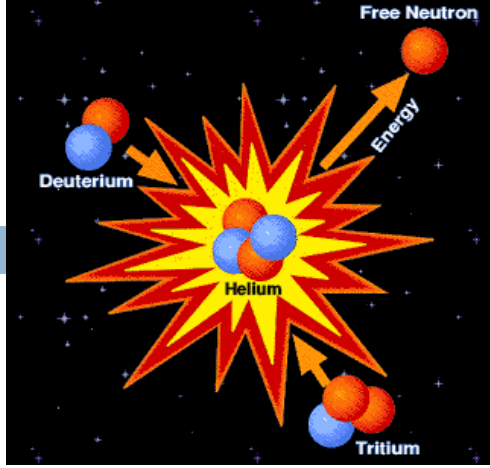
2. 빛의 성질

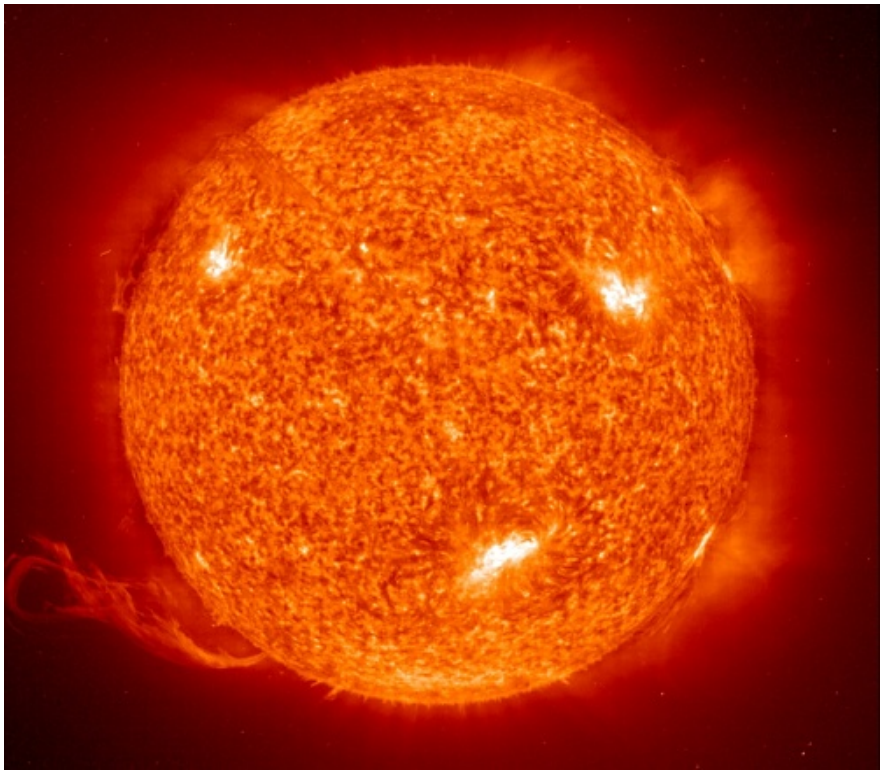
화공과 김영훈 교수

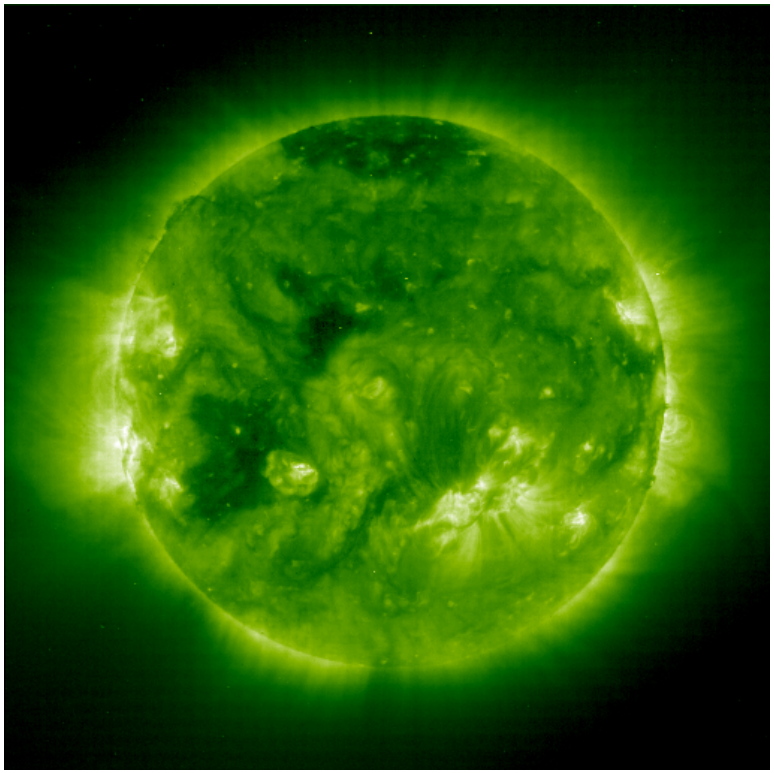
korea1@kw.ac.kr

빛의 근원, 태양



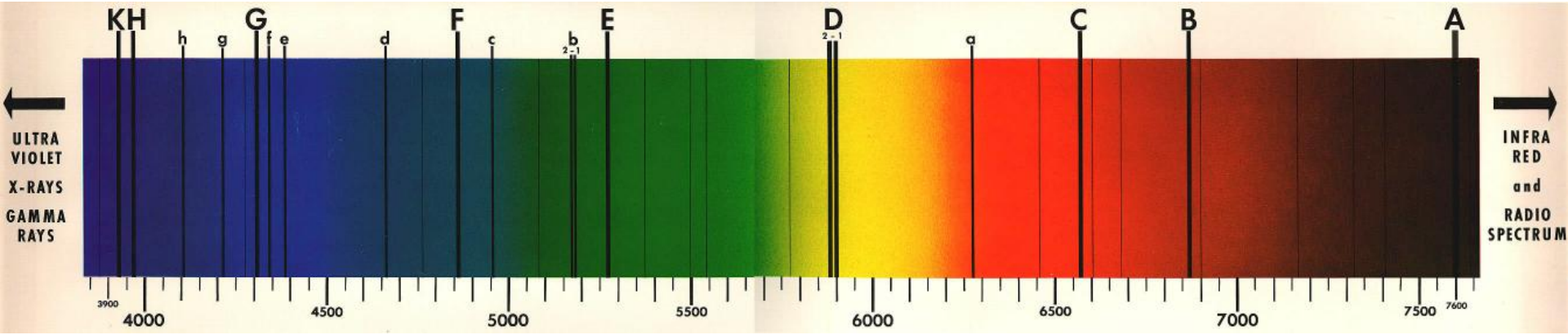
- 태양빛
  - 백색광? → 다양한 색(?)의 빛 집합체





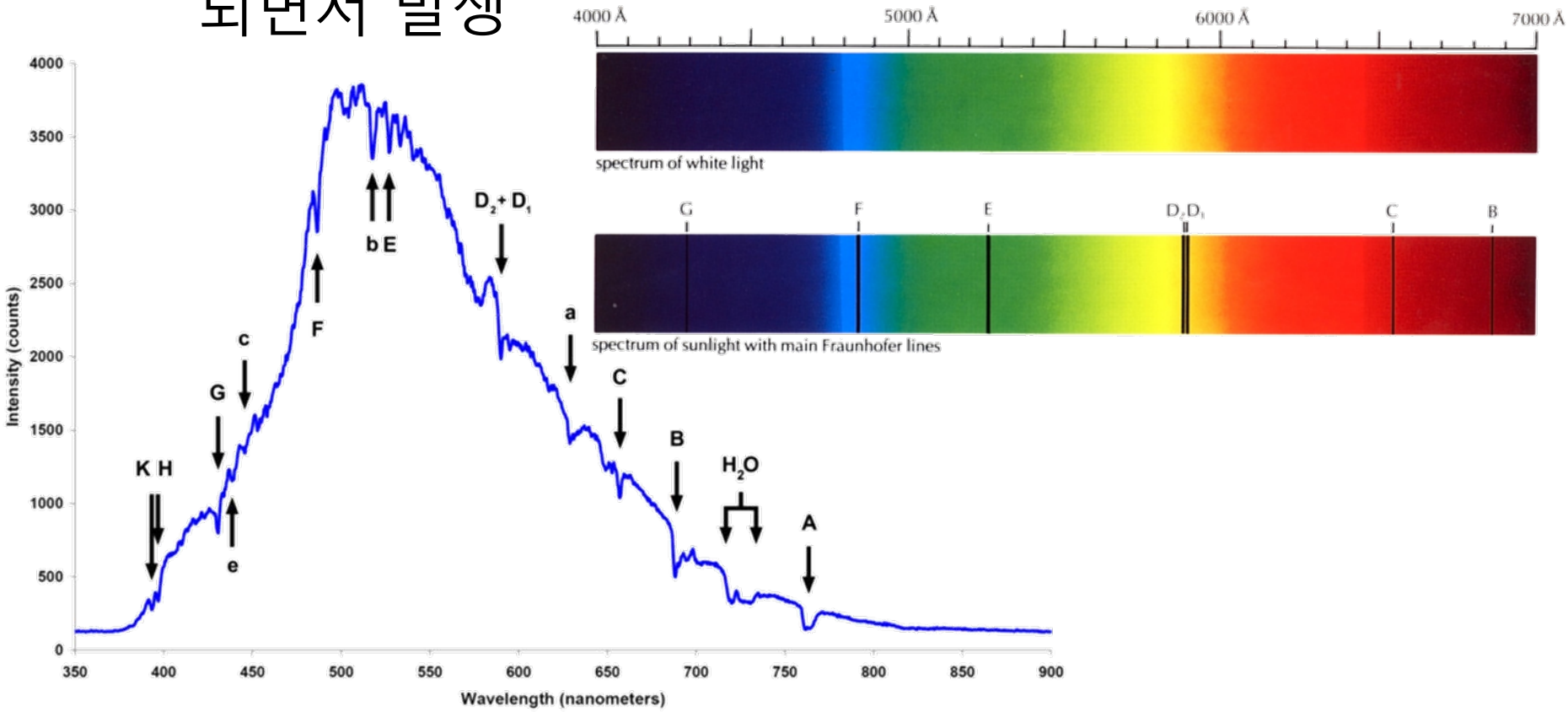
태양광 스펙트럼

- 태양광 스펙트럼
  - 다양한 색깔의 빛으로 분해: 분산
  - 7가지 색인가?

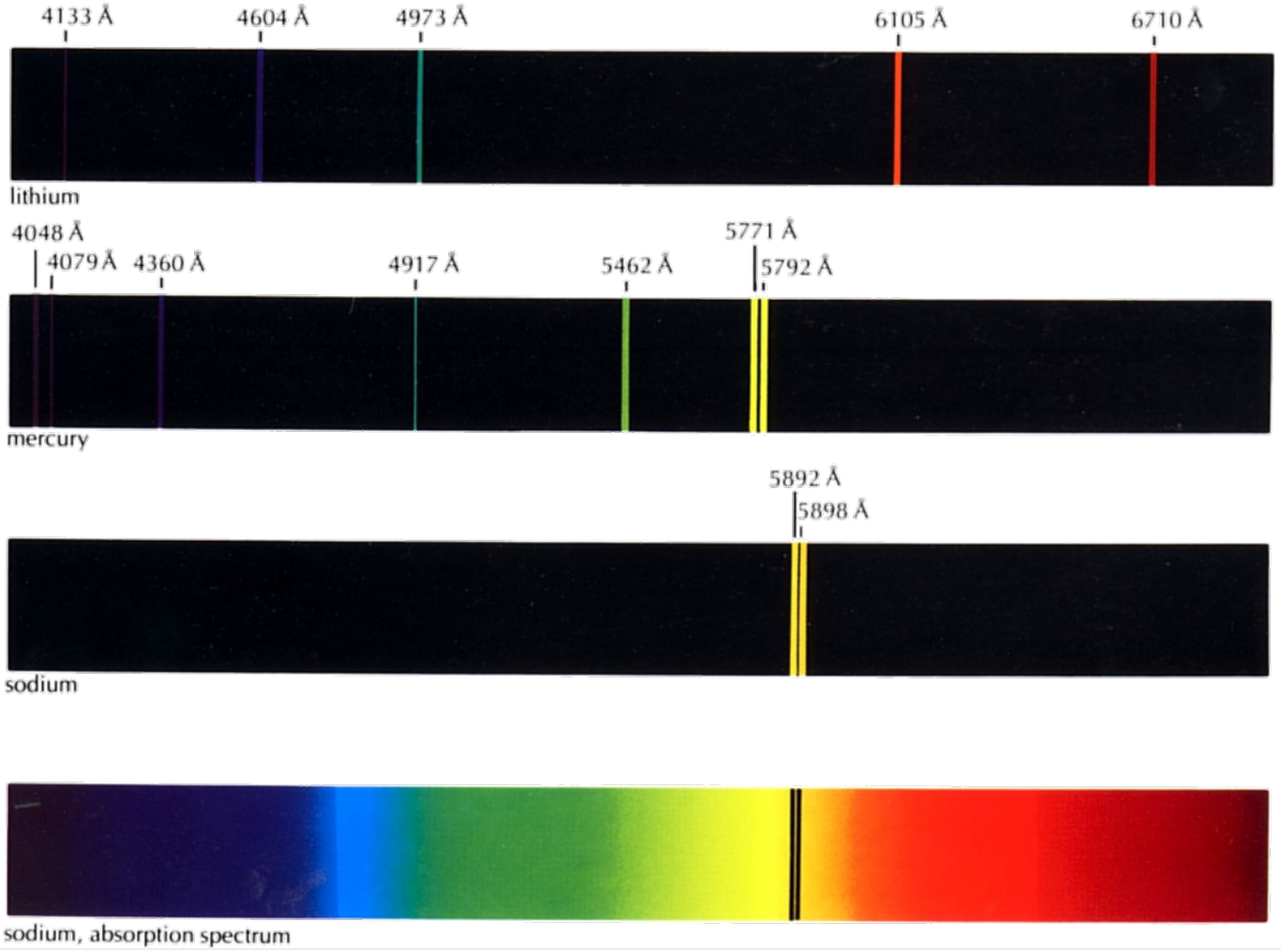


프라운호퍼 선(Fraunhofer lines)

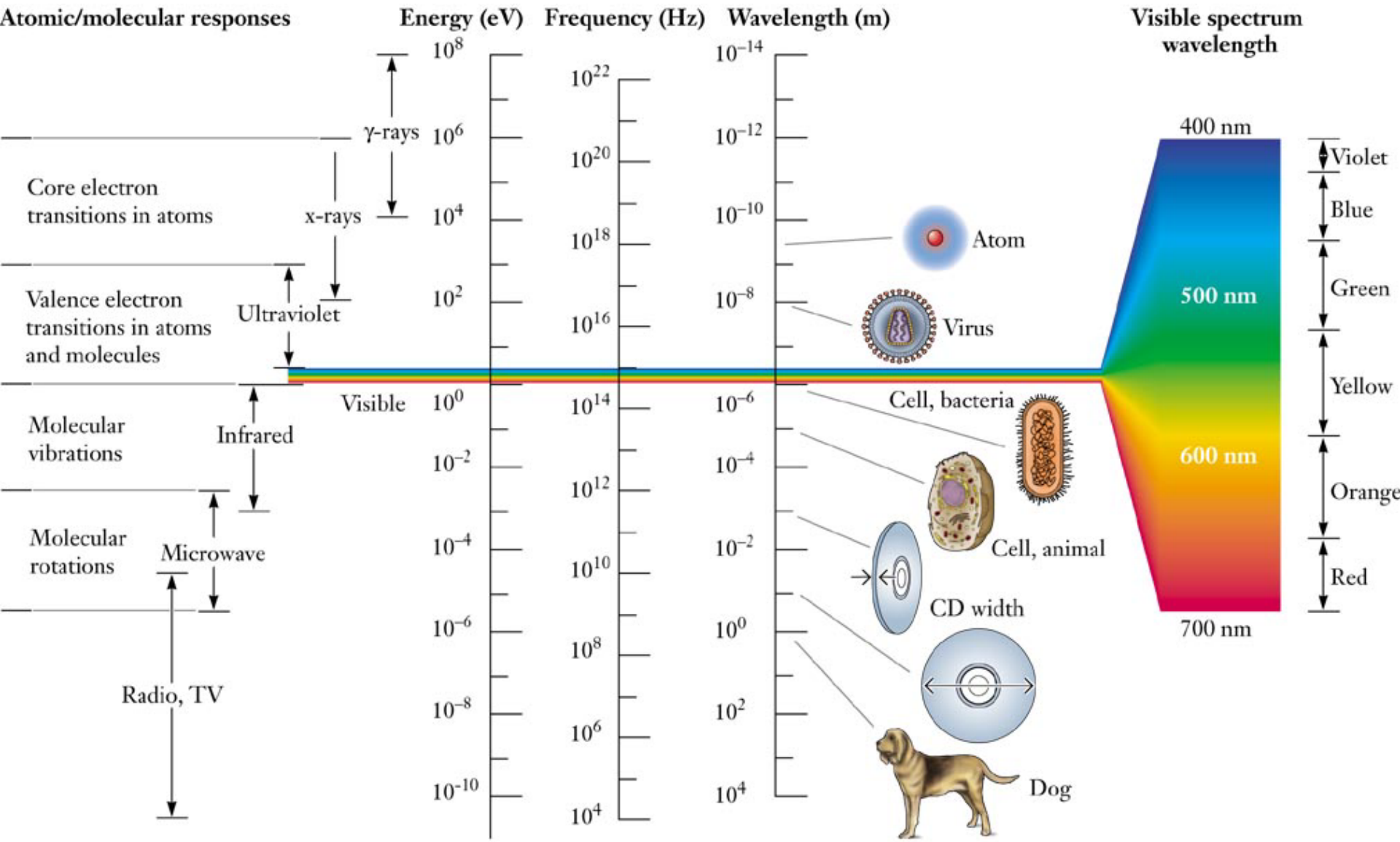
- 태양광 vs. 백색광
  - 태양광이 태양대기나 지구대기 중의 기체에 흡수되면서 발생



모든 빛이 무지개 색인가?

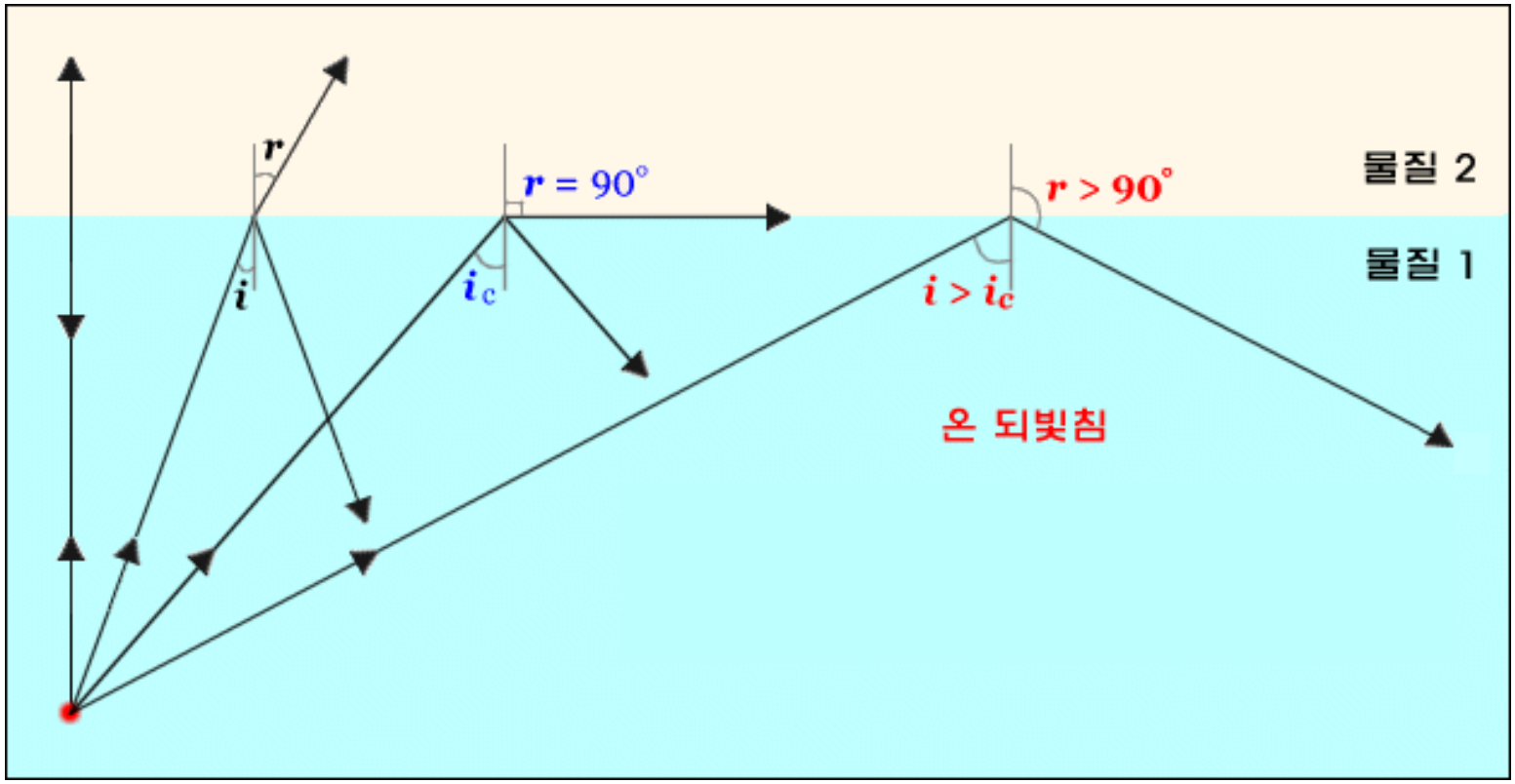

4133 Å
4604 Å
4973 Å
6105 Å
6710 Å
lithium
4048 Å
4079 Å
4360 Å
4917 Å
5462 Å
5771 Å
5792 Å
mercury
5892 Å
5898 Å
sodium
sodium, absorption spectrum

광에 따른 에너지


Atomic/molecular responses
Energy (eV)
Frequency (Hz)
Wavelength (m)
Visible spectrum wavelength
γ-rays
x-rays
Ultraviolet
Visible
Infrared
Microwave
Radio, TV
Core electron transitions in atoms
Valence electron transitions in atoms and molecules
Molecular vibrations
Molecular rotations
Atom
Virus
Cell, bacteria
Cell, animal
CD width
Dog
400 nm
500 nm
600 nm
700 nm
Violet
Blue
Green
Yellow
Orange
Red

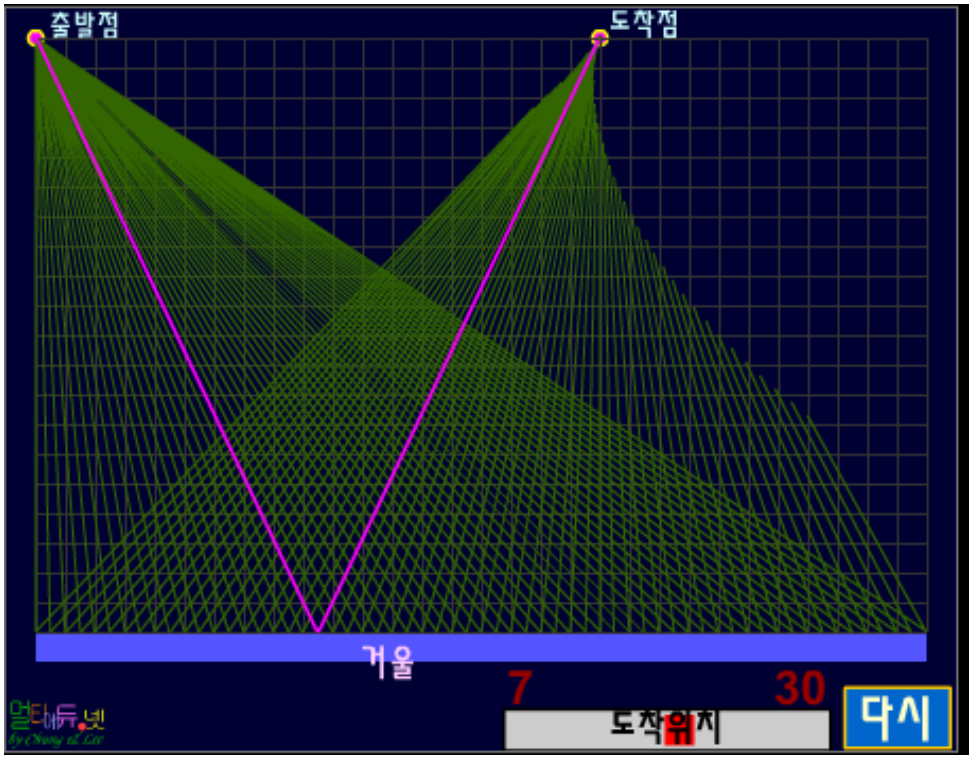
반사(reflection)

- 유리(부분반사), 거울(전반사), 백지(난반사)



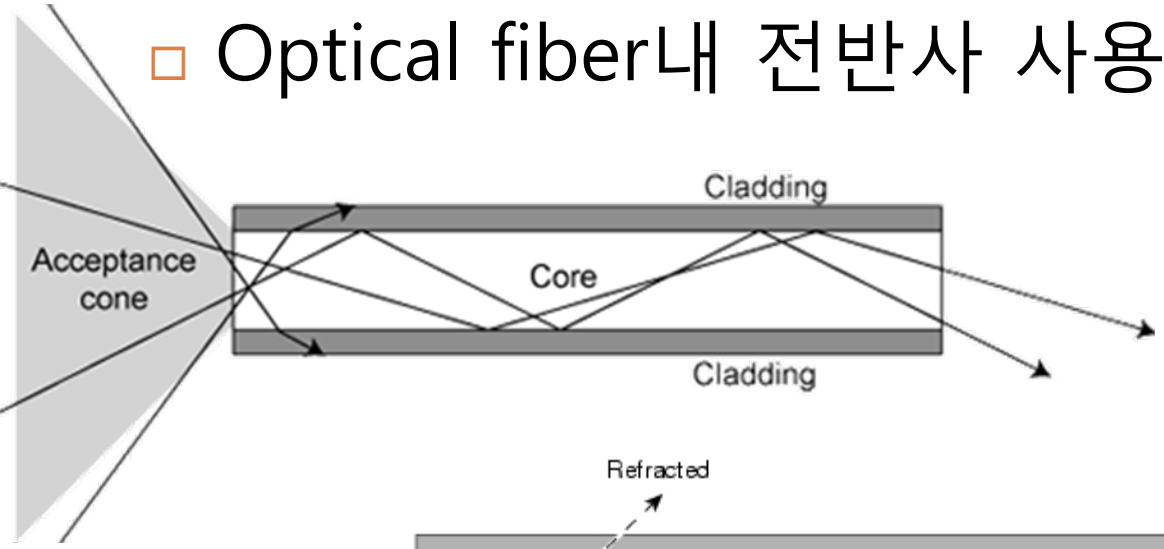
반사법칙

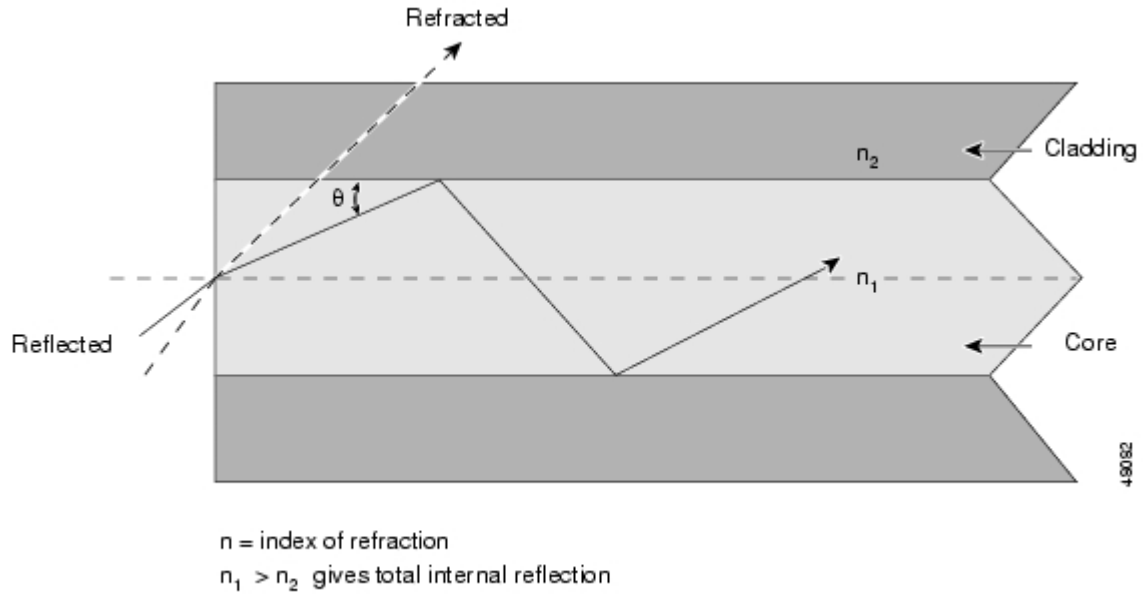
- 페르마 원리
  - 주변의 경로에 비하여 소요시간이 가장 짧은 경로를 따른다
  - 광로 최단거리
  - 동일시간 최고거리



광섬유의 전반사

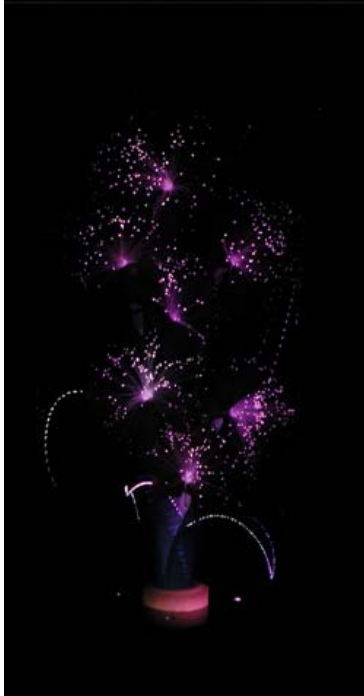
- Optical fiber내 전반사 사용





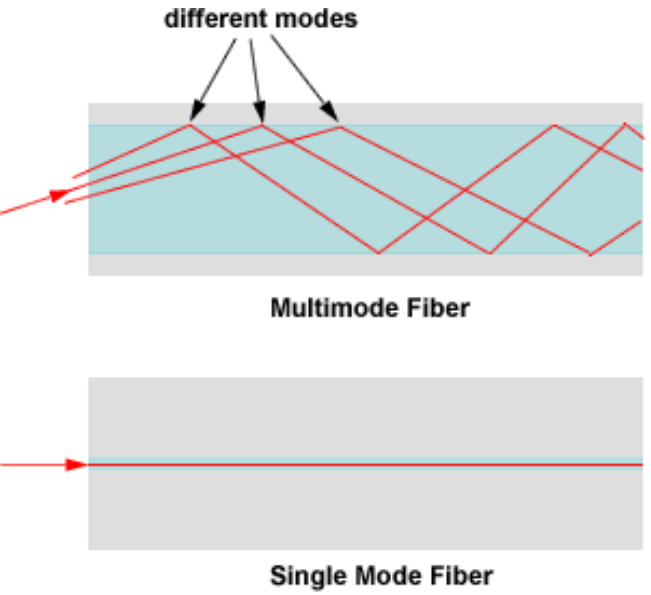
n = index of refraction

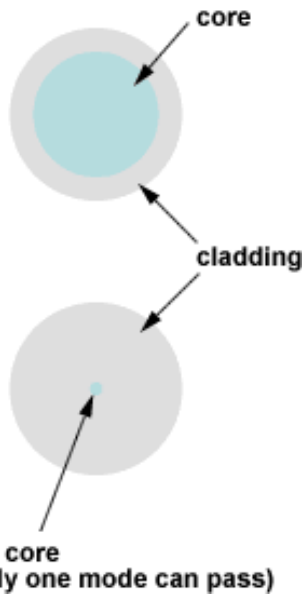
$n_1 > n_2$ gives total internal reflection

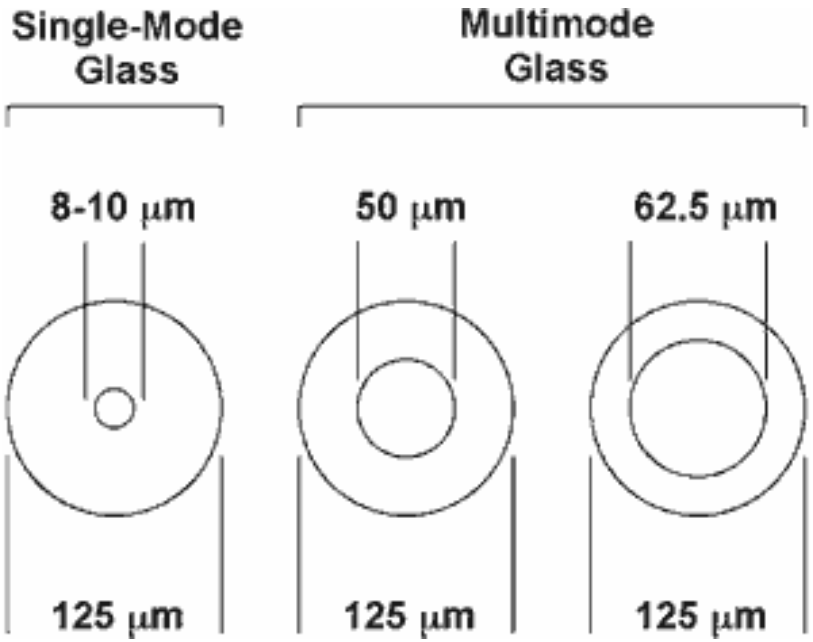


광섬유 종류

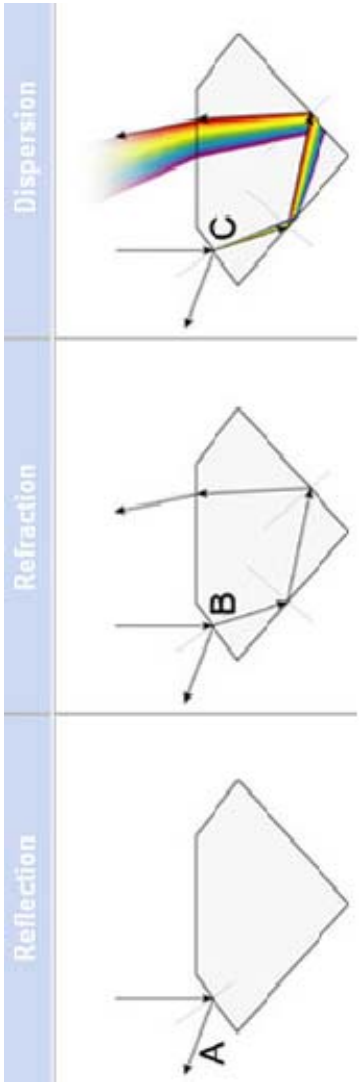
- Single mode
- Multimode

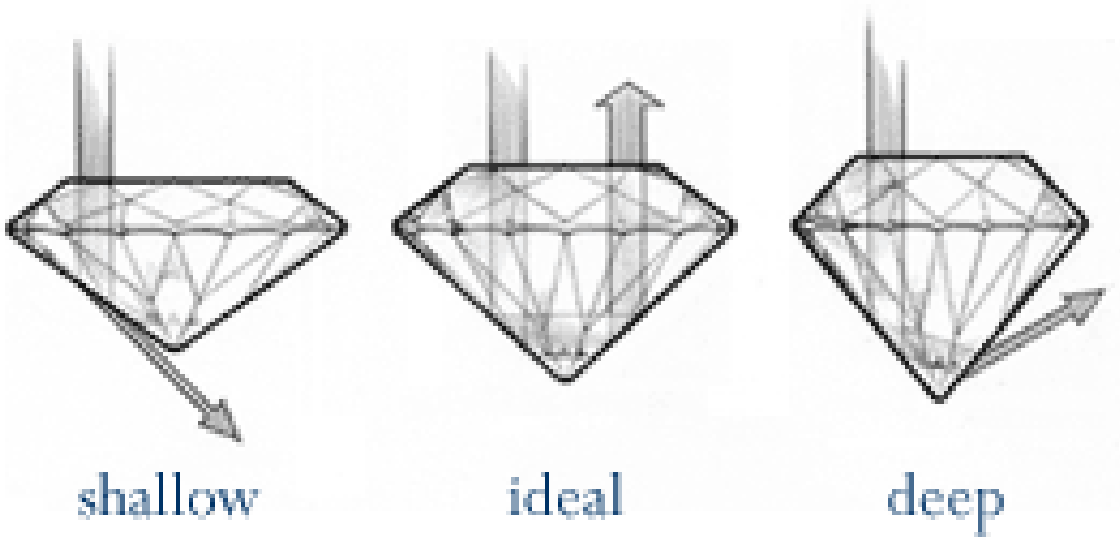


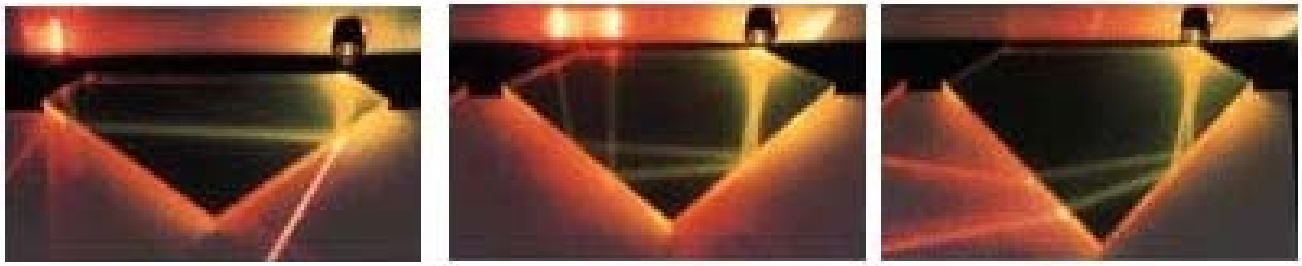




다이아몬드의 전반사

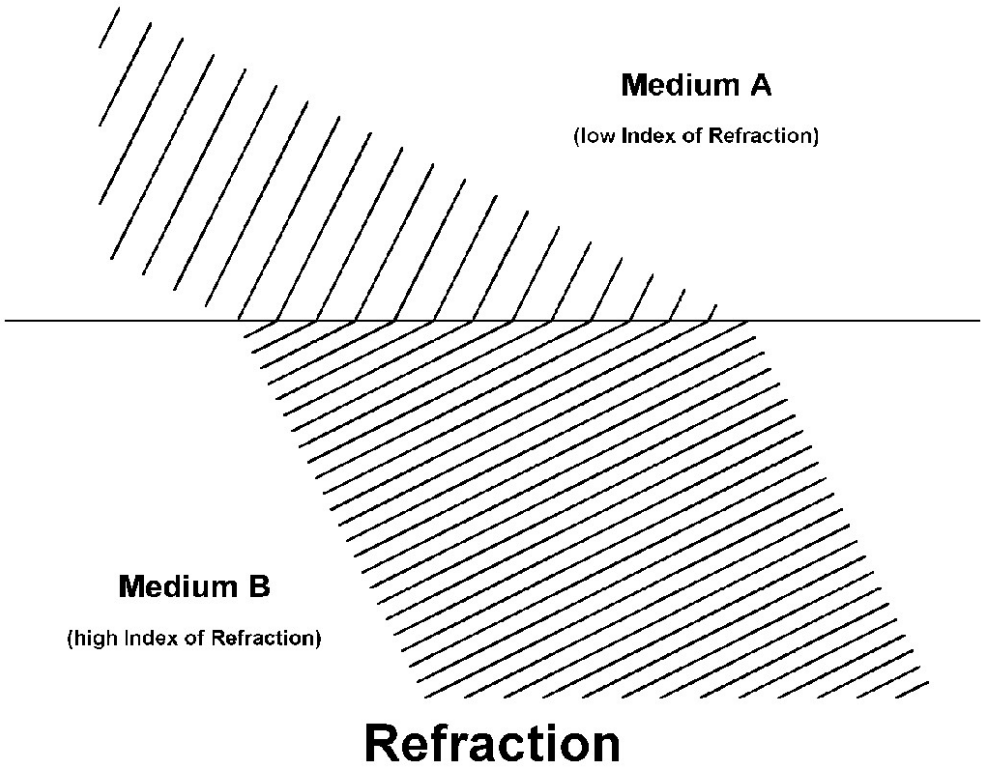


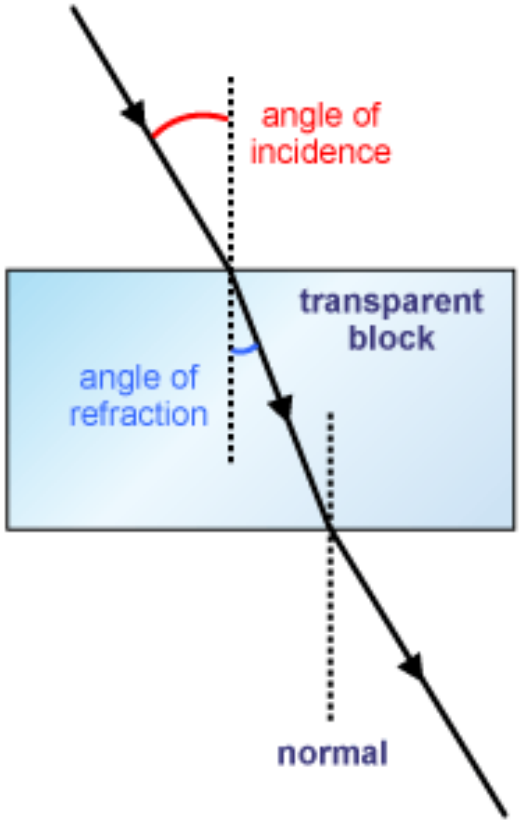




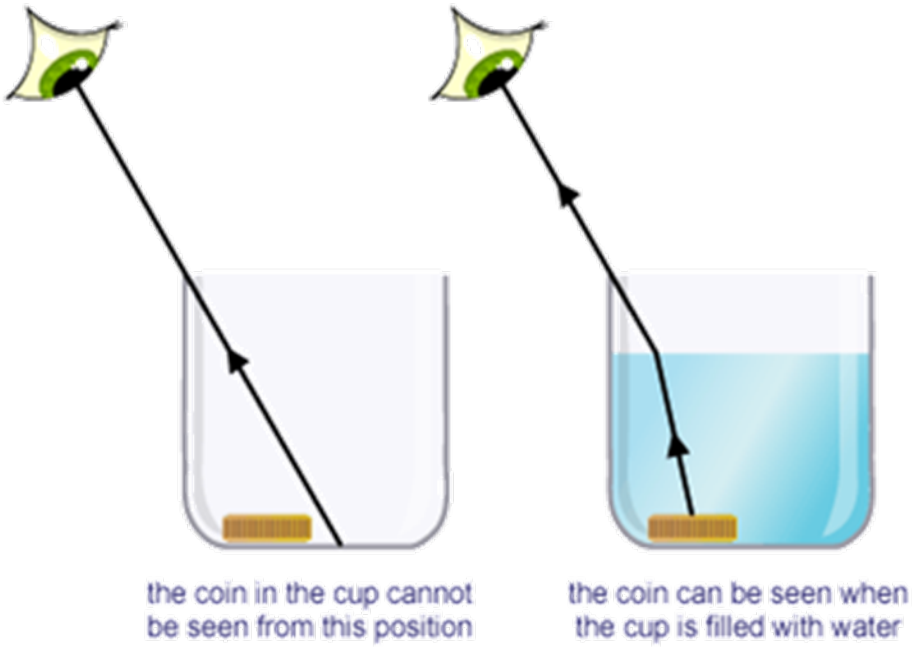
굴절(Refraction)

- 굴절현상
  - 매질(굴절률)에 따른 빛의 진행 속도 차이





Water trick


the coin in the cup cannot be seen from this position
the coin can be seen when the cup is filled with water

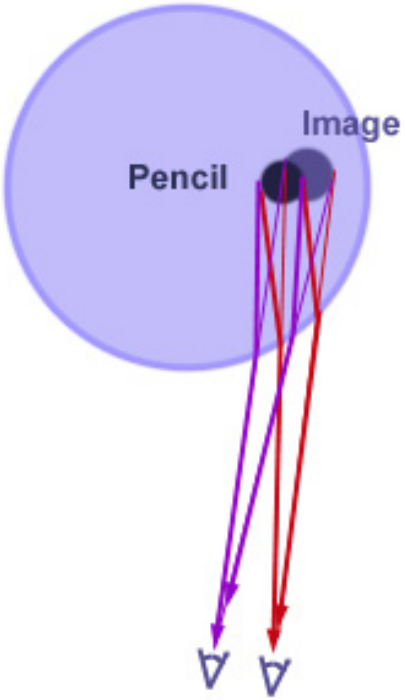
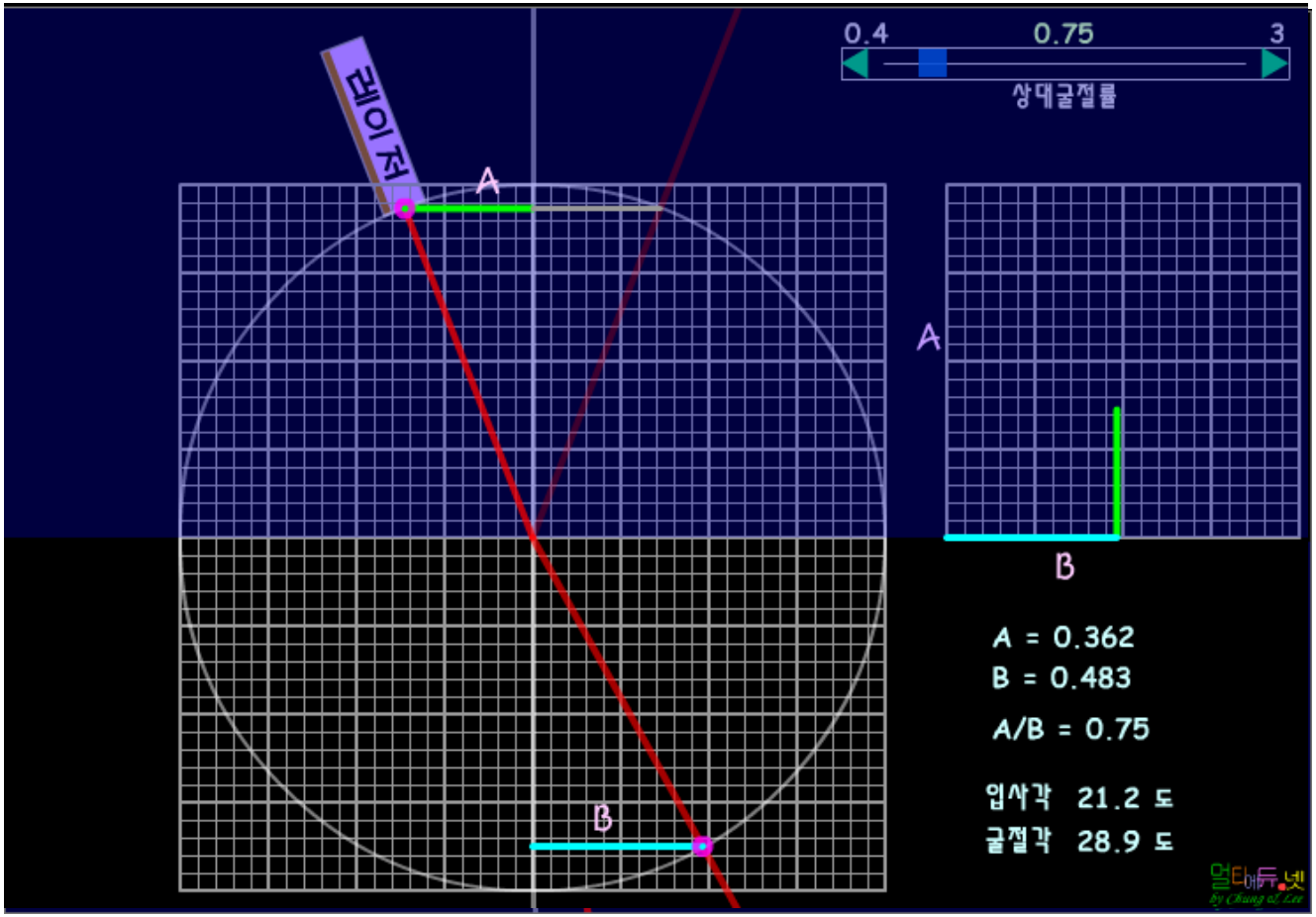


Image
Pencil

상대굴절률 실험

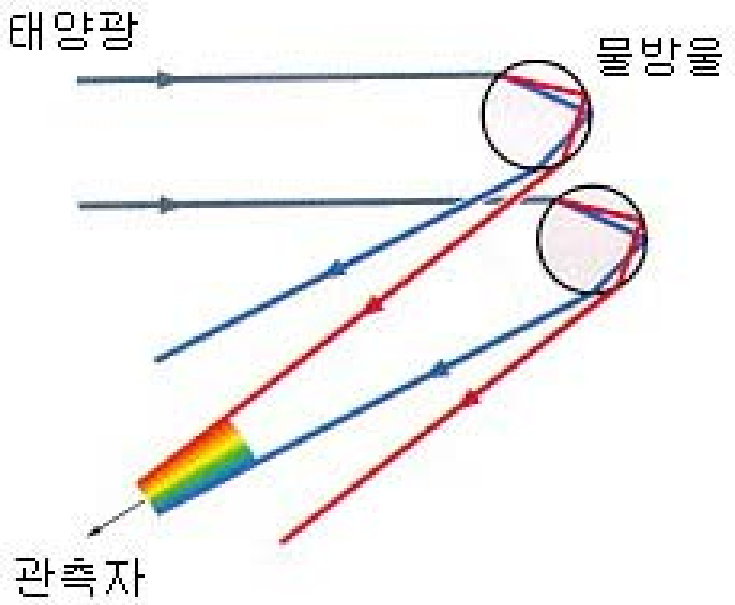
- 물질별 굴절률
  - 진공: 1
  - 물: 1.33
  - 다이아몬드: 2.42



대기에 의한 굴절: 신기루

- 신기루 현상: 기온에 따른 굴절률 차이

빛의 분산: 무지개



간섭(Interference)

- 파장의 특성
  - 보강간섭 (constructive interference)
  - 소멸간섭 (destructive interference)

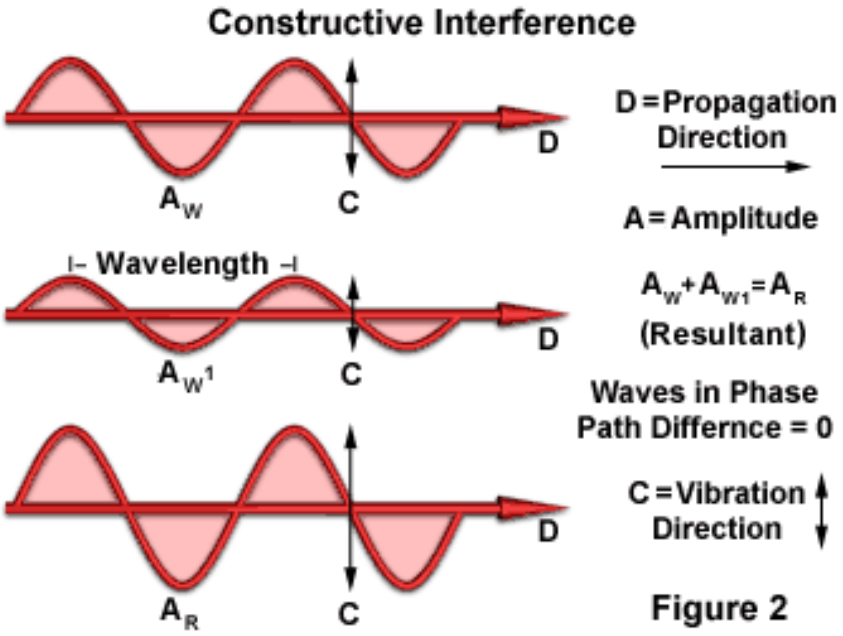


Figure 2

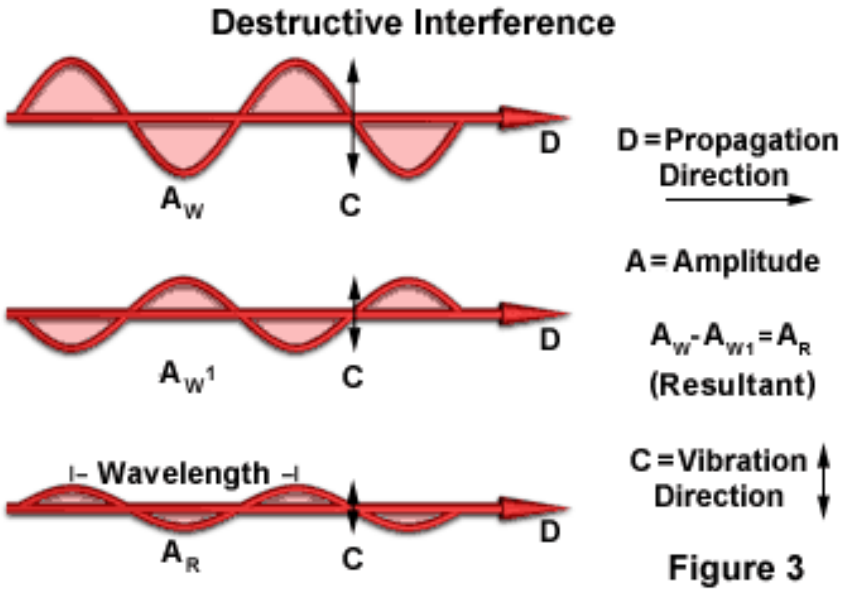


Figure 3

비눗방울 반사+간섭

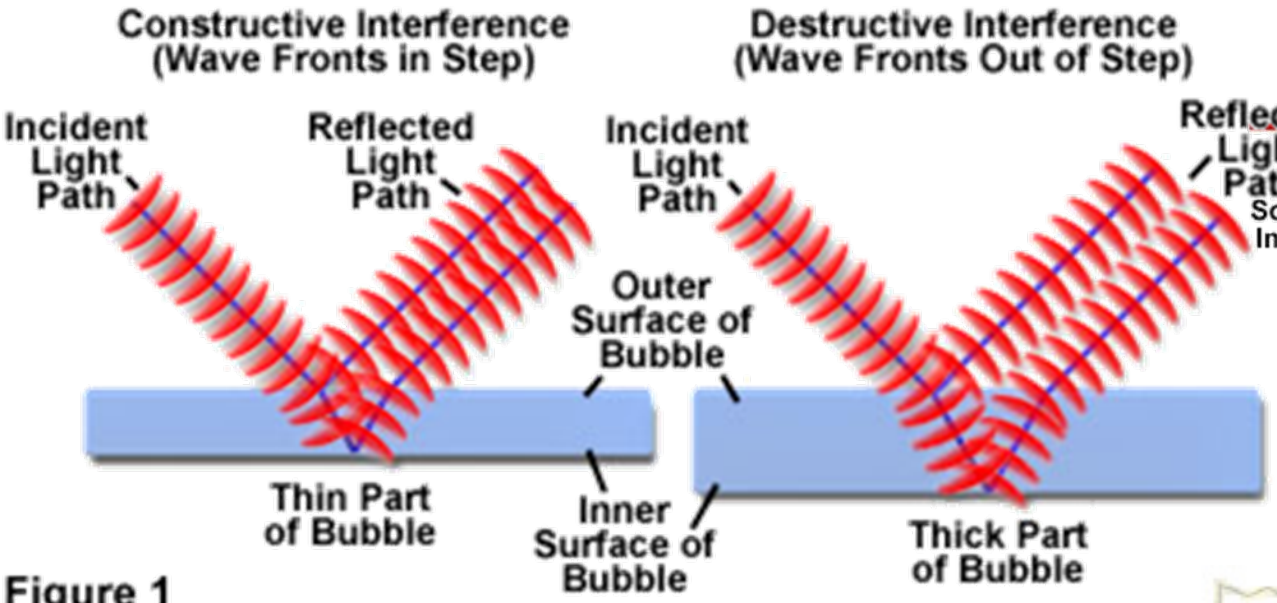


Figure 1

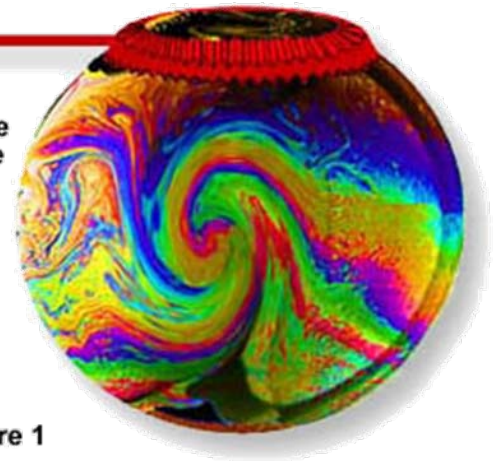
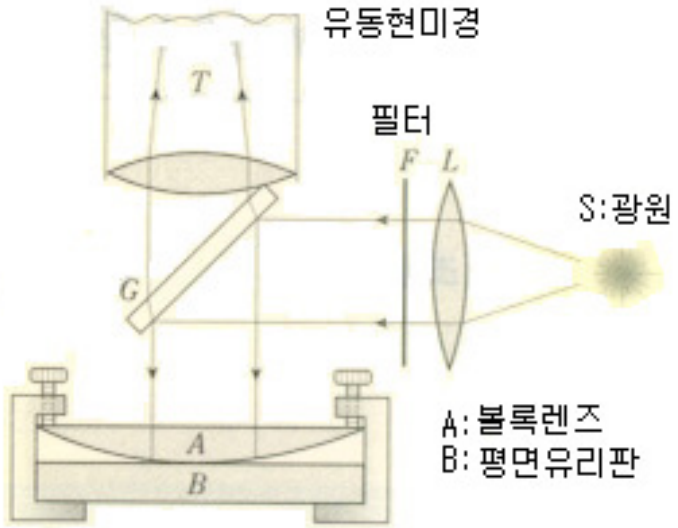


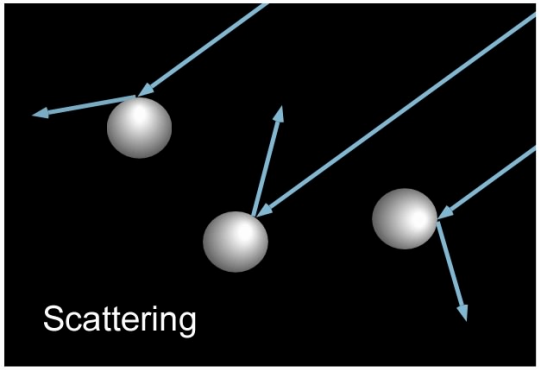
Figure 1

Newton's Rings



구조적 간섭

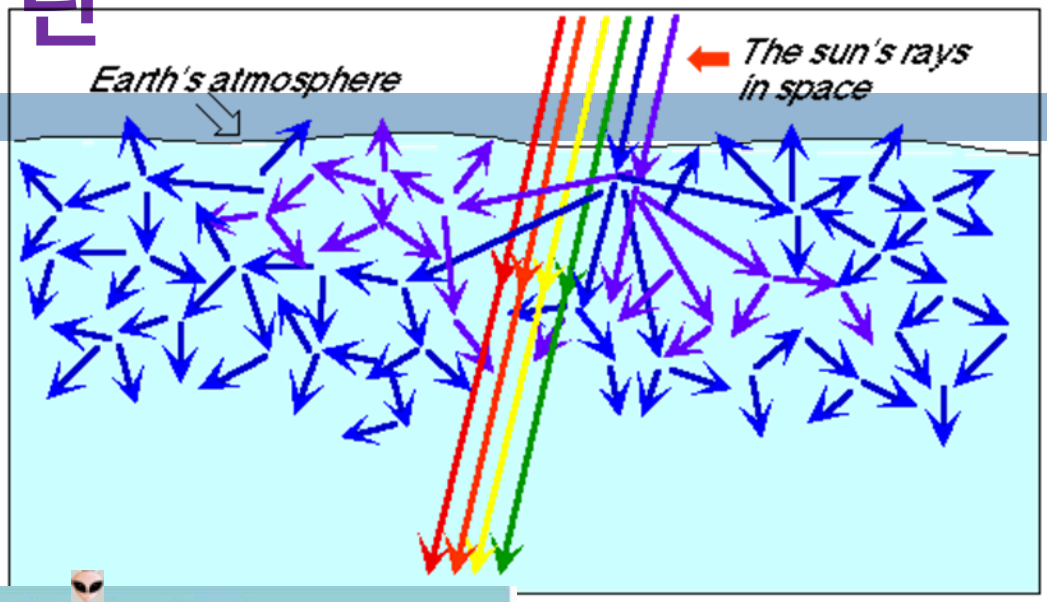
산란(Scattering)



- 산란의 이유
  - 대기 속의 기체 분자들에 의한 가시광선 산란
  - 기체 분자들이 가시광선의 파장보다 훨씬 작기 때문에 Rayleigh scattering 발생

- Rayleigh scattering
  - 파장이 짧을 수록 빛을 강하게 산란: $1/\lambda^4$
  - 산란도: 파란색(450 nm)=$(700/450)^4 \fallingdotseq 5.9$X붉은색(700 nm)
  - 대기에서 파란색이 많이 산란

다양한 가시광 산란



The Various Types of Scattering of Visible Light

TYPE OF PARTICLE	PARTICLE DIAMETER (MICROMETERS, μm)	TYPE OF SCATTERING	PHENOMENA
Air molecules	0.0001 to 0.001	Rayleigh	Blue sky, red sunsets
Aerosols (pollutants)	0.01 to 1.0	Mie	Brownish smog
Cloud droplets	10 to 100	Geometric	White clouds

편광(polarization)

필터를 사용하지 않은 사진

Filter B+W Circular Pol 사용한 사진