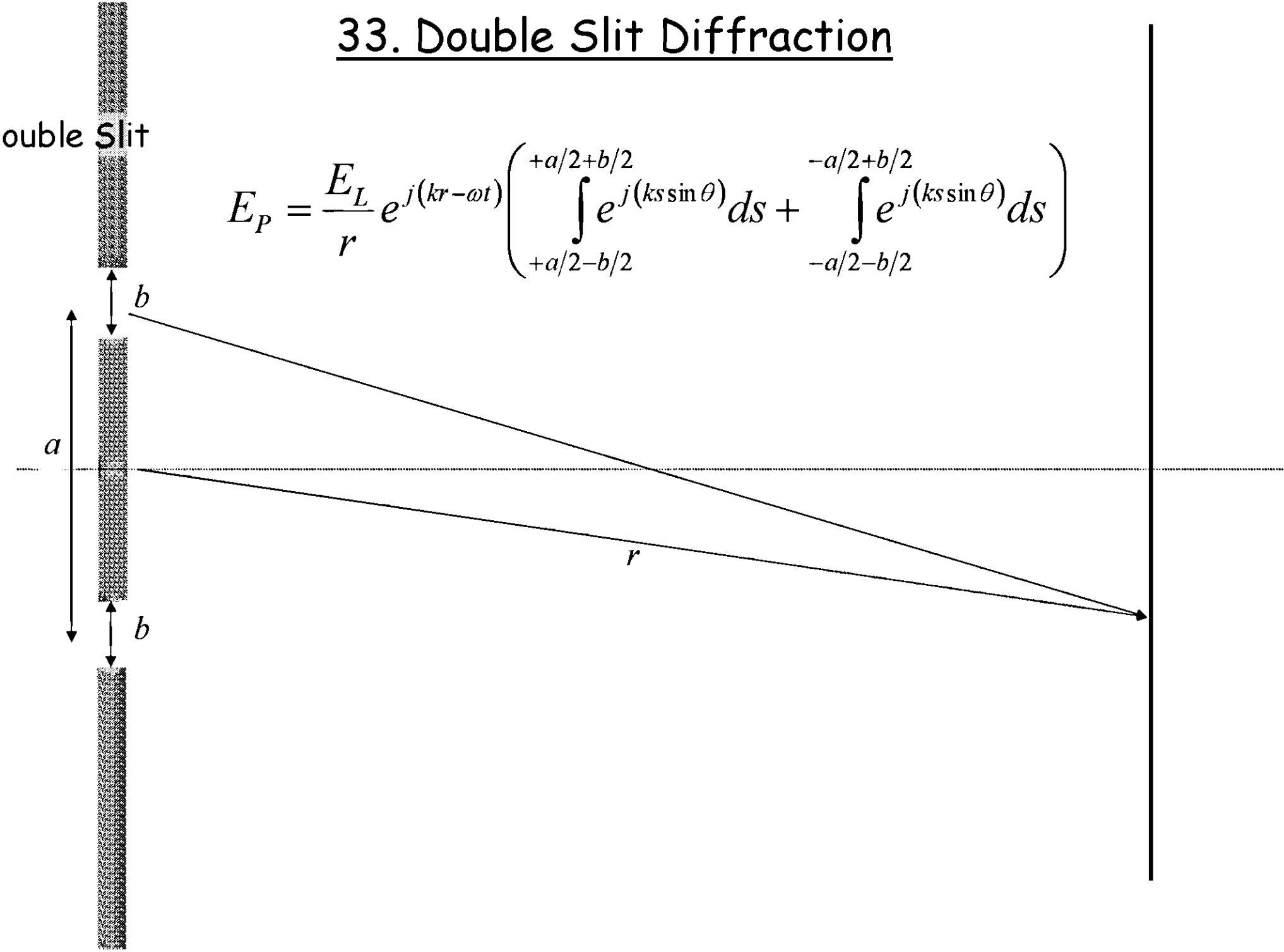
33. Double Slit Diffraction

Double Slit

$$E_P = \frac{E_L}{r} e^{j(kr-\omega t)} \left(\int_{+a/2-b/2}^{+a/2+b/2} e^{j(ks\sin\theta)} ds + \int_{-a/2-b/2}^{-a/2+b/2} e^{j(ks\sin\theta)} ds \right)$$

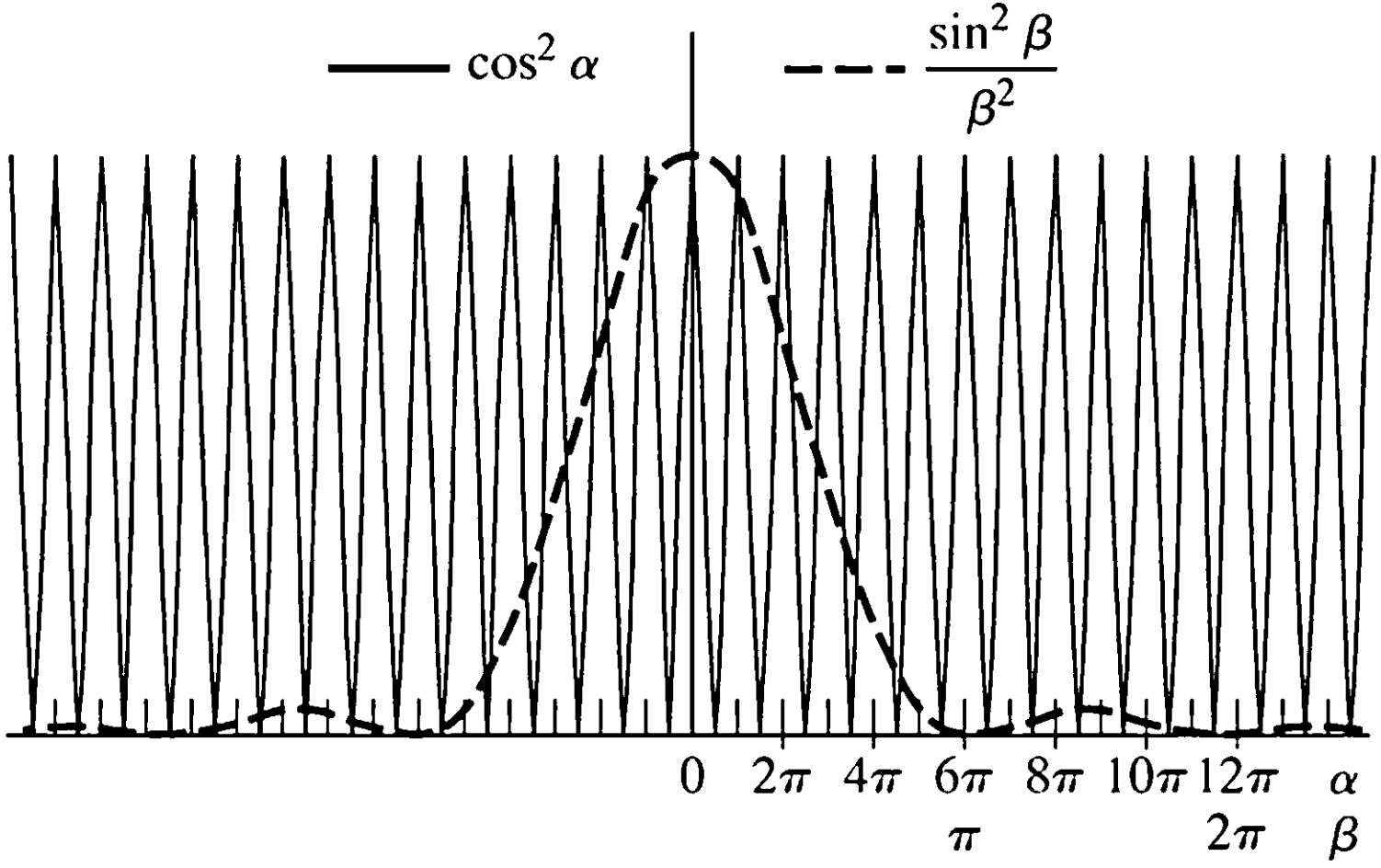


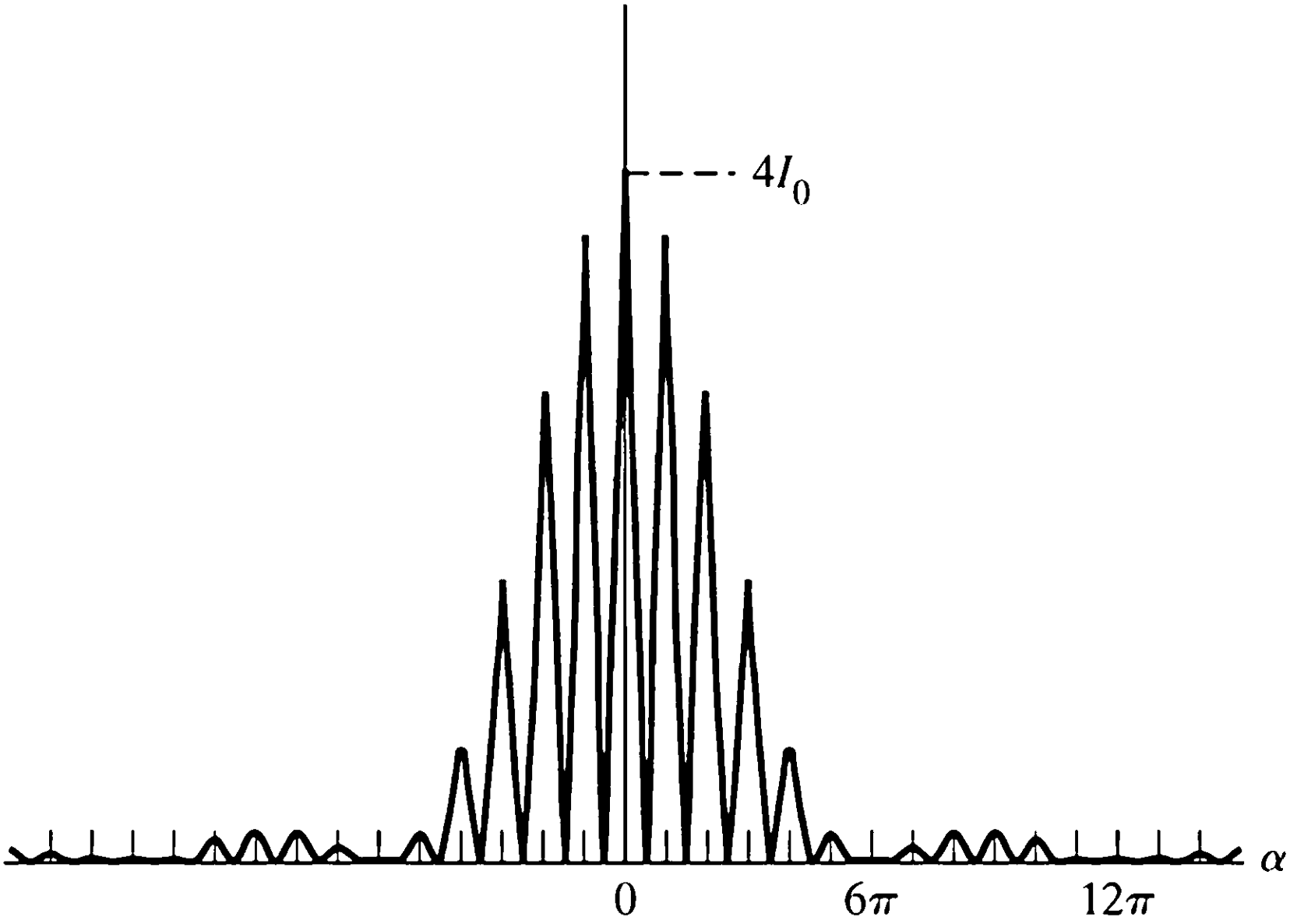
$$E_P = \frac{E_L}{r} e^{j(kr-\omega t)} \frac{1}{jk\sin\theta} \left(e^{j(ks\sin\theta)}\Big|_{+a/2-b/2}^{+a/2+b/2} + e^{j(ks\sin\theta)}\Big|_{-a/2-b/2}^{-a/2+b/2} \right)$$

1. apply limits of integration
2. let: $\beta = \frac{1}{2} kb\sin\theta \quad \alpha = \frac{1}{2} ka\sin\theta$
3. factor α's from βs
4. apply Euler's formula

$$E_P = \frac{2bE_L}{r} \frac{\sin(\beta)\cos(\alpha)}{\beta} e^{j(kr-\omega t)}$$

$$I = \varepsilon_o c \langle E_P{}^2 \rangle = 4 I_o \underbrace{\left(\frac{\sin^2(\beta)}{\beta^2} \right)}_{\text{Single slit diffraction}} \underbrace{\cos^2(\alpha)}_{\text{Double slit interference}}$$




$4I_0$
α
0
6π
12π