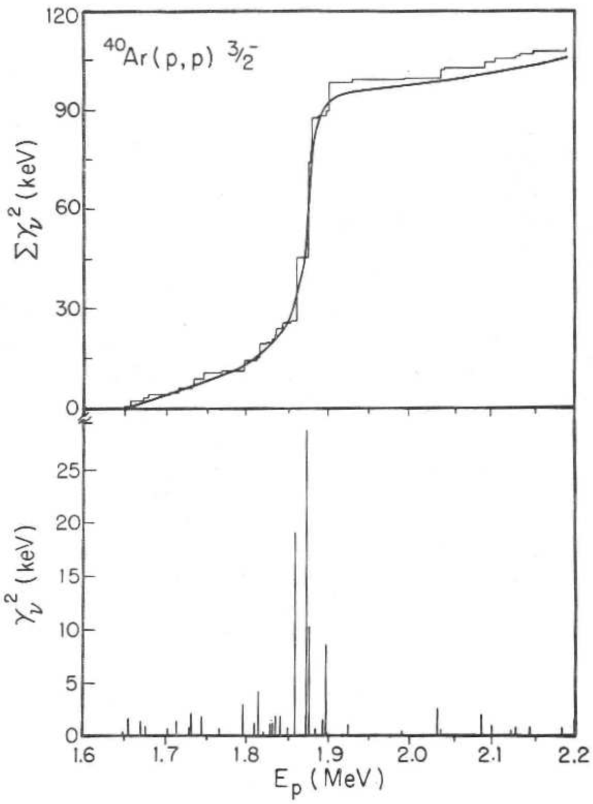

FIG. 20 Same as in FIG. 19 but for the target nucleus ^{40}Ar. From (Keyworth *et al.*, 1968).

structure data, see Section III.C. The object of interest is the strength function $\langle\gamma_\mu^2\rangle/d$ obtained as an average over a number of neighboring resonances, see Figs. 19 and 20. We replace in Eq. (99) E by $E + iI$ and obtain $-(1/\pi)\Im K(E + iI) \approx \langle\gamma_\mu^2\rangle/d$, see Section IV.A. The averaging interval I should contain many CN resonances (to reduce the statistical error), but be small compared to the spreading width of the IAR defined below (to display the resonance enhancement and asymmetry). In the analysis of actual data it may be hard to meet both requirements. To calculate $K(E)$ we drop V in Eq. (95) and use Eqs. (41) and (42) keeping the shift function F. After a little algebra we obtain

$$K(E) = \pi \sum_{ij} W_i(\mathcal{B}^{-1})_{ij} W_j \ . \tag{100}$$

The matrix $\mathcal{B}$ has the same form as expression (95). The indices (i, j) take the values 1 to N (for the background states) and zero (for the analogue state) while μ and ν run from 1 to N as before. Explicitly we have

$$\mathcal{B} = \begin{pmatrix} (E - \varepsilon_\mu)\delta_{\mu\nu} & -\Re F_{\mu 0} \\ -\Re F_{0\nu} & (E - E_0 + F_{00}) \end{pmatrix} \ . \tag{101}$$

We have assumed that the matrix $H^{(1)}_{\mu\nu} + \Re F_{\mu\nu}$ has been diagonalized. The resulting eigenvalues are denoted by ε_μ but the notation on the transformed matrix elements W_μ and $\Re F_{\mu 0}$ has not been changed. The W_μ are random Gaussian variables which also appear as arguments of the integrals defining the matrix elements $\Re F_{\mu 0}$. Thus, W_μ and $\Re F_{\nu 0}$ are correlated for $\mu = \nu$. The energy of the unperturbed IAR is denoted by E_0. The matrix element W_0 is not random.

For a common doorway state, the spreading width $\Gamma^\downarrow$ is defined as $\Gamma^\downarrow = 2\pi v^2/d$, see Eq. (I.26). Here d is the mean spacing of the background states and v^2 is the average squared coupling matrix element. Using the analogy between Eq. (101) and the matrix description Eq. (I.24) for a doorway state, we define the spreading width of an IAR as

$$\Gamma^\downarrow = 2\pi \langle (\Re F_{0\mu})^2 \rangle / d \ . \tag{102}$$

This equation shows once again that isospin mixing is due to the proton channel.

The strength function is obtained from Eq. (100) by replacing E by $E + iI$ and assuming $d \ll I \ll \Gamma^\downarrow$. The explicit calculation uses the statistical assumptions mentioned above and may, for instance, be found in Chapter 13 of (Mahaux and Weidenmüller, 1969). The result is

$$\frac{\langle\gamma_\mu^2\rangle}{d} = s^{bg} \ \frac{(E - E_0)^2}{(E - E_0 + \Re F_{00})^2 + (1/4)(\Gamma^\downarrow)^2} \ . \tag{103}$$

Here s^{bg} is the strength function of the background states in the absence of the IAR. The IAR enhances the strength function in the vicinity of the analogue state. Since $\Gamma^\downarrow \gg d$ the resonance is completely mixed with the background states and is seen only through the enhancement factor in Eq. (103). That factor has the shape of an asymmetric Lorentzian and approaches the value unity far from the resonance. The width of the Lorentzian is given by the spreading width. The strength function vanishes at $E = E_0$ where there is no isospin mixing. The zero occurs above the resonance energy $E_0 - \Re F_{00}$: Because of the Coulomb barrier, the main contribution to the integral defining $\Re F_{00}$ stems from states with energies larger than E_0, and $\Re F_{00}$ is, therefore, positive.

In general (several open channels, both external and internal mixing) the asymmetry of the strength function in channel c in the vicinity of an analogue state is reduced. For purposes of fitting data the expression given, for instance, by Lane (1969) can be written in the form (Bilpuch *et al.*, 1976)

$$\begin{aligned} \frac{\langle\gamma_{c\mu}^2\rangle}{d} \ &= \ s_c^{bg} + \frac{2 s_c^{bg} \Delta_c (\varepsilon_0 - E)}{(\varepsilon_0 - E)^2 + (1/4)(\Gamma^\downarrow)^2} \\ &+ \frac{\gamma_c^2 \Gamma^\downarrow/(2\pi)}{(\varepsilon_0 - E)^2 + (1/4)(\Gamma^\downarrow)^2} \ . \end{aligned} \tag{104}$$

Here s_c^{bg} is the background strength function in channel c, ε_0 is the resonance energy, Δ_c is the asymmetry parameter in channel c, and γ_c^2 is the total reduced width