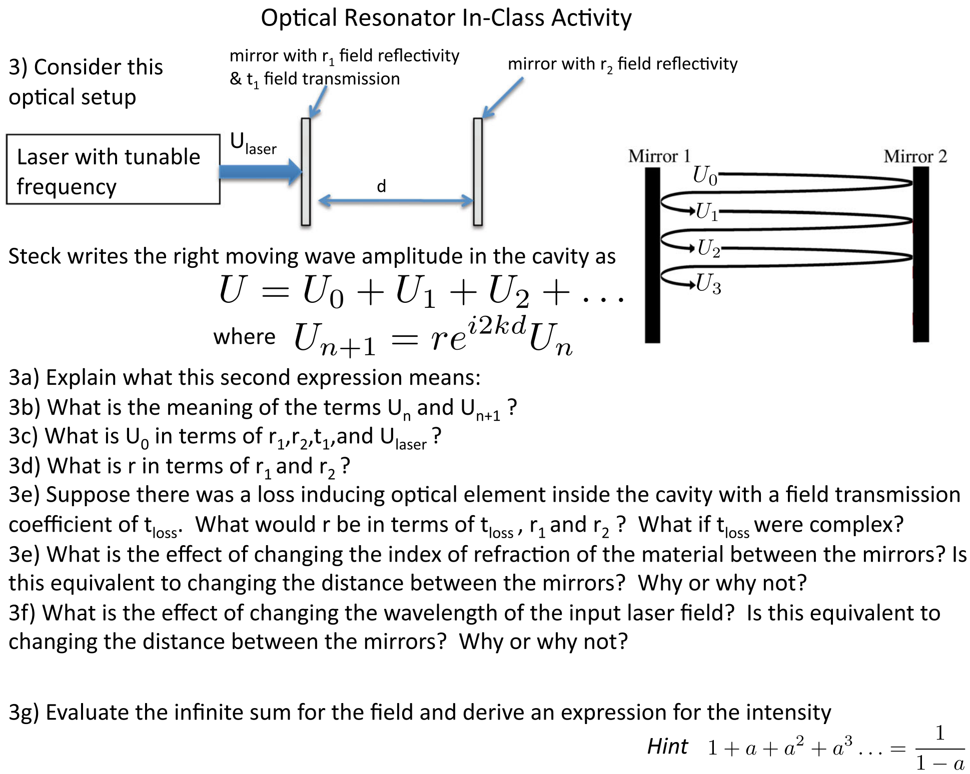


FIG. 2. An in-class derivation for the field inside an optical resonator.

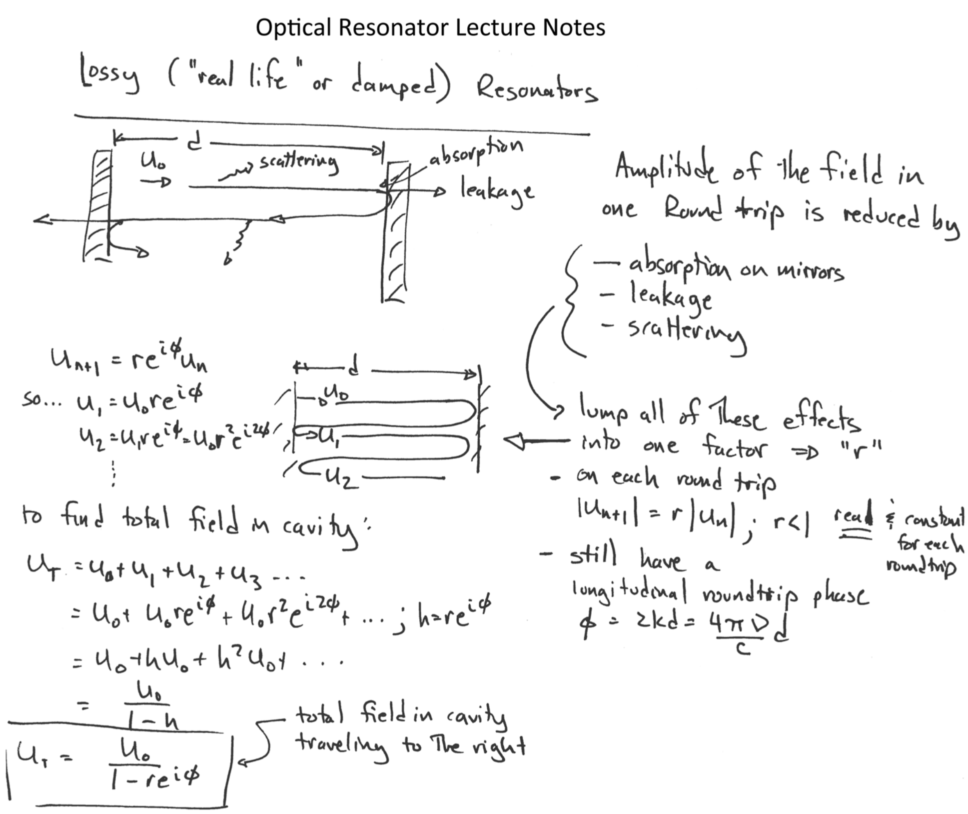


FIG. 3. The corresponding lecture notes for the in-class activities as shown in Fig. 2.

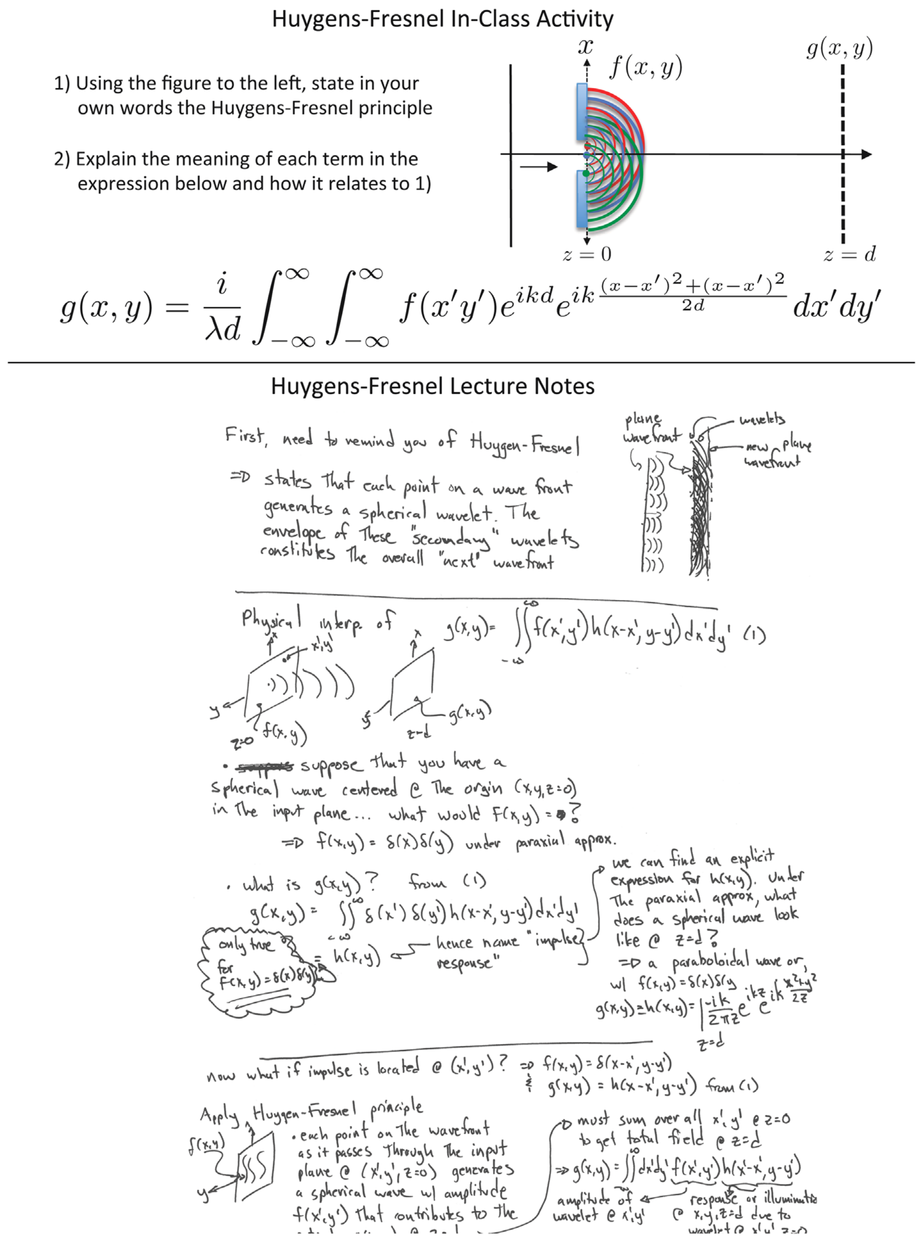
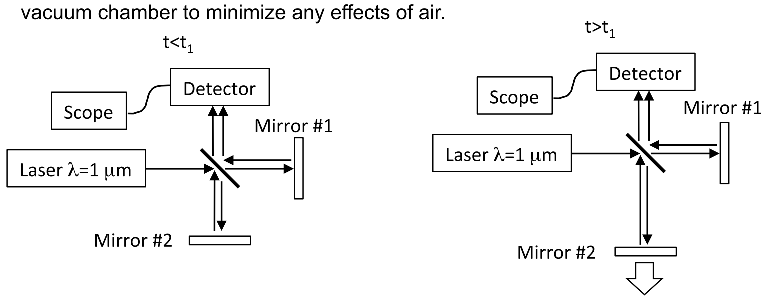


FIG. 4. An in-class activity on the Huygens-Fresnel principle and the corresponding lecture notes.

Interferometer Application Activity

You and your lab partner are using the interferometer below to measure the acceleration of gravity (g). Mirror #1 is held fixed and mirror #2 is dropped at $t=t_1$ and the scope records the output of the photo-detector. The entire interferometer is located in a vacuum chamber to minimize any effects of air.



1a) Qualitatively in your own words describe how this setup can measure g. How does the mirror in time?
1b) Sketch the output voltage measured by the scope
1c) Find an expression for g based on the measurements from the scope

Bonus- An interferometer can be used as a gyroscope to measure rotation. Describe how it could work and estimate if a hand sized device could measure the rotation of the earth

Gaussian Beam Application Activity

The ongoing Lunar Laser Ranging Experiment measures the distance between Earth and Moon using laser ranging. Lasers on Earth are aimed at retro-reflectors previously planted on the Moon (Apollo 11) and via the reflected signal the distance is measured.

3-As an optical design engineer on the project you must model the laser beam propagation as a Gaussian Beam and you need to optimize the return signal as measured on earth. The laser (λ=532 nm, 10 Watt) is pointed to the moon through a telescope and you are offered three different telescopes with varying apertures. Via calculations of Gaussian beams, discuss the advantages and disadvantages of each.

Bonus-If the retroreflector is $1m^2$ how much total power is reflector to earth?

Gran Telescopio Canarias (10.4 m)

Gran Telescopio
©Pachango,
CC BY-NC-SA 2.0

Hale Telescope (5.1 m)

Hale Telescope
©Matthew Hunt,
CC BY 3.0

Hooker Telescope (2.5 m)

Hooker Telescope
©frankenschulz,
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FIG. 5. In-class activities on the applications of optics to measure the acceleration due to gravity and for lunar ranging.