Why a moving cricket ball do not behave as wave?

For $m = 0.12$ kg and $v = 20$ m/s
$\lambda = 2.76 \times 10^{-34}$ m $= 2.76 \times 10^{-24}$ Å

This wavelength is so small that it is beyond any measurement. This is the reason why macroscopic objects in our daily life do not show wave-like properties. On the other hand, in the sub-atomic domain, the wave character of particles is significant and measurable. for electrons

LOUIS VICTOR DE BROGLIE (1892 – 1987)

Louis Victor de Broglie (1892 – 1987) French physicist who put forth revolutionary idea of wave nature of matter. This idea was developed by Erwin Schródinger into a full-fledged theory of quantum mechanics commonly known as wave mechanics. In 1929, he was awarded the Nobel Prize in Physics for his discovery of the wave nature of electrons.

Consider an electron (mass m, charge e) accelerated from rest through a potential V. The kinetic energy K of the electron equals the work done (eV) on it by the electric field:

$$K = e\,V \tag{11.8}$$

Now, $K = \dfrac{1}{2} m v^2 = \dfrac{p^2}{2m}$, so that

$$p = \sqrt{2\,m\,K} = \sqrt{2\,m\,eV} \tag{11.9}$$

The de Broglie wavelength λ of the electron is then

$$\boxed{\lambda = \frac{h}{p} = \frac{h}{\sqrt{2\,mK}} = \frac{h}{\sqrt{2\,meV}}} \tag{11.10}$$

→ In general $\lambda = \dfrac{h}{\sqrt{2mqV}}$

Substituting the numerical values of h, m, e, we get

$$\boxed{\lambda = \frac{1.227}{\sqrt{V}}\ \text{nm}} \tag{11.11}$$

→ This eq. is for an electron accelerated through a pot. difference V

where V is the magnitude of accelerating potential in volts. For a 120 V accelerating potential, Eq. (11.11) gives λ = 0.112 nm. This wavelength is of the same order as the spacing between the atomic planes in crystals. This suggests that matter waves associated with an electron could be verified by crystal diffraction experiments analogous to X-ray diffraction. We describe the experimental verification of the de Broglie hypothesis in the next section. In 1929, de Broglie was awarded the Nobel Prize in Physics for his discovery of the wave nature of electrons.

The matter–wave picture elegantly incorporated the Heisenberg's *uncertainty principle*. According to the principle, it is not possible to measure *both* the position and momentum of an electron (or any other particle) *at the same time* exactly. There is always some uncertainty (Δx) in the specification of position and some uncertainty (Δp) in the specification of momentum. The product of Δx and Δp is of the order of $\hbar$* (with $\hbar = h/2\pi$), i.e.,

$$\Delta x\, \Delta p \approx \hbar \tag{11.12}$$

Equation (11.12) allows the possibility that Δx is zero; but then Δp must be infinite in order that the product is non-zero. Similarly, if Δp is zero, Δx must be infinite. Ordinarily, both Δx and Δp are non-zero such that their product is of the order of $\hbar$.

Now, if an electron has a definite momentum p, (i.e.$\Delta p = 0$), by the de Broglie relation, it has a definite wavelength λ. A wave of definite (single)

* A more rigorous treatment gives $\Delta x\, \Delta p \geq \hbar/2$.