

Matsubara representation

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$$u_{nl}^\alpha \equiv \frac{1}{\sqrt{2}} \int_{-1}^1 dx \, e^{i\pi\{n+(1/2)\delta_{\alpha,\text{F}}\}(x+1)} u_l^\alpha(x), \quad (1)$$

$$= \tilde{u}_{nl} + (-1)^{\delta_{\alpha,\text{F}}+l} \tilde{u}_{nl}^*, \quad (2)$$

$$\tilde{u}_{nl}^\alpha \equiv \frac{1}{\sqrt{2}} \int_0^1 dx \, e^{i\pi\{n+(1/2)\delta_{\alpha,\text{F}}\}(x+1)} u_l^\alpha(x), \quad (3)$$

$$= \sum_s \frac{\sqrt{\Delta x_s}}{2} \sqrt{p + \frac{1}{2}} e^{i\omega((x_{s+1}+x_s)/2+1)} \int_{-1}^1 dx P_p(x) e^{i\omega \Delta x_s/2x}. \quad (4)$$

$$\int_{-1}^1 dx P_l(x) e^{ia} = 2i^l j_l(a). \quad (5)$$