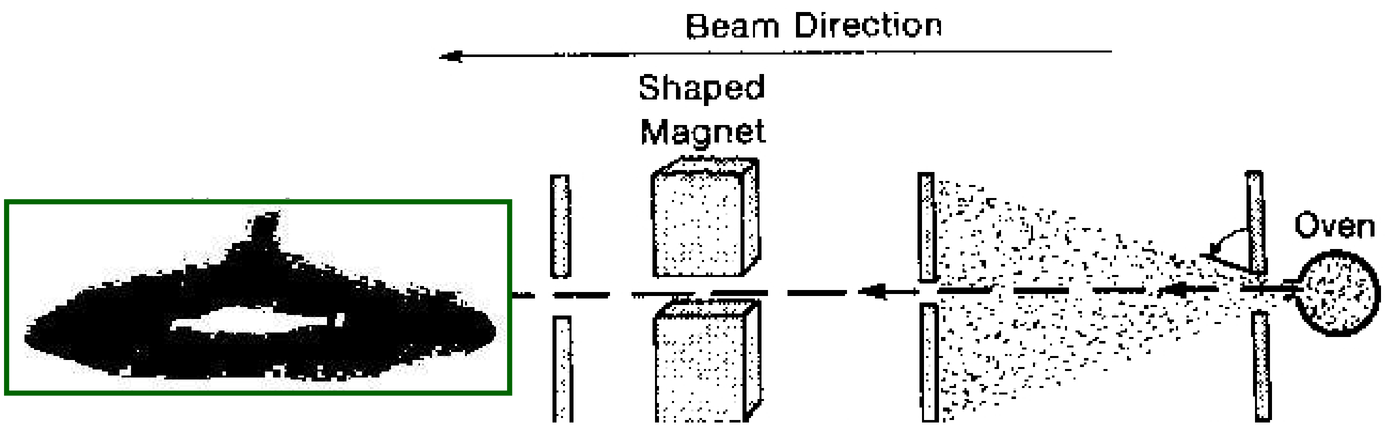
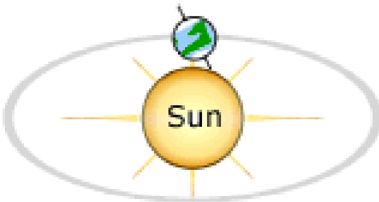
Spin: intrinsic angular momentum

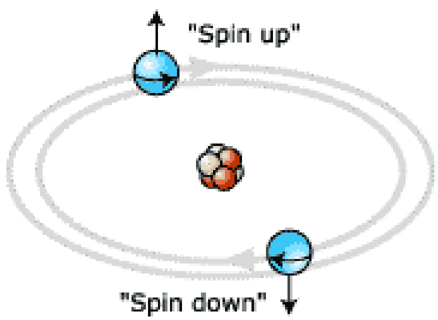


Note that the Stern-Gerlach experiment split a neutral silver beam into two beams. The vertical component of the magnetic moment has therefore 2 quantum states, but:

$$l=0 \quad \rightarrow \quad m=0$$

$$l=1 \quad \rightarrow \quad m\in\{-1,0,1\}$$





The magnetic moment of silver can not come from the orbital angular momentum.

Other possible source: An internal angular momentum of the electrons, like for a rotating sphere.

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Quantization of spin

The intrinsic angular momentum is not a property of the wave function

The argument for the orbital angular momentum no longer hold:

$$\hat{L}_z Y_{l\,m} = -i\hbar \tfrac{\partial}{\partial\varphi} Y_{l\,m} \quad \rightarrow \quad Y_{l\,m} = f(\vartheta) e^{im\varphi}$$

$$Y_{l\,m}(\varphi + 2\pi) = Y_{l\,m}(\varphi) \quad \rightarrow \quad m \in \mathbf{Z}$$

But assuming that the commutators for spin are like those for angular momentum:

$$[S_i, S_j] = i\hbar\varepsilon_{ijk} S_k$$

one obtains:

$$m_{\max} = -m_{\min} = \tfrac{n}{2}$$

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