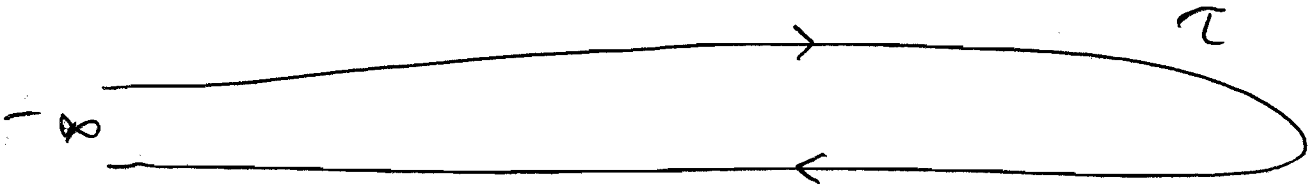
Lecture 25

NEGF III

Keldysh time contour



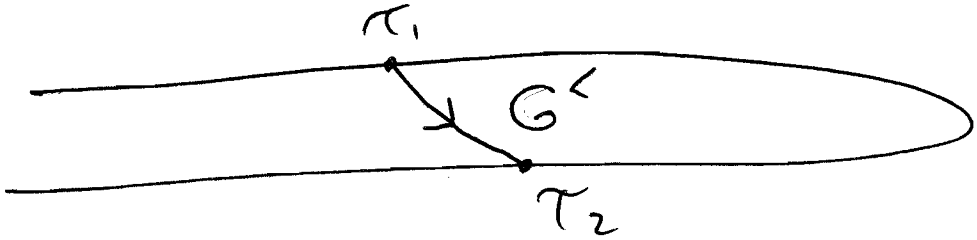
$$G^{t}_{nm}(\tau_1,\tau_2) = -i\,\frac{\langle T_c\, \hat{d}_n(\tau_1)\, \hat{d}^{\dagger}_m(\tau_2)\, S(\infty,-\infty)\rangle}{\langle S(\infty,-\infty)\rangle}$$

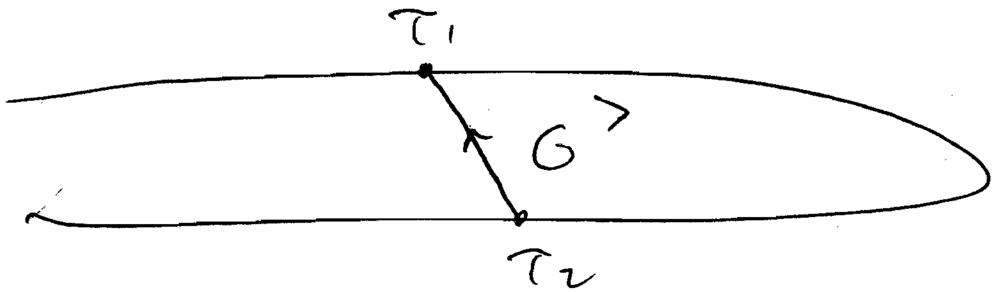
since initial and final states of the time evolution are the same

$\tau \to -\infty \Leftrightarrow t \to -\infty$

$\tau \to +\infty \Leftrightarrow t \to -\infty$,

we can take the QM and stat. average in the known distribution at $t = -\infty$.





$$G^< = i \langle d^+(2)\, d(1) \rangle$$

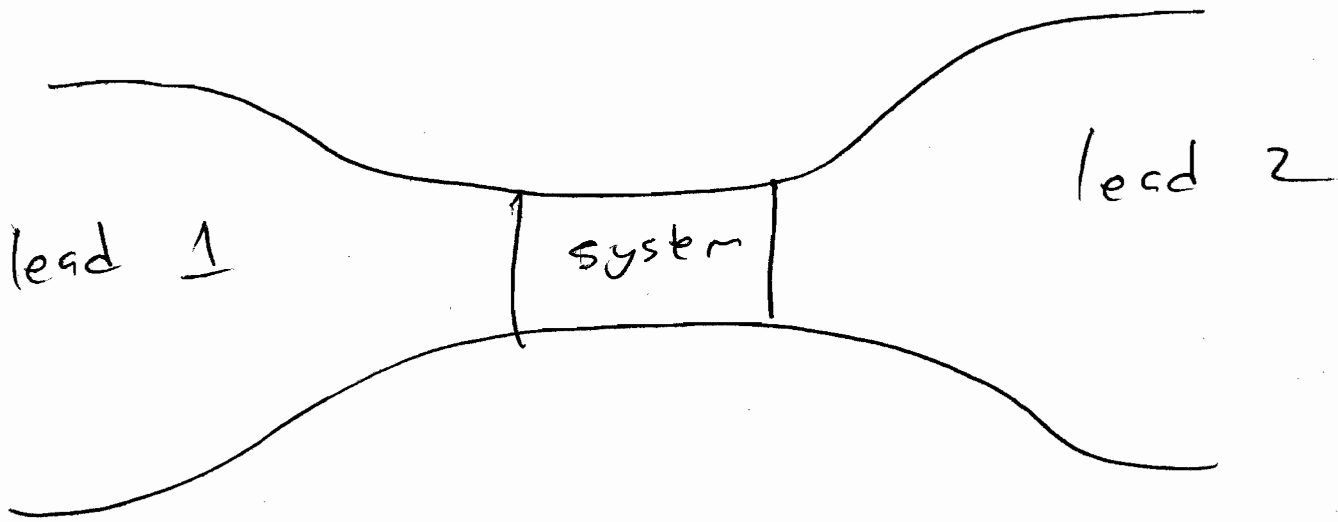
$$G^> = -i \langle d(1)\, d^+(2) \rangle$$

$$G^r = G^t - G^<$$

$$G^a = G^t - G^>$$

General transport problem

$$H = H_{system} + H_{leads} + H_T$$



$$H_{system} = \sum_{n,m} H^{(1)}_{nm}\, d_n^\dagger d_m$$

$$H_{leads} = \sum_{\alpha=1}^{2} \sum_{k\in\alpha} \epsilon_k\, c_k^\dagger c_k$$

$$H_T = \sum_{\alpha=1}^{2} \sum_{k\in\alpha} \sum_{n} \left(V_{nk}\, d_n^\dagger c_k + H.c. \right)$$

leads = noninteracting Fermi gases

Lead Green's functions

$$g^r_{kk'}(\omega) = \frac{\delta_{kk'}}{\omega - \epsilon_k + i0^+}$$

$$g^<_{kk'}(\omega) = 2\pi i\, \delta_{kk'}\, f_\alpha(\epsilon_k)\, \delta(\omega - \epsilon_k)$$

$$g^>_{kk'}(\omega) = -2\pi i\, \delta_{kk'} \left[1 - f_\alpha(\epsilon_k)\right] \delta(\omega - \epsilon_k)$$

where

$$g(\omega) = \int_{-\infty}^{\infty} dt\, e^{i\omega t}\, g(t,0)$$