

# Aula 1


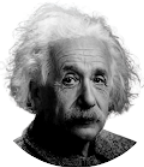


Prof. Márcio Sampaio Gomes Filho



# Observação

- ❖ Esses slides são um complemento à aula ministrada em sala;
- ❖ Explicações/desenvolvimentos serão feitas no quadro.



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

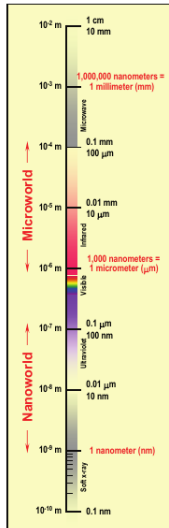
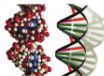
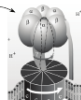
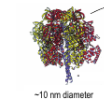
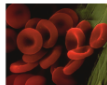


Dust mite  
200  $\mu\text{m}$



Human hair  
~ 60-120  $\mu\text{m}$  wide

Red blood cells  
(~7-8  $\mu\text{m}$ )

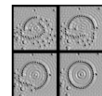
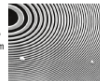


## Things Manmade



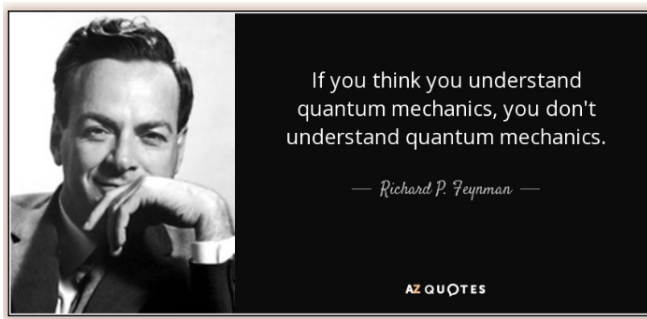
Pollen grain  
Red blood cells

Zone plate x-ray "lens"  
Outer ring spacing ~35 nm



**The Challenge**

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



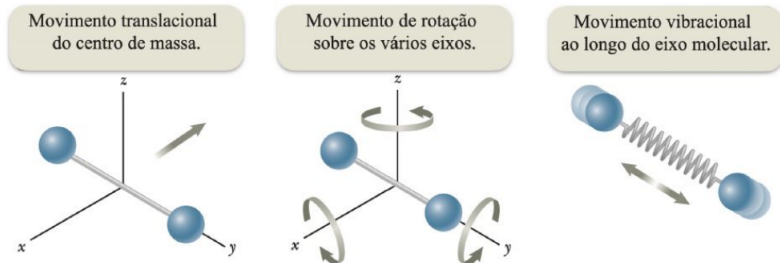
❖ [https://www.azquotes.com/quote/847297#google\\_vignette](https://www.azquotes.com/quote/847297#google_vignette)

# Calor específico molar de gases

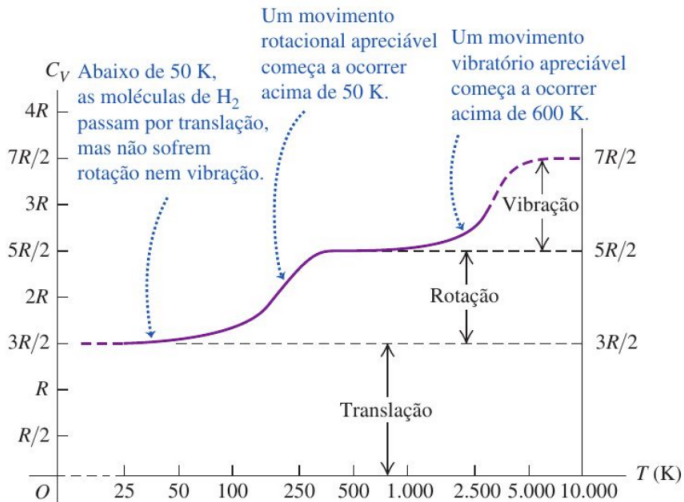
**TABELA 17.3 | Calor específico molar de vários gases**

Calor específico molar (J/mol · K) <sup>a</sup>					
Gás	$C_p$	$C_V$	$C_p - C_V$	$\gamma = C_p/C_V$	
<b>Gases monoatômicos</b>					
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	
<b>Gases diatômicos</b>					
H <sub>2</sub>	28,8	20,4	8,33	1,41	
N <sub>2</sub>	29,1	20,8	8,33	1,40	
O <sub>2</sub>	29,4	21,1	8,33	1,40	
CO	29,3	21,0	8,33	1,40	
Cl <sub>2</sub>	34,7	25,7	8,96	1,35	
<b>Gases poliatômicos</b>					
CO <sub>2</sub>	37,0	28,5	8,50	1,30	
SO <sub>2</sub>	40,4	31,4	9,00	1,29	
H <sub>2</sub> O	35,4	27,0	8,37	1,30	
CH <sub>4</sub>	35,5	27,1	8,41	1,31	
<sup>a</sup> Todos os valores foram obtidos a 300K, exceto para água.					

# Calor específico molar de gases

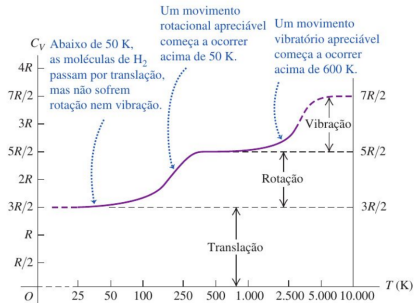


**Calor específico molar a volume constante, para o gás hidrogênio ( $H_2$ ).**  
A temperatura é representada em escala logarítmica.

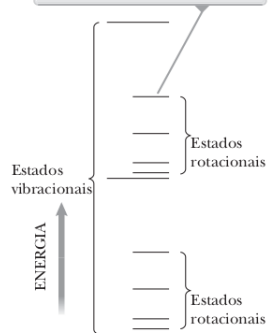




**Calor específico molar a volume constante, para o gás hidrogênio ( $H_2$ ).**  
A temperatura é representada em escala logarítmica.

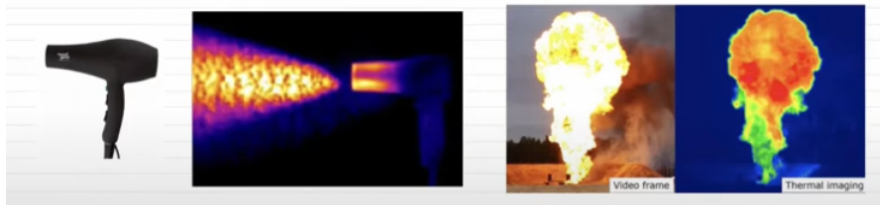


Os estados de rotação estão mais próximos em energia do que os vibracionais.

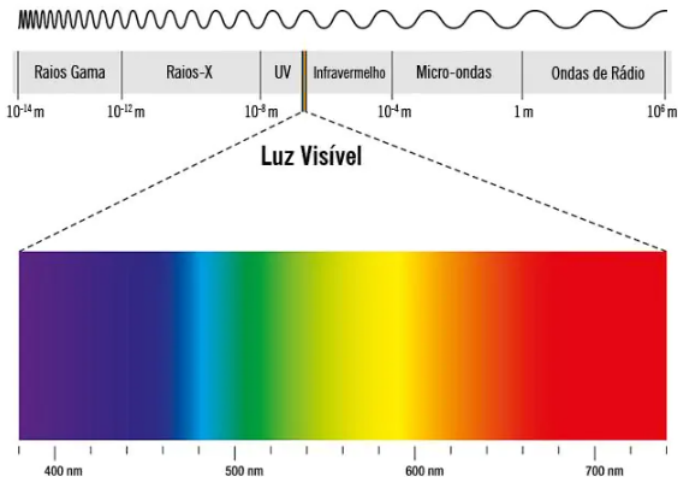


# Física Quântica: Evidências Experimentais

## ❖ Radiação e Temperatura



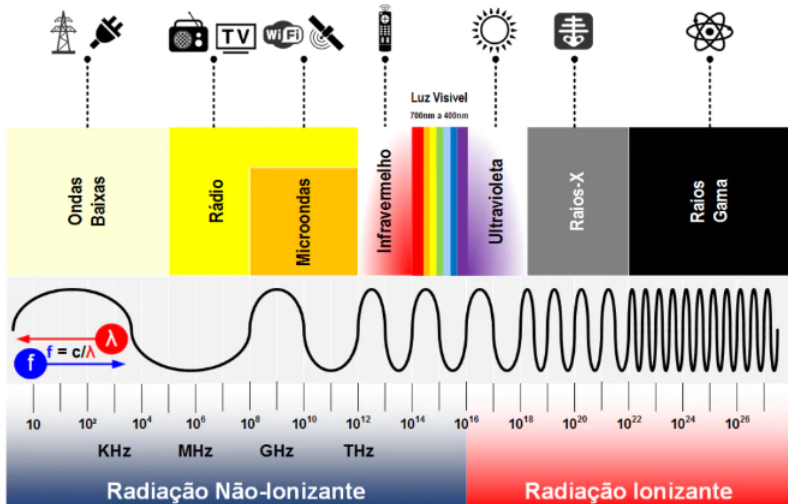
# Espectro eletromagnético



❖ <https://adenilsongiovanini.com.br/blog/espectro-eletromagnetico/>

# Espectro eletromagnético

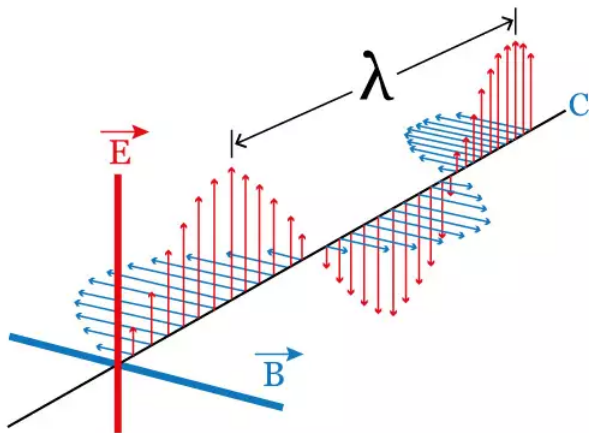
## A descoberta do espectro eletromagnético



# Luz branca



# Ondas eletromagnética



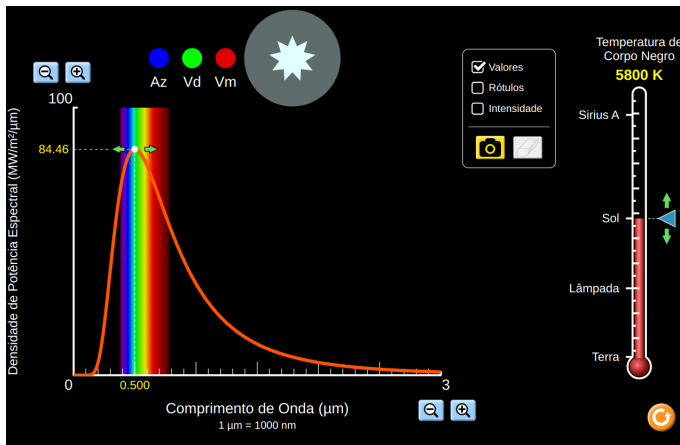
*Campos eletromagnéticos. (Imagem: Educa Mais Brasil)*

# Radiação vs Temperatura



❖ [https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum\\_all.html?locale=pt\\_BR](https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_all.html?locale=pt_BR)

# PhET: Espectro de corpo negro (simulação)



❖ [https:](https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_all.html?locale=pt_BR)

[//phet.colorado.edu/sims/html/blackbody-spectrum/  
latest/blackbody-spectrum\\_all.html?locale=pt\\_BR](https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_all.html?locale=pt_BR)

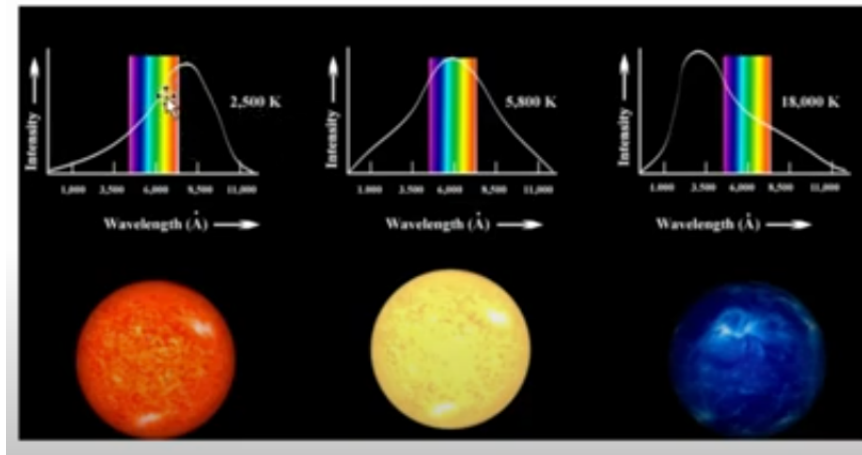


# Teste: Qual estrela tem a maior Temperatura?

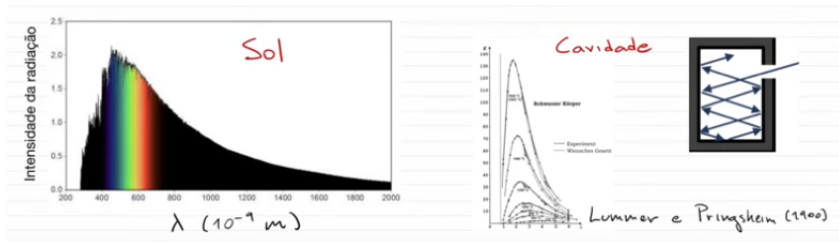


❖ <https://www.youtube.com/watch?v=JSpSVL3l5NA>

# Teste: Qual estrela tem a maior Temperatura?

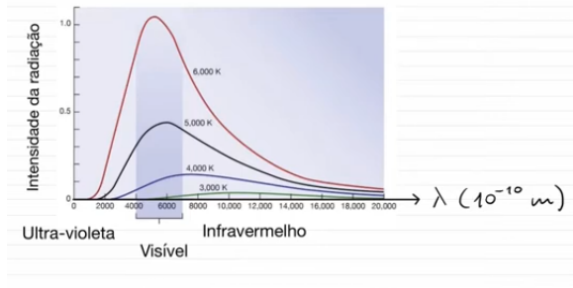


# Corpo negro (ideal)



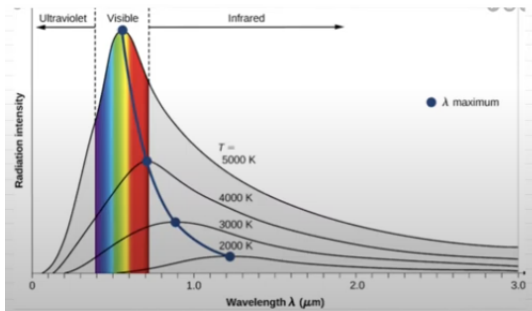
❖ <https://www.youtube.com/watch?v=I9dnJT5dEYY&list=PLpDFI2iyPpsxOT4ttkHZ-Z1vSONcT-AbL&index=2>

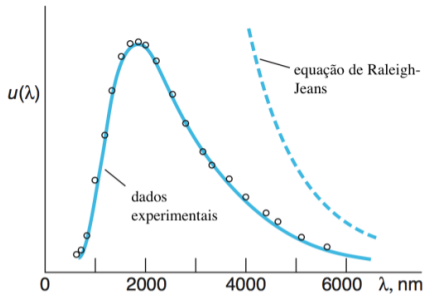
# Corpo negro (ideal)



❖ <https://www.youtube.com/watch?v=I9dnJT5dEYY&list=PLpDFI2iyrPsxOT4ttkHZ-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

