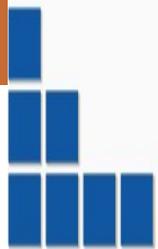


DA MECÂNICA QUÂNTICA À NANOTECNOLOGIA

JOÃO PENEDONES
Setembro, 2008



Escola de Verão de Física



U. PORTO

FACULDADE DE CIÊNCIAS
UNIVERSIDADE DO PORTO

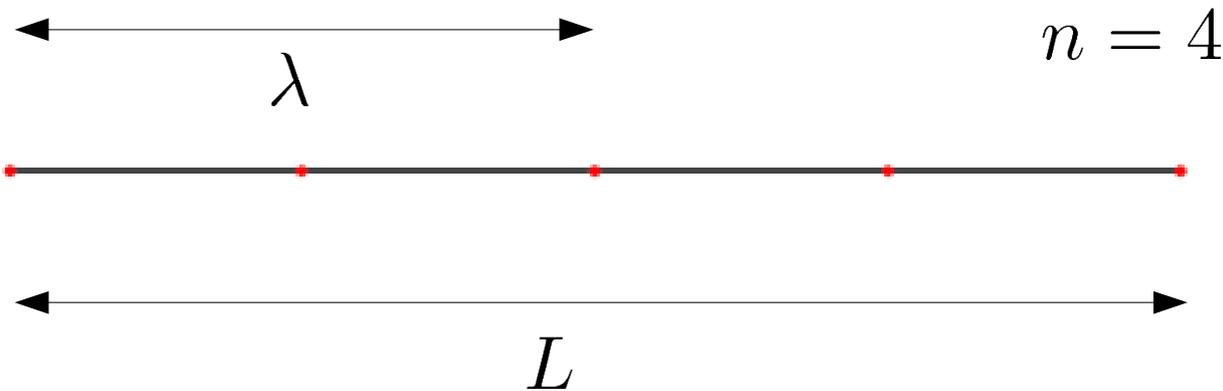
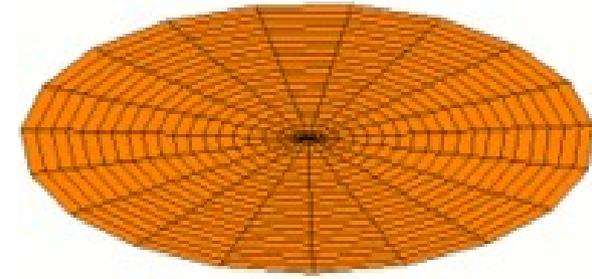
Plano do Curso:

- **Experiência da dupla fenda**
- **Mecânica Quântica em todo o lado**
- **Nanotecnologia**
- **Interpretações da Mecânica Quântica**

Mecânica quântica em todo o lado

Quantificação de Energia

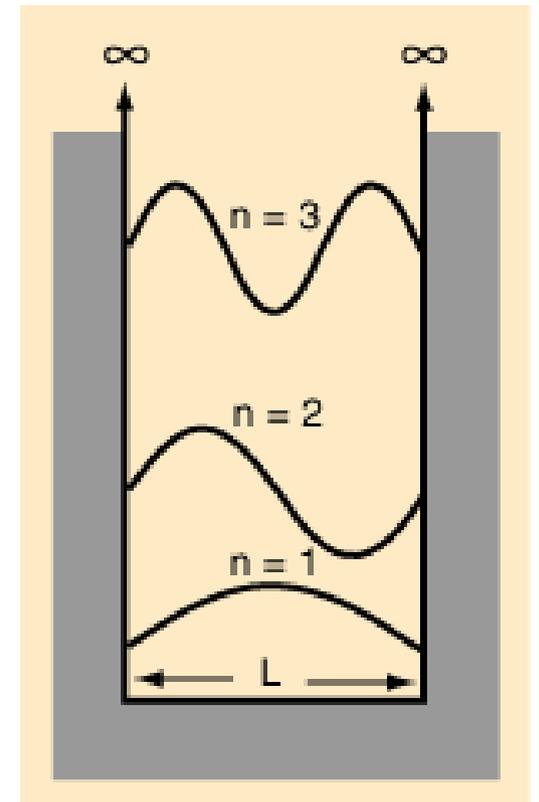
Ondas estacionárias



Electrão numa caixa

$$E = \frac{1}{2}mv^2 = \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2} = \frac{h^2}{8mL^2}n^2$$

$p = mv$ $p = \frac{h}{\lambda}$ $L = n \frac{\lambda}{2}$



O Átomo de Hidrogénio

Força eléctrica = Força centrípeta

$$k \frac{e^2}{r^2} = m \frac{v^2}{r}$$

Relação de De Broglie

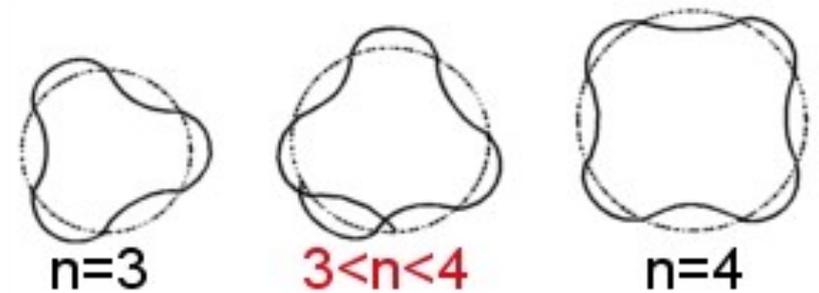
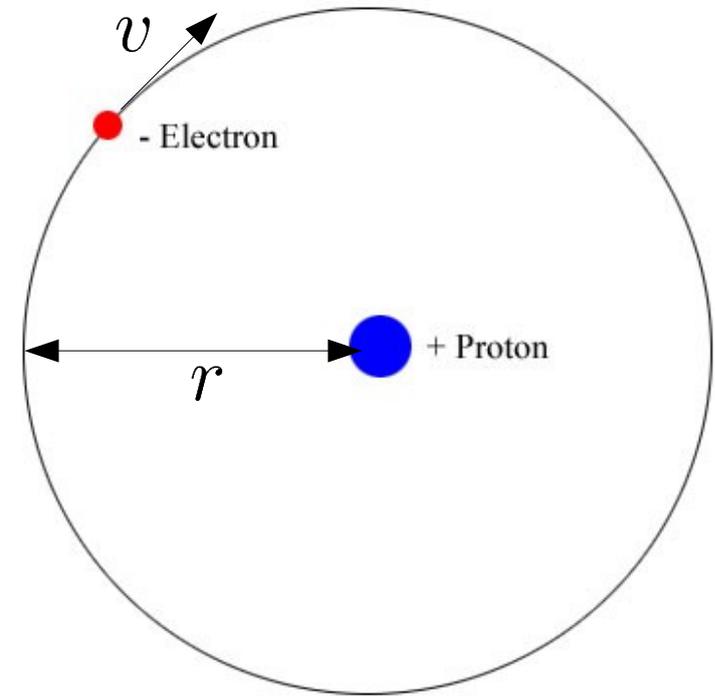
$$p = mv = \frac{h}{\lambda}$$

Condição de estacionaridade

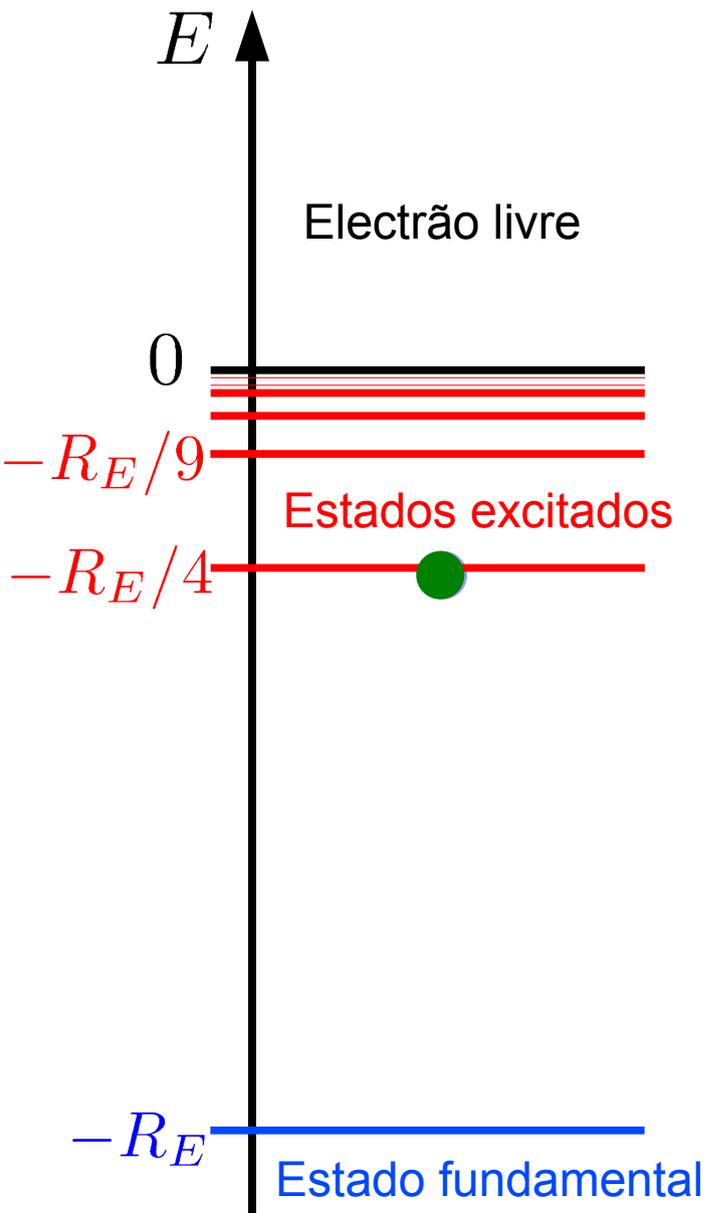
$$2\pi r = n\lambda$$

Quantificação de energia

$$E = \frac{1}{2}mv^2 - k \frac{e^2}{r} = -\frac{R_E}{n^2}, \quad R_E = \frac{2\pi^2 k^2 e^4 m}{h^2} = 13,6 \text{ eV}$$



O Átomo de Hidrogénio



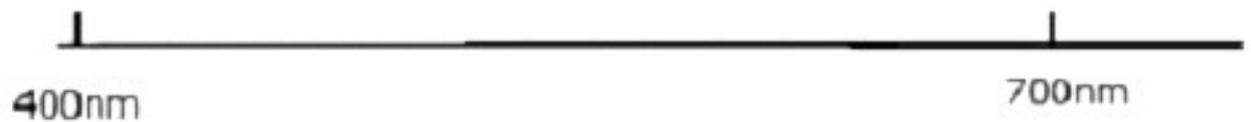
Energia do fóton

$$E_{\text{fotao}} = -\Delta E_{\text{electrao}}$$

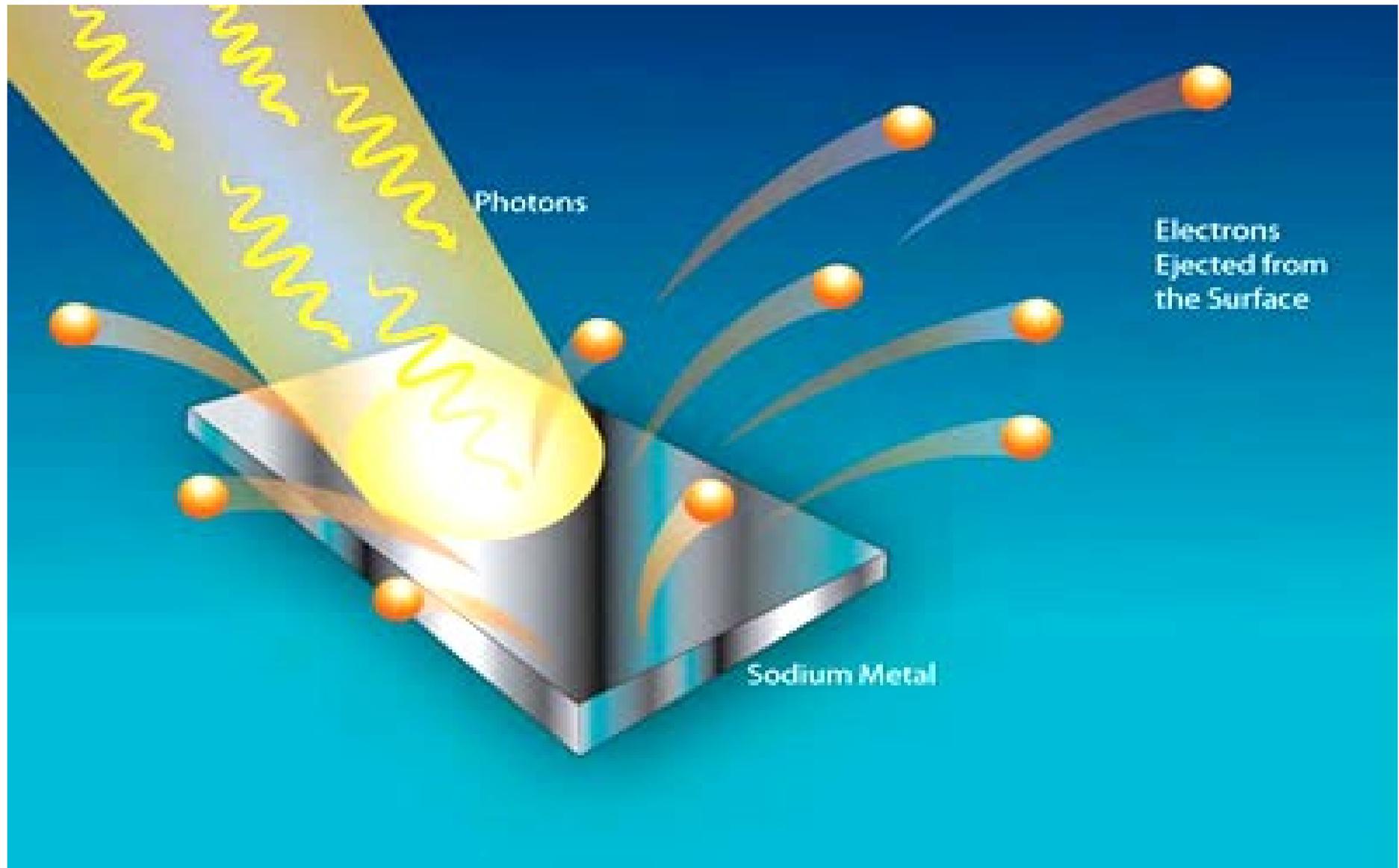
Hydrogen Absorption Spectrum



Hydrogen Emission Spectrum



O Efeito fotoeletrico



Átomos

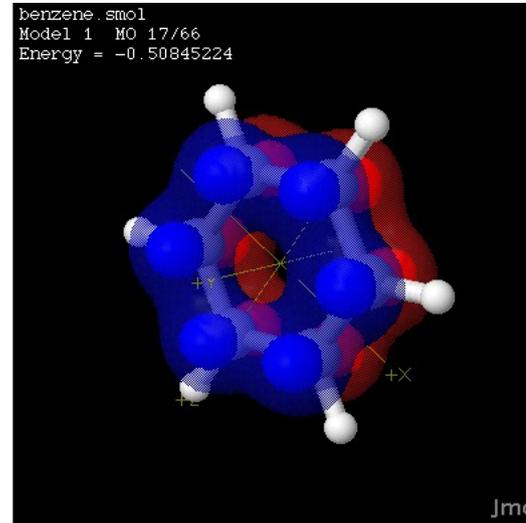
Periodic Table of the Elements

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Unn								
58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu				
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr				

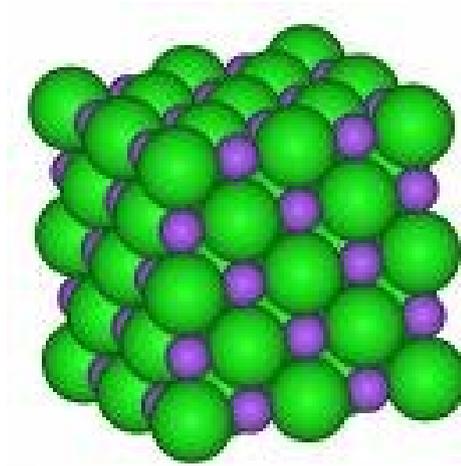
Legend:

- hydrogen
- alkali metals
- alkali earth metals
- transition metals
- poor metals
- nonmetals
- noble gases
- rare earth metals

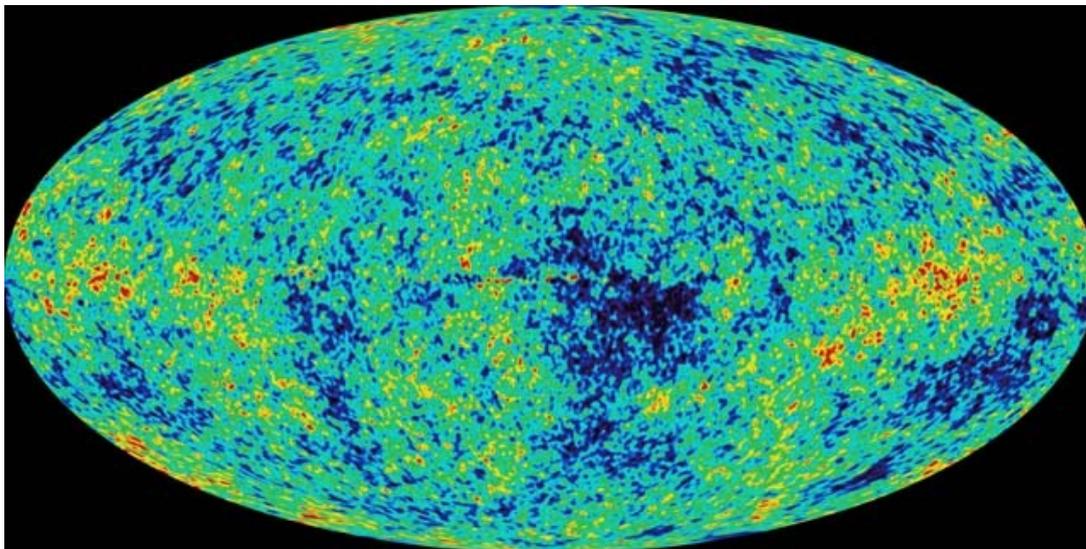
Moléculas



Sólidos



Big-Bang



Partículas Elementares

Quarks	u up	c charm	t top	γ photon		
	d down	s strange	b bottom		g gluon	
Leptons	ν_e electron neutrino	ν_μ muon neutrino	ν_τ tau neutrino	Z Z boson		
	e electron	μ muon	τ tau		W W boson	
			I	II	III	
Three Families of Matter						