ELECTROMAGNETIC SPECTRUM

Astronomy band reference • TeV gamma rays to long-wavelength radio

01 GAMMA RAYS

$10^{-18} \rightarrow 10^{-14}$ m

λ vacuum	10^{-8} Å		5×10^{-8} Å		10^{-7} Å		2×10^{-7} Å		5×10^{-7} Å		10^{-6} Å		2×10^{-6} Å		5×10^{-6} Å		10^{-5} Å		2×10^{-5} Å		10^{-4} Å
ν frequency	2×10^{26} Hz		10^{26} Hz		5×10^{25} Hz		2×10^{25} Hz		10^{25} Hz		5×10^{24} Hz		2×10^{24} Hz		10^{24} Hz		5×10^{23} Hz		2×10^{23} Hz		10^{23} Hz	5×10^{22} Hz
E photon	1 TeV	500 GeV		200 GeV		100 GeV		50 GeV		20 GeV		10 GeV		5 GeV		2 GeV		1 GeV		500 MeV		200 MeV
σ̃ cm⁻¹	10^{16}		5×10^{15}		2×10^{15}		10^{15}		5×10^{14}		2×10^{14}		10^{14}		5×10^{13}		2×10^{13}		10^{13}		5×10^{12}	2×10^{12}	10^{12}

Gamma rays

02 GAMMA RAYS · HARD X-RAYS

$10^{-14} \rightarrow 10^{-10}$ m

λ vacuum	10^{-4} Å		5×10^{-4} Å		0.001 Å		0.002 Å		0.005 Å		0.01 Å		0.02 Å		0.05 Å		0.1 Å		0.2 Å		0.5 Å	1 Å
ν frequency	2×10^{22} Hz		10^{22} Hz		5×10^{21} Hz		2×10^{21} Hz		10^{21} Hz		5×10^{20} Hz		2×10^{20} Hz		10^{20} Hz		5×10^{19} Hz		2×10^{19} Hz		10^{19} Hz	5×10^{18} Hz
E photon	100 MeV	50 MeV		20 MeV		10 MeV		5 MeV		2 MeV		1 MeV		500 keV		200 keV		100 keV		50 keV		20 keV
σ̃ cm⁻¹	10^{12}		5×10^{11}		2×10^{11}		10^{11}		5×10^{10}		2×10^{10}		10^{10}		5×10^{9}		2×10^{9}		10^{9}		5×10^{8}	2×10^{8}	10^{8}

Gamma rays | Hard X-ray

03 X-RAYS · ULTRAVIOLET · OPTICAL

$10^{-10} \rightarrow 10^{-6}$ m

λ vacuum	1 Å		2 Å		5 Å		10 Å		20 Å		50 Å		100 Å		200 Å		500 Å	0.1 µm		0.2 µm		0.5 µm	1 µm
ν frequency	2×10^{18} Hz		10^{18} Hz		5×10^{17} Hz		2×10^{17} Hz		10^{17} Hz		5×10^{16} Hz		2×10^{16} Hz		10^{16} Hz		5×10^{15} Hz		2×10^{15} Hz		10^{15} Hz	500 THz
E photon	10 keV		5 keV		2 keV		1 keV		500 eV		200 eV		100 eV		50 eV		20 eV		10 eV		5 eV	2 eV
σ̃ cm⁻¹	10^{8}		5×10^{7}		2×10^{7}		10^{7}		5×10^{6}		2×10^{6}		10		5×10^{5}		2×10^{5}		10^{5}		5×10^{4}	2×10^{4}	10^{4}

Soft X-ray | EUV | FUV | NUV | Opt.

H edge, Lyα, U, B, V, R, I

04 INFRARED · SUB-mm · mm

$10^{-6} \rightarrow 10^{-2}$ m

λ vacuum	1 µm		2 µm		5 µm		10 µm		20 µm		50 µm		100 µm		200 µm		500 µm	1 mm		2 mm		5 mm	1 cm
ν frequency	200 THz		100 THz		50 THz		20 THz		10 THz		5 THz		2 THz		1 THz		500 GHz		200 GHz		100 GHz	50 GHz	
E photon	1 eV		0.5 eV		0.2 eV		0.1 eV		0.05 eV		0.02 eV		0.01 eV		0.005 eV		0.002 eV	0.001 eV		5×10^{-4} eV		2×10^{-4} eV	
σ̃ cm⁻¹	10^{4}		5000		2000		1000		500		200		100		50		20	10		5		2	1

Near-IR | Mid-IR | Far-IR | Sub-mm | Millimetre

J, H, K, L, M, N, Q

A10, A9, A8, A7, A6, A5, A4, A3, A2, A1, Q, Ka

05 CENTIMETRE · METRE · DECAMETRE RADIO

$10^{-2} \rightarrow 10^{2}$ m

λ vacuum	1 cm		2 cm		5 cm		10 cm		20 cm		50 cm		1 m		2 m		5 m	10 m		20 m		50 m	100 m
ν frequency	20 GHz		10 GHz		5 GHz		2 GHz		1 GHz		500 MHz		200 MHz		100 MHz		50 MHz		20 MHz		10 MHz	5 MHz	
E photon	10^{-4} eV		5×10^{-5} eV		2×10^{-5} eV		10^{-5} eV		5×10^{-6} eV		2×10^{-6} eV		10^{-6} eV		5×10^{-7} eV		2×10^{-7} eV	10^{-7} eV		5×10^{-8} eV		2×10^{-8} eV	
σ̃ cm⁻¹	1		0.5		0.2		0.1		0.05		0.02		0.01		0.005		0.002	0.001		5×10^{-4}		2×10^{-4}	10^{-4}

Ka | K | Ku | X | C | S | L | P | 4

H I 21 cm

06 LONG-WAVELENGTH RADIO

$10^{2} \rightarrow 10^{6}$ m

λ vacuum	100 m		200 m		500 m		1000 m		2000 m		5000 m		10 km		20 km		50 km	100 km		200 km		1000 km	
ν frequency	2 MHz		1 MHz		500 kHz		200 kHz		100 kHz		50 kHz		20 kHz		10 kHz		5 kHz		2 kHz		1 kHz	500 Hz	
E photon	10^{-8} eV		5×10^{-9} eV		2×10^{-9} eV		10^{-9} eV		5×10^{-10} eV		2×10^{-10} eV		10^{-10} eV		5×10^{-11} eV		2×10^{-11} eV	10^{-11} eV		5×10^{-12} eV		2×10^{-12} eV	
σ̃ cm⁻¹	10^{-4}		5×10^{-5}		2×10^{-5}		10^{-5}		5×10^{-6}		2×10^{-6}		10^{-6}		5×10^{-7}		2×10^{-7}	10^{-7}		5×10^{-8}		2×10^{-8}	10^{-8}

Long-wavelength radio

The lowest-frequency portion is mainly accessible from space.

λν = c E = hν = hc/λ σ̃ = 1/λ(cm)