# Spectroscopy

The pattern of states of a quantum system is a direct consequence of the force binding the system.





Energy levels of the helium atom.

$$V = k_e \frac{q_1 q_2}{r}$$

Energy levels of the nucleon.

$$V = -\frac{4}{3}\frac{\alpha_s \hbar c}{r} + kr$$

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# **The Optical Spectrum of Hydrogen**





The Optical Spectrum of Hudrogen -p. 2/12

### **Double-Slit Interference**





Interfering waves

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#### **Double Slit Interference**



**Double Slit Interference** 



#### **Double Slit Interference**



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# **The Hydrogen Lines**



$$\frac{1}{\lambda} = R_H \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

 $R_H$  - Rydberg constant

### **The Gaussian Distribution**



### **The Differential**



### **The Differential**



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#### Which Point is Best?



#### Which Point is Best?



# **Identifying Your Unknown - 1**

1. Pattern recognition - http://astro.u-strasbg.fr/~koppen/discharge/.



2. Listing of hydrogen data from website (wavelength (Å) and relative intensity).

3970.07	8
4101.74	15
4340.47	30
4861.33	80
6562.72	120
6562.85	180

# **Identifying Your Unknown - 2**

3. Quantitative comparison for hydrogen in units of  $\sigma$ .

Line	My Results (Å)	NIST Results (Å)	Normalized Difference
$\alpha$	$6.64\pm0.09\times10^3$	$6.56280\times 10^3$	0.95
eta	$4.85\pm0.15\times10^3$	$4.86133\times 10^3$	0.11
$\gamma$	$4.39 \pm 0.06 \times 10^{3}$	$4.34047\times 10^3$	0.9