HOLE SPECTRAL DENSITY FUNCTION

in momentum representation

$$S(E;\vec{p},\vec{p}') = \langle\Psi_0|\, a^\dagger(\vec{p}') \quad \delta(H_{A-1}-E-W_A) \quad a(\vec{p})\,|\Psi_0\rangle$$

$$\sum_{\alpha} \sum\!\!\!\!\!\!\int d\varepsilon\, |\varepsilon\alpha\rangle\langle\varepsilon\alpha| \qquad \sum_{\alpha'} \sum\!\!\!\!\!\!\int d\varepsilon'\, |\varepsilon'\alpha'\rangle\langle\varepsilon'\alpha'|$$

$$= \sum_{\alpha} \sum\!\!\!\!\!\!\int d\varepsilon\, \langle\Psi_0|a^\dagger(\vec{p}')|\varepsilon\alpha\rangle\, \delta(\varepsilon-E-W_A)\, \langle\varepsilon\alpha|\, a(\vec{p}')|\Psi_0\rangle$$

$$= \sum_{\alpha} \varphi^*_{E\alpha}(\vec{p}')\ \lambda_\alpha(E)\ \varphi_{E\alpha}(\vec{p}')$$

It is related to the hole Green's function

$$G^h(E-i\eta;\vec{p},\vec{p}') = \langle\Psi_0|\, a^\dagger(\vec{p}') \frac{1}{E-i\eta-W_A+H_{A-1}}\, a(\vec{p})\,|\Psi_0\rangle$$

$$= \lim_{\eta\to+0} \frac{1}{2\pi i} \left\{ G^h(E-i\eta;\vec{p},\vec{p}') - G^h(-E+i\eta;\vec{p},\vec{p}') \right\}$$

and provides direct information on the propagation of proton holes in the target.