DeBroglie Wavelength

The relativistic energy of a particle is

$$E = mc^2$$

Where m is the mass of the particle and c is the speed of light. Einstein showed that

$$m = \frac{m_0}{\sqrt{1 - \left(\frac{\mathrm{v}}{c}\right)^2}}$$

where m_0 is the rest mass of the particle and v is the magnitude of the particles velocity. Using this equation the energy may be rewritten as

$$E = \sqrt{p^2c^2 + m_0^2c^4}$$

where the momentum is given by

$$p = m\mathrm{v}.$$

This suggests that the energy for a zero mass particle (a photon) is

$$E = pc \text{ and therefore } p = \frac{E}{c}.$$

From the Planck Einstein law $E = h\nu$ and so $p = \frac{h\nu}{c} = \frac{h}{\lambda}$. De Broglie suggested that since this was correct for a particle with zero rest mass perhaps it would also be true for a particle with momentum $p = m_0\mathrm{v}$ and if so this particle would have a wavelength given by

$$\lambda = \frac{h}{m_0\mathrm{v}}$$