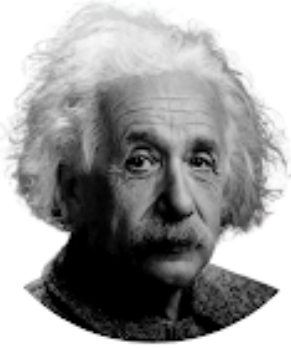
Aula 1

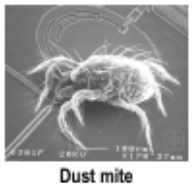
Prof. Márcio Sampaio Gomes Filho

Quantum Mechanics			
			
Max Planck	Albert Einstein	Werner Heisenberg	Erwin Schrödinger
Black body radiation	Photoelectric effect	Uncertainty principle	Schrödinger equation

- https://www.atlearner.com/2023/09/Quantum-mechanics.html

The Scale of Things – Nanometers and More

Things Natural



Dust mite

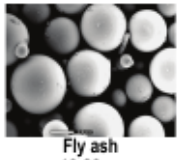
200 μm

Ant

~ 5 mm

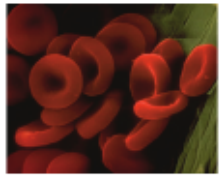
Human hair

~ 60-120 μm wide



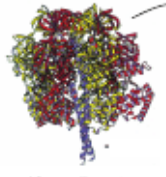
Fly ash

~ 10-20 μm

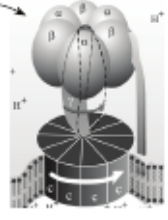


Red blood cells

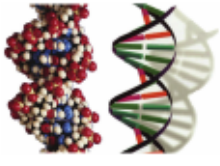
(~7-8 μm)



~10 nm diameter

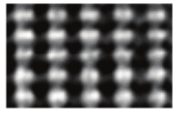


ATP synthase



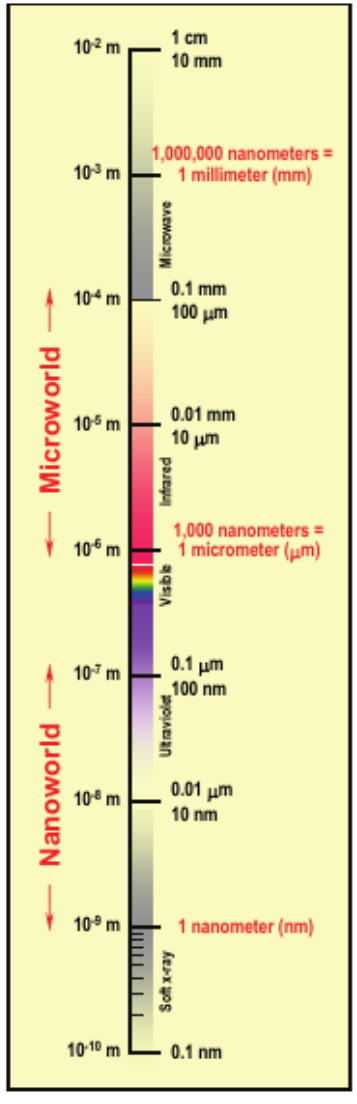
DNA

~2-1/2 nm diameter

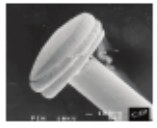


Atoms of silicon

spacing 0.078 nm

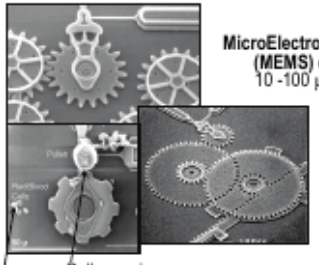


Things Manmade



Head of a pin

1-2 mm

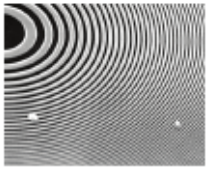


MicroElectroMechanical (MEMS) devices

10 -100 μm wide

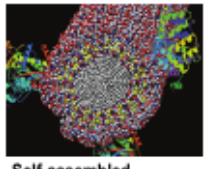
Pollen grain

Red blood cells



Zone plate x-ray "lens"

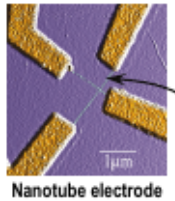
Outer ring spacing ~35 nm



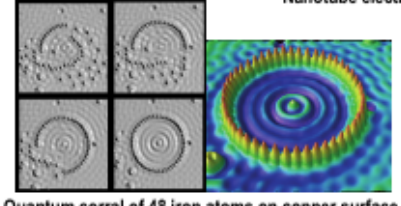
Self-assembled,

Nature-inspired structure

Many 10s of nm

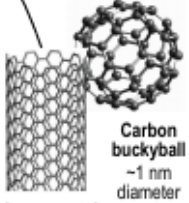


Nanotube electrode



Quantum corral of 48 iron atoms on copper surface positioned one at a time with an STM tip

Corral diameter 14 nm



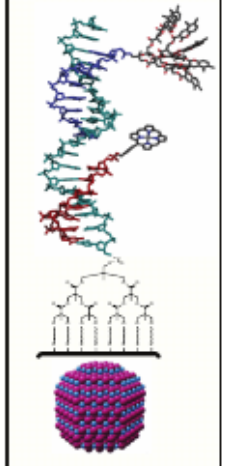
Carbon buckyball

~1 nm diameter

Carbon nanotube

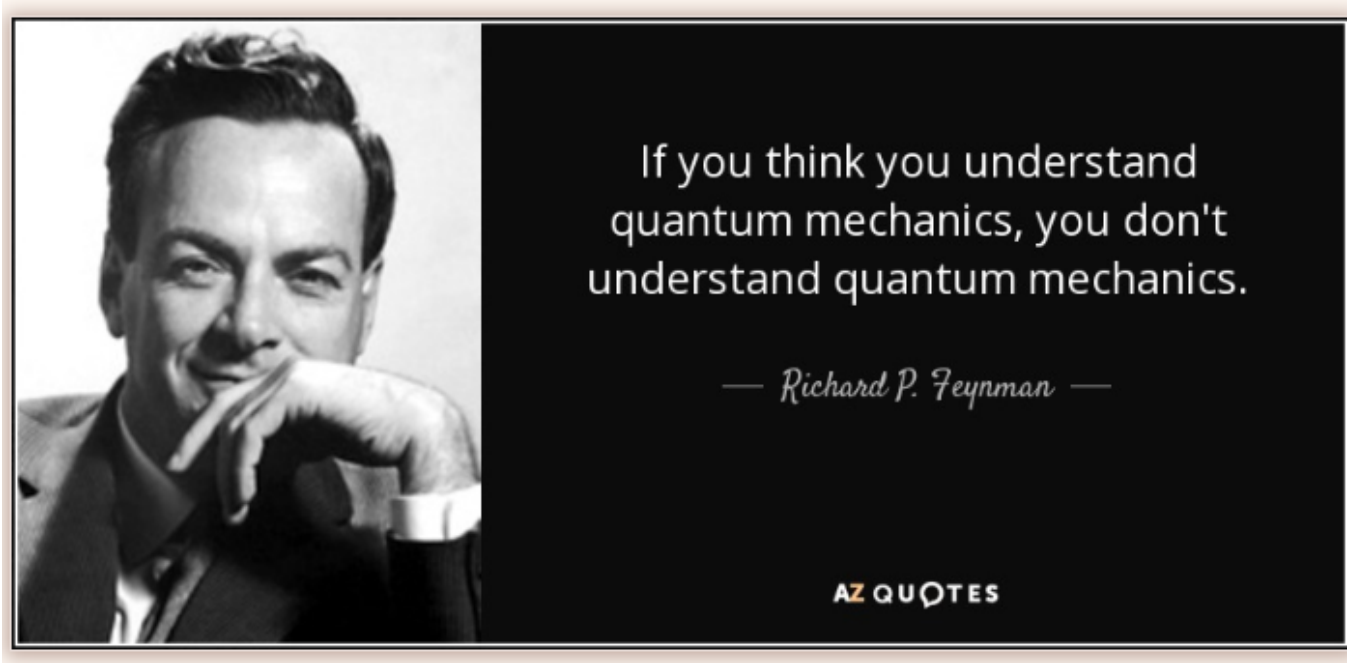
~1.3 nm diameter

The Challenge



Fabricate and combine nanoscale building blocks to make useful devices, e.g., a photosynthetic reaction center with integral semiconductor storage.

Office of Basic Energy Sciences
Office of Science, U.S. DOE
Version 05-26-06, jmd



- https://www.azquotes.com/quote/847297#google_vignette

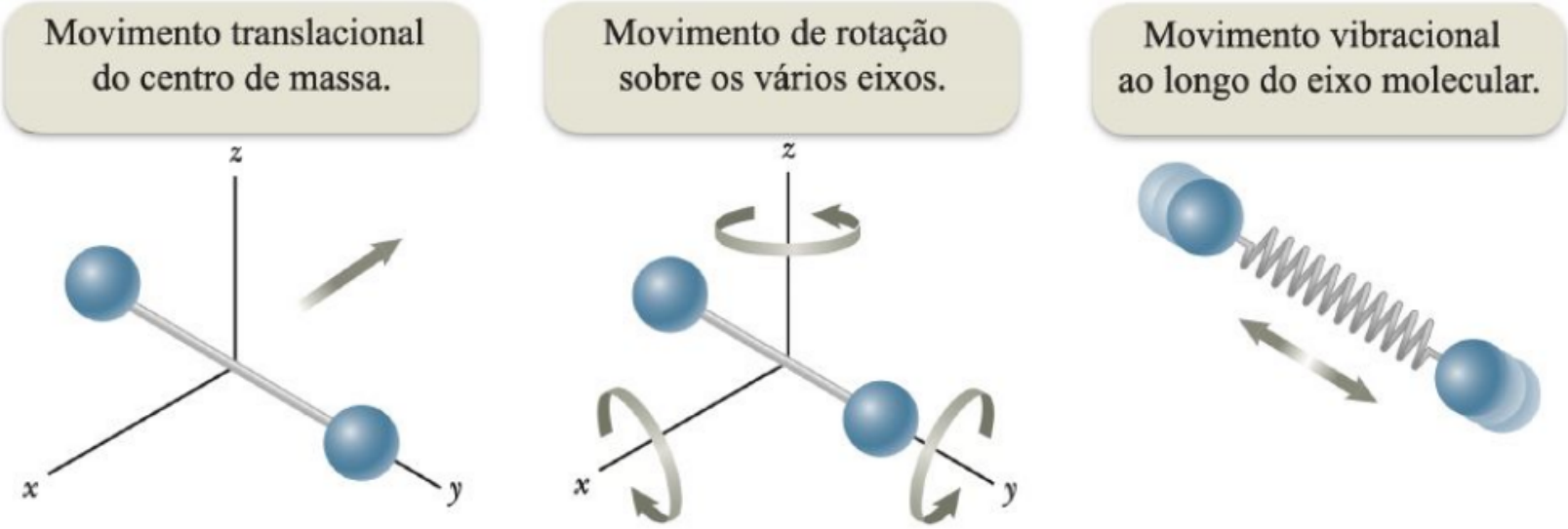
Calor específico molar de gases

TABELA 17.3 | Calor específico molar de vários gases

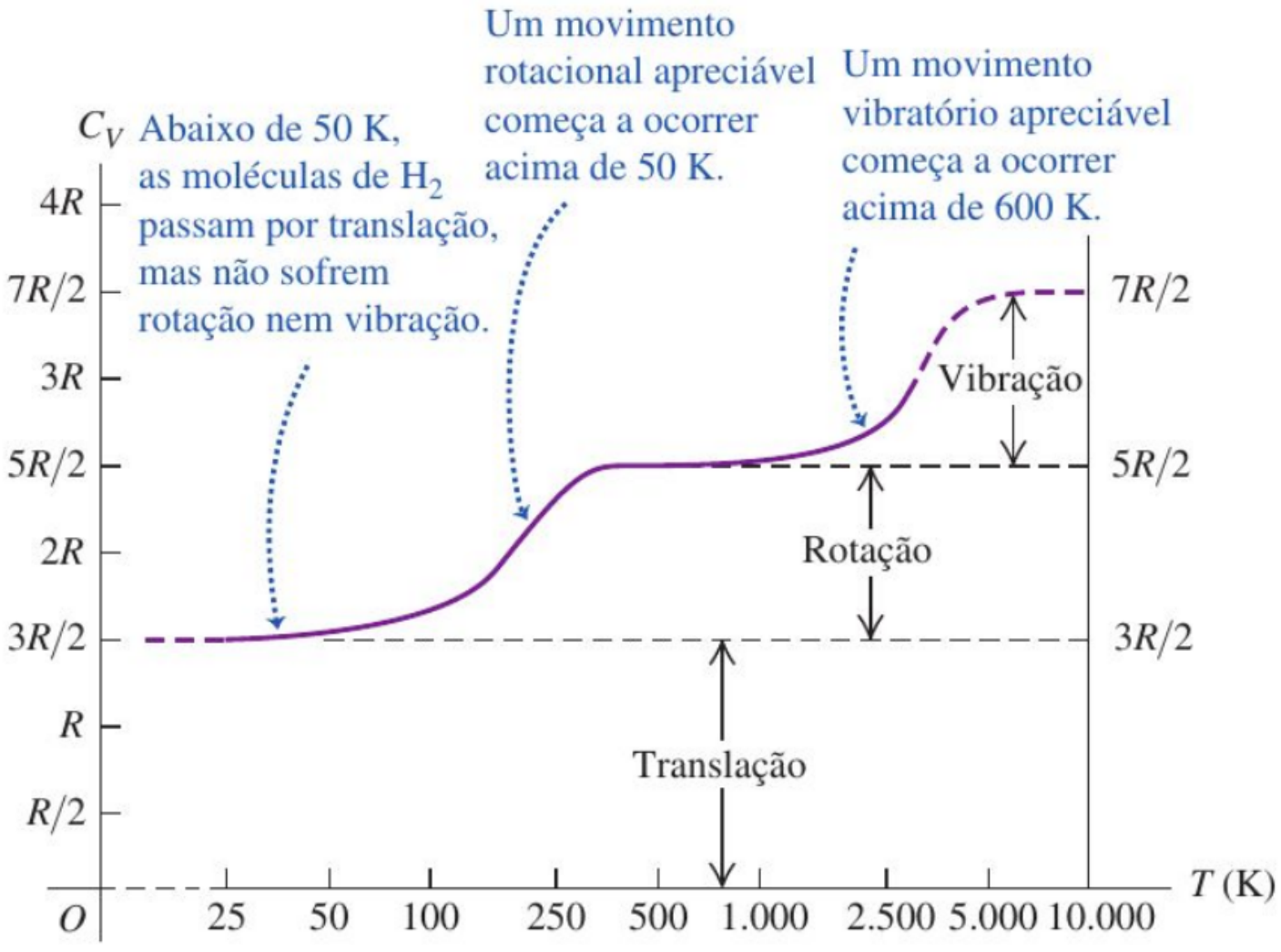
	Calor específico molar (J/mol · K)[a]			
Gás	C_P	C_V	$C_P - C_V$	$\gamma = C_P/C_V$
Gases monoatômicos				
He	20,8	12,5	8,33	1,67
Ar	20,8	12,5	8,33	1,67
Ne	20,8	12,7	8,12	1,64
Kr	20,8	12,3	8,49	1,69
Gases diatômicos				
H_2	28,8	20,4	8,33	1,41
N_2	29,1	20,8	8,33	1,40
O_2	29,4	21,1	8,33	1,40
CO	29,3	21,0	8,33	1,40
Cl_2	34,7	25,7	8,96	1,35
Gases poliatômicos				
CO_2	37,0	28,5	8,50	1,30
SO_2	40,4	31,4	9,00	1,29
H_2O	35,4	27,0	8,37	1,30
CH_4	35,5	27,1	8,41	1,31

[a]Todos os valores foram obtidos a 300K, exceto para água.

Calor específico molar de gases



Calor específico molar a volume constante, para o gás hidrogênio (H_2).
A temperatura é representada em escala logarítmica.



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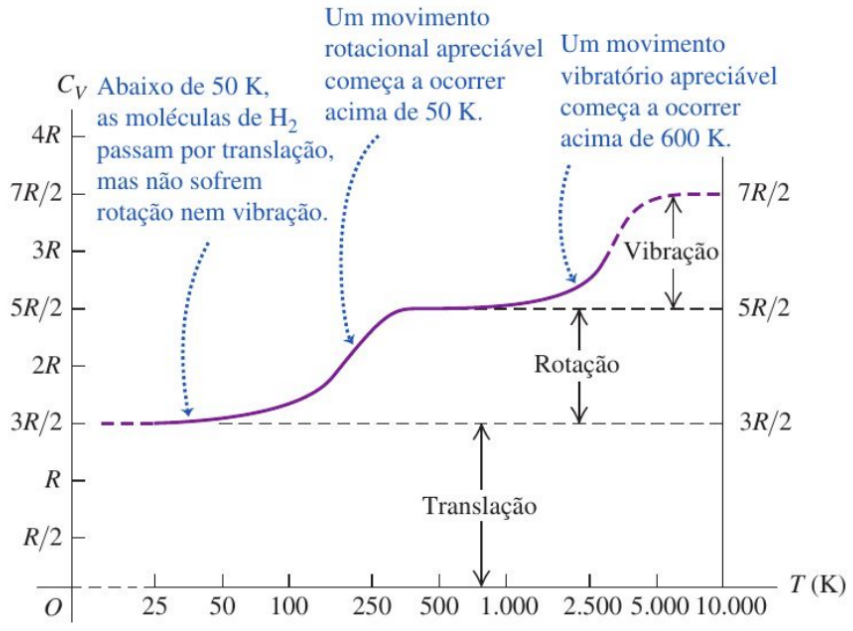
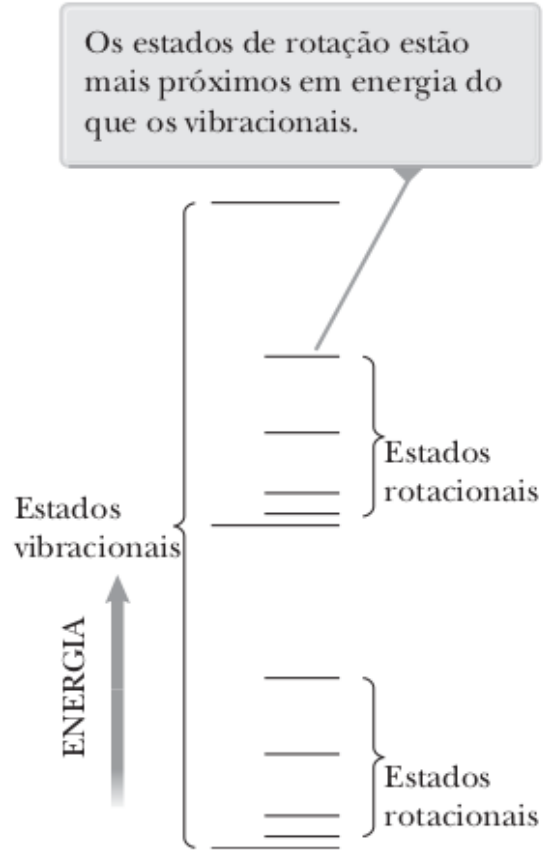
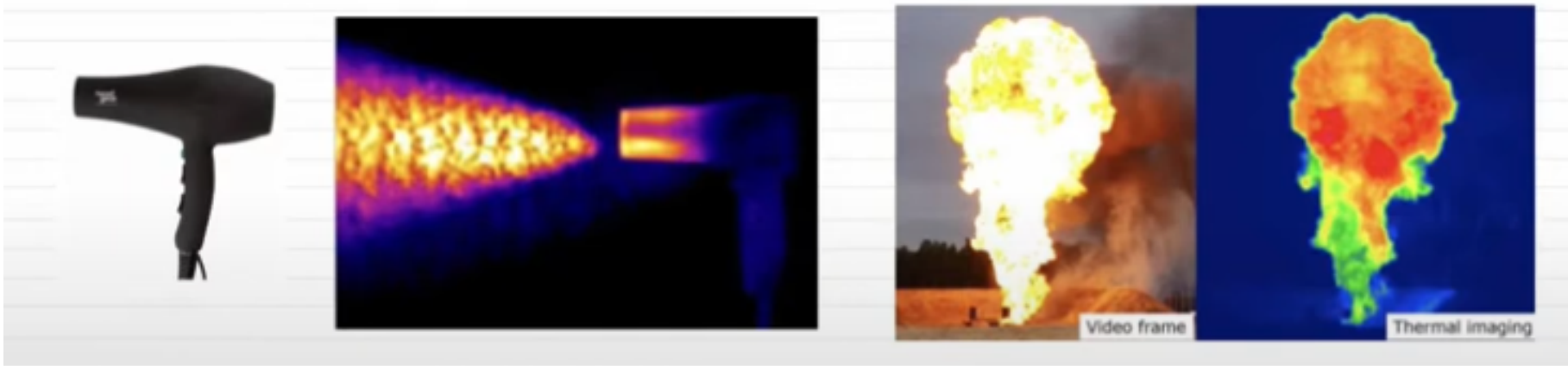


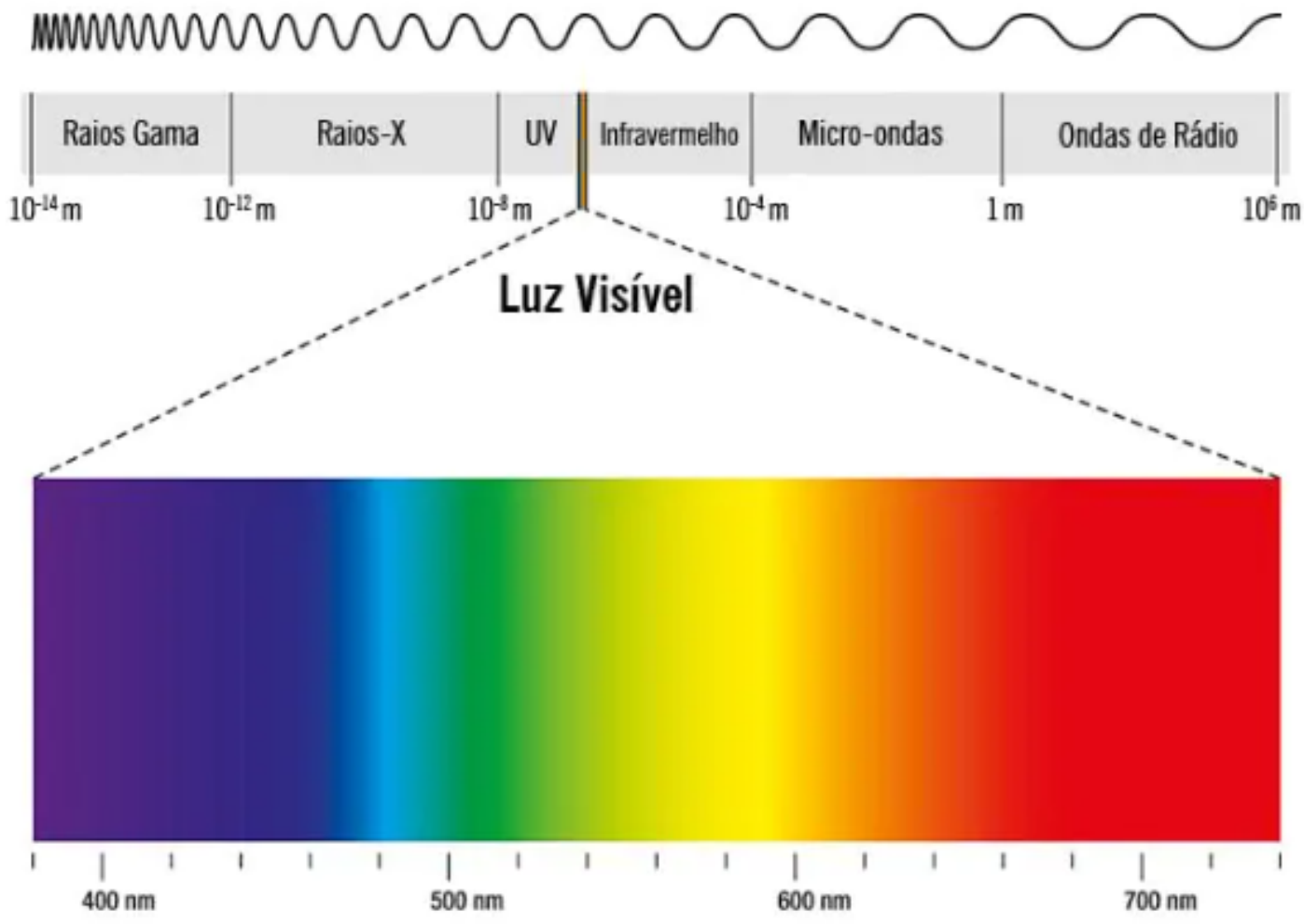


Física Quântica: Evidências Experimentais

- Radiação e Temperatura

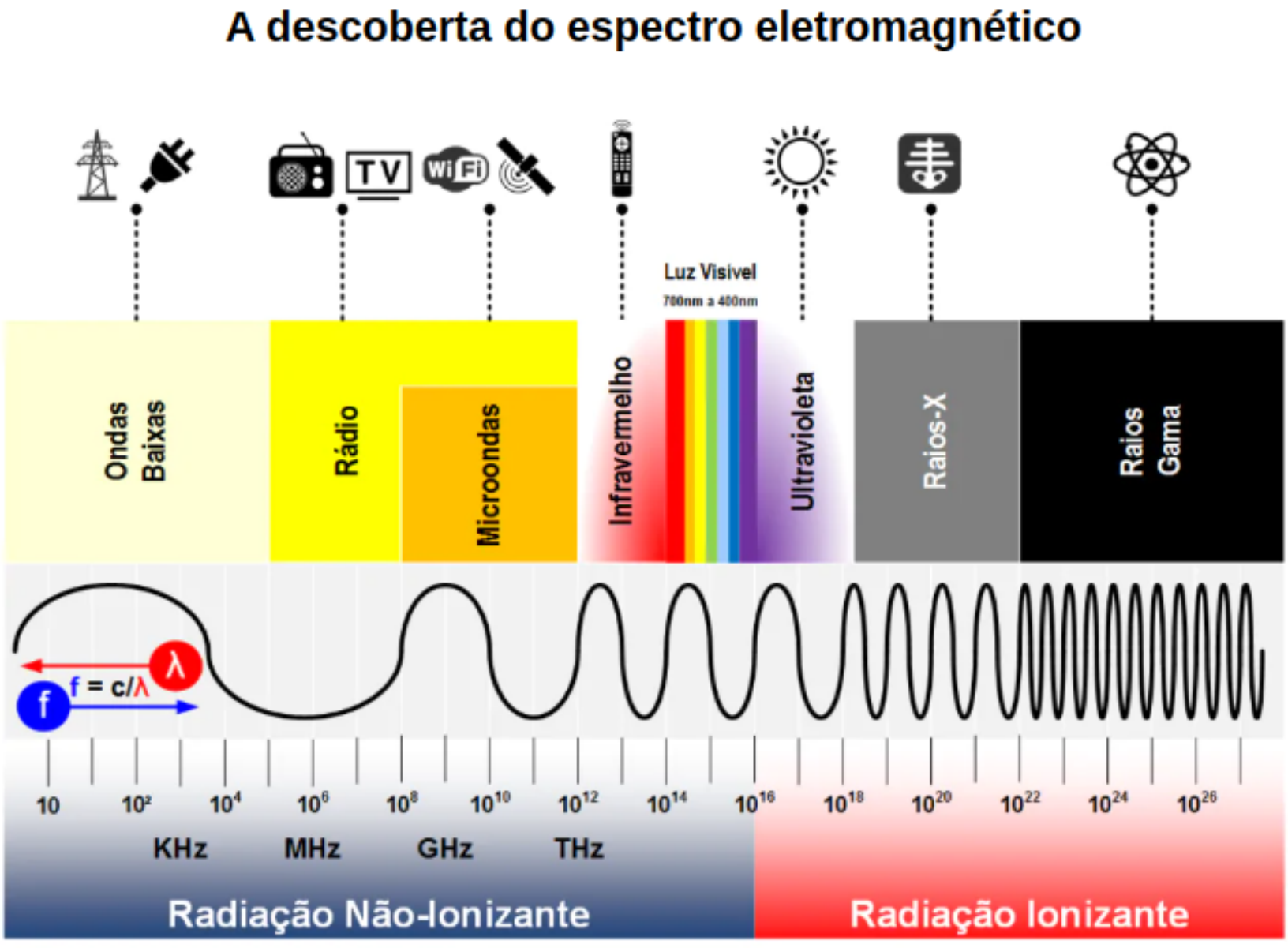


Espectro eletromagnético

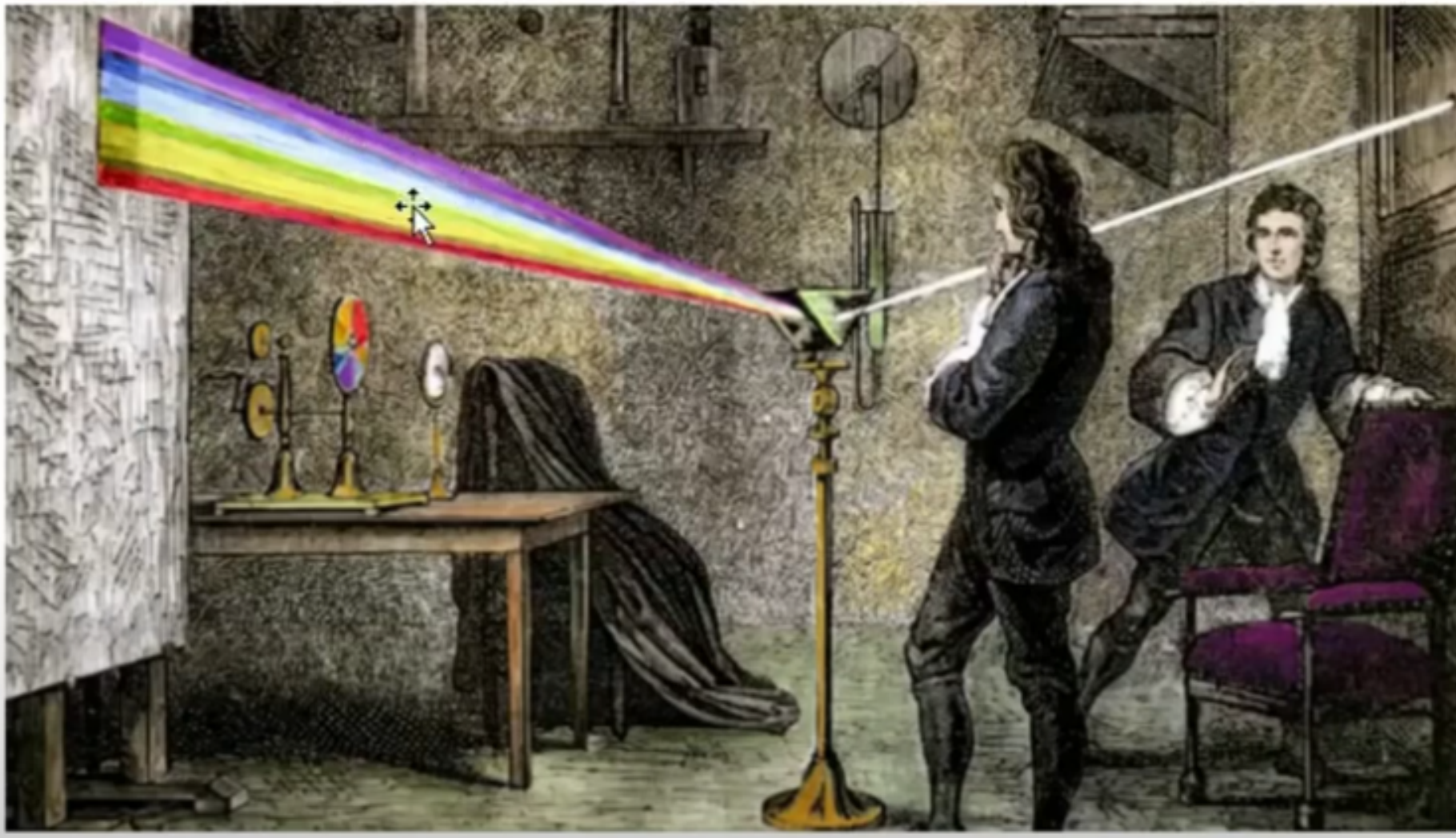


- https://adenilsongiovanini.com.br/blog/espectro-eletromagnetico/

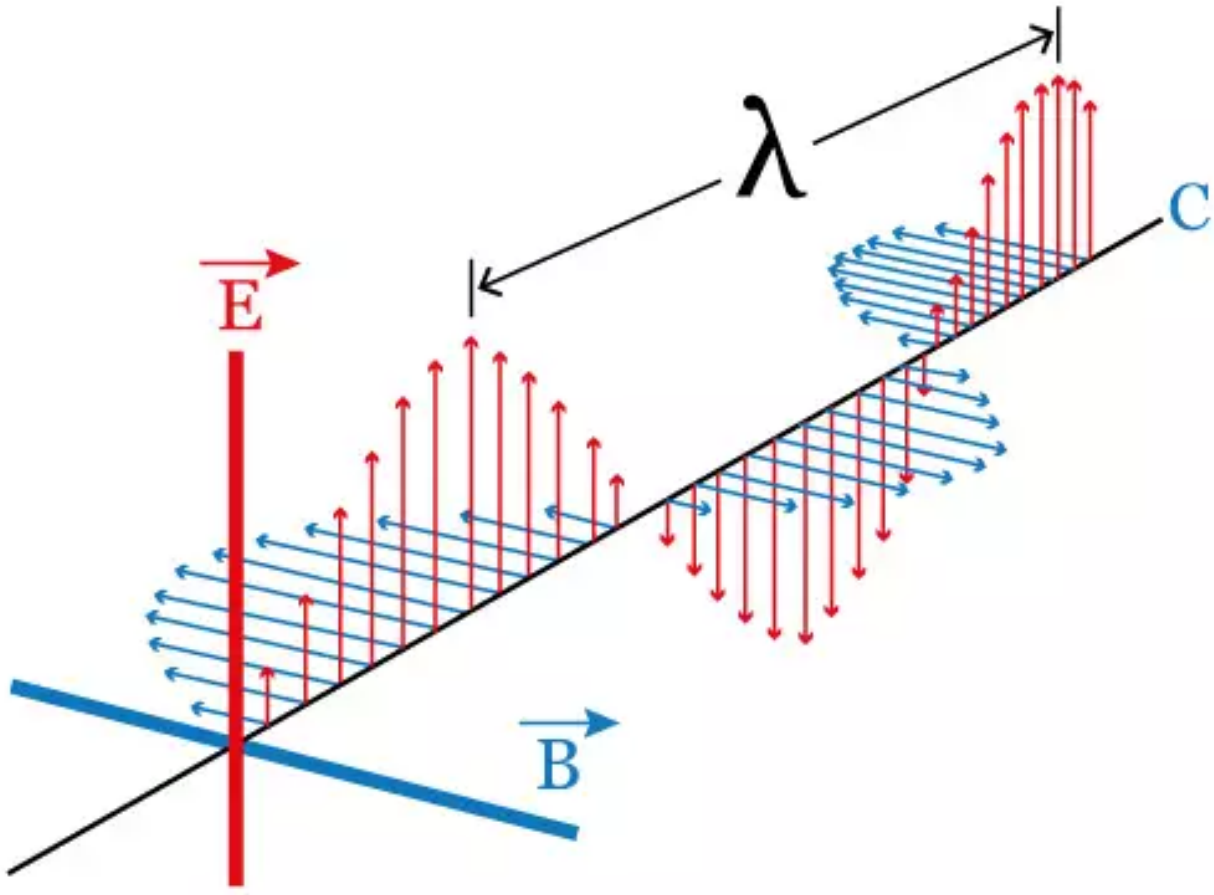
Espectro eletromagnético



Luz branca



Ondas eletromagnética

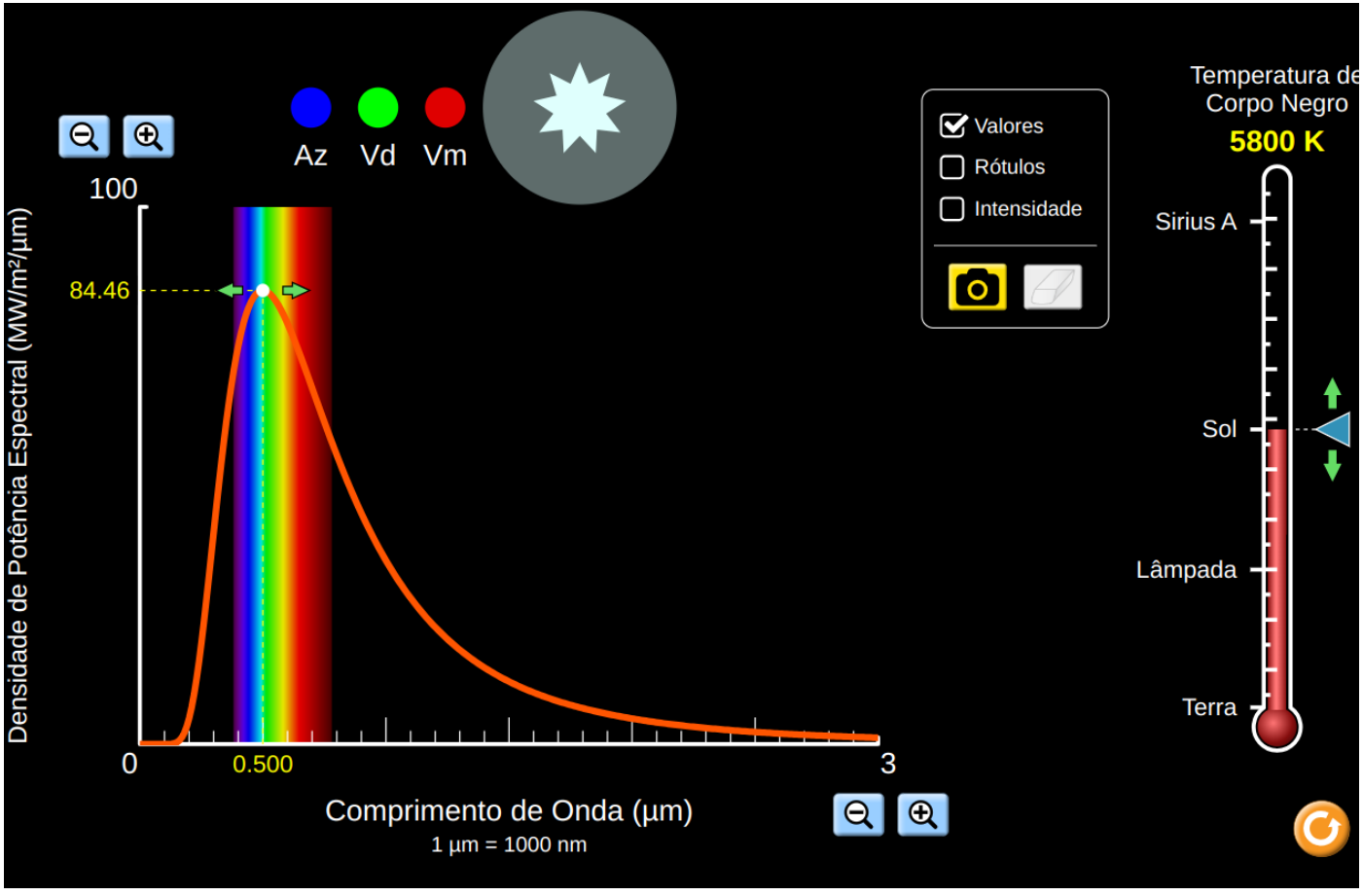


Campos eletromagnéticos. (Imagem: Educa Mais Brasil)

Radiação vs Temperatura

- https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_all.html?locale=pt_BR

PhET: Espectro de corpo negro (simulação)

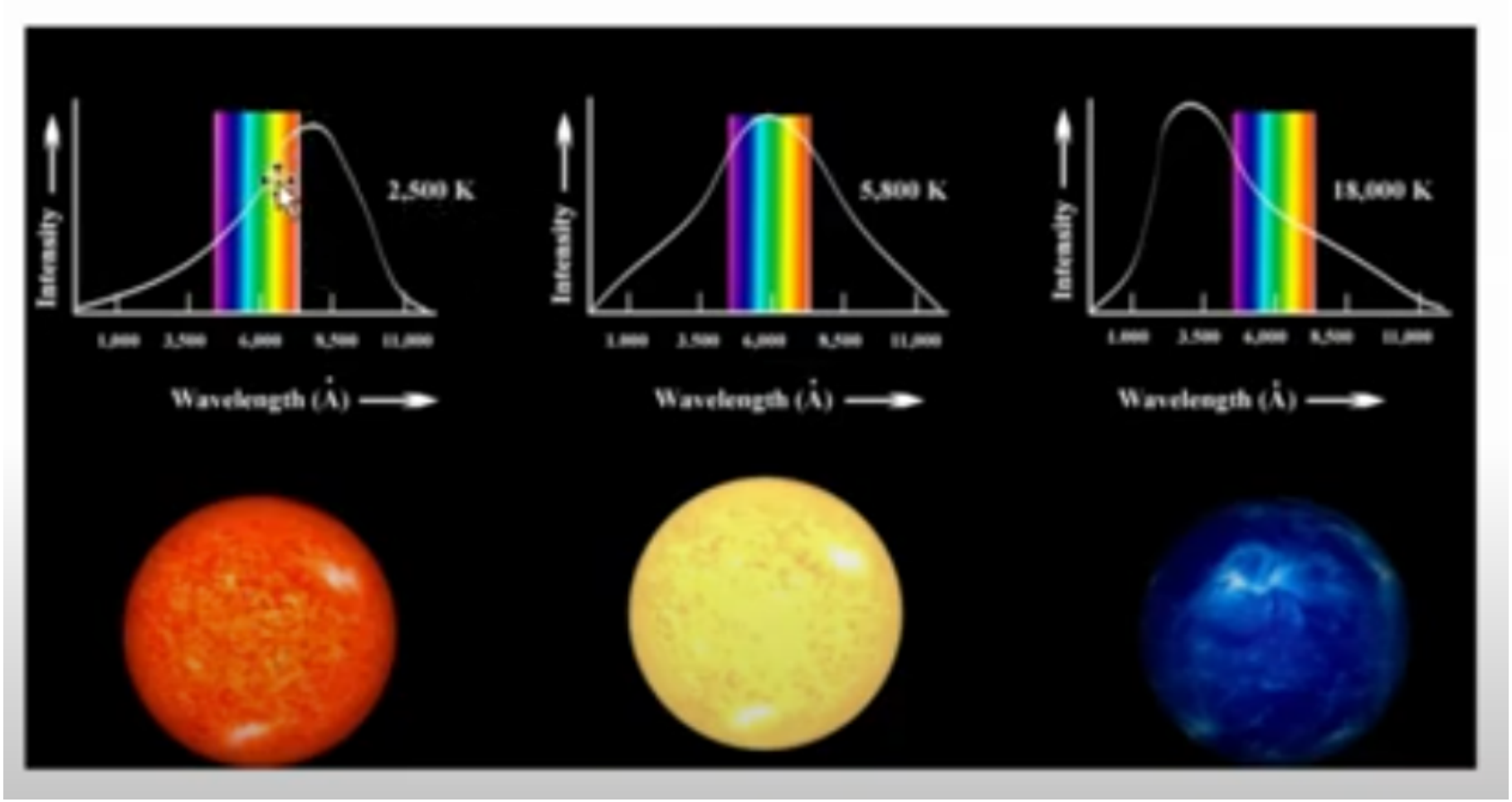


- https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_all.html?locale=pt_BR

Teste: Qual estrela tem a maior Temperatura?

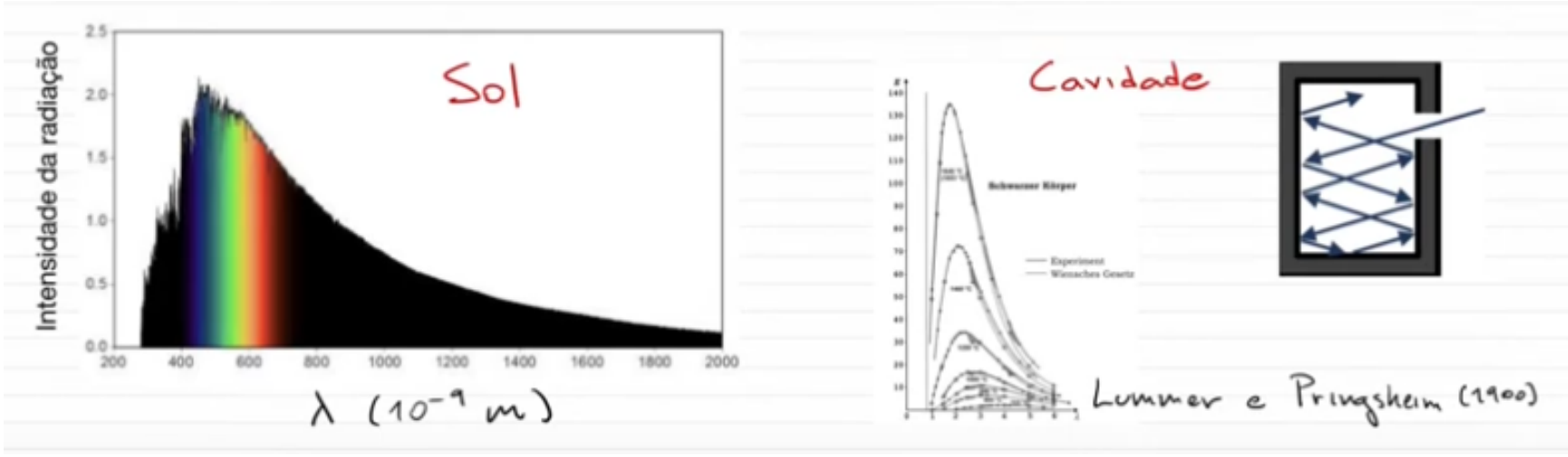
- https://www.youtube.com/watch?v=JSpSVL3l5NA

Teste: Qual estrela tem a maior Temperatura?



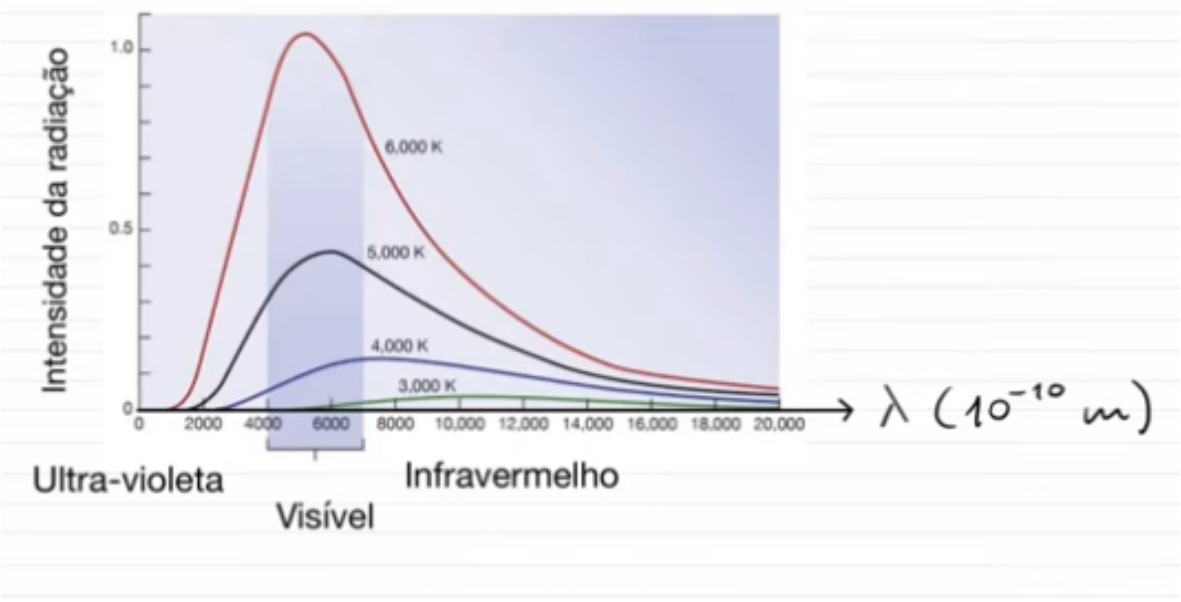
- https://www.youtube.com/watch?v=JSpSVL3l5NA

Corpo negro (ideal)



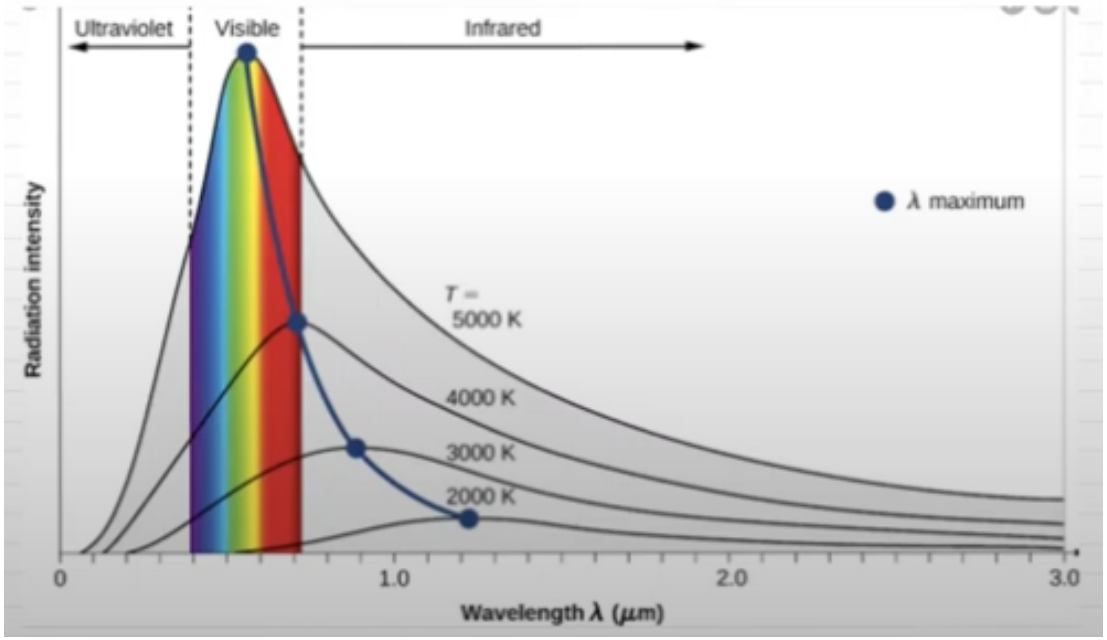
- https://www.youtube.com/watch?v=I9dnJT5dEYY&list=PLpDFI2iyrPsx0T4ttkHZ-Z1vSONcT-AbL&index=2

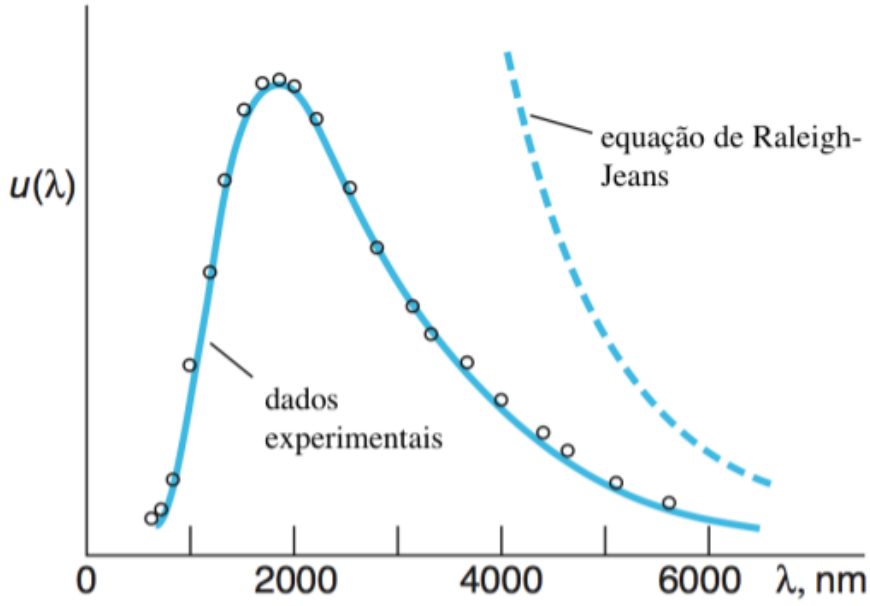
Corpo negro (ideal)



- https://www.youtube.com/watch?v=I9dnJT5dEYY&list=PLpDFI2iyrPsx0T4ttkHZ-Z1vSONcT-AbL&index=2

Lei de deslocamento de Wien





A equação de Rayleigh-Jeans (RJ) e a distribuição espectral de energia determinada experimentalmente.

Lei de Planck