

What is a physicist and how to become one

Venus Keus

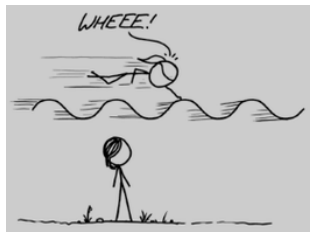
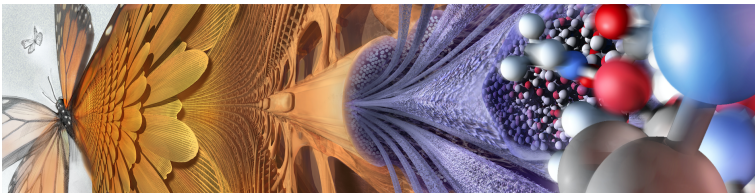
DIAS

Institiúid Ard-Léinn | Dublin Institute for
Bhaile Átha Cliath | Advanced Studies



February 9, 2024

Why I became a physicist



How I ended up here

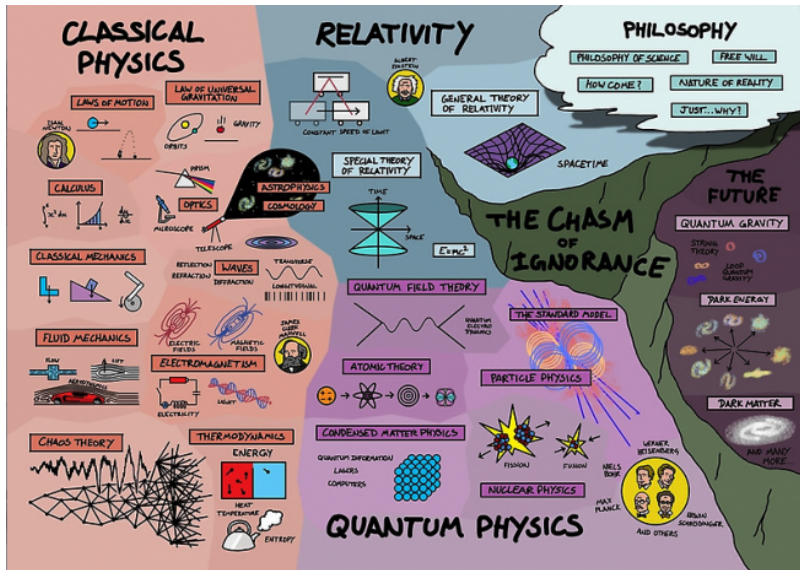


Kerman, Iran to Helsinki

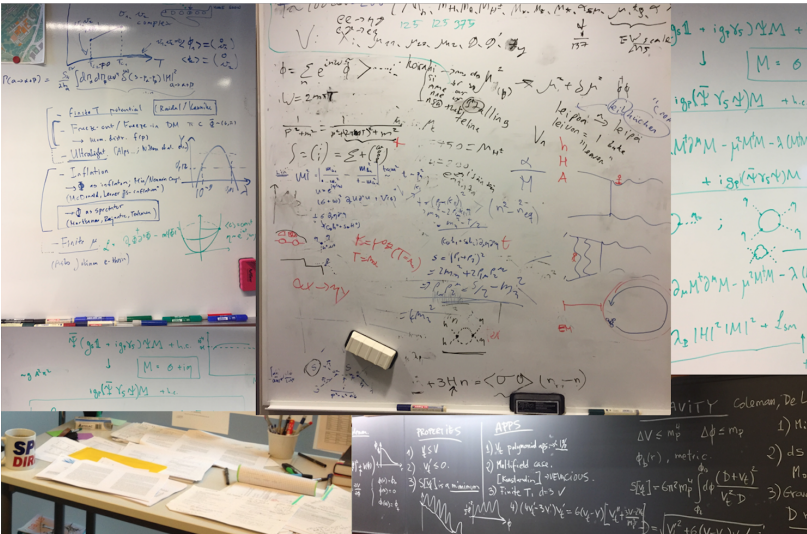
Directions from primary school to postdoc university



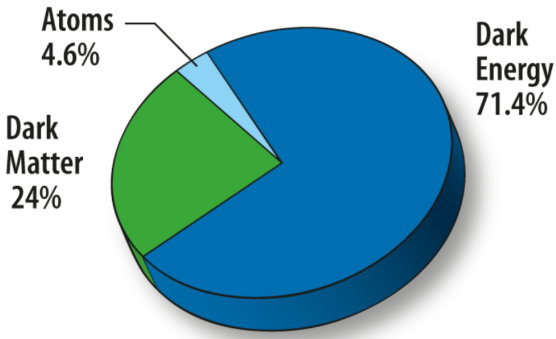
The map of physics



What I do all day



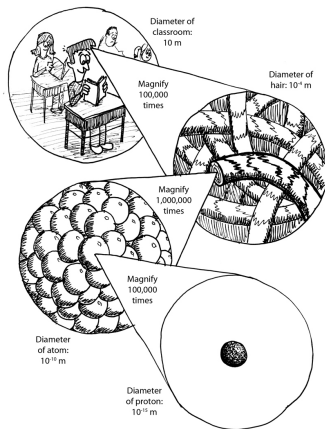
What is the universe made of?



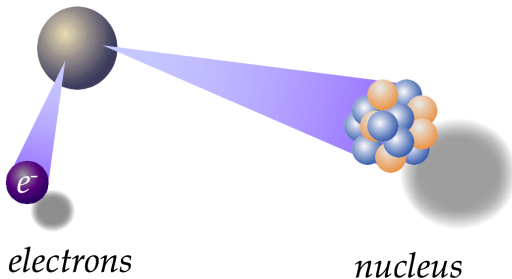
Visible matter: stuff we see



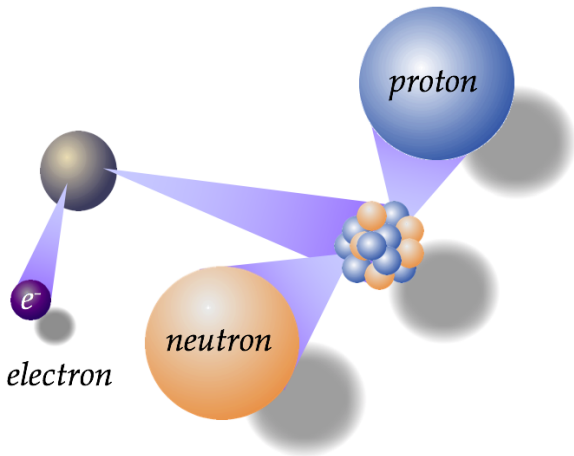
atom



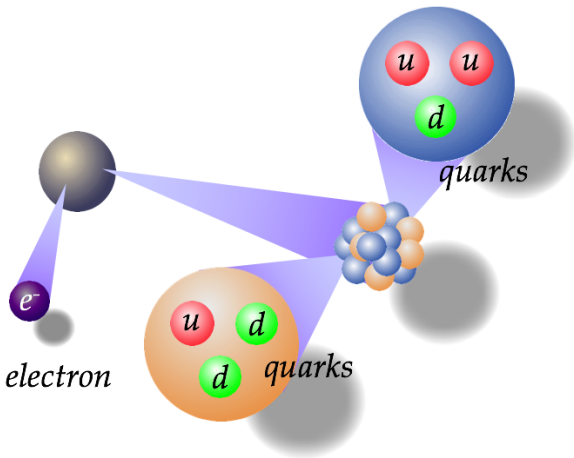
Visible matter: stuff we see



Visible matter: stuff we see



Visible matter: stuff we see



Visible matter: the Standard Model of particle physics

The Periodic Table

three generations of matter (fermions)

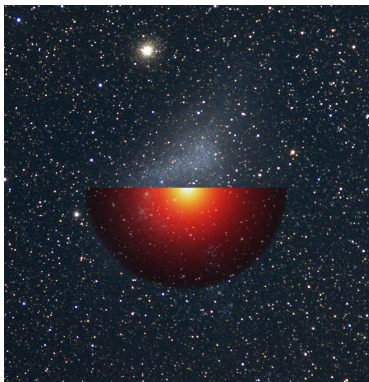
Generation	Quarks	Leptons	Bosons	
I	u up mass: 2.2 MeV/c ² charge: 2/3 spin: 1/2	e electron mass: 0.511 MeV/c ² charge: -1 spin: 1/2	g gluon mass: 0 charge: 0 spin: 1	
II	c charm mass: 1.275 GeV/c ² charge: 2/3 spin: 1/2	μ muon mass: 105.67 MeV/c ² charge: -1 spin: 1/2		γ photon mass: 0 charge: 0 spin: 1
III	t top mass: 172.44 GeV/c ² charge: 2/3 spin: 1/2	τ tau mass: 1.7768 GeV/c ² charge: -1 spin: 1/2		
		H Higgs mass: 125.09 GeV/c ² charge: 0 spin: 0		
		Z Z boson mass: 91.19 GeV/c ² charge: 0 spin: 1	GAUGE BOSONS	
		W W boson mass: 80.39 GeV/c ² charge: ±1 spin: 1		

QUARKS (vertical label on the left)

LEPTONS (vertical label on the left)

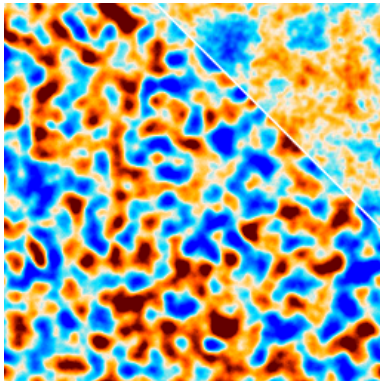
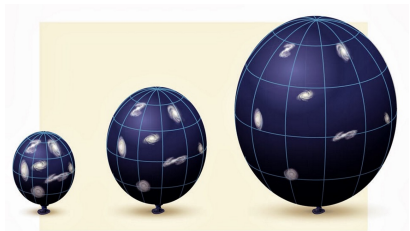
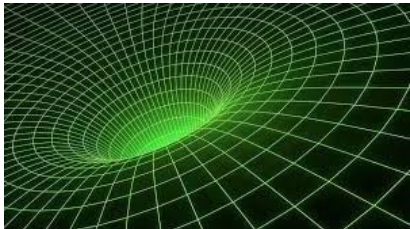
SCALAR BOSONS (vertical label on the right)

Dark Matter: matter we don't see



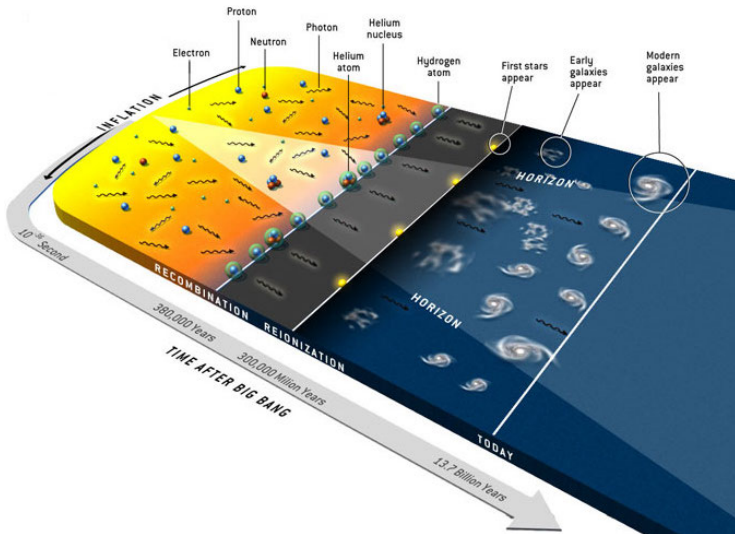
Collision of two galaxy clusters

Dark Energy: “a gift that keeps on giving”

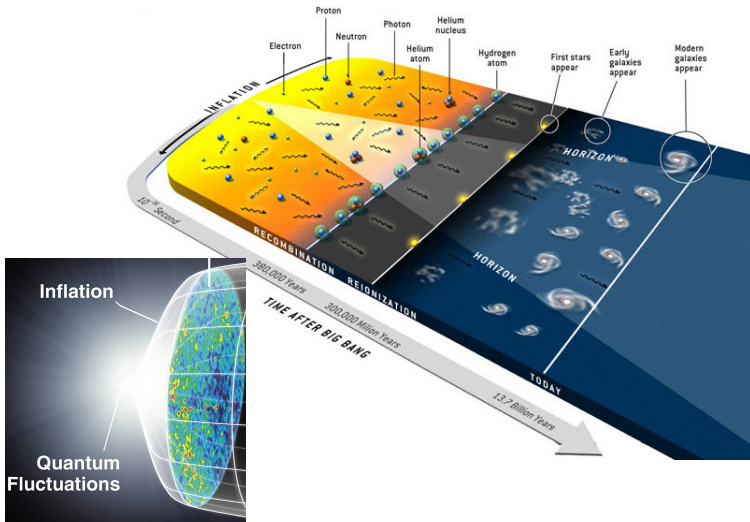


Planck CMB simulator

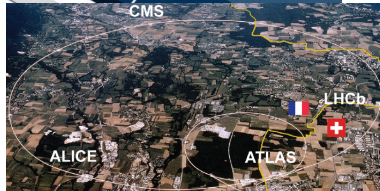
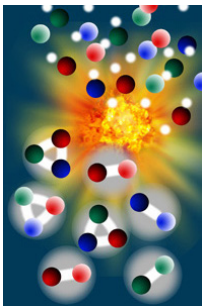
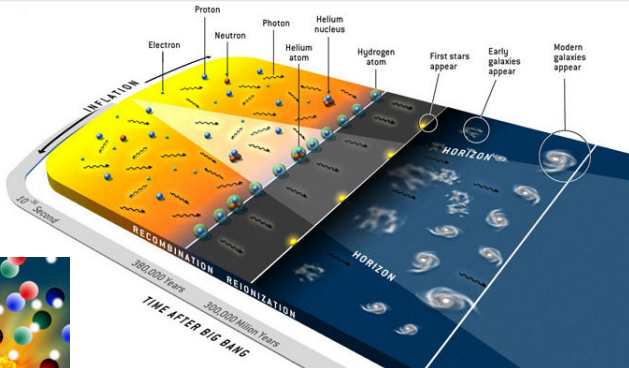
The evolution of the universe



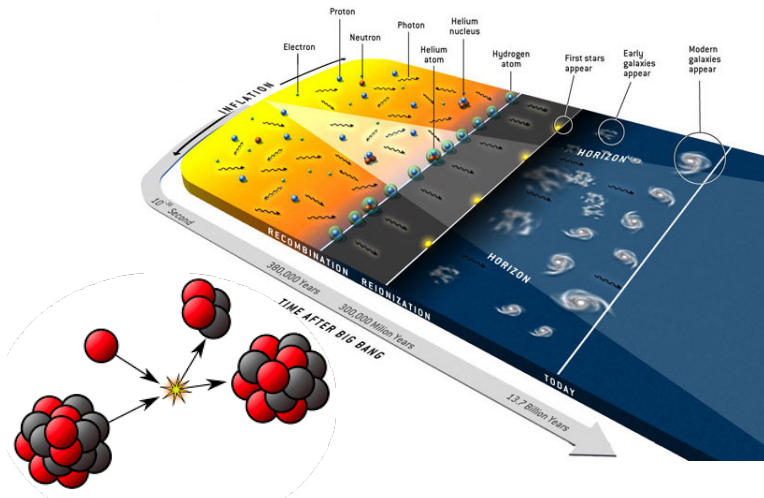
10^{-36} seconds: a spectacular expansion called inflation



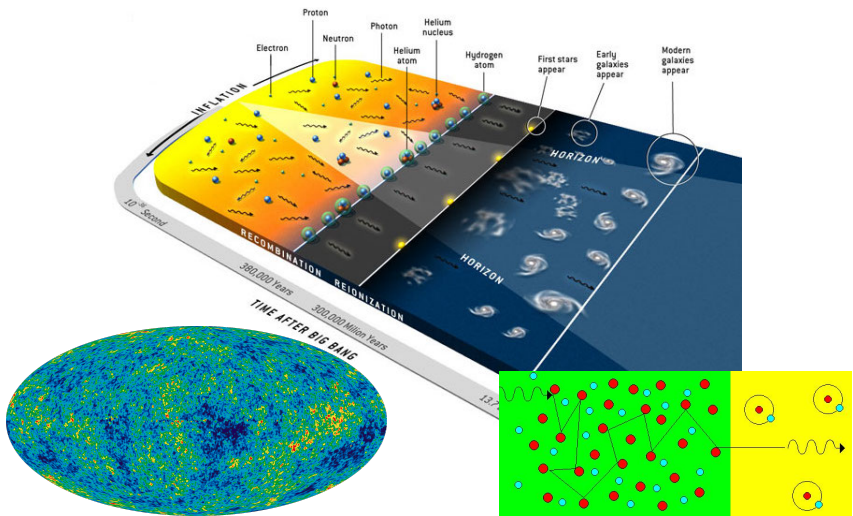
1 second: protons and neutrons are formed



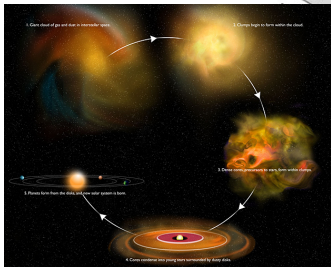
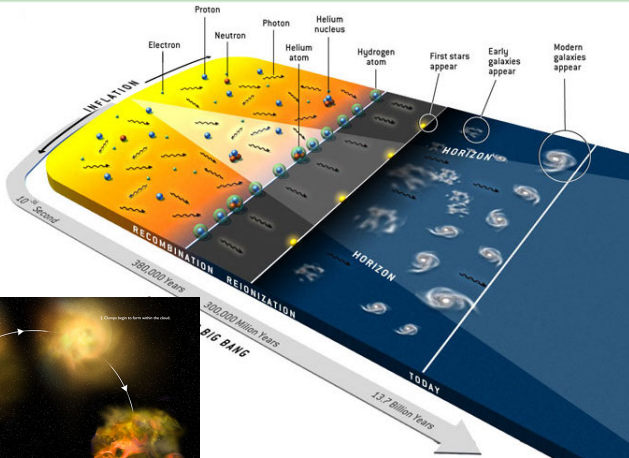
3 minutes: atomic nuclei form



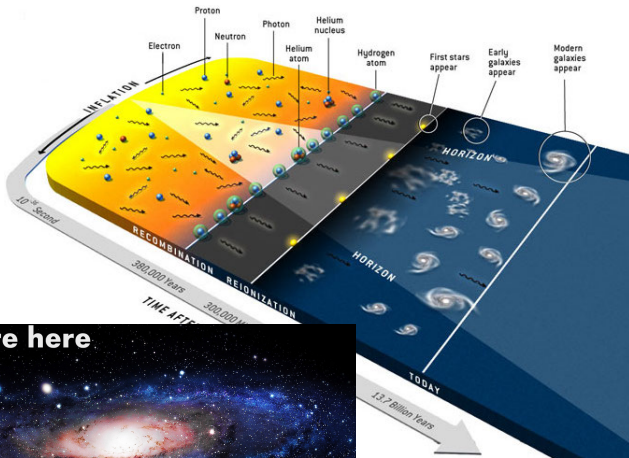
380,000 years: electrons are captured



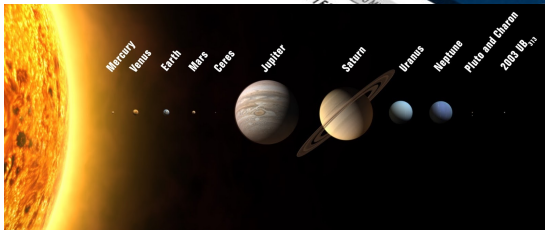
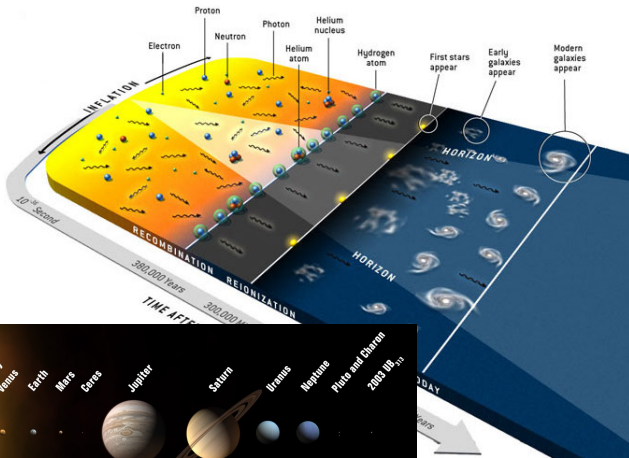
30 million years: first stars appear



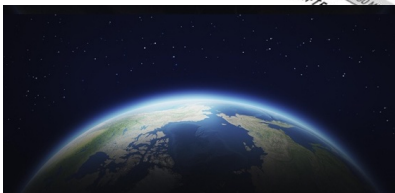
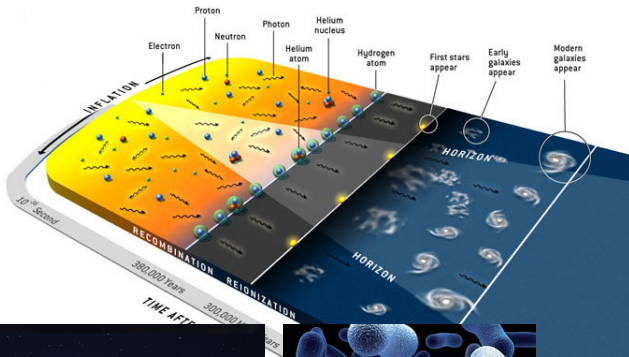
200 million years: the Milky Way forms



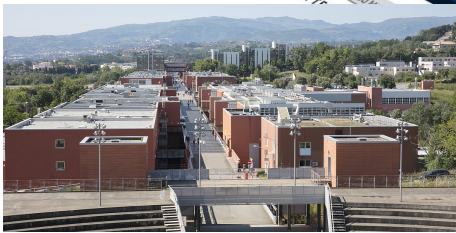
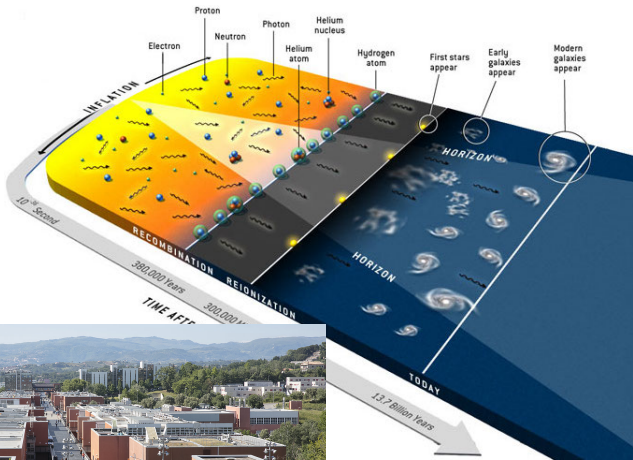
9 billion years: our solar system forms



10 – 11 billion years: life on Earth begins

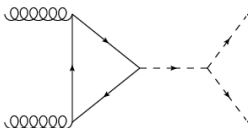


13.5 – 13.8 billion years: humans appear here



What I work on: Beyond the Standard Model physics

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + i\bar{\Psi}\not{D}\Psi + h.c. + \bar{\Psi}_i y_{ij} \Psi_j \phi + h.c. + \frac{1}{2} D_\mu \phi^2 - V(\phi)$$



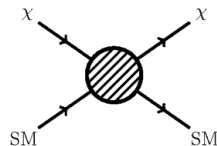
	I	II	III	
QUARKS	2.2 MeV u up	1.28 GeV c charm	173.1 GeV t top	0 g gluon
	4.7 MeV d down	96 MeV s strange	4.18 GeV b bottom	0 γ photon
	0.511 MeV e electron	105.66 MeV μ muon	1.776 GeV τ tau	91.19 GeV Z Z boson
LEPTONS	<1.0 eV ν_e e-neutrino	<0.17 MeV ν_μ μ-neutrino	<18.2 MeV ν_τ τ-neutrino	80.39 GeV W W boson
	125 GeV H₁ Higgs	H₂ Higgs	H₃ Higgs	
	SCALAR BOSONS			

Theory, Experiment, Observation

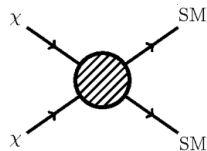
Direct Method

Indirect Method

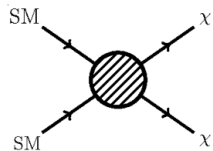
Production at the Large Hadron Collider



(a) Direct detection



(b) Indirect detection



(c) Collider production

Find a role model

The amazing and imaginative theory of relativity by:

Mileva Maric-Einstein and Albert Einstein



The only human with one Nobel prize in Physics and another one in Chemistry:

Maria Sokolowska-Curie

Her daughter, **Irene Curie**, is also a Nobel prize winner



Do not let disabilities stop you!

Women can do more

To the women in my engineering classes:

While it is my intention in every other interaction I share with you to treat you as my peer, let me deviate from that to say that you and I are in fact unequal.

Sure, we are in the same school program, and you are quite possibly getting the same GPA as I, but does that make us equal?

I did not, for example, grow up in a world that discouraged me from focusing on hard science.

Nor did I live in a society that told me not to get dirty, or said I was bossy for exhibiting leadership skills.

In grade school I never had to fear being rejected by my peers because of my interests.

I was not bombarded by images and slogans telling me that my true worth was in how I look, and that I should abstain from certain activities because I might be thought too masculine.

I was not overlooked by teachers who assumed that the reason I did not understand a tough math or science concept was, after all, because of my gender.

I have had no difficulty whatsoever with a boys club mentality, and I will not face added scrutiny or remarks of my being the "diversity hire".

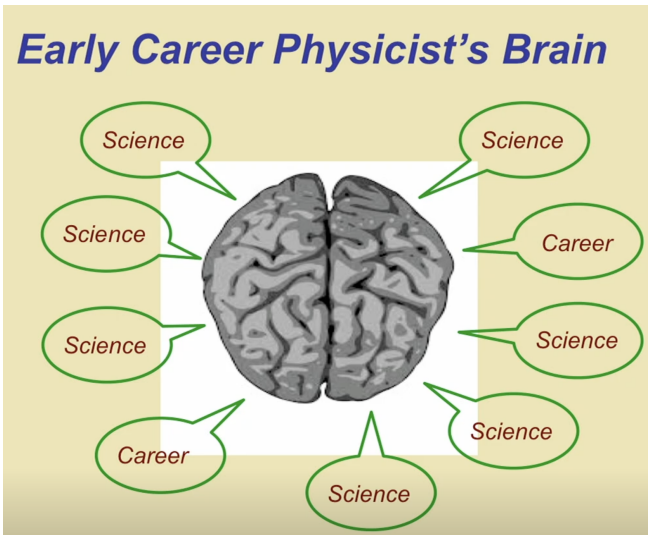
When I experience success the assumption of others will be that I earned it.

So, you and I cannot be equal. You have already conquered far more to be in this field than I will ever face.

By Jared Mauldin
Senior in Mechanical Engineering

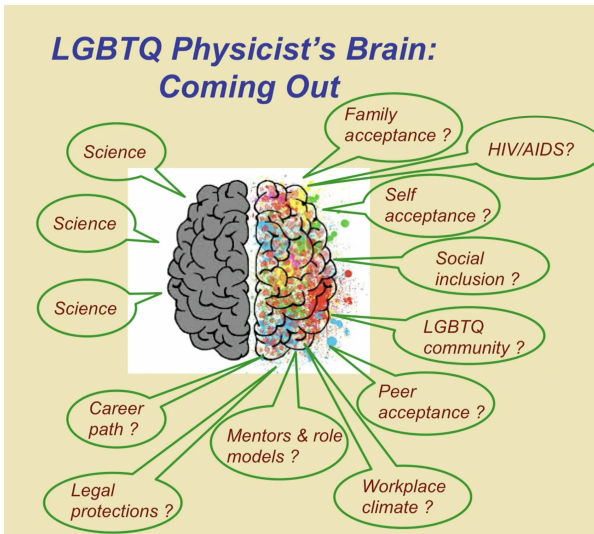
Published in campus newspaper at Eastern Washington University

What a stereotypical white male physicist worries about



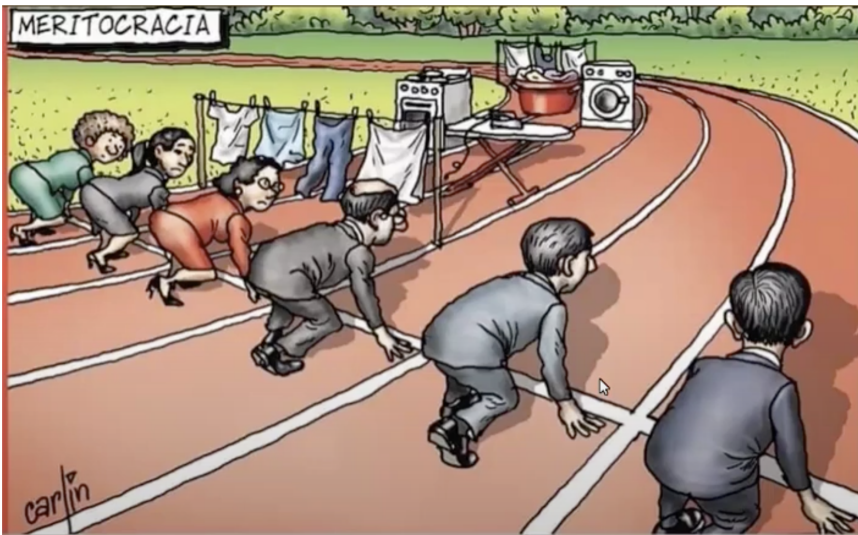
Slide credit: Prof. Michael Ramsey-Musolf

What a non-stereotypical physicist worries about



Slide credit: Prof. Michael Ramsey-Musolf

Women are stronger



Slide credit: Dr. Pauline Gagnon

Don't wait for a miracle, be one!



Questions?

Join link

<https://edu.flinga.fi/s/ET3B6PK>

