Korrelation nicht Green

$$G^{>}_{AB}(t) = \langle A_t B_0 \rangle_0 = C(\langle(t) \langle t_0 \rangle)$$

$$= \mathrm{Tr}\left[\varrho \cdot e^{\frac{i}{\hbar} H_0 t} A e^{-\frac{i}{\hbar} H_0 t} B \right]$$

$$\mathrm{Tr}[\hat{\varrho}\hat{O}] = \frac{\mathrm{tr}\, \hat{O} e^{-\beta \hat{H} - \mu \hat{N}}}{\mathrm{Tr}\, e^{-\beta \hat{H} - \mu \hat{N}}}$$

$$\hat{\varrho} = \frac{1}{e^{\beta \varepsilon_n - \mu N}} |n\rangle\langle n|$$

m und N

$A|n\rangle = n, \quad B|n\rangle = m$

bei Lorenzian

γ = breite

$\gamma = g$ in meinem Fall ?

$$f(\omega) = \frac{1}{(\omega^2 - \omega_0^2)^2 + \gamma^2 \omega_0^2}$$

Spektraldichte = $G^{>} - G^{<}$

Spektraltheorem

$$\langle B(0) \hat{A}(t) \rangle = \frac{\sqrt{2\pi}}{\hbar} \int dE\, e^{-\frac{i}{\hbar} E t} \frac{J(\omega}{e^{\beta(E - \mu \Delta N)} - 1} + 2\pi$$

$$= \mathrm{Tr}\left[\frac{1}{e^{\beta \varepsilon_i - \mu}}\right.$$

$$\frac{x \cdot \gamma}{\tan\left(\frac{\gamma}{2T}\right)} + \sum_k \frac{8x \cdot \gamma \cdot T \cdot \pi \cdot kT}{(2\pi kT)^2 - \gamma^2}$$

H

$H_0 = \sum \omega_k a^\dagger_k a_k \rightarrow$

0

$\langle a_{0k} a(t)_k \rangle = e^{H_0} a_k e^{H_0}$

$\circ\ e^{H_0 t} a_k e^{H_0 t}$

interacting picture
complex time

$g_{kk}(t - \tau') = \Big(\Theta(t - t')(1 \pm n_B) + \Theta(t' - t)$
$n_B\Big) \cdot e^{-\varepsilon_k(t - \tau)}$

$g_{kk}(i\omega_m) = \dfrac{1}{i\omega_m - \varepsilon_k}$

$= \dfrac{(1 + n_B)\, e^{i\omega\beta}\, e^{-\varepsilon_k \beta} - 1)}{i\omega_m - \varepsilon_k}$

$$\langle a_k^\dagger a_k \rangle \simeq \langle \hat{n}_k \rangle = n_\beta(\varepsilon_k)$$

Lorenzian peaks

Fourier / Lorenz transform of spectral density

Markov fall

$$C(t) = \eta \gamma \cdot e^{-\gamma t}$$

γ Damping

$$\mathcal{K} = \int_0^\infty J(\omega)\, d\omega = g \int$$

Fouriertra. tranfaun

$$C(t) = \int J(\omega)\left[n(\omega) e^{i\omega t} + (1+n(\omega) e^{-i\omega t}\right.$$

Ck_rea

$$\int g^2 \left(\cos(\omega t) \cdot \coth\left[\frac{\omega \beta}{2}\right] - i \sin(\omega \tau) \right) d\omega$$

$$\frac{\delta(\omega - \omega_k)}{\pi}$$

$$= \Theta(t-t) \, g^2 \left(\cos(\omega_0 t) \cdot \coth\left[\frac{\omega_0 \beta}{2}\right] - i \sin(\omega_0 \tau) \right)$$

$$= n_b \cdot (\cos(\omega t) + i\sin(\omega t))$$

$$(n_b + 1)(\cos(\omega t) - i\sin(\omega t))$$

$$\mathrm{Re}[C] = g^2(2n_b + 1)\cos(\omega t)$$

$$\mathrm{Im}[C] = \sin(\omega t) \cdot g^2$$

$$\langle X(t) X_0 \rangle = \quad C(t) = \frac{\partial F}{\partial b^+}$$

$$X(t) = \sum_k g_k \left(b_k^+ e^{i\omega_k t} + b_k e^{-i\omega_k t} \right)$$

$$C(t) = \sum_k g_k^2 \left[\langle b_k^+ b_k \rangle e^{i\omega_k t} \right.$$

$$\left. + \langle b_k b_k^+ \rangle e^{-i\omega_k t} \right]$$

$$= \sum g_k^2 \left(n_b e^{i\omega_k t} + (n_b + 1) e^{-i\omega_k t} \right)$$

$$= \sum g_k^2 \left(n_b \cdot (\cos(\omega_k t) + i \sin(\omega_k t)) \right.$$

$$\left. + (n_b + 1)(\cos(\omega_k t) - i \sin(\omega_k t)) \right)$$

$$= \sum g_k^2 \left((2n_b + 1) \cdot \cos(\omega_k t) - i \sin() \right)$$

$$\mathrm{R}[C(t)] = \sum_k \overset{c_{k1},\, c_{k2}}{g_k^2 (2n_b+1)} \cdot \left(\frac{1}{2} e^{-i\omega_k t} + e^{i\omega_k t}\right)$$

$$\mathrm{Im}[C(t) = \sum_k \overset{c_{k1},\, c_{k2}}{-g_k^2} \cdot \frac{1}{2} e^{-i\omega_k t} + e^{i\omega_k t}$$

$v_{k1} = \omega_k$, $v_{k2} = \pi \cdot \omega_k$