Drift velocity

We see that the drift velocity of an electron in a field of 1 V cm^{-1} is not particularly high and is equal to the velocity an electron would attain in free space in a few nanoseconds. The reason for this is that the electrons have frequent elastic collisions in which they change direction and hence velocity. Free electrons in Si have an average kinetic energy determined by the temperature. At room temperature this is about 0.025 eV, which corresponds to a velocity of $v = \sqrt{\frac{2q \times 0.025}{m}} = 6.7 \times 10^6 \text{ cm sec}^{-1}$. An electric field of about 5 x 10^3 V cm^{-1} gives a drift velocity of this size. It is found experimentally that the drift velocity becomes independent of the electric field when it is about twice the thermal velocity - the velocity "saturates". The reason is that collisions happen so frequently that the electron can't gain any more speed no matter how strong the field.