



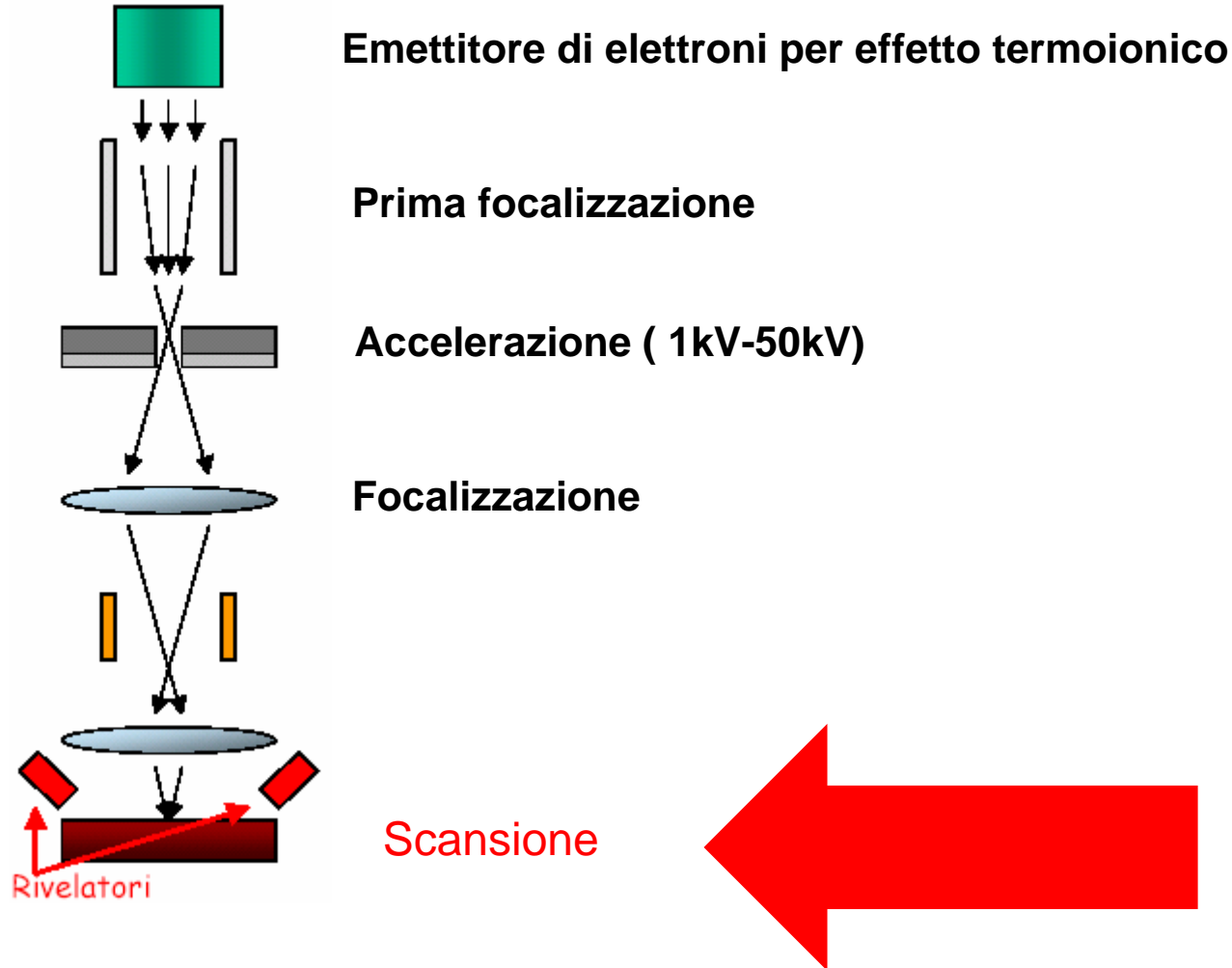
## Tecniche di analisi fisica

**Massimiliano Pieraccini**

# Microscopia elettronica

Massima risoluzione ottica:  $1\mu\text{m}$

Massima risoluzione elettronica:  $1\text{nm}$



# Microscopia elettronica



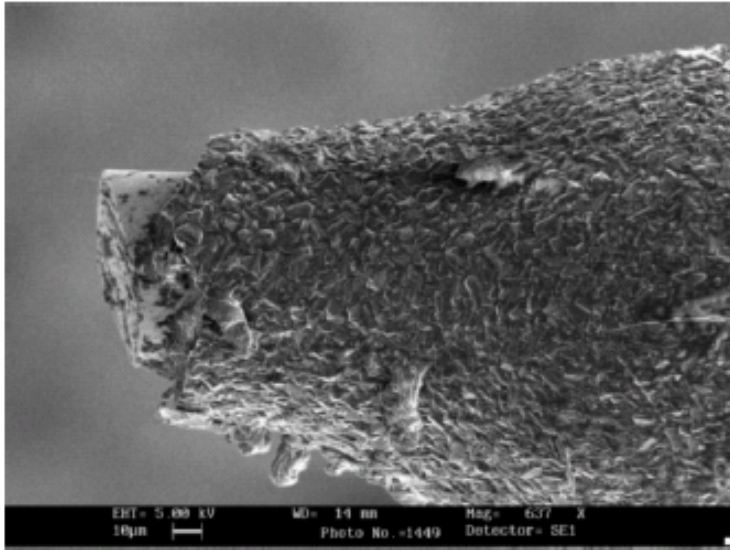


Immagine di elettroni secondari

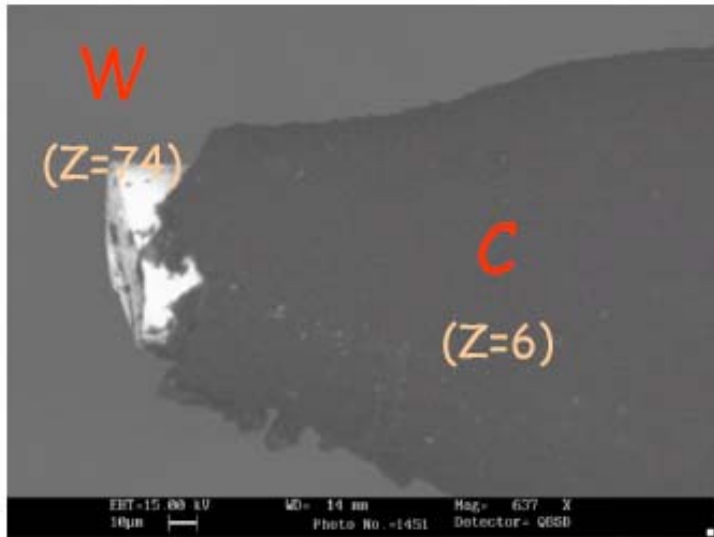


Immagine di elettroni retrodiffusi

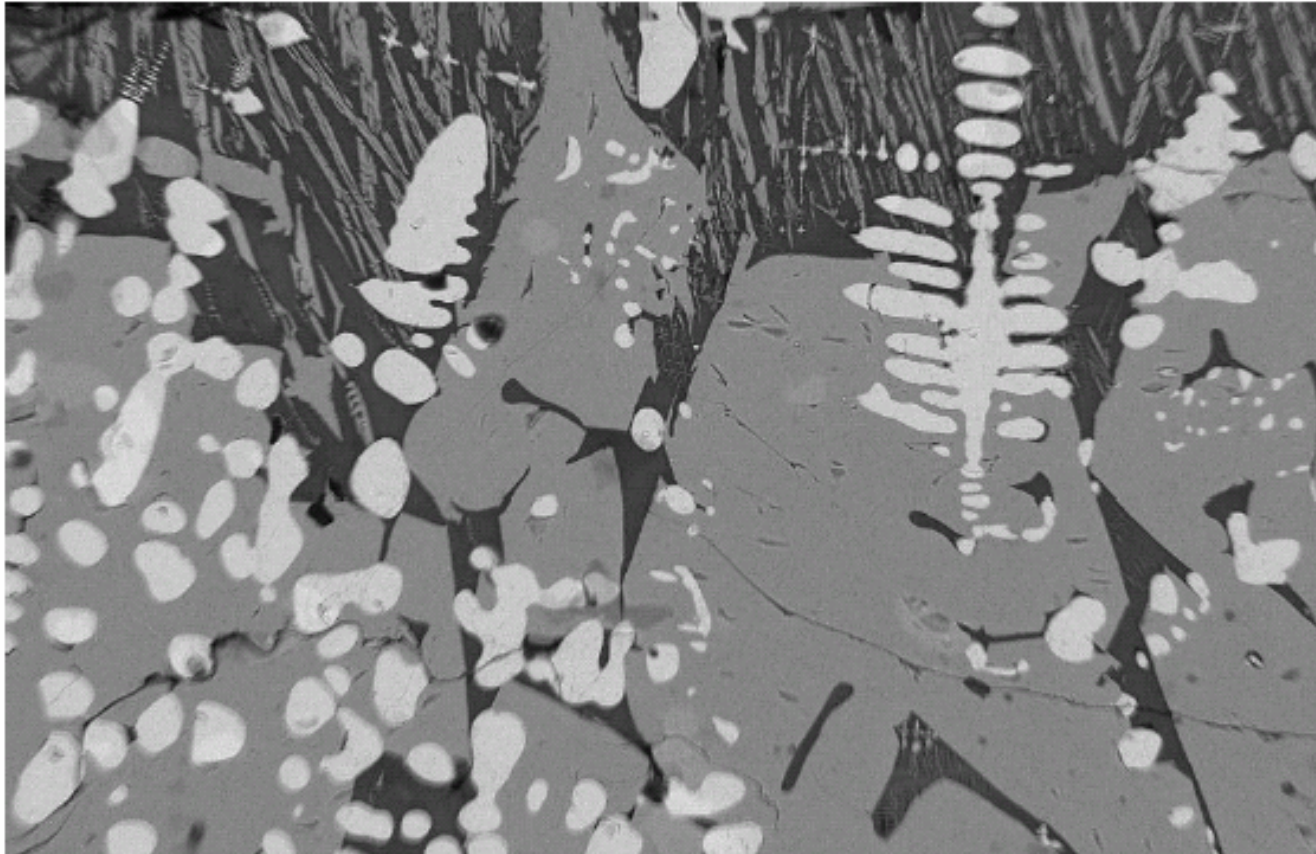


Immagine di retrodiffusi di scorie della lavorazione del ferro

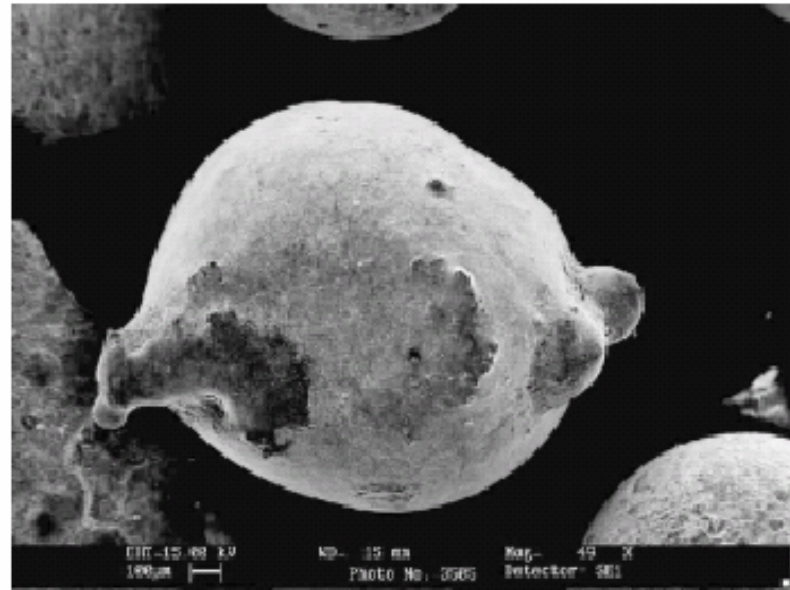
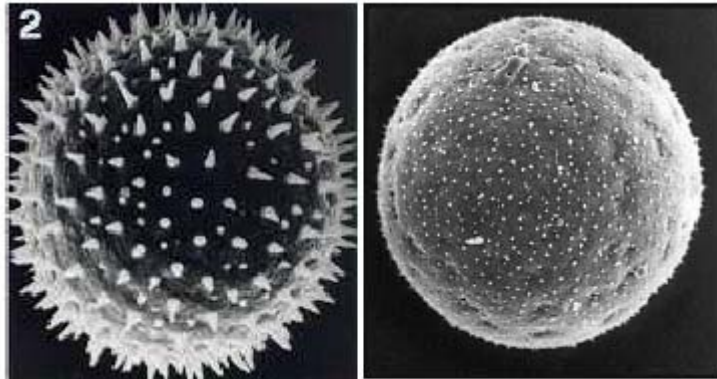


Immagine di secondari di sfere e scaglie di lavorazione del ferro





Segno prodotta da un punzone  
su una brocca anglo-sassone



Pollini

# Catodoluminescenza

Il marmo ha due picchi di luminescenza nel rosso (630nm) e nel blu (340nm)  
dati dalle impurità di Fe Mn

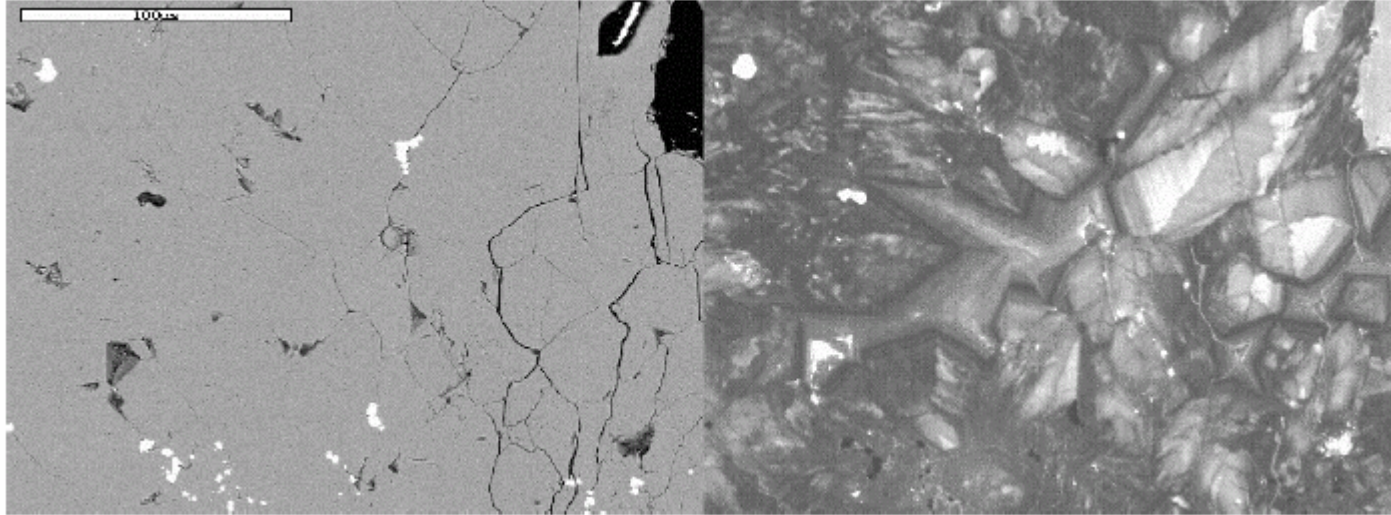
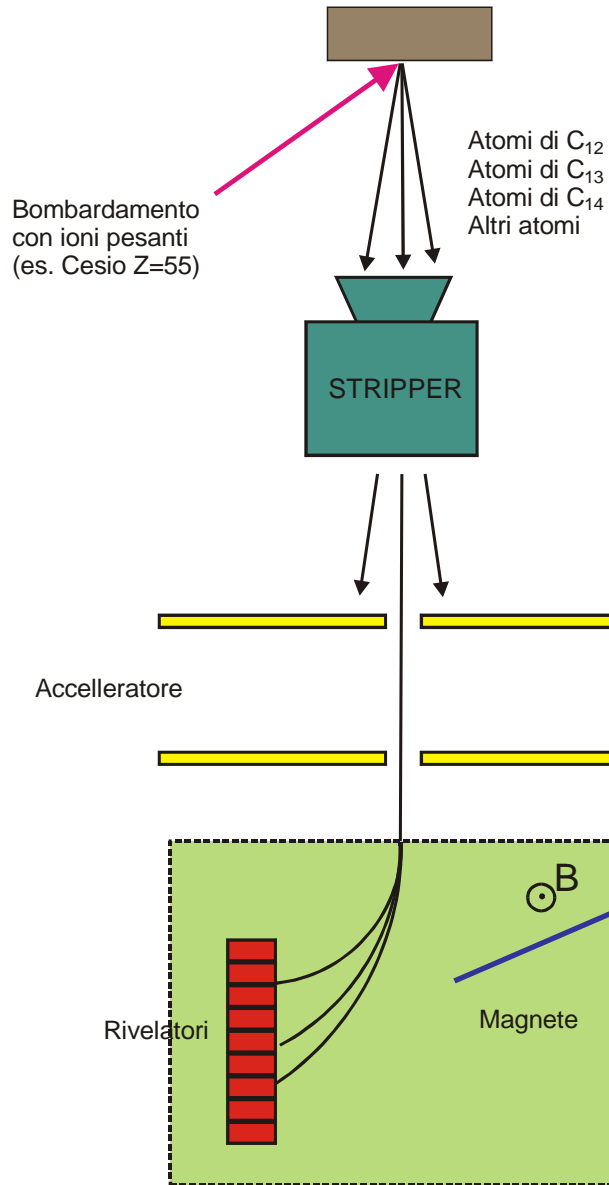


Immagine di retrodiffusi

Immagine di luminescenza



# Spettroscopia di massa



$$\frac{1}{2}mv^2 = qV$$

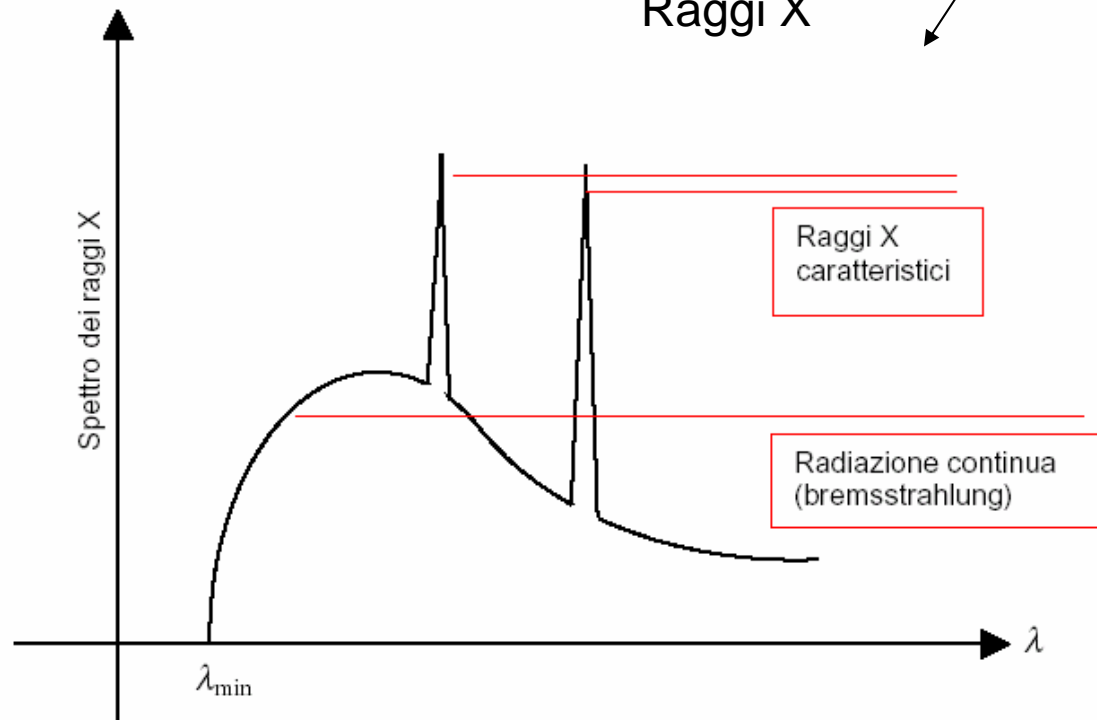
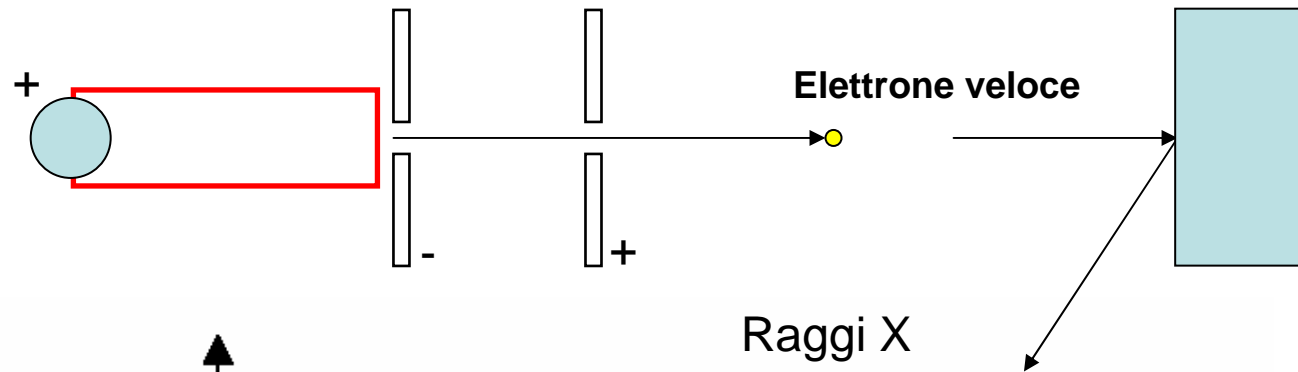
$$v = \sqrt{\frac{2qV}{m}}$$

$$F = qvB$$

$$F = m \frac{v^2}{R}$$

$$R = \frac{\sqrt{2V}}{B} \sqrt{\frac{m}{q}}$$

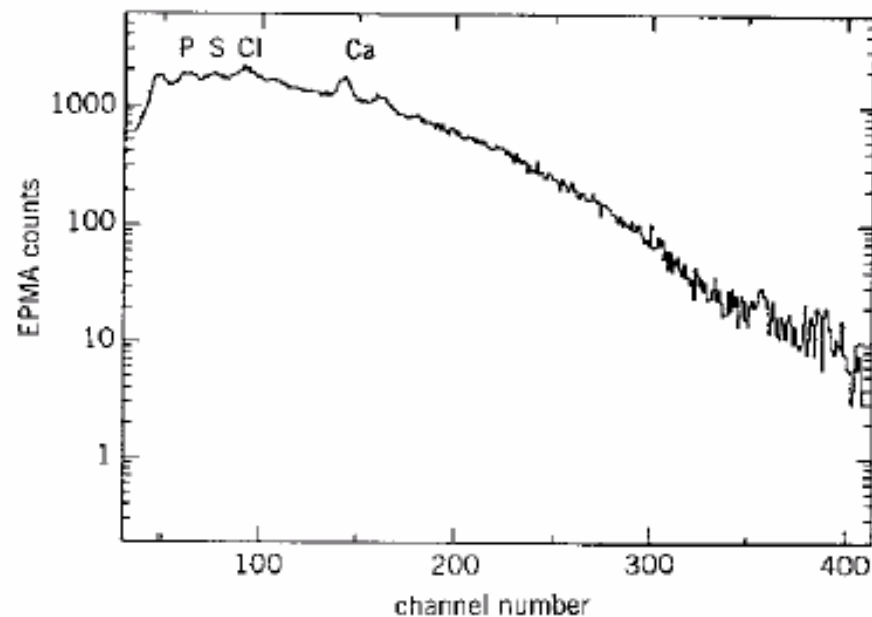
# Raggi X



$$\Delta E_{\text{BREMSSTRAHLUNG}} \propto \left( \frac{1}{\text{massa}} \right)^2$$

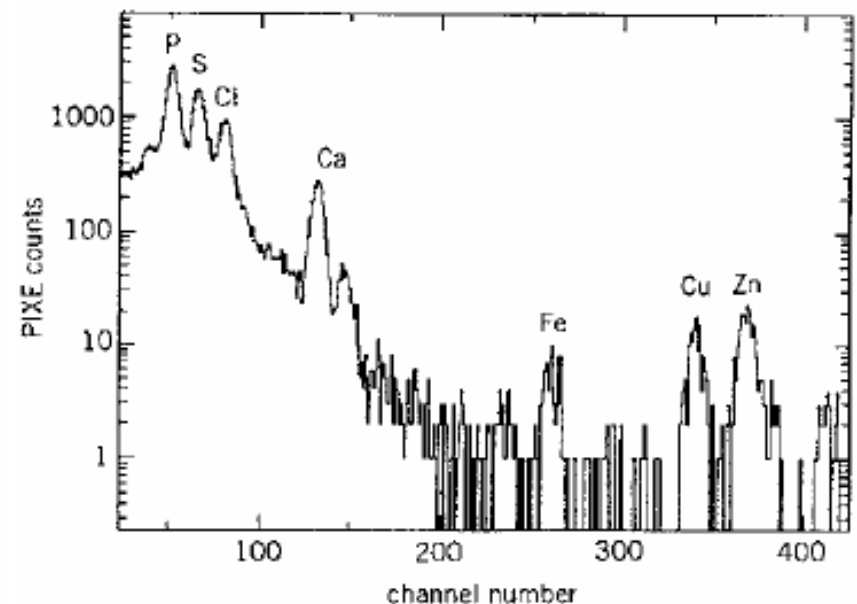
- Elettroni

(EPMA: Electron Probe Micro Analysis)

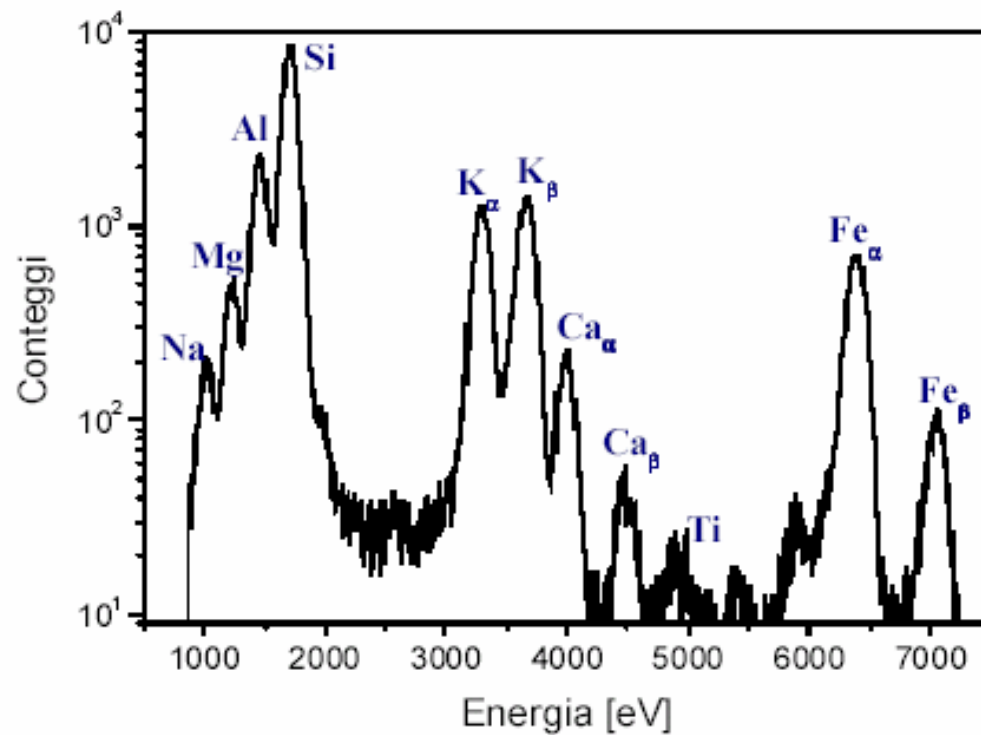


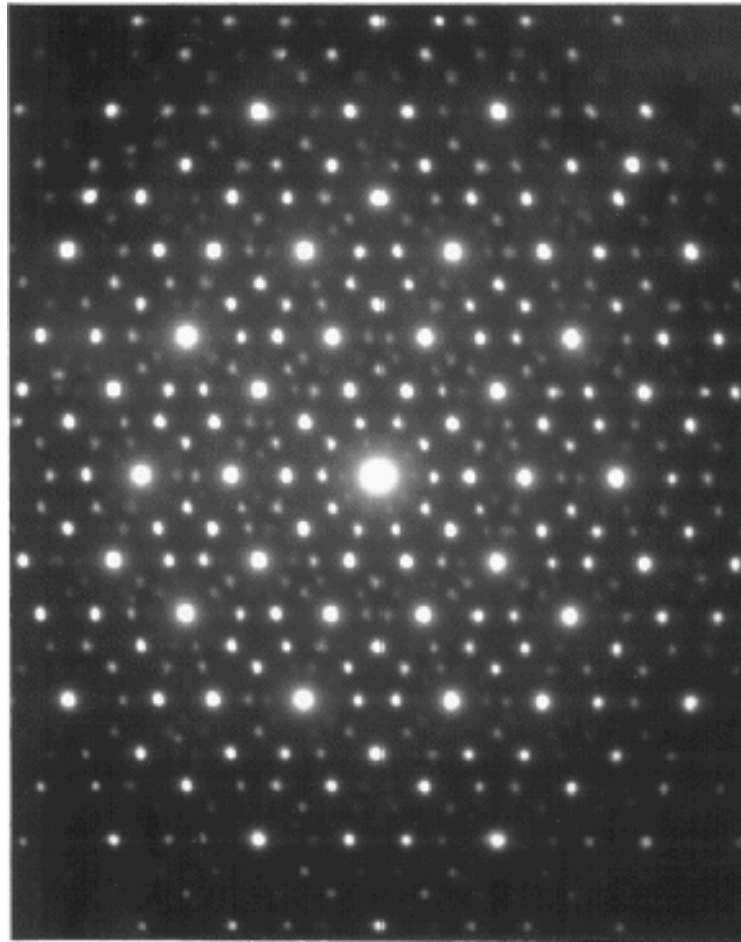
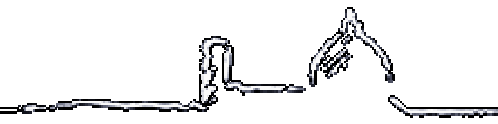
- Protoni

(PIXE: Particle Induced X- Emission)



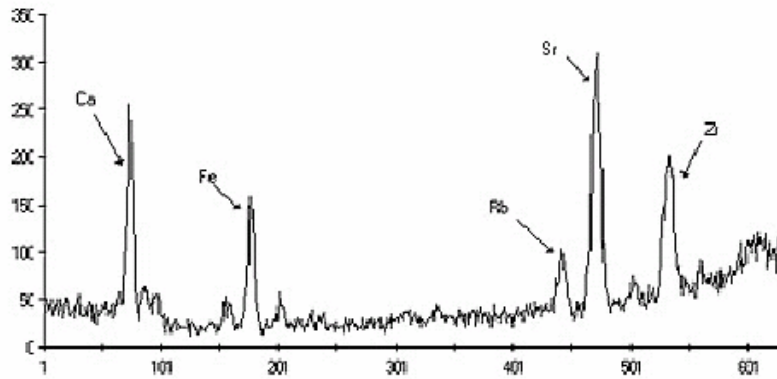
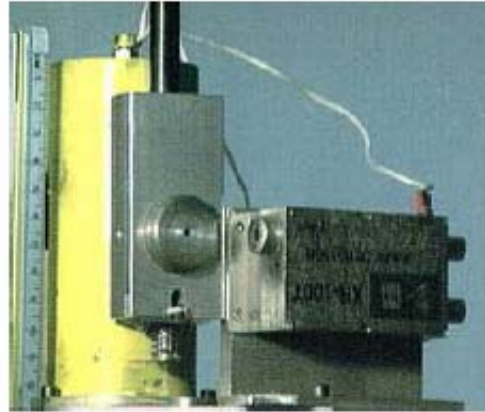
(XRF: X ray Fluorescence)

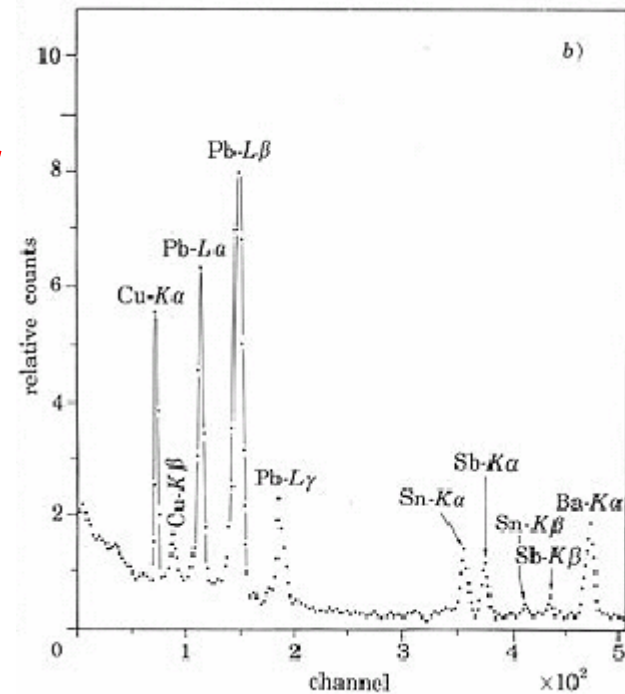
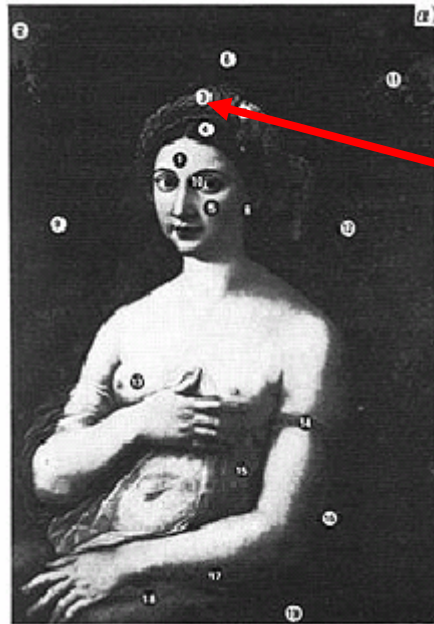






# XRF





La Fornarina (Raffaello), Galleria Nazionale di Palazzo Barberini - Roma



XRF



ioni



protoni