

1-5 흡수

X선 어떤 형태의 물질 만나면 → 일부는 투과 일부는 흡수

→ 강도 I 인 X선이 균일한 물질 통과 할 때 강도 감소

& 거리 x 에 비례 (dx : distance traversed)

$$\rightarrow -\frac{dI}{I} = \mu \, dx \quad \mu : \text{선형흡수계수}$$

(linear absorption coefficient)

by Röntgen

물질의 종류, 밀도, X선 파장에 의존

$$\rightarrow \text{적분} \quad I_x = I_0 e^{-\mu x} \quad I_0 : \text{입사 X선 강도}$$

I_x : 두께 x 를 통과한 뒤 X선 강도

$$\rightarrow I_x = I_0 e^{-(\mu/\rho)\rho x}$$

μ/ρ : 질량흡수계수

(물리적 상태(고체, 액체, 기체)와 무관
질량흡수계수 증가 → 흡수강도 감소

두 종류 이상 원소 함유한 물질의 질량 흡수계수

$$\frac{\mu}{\rho} = w_1 \left(\frac{\mu}{\rho} \right)_1 + w_2 \left(\frac{\mu}{\rho} \right)_2 + \dots$$

w_1, w_2, \dots : 원소 1, 2...들의 무게 분율

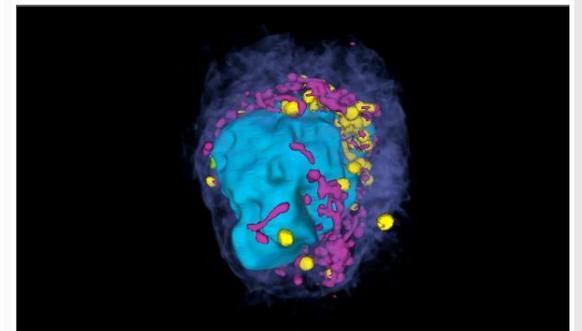
파장에 따른 흡수 계수 변화

$$\frac{\mu}{\rho} = k\lambda^3 Z^3$$

λ : 파장, Z : 흡수물질 원자번호, k : 상수

파장이 짧은 X선, 물질을 잘 투과 \rightarrow 경질(hard)

파장이 긴 X선, 물질에 잘 흡수 \rightarrow 연질(soft)



Whole-cell portraits can be created using an imaging technique called soft X-ray tomography, or SXT.

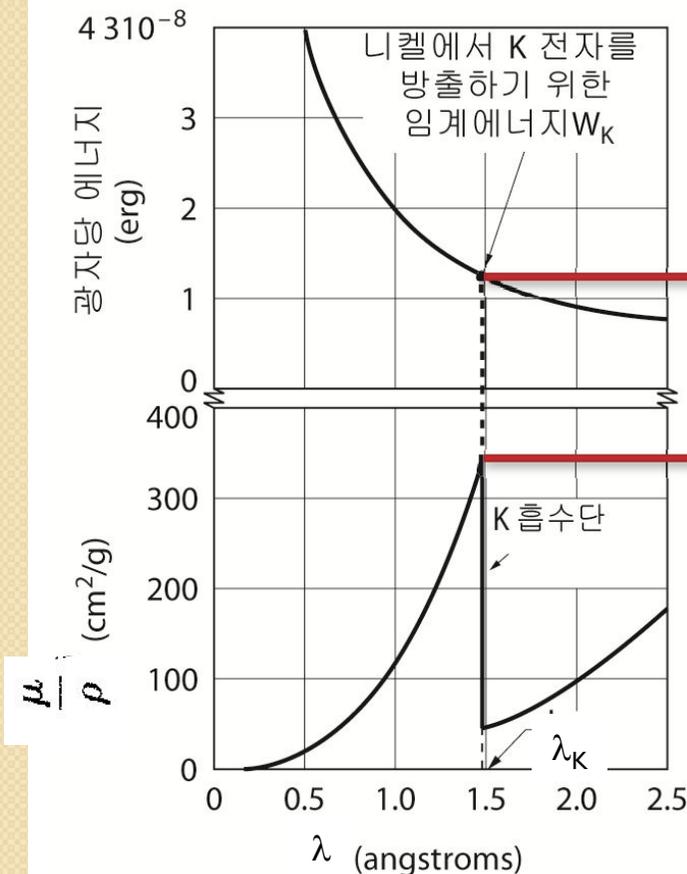
물질은 X-선을 산란(scattering)과 진흡수(true absorption)한다.

산란 : 공기중의 먼지에서 빛의 산란과 유사, 총 흡수에서 일부.

진 흡수 : 원자 안에서 전자의 전이로 발생

→ 광전자(photoelectron)으로 방출

→ 형광방사선(fluorescent radiation)으로 변환



1.6 필터

단색에 가까운 X선 필요

→ Cu 타겟에서 $K\alpha$ 와 $K\beta$ 선 발생

→ Ni K 흡수단(absorption edge)을 필터로 사용

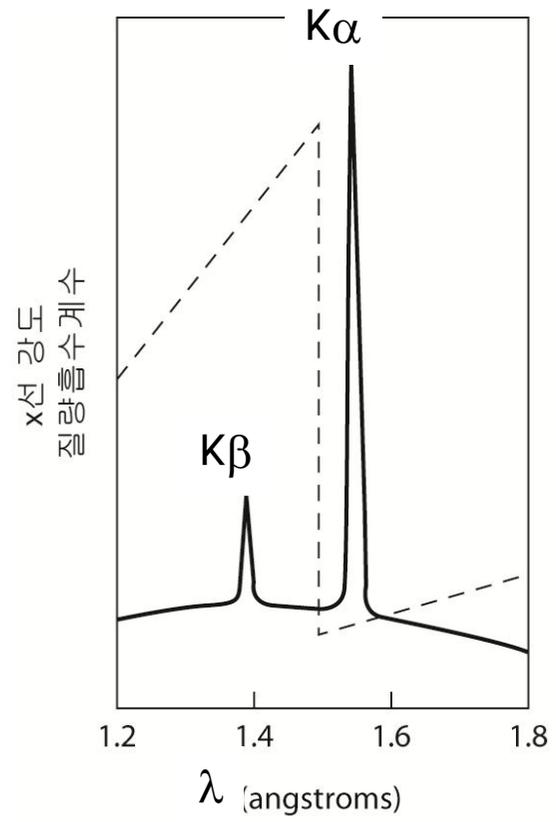
1.488 Å 이하 진 흡수 할 수 있다.

(필터 사용시 필요한 두께 조절 필요)

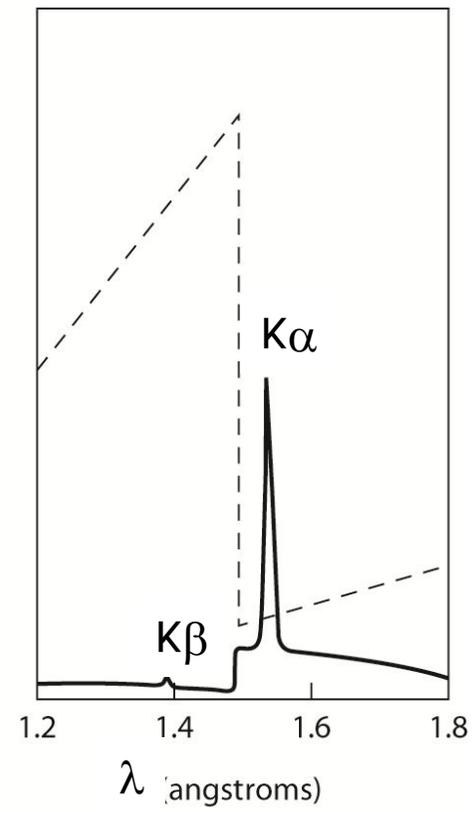
→ Cu $K\beta$ 선 억제(흡수) $K\alpha$ (통과)

Cu(Z=29), Ni(Z=28) : 필터는 타겟보다 원자번호 1 작은 물질사용.

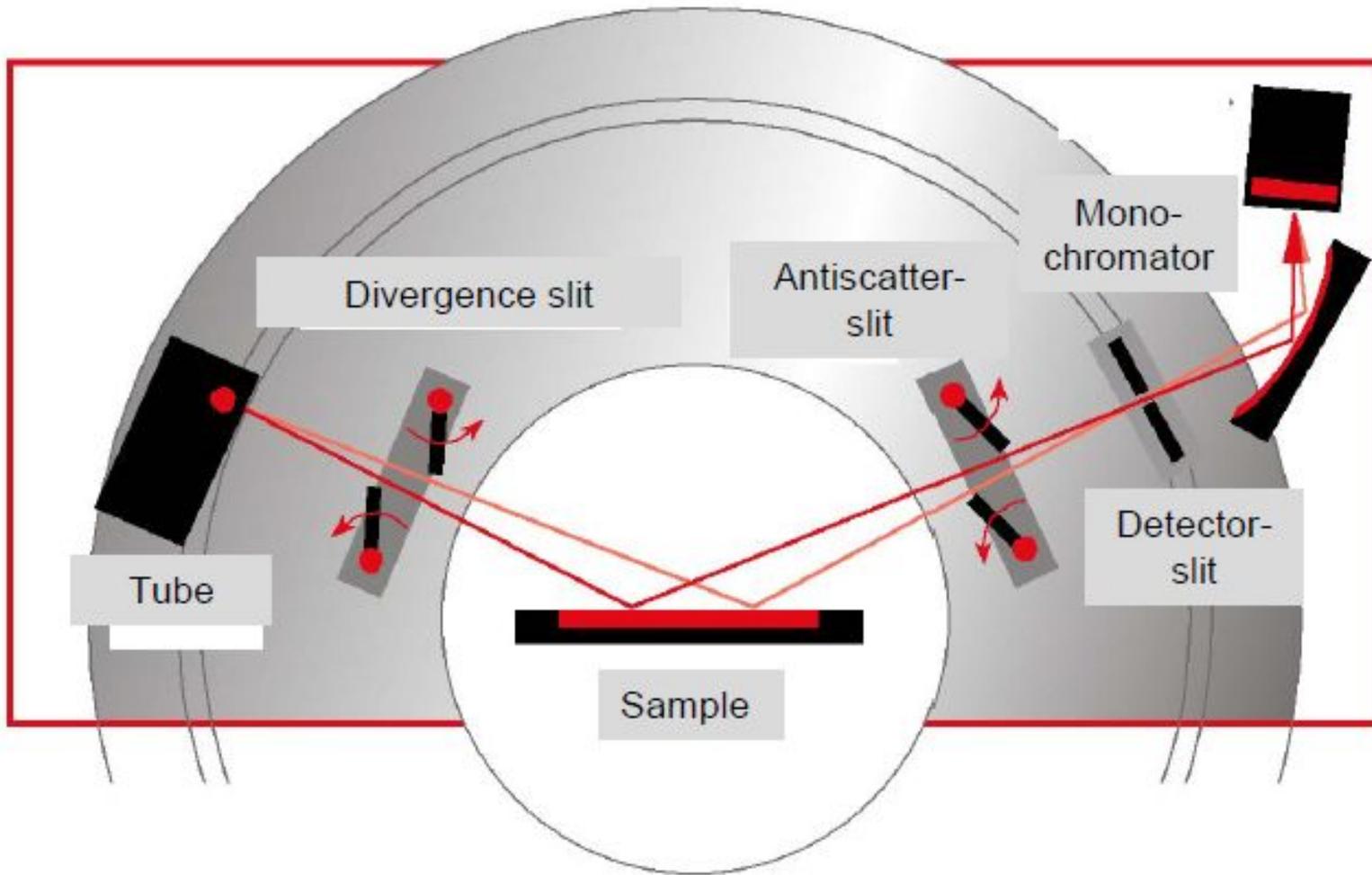
Target	Filter	Incident beam* $\frac{I(K\alpha)}{I(K\beta)}$	Filter thickness for		$\frac{I(K\alpha) \text{ trans}}{I(K\alpha) \text{ incident}}$
			$\frac{I(K\alpha)}{I(K\beta)} = \frac{500}{1}$ in trans. beam		
			mg/cm ²	in	
Mo	Zr	5.4	77	0.0046	0.29
Cu	Ni	7.5	18	0.0008	0.42
Co	Fe	9.4	14	0.0007	0.46
Fe	Mn	9.0	12	0.0007	0.48
Cr	V	8.5	10	0.0006	0.49

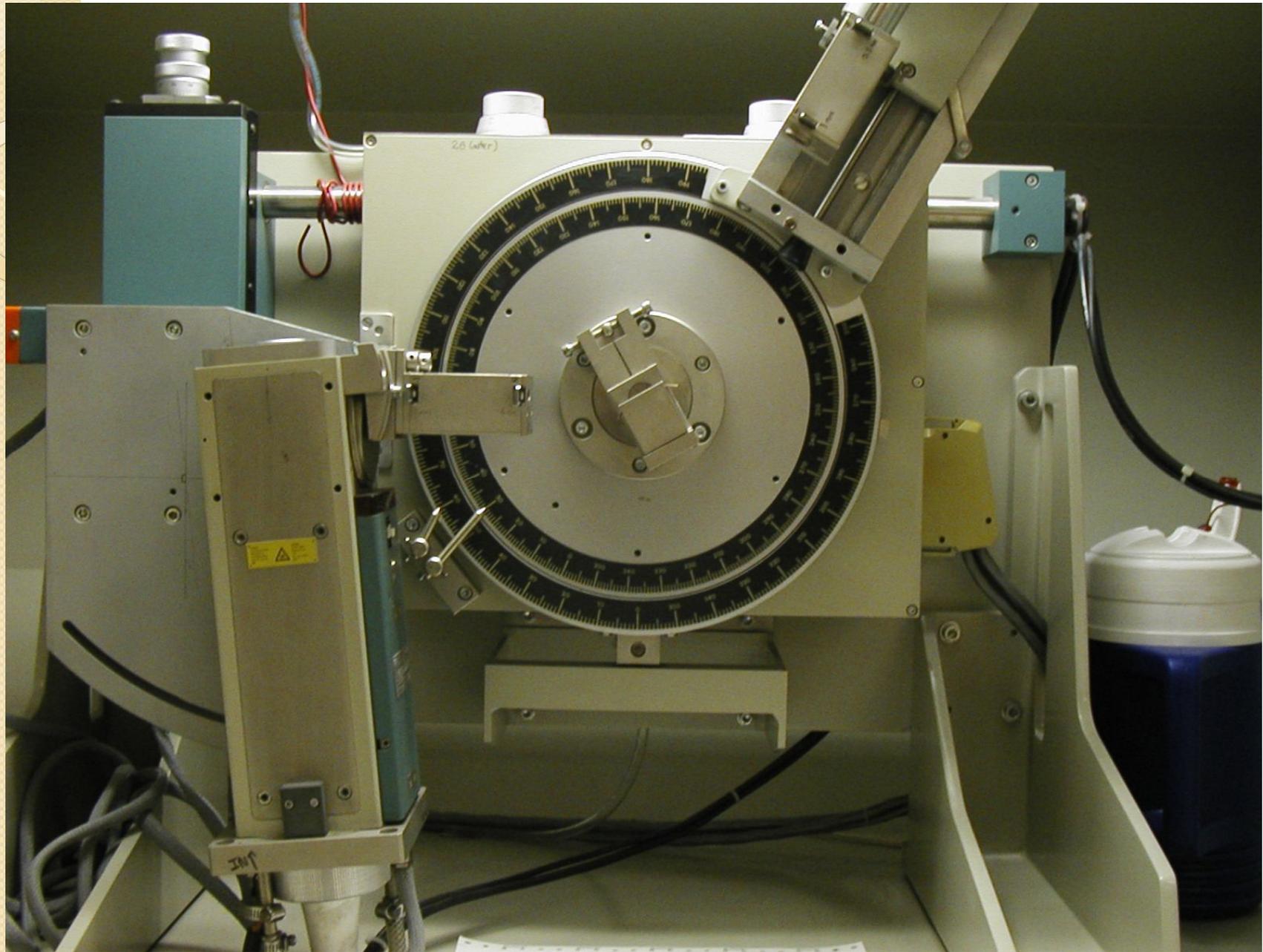


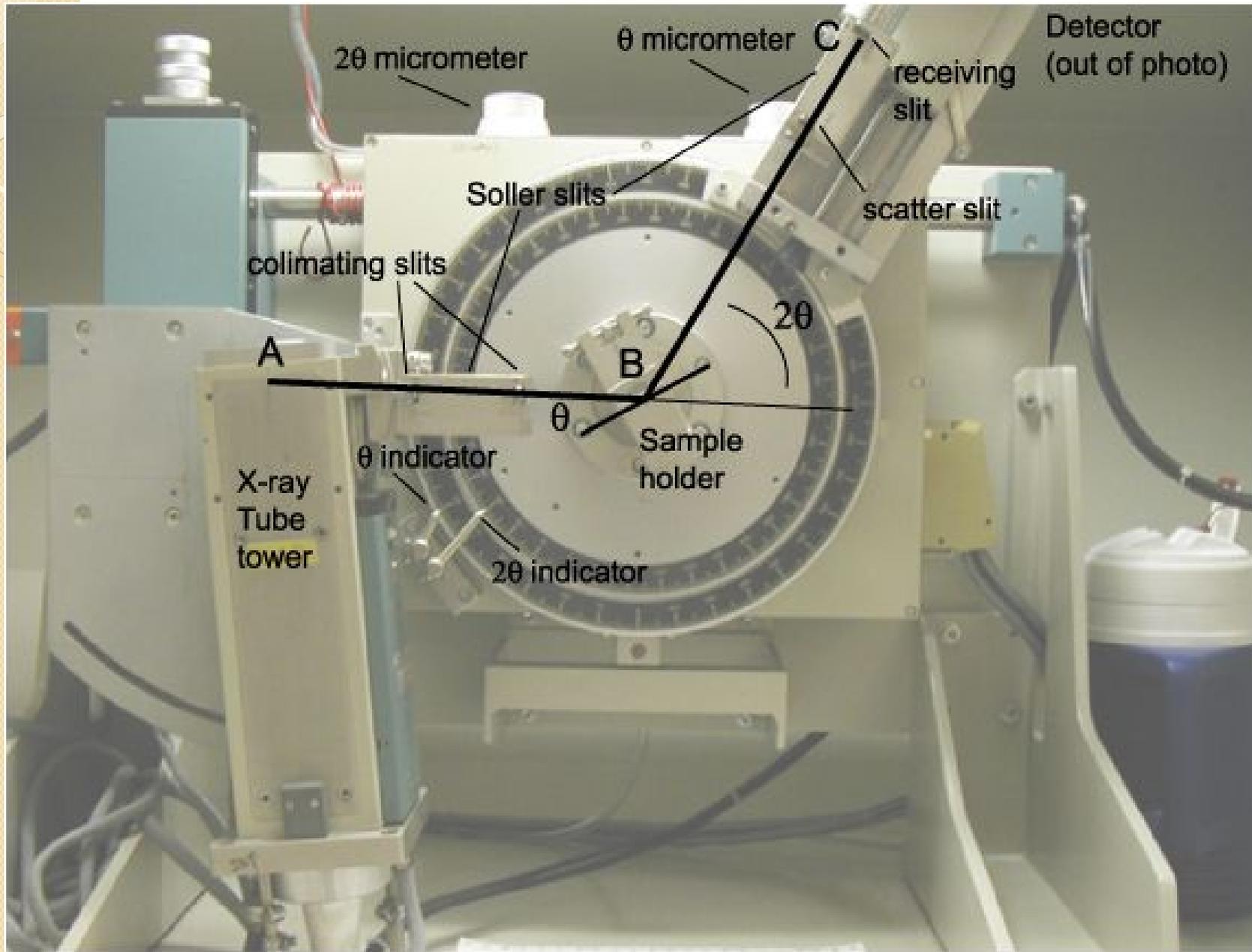
(a) 무필터

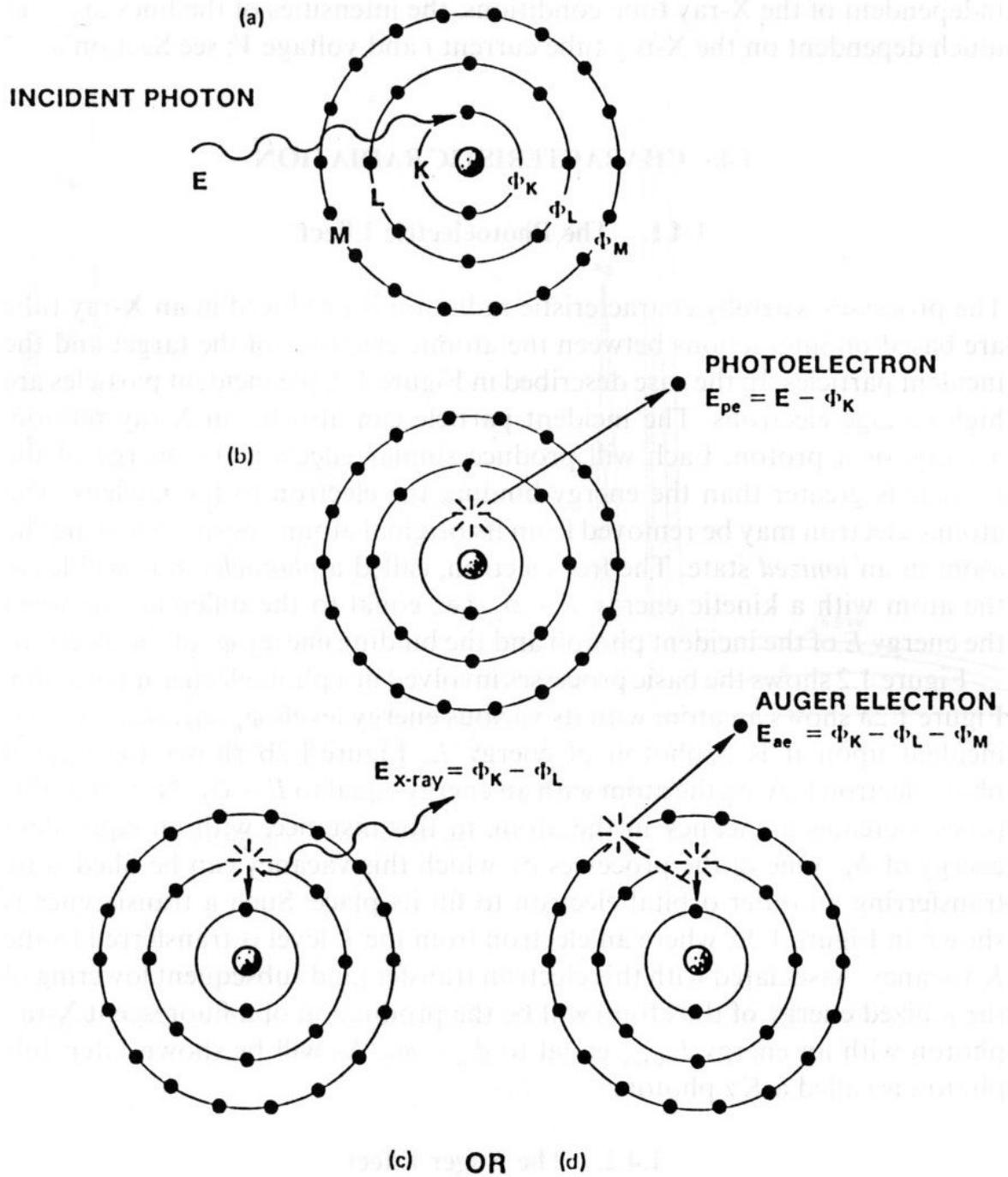


(b) 니켈 필터









싱크로트론 방사선

: 가속기에서 전자나 양성자가 자기장으로 곡선형 궤적을 따라서
편이 한다면 싱크로트론 (synchrotron) 방사선 발생

BNL Open to Public on Summer Sundays — July 18 Stars The National Synchrotron Light Source

Exciting science shows, tours of world-class science facilities, and entertaining activities for children and adults are all part of the free fun and learning opportunities offered to the public by BNL during Summer Sundays.

No reservations are needed, but visitors 16 and older must bring a photo ID. Visitors may arrive any time between 10 a.m. and 3 p.m. A different tour and exciting new science show will be featured each week. Arrive early to avoid crowds and to take advantage of the full program.

The last facility visit takes place at 3 p.m. each week, and science shows will be held at noon, 1:30 and 3 p.m. each Sunday in Berkner Hall. A new hands-on exhibit, "Creating Our Future, Sustainability by Design," will be displayed every Sunday in the Berkner Hall lobby. The cafeteria and gift shop, both in Berkner Hall, will be open from 10 a.m. to 3 p.m.

July 18 — Bright Light, Dazzling Discoveries

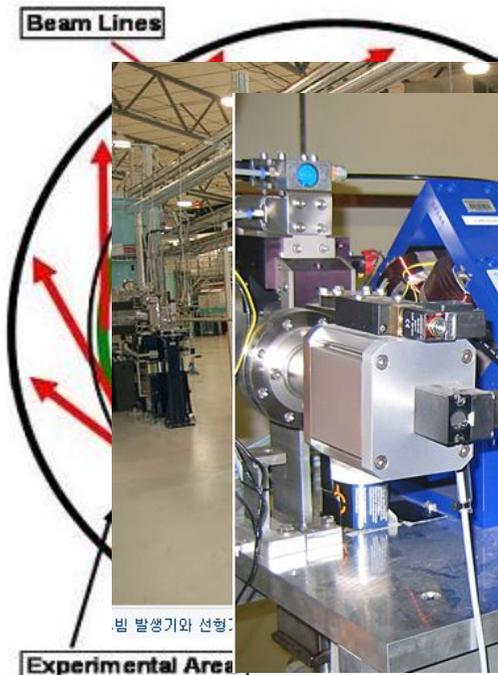
Step inside the National Synchrotron Light Source, where scientists illuminate the inner workings of proteins, polymers, computer chips, and more.



The National Synchrotron Light Source



The Diamond
a variety of
manuscript
Image courtesy



빛 발생기와 선형

Experimental Area