$$\langle \Delta m \rangle = i\gamma \int_0^\infty dt \oint \frac{dk}{2\pi} \cdot \overset{u_k(t)\, e^{-i\theta_k(t)}}{\overset{\uparrow}{\underline{\psi_k^{R*}}}} \, \partial_k \left(u_k(t)\, e^{i\theta_k(t)} \right)$$

$$= i\gamma \int_0^\infty dt \oint \frac{dk}{2\pi} \; u_k(t)\, e^{-i\theta_k(t)} \cdot \left[\left(\partial_k u_k(t)\right) e^{i\theta_k(t)} + u_k(t)\, e^{i\theta_k(t)} \cdot i\left(\partial_k \theta_k(t)\right) \right]$$

$$\downarrow \qquad \swarrow$$

$$\oint dk \left(u_k \partial_k u_k \right) = 0$$

$$= i\gamma \int_0^\infty dt \oint \frac{dk}{2\pi} \; u_k^2(t) \cdot i\, \partial_k \theta_k(t) = -\gamma \int_0^\infty dt \oint \frac{dk}{2\pi} \; u_k^2(t)\, \partial_k \theta_k(t).$$

$$= \oint \frac{dk}{2\pi} \int_0^\infty \left(\partial_t P_k \right) \left(\partial_k \theta_k(t) \right).$$