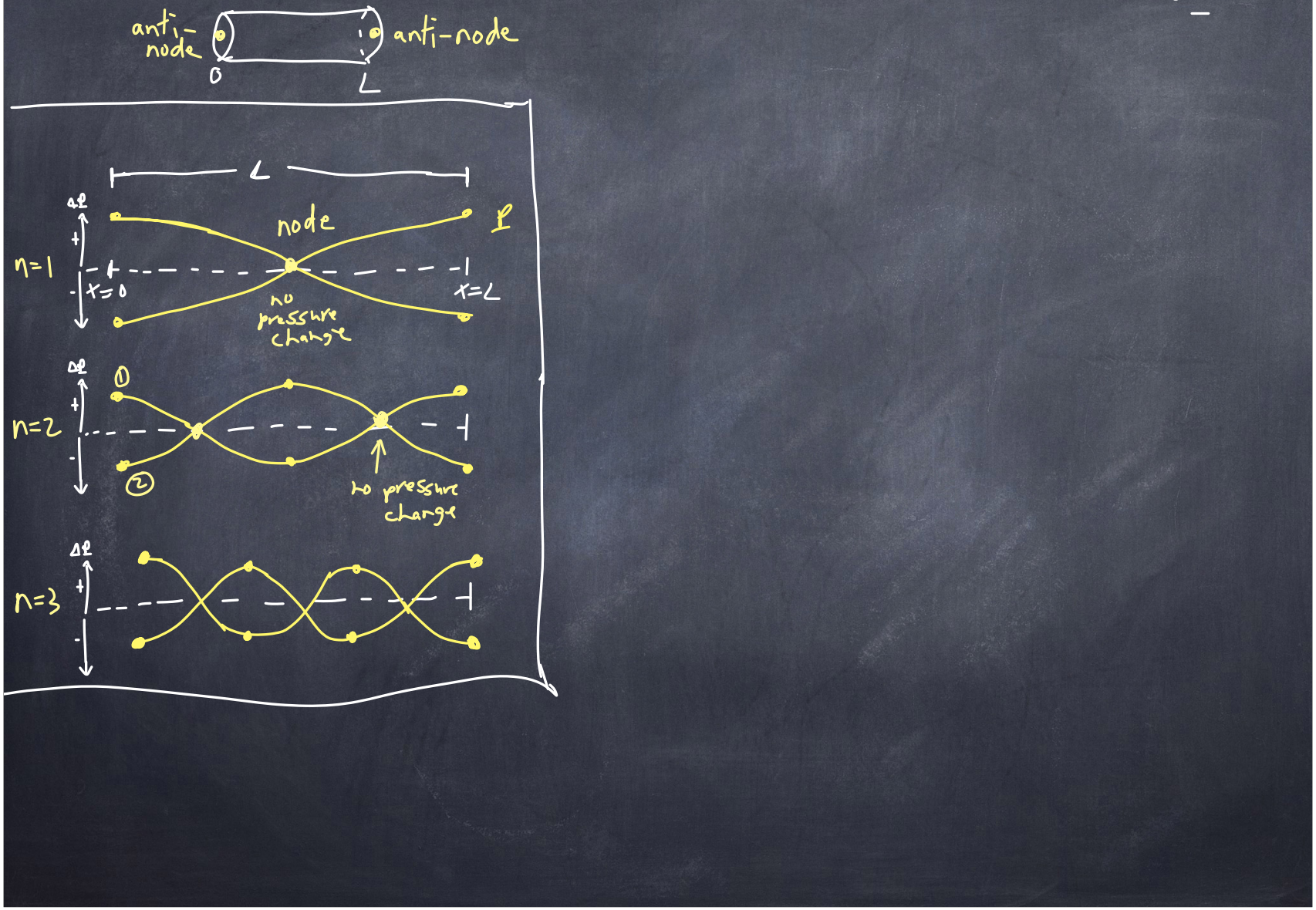
PHY117 HS2024

Today:

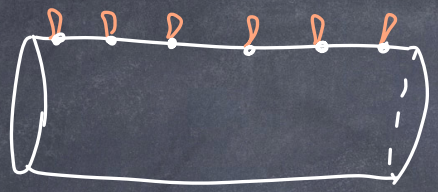
- standing sound waves
- spherical wave propagation
- interference patterns
- formula for interference

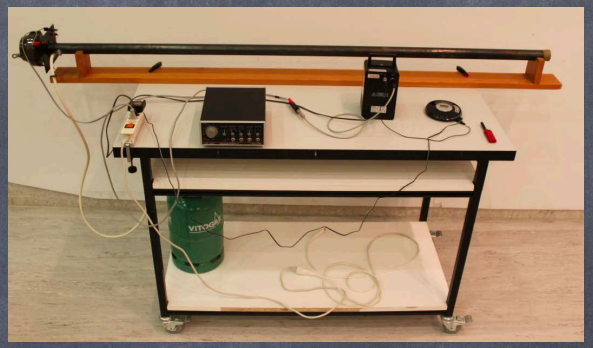
Week 12, Lecture 2
Dec. 4th, 2024
Prof. Ben Kilminster

Standing sound waves in a closed tube of length L



Ruben's flame tube

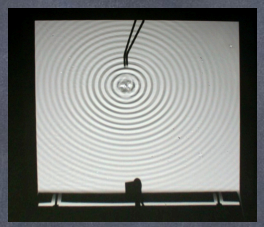
① 

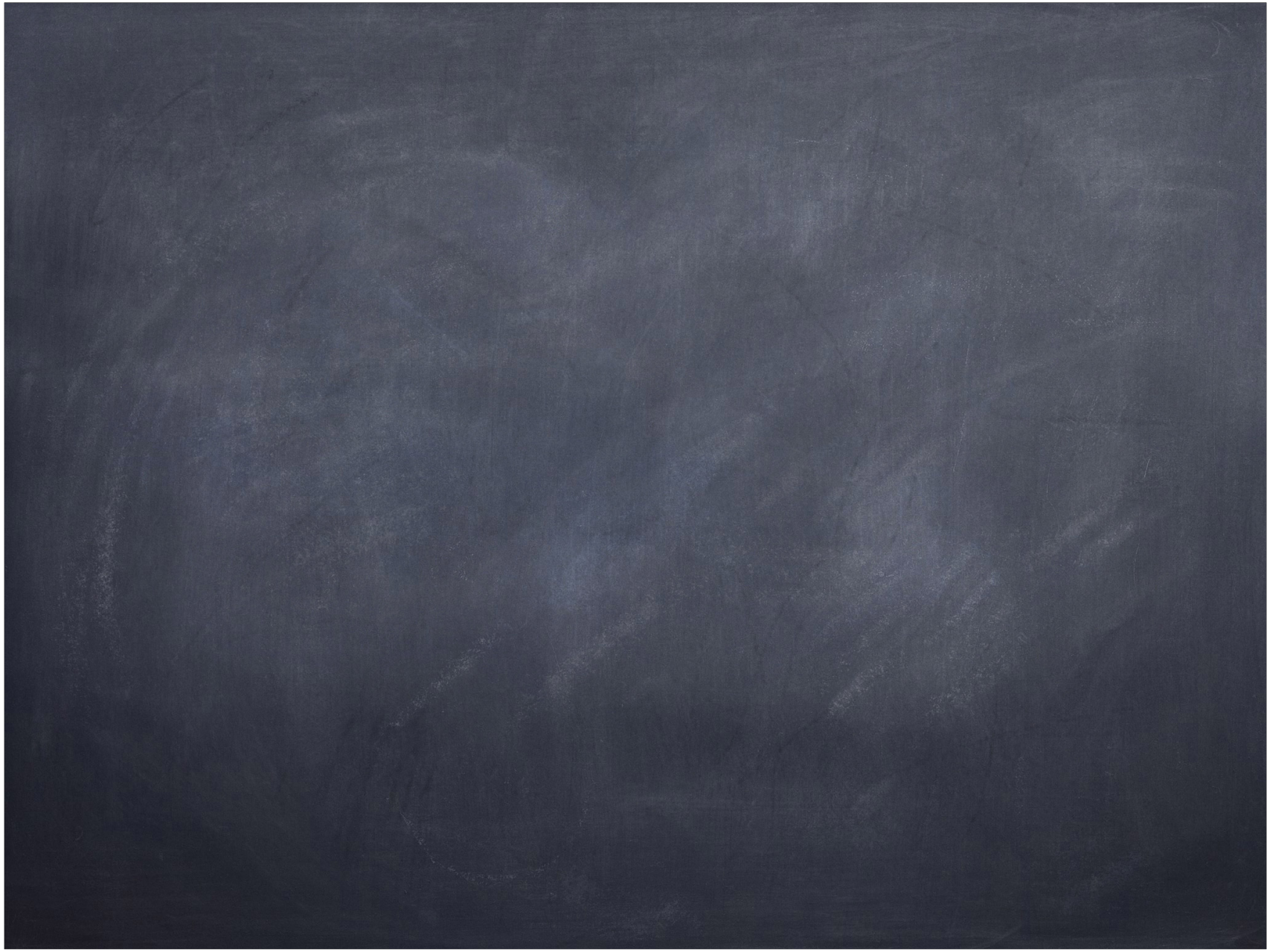


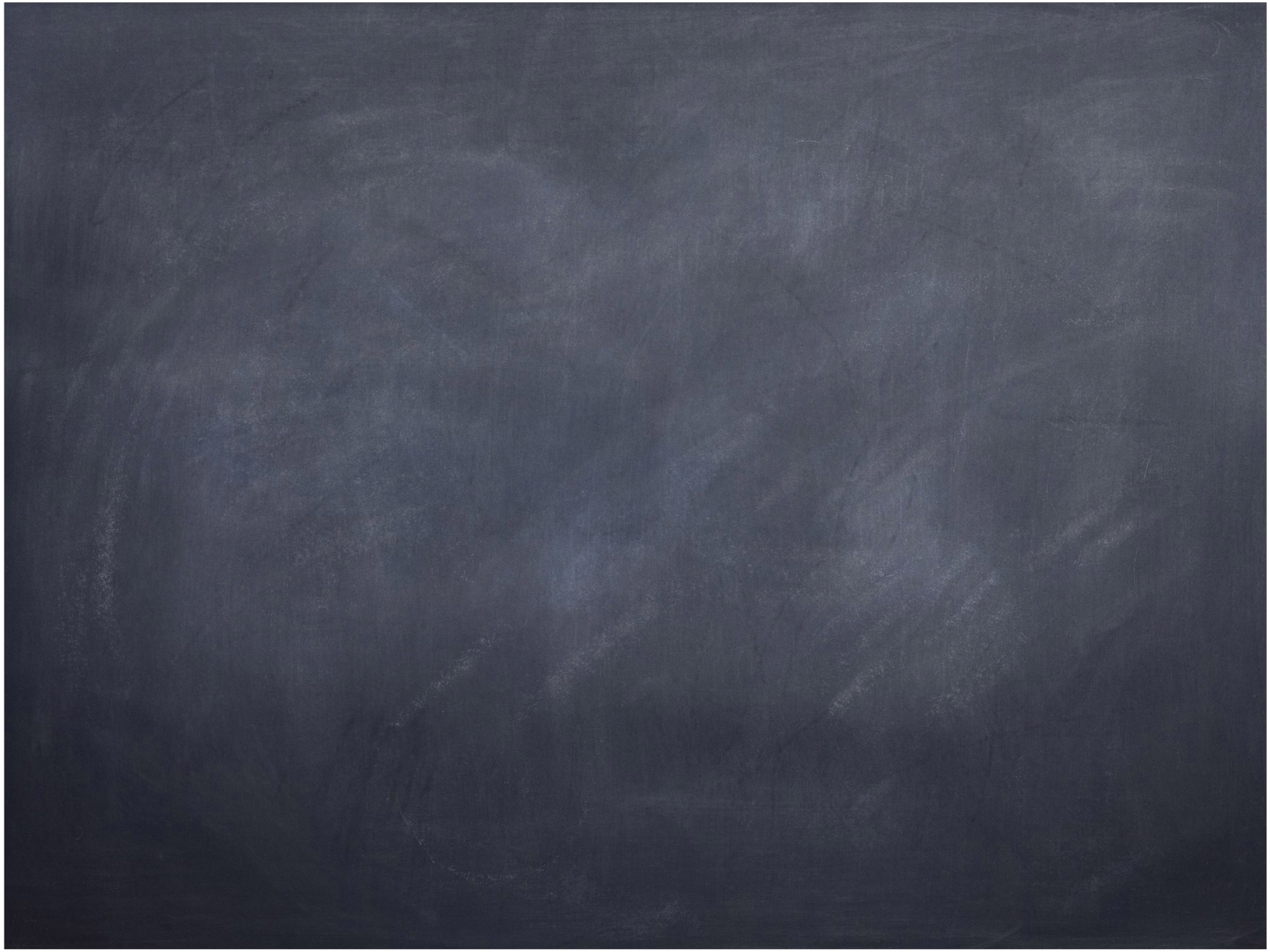
n=1

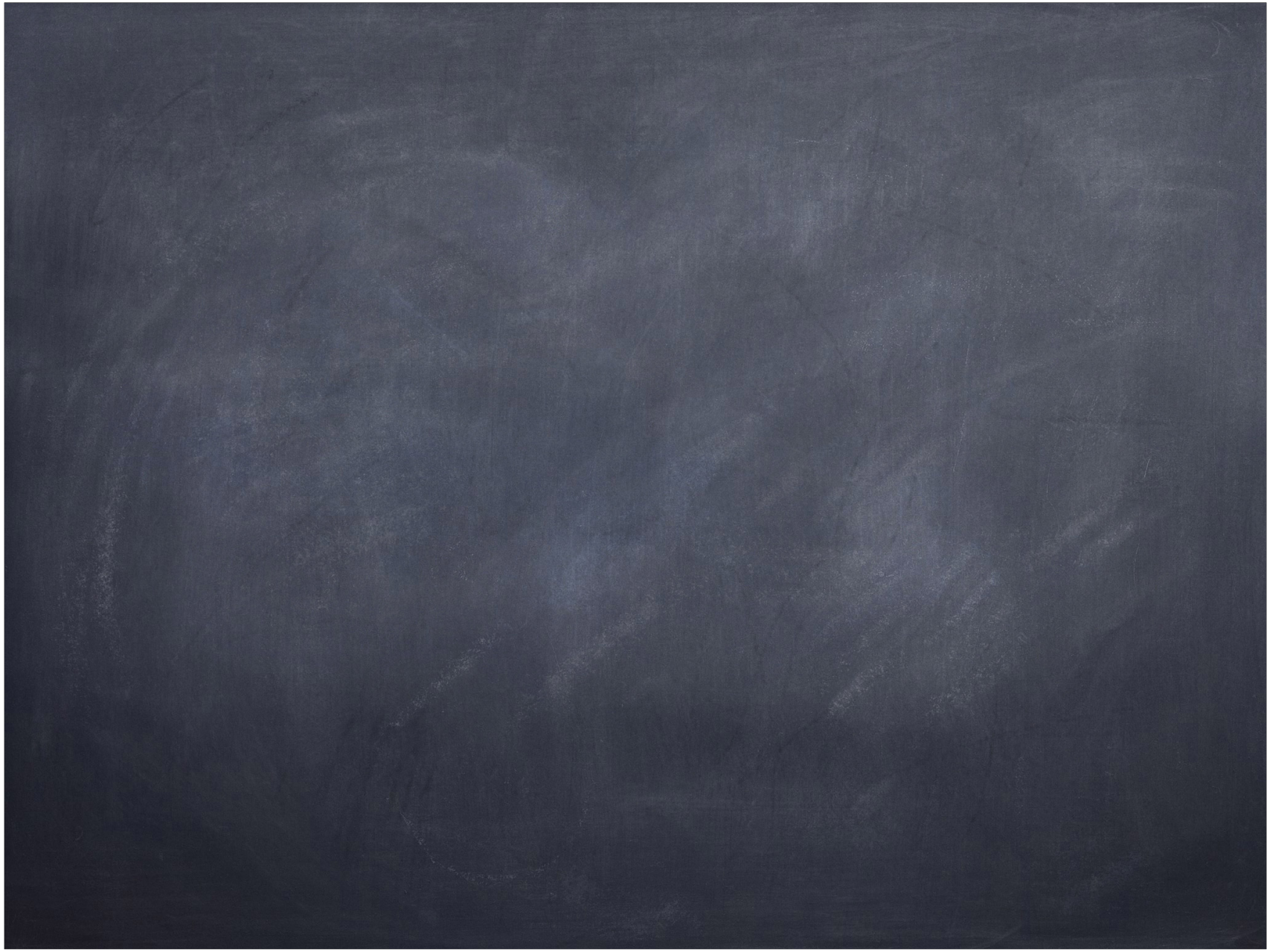
n=2

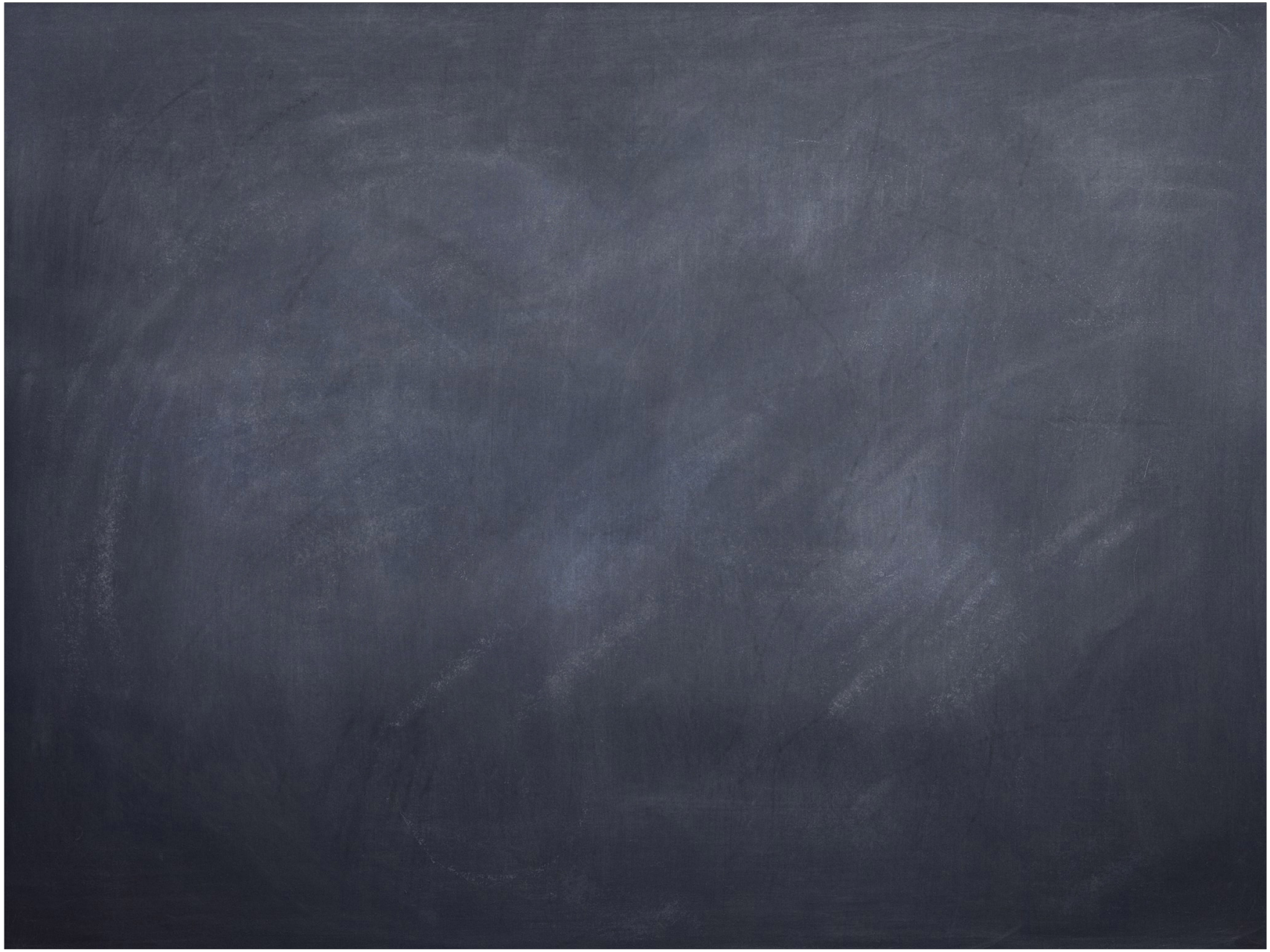
n=1 + n=2



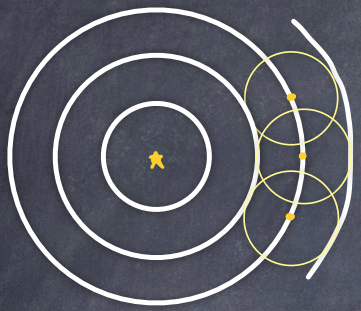


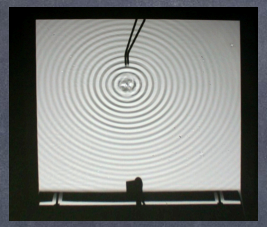


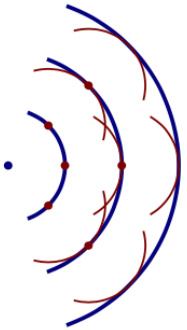




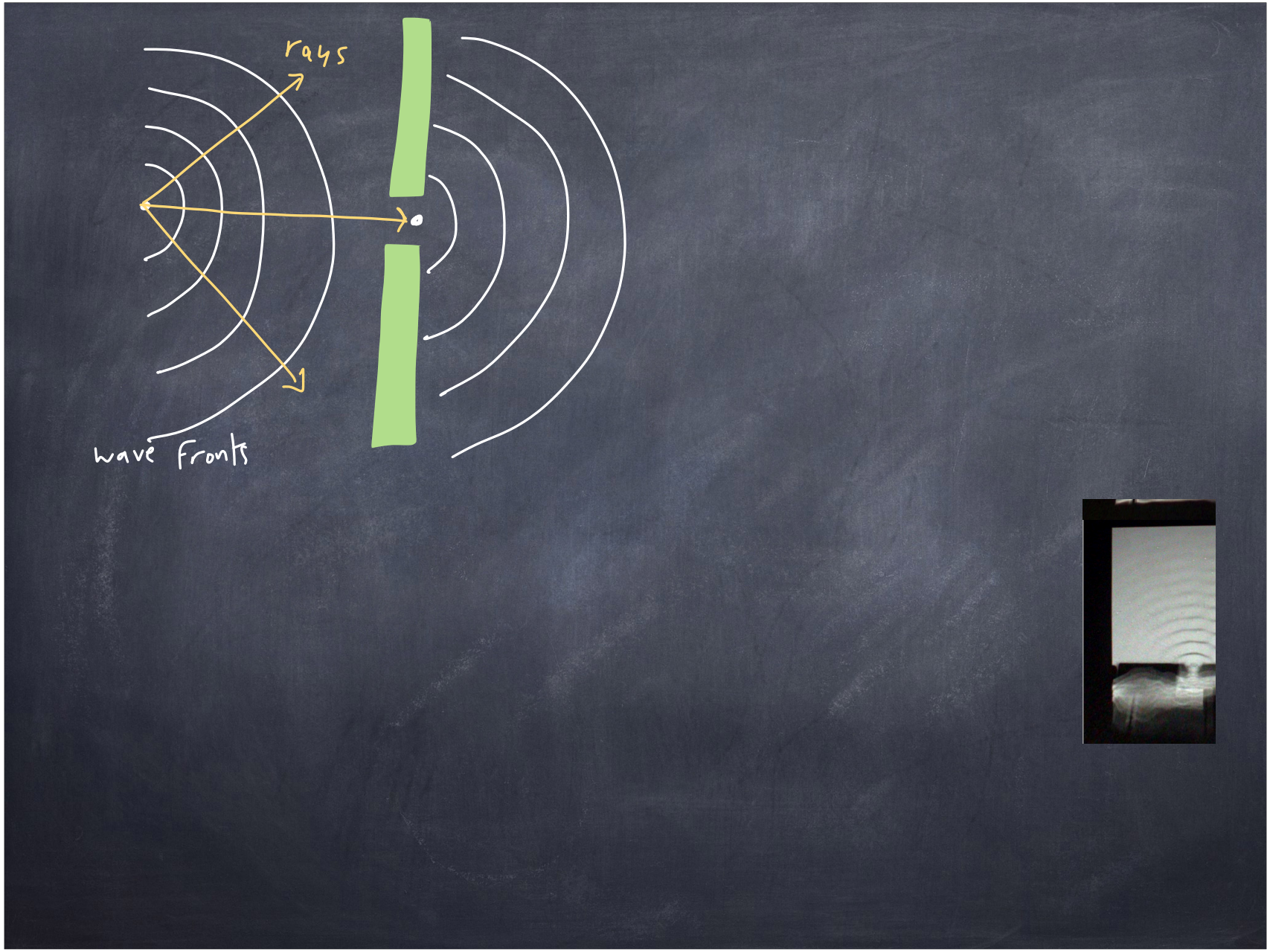
Huygen's principle-

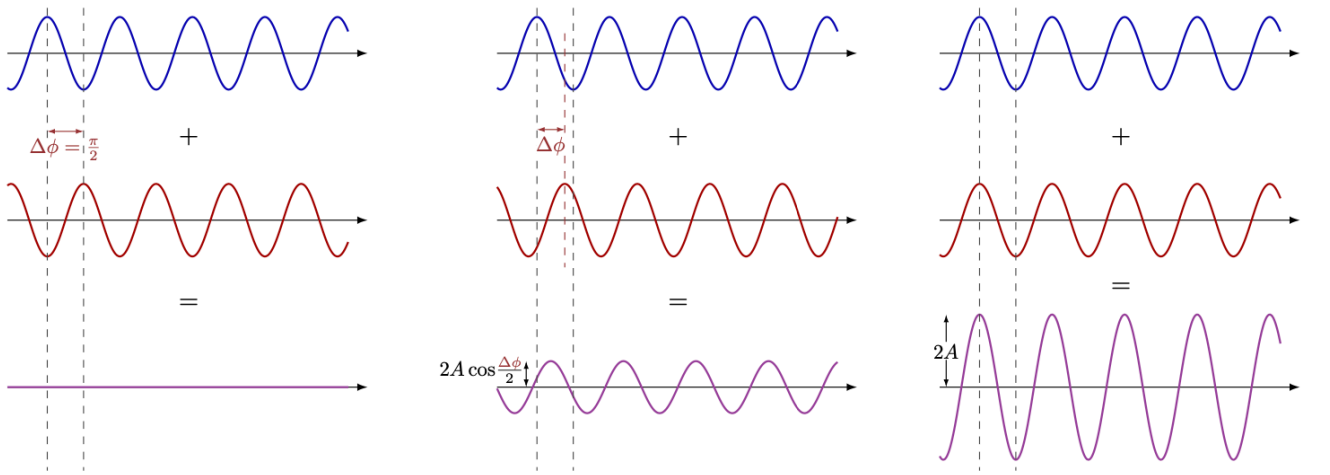






(b) Each point on a wavefront is a new point source.


rays
wave fronts

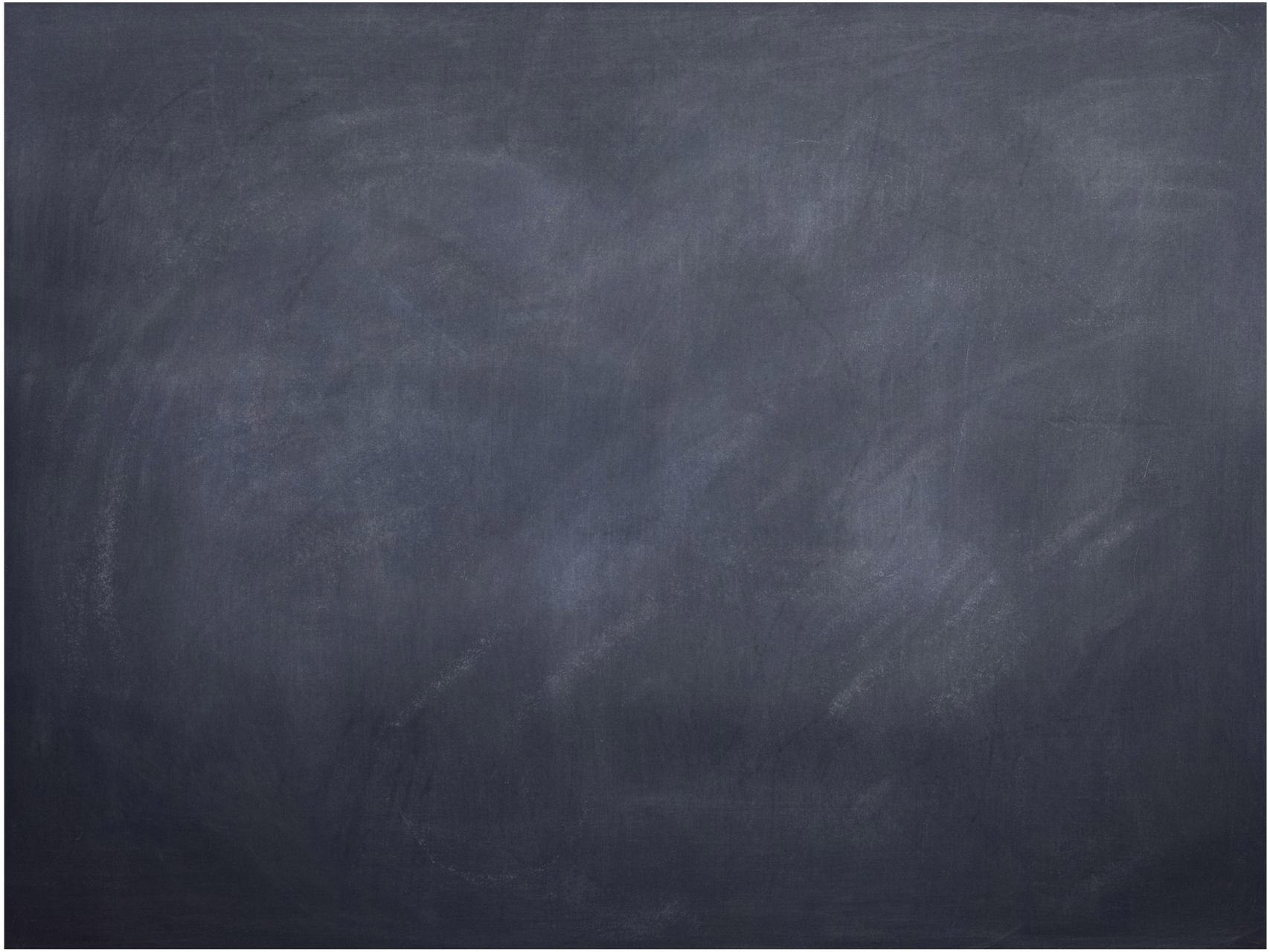


(a) If $\Delta\phi = 90°$, there is destructive interference.

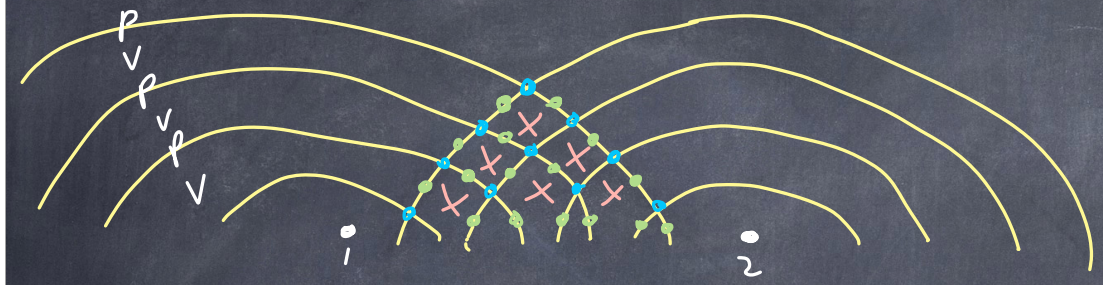
(b) If $0° < \Delta\phi < 90°$, there is partial interference with amplitude $2A\cos\frac{\Delta\phi}{2}$.

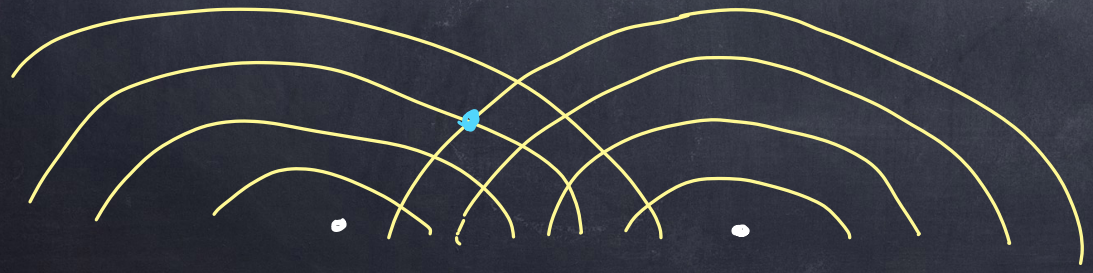
(c) If $\Delta\phi = 0°$, there is constructive interference with amplitude $2A$.

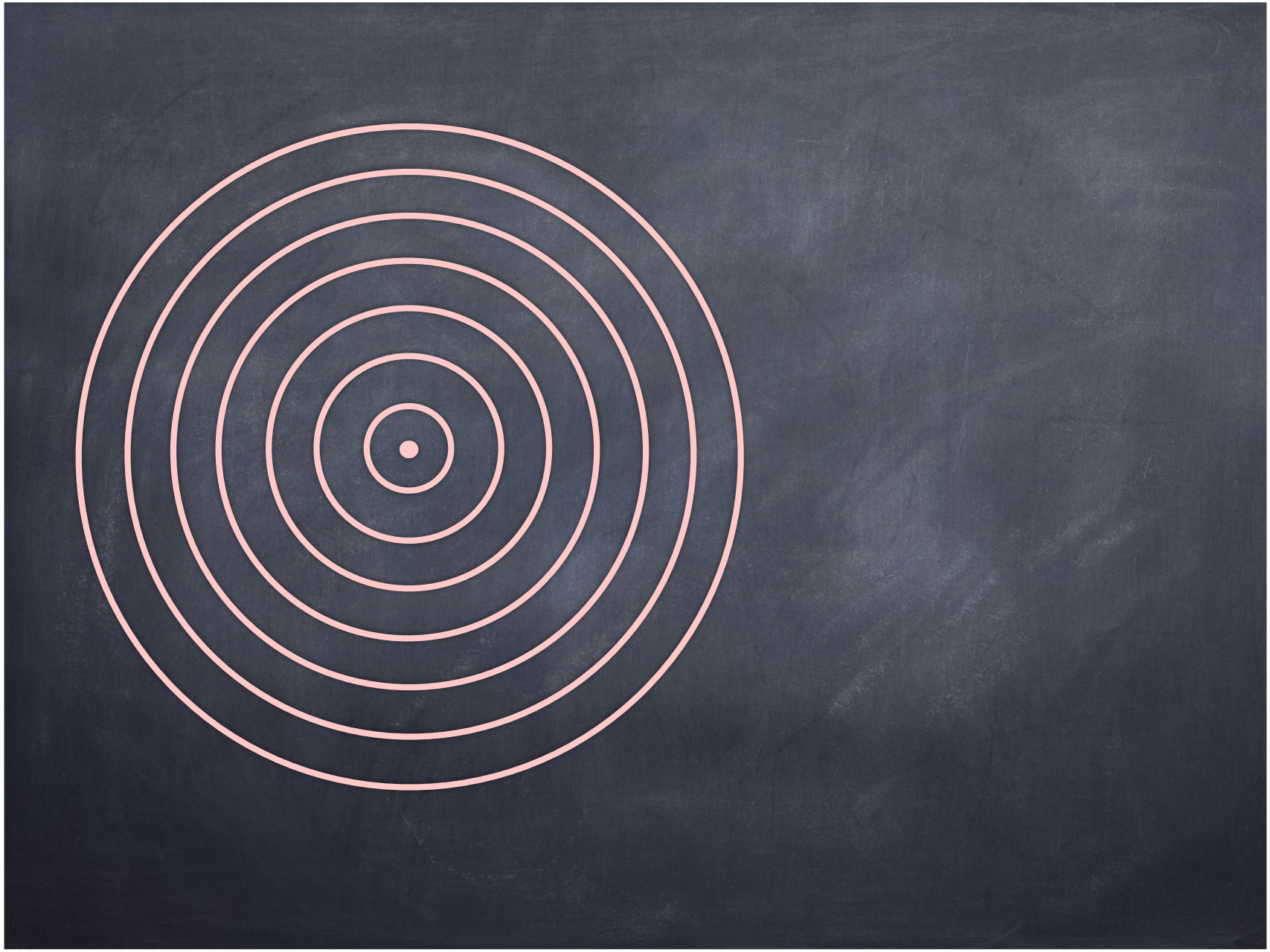
Figure 14.11: Interference between two waves with the same wavelength λ and amplitude A, but phase difference $\Delta\phi$.

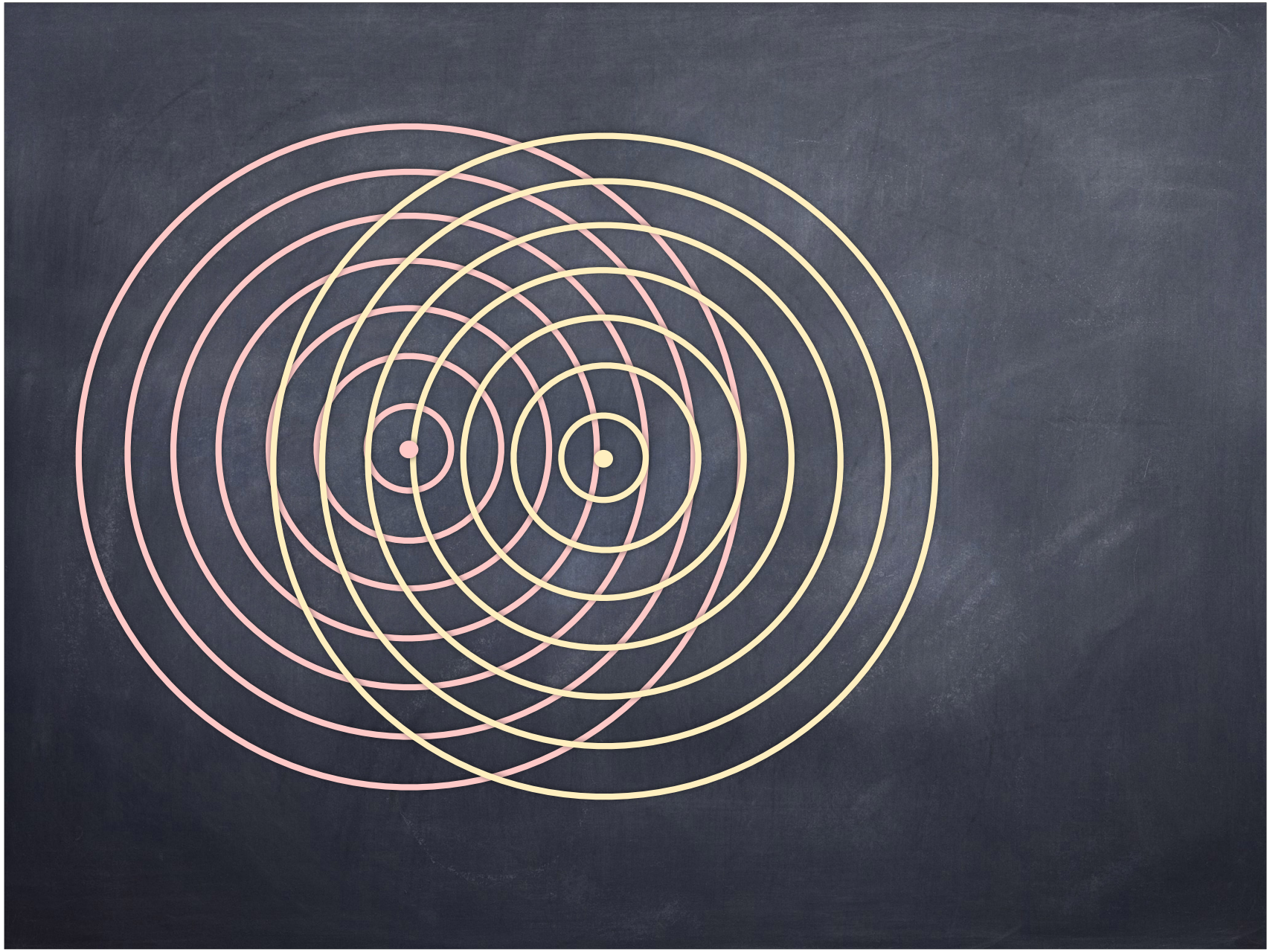


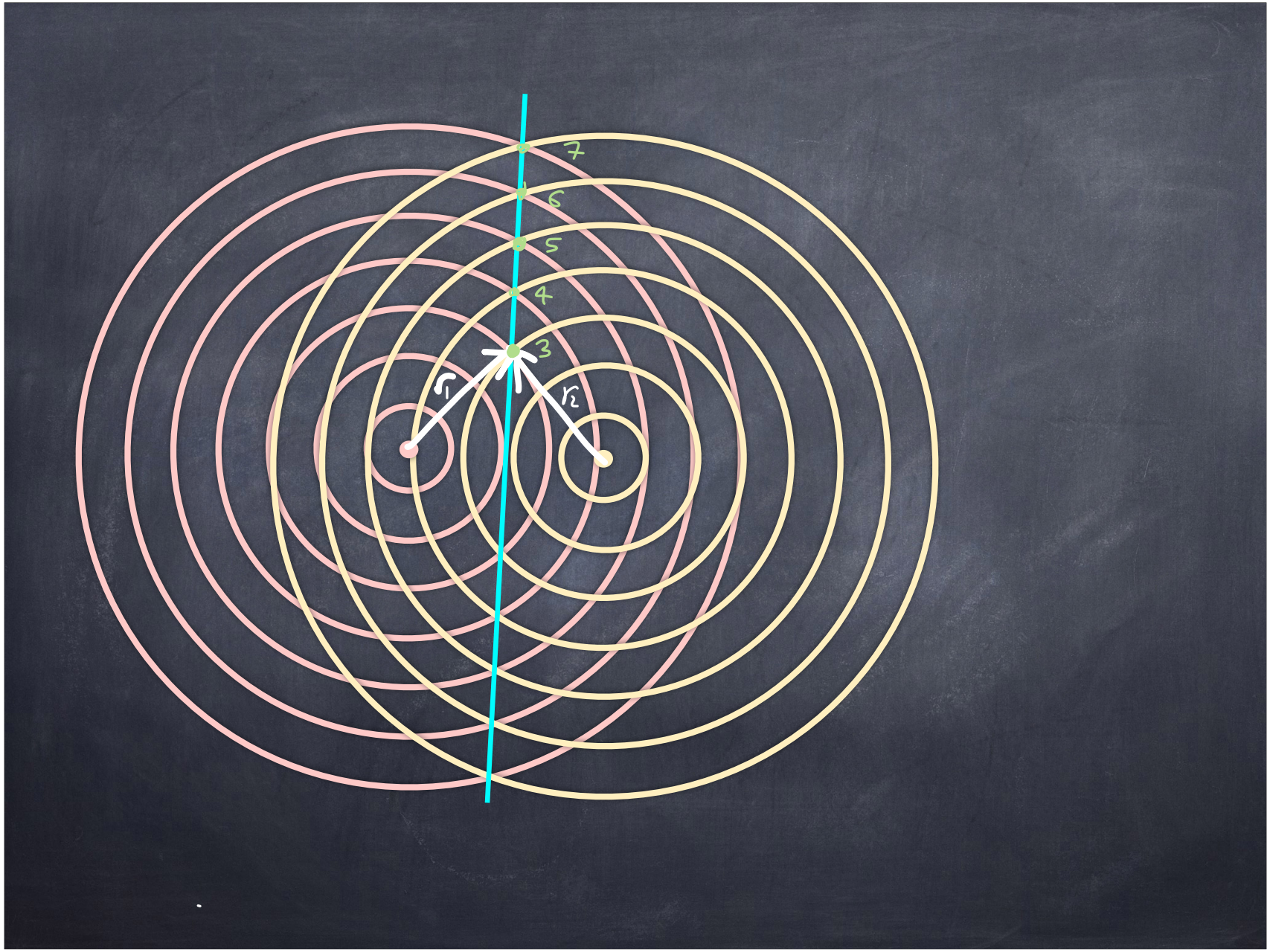
2 sources coherently emitting waves

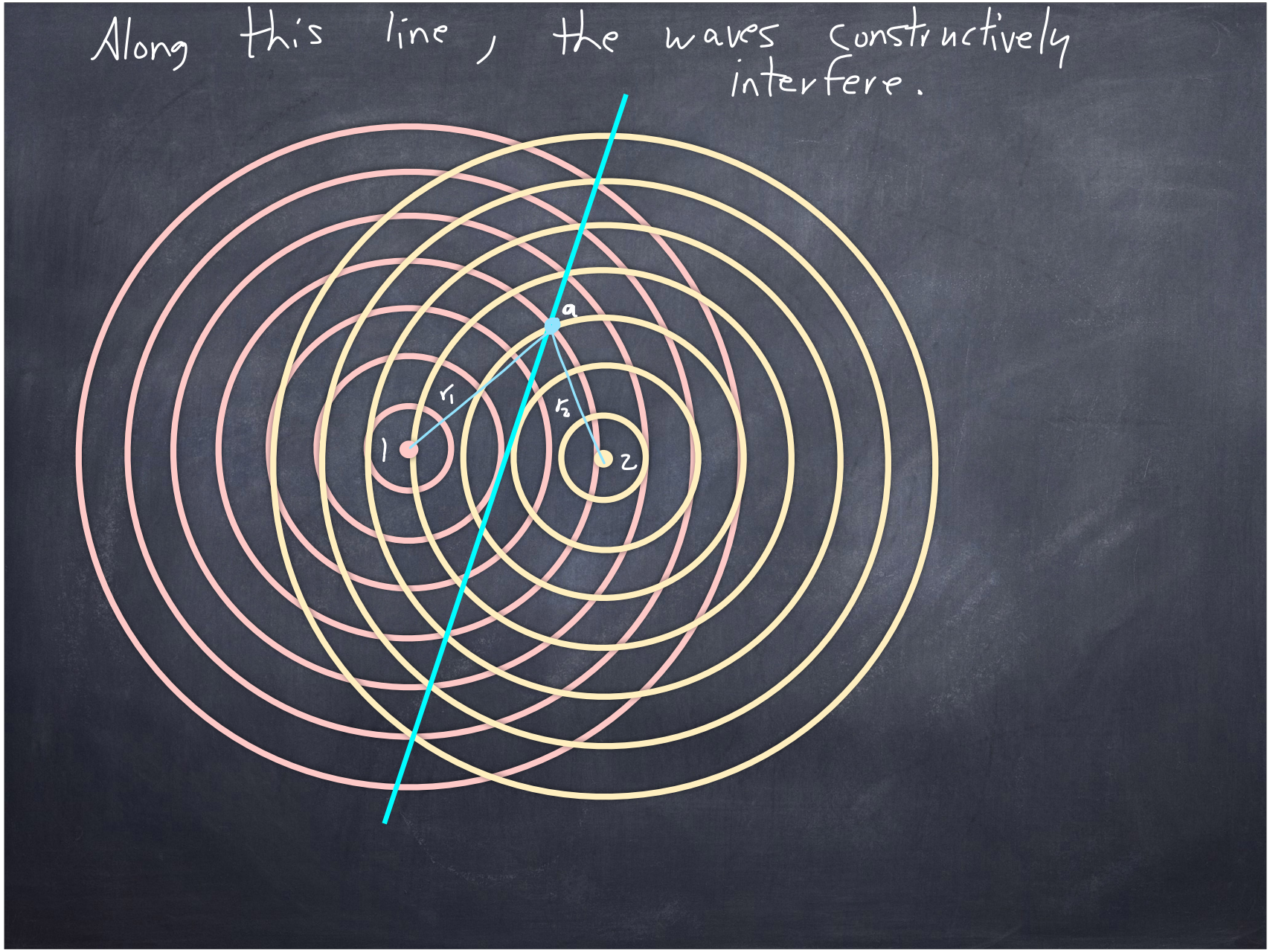


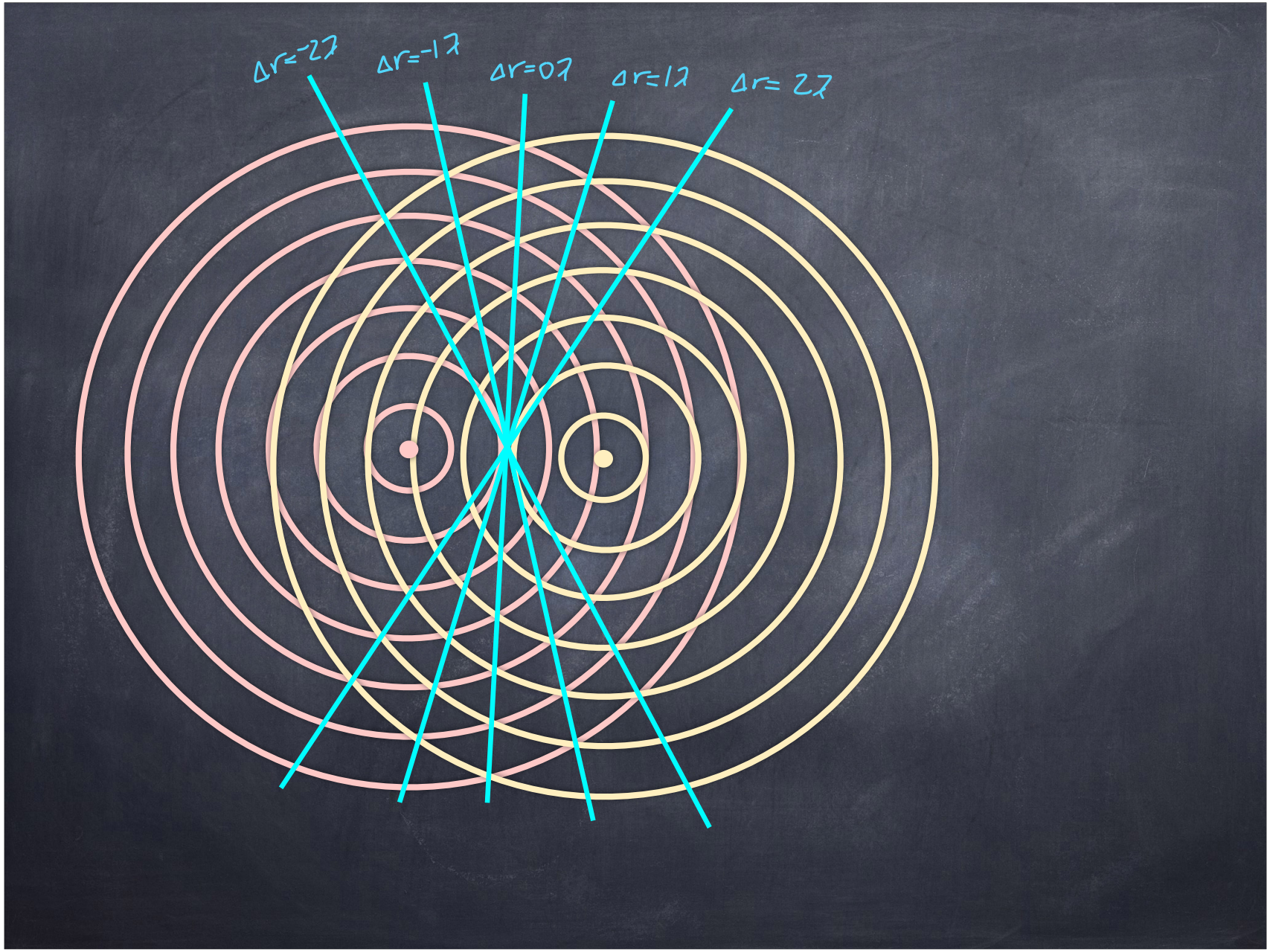


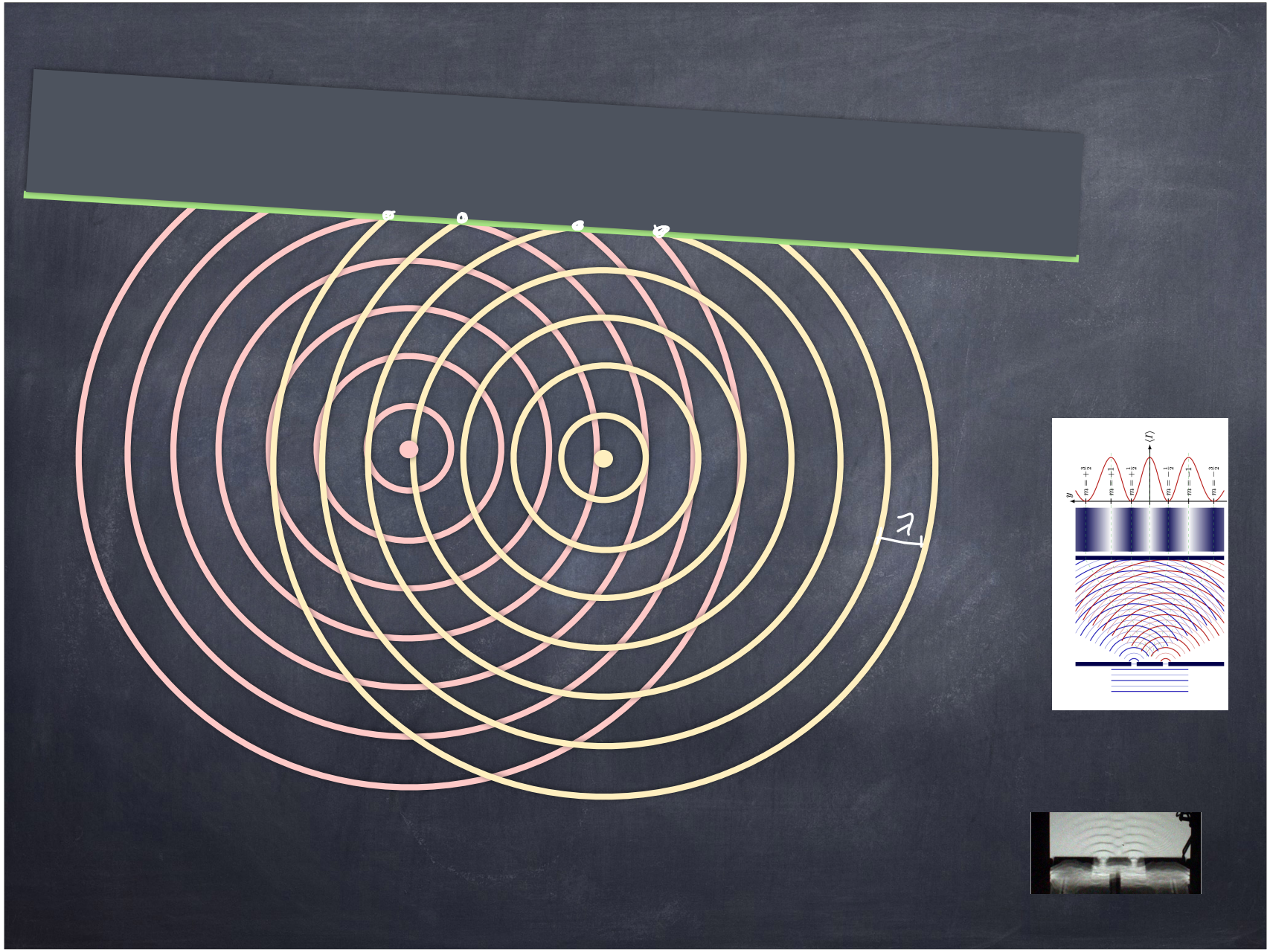


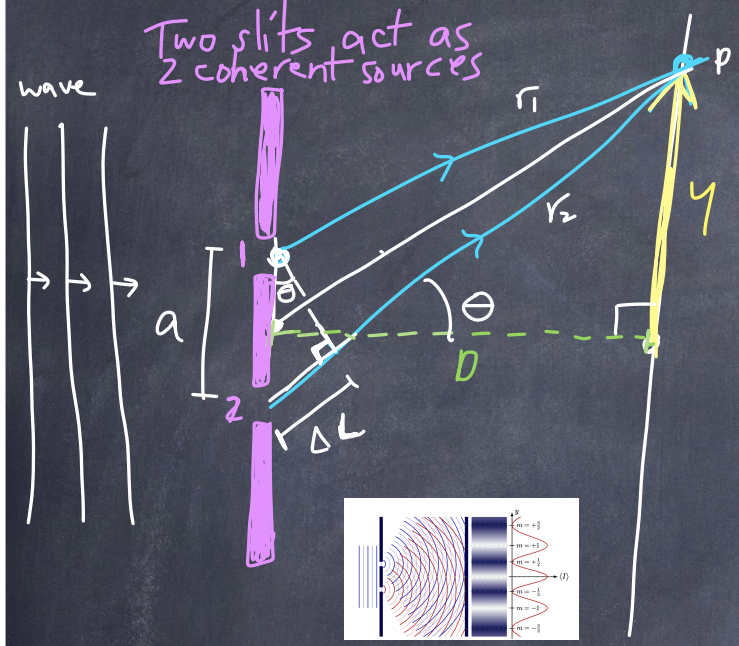



7
6
5
4
3
r_1
r_2


Along this line, the waves constructively interfere.
a
r_1
r_2
1
2

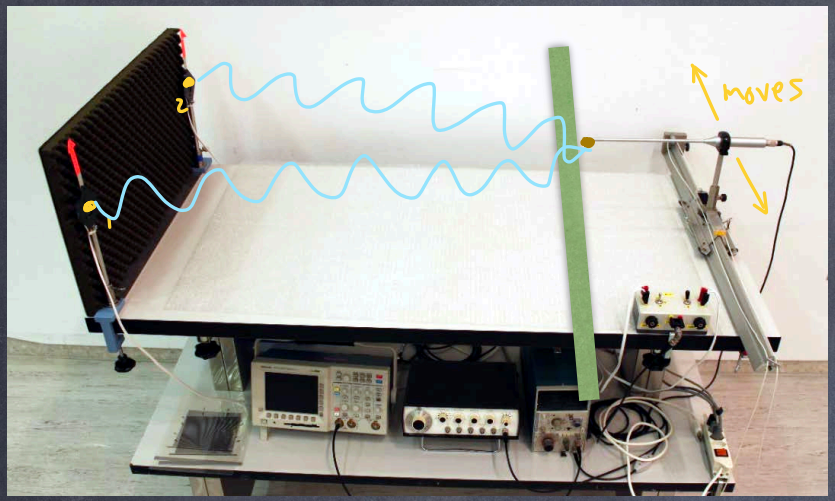

Δr=-2λ
Δr=-1λ
Δr=0λ
Δr=1λ
Δr= 2λ

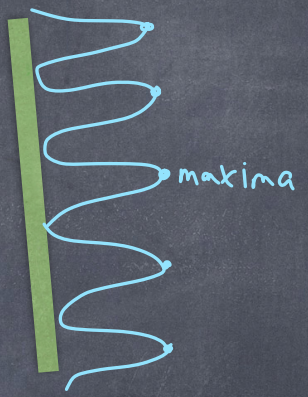

λ

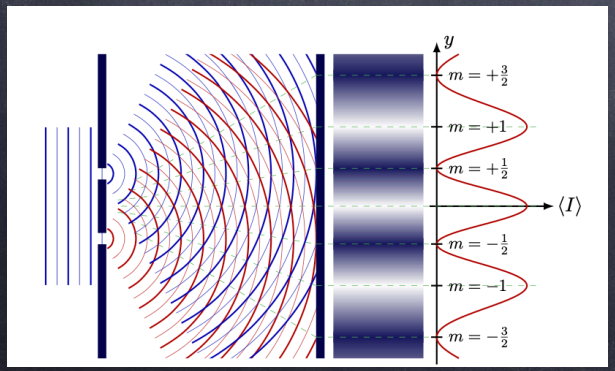

Two slits act as
2 coherent sources
wave
P
r_1
r_2
y
a
1
2
θ
D
ΔL

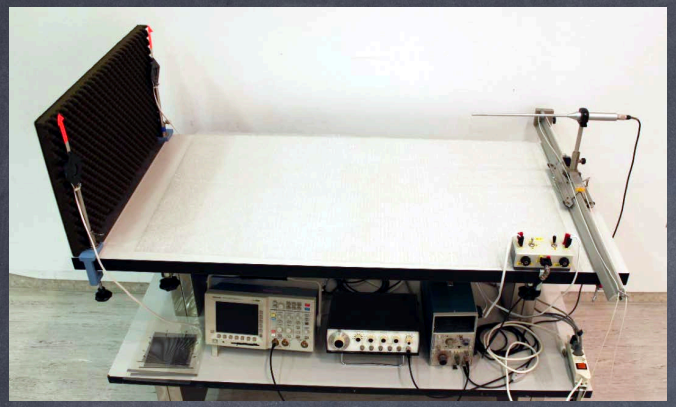
2 sources

1 receiver

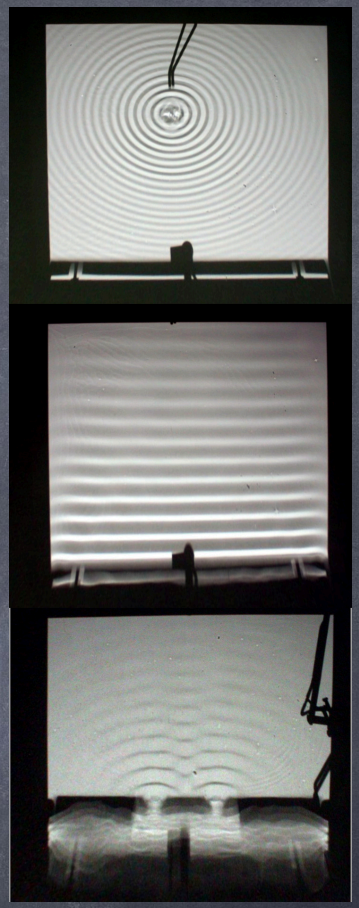






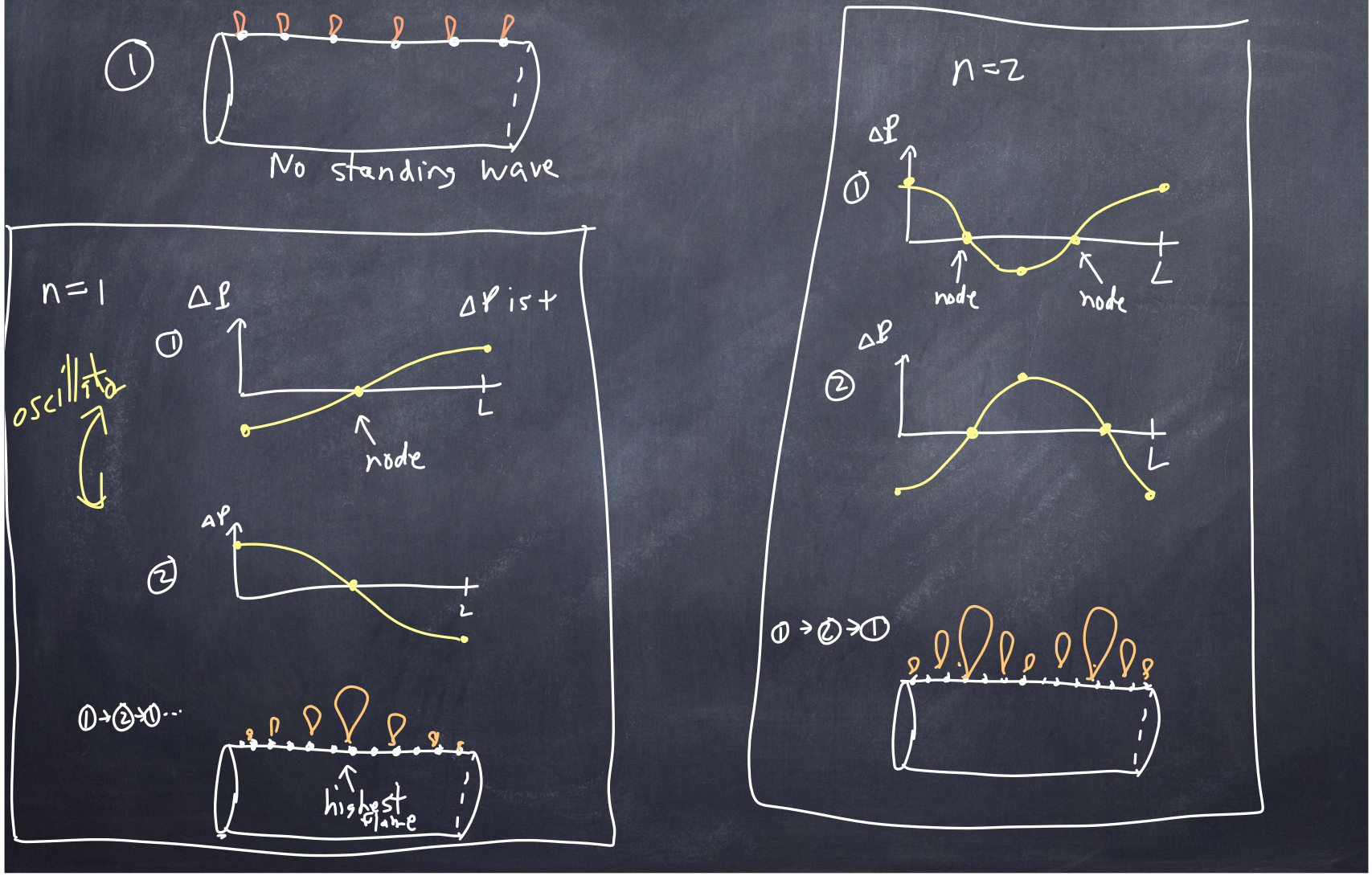


W110



W108

Ruben's flame tube – more understanding



Extra!

Why is pressure higher at pressure nodes?

For Ruben's flame tube:

For quiet sounds, ΔP of the gas $< P$ of the gas

From Bernoulli's equation, gas flow is proportional to square root of the pressure difference between inside & outside tube.

$$\text{flow} \sim \sqrt{P_{inside} - P_{outside}}$$

(The flow of gas out of the pipe)

When $\Delta P_{maximal}$, anti-nodes produce lower flames (flow rate is lower)

When $\Delta P = 0$, nodes, flow rate is higher

Part of the cycle, pressure is higher than average but part is lower. On average

This is why pressure is higher at nodes:

$$\sqrt{P + \Delta P \text{ at anti-nodes}} < \sqrt{P + \cancel{\Delta P}^{\,0} \text{ at nodes}}$$