Optics and Images

I. Reflection and Refraction
- Law of Reflection, Snell's Law
- index of refraction
- total internal reflection
- dispersion
- **thin film interference**

II. Lenses and Mirrors
- formation of images
- equations: image vs. object
- ray diagrams

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	The student will be able to:	HW:
1	State and apply laws of reflection and refraction, Snell's Law, and solve related problems and/or describe qualitatively the phenomena of absorption, transmission, dispersion, and reflection of light undergoing a change in medium. ✓	1 – 7
2	Solve problems involving thin film interference by relating wavelength, film thickness, and indices of refraction to path difference and type of interference.	8 – 10
3	Apply the ray model of light to explain and analyze formation of real and virtual images by plane, concave, and convex mirrors and solve related problems involving object and image distance, magnification, focal length and/or radius of curvature.	11 – 16
4	Apply the ray model of light to explain and analyze formation of real and virtual images by converging or diverging thin lenses and solve related problems involving object and image distance, magnification, focal length and/or radius of curvature.	17 – 23

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image: Wikipedia, Brocken Inaglory, Alvesgaspar


image: NOAA

image: Meade

image: Nikon

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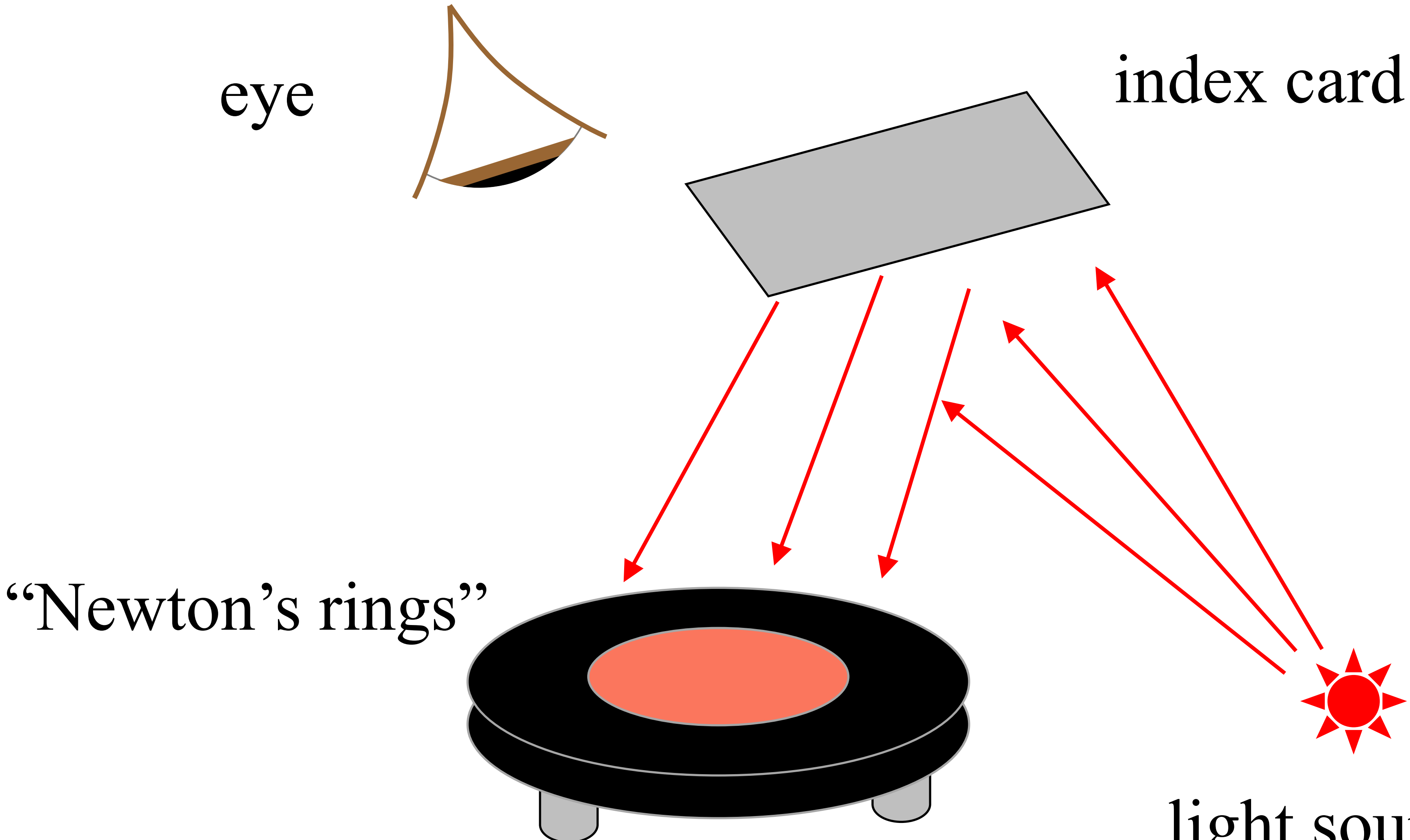

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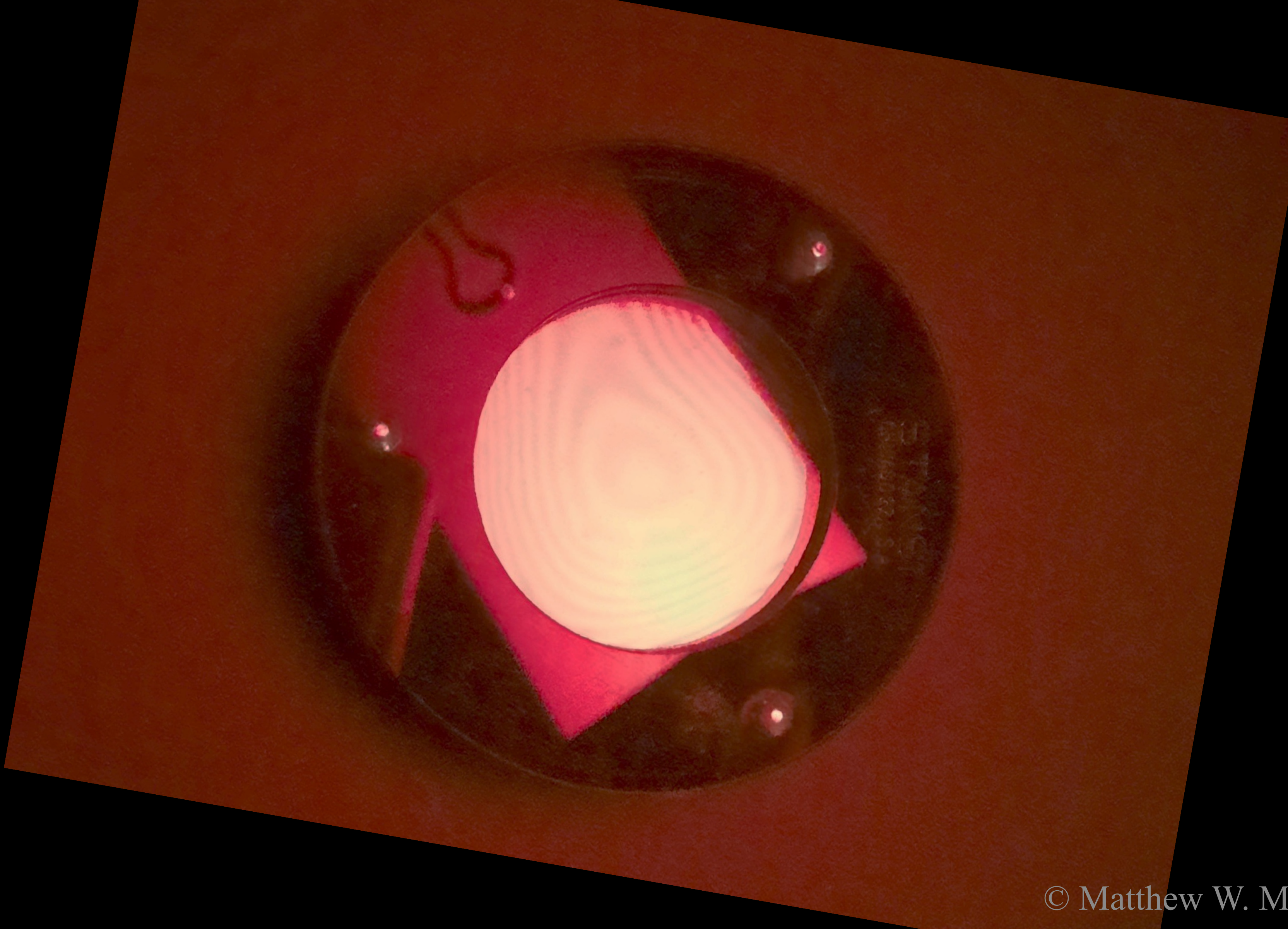

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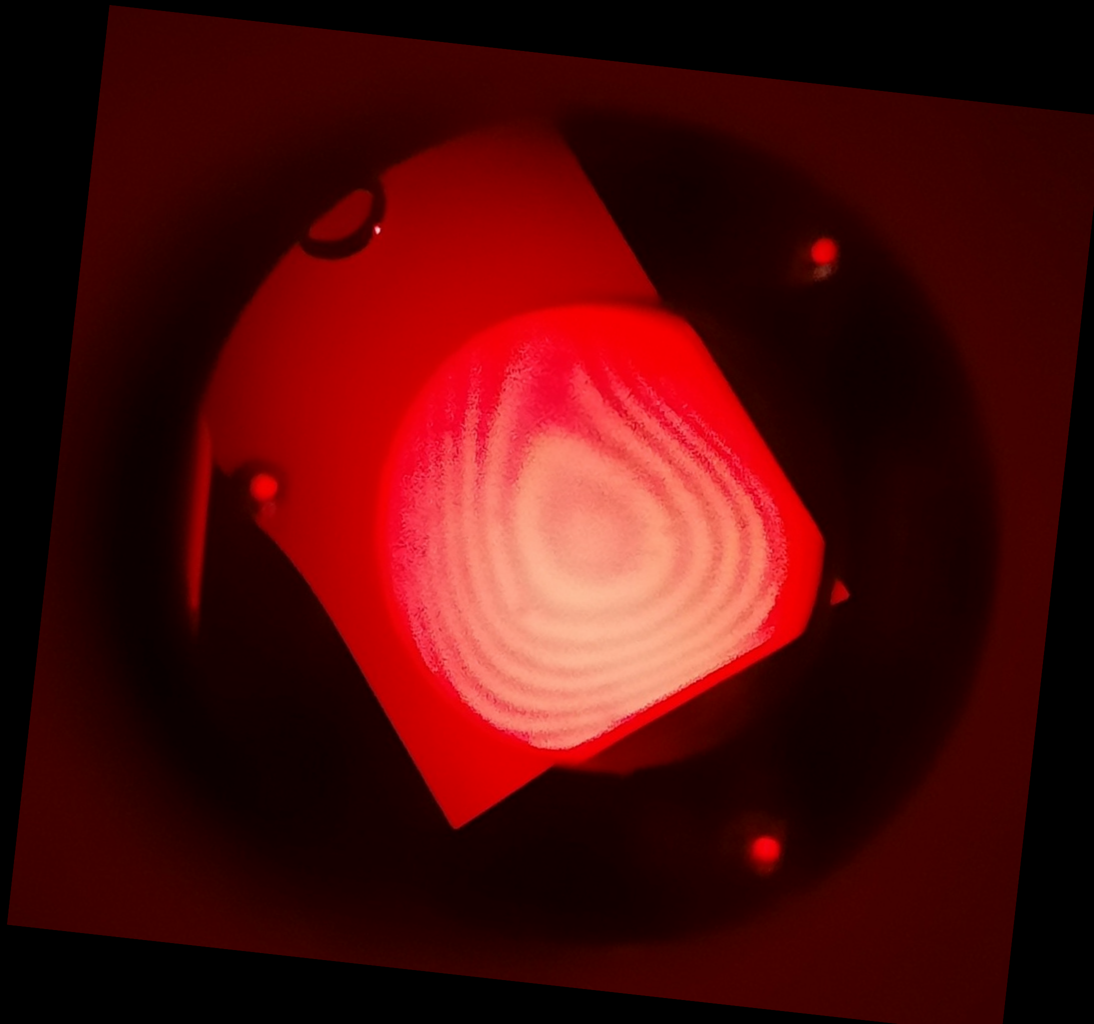

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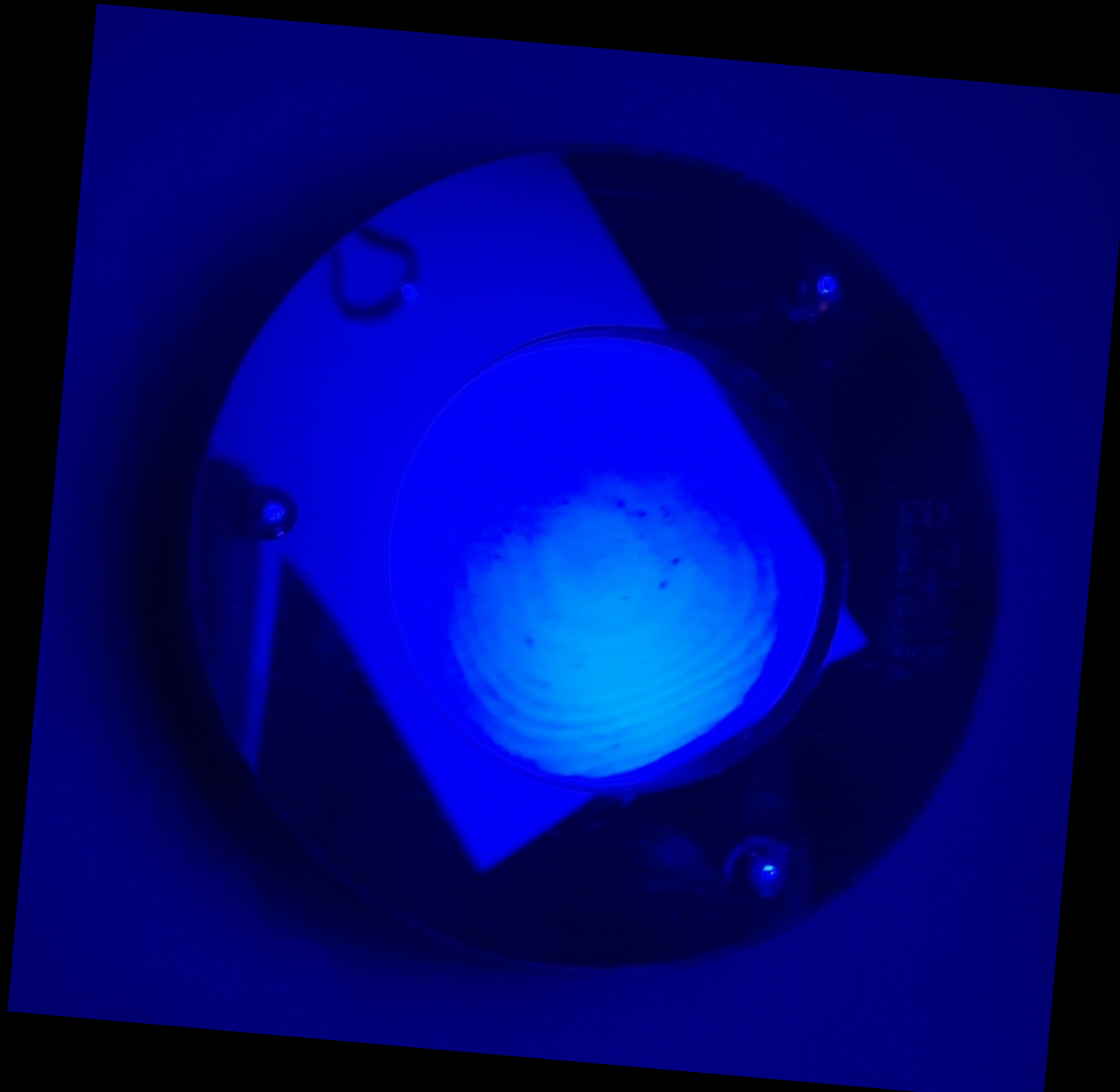

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Thin Film Interference

- Light reflecting off the "front surface" of a thin film of material can interfere with light reflecting off of the "back surface" of the same thin film.
- The type of interference depends on the wavelength, the thickness of the film, and the type of reflection occurring at each interface.

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Path Difference vs. Interference

Recall the "path difference" concept…

$$|d_1 - d_2| = m \cdot \lambda$$

where: d_1 = distance to one source

d_2 = distance to other source

$m = 0, 1, 2, 3 \ldots$ (constr. interf.)

$m = 0.5, 1.5, 2.5 \ldots$ (destr. interf.)

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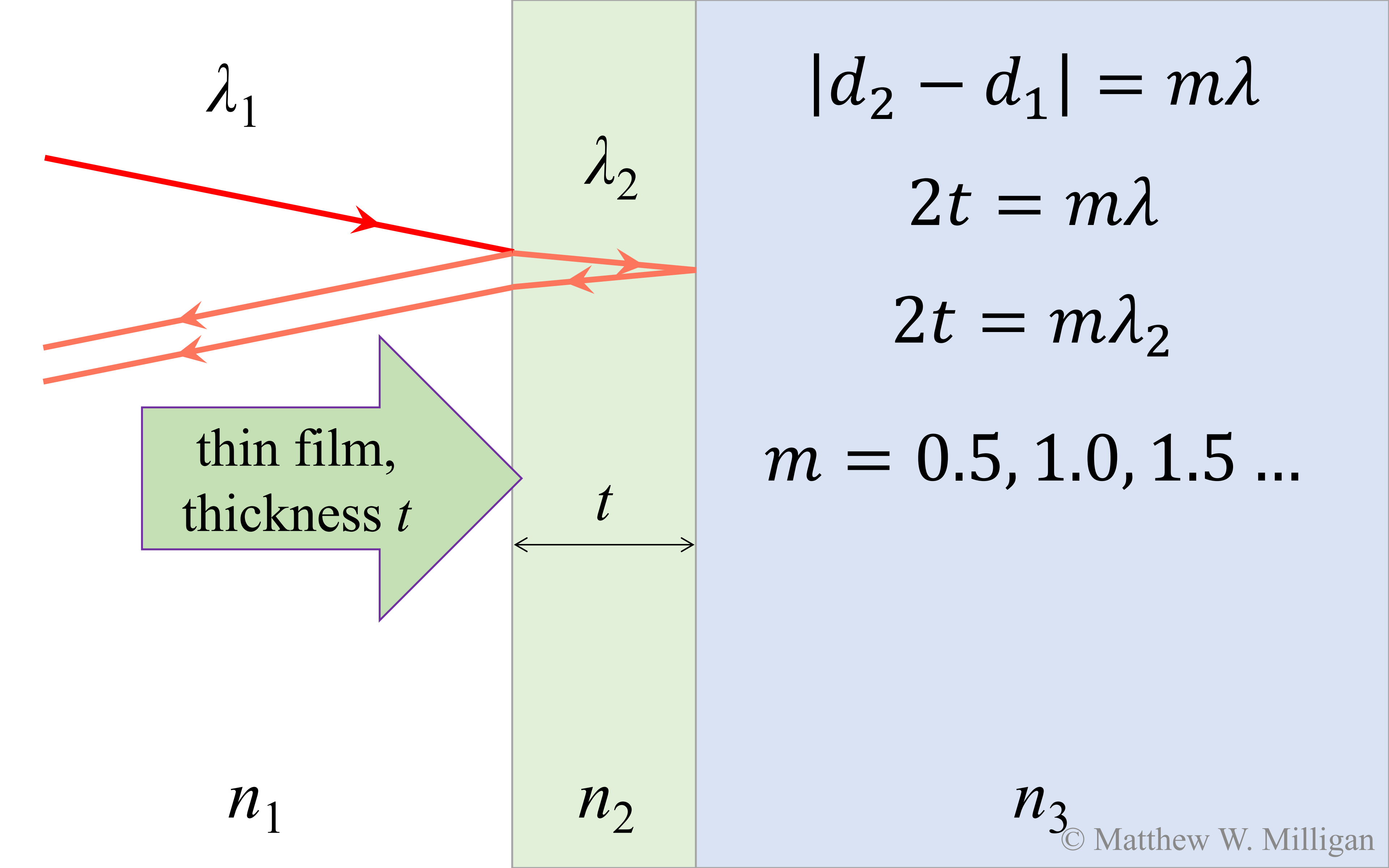
λ_1
λ_2
$|d_2 - d_1| = m\lambda$
$2t = m\lambda$
$2t = m\lambda_2$
$m = 0.5, 1.0, 1.5 \ldots$
thin film,
thickness t
t
n_1
n_2
n_3
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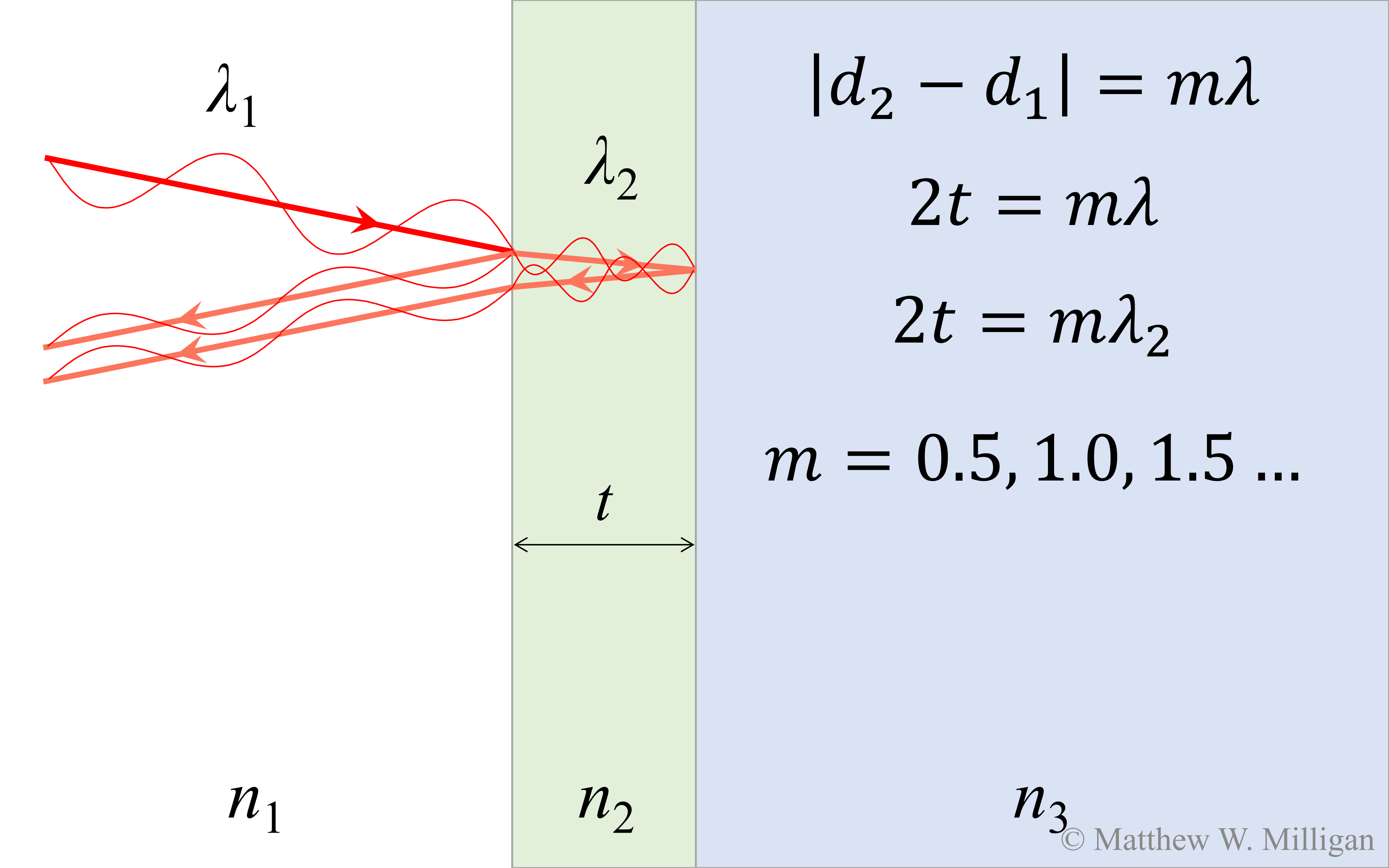

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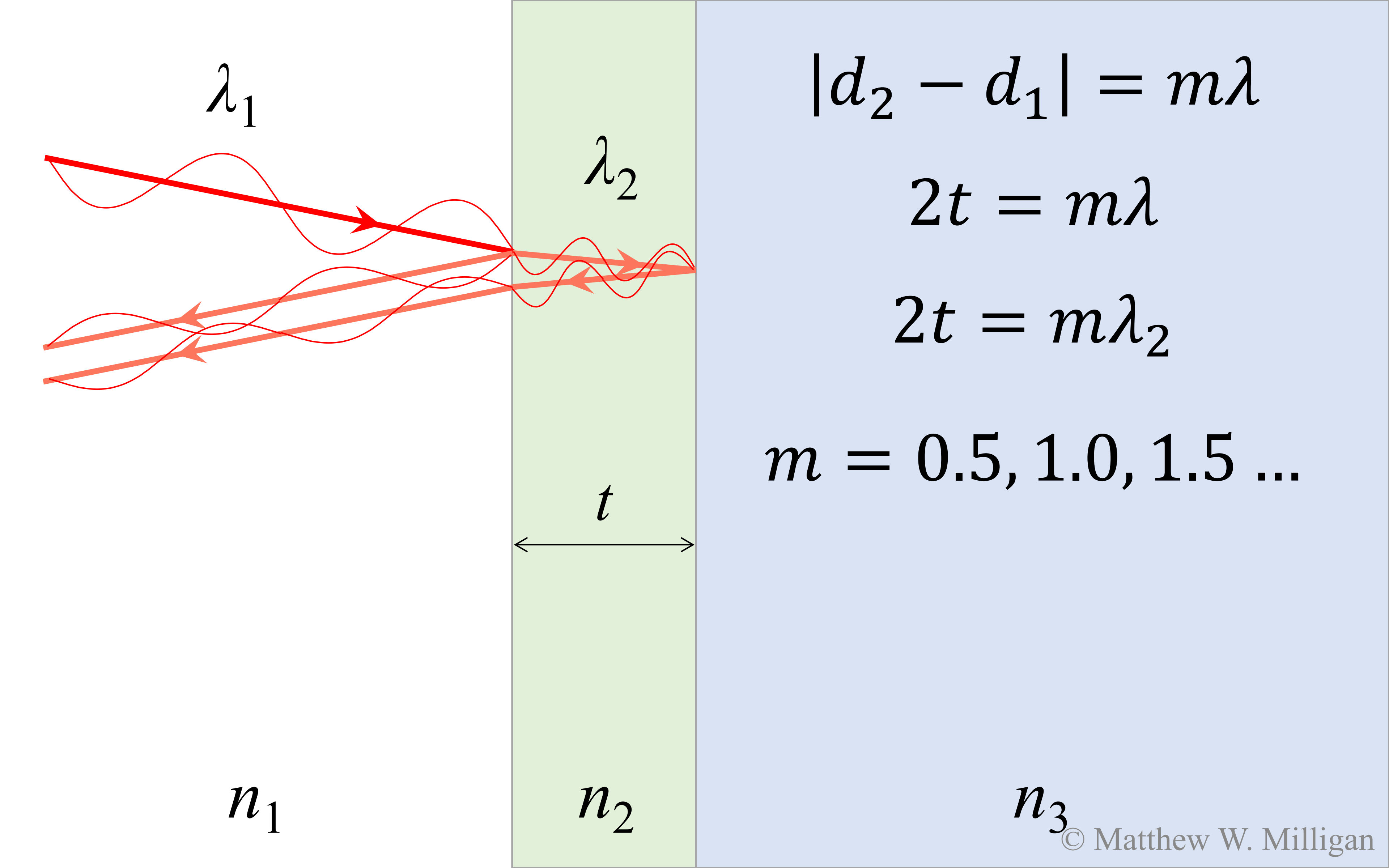

λ_1
λ_2
$|d_2 - d_1| = m\lambda$
$2t = m\lambda$
$2t = m\lambda_2$
$m = 0.5, 1.0, 1.5 \ldots$
t
n_1
n_2
n_3
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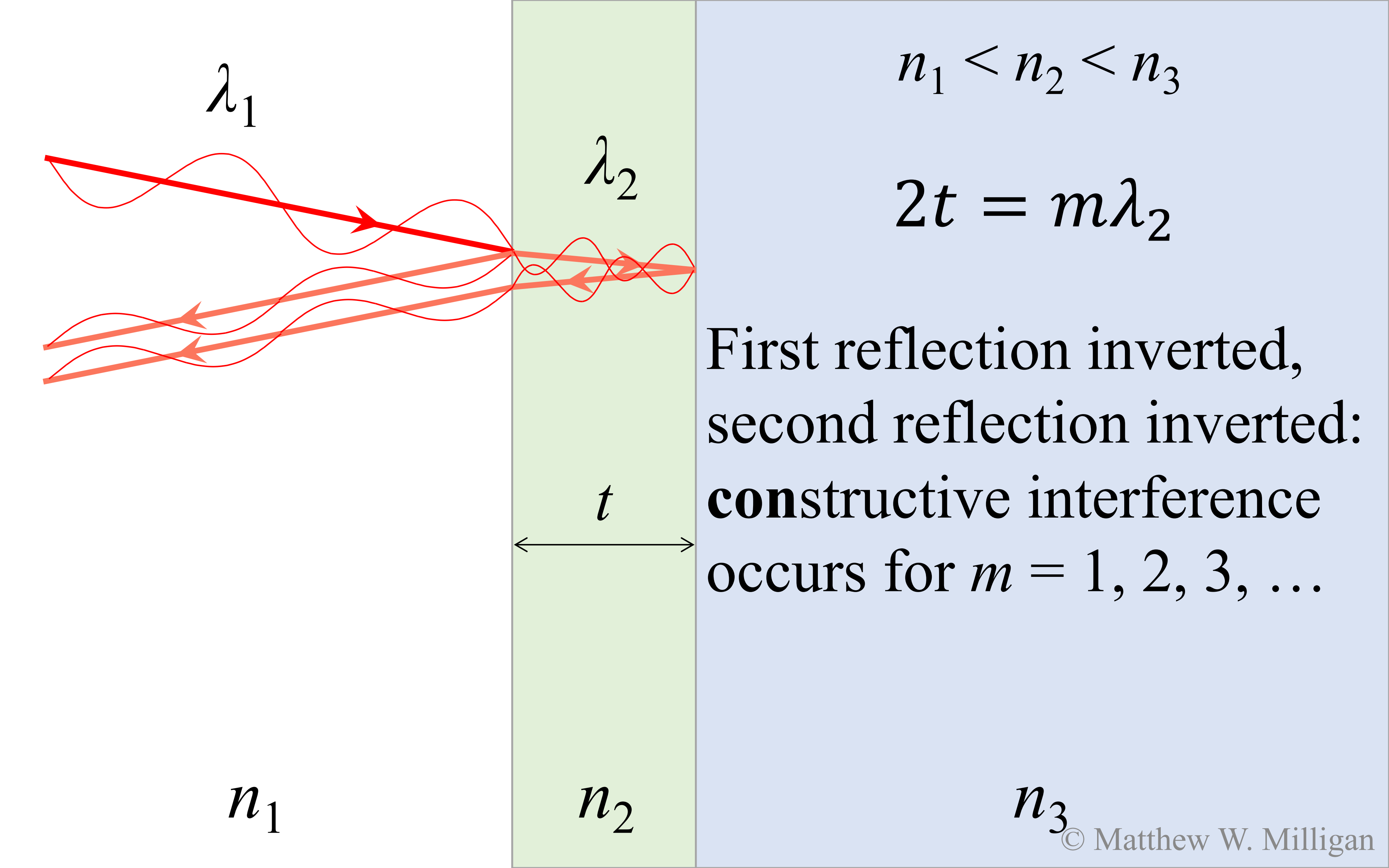

λ_1
λ_2
$n_1 < n_2 < n_3$
$2t = m\lambda_2$
First reflection inverted,
second reflection inverted:
constructive interference
occurs for $m = 1, 2, 3, \ldots$
t
n_1
n_2
n_3
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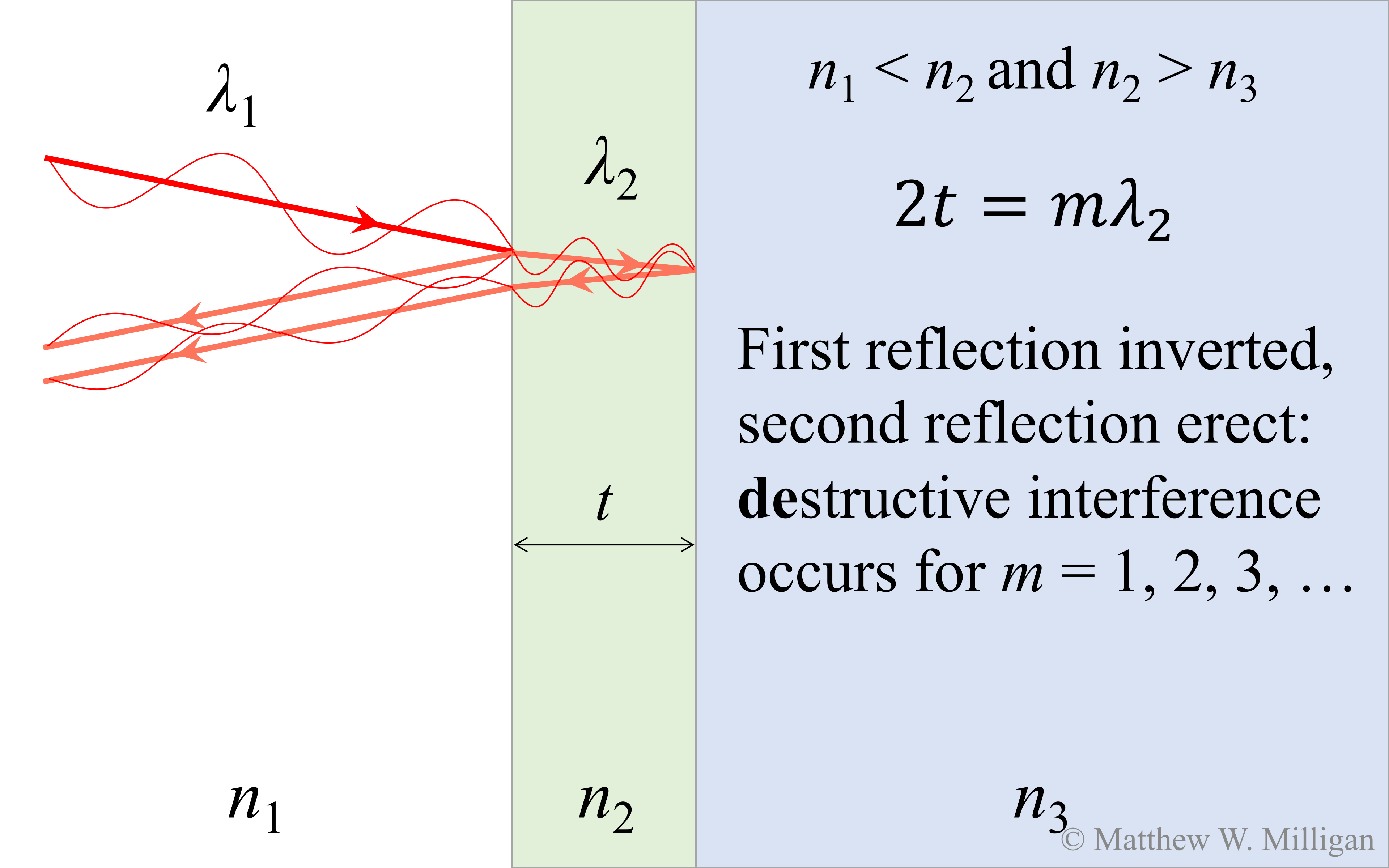

λ_1
λ_2
$n_1 < n_2$ and $n_2 > n_3$
$2t = m\lambda_2$
First reflection inverted, second reflection erect: **de**structive interference occurs for $m = 1, 2, 3, \ldots$
t
n_1
n_2
n_3
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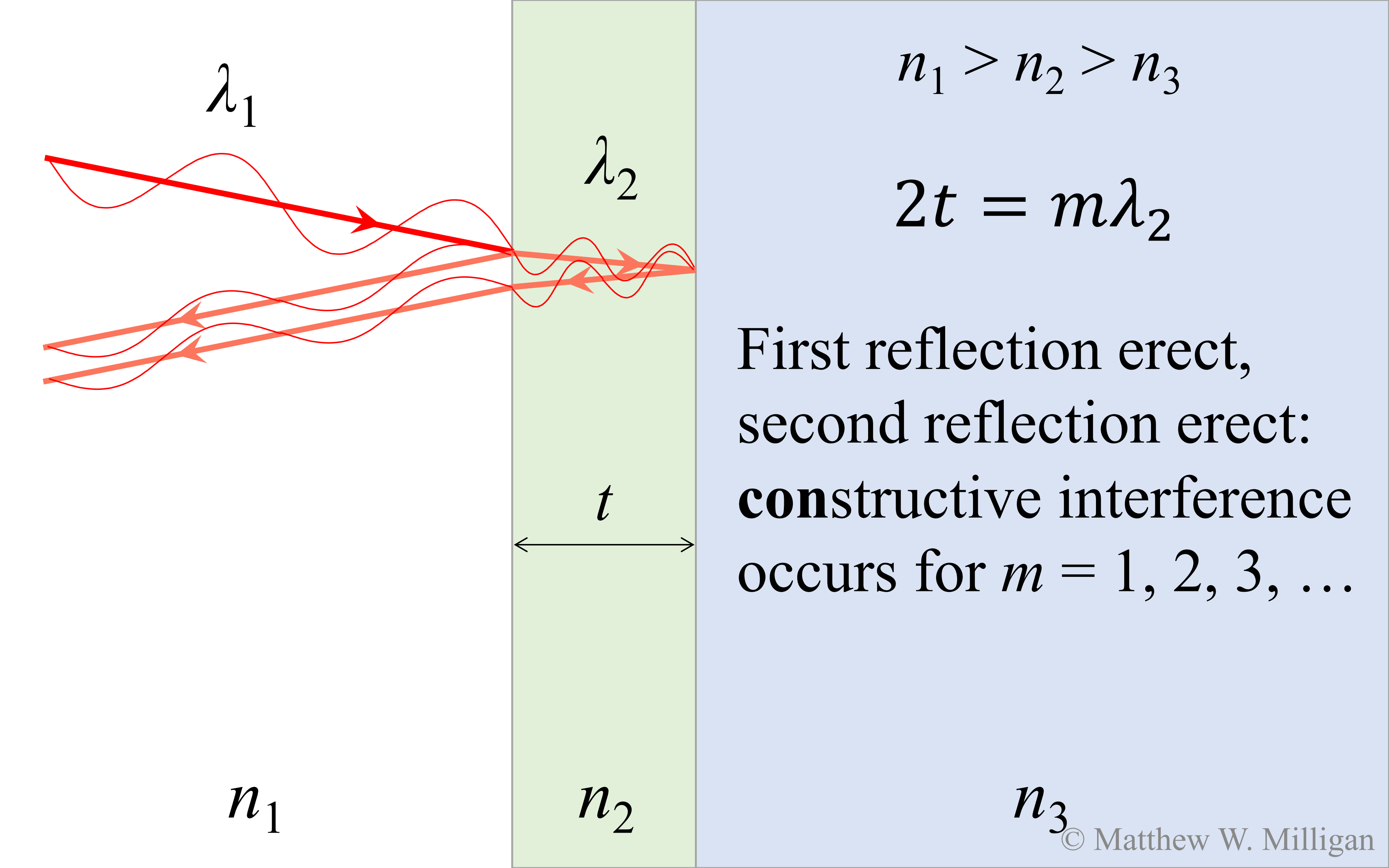

$n_1 > n_2 > n_3$
λ_1
λ_2
$2t = m\lambda_2$
First reflection erect,
second reflection erect:
constructive interference
occurs for $m = 1, 2, 3, \ldots$
t
n_1
n_2
n_3
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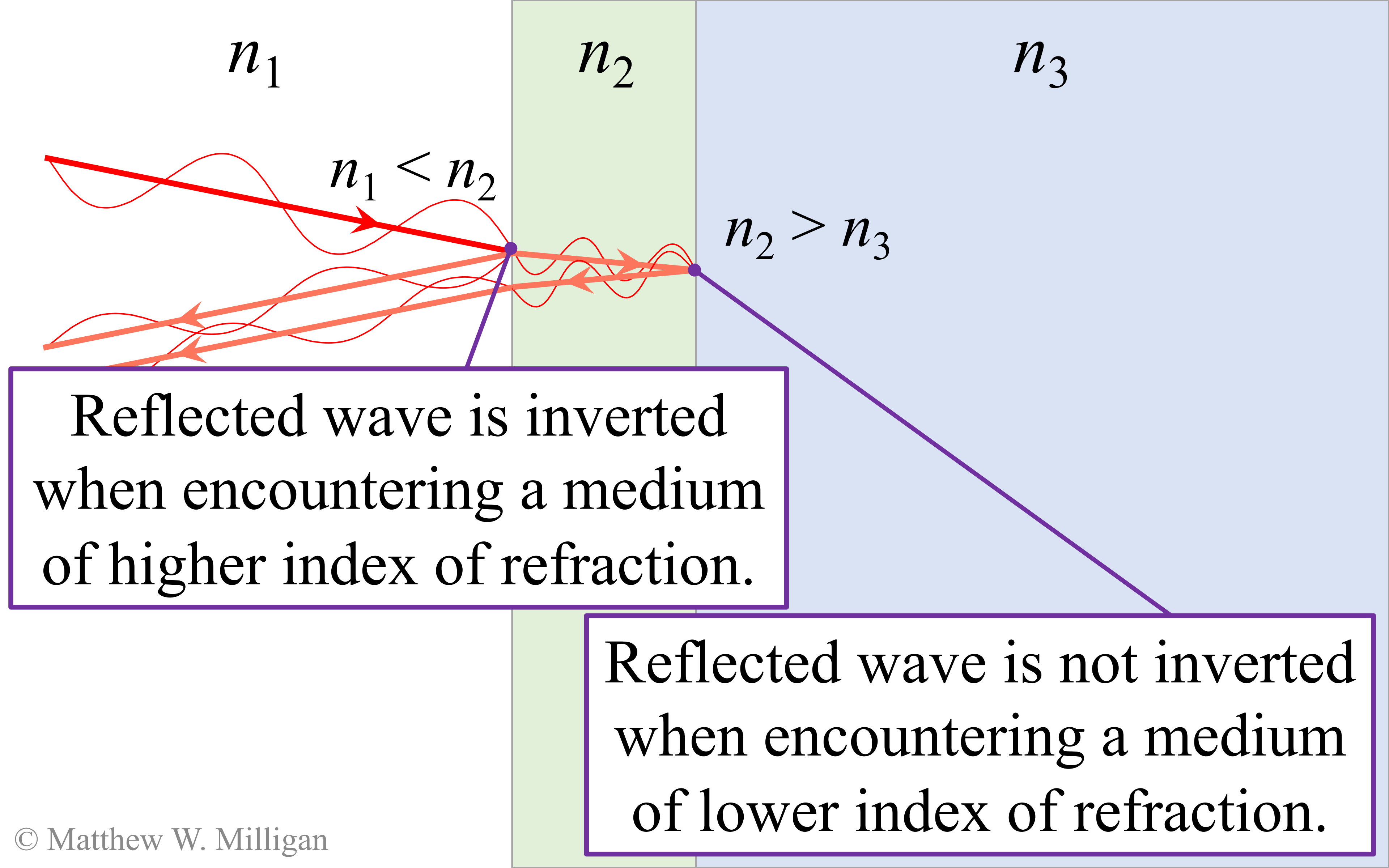

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Thin Film Interference

$$2t = m\lambda$$

where: t = thickness of film
n = index of refraction of film
λ = wavelength inside the film

Constructive interference occurs for $m = 1, 2, 3, \ldots$ if both reflections are inverted or if neither is inverted.

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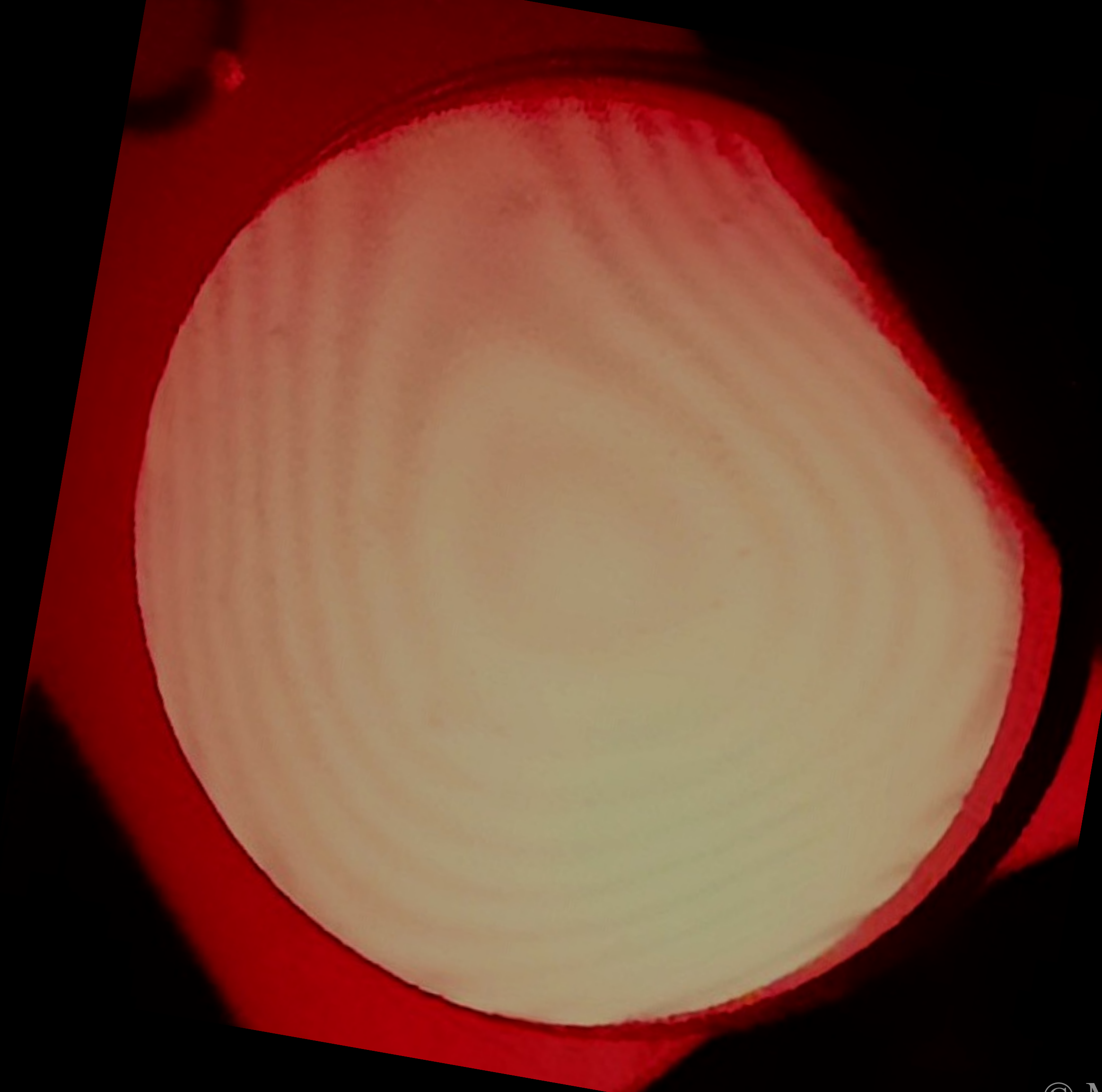

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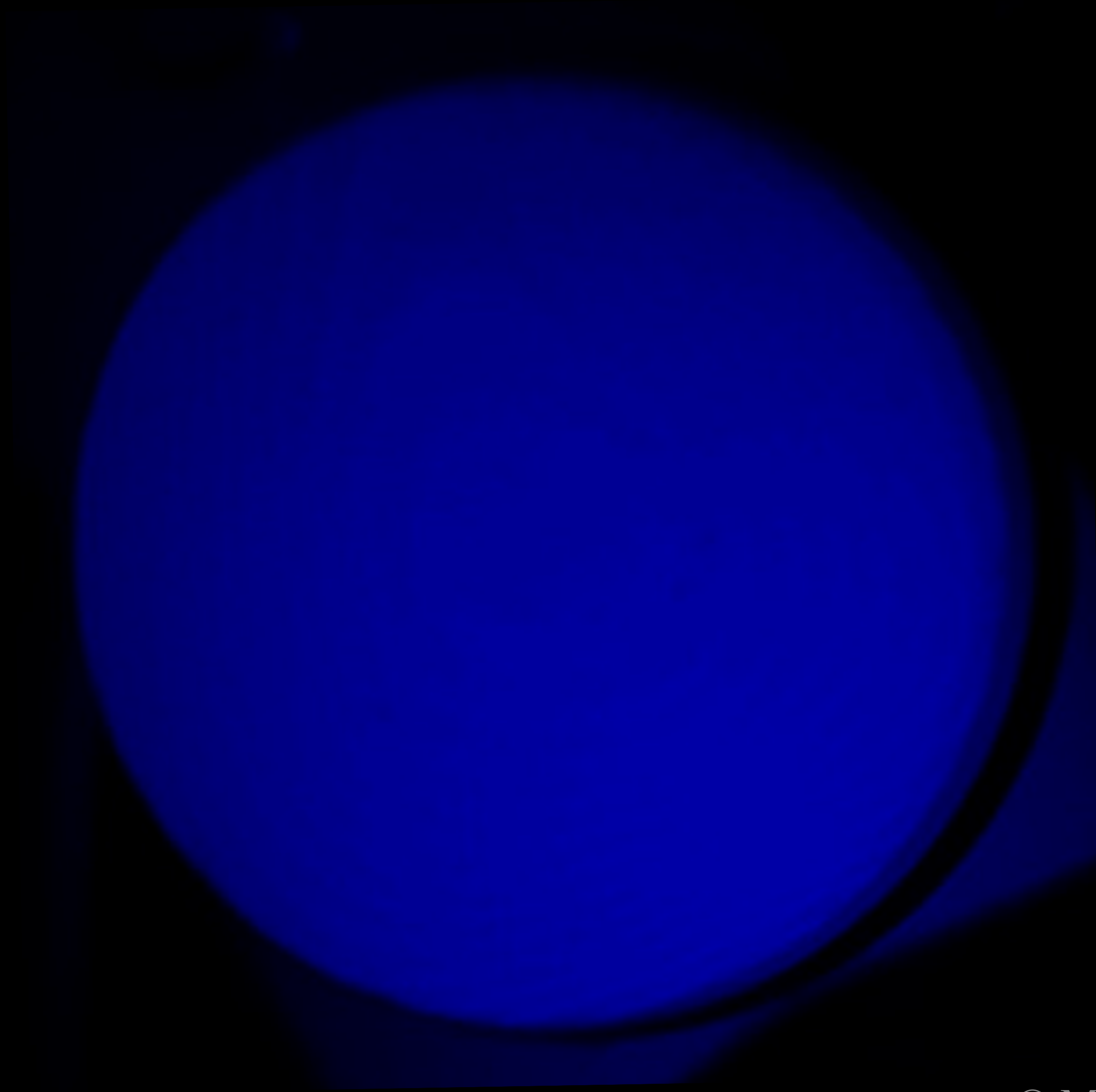

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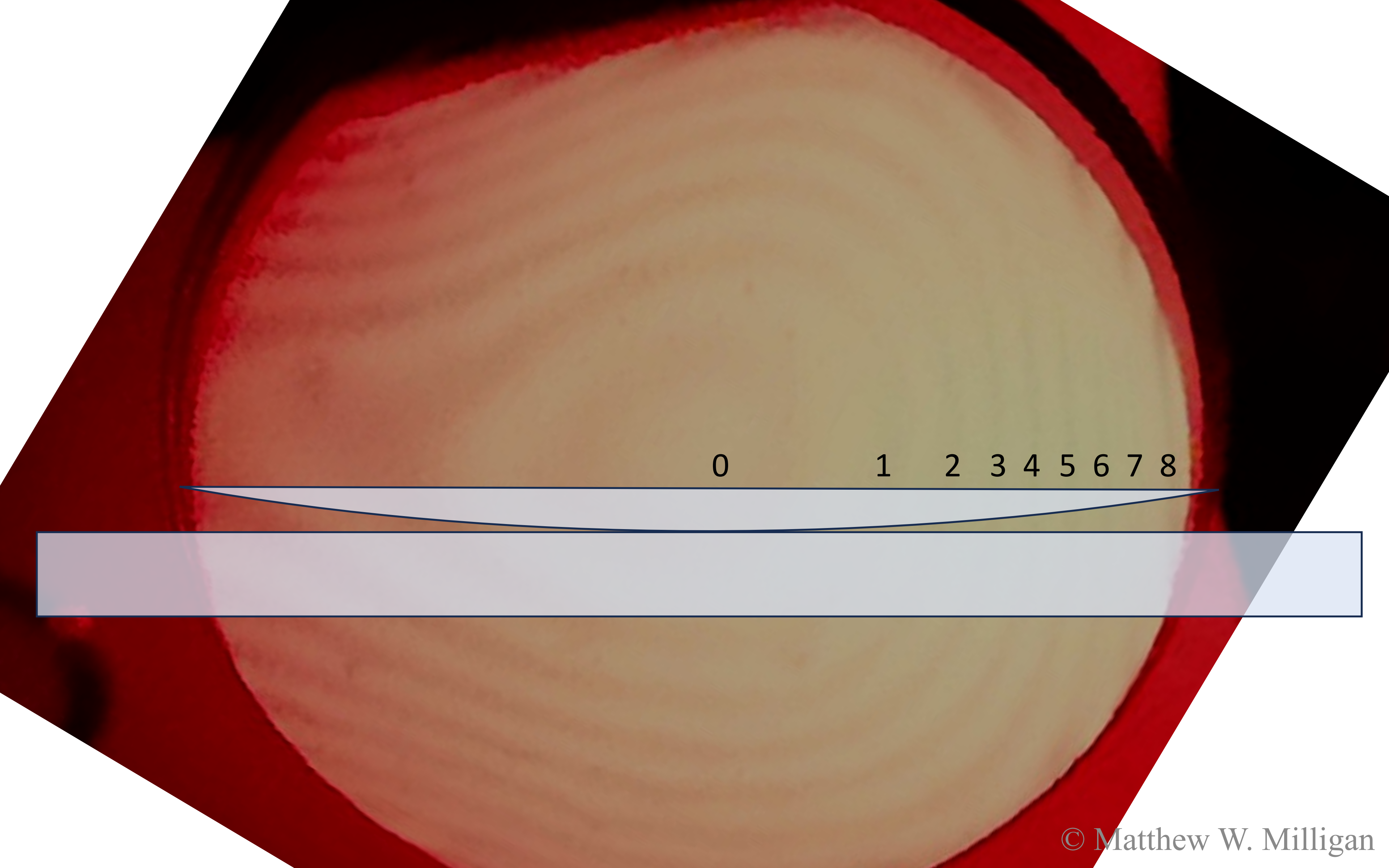
0
1
2
3
4
5
6
7
8
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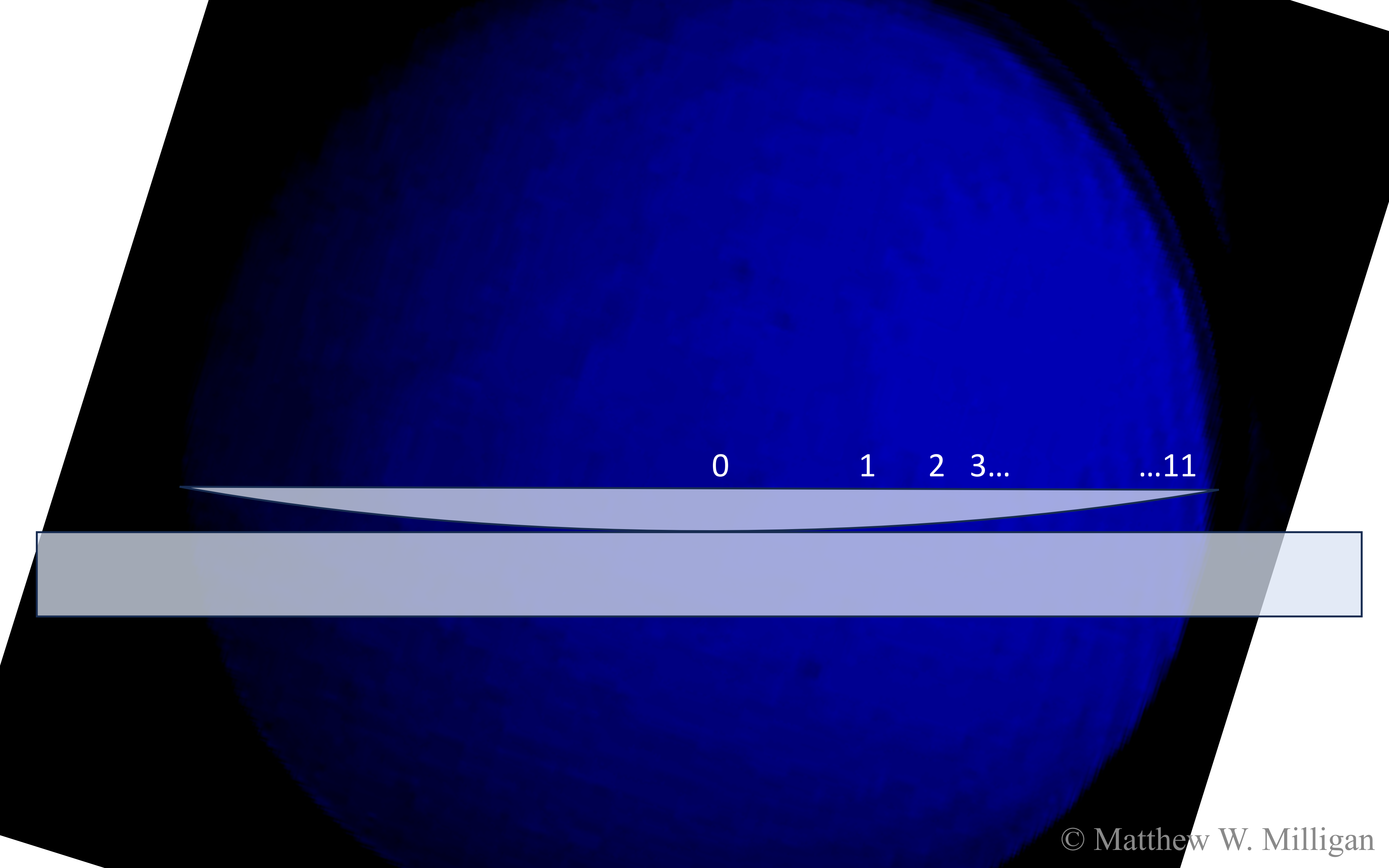

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