It is possible to use interference phenomena to obtain very slow neutrons. Rewriting the Bragg formula, equation (5-12), as $\lambda = 2a (\sin \theta/n)$ or $\lambda < 2a$, it is apparent that neutrons with $\lambda > 2a$ cannot be Bragg-reflected. All scattering of neutrons with wavelength greater than twice the interplanar spacing would be due to the four listed causes. If graphite is used, the fact that there is only one isotope (~99%) and the spin is zero (even mass numbers usually have zero spins) minimizes scattering from spin and isotopic irregularities. For graphite, $2a = 6.69 \times 10^{-8}$ cm, so that the limiting λ is 6.69 Angstroms, corresponding to a neutron energy of $(0.2848)^2/\lambda^2$ (see Figure 11, page 21), or 0.0018 ev. Suppose (Figure 27) a Maxwellian distribution of neutrons, peaking at 0.025 ev for graphite at room temperature, is incident on a polycrystalline piece of graphite. Then, as a consequence of interference, the graphite will (in an appreciable distance) weed out all neutrons with energies above 0.0018 ev. Only those very slow neutrons with $\lambda > 2a$ will not be scattered out of the beam by Bragg reflections. Moreover, because of relative isotopic uniformity, zero spin, and small absorption, these "cold" neutrons will be able to get through the graphite with minimum attenuation. Thus it is possible to secure a very "cold" beam using thermal neutrons and a polycrystalline graphite "filter."*

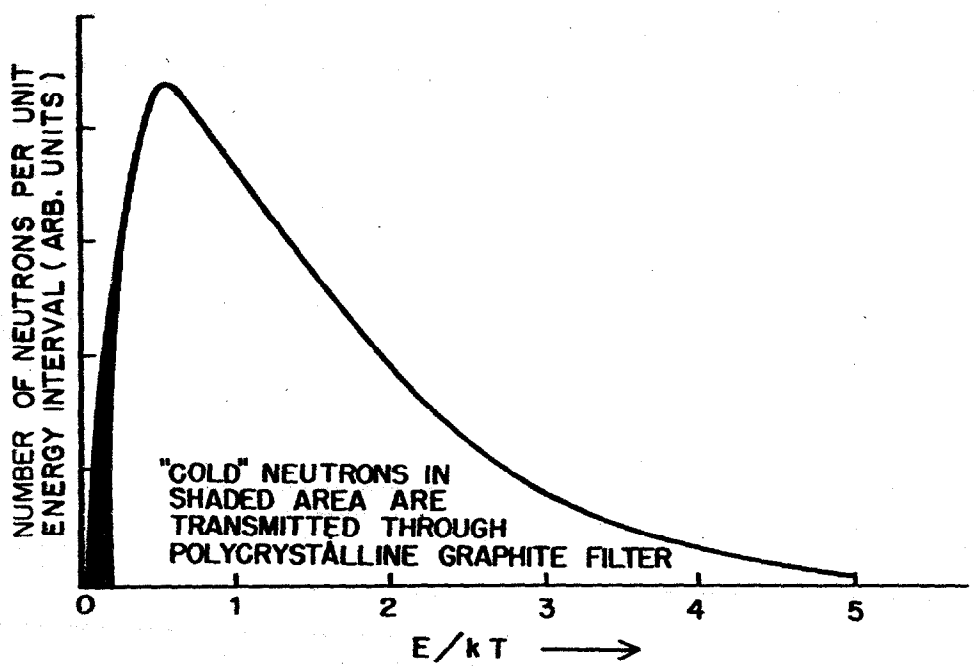

Figure 27. Maxwell distribution and "cold" neutrons.

*See "Production of Low Energy Neutrons by Filtering through Graphite" by H. L. Anderson, E. Fermi, L. Marshall, Physical Review 70:815 (1946). With a 23 cm graphite filter, neutrons corresponding to 18K (or 7.15 Angstroms) were obtained.

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