Los Rayos X: Algo más que imágenes

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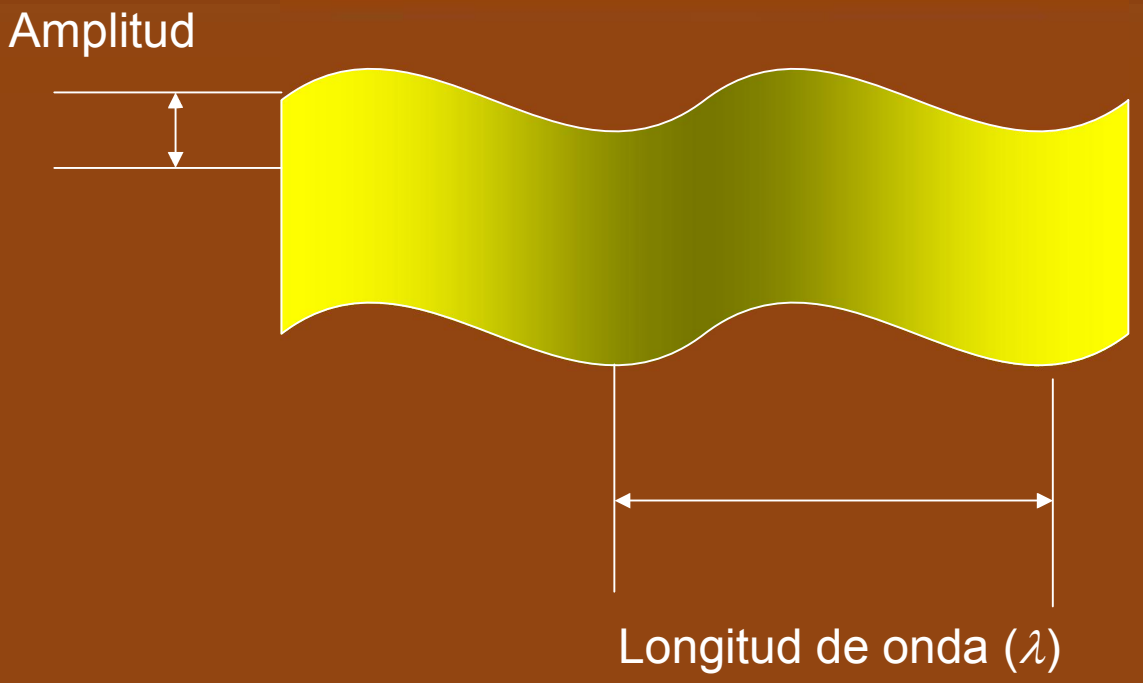
Contenido

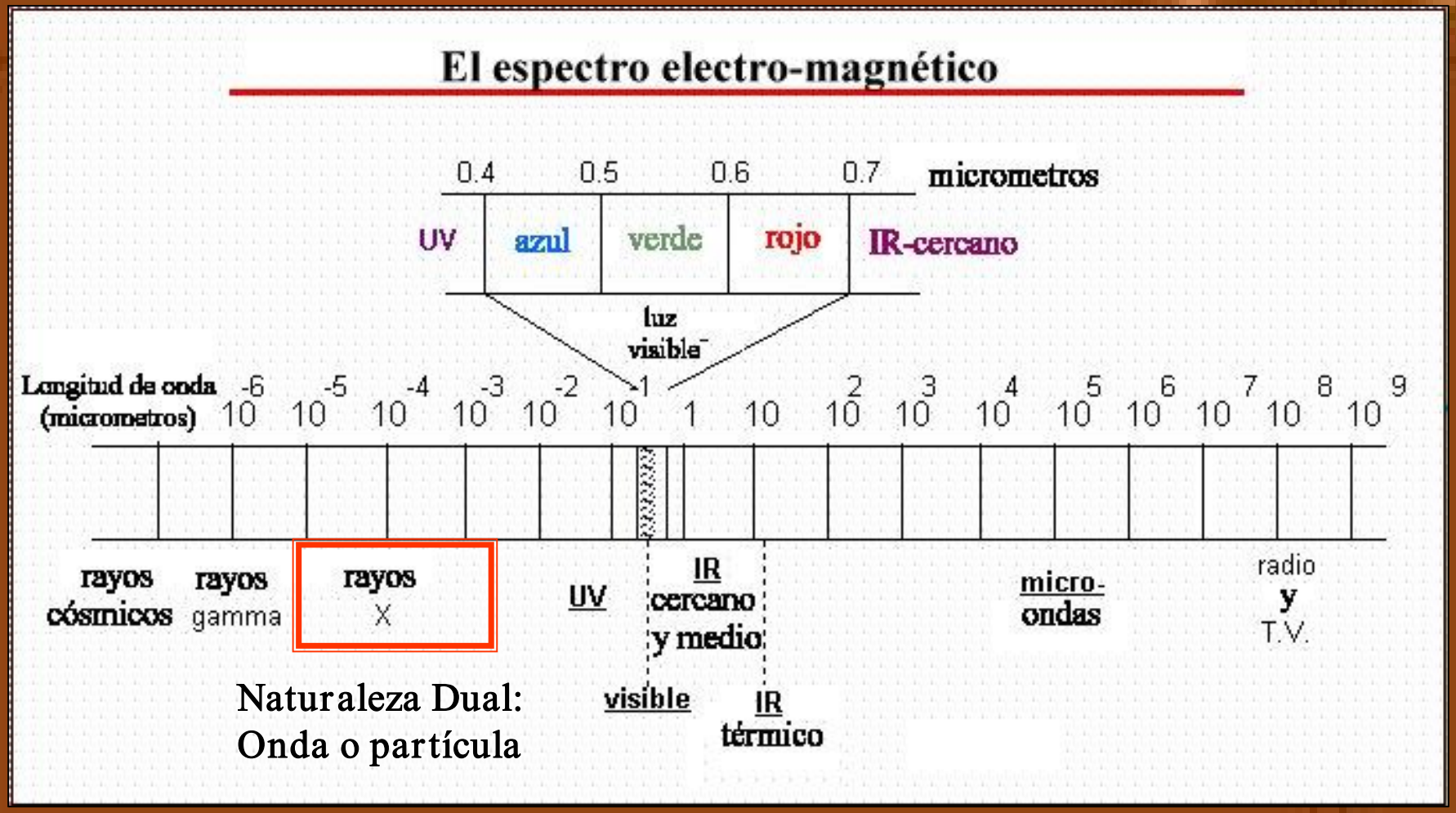
- ¿Qué son los rayos X?
- ¿Cómo se producen los rayos X?
- ¿Cómo se aplican los rayos X en la investigación científica?

Características de una onda



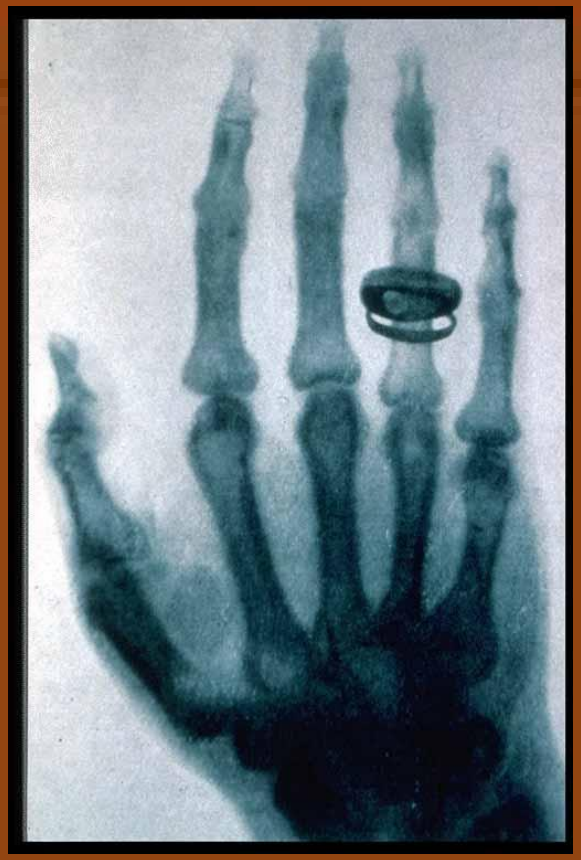
Frecuencia *f*
Velocidad de propagación *c*

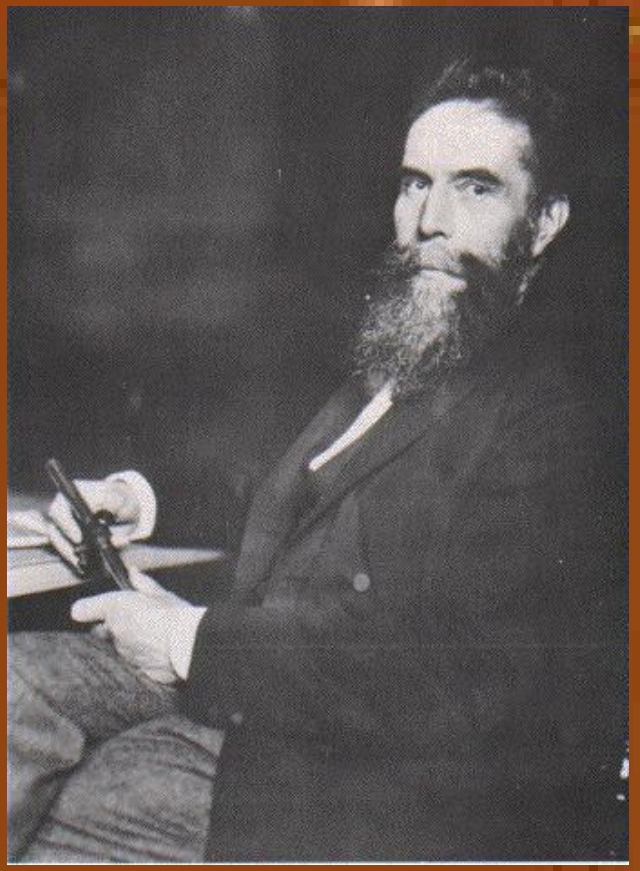
¿Qué son los rayos X?



Naturaleza Dual:
Onda o partícula

Descubridor: Wilhelm Röntgen





¿Cómo se producen los rayos X?

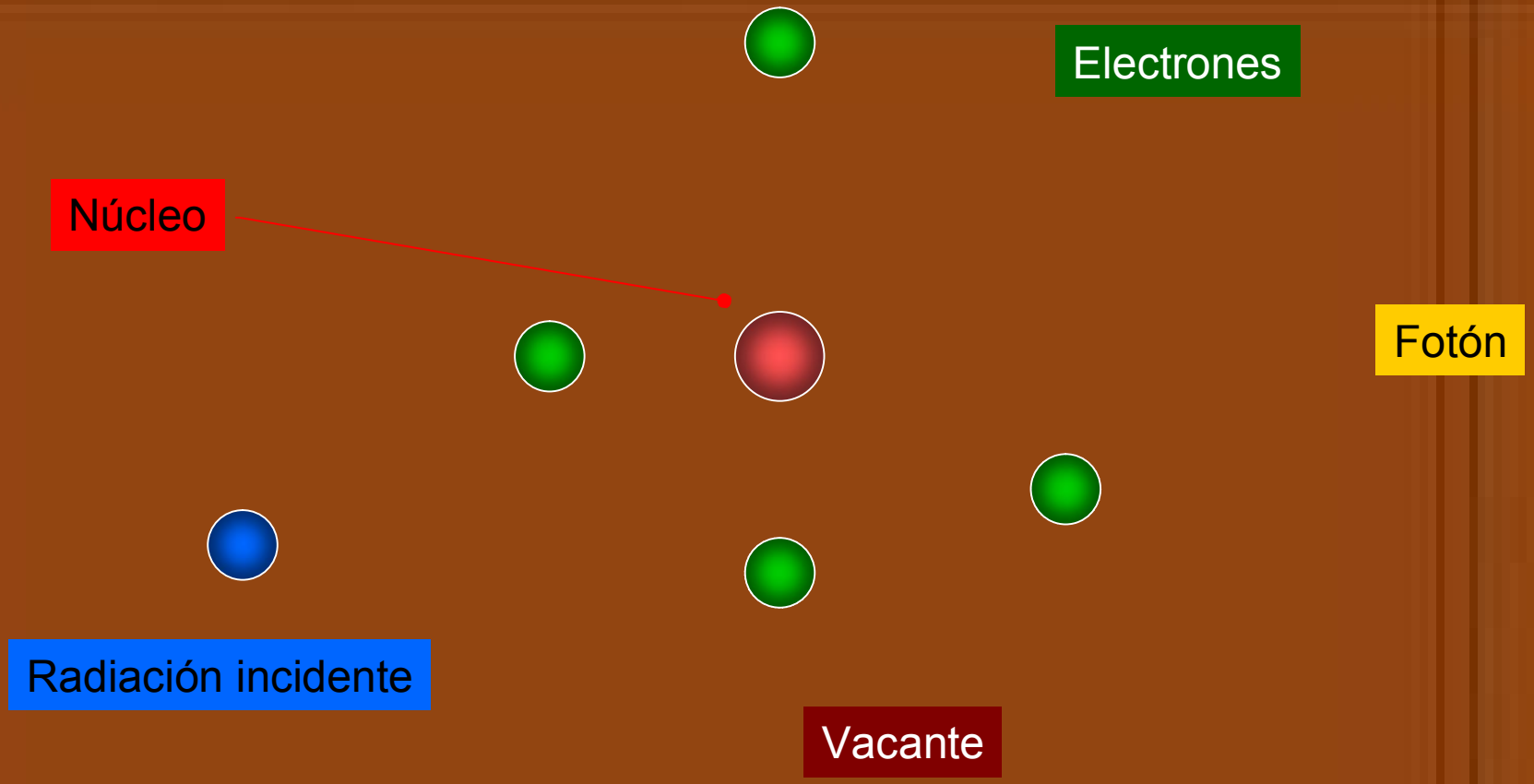
- Aceleración de partículas cargadas
- Emisión de Rayos X característicos en un átomo

Carga eléctrica en una trayectoria curva (*Brehmsstrahlung)*

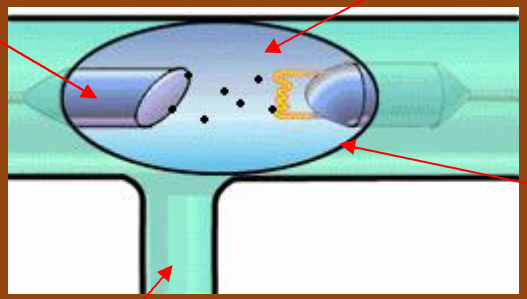
Partícula cargada

Fotón de rayos X

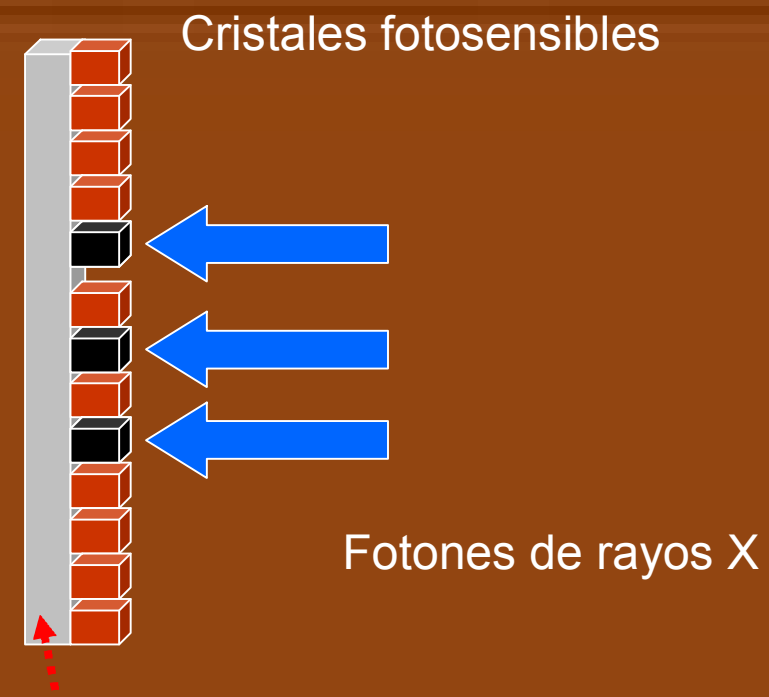
Emisión de rayos X característicos



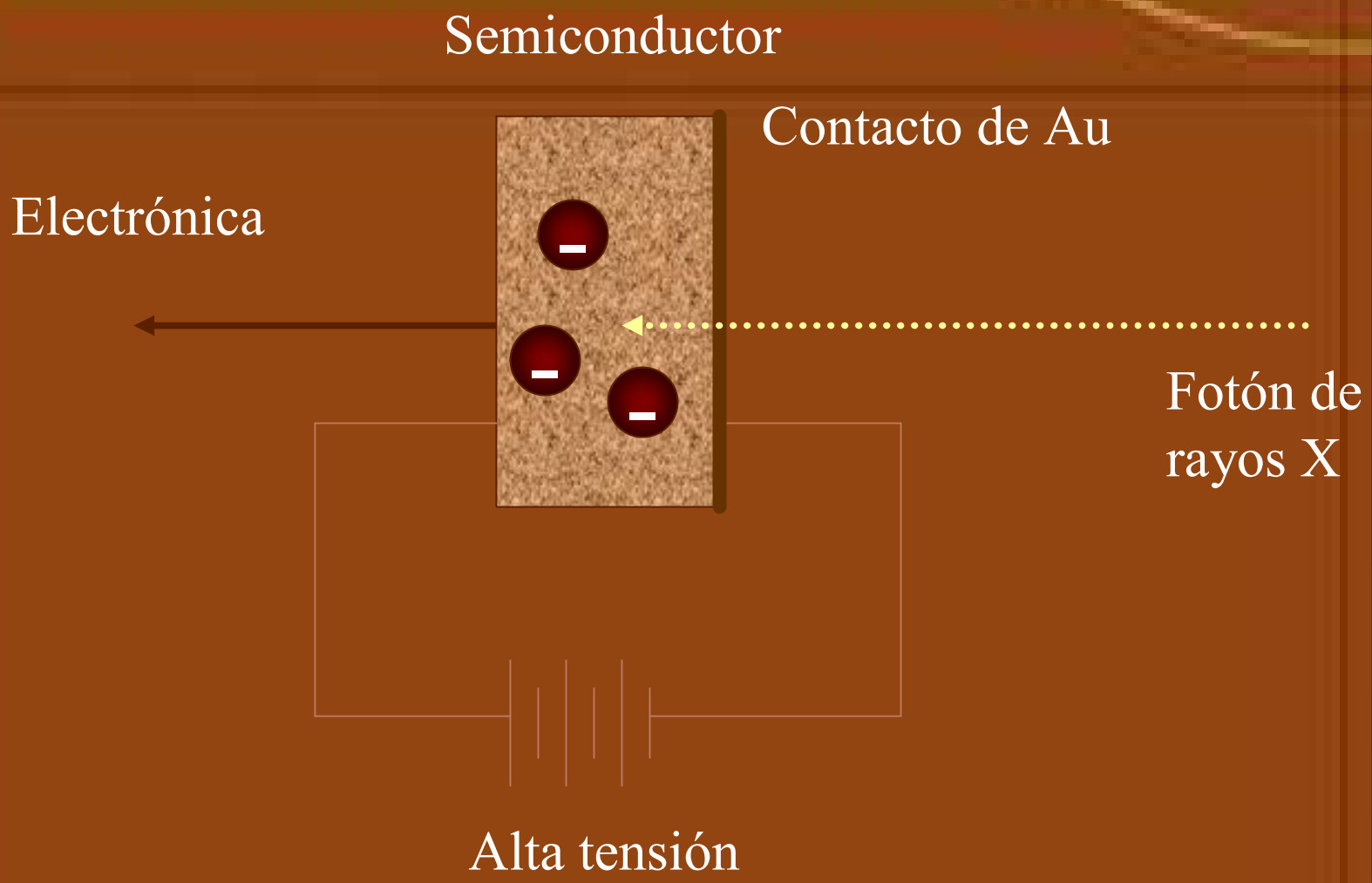
Producción en un tubo de rayos X



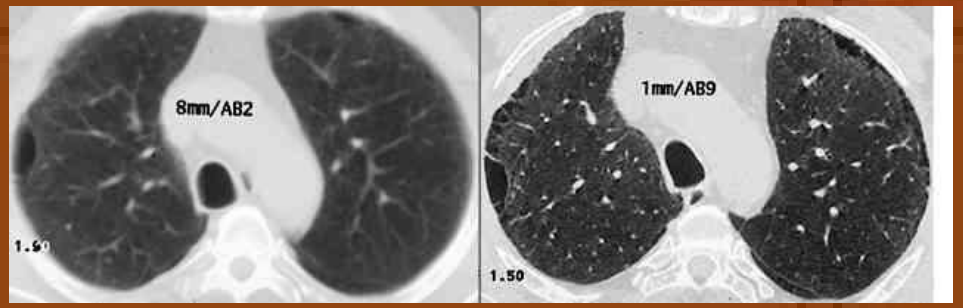
Detección de rayos X: película fotográfica



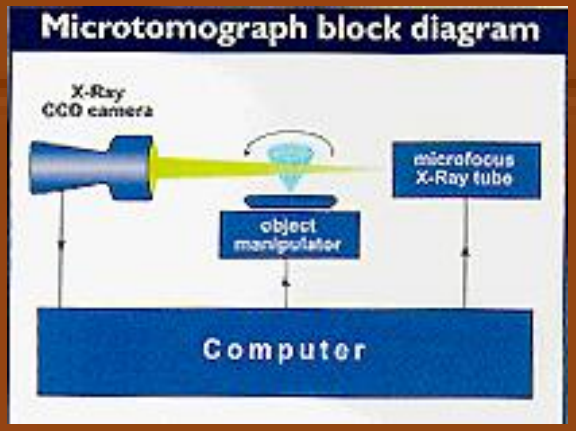
Detección de los rayos X

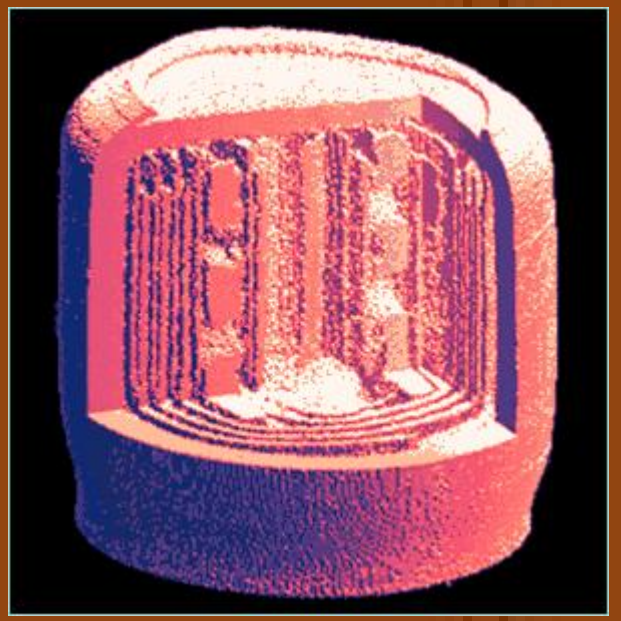


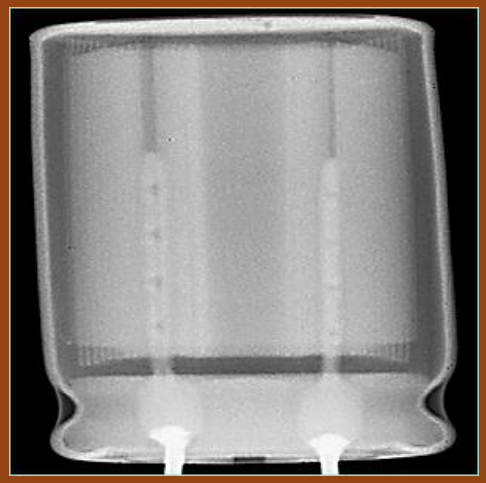
Tomografía de Rayos X

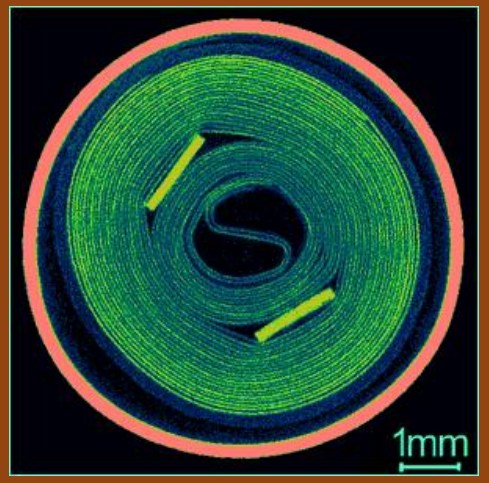


Microtomografía

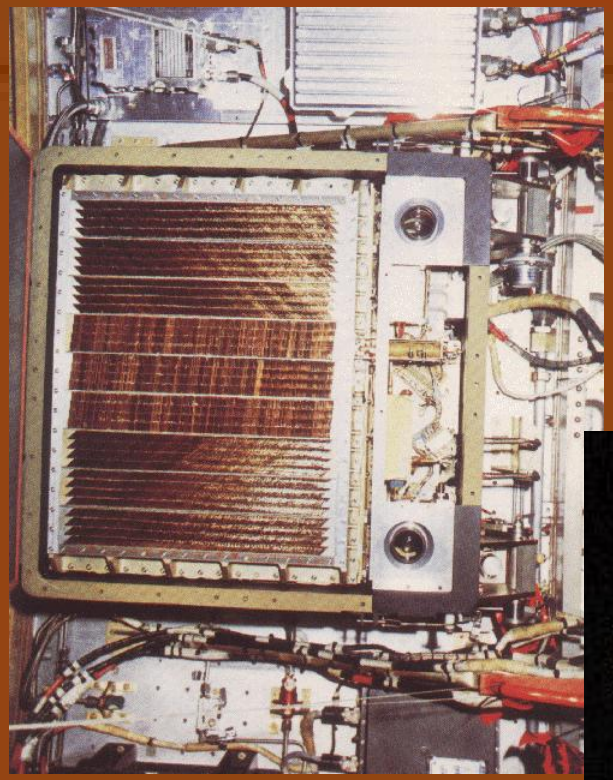


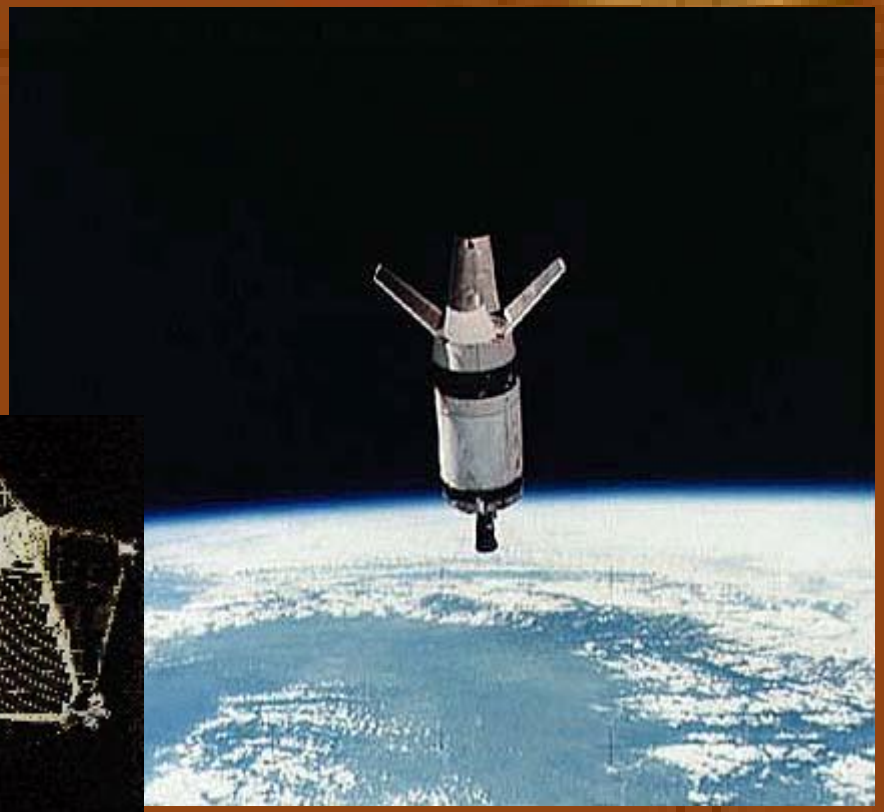




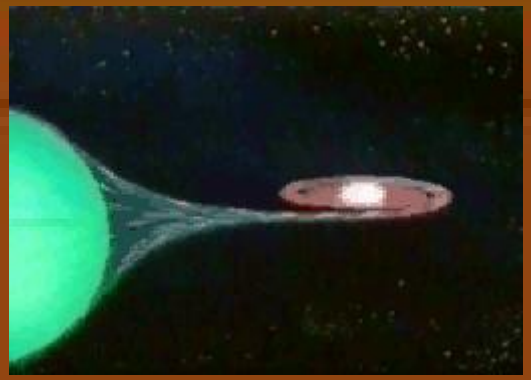


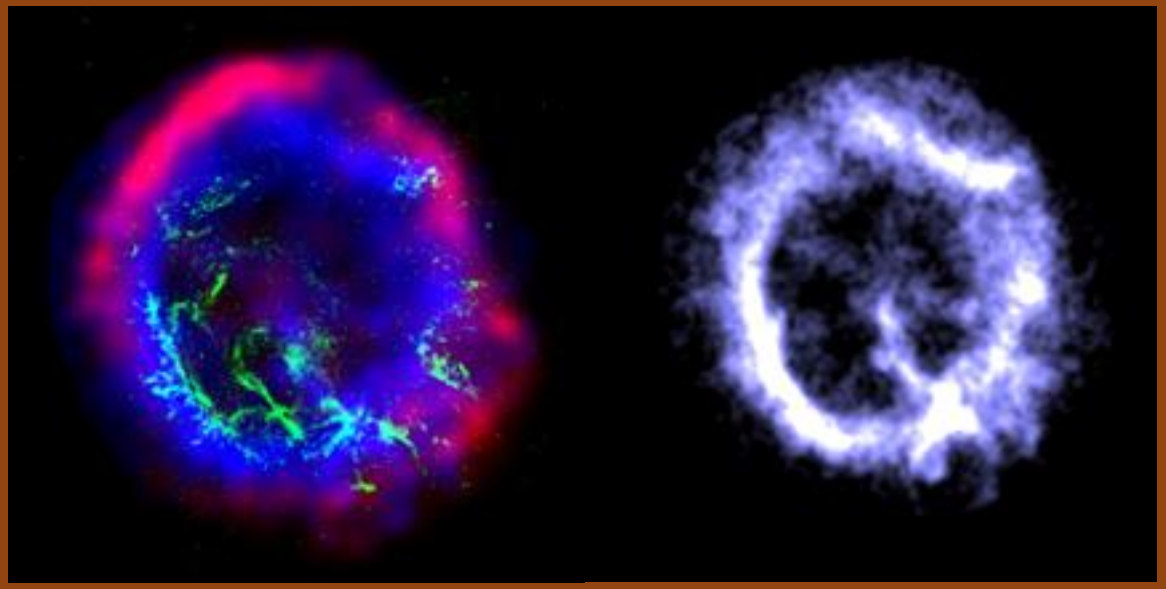
Detectores de rayos X en el espacio



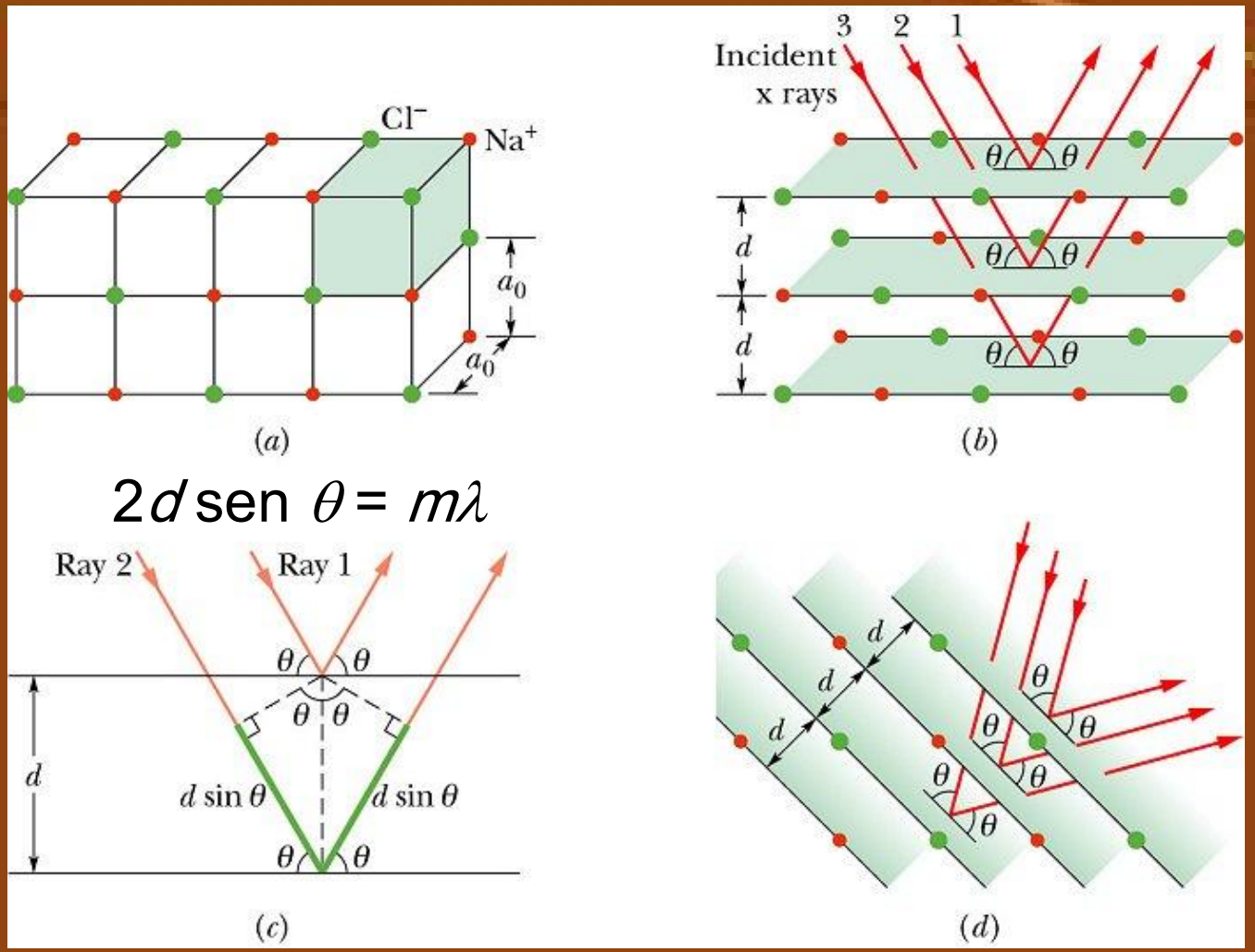


Rayos X en astronomía



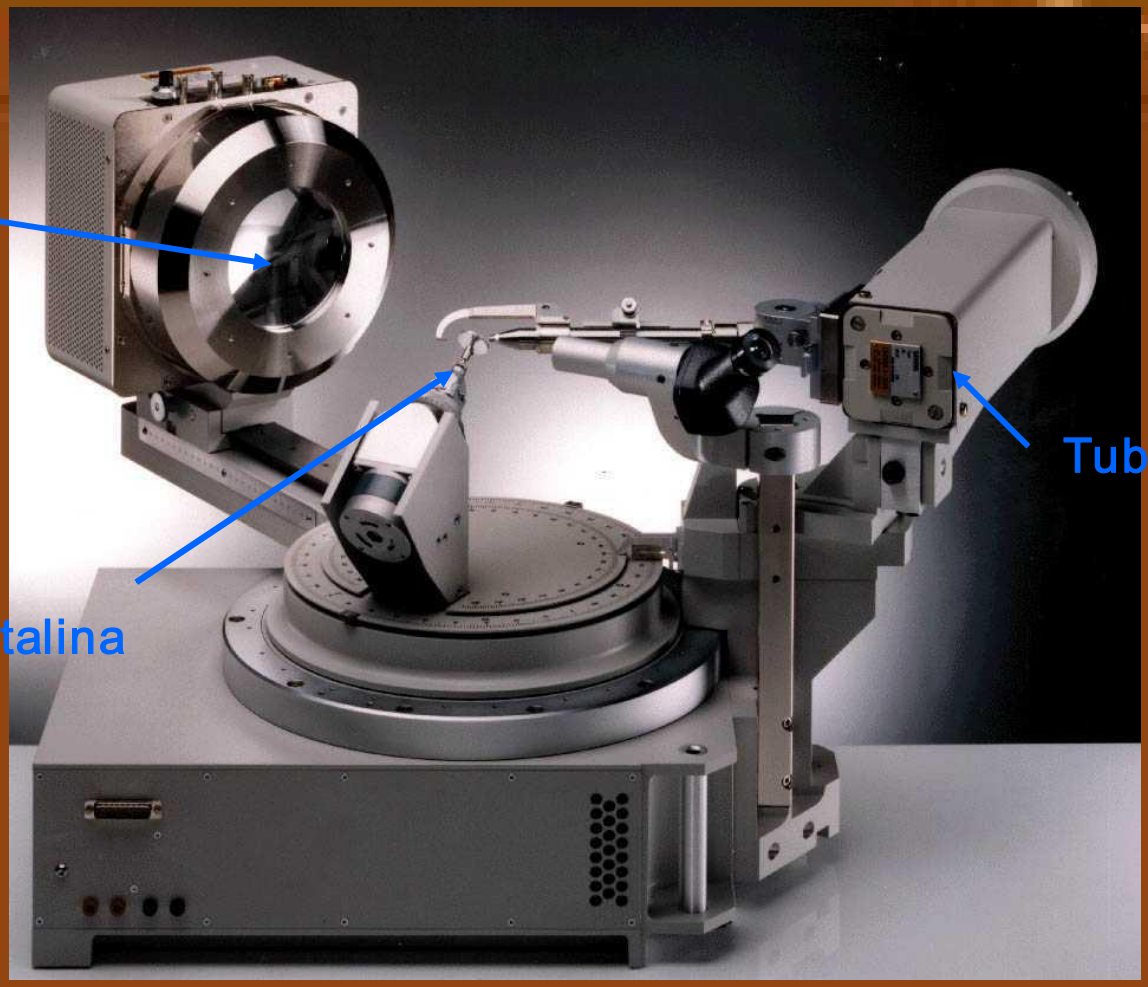


Difracción de rayos X

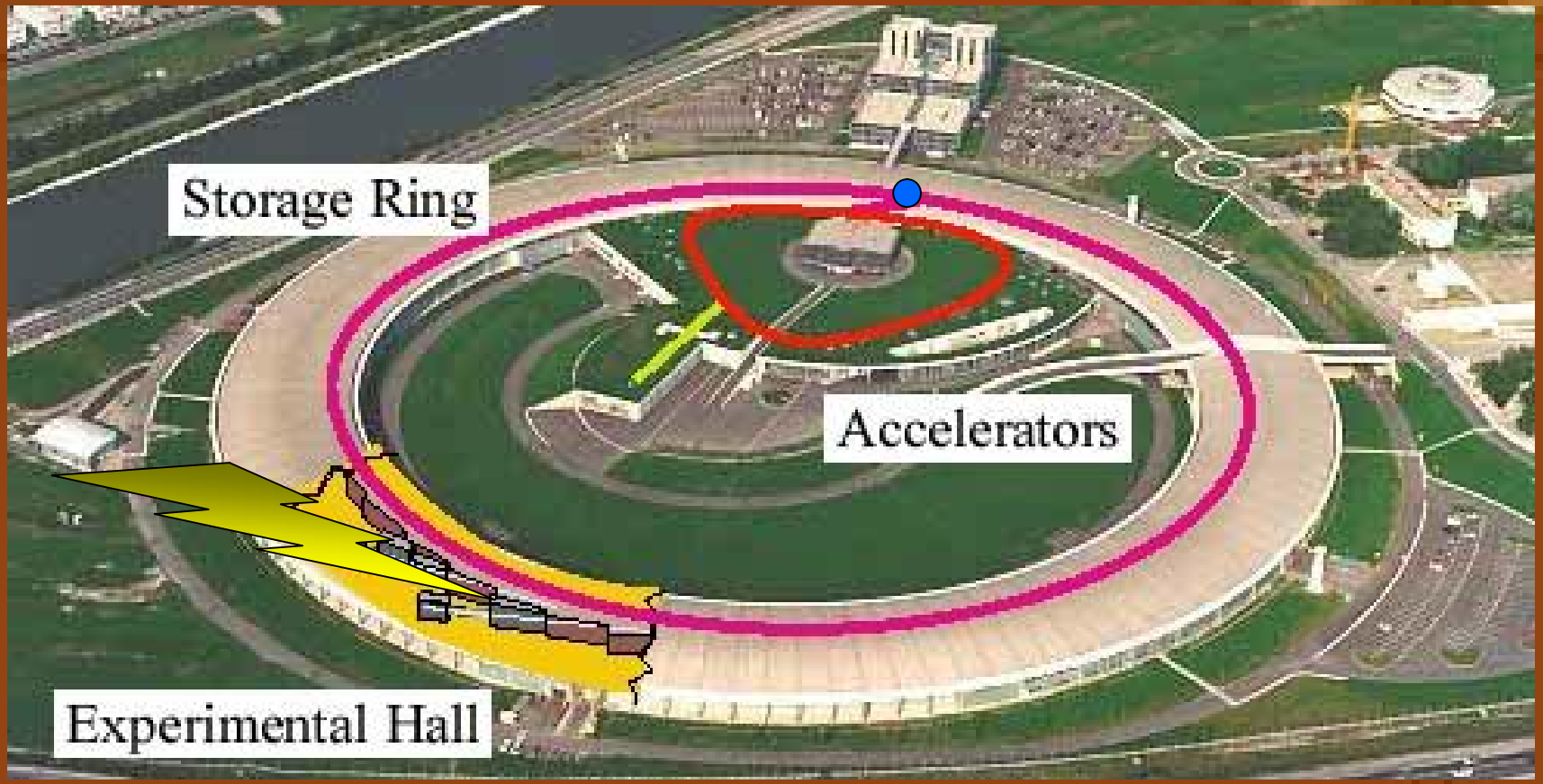


$2d \operatorname{sen} \theta = m\lambda$

Difractómetro de rayos X

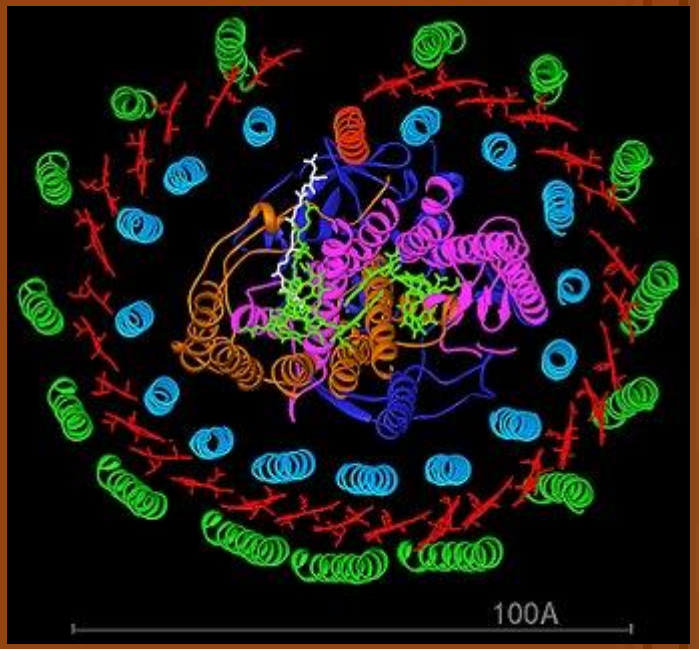


Sincrotrón

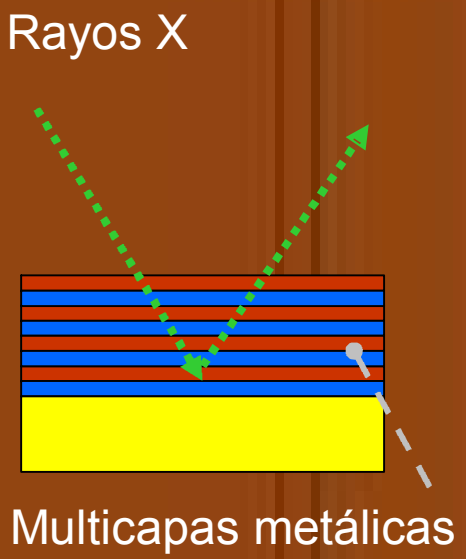


Laboratorio Europeo de Luz Sincrotrón

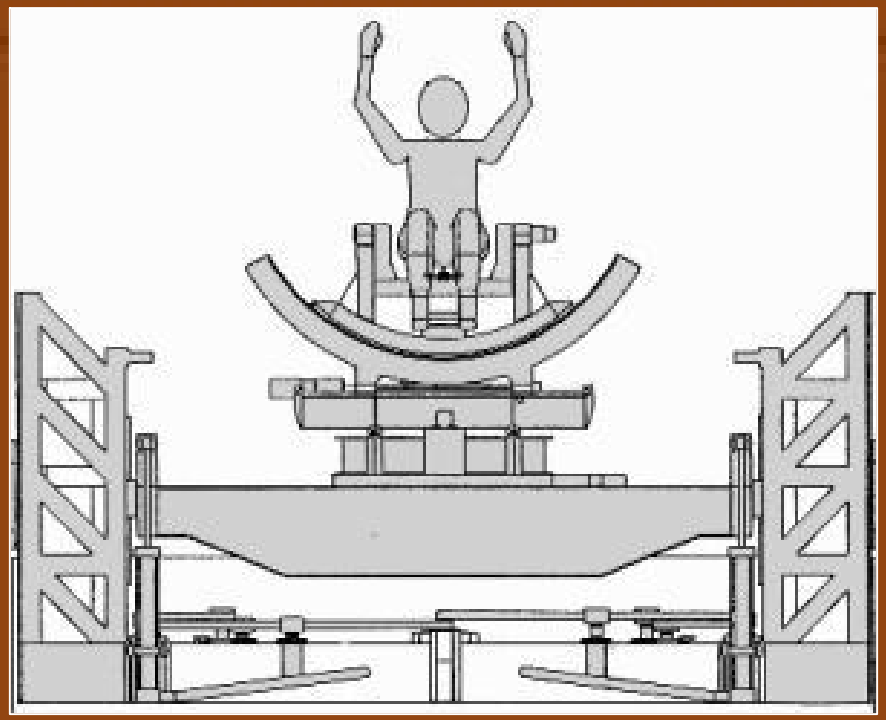
Reconstrucción de moléculas de proteínas

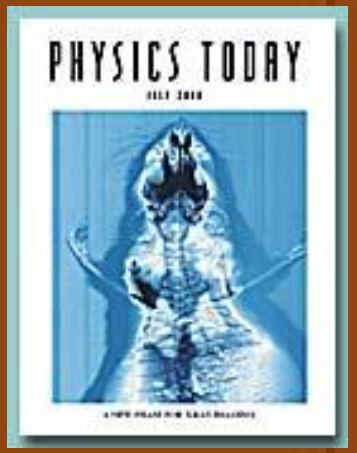


Espejos de rayos X



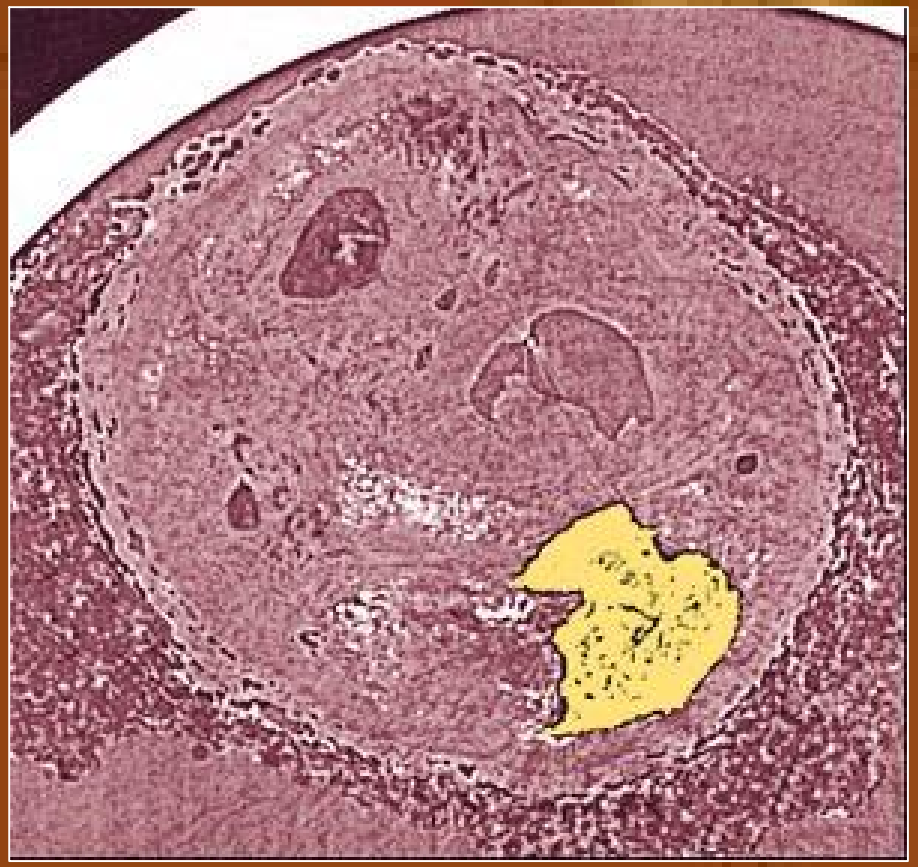
Aplicaciones en Medicina



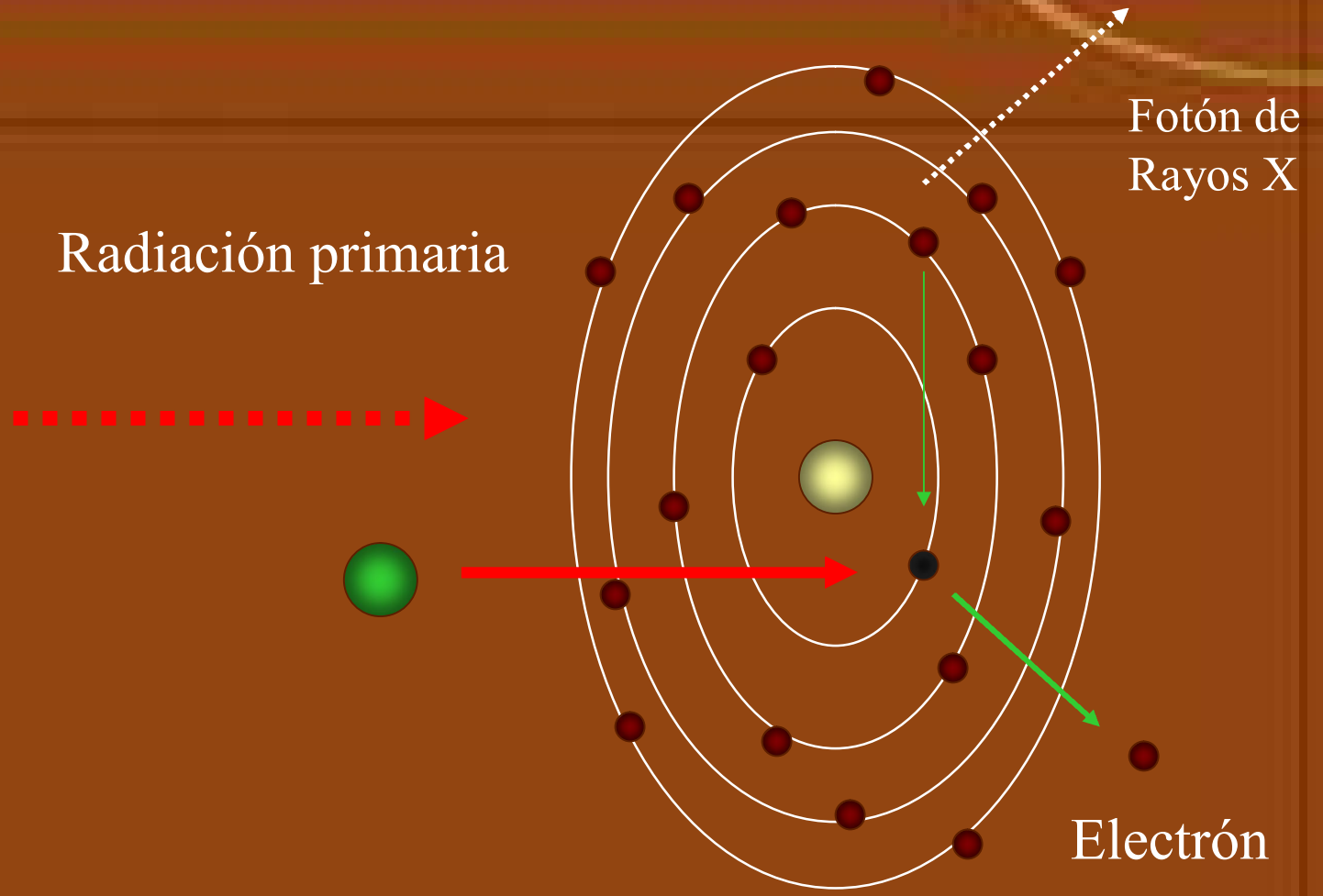


Aplicaciones en Medicina

Imagen de arteria con esclerosis



Espectroscopías de rayos X



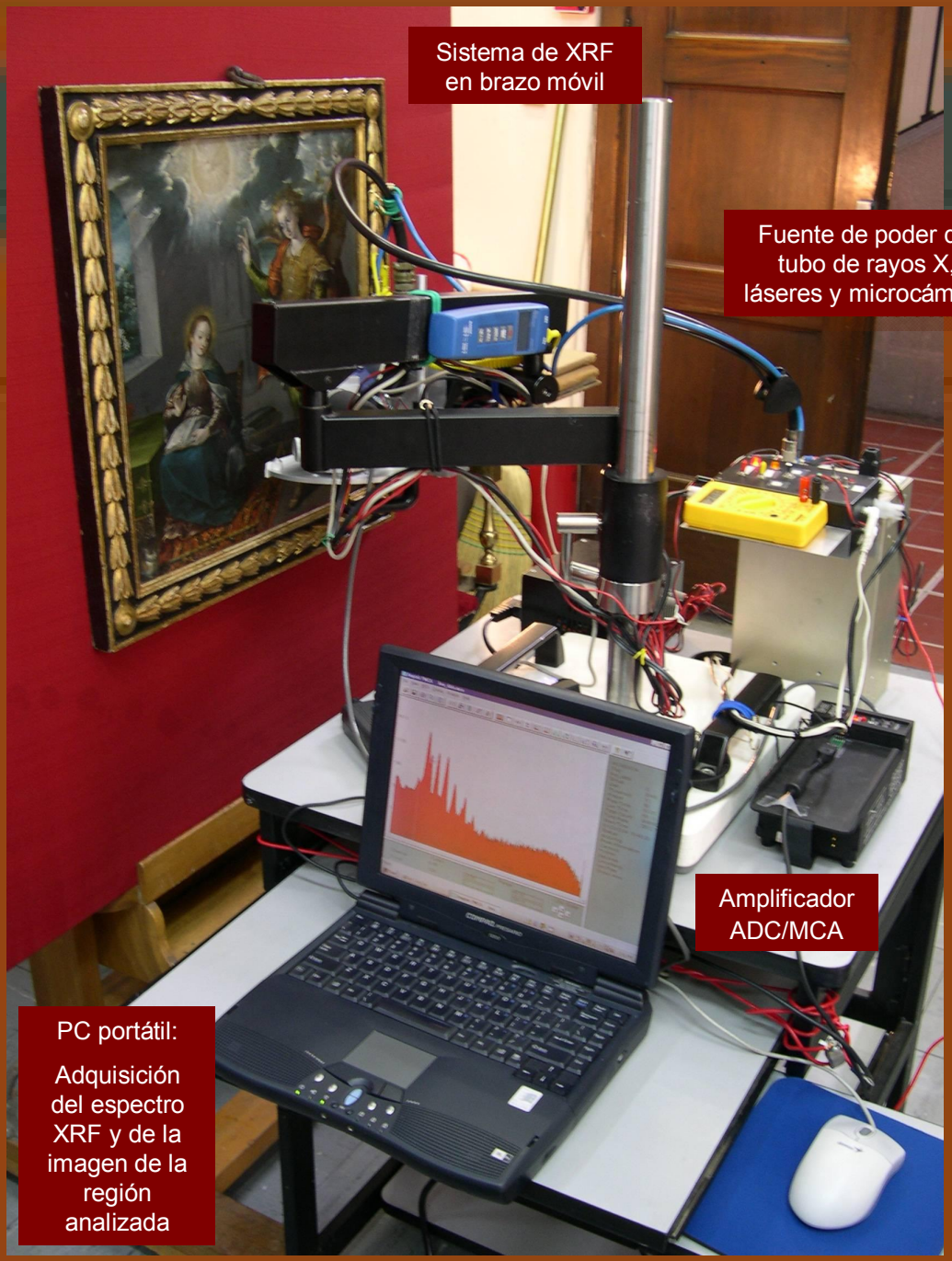
Investigación interdisciplinaria

Radiación primaria

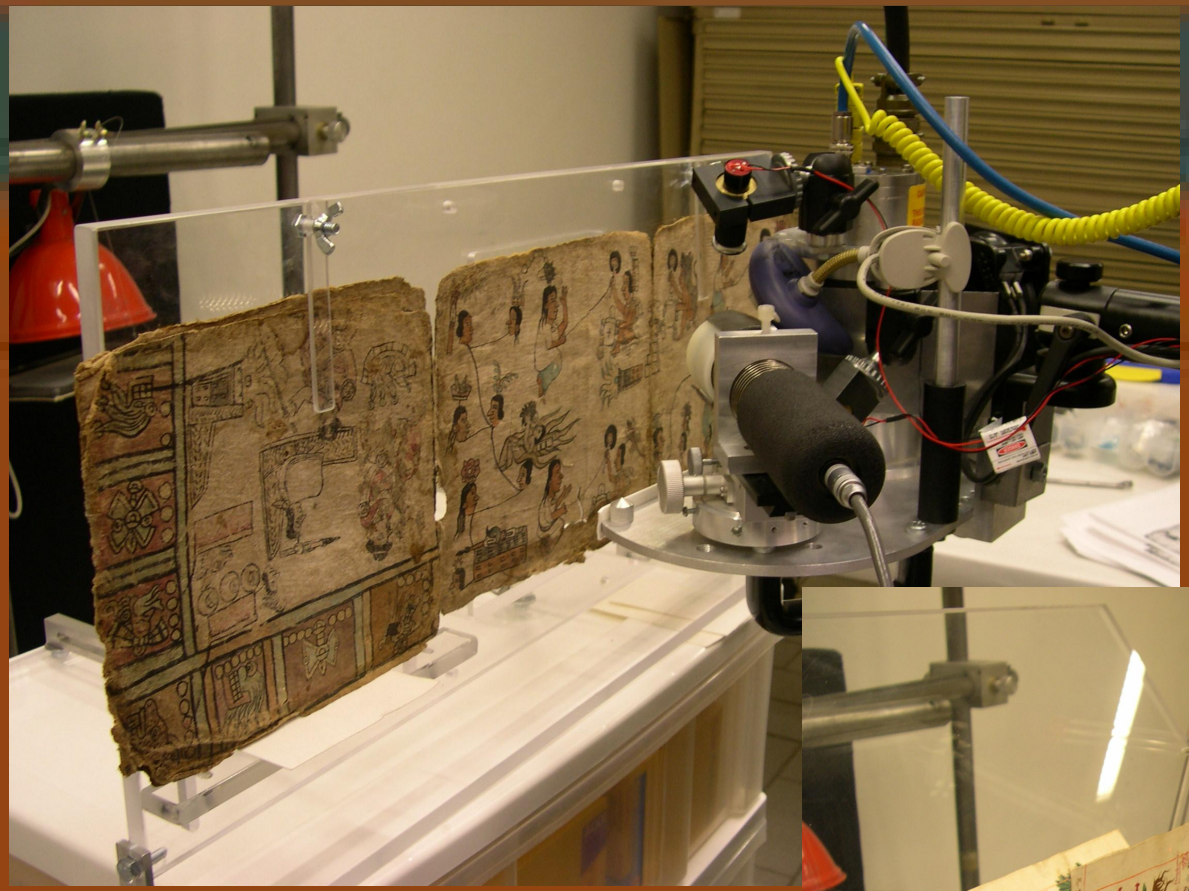
- Fotones de rayos X: Fluorescencia de Rayos X (XRF)
  - Tubo de rayos X
  - Fuente radiactiva
  - Sincrotrón
- Electrones: Electron Probe Microanalysis (EPMA)
- Iones: Particle Induced X-ray Emission (PIXE)
  - Protones
  - Helio
  - Pesados

XRF Comercial

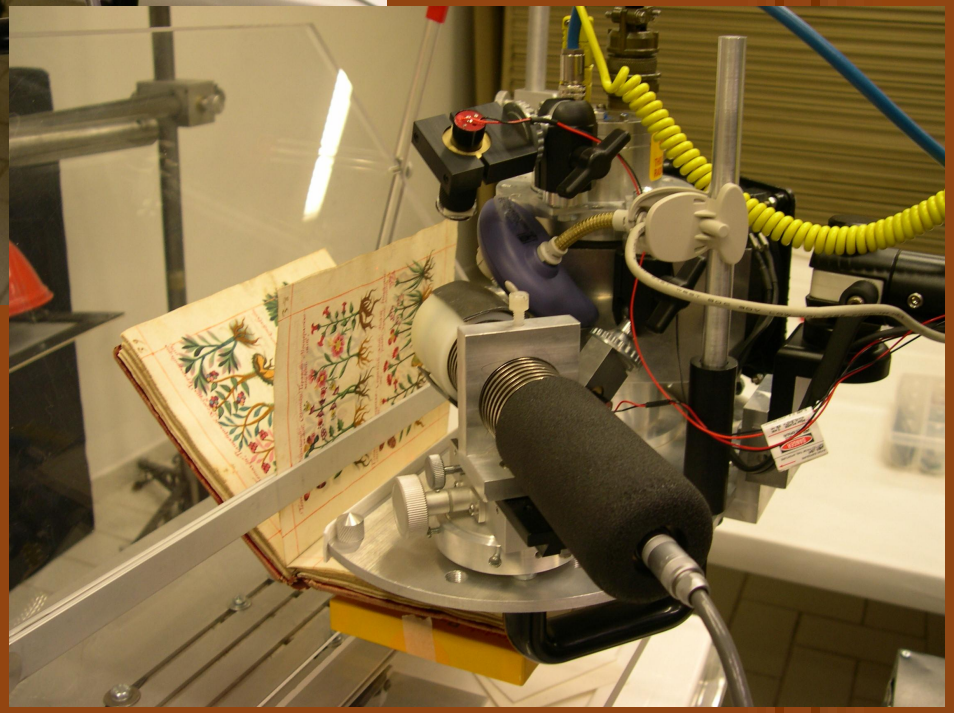
XRF portátil



Cortesía Dr. J.L. Ruvalcaba



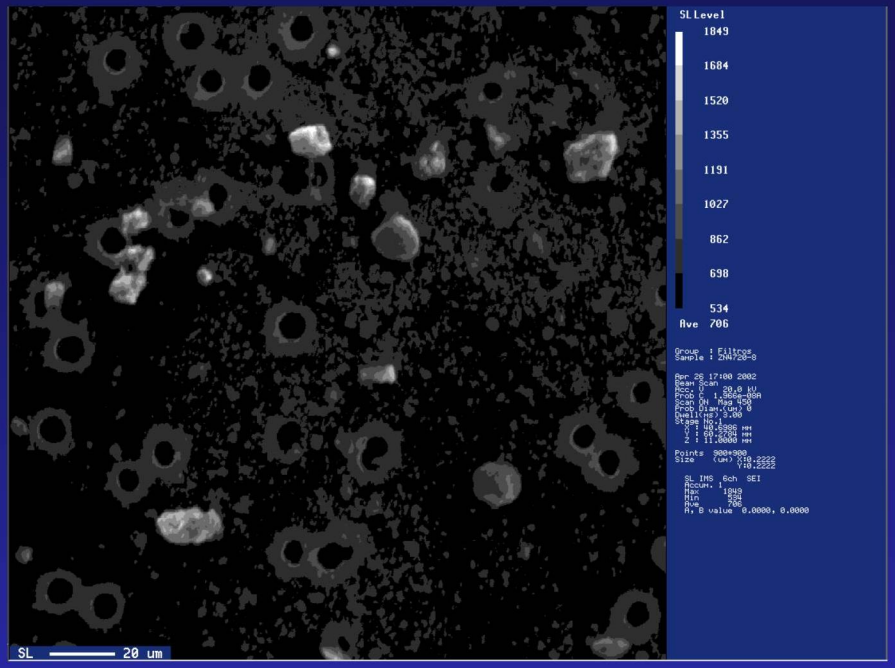
Códice Azoyú I



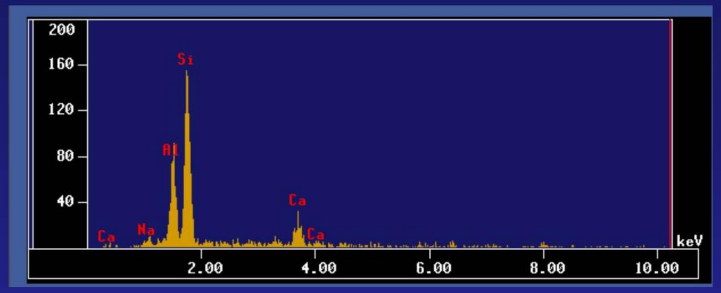
Códice
De la Cruz-
Badiano
s. XVI

Cortesía Dr. J.L. Ruvalcaba

EPMA Comercial

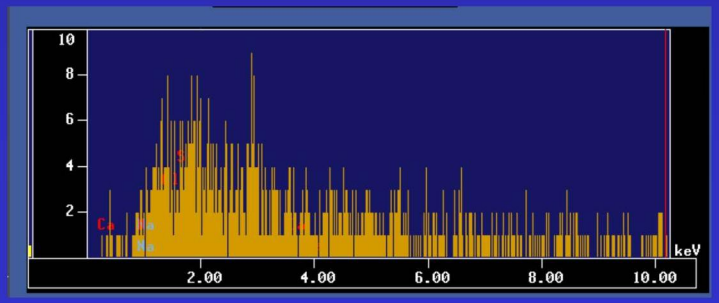


North

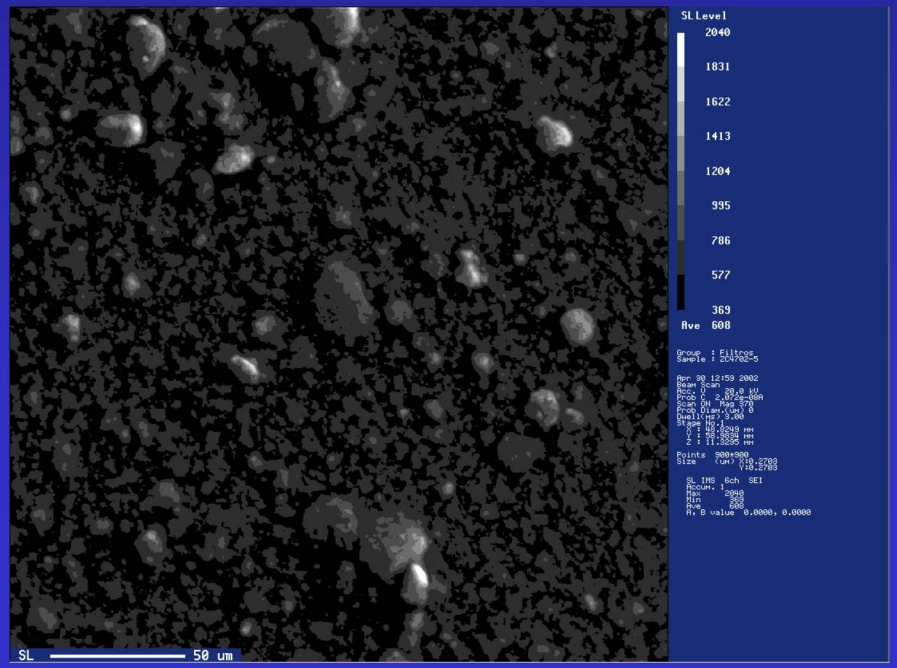


soil

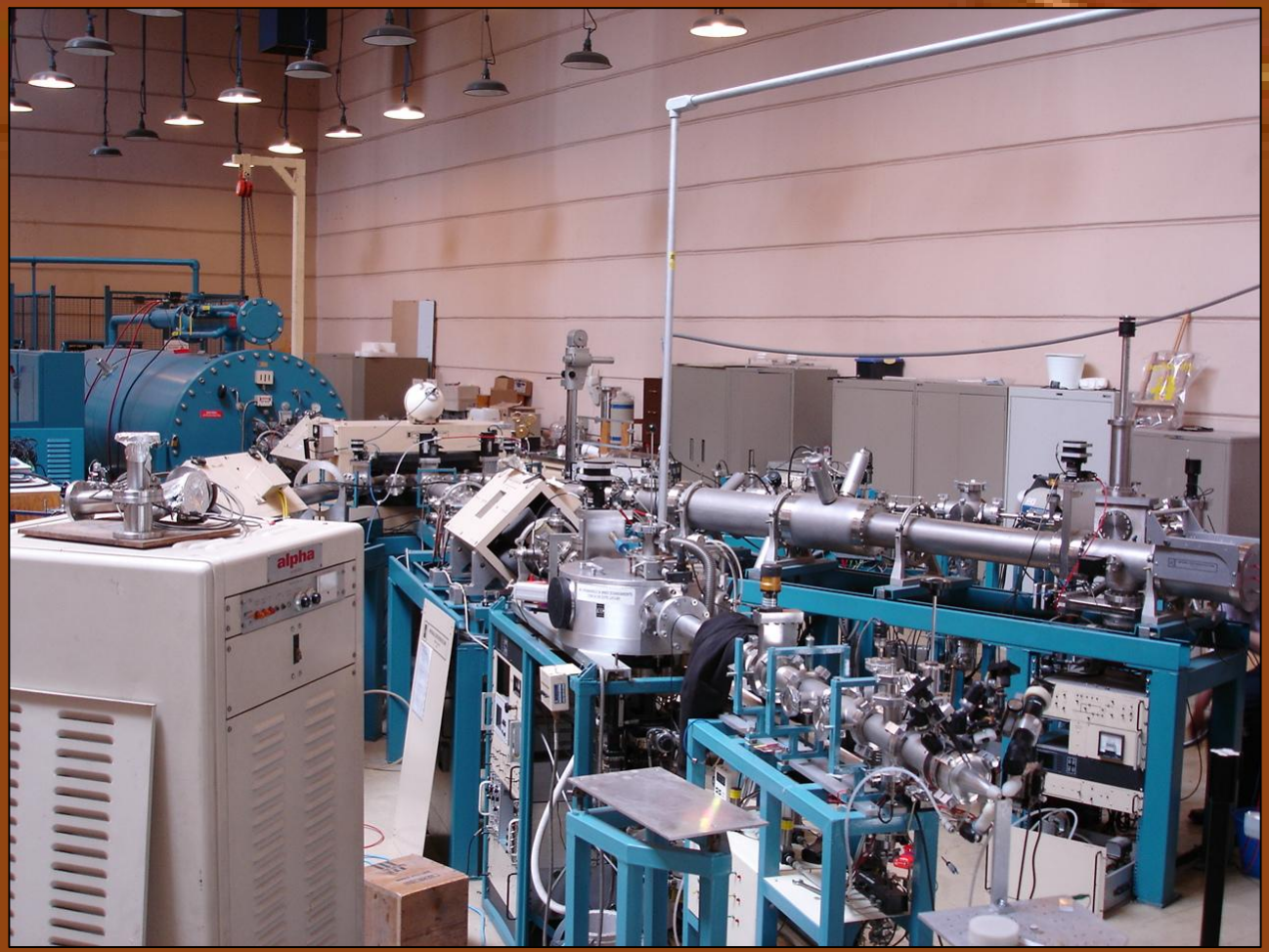
Center & South



organics



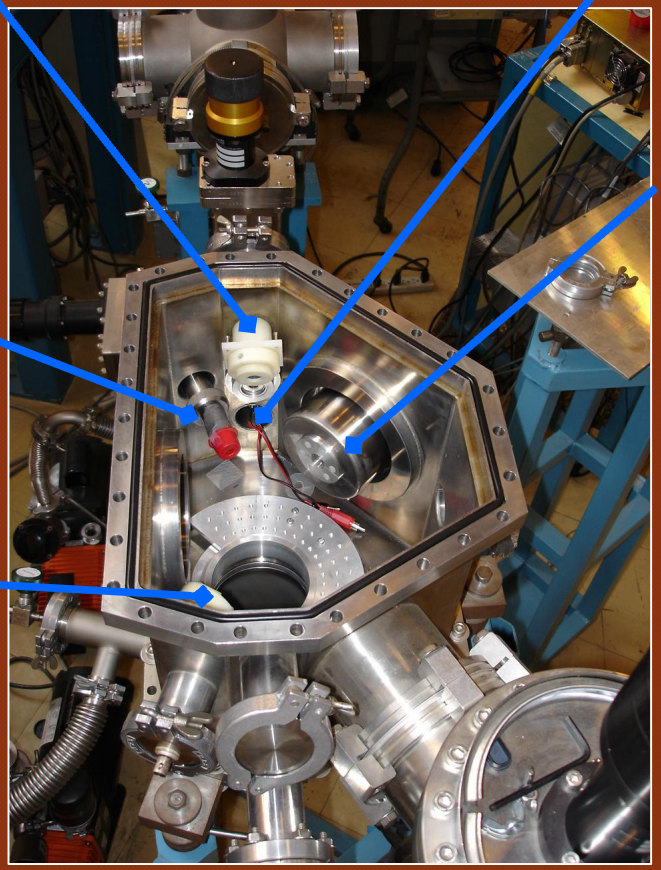
Acelerador Peletrón IFUNAM



Cámara de análisis

detector PIPS
(RBS)

Colimador
Ta

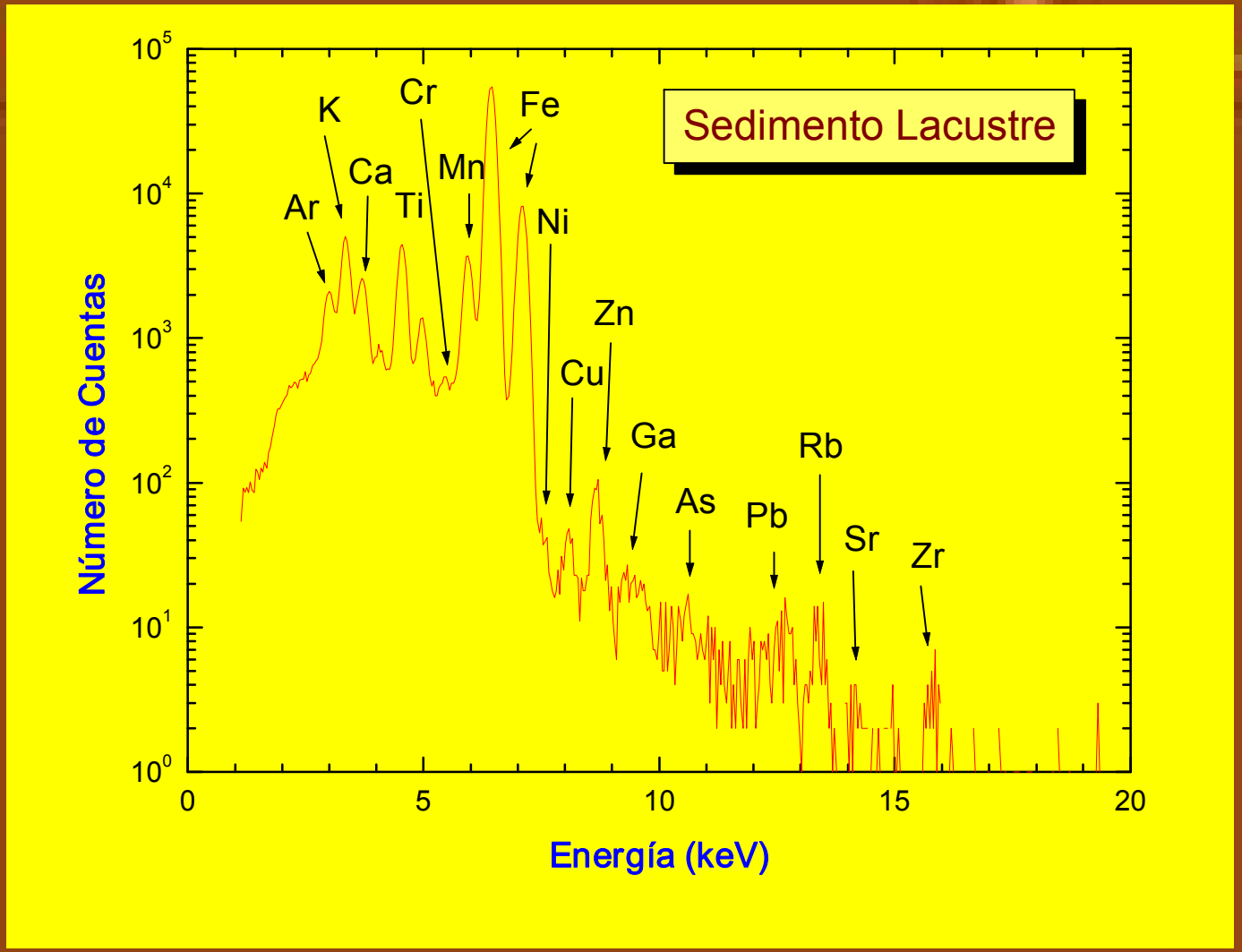


Ventana Mylar
Para detector
Ge (PIXE 2)

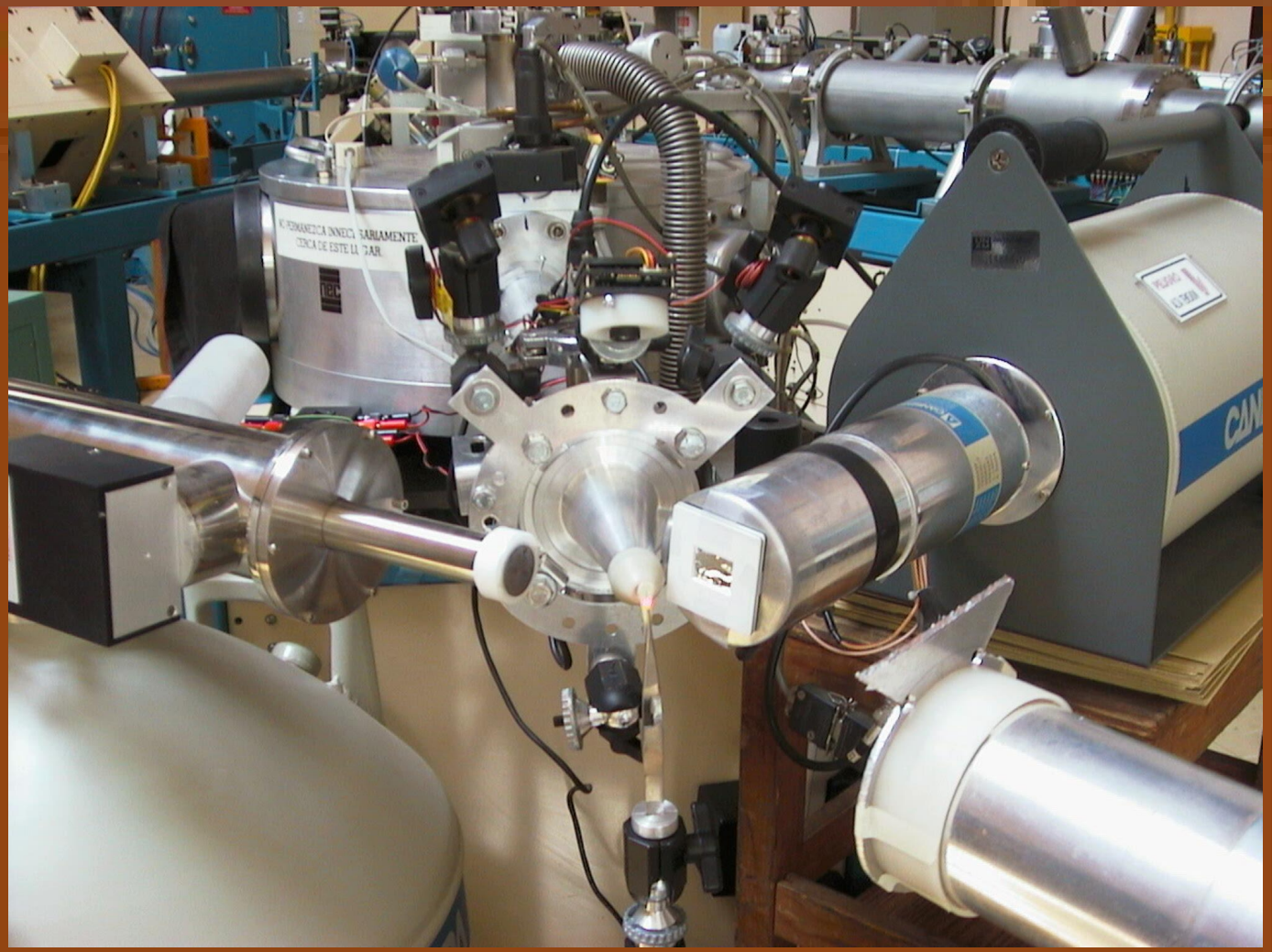
detector Si
(PIXE 1)

detector PIPS
(PESA)

Espectro de Rayos X



Haz externo PIXE-PIGE



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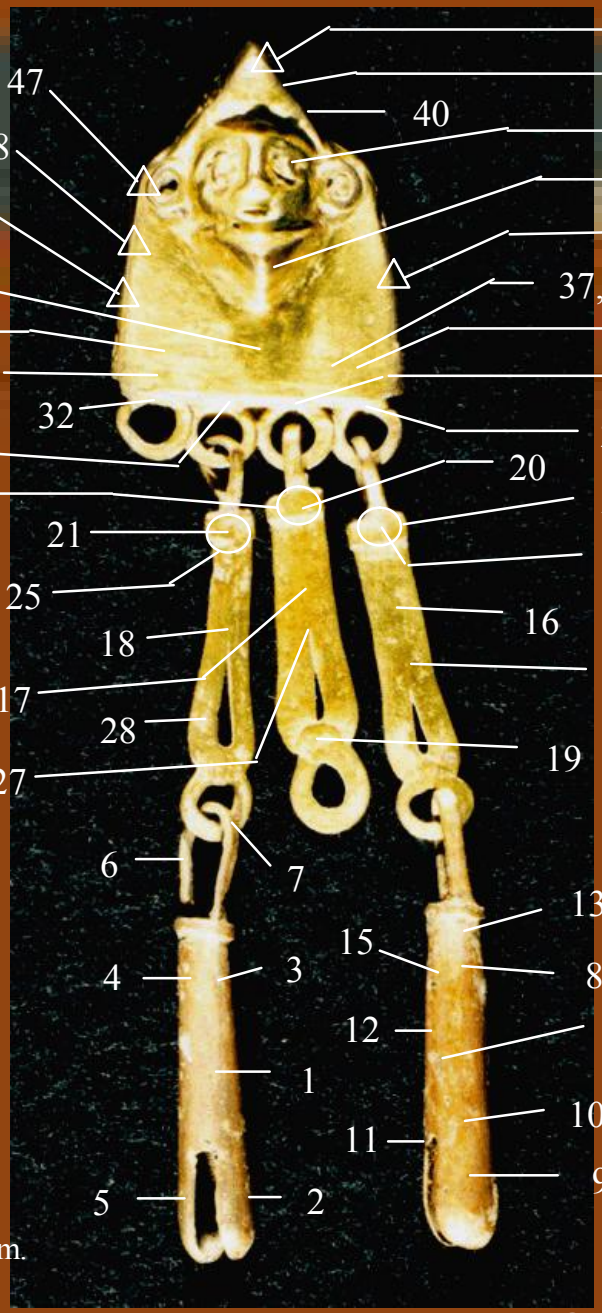
Pendiente de Oro
San Francisco Caxonos
Oaxaca, México.
Postclásico tardío
~1500 D.C.



Cuerpo principal Sección A

Plumas Sección B

Cascabeles Sección C

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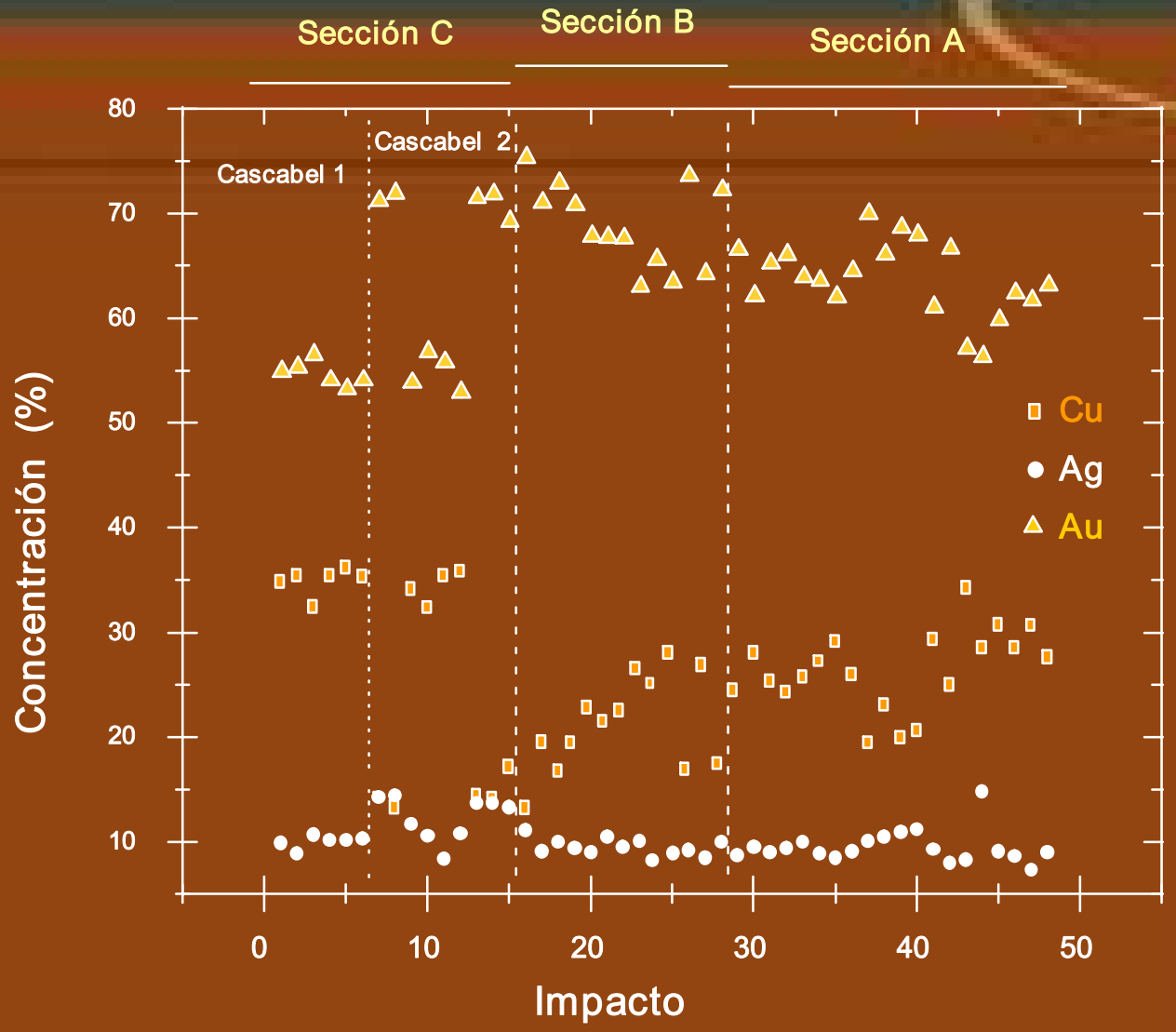
Resultados con PIXE



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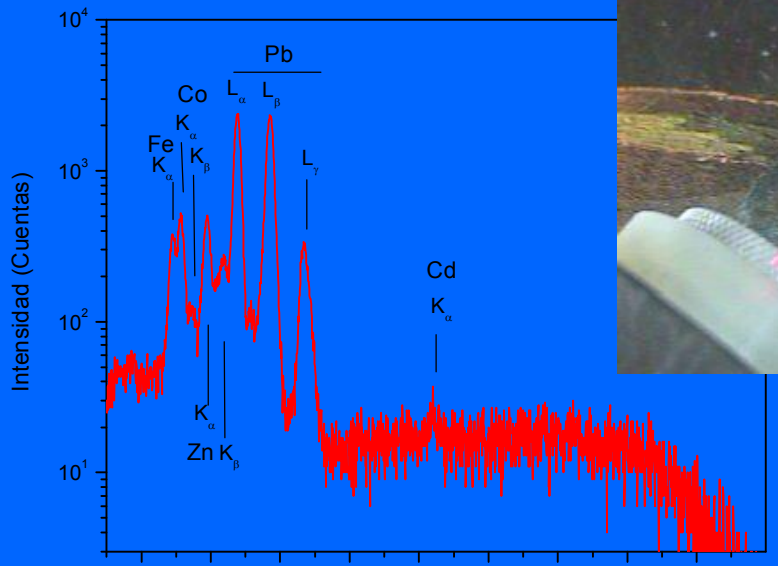

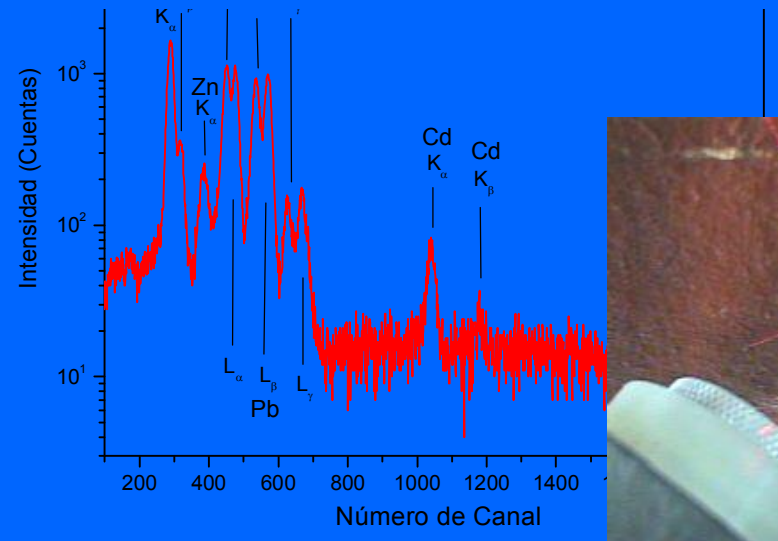

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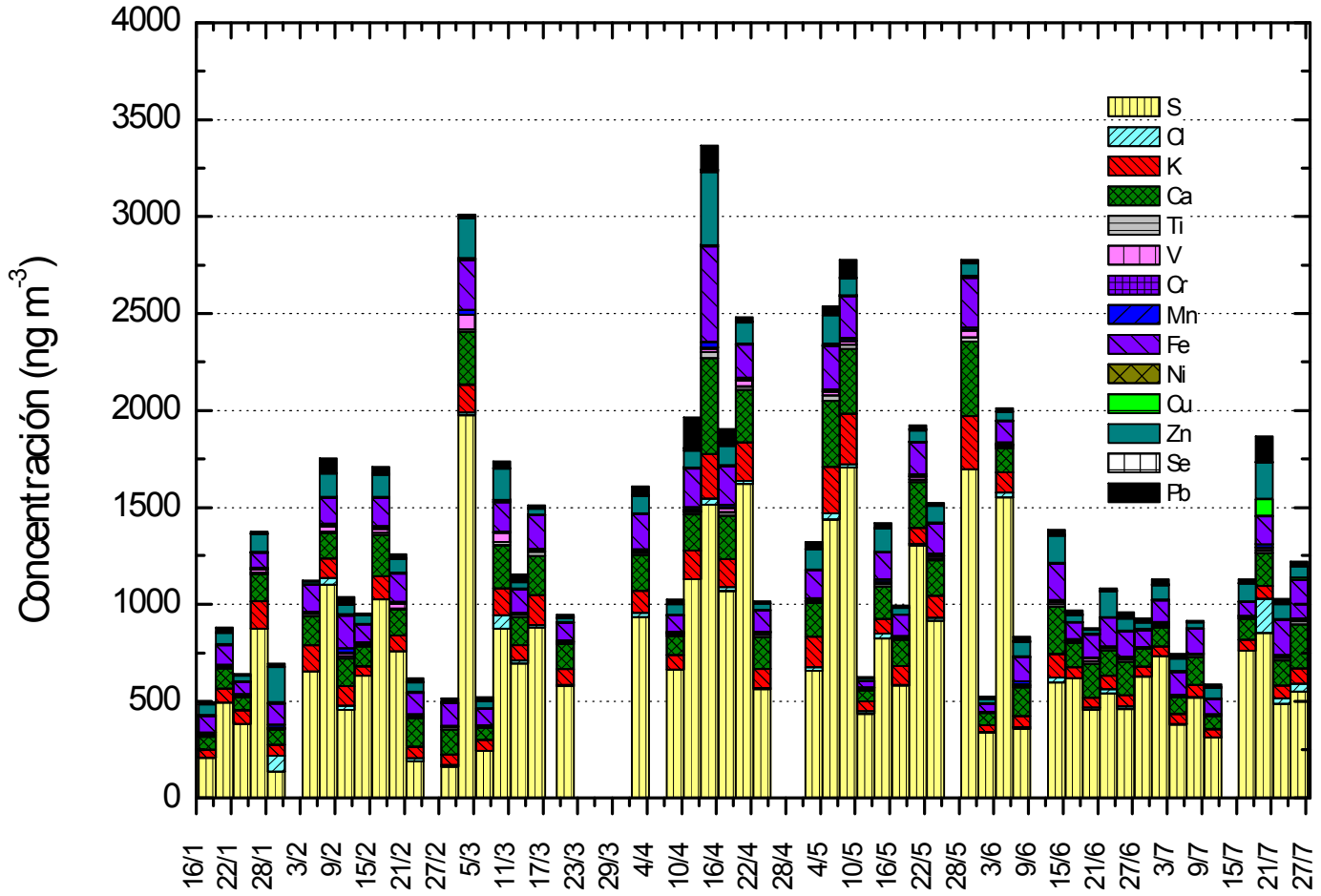
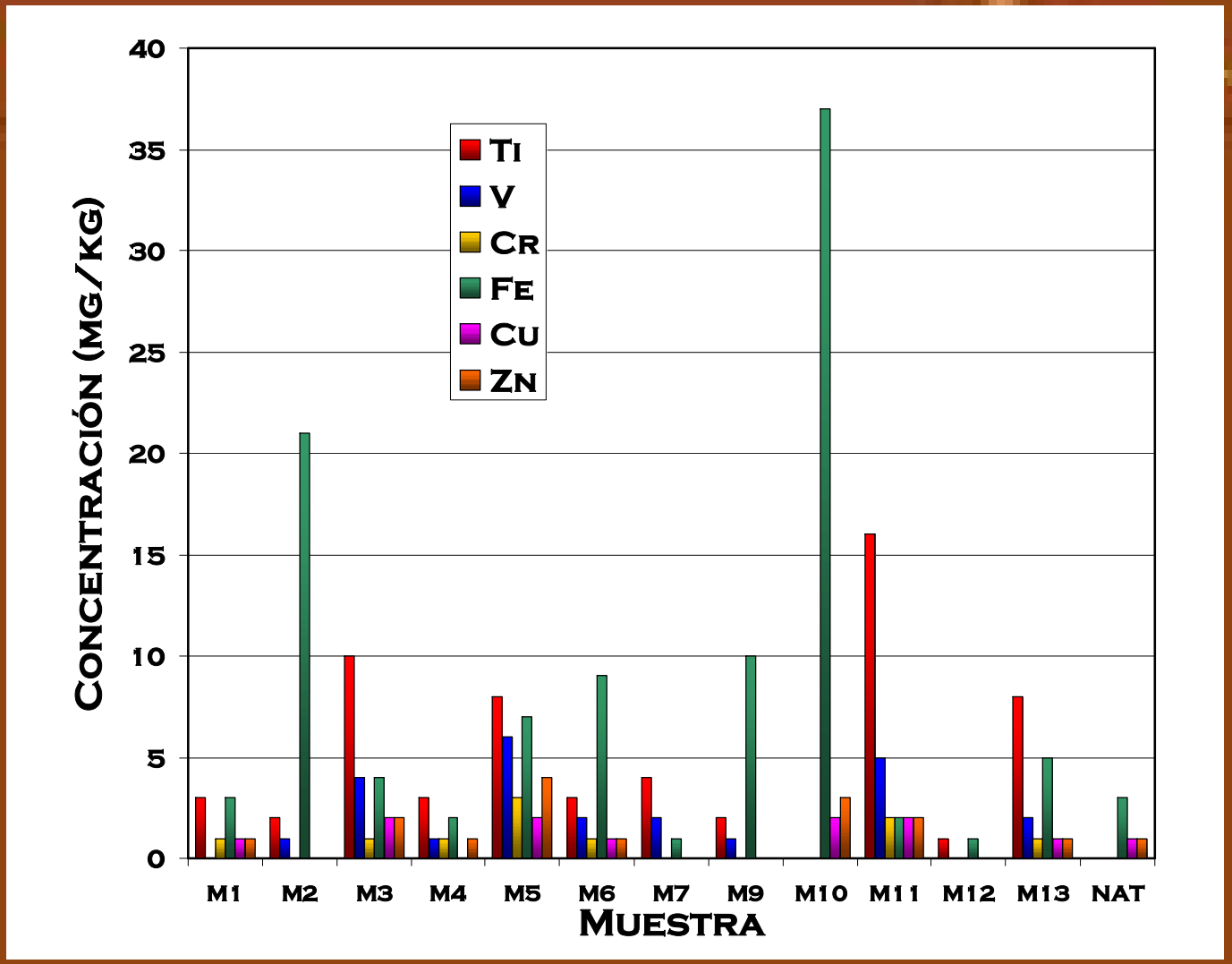
Muestreo y análisis de aerosoles

Partículas suspendidas, Zona Norte de la Ciudad de México

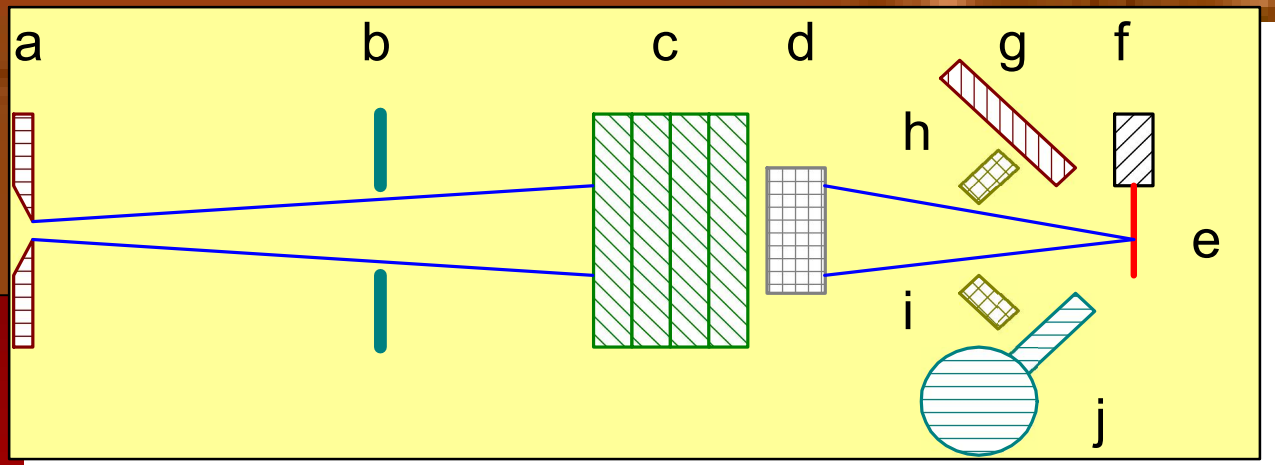


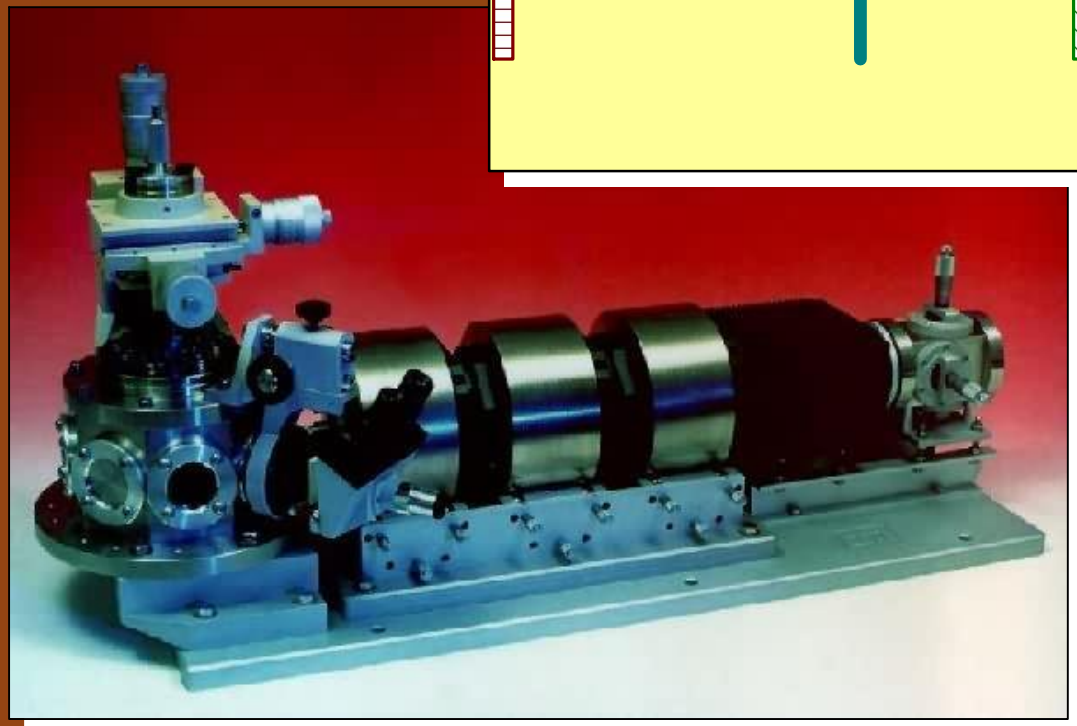
Puré de Jitomate/Nacional



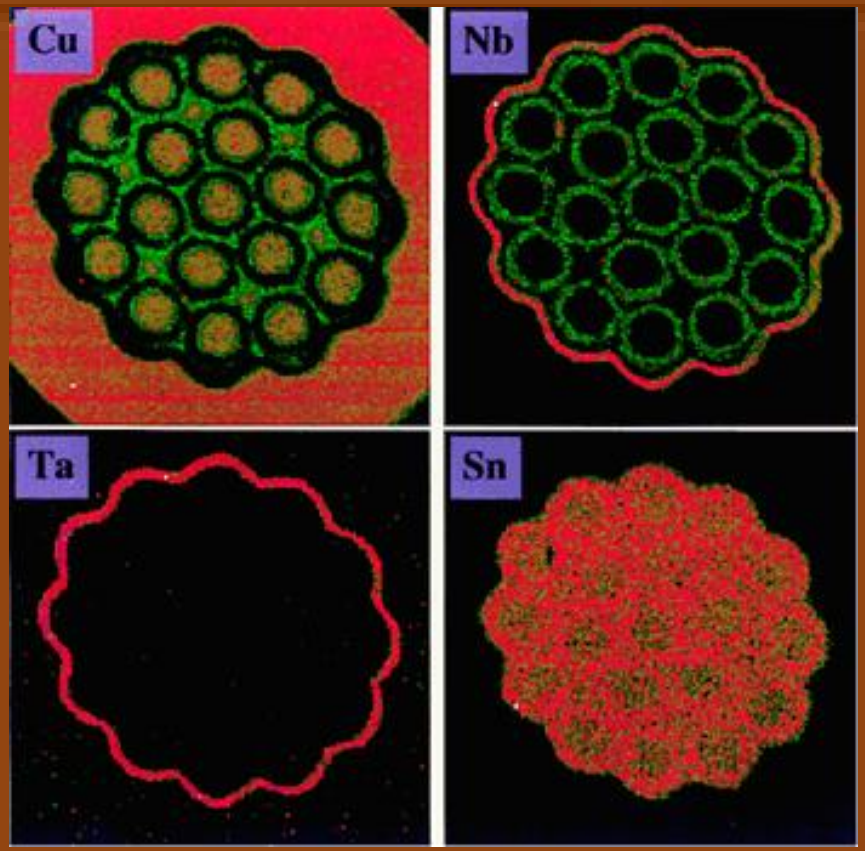
Técnicas de análisis con rayos X: Sondas en Marte

Microsonda de iones





Haz de fibras superconductoras



Laboratorio Nacional de Los Alamos

Conclusiones

- La aplicación de los rayos X actualmente no se limita a la obtención de imágenes
- El uso de los rayos X permite obtener información muy valiosa en la Física y otras ciencias