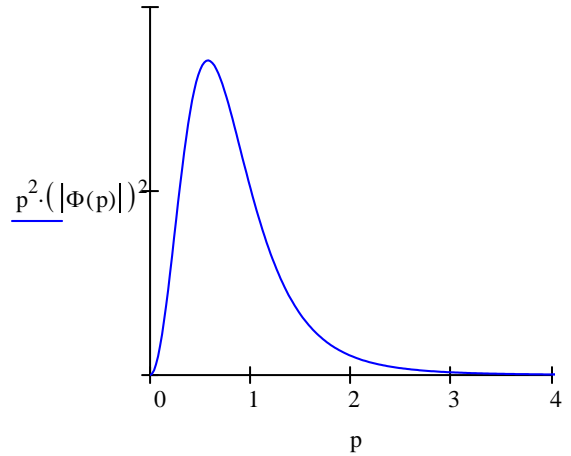
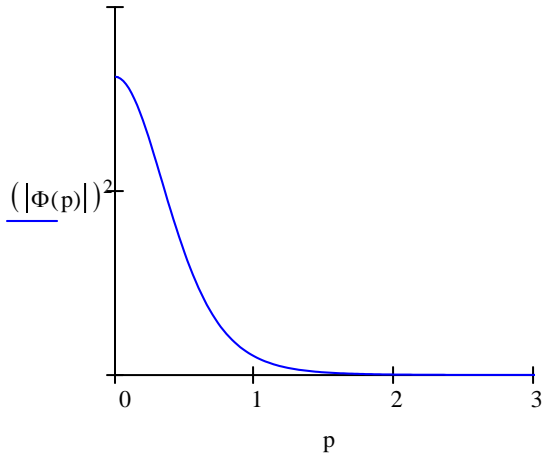


## Momentum Distributions for Hydrogen Atomic Orbitals

The Fourier transform for the 1s orbital

$$\Phi(p) := \frac{1}{\sqrt{8 \cdot \pi^4}} \int_0^\infty \int_0^\pi \int_0^{2 \cdot \pi} \exp(-r) \cdot \exp(-i \cdot p \cdot r \cdot \cos(\theta)) \cdot r^2 \cdot \sin(\theta) \, d\phi \, d\theta \, dr \rightarrow 2 \cdot \frac{\frac{1}{2^2}}{\pi \cdot [(-1) + i \cdot p]^2 \cdot (1 + i \cdot p)^2}$$

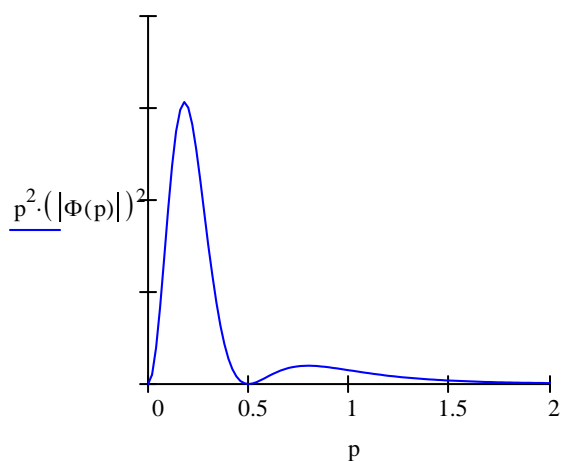
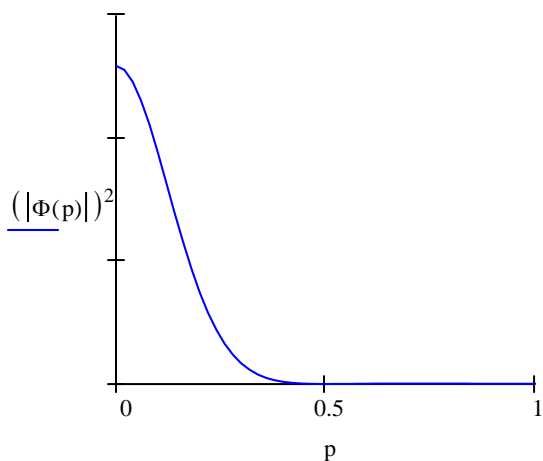
$$p := 0, .02 \dots 5$$



The Fourier transform for the 2s orbital

$$\Phi(p) := \frac{1}{16 \cdot \pi^2} \int_0^\infty \int_0^\pi \int_0^{2 \cdot \pi} (2 - r) \cdot \exp\left(-\frac{r}{2}\right) \cdot \exp(-i \cdot p \cdot r \cdot \cos(\theta)) \cdot r^2 \cdot \sin(\theta) \, d\phi \, d\theta \, dr$$

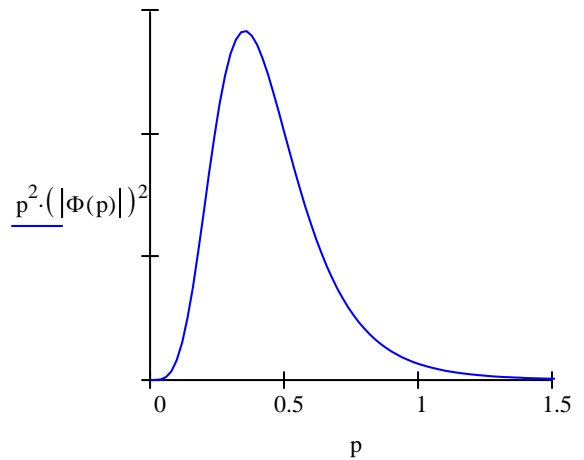
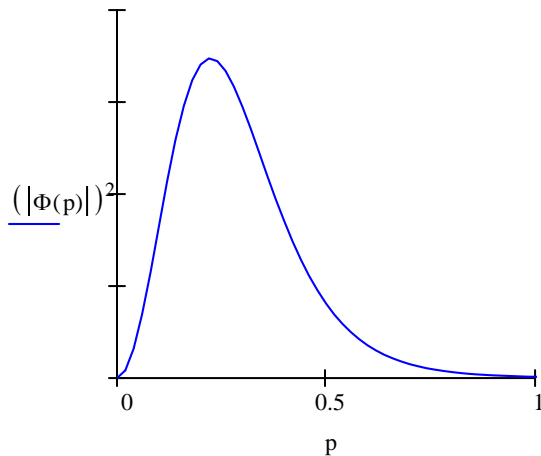
$$\text{yields } \Phi(p) := \frac{-16}{\pi} \cdot \frac{(-1) + 4 \cdot p^2}{[(-1) + 2 \cdot i \cdot p]^3 \cdot (1 + 2 \cdot i \cdot p)^3} \quad p := 0, .02 \dots 2$$



### The Fourier transform for the $2p_z$ orbital

$$\Phi(p) := \frac{1}{16 \cdot \pi^2} \int_0^\infty \int_0^\pi \int_0^{2\pi} r \cdot \exp\left(-\frac{r}{2}\right) \cdot \exp(-i \cdot p \cdot r \cdot \cos(\theta)) \cdot \cos(\theta) \cdot r^2 \cdot \sin(\theta) \, d\phi \, d\theta \, dr$$

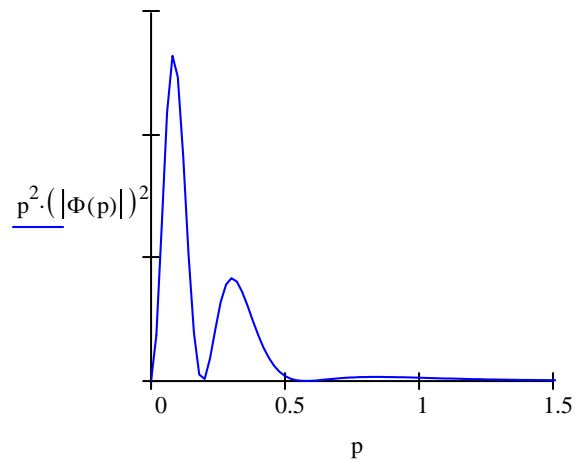
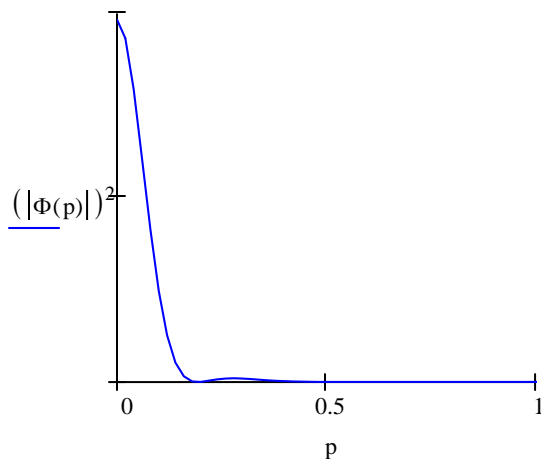
yields 
$$\Phi(p) := 64 \cdot \frac{i}{\pi} \cdot \frac{p}{[(-1) + 2 \cdot i \cdot p]^3 \cdot (1 + 2 \cdot i \cdot p)^3}$$



### The Fourier transform for the 3s orbital

$$\Phi(p) := \frac{1}{162 \cdot \sqrt{6} \cdot \pi^2} \int_0^\infty \int_0^\pi \int_0^{2\pi} (27 - 18 \cdot r + 2 \cdot r^2) \cdot \exp\left(-\frac{r}{3}\right) \cdot \exp(-i \cdot p \cdot r \cdot \cos(\theta)) \cdot r^2 \cdot \sin(\theta) \, d\phi \, d\theta \, dr$$

yields 
$$\Phi(p) := 18 \cdot \frac{1}{6^2} \cdot \frac{(-30) \cdot p^2 + 1 + 81 \cdot p^4}{\pi [(-1) + 3 \cdot i \cdot p]^4 \cdot (1 + 3 \cdot i \cdot p)^4}$$



### The Fourier transform for the $3p_z$ orbital

$$\Phi(\mathbf{p}) := \frac{1}{162 \cdot \pi^2} \int_0^\infty \int_0^\pi \int_0^{2\pi} (6 \cdot r - r^2) \cdot \exp\left(-\frac{r}{3}\right) \cdot \exp(-i \cdot \mathbf{p} \cdot \mathbf{r} \cdot \cos(\theta)) \cdot \cos(\theta) \cdot r^2 \cdot \sin(\theta) \, d\phi \, d\theta \, dr$$

yields 
$$\Phi(\mathbf{p}) := (-432) \cdot \frac{i}{\pi} \cdot \mathbf{p} \cdot \frac{9 \cdot \mathbf{p}^2 - 1}{[(-1) + 3 \cdot i \cdot \mathbf{p}]^4 \cdot (1 + 3 \cdot i \cdot \mathbf{p})^4}$$

