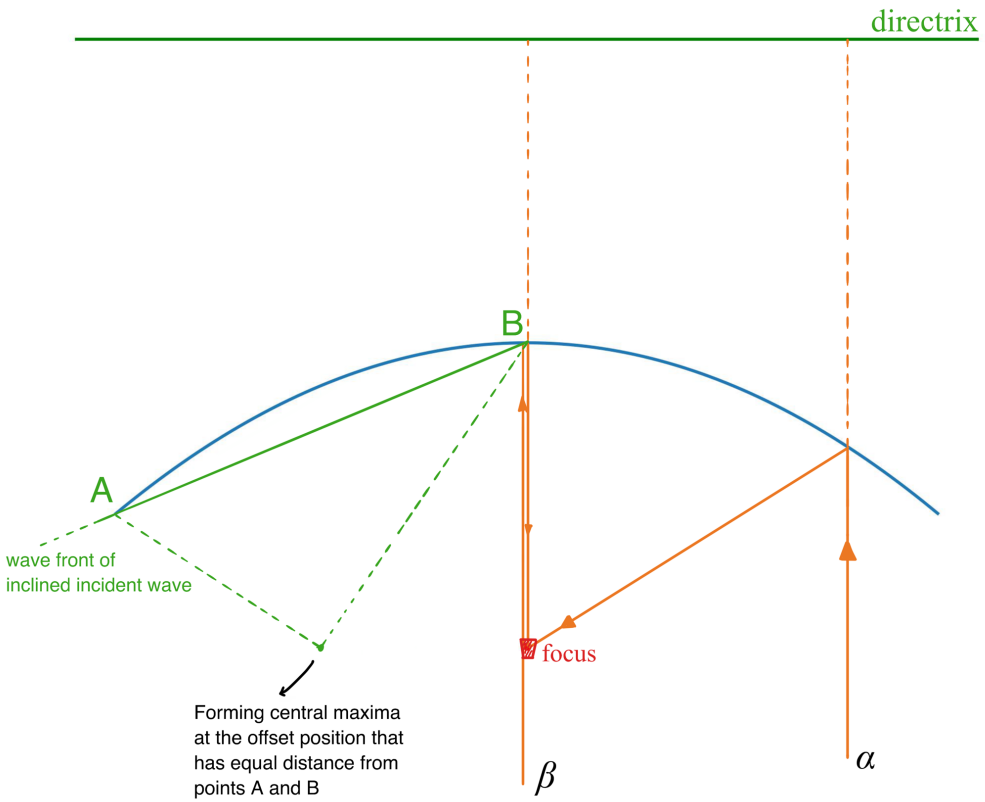
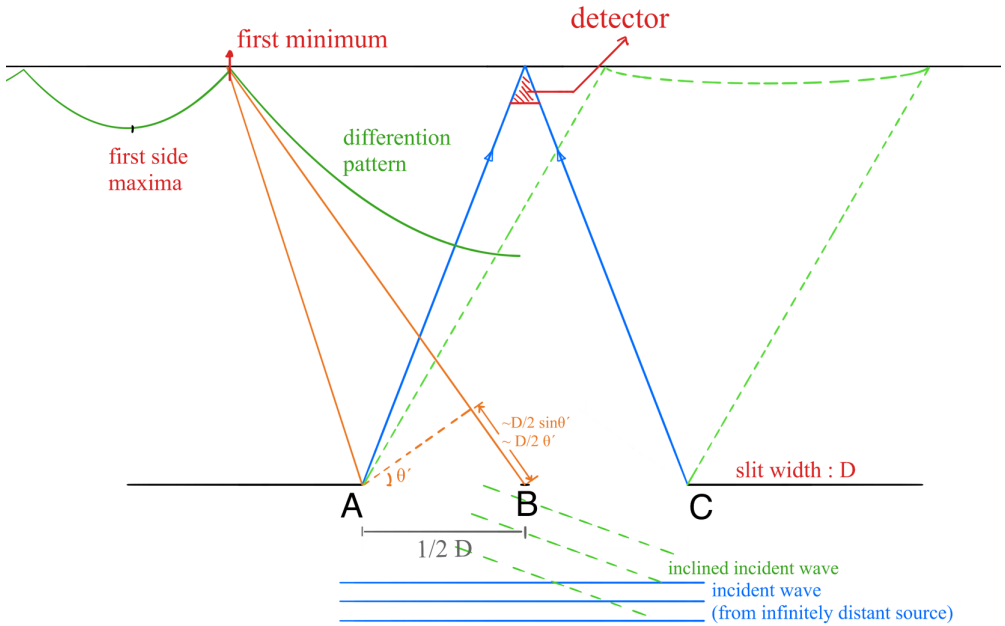
An Introduction to Radio Interferometry

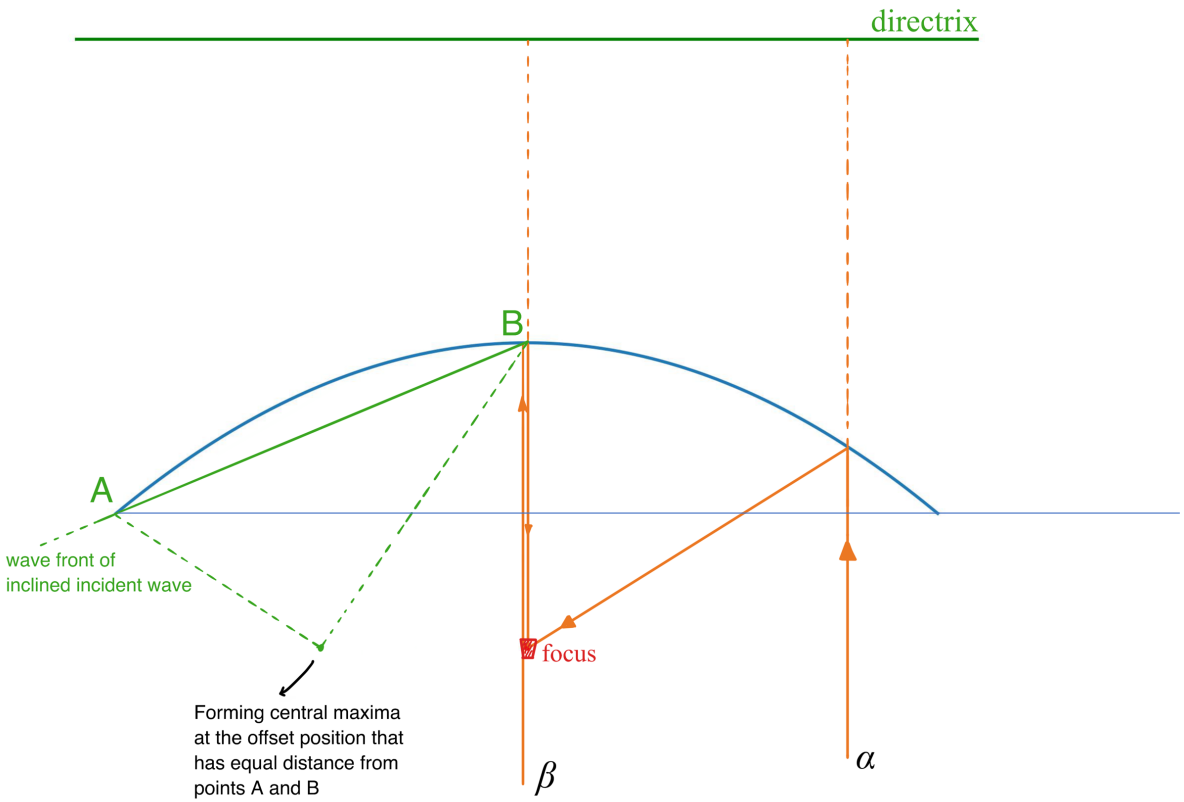
2-3 Response function of a single-dish telescope

You can find relevant material on my personal webpage

NSYSU EMI Online Lecture Series Hauyu Baobab Liu (呂浩宇),
Department of Physics


directrix
B
A
wave front of
inclined incident wave
focus
Forming central maxima
at the offset position that
has equal distance from
points A and B
β
α


detector
first minimum
first side
maxima
differention
pattern
~D/2 sinθ´
~ D/2 θ´
θ´
slit width : D
A
B
C
1/2 D
inclined incident wave
incident wave
(from infinitely distant source)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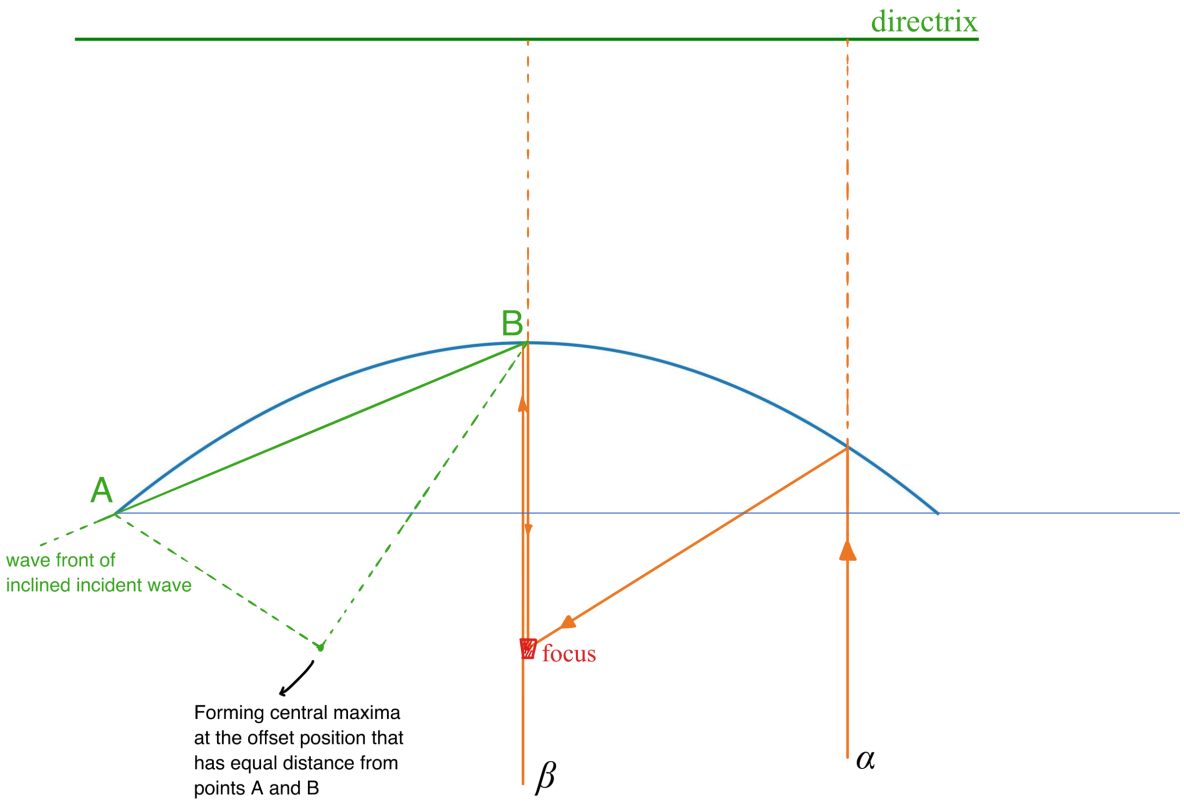
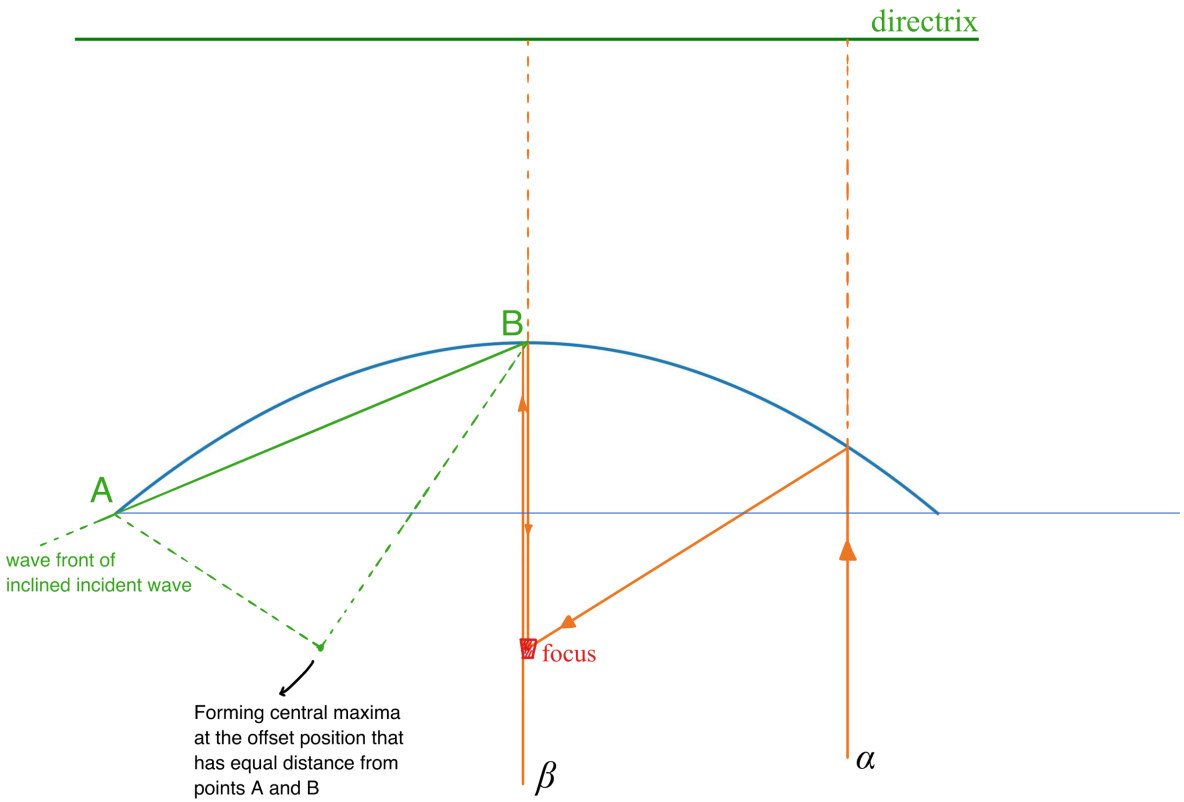


How do we find the first minimum?



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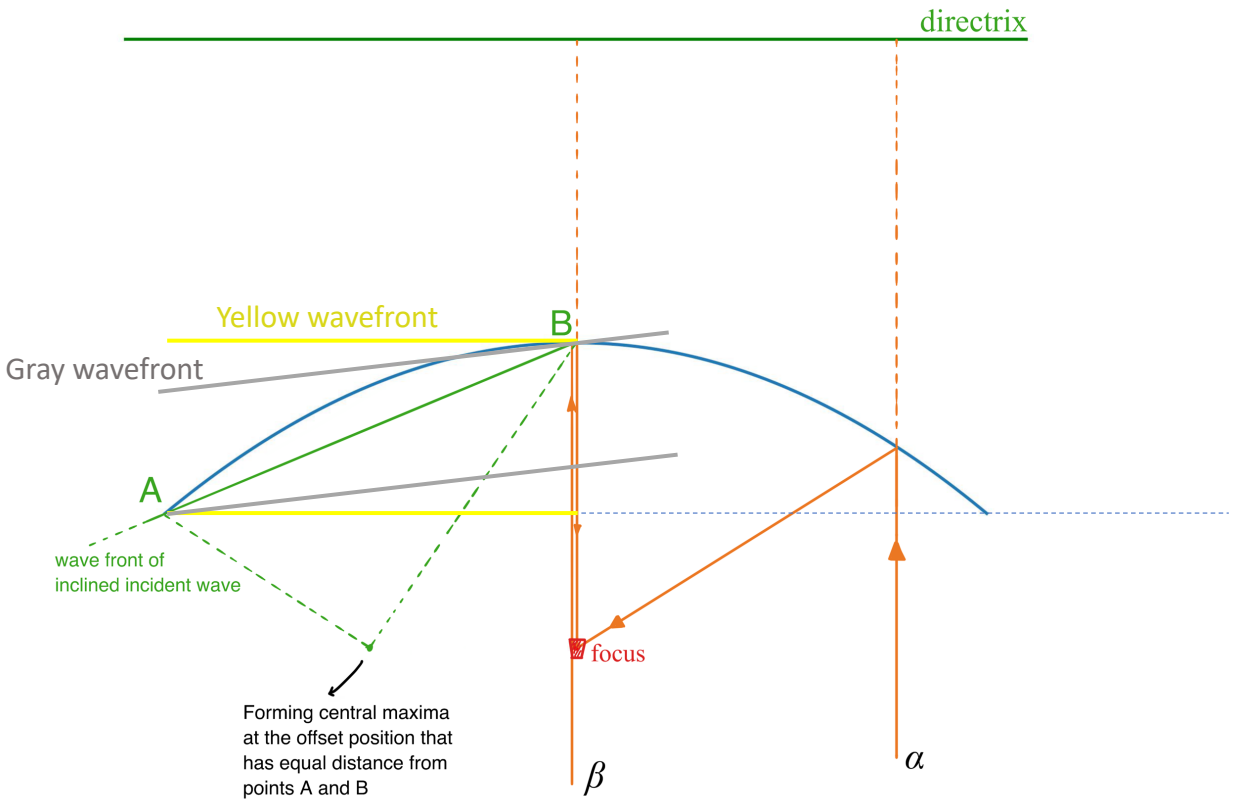
The trick we knew when working on single-slit.



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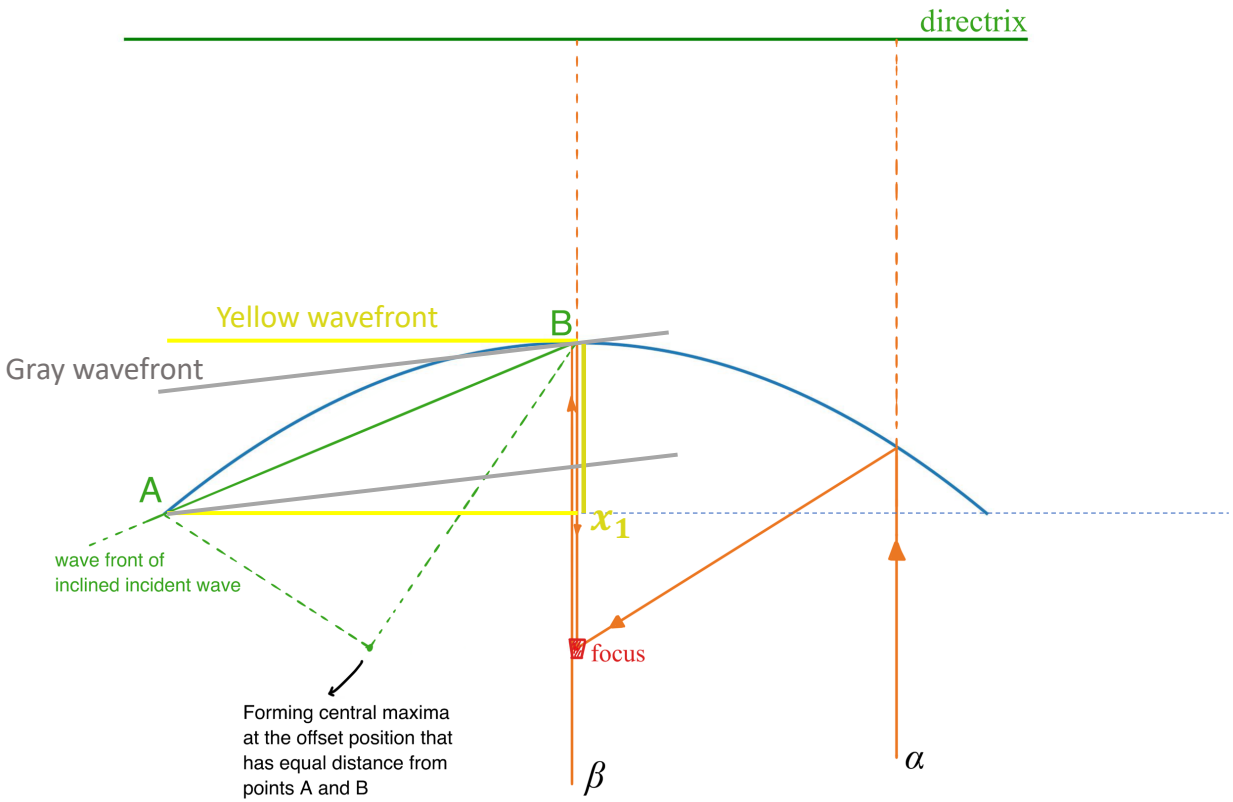

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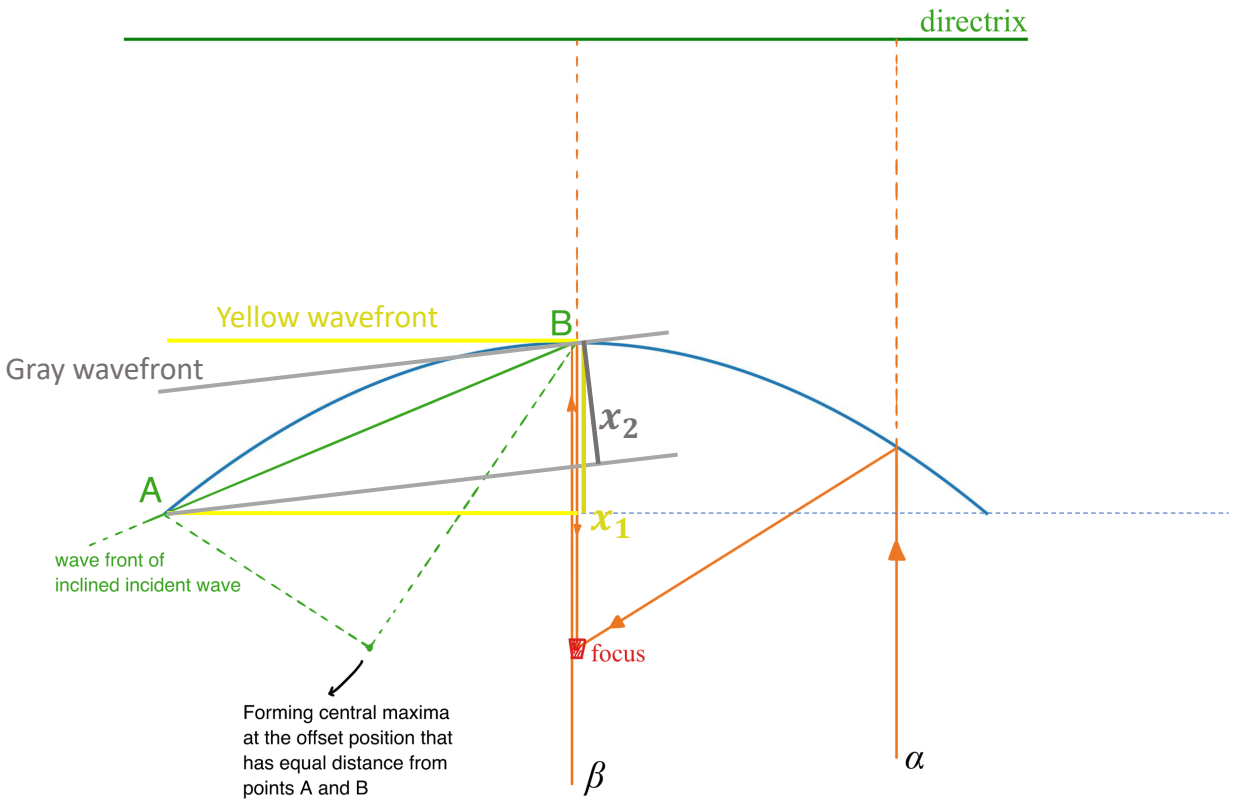

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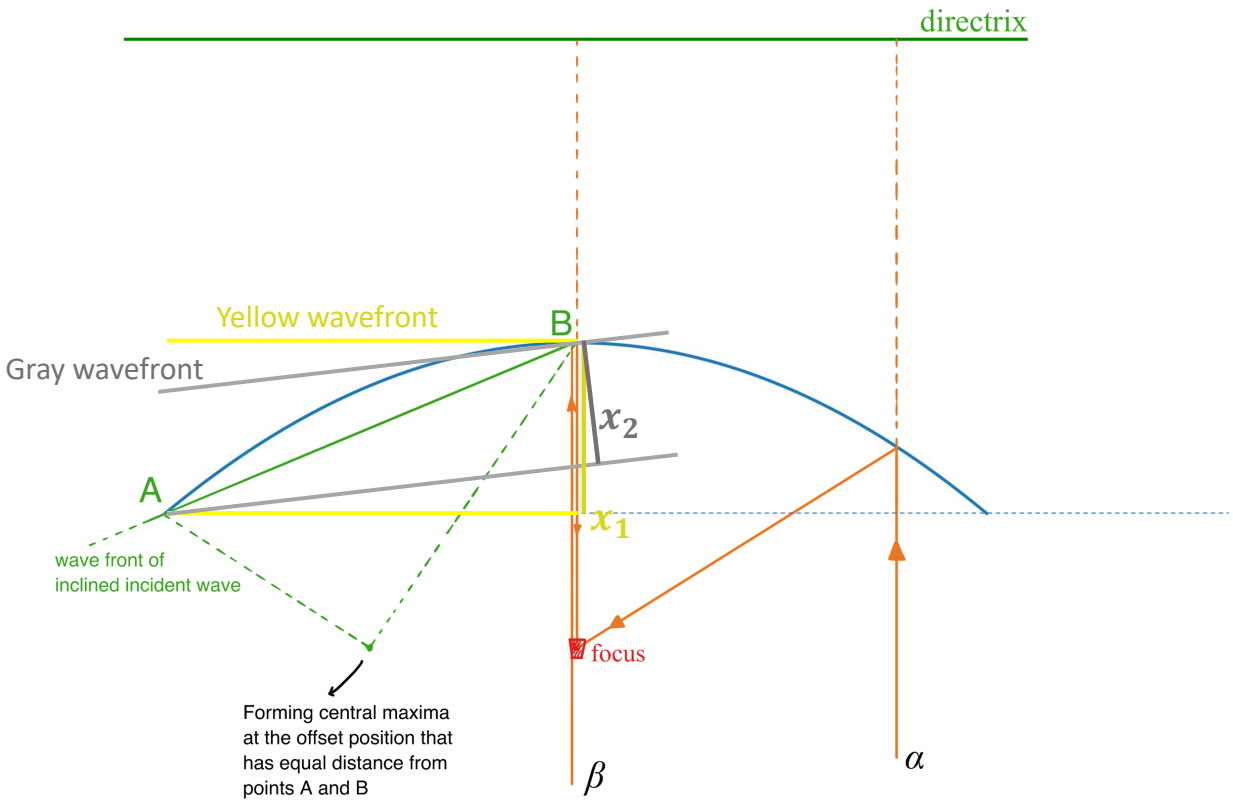

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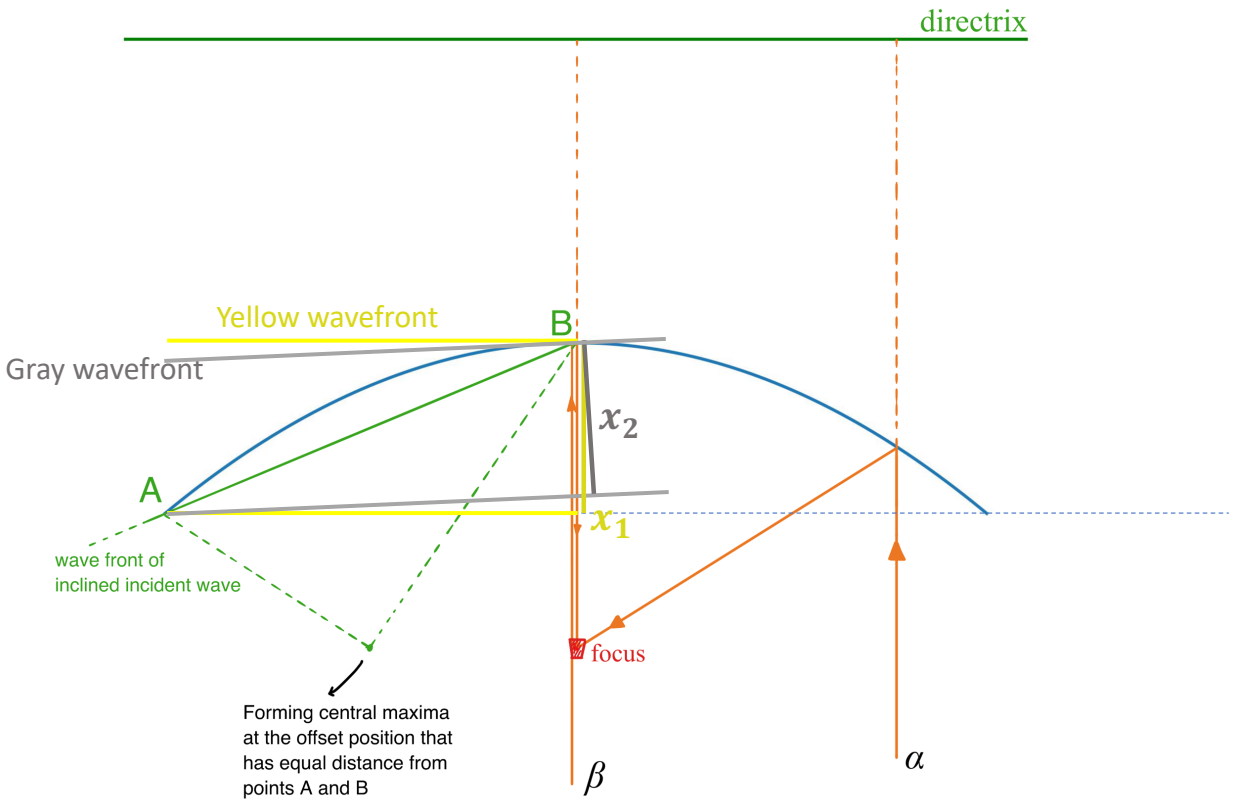

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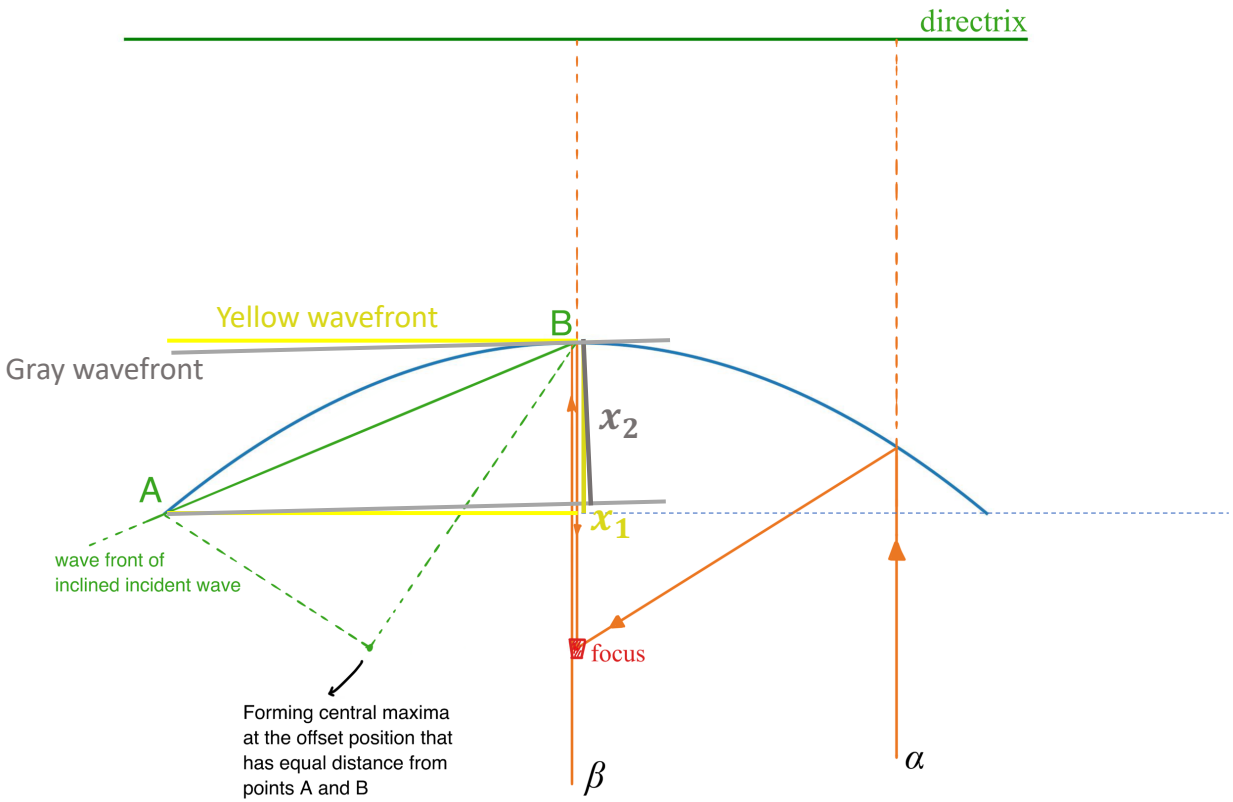

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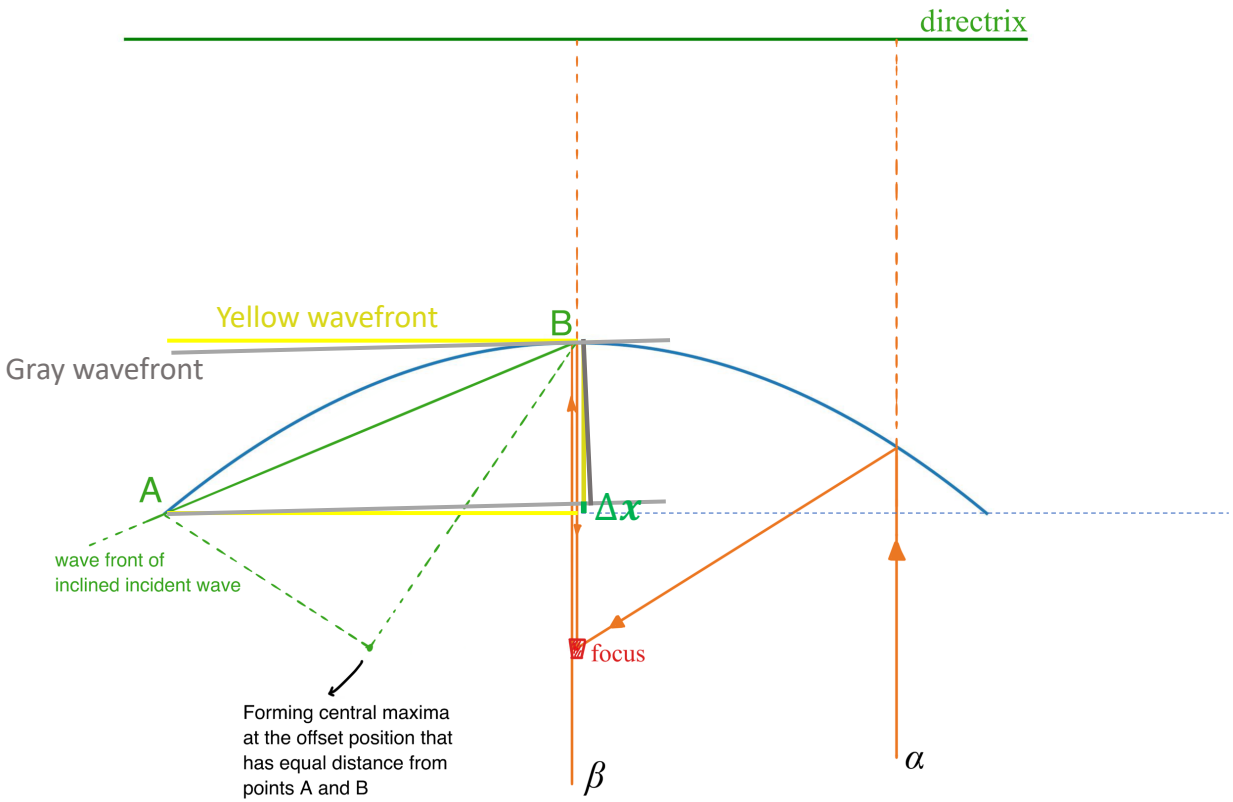

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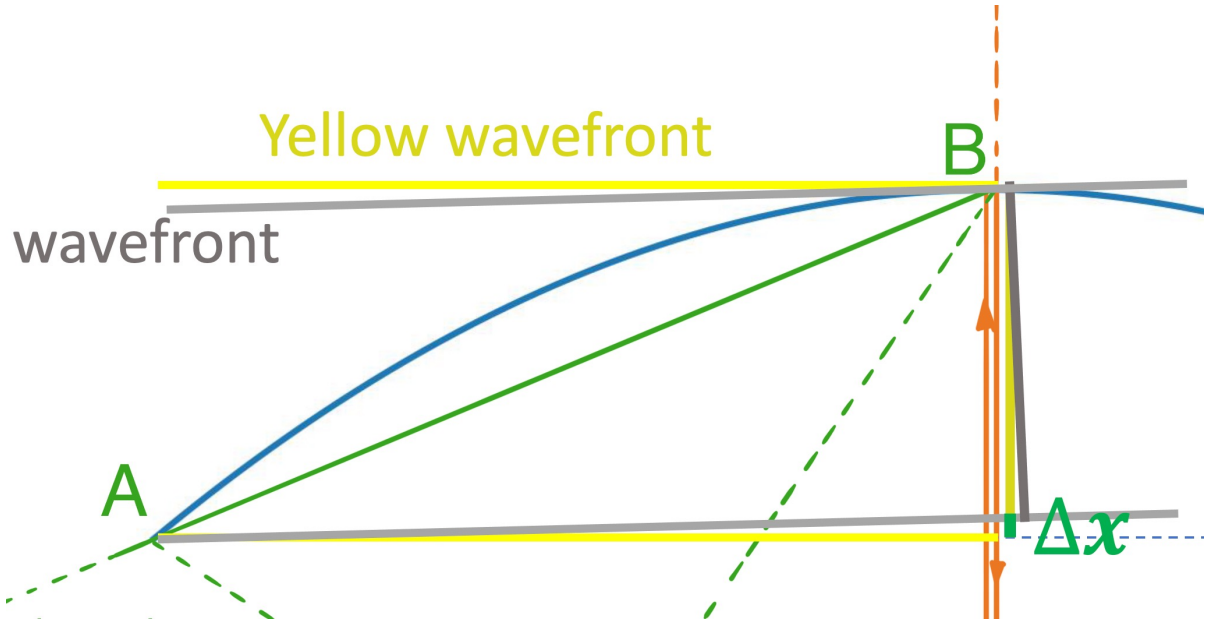

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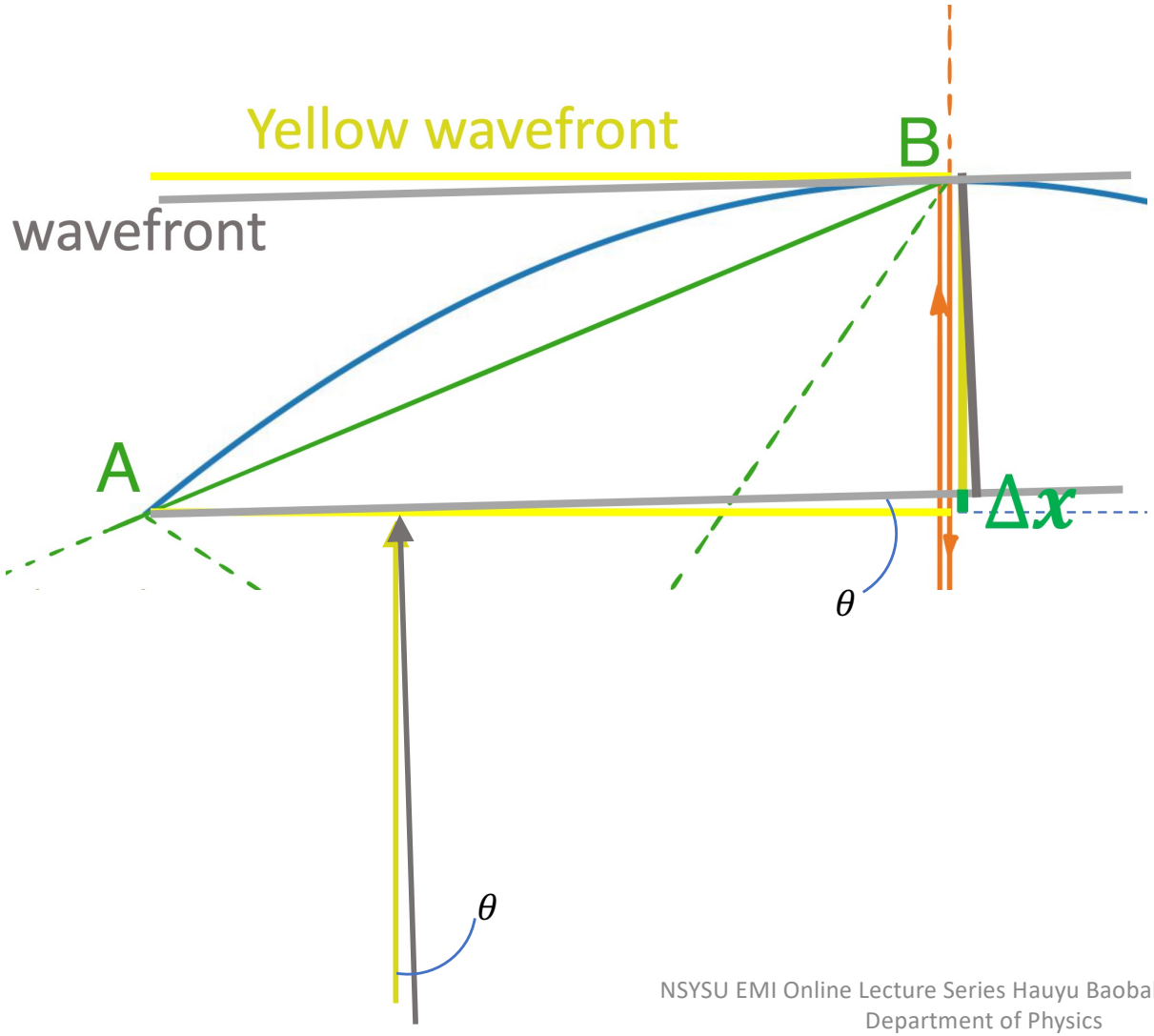

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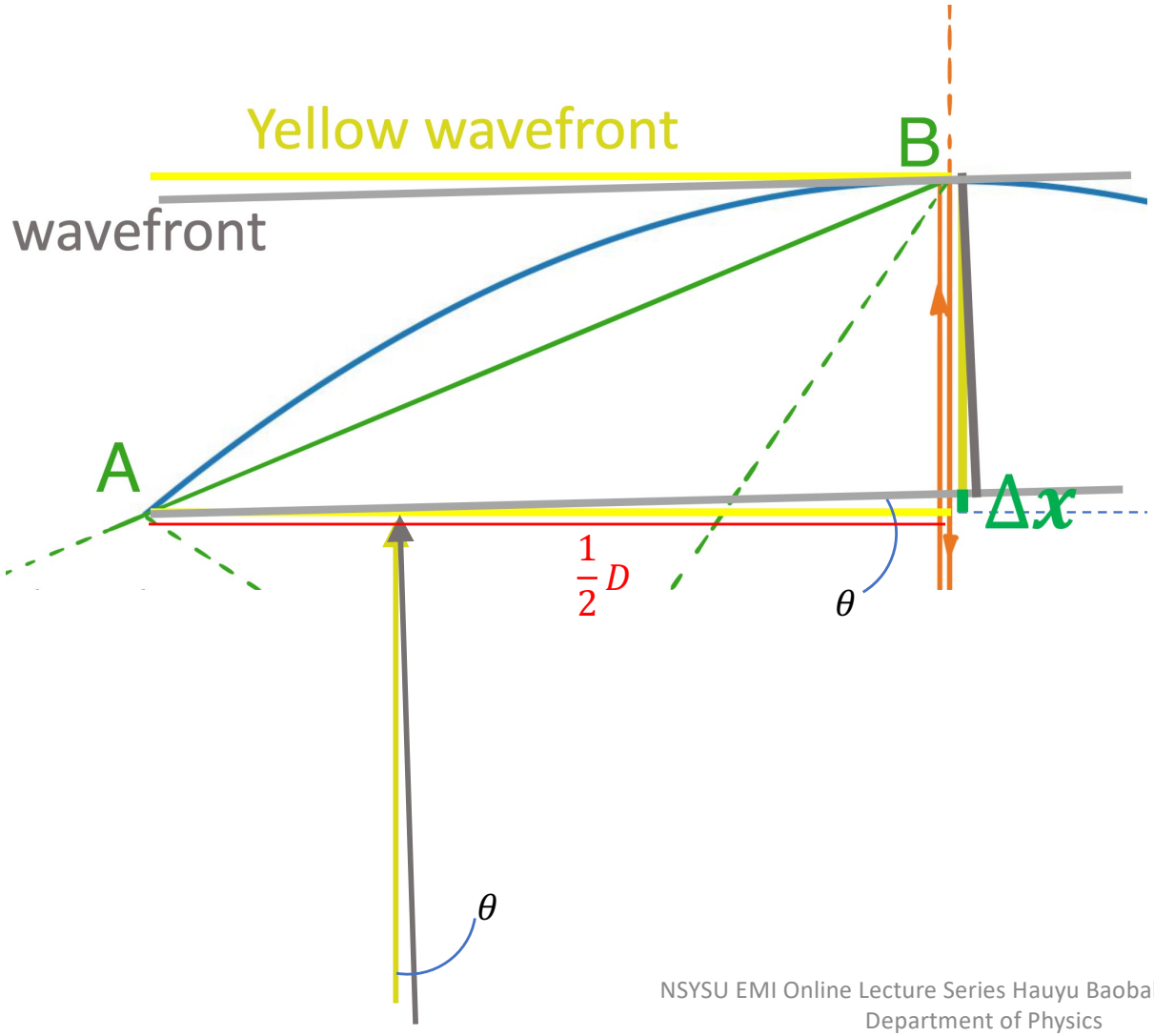

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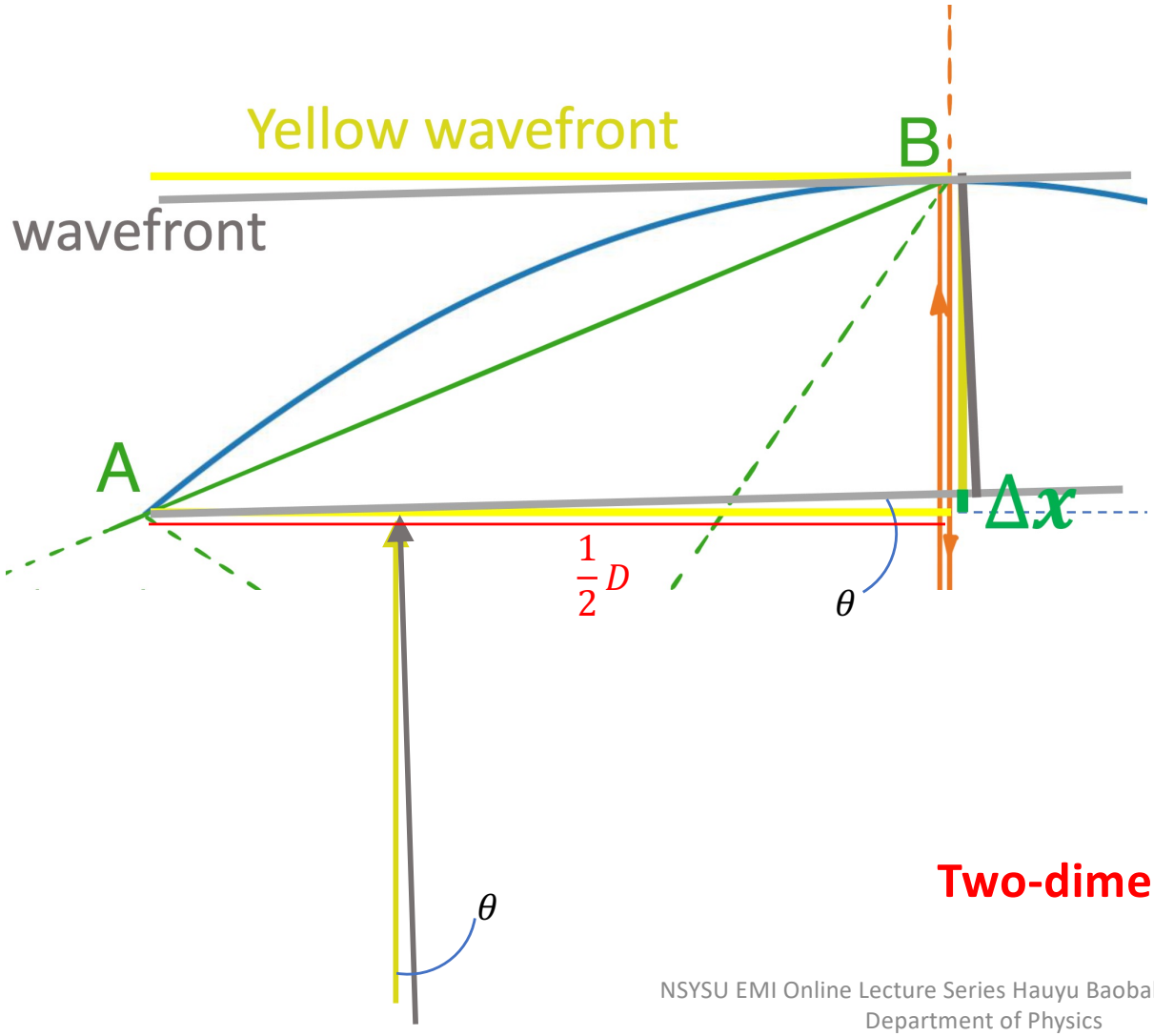
Path length difference: $\Delta x = x_1 - x_2 \sim \frac{1}{2} D\theta$

First zero: $\mathrm{k}\Delta x = \frac{1}{2} kD\theta = \pi$

$$\Rightarrow \frac{1}{2}\frac{2\pi}{\lambda} D\theta = \pi \Rightarrow \theta = \frac{\lambda}{D}$$



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Two-dimensional dish: FWHM $= 1.22\frac{\lambda}{D}$

1. Diffraction pattern of a single dish telescope is very similar to that of a single-slit.

2. For a single dish telescope, the primary beam FWHM $\sim 1.22\frac{\lambda}{D}$