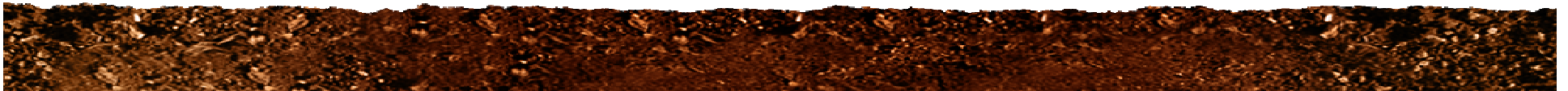


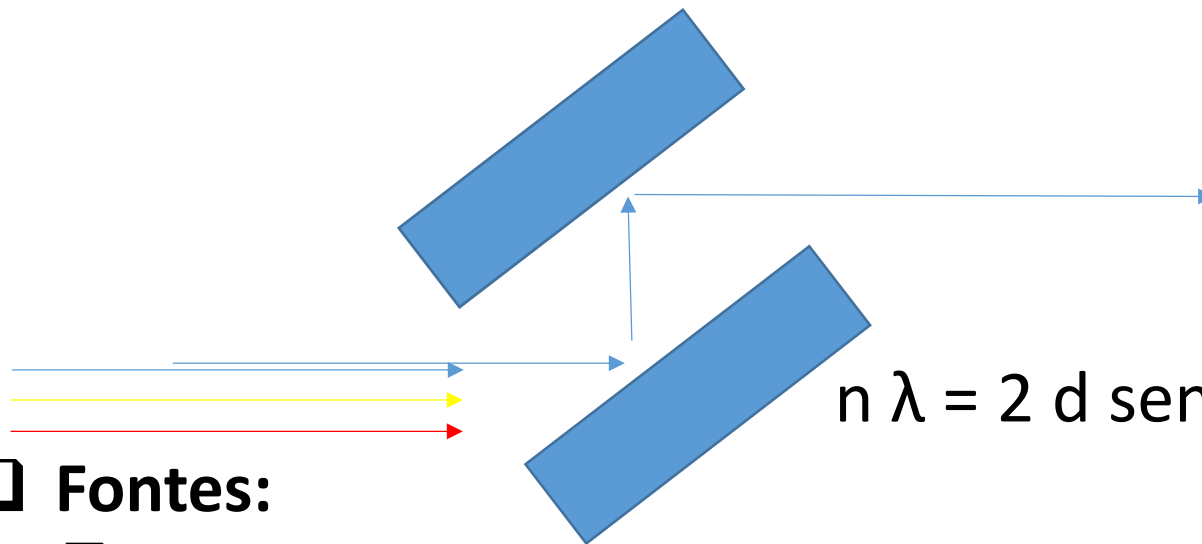
X-rays



X-rays

Monocromadores

nm = ev divide 1240



Teta= 12,69°

$$n \lambda = 2 d \sin (\text{teta})$$

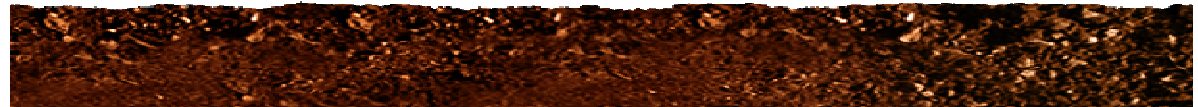
$$n \lambda = 2 \times 3,1356 \text{ \AA} \sin (12,69^\circ)$$

$$N \lambda = 1,37763 \text{ \AA}$$

$$\text{eV} = 9008$$

Fontes:

- Síncrotron
- Tubo de raios X



X-rays

☐ Natureza

$$I_1 = I_0 e^{-\mu x}$$

$$A = c L \mu$$

$x \mu$

$I_1 =$ detector após a amostra

$I_0 =$ detector antes da amostra

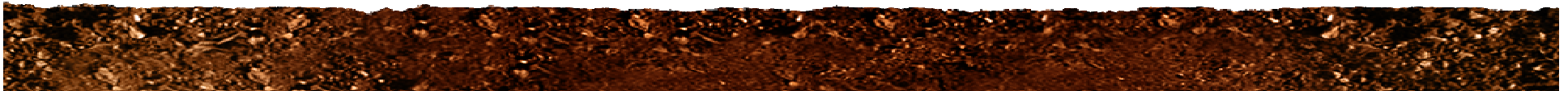
$\mu =$ coeficiente atenuação ($\mu_{EE} + \mu_{EI} + \mu_{\text{absorção Fotoelétrico}}$)

$x =$ espessura

$$\frac{I_1}{I_0} = e^{-\mu x}$$

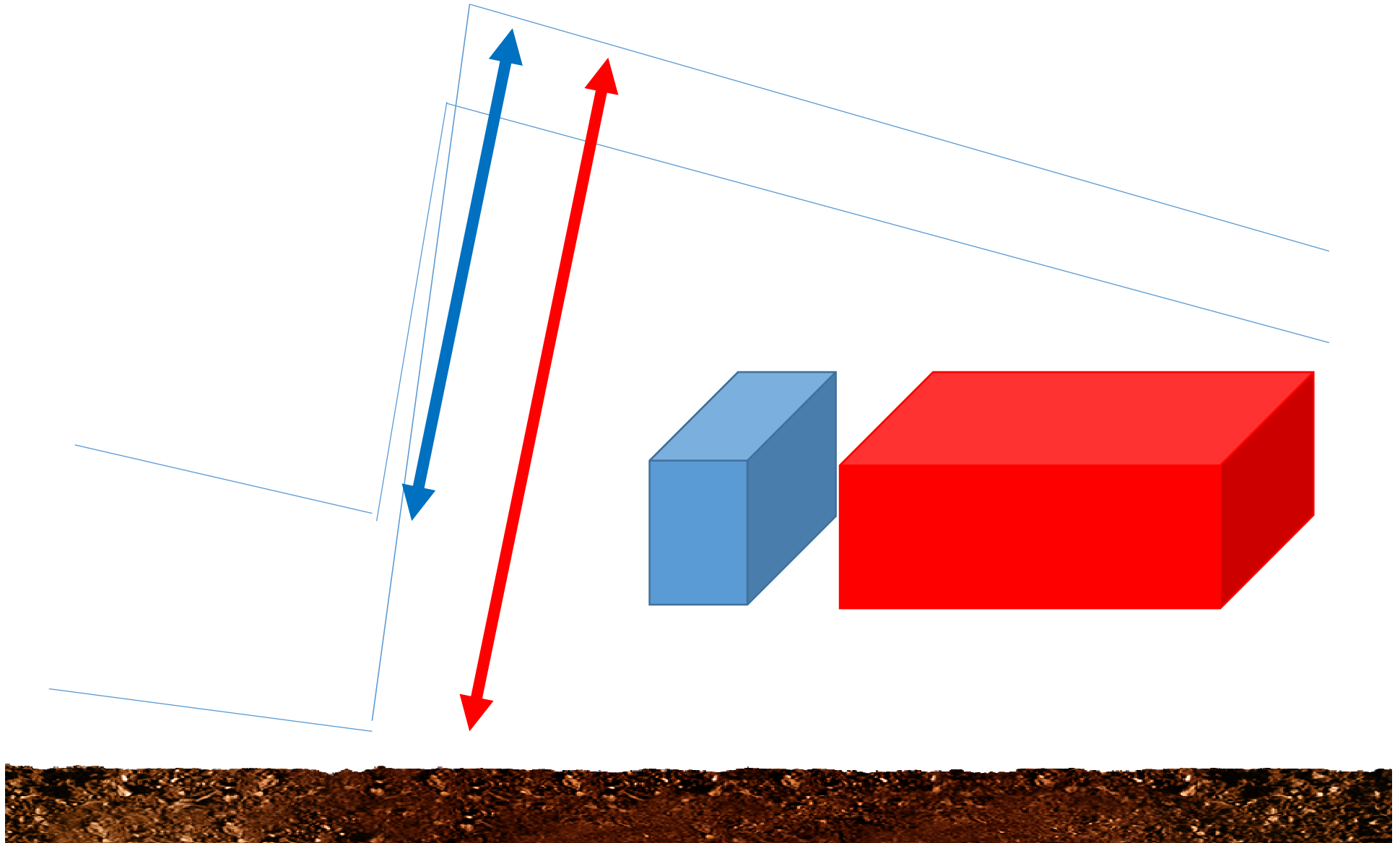
$$\ln\left(\frac{I_1}{I_0}\right) = -\mu x$$

$$\ln\left(\frac{I_0}{I_1}\right) = \mu x$$



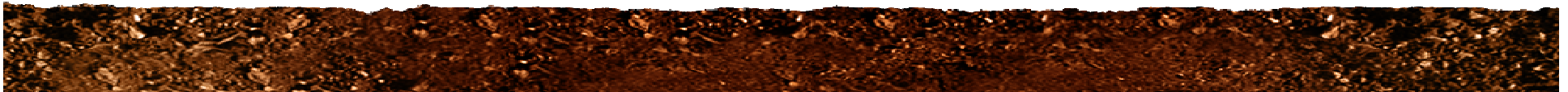
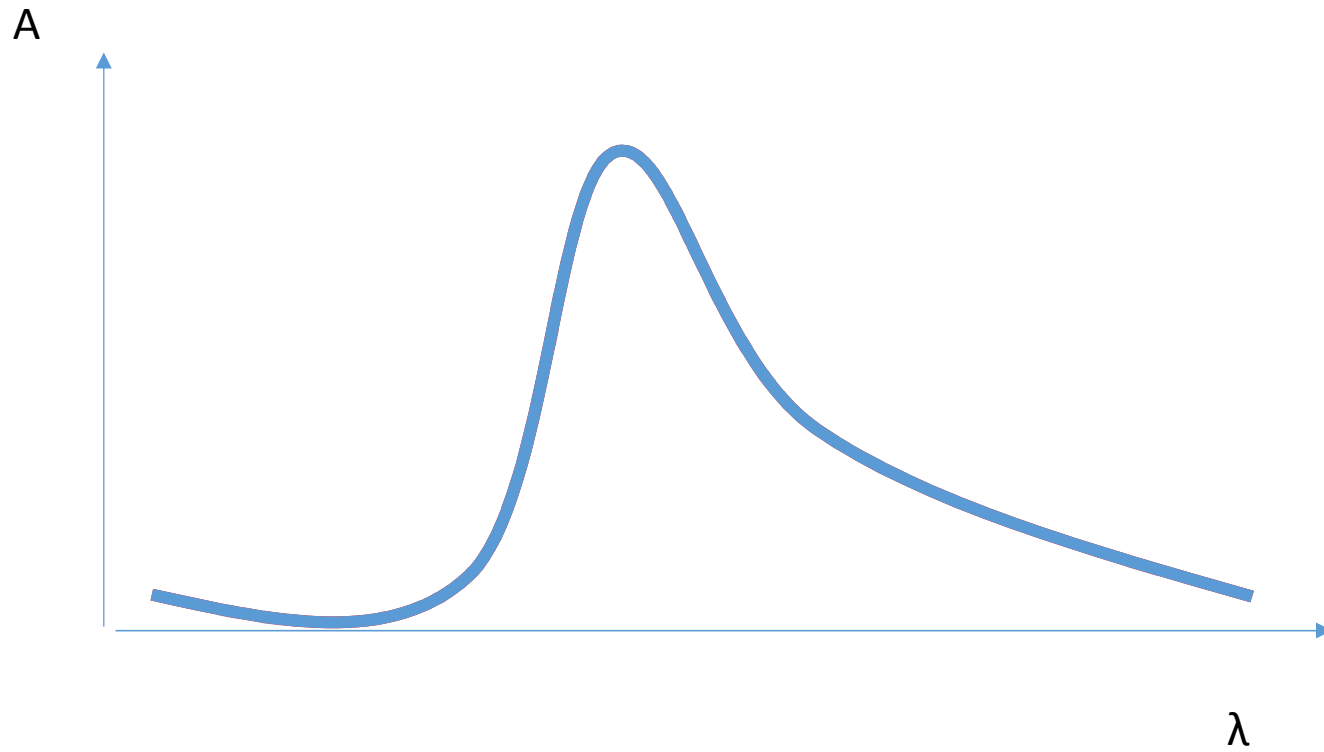
X-rays

☐ Natureza



X-rays

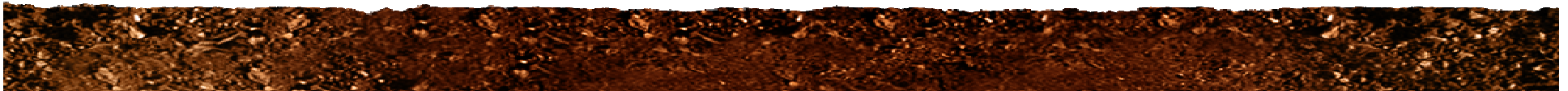
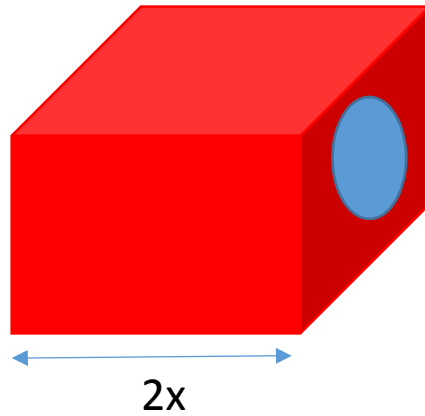
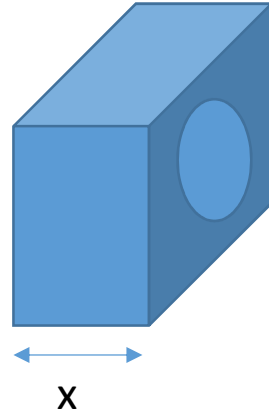
☐ Natureza



X-rays

☐ Natureza

100 átomos de Cu cm^2



X-rays

☐ Natureza

☐ Ondas eletromagnéticas (vamos pensar em fótons)

$$E = h \nu$$



Constante de Plack ($6,62 \times 10^{-34} \text{ J s}$)

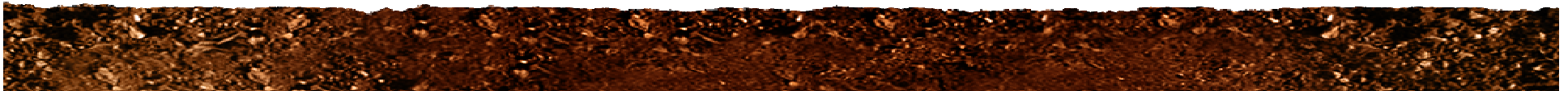
$$\nu = c / \lambda$$



Velocidade de luz

Comprimento de onda

☐ Nós vamos sempre pensar, apresentar os dados em eV



X-rays

- A fonte de raios X do experimento normalmente será um Síncrotron. Ou melhor, um dispositivo magnético dentro do Anel síncrotron: dipolo (bending magnet), wiggler ou undulator

(First) Lab XES/XANES instrument

“Cheap”: \$40k total components and manpower

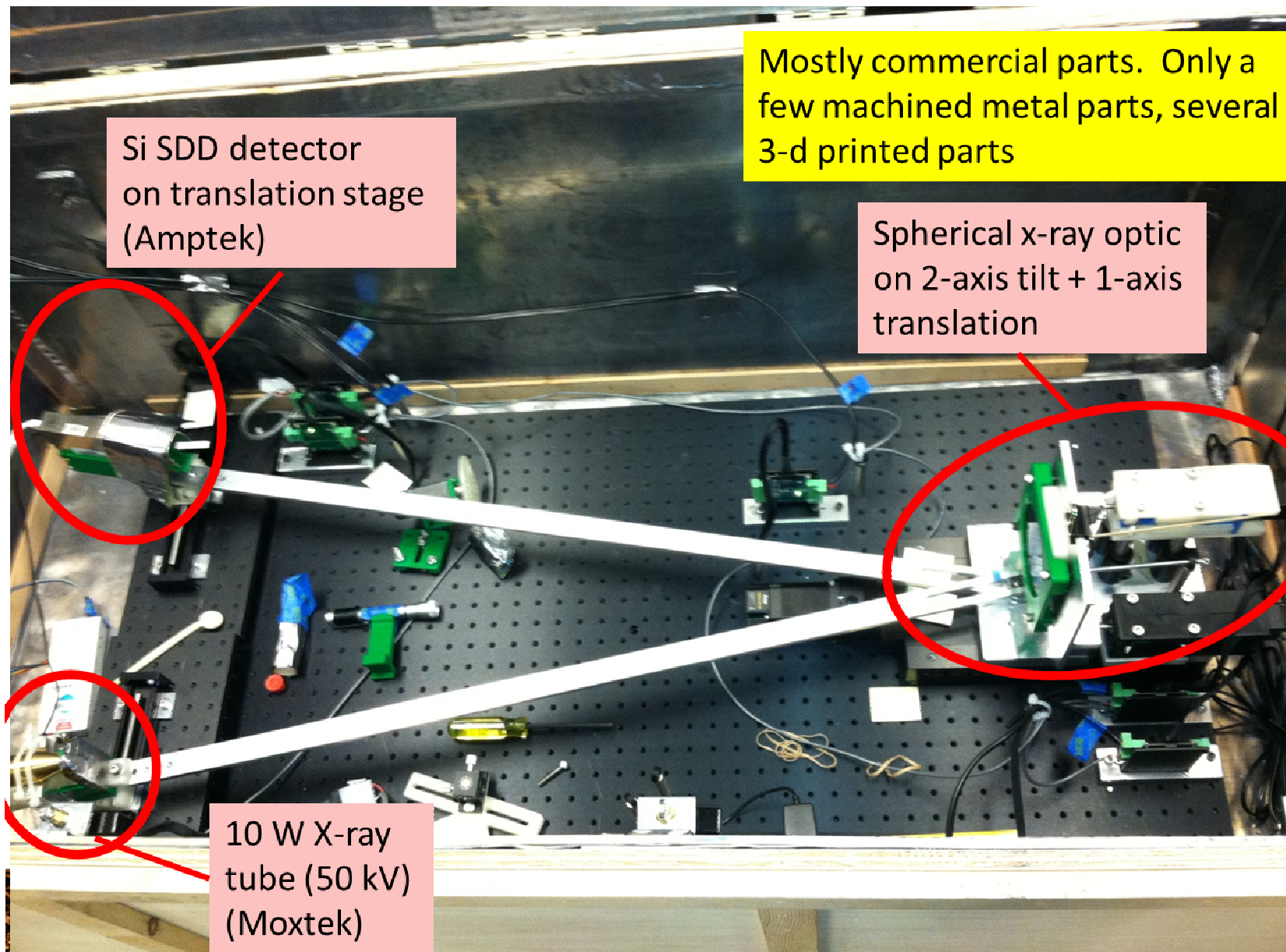


Installation and radiation-safety certification on 16 Oct. 2013

“X-ray coffin”

1st iteration He space (i.e. garbage bag)

X-rays

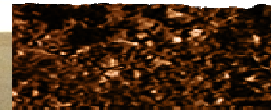


Si SDD detector
on translation stage
(Amptek)

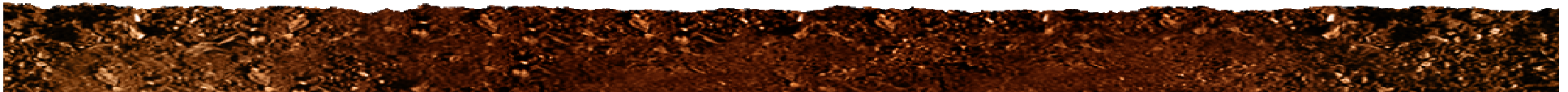
Mostly commercial parts. Only a
few machined metal parts, several
3-d printed parts

Spherical x-ray optic
on 2-axis tilt + 1-axis
translation

10 W X-ray
tube (50 kV)
(Moxtek)

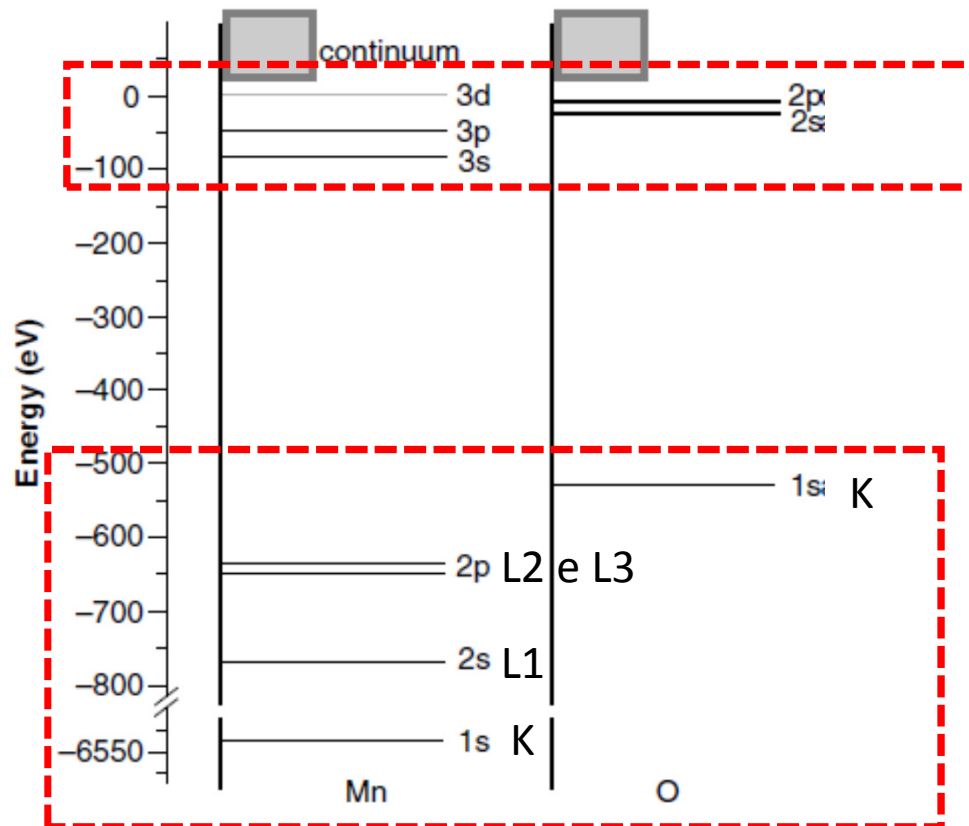


The structure of atoms



Energy diagrams

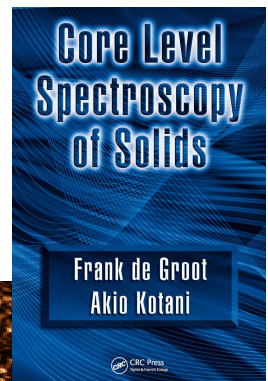
□ What means zero energy?



Valence electron states (VES)

Core electron states (VES)

FIGURE 1.1 Energies of the core levels and VES of Mn and O in MnO.

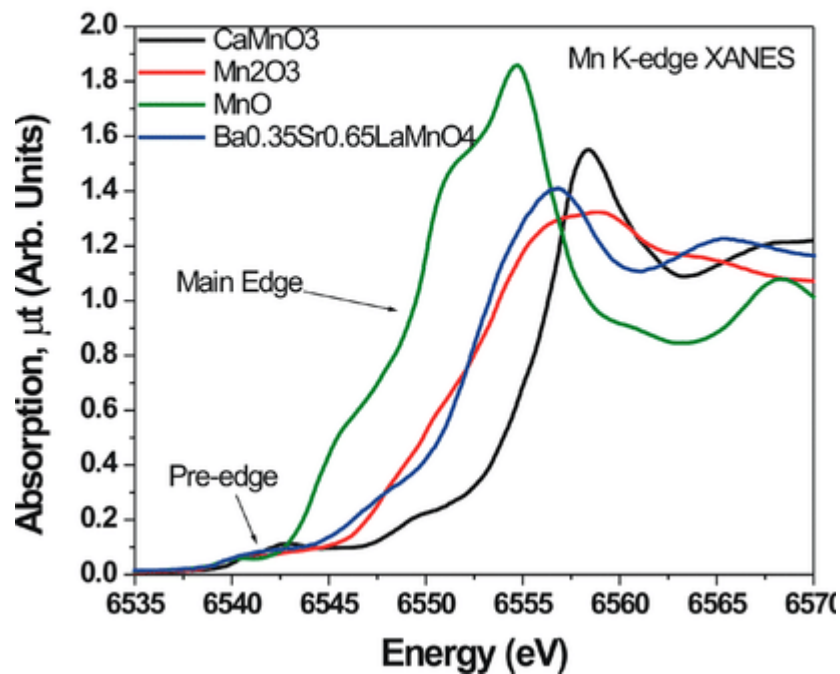


Energy diagrams

https://www.researchgate.net/figure/Manganese-L-edge-X-ray-absorption-spectra-of-the-samples-given-in-Table-1-The-formal-Mn_fig1_228587328

Norm. u(E)

(a)



https://www.researchgate.net/figure/a-Comparison-of-Mn-K-edge-XANES-spectra-for-CaMnO-3-Mn-2-O-3-MnO-and-Ba-035-Sr_fig3_331717227

Mn L edge

