Mobility

Here is a simplified argument for the equation $\mu = \frac{q\tau}{m}$. Recall that the mobility μ is defined by $\bar{v} = \mu E$ where $\bar{v}$ is the average, or drift speed and E is the electric field strength. Suppose the average distance an electron or hole travels between collisions is l and the average time between collisions is τ; when there is a collision the particle changes direction and begins to accelerate in the direction of the electric field again. The average speed is then $\bar{v} = \frac{l}{\tau}$ and the average momentum is $p = m\bar{v}$. The particle is subject to a force F = qE due to the electric field. From $F = \frac{dp}{dt}$ we can identify the force F with the momentum divided by the time between collisions, or, conversely, $p = m\bar{v} = F\tau = qE\tau$. We then have: $\bar{v} = \mu E = \frac{p}{m} = \frac{qE\tau}{m}$ or, cancelling the common factor E, $\mu = \frac{q\tau}{m}$. A tighter argument can be made by calculating the average speed and mean free path using appropriate distribution functions, but the result is the same.