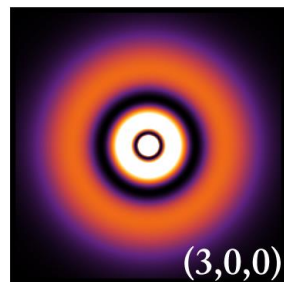
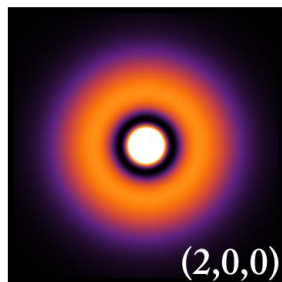


Hydrogen atom: Wave functions and their components

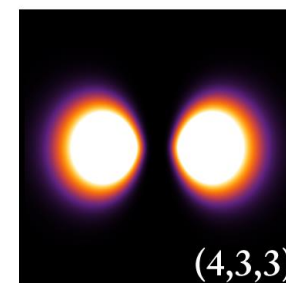
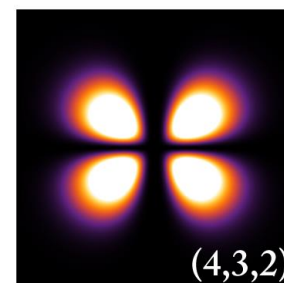
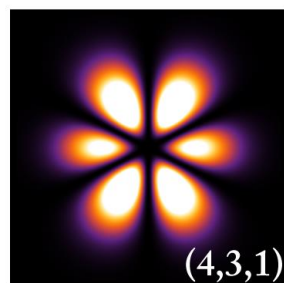
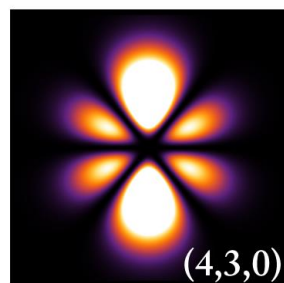
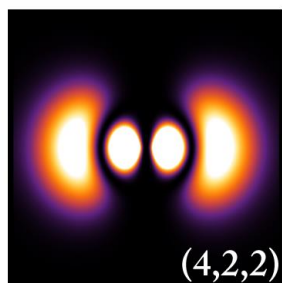
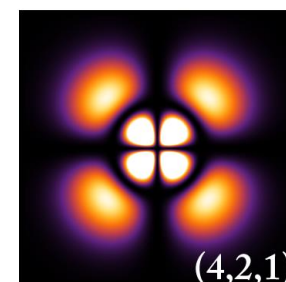
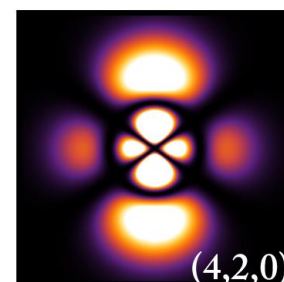
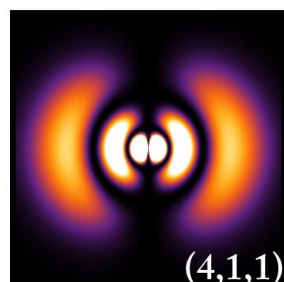
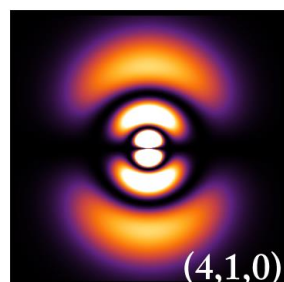
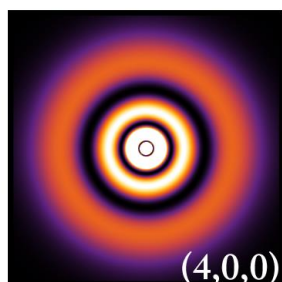
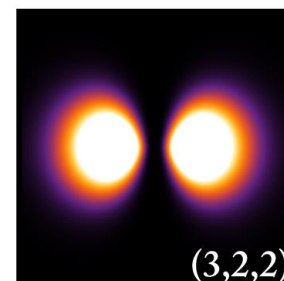
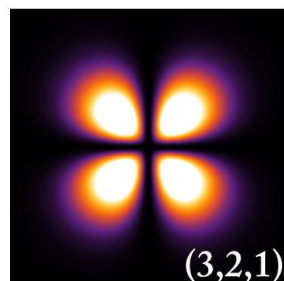
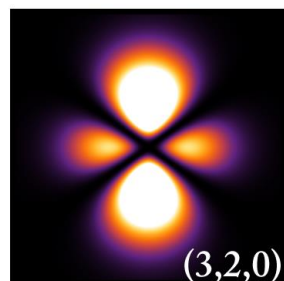
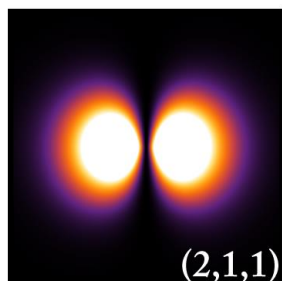
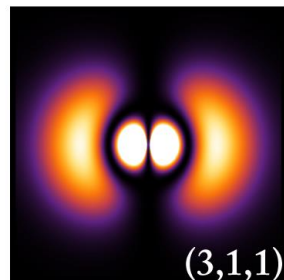
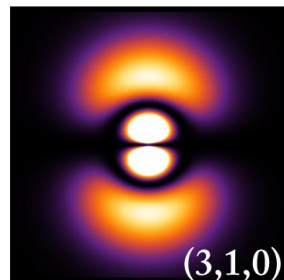
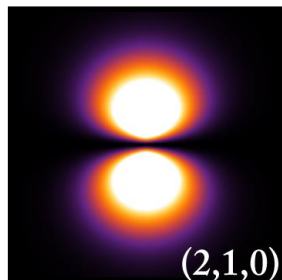
n	ℓ	m	$R_{n\ell}$	$Y_{\ell m}$	$\psi_{n\ell m} = R_{n\ell} Y_{\ell m}$
1	0	0	$2 \left(\frac{1}{a_0} \right)^{3/2} e^{-r/a_0}$	$\frac{1}{2\sqrt{\pi}}$	$\frac{1}{\sqrt{\pi}} \left(\frac{1}{a_0} \right)^{3/2} e^{-r/a_0}$
2	0	0	$\left(\frac{1}{2a_0} \right)^{3/2} \left(2 - \frac{r}{a_0} \right) e^{-r/2a_0}$	$\frac{1}{2\sqrt{\pi}}$	$\frac{1}{4\sqrt{2\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(2 - \frac{r}{a_0} \right) e^{-r/2a_0}$
2	1	0	$\left(\frac{1}{2a_0} \right)^{3/2} \frac{1}{\sqrt{3}} \frac{r}{a_0} e^{-r/2a_0}$	$\frac{1}{2} \sqrt{\frac{3}{\pi}} \cos \theta$	$\frac{1}{4\sqrt{2\pi}} \left(\frac{1}{a_0} \right)^{3/2} \frac{r}{a_0} e^{-r/2a_0} \cos \theta$
2	1	± 1	$\left(\frac{1}{2a_0} \right)^{3/2} \frac{1}{\sqrt{3}} \frac{r}{a_0} e^{-r/2a_0}$	$\pm \frac{1}{2} \sqrt{\frac{3}{2\pi}} \sin \theta e^{\pm i\phi}$	$\frac{1}{8} \sqrt{\frac{1}{\pi}} \left(\frac{1}{a_0} \right)^{3/2} \frac{r}{a_0} e^{-r/2a_0} \sin \theta e^{\pm i\phi}$
3	0	0	$2 \left(\frac{1}{3a_0} \right)^{3/2} \left(1 - \frac{2}{3} \frac{r}{a_0} + \frac{2}{27} (r/a_0)^2 \right) e^{-r/3a_0}$	$\frac{1}{2\sqrt{\pi}}$	$\frac{1}{81\sqrt{3\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(27 - 18 \frac{r}{a_0} + 2(r/a_0)^2 \right) e^{-r/3a_0}$
3	1	0	$\left(\frac{1}{3a_0} \right)^{3/2} \frac{4\sqrt{2}}{3} \left(1 - \frac{1}{6} \frac{r}{a_0} \right) \frac{r}{a_0} e^{-r/3a_0}$	$\frac{1}{2} \sqrt{\frac{3}{\pi}} \cos \theta$	$\frac{1}{81} \sqrt{\frac{2}{\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(6 - \frac{r}{a_0} \right) \frac{r}{a_0} e^{-r/3a_0} \cos \theta$
3	1	± 1	$\left(\frac{1}{3a_0} \right)^{3/2} \frac{4\sqrt{2}}{3} \left(1 - \frac{1}{6} \frac{r}{a_0} \right) \frac{r}{a_0} e^{-r/3a_0}$	$\pm \frac{1}{2} \sqrt{\frac{3}{2\pi}} \sin \theta e^{\pm i\phi}$	$\frac{1}{81\sqrt{\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(6 - \frac{r}{a_0} \right) \frac{r}{a_0} e^{-r/3a_0} \sin \theta e^{\pm i\phi}$
3	2	0	$\left(\frac{1}{3a_0} \right)^{3/2} \frac{2\sqrt{2}}{27\sqrt{5}} \left(\frac{r}{a_0} \right)^2 e^{-r/3a_0}$	$\frac{1}{4} \sqrt{\frac{5}{\pi}} (3 \cos^2 \theta - 1)$	$\frac{1}{81\sqrt{6\pi}} \left(\frac{1}{a_0} \right)^{3/2} \frac{r^2}{a_0^2} e^{-r/3a_0} (3 \cos^2 \theta - 1)$
3	2	± 1	$\left(\frac{1}{3a_0} \right)^{3/2} \frac{2\sqrt{2}}{27\sqrt{5}} \left(\frac{r}{a_0} \right)^2 e^{-r/3a_0}$	$\pm \frac{1}{2} \sqrt{\frac{15}{2\pi}} \sin \theta \cos \theta e^{\pm i\phi}$	$\frac{1}{81\sqrt{\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(\frac{r}{a_0} \right)^2 e^{-r/3a_0} \sin \theta \cos \theta e^{\pm i\phi}$
3	2	± 2	$\left(\frac{1}{3a_0} \right)^{3/2} \frac{2\sqrt{2}}{27\sqrt{5}} \left(\frac{r}{a_0} \right)^2 e^{-r/3a_0}$	$\frac{1}{4} \sqrt{\frac{15}{2\pi}} \sin^2 \theta e^{\pm 2i\phi}$	$\frac{1}{162\sqrt{\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(\frac{r}{a_0} \right)^2 e^{-r/3a_0} \sin^2 \theta e^{\pm 2i\phi}$



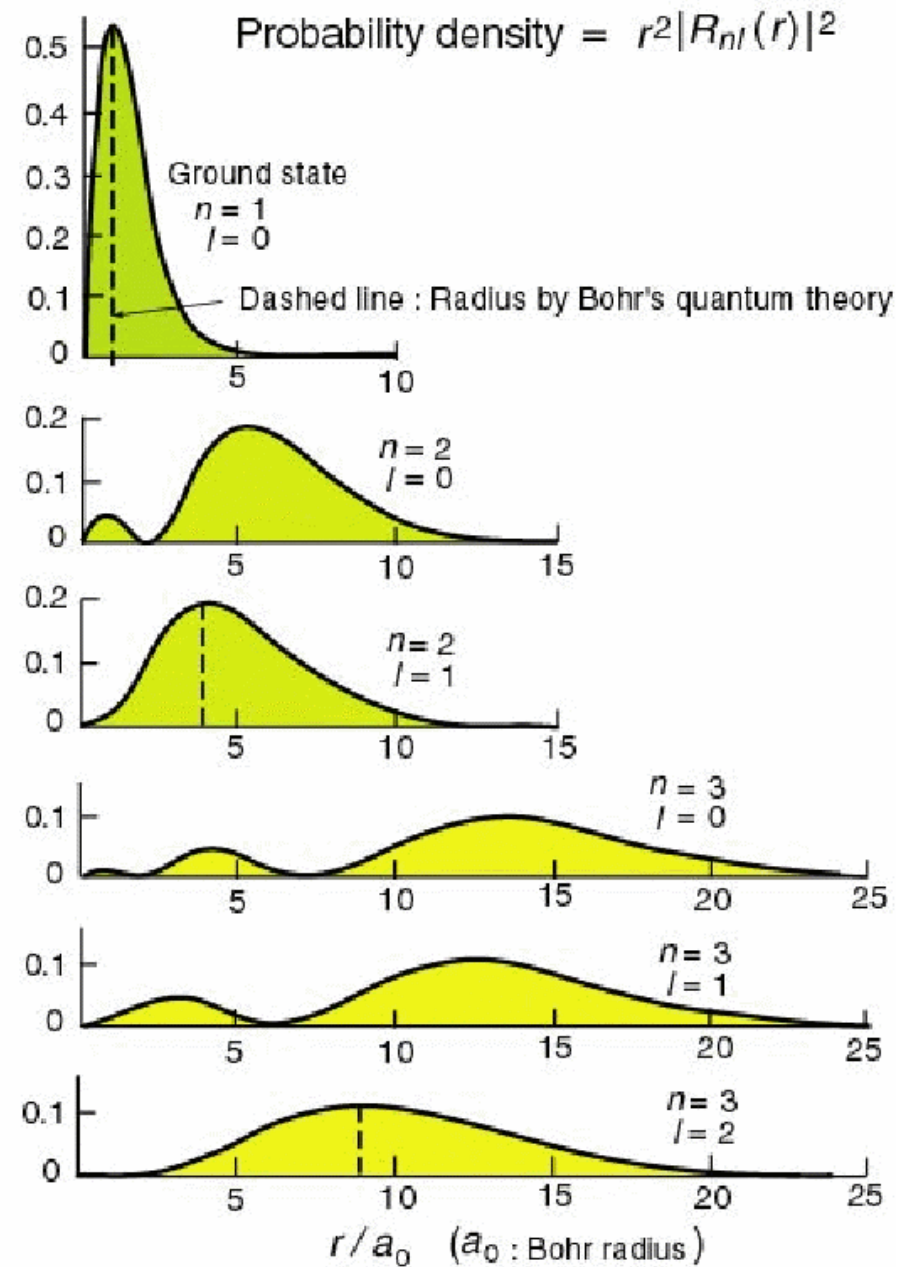
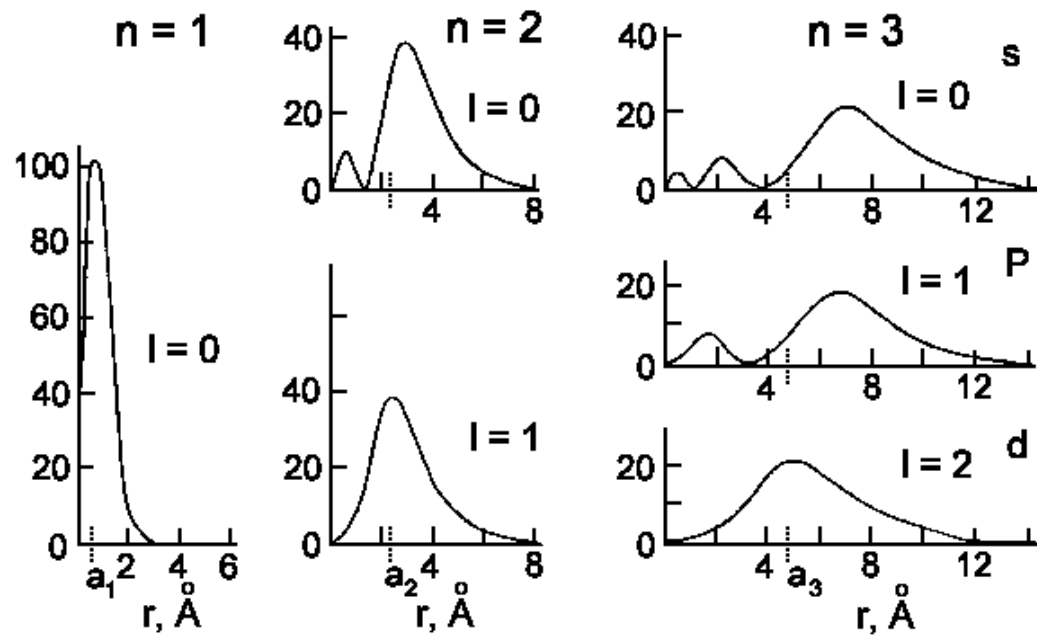
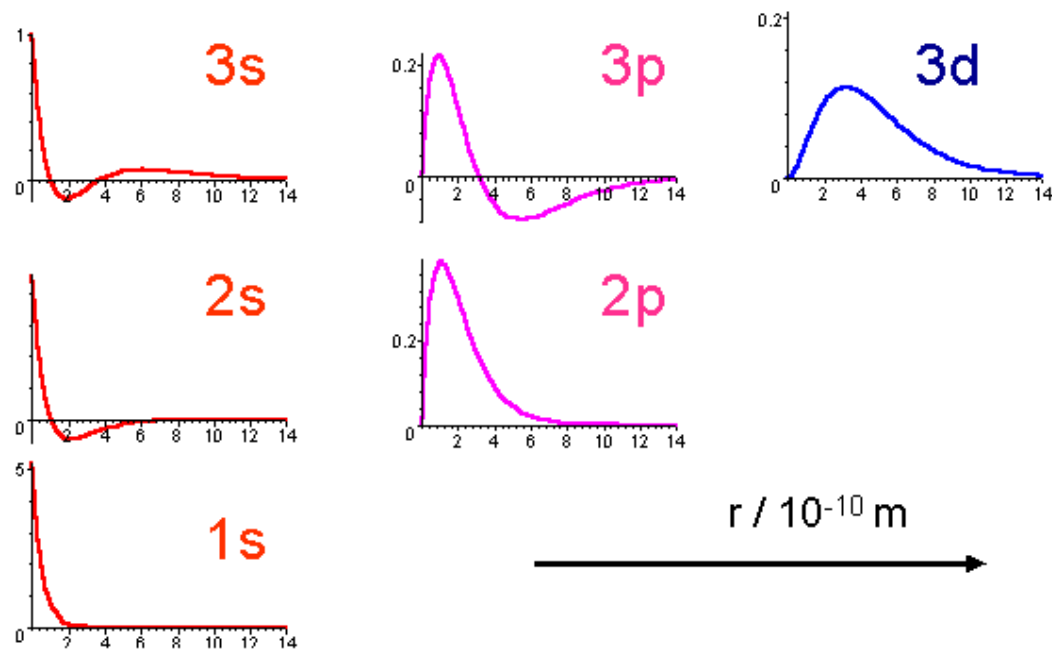
Hydrogen Wave Function

Probability density plots.

$$\psi_{nlm}(r, \theta, \varphi) = \sqrt{\left(\frac{2}{na_0}\right)^3 \frac{(n-l-1)!}{2n[(n+l)!]}} e^{-r/2} \rho^l L_{n-l-1}^{2l+1}(\rho) \cdot Y_{lm}(\theta, \varphi)$$



Electron wave functions of atomic hydrogen $R_{nl}(r)$



Ciekawe linki:

- (1) <https://www.youtube.com/watch?v=DvRzdCnsiYw>
- (2) <https://www.youtube.com/watch?v=BMIvWz-7GmU> (chemicy lubią nazywać funkcję falową orbitalem, i zamiast nazywać stany $2p_{1/2}$ lubią używać oznaczeń bardziej geometrycznych – np. $2p_{xy}$)
- (3) Narzędzia dostępne na wolframalpha.com do wizualizacji funkcji falowej:
<http://demonstrations.wolfram.com/HydrogenOrbitals/>
<http://demonstrations.wolfram.com/HydrogenAtomRadialFunctions/>
<http://demonstrations.wolfram.com/SphericalHarmonics/>