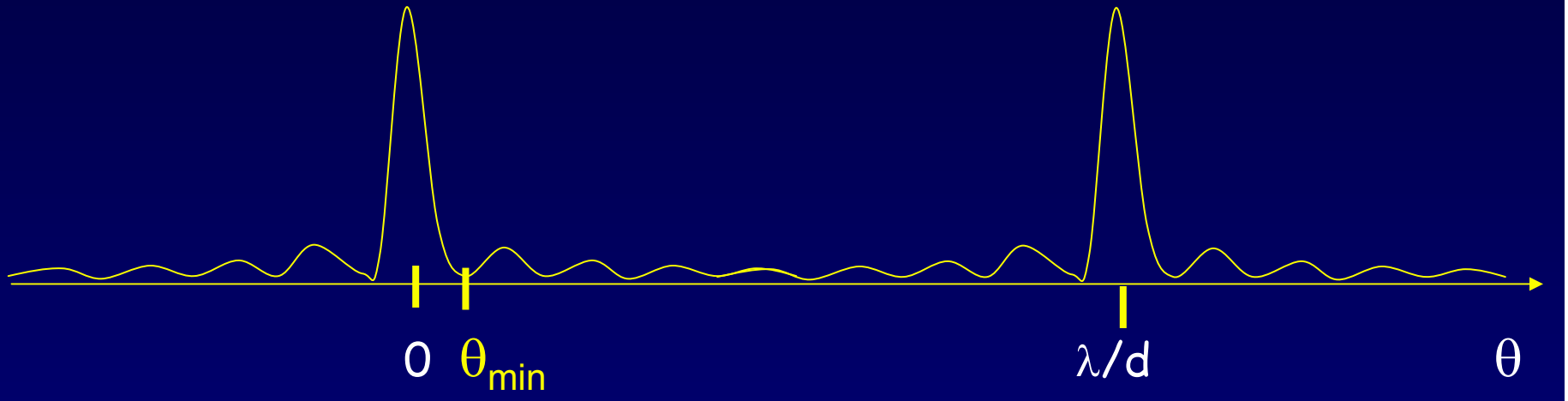
Solution

In an N-slit interference pattern, at what angle θ_{min} does the intensity first go to zero? (In terms of λ, d and N).



$I_N = I_1 \left(\frac{\sin(N\phi/2)}{\sin(\phi/2)} \right)^2$ has a zero when the numerator is zero. That is, $\phi_{min} = 2\pi/N$.

Exception: When the denominator is also zero.
That's why there are only N-1 zeros.

But $\phi_{min} = 2\pi(d \sin\theta_{min})/\lambda \approx 2\pi d\, \theta_{min}/\lambda = 2\pi/N$. Therefore, $\theta_{min} \approx \lambda/Nd$.

As the number of illuminated slits increases, the peak widths decrease!
General feature: Wider slit features → narrower patterns
Narrower slit features → wider patterns....