[nex37] Campbell processes.

Consider a stationary stochastic process of the general form $Y(t) = \sum_k F(t - t_k)$, where the times t_k are distributed randomly with an average rate λ of occurrences. Campbell's theorem then yields the following expressions for the mean value and the autocorrelation function of Y:

$$\langle Y \rangle = \lambda \int_{-\infty}^{\infty} d\tau\, F(\tau), \qquad \langle\langle Y(t)Y(0)\rangle\rangle \equiv \langle Y(t)Y(0)\rangle - \langle Y(t)\rangle\langle Y(0)\rangle = \lambda \int_{-\infty}^{\infty} d\tau\, F(\tau)F(\tau + t).$$

Apply Campbell's theorem to calculate the average current $\langle I \rangle$ and the current autocorrelation function $\langle\langle I(t)I(0)\rangle\rangle$ for a shot noise process with $F(t) = qe^{-\alpha t}\theta(t)$, where $\theta(t)$ is the step function. Compare the results with those derived in [nln70] along a somewhat different route.

Solution: