- More research on details may be advisable!

- Now, I will pull this together and present my conclusion...



Christmas equation:

$$y = \frac{\log_e \left(\frac{x}{m} - sa \right)}{r^2}$$

$$y r^2 = \log_e \left(\frac{x}{m} - sa \right)$$

$$e^{y r^2} = \frac{x}{m} - sa$$

$$m e^{y r^2} = x - msa$$

$$m e^{rry} = x - mas$$

