ENGINEERING CHEMISTRY

Department of Science and Humanities

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Module 1- Molecular spectroscopy

Class Content :

- ***Electromagnetic spectrum***
- ***Information obtained from each region of the spectrum***

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Module I- Molecular Spectroscopy

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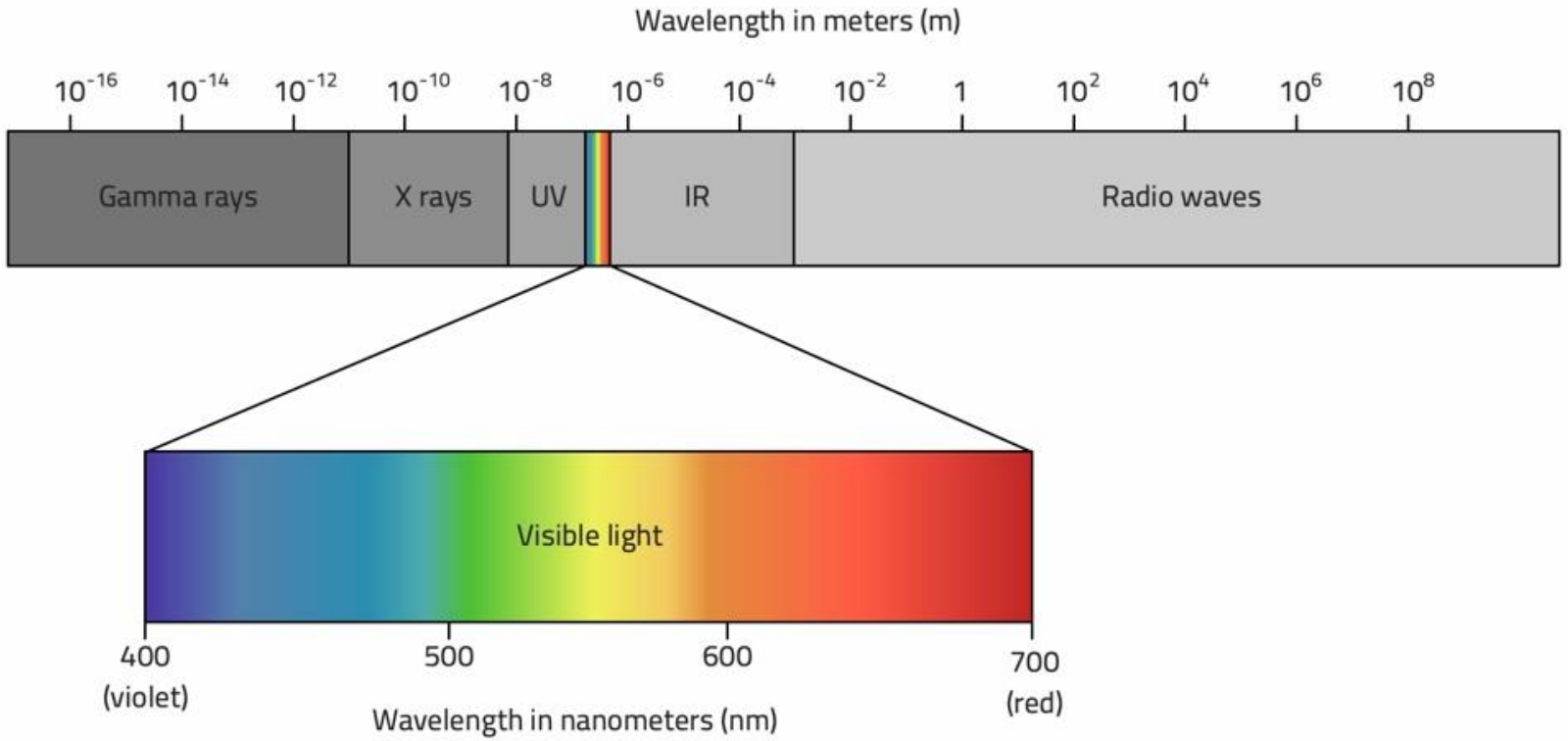
Electromagnetic spectrum



Source: https://www.radio2space.com/components-of-electromagnetic-spectrum/

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Information obtained from different regions of electromagnetic spectrum

Radiofrequency region	**Wavelength (10m-1cm)** **NMR, ESR** **Nuclear and electron spin reversal**
Microwave region	**Wavelength (1cm-100µm)** **Rotational spectroscopy** **Rotational levels**
Infra Red region	**Wavelength (100µm-1µm)** **Vibrational spectroscopy** **Vibrational levels**

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Information obtained from different regions of electromagnetic spectrum

Visible and Ultra-Violet region	Wavelength (1µm-10nm) UV-Visible spectroscopy Electronic states Change in electronic distribution of valence electrons
X-ray region	Wavelength (10nm-100pm) X-ray spectroscopy Change in electronic distribution of inner electrons
γ- ray region	Wavelength (100pm-1pm) γ- ray spectroscopy Rearrangement of nuclear particles

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Raman Spectroscopy: **scattering of light**

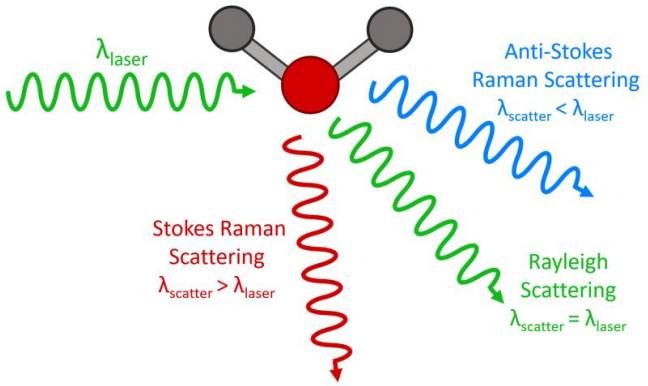
When monochromatic radiation is passed through a transparent medium:

Most of the scattered radiation consists of radiation of incident wavelength – **Rayleigh scattering**

Some of the scattered radiation consists of radiation with different wavelength from incident wavelength – **Raman scattering**

When the wavelength of scattered radiation is more than that of incident radiation – **Stokes lines**

When the wavelength of scattered radiation is less than that of incident radiation – **anti -Stokes lines**



https://www.edinst.com/blog/what-is-raman-spectroscopy/

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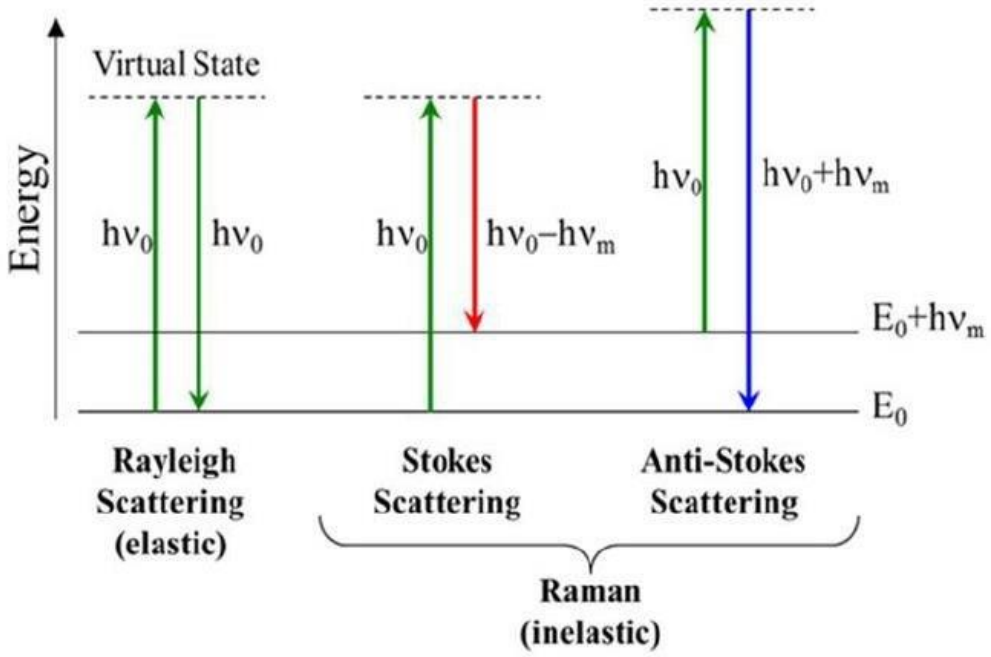

Source:https://www.researchgate.net/figure/A-simplified-diagram-of-energy-transitions-for-Rayleigh-and-Raman-scattering_fig7_327321311

Exchange of energy between the molecules and radiation

Homonuclear diatomic molecules which are microwave and Infra-red inactive are Raman active

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Information obtained from different regions of electromagnetic spectrum

Spectral region	VHF	UHF	Microwave	Infrared	Visible	Ultraviolet	X-rays	γ-rays
Common usage	NMR	EPR	rotational transitions	vibrational transitions	electronic transitions		ionisation	nuclear effects
Frequency (Hz)	5×10^{8}	3×10^{10}	3×10^{11}	3×10^{13}	6×10^{14}	1.2×10^{15}	3.0×10^{17}	1.5×10^{19}
Wavelength	0.6 m	1 cm	1 mm	10 μm	500 nm	250 nm	1 nm	20 pm
Wavenumber (cm^{-1})	0.017	1.0	10.0	1000	20,000	40,000	1.0×10^{7}	5.0×10^{8}

Source: http://photobiology.info/Visser-Rolinski.html

THANK YOU

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