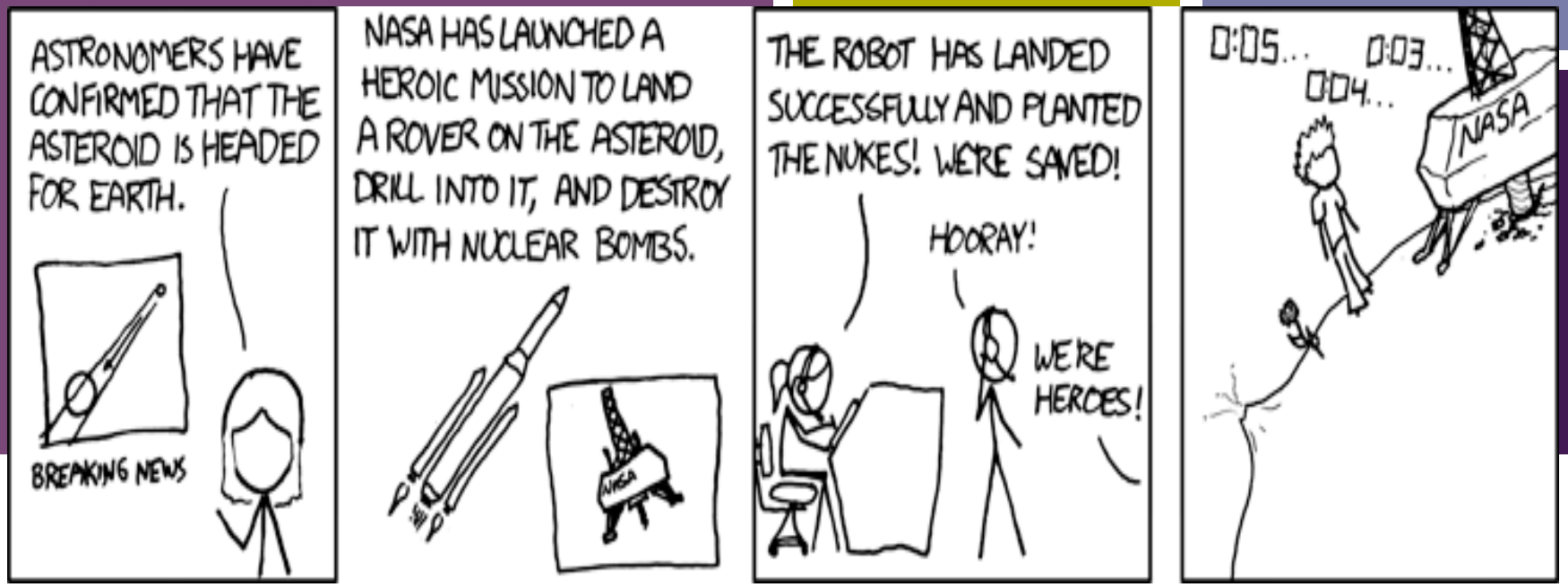
xkcd



http://xkcd.com/618/

CONACYT

Consejo Nacional de Ciencia y Tecnología

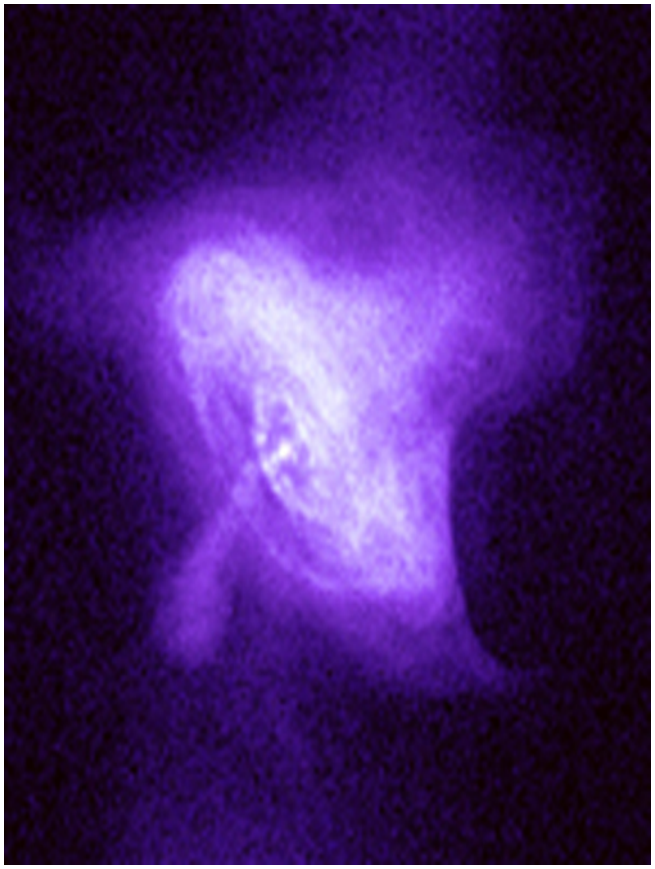
RedTULS

The Mexican Synchrotron Radiation Users Network

Guadalupe de la Rosa

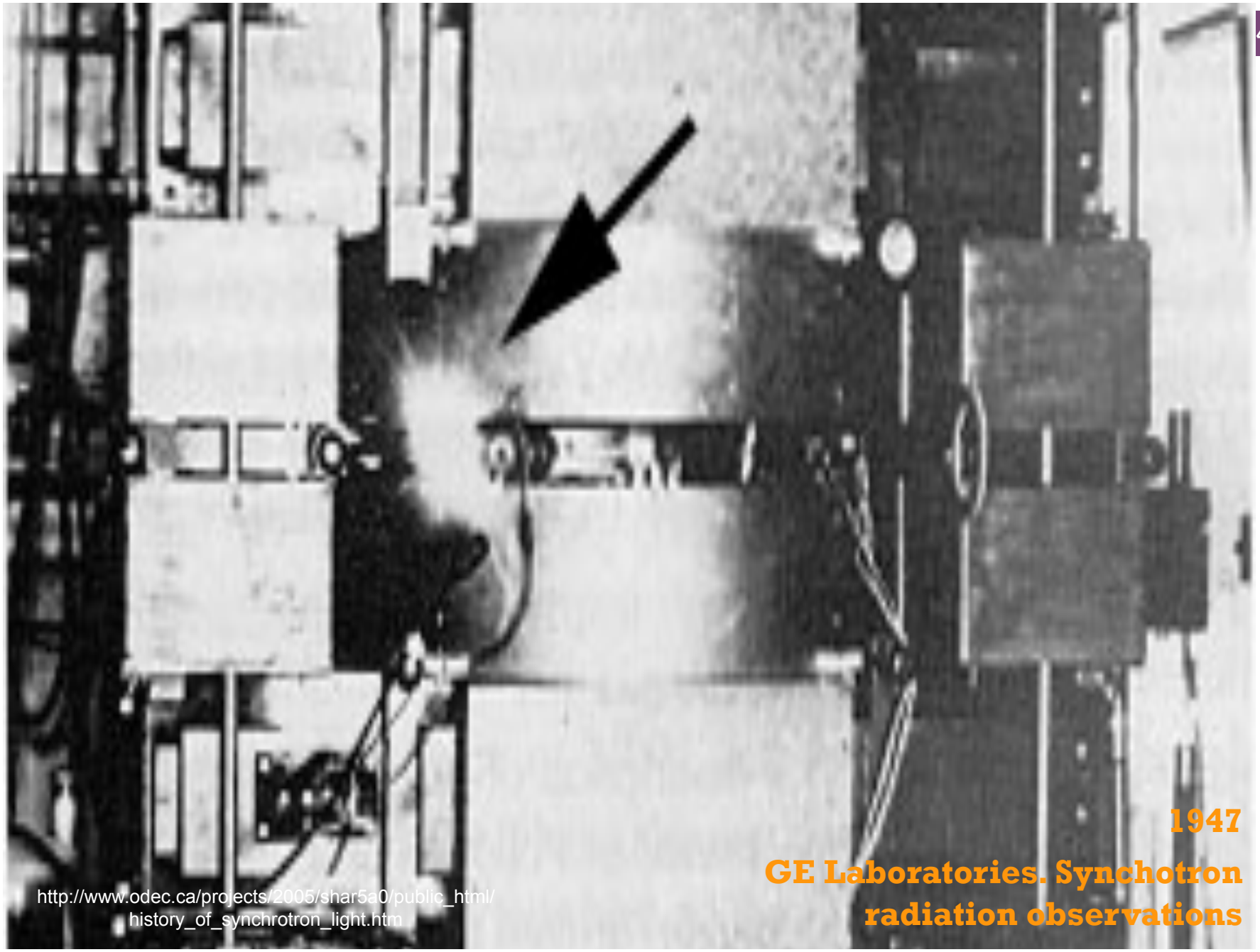
MePAS 2015

Synchrotron radiation –Crab nebula-



http://chandra.harvard.edu/photo/0052/0052_xray_lg.jpg

http://chandra.harvard.edu/photo/

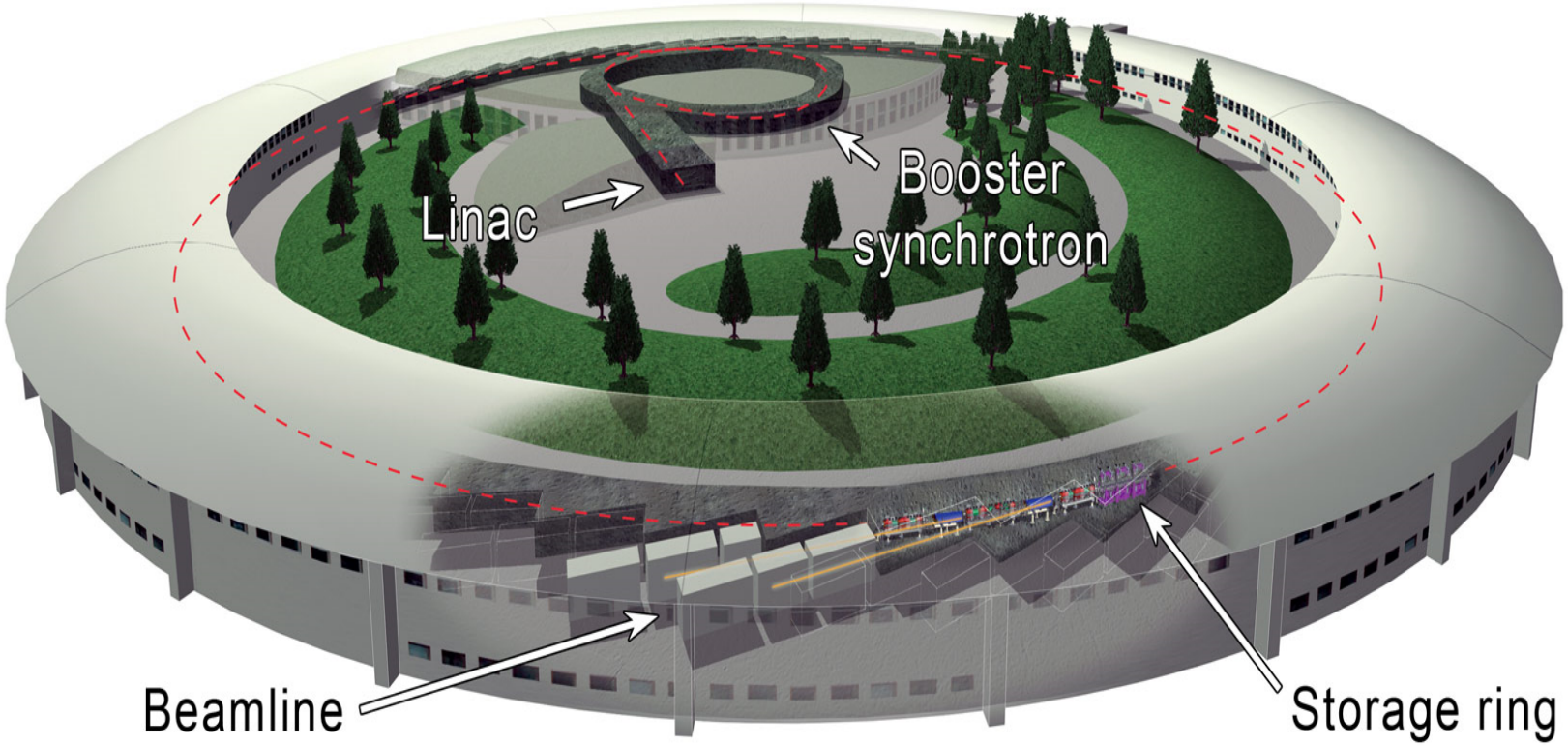


1947

GE Laboratories. Synchotron radiation observations

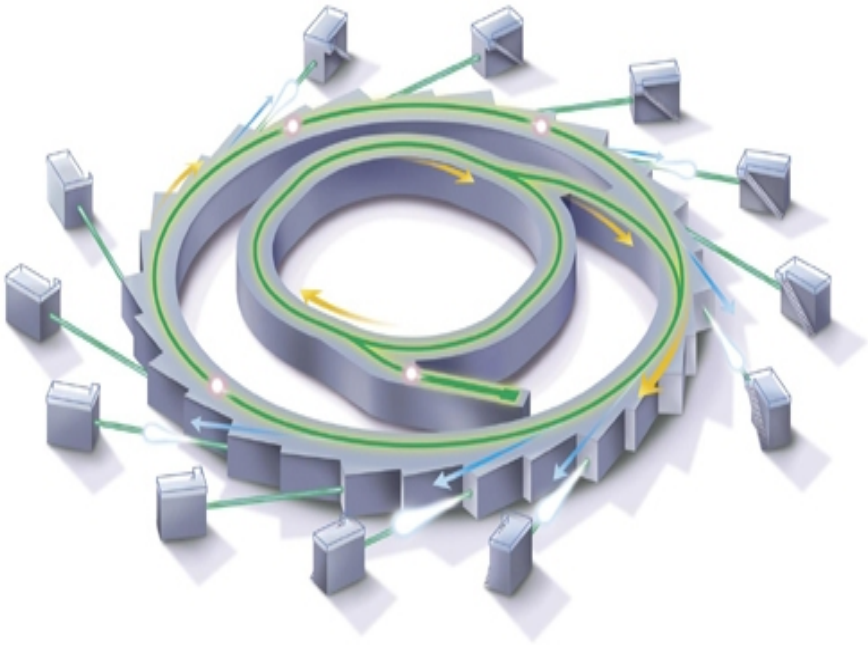
http://www.odec.ca/projects/2005/shar5a0/public_html/history_of_synchrotron_light.htm

Synchrotron radiation

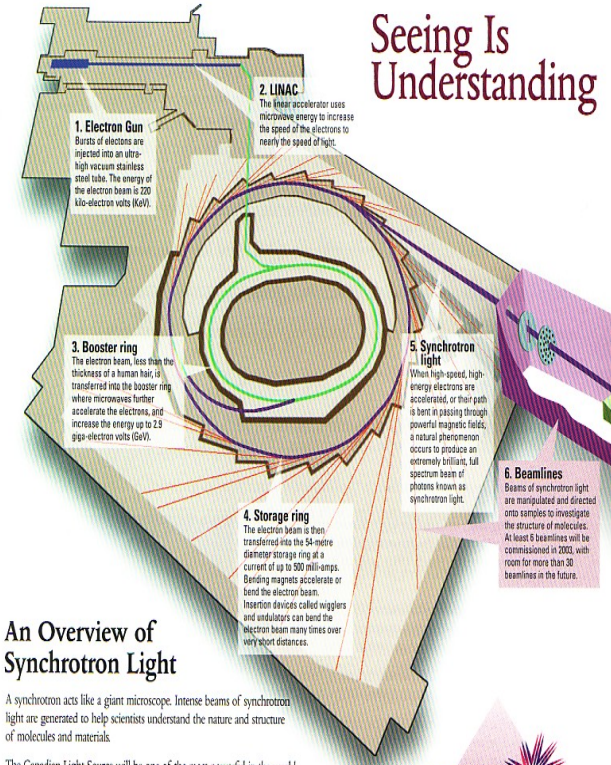


¿What is a synchrotron?

- e- accelerator
- e- produce synchrotron radiation in a tangential manner
- X-ray 10^6 more intense than those in tubes



Seeing Is Understanding



An Overview of Synchrotron Light

A synchrotron acts like a giant microscope. Intense beams of synchrotron light are generated to help scientists understand the nature and structure of molecules and materials.

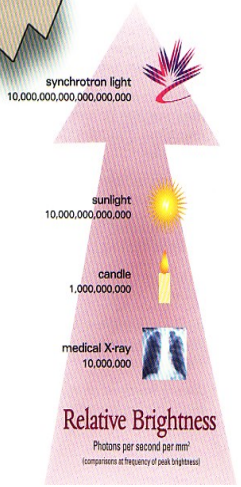
The Canadian Light Source will be one of the most powerful in the world, producing synchrotron light that is millions of times brighter than sunlight. This new research tool at the University of Saskatchewan will help to find solutions to challenges in health, the environment, and advanced materials.

What is light and what does it do?

Light is energy that travels in waves. Visible light is the small portion of the electromagnetic spectrum that can be seen with human eyes. The spectrum is composed of varying energies of light that have different wavelengths.

The length of the wave of light, or wavelength, is very important to the scientist. To examine a material using some synchrotron techniques, the wavelength must be the same size or smaller than the material being examined. Some wavelengths are like specialized X-rays that can 'see through' some materials.

The data produced when synchrotron light interacts with various materials is analyzed to produce images and charts that can illustrate such things as the relationships of atoms within molecules.



Synchrotron Analysis of Molecules

Beams of synchrotron light are transferred into the beamline 'mini-laboratories' where the chemical analysis takes place. For any given chemical question or molecular analysis, selected wavelengths of synchrotron light and a variety of synchrotron techniques are necessary to characterize different aspects of the nature and structure of molecules or materials. A few days of data collection can result in several months of data interpretation.

Beamlines can be categorized into groups or types based on selected wavelengths. These groupings include infrared, soft X-ray, and hard X-ray beamlines.

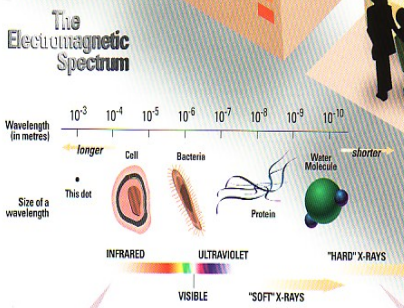
5

www.lightsource.ca

An Overview of Beamline Operations

"One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike and yet it is the most precious thing we have."

Albert Einstein



Infrared beamlines

Infrared (IR) beamlines will capture the wavelengths of synchrotron light that are longer than visible light. IR beamlines will explore the spectral resolution of gas phase molecules, the molecular vibrations of biological molecules, and the transition states of molecules under pressure in advanced materials.

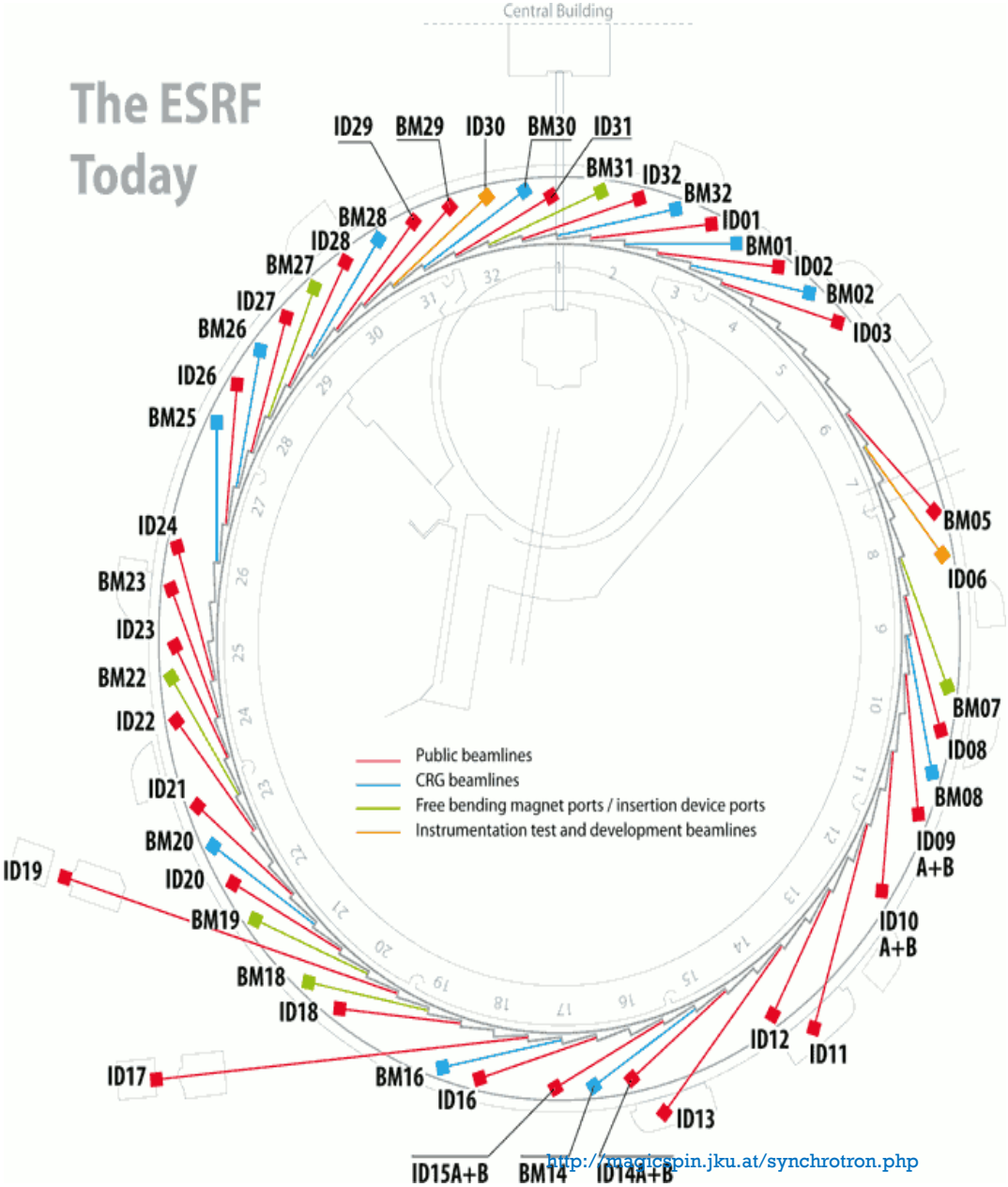
Soft X-ray beamlines

Soft X-rays include wavelengths that are shorter than visible light. Soft X-ray beamlines will be used to study the chemistry and structure of gases, liquids and solids by measuring the absorption of the light, as well as the energies and directions of various particles such as electrons emitted after a soft X-ray photon is absorbed. A variety of soft X-ray microscopes will be available to perform chemical analysis of solids and surfaces at spatial scales of 20 nanometres (1 nanometre is 1 billionth of a metre).

Hard X-ray beamlines

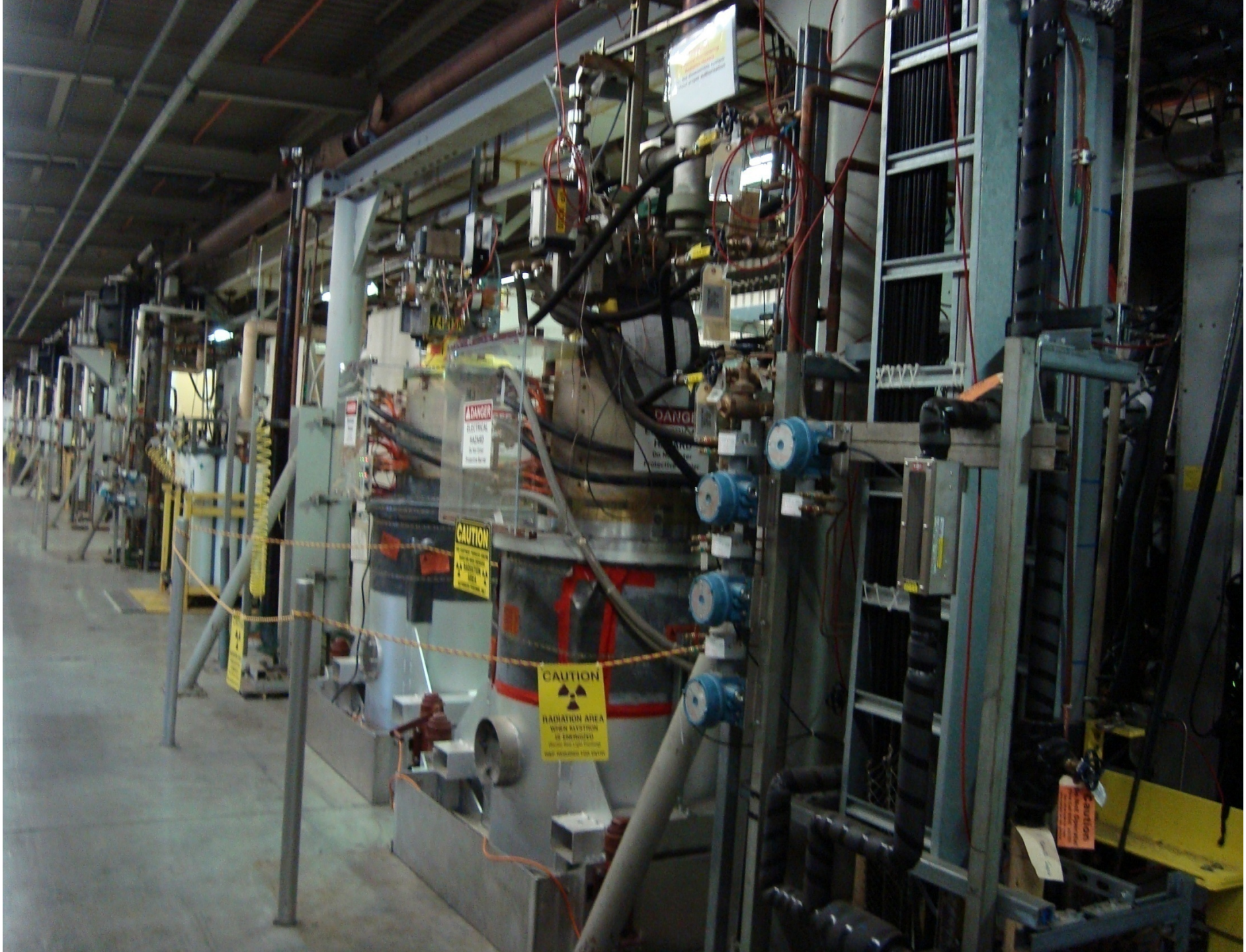
Hard X-rays probe matter with light of very short wavelengths, about the same size as an atom. Synchrotron techniques on hard X-ray beamlines include crystallography, scattering, spectroscopy and microanalysis. Measurements can be made of the diffraction, or bending and scattering, of the synchrotron light as it interacts with sample materials. The protein crystallography beamline will determine the structure of biological macromolecules, the function of proteins, and the molecular interactions of potential pharmaceuticals to develop improved drugs.

Several experiments at the same time

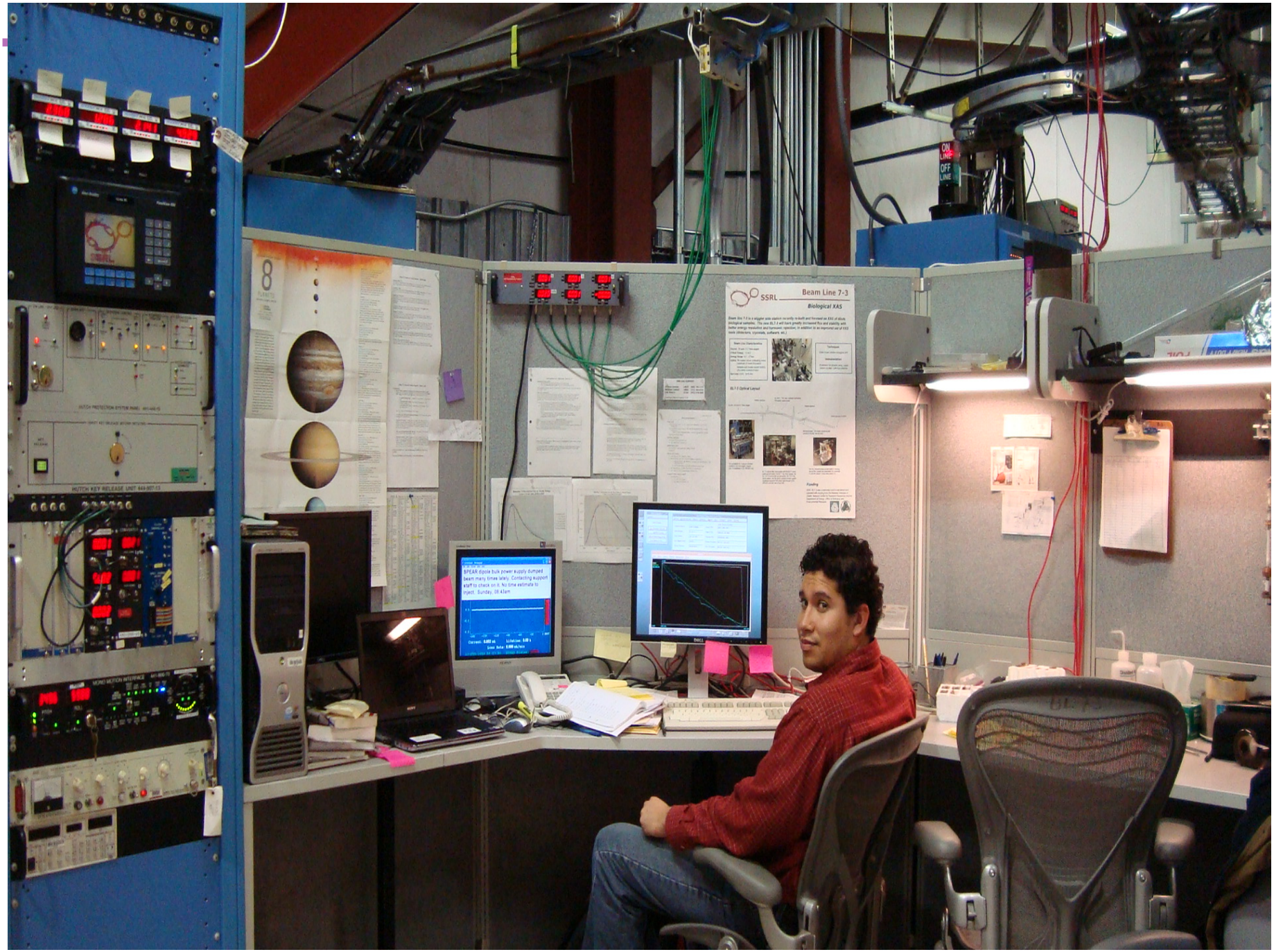


http://magicspin.jku.at/synchrotron.php

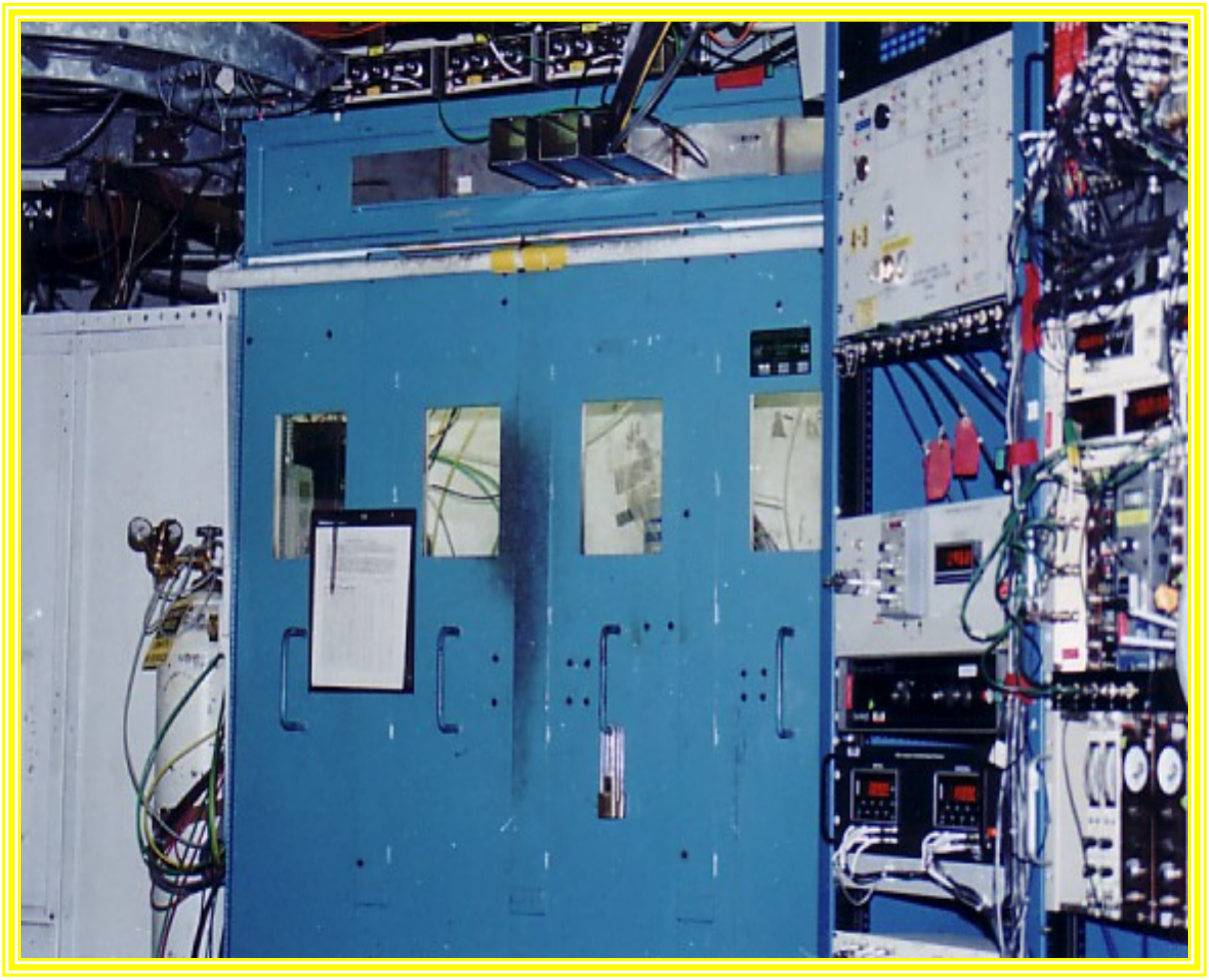
Every researcher takes a little bunch of light


DANGER
CAUTION
CAUTION
RADIATION AREA
WHEN KLYSTRON
IS ENERGIZED

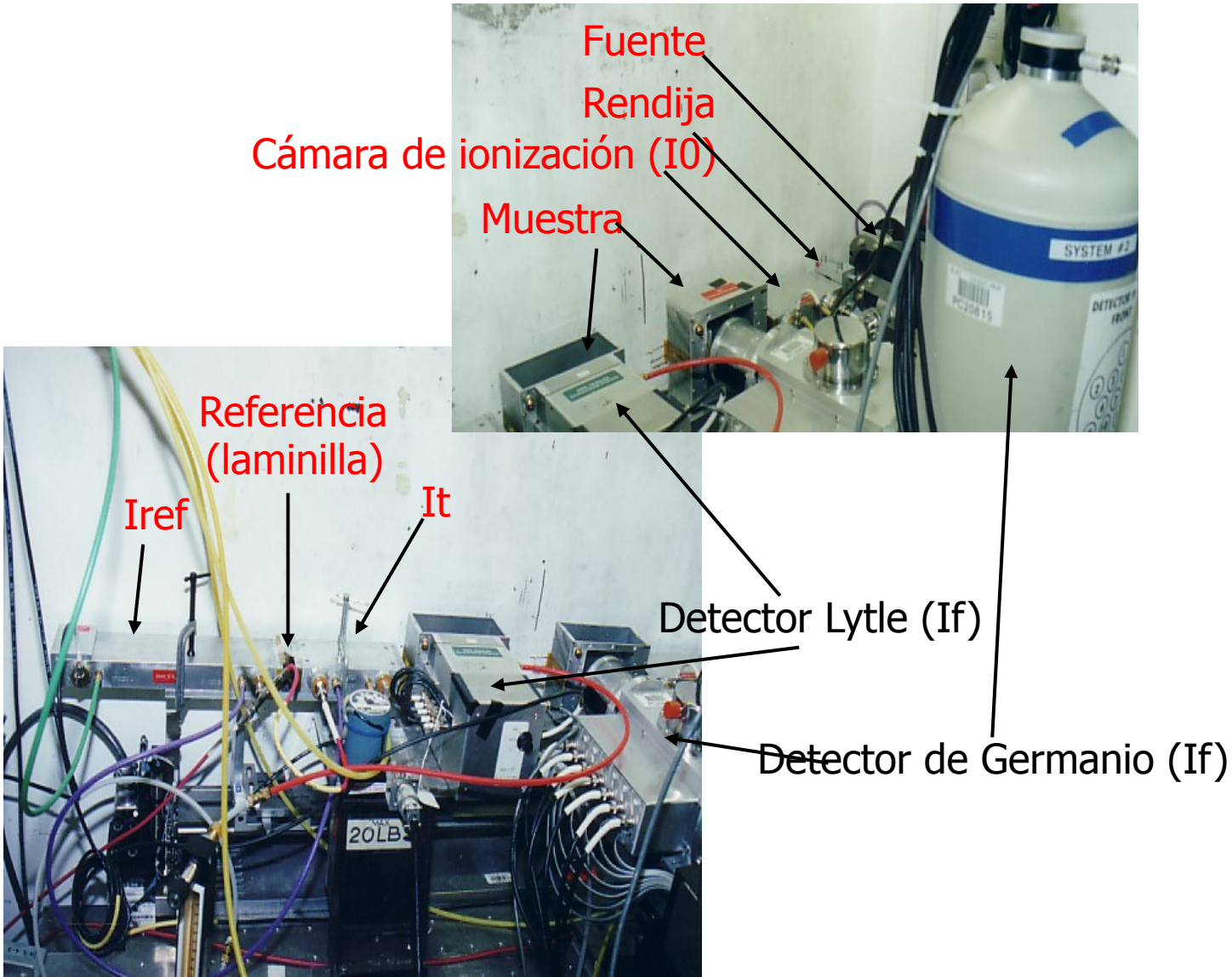

GALLERY
148
MCC
130
SLC ARCS
145
CRYO
136
PEP
138
SSRL
141
144
BTH
155
5118
5117


SSRL
Beam Line 7-3
Biological XAS
ON LINE
OFF LINE

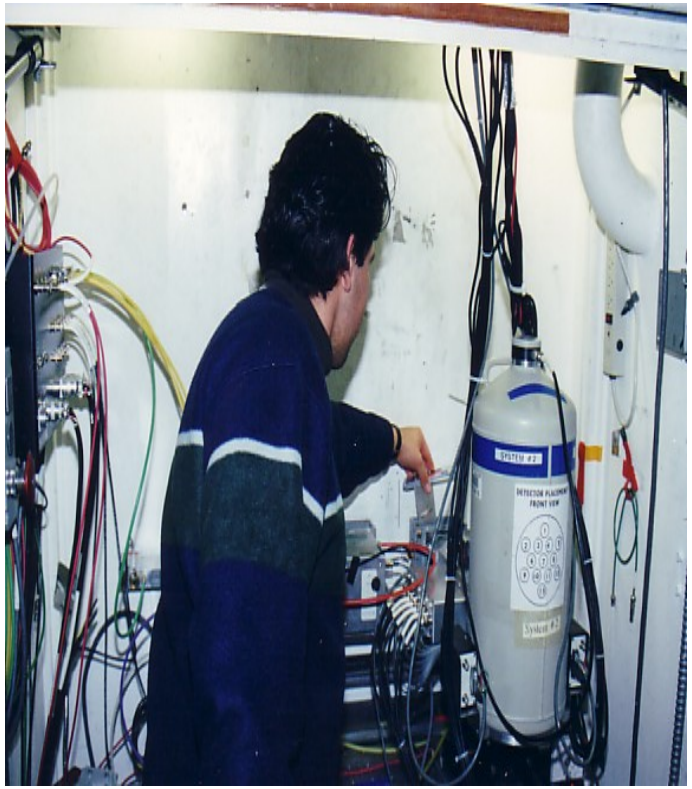
Workstation (Hutch)

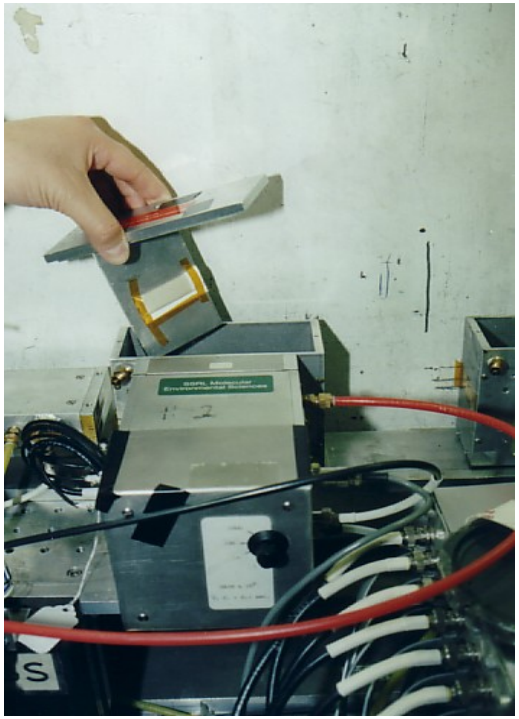


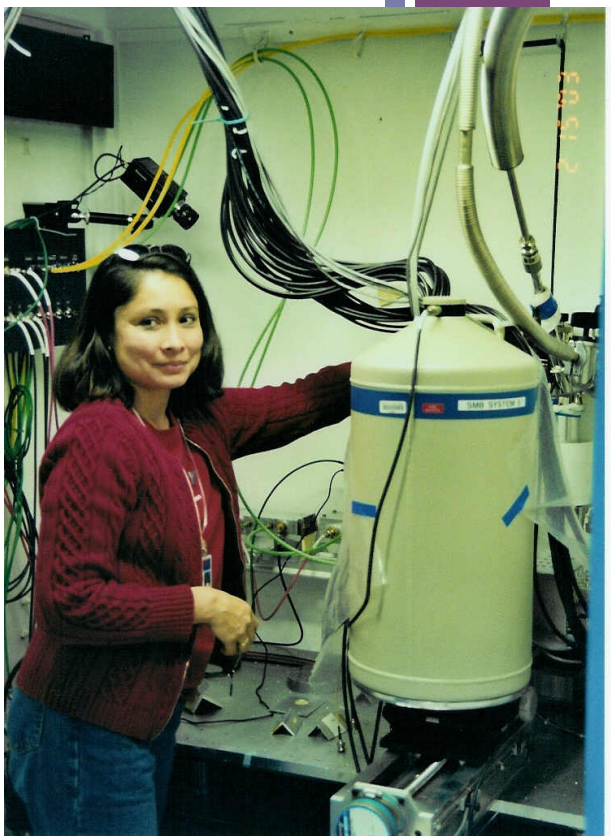
XAS: Detectors…



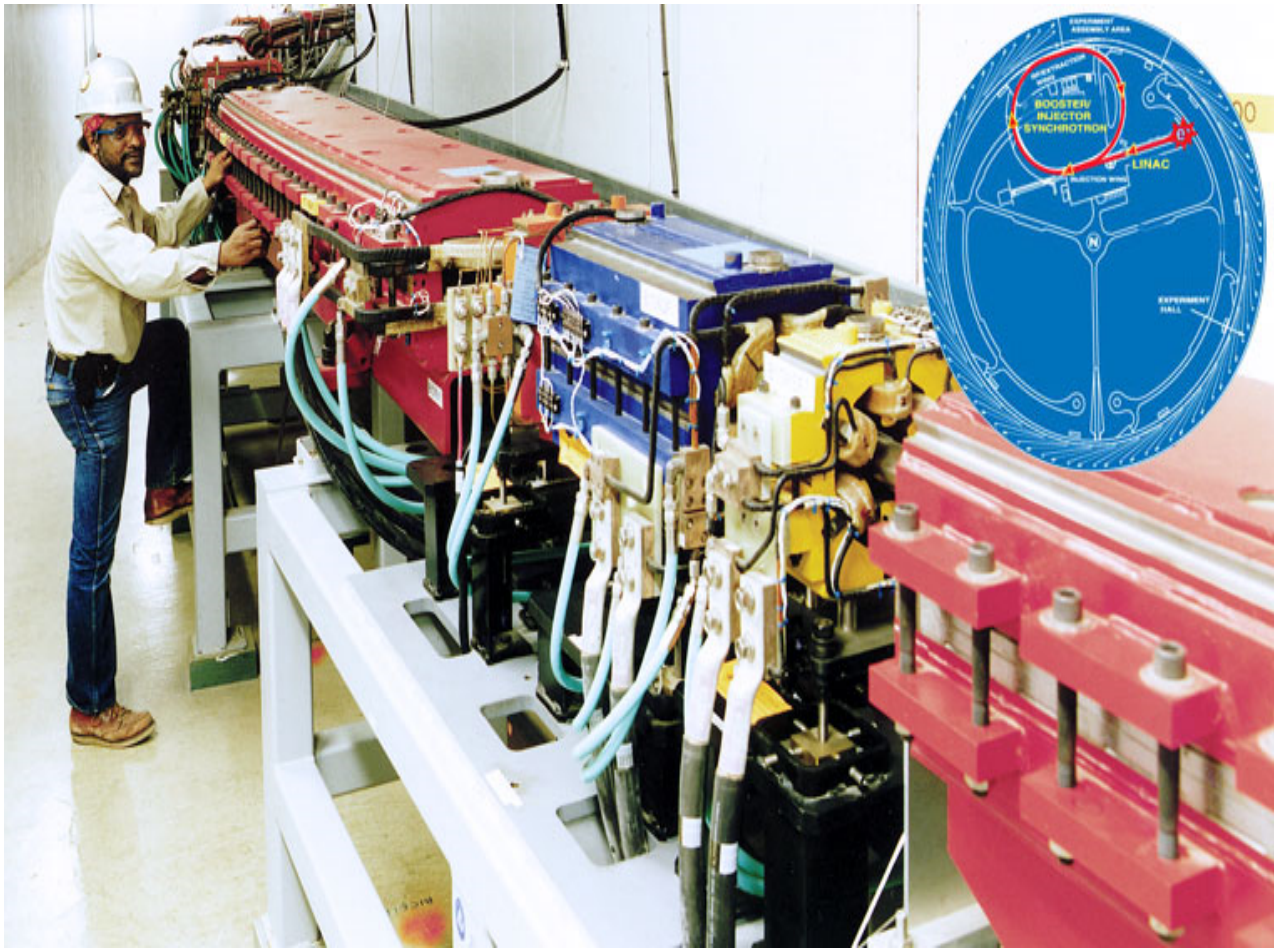
The sample





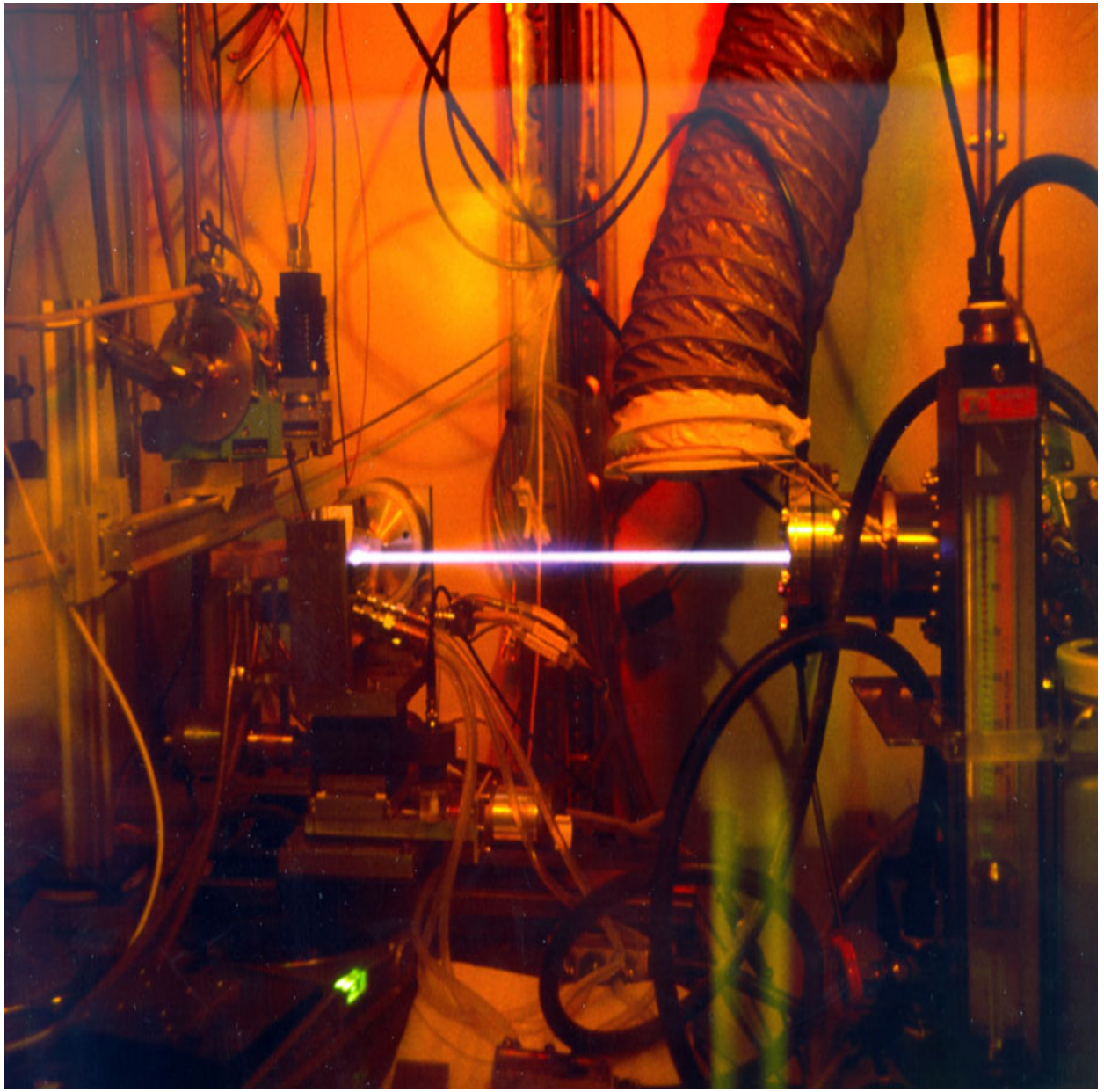


Booster section APS



http://www.aps.anl.gov/About/APS_Overview/booster.html

Inside



http://www.esrf.eu/files/live/sites/www/files/about/synchrotron-science/first-beam.jpg

https://www.youtube.com/watch?v=PAQhcz3HPaw#t=225

European Synchrotron Radiation Facility

Grenoble, Fr

A little bit of history….
High Energy Physics Network - CONACyT

First Mexican Synchrotron Radiation Users' Meeting

4-6 May 2011 Holiday Inn. Cuernavaca, Morelos.

to evaluate the feasibility of building a synchrotron light source in Mexico

74 participants

First Mexican Synchrotron Radiation Users' Meeting

4-6 May 2011 Holiday Inn, Cuernavaca, Morelos.

Meetings

Edition	Year	Venue	Participants
1	2011	Cuernavaca, Mor	74
2	2012	León, Gto	80
3	2013	Querétaro, Qro.	40
4	2014	Huatulco, Oax	100
5	2015	Cuernavaca, Mor	130

2013

	Meeting
2013	**León, Gto. Taller Temático: Técnicas de luz sincrotrón en el análisis de materiales y muestras de interés ambiental (CONACYT-SRE)**
	Guanajuato, Gto. 48° Congreso Nacional de Química, Sociedad Química de México
	Querétaro, Qro. Simposium en Nanotecnología, Universidad Autónoma de Querétaro
	Seminarios: Universidad Autónoma de San Luis Potosí, Instituto Tecnológico de Ciudad Madero, Universidad Autónoma de Querétaro, Instituto Tecnológico de Salamanca
	Talleres: Instituto Tecnológico de Cd. Madero

2014

- Conacyt call
- To register and restructure networks
- Attend problems of national concern in Science, Technology and Innovation

RedTULS

Objective

- RedTULS wants to extend and promote the use of synchrotron techniques so as to the mexican users community grows. We believe with that, the generation of high quality products in science and technology will significantly increase in our country. This will help us to be more competitive. We also want to promote the collaboration between Mexico and the synchrotrons around the world, and in the meantime participate in decision making related to the construction of a mexican synchrotron. We believe we can help industry in our country to also be more competitive.

CONACYT
Consejo Nacional de Ciencia y Tecnología

RedTULS
TEMÁTICA DE USUARIOS DE LUZ SINCROTRÓN

ReDTULS at a glance

DRA. GUADALUPE DE LA ROSA

DR. GUSTAVO CRUZ JIMÉNEZ

Membership distribution by type

- 13 CTA
- 12 EXTERNAL
- 55 RESEARCHERS
- 52 STUDENTS

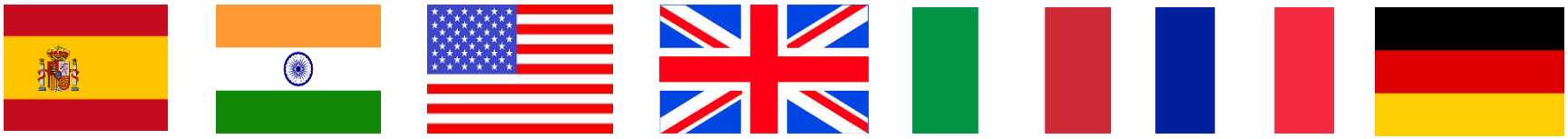
132 TOTAL

REDTULS- INSTITUTES/ UNIVERSITIES

NACIONALES	29
INTERNACIONALES	10
TOTALES	**39**

INTERNATIONAL CENTERS

ALBA, ESPAÑA
ANNA UNIVERSITY, INDIA
BROOKHAVEN NATIONAL LABORATORY, USA
DIAMOND, GRAN BRETAÑA
ELETTRA, ITALIA
ESRF, FRANCIA
GOETHE-UNIVERSITÄT FRANKFURT AM MAIN, ALEMANIA
LBNL, USA
MIDWEST CENTER FOR STRUCTURAL TECHNOLOGY, USA
UNIVERISTE DE POITIERS, FRANCIA



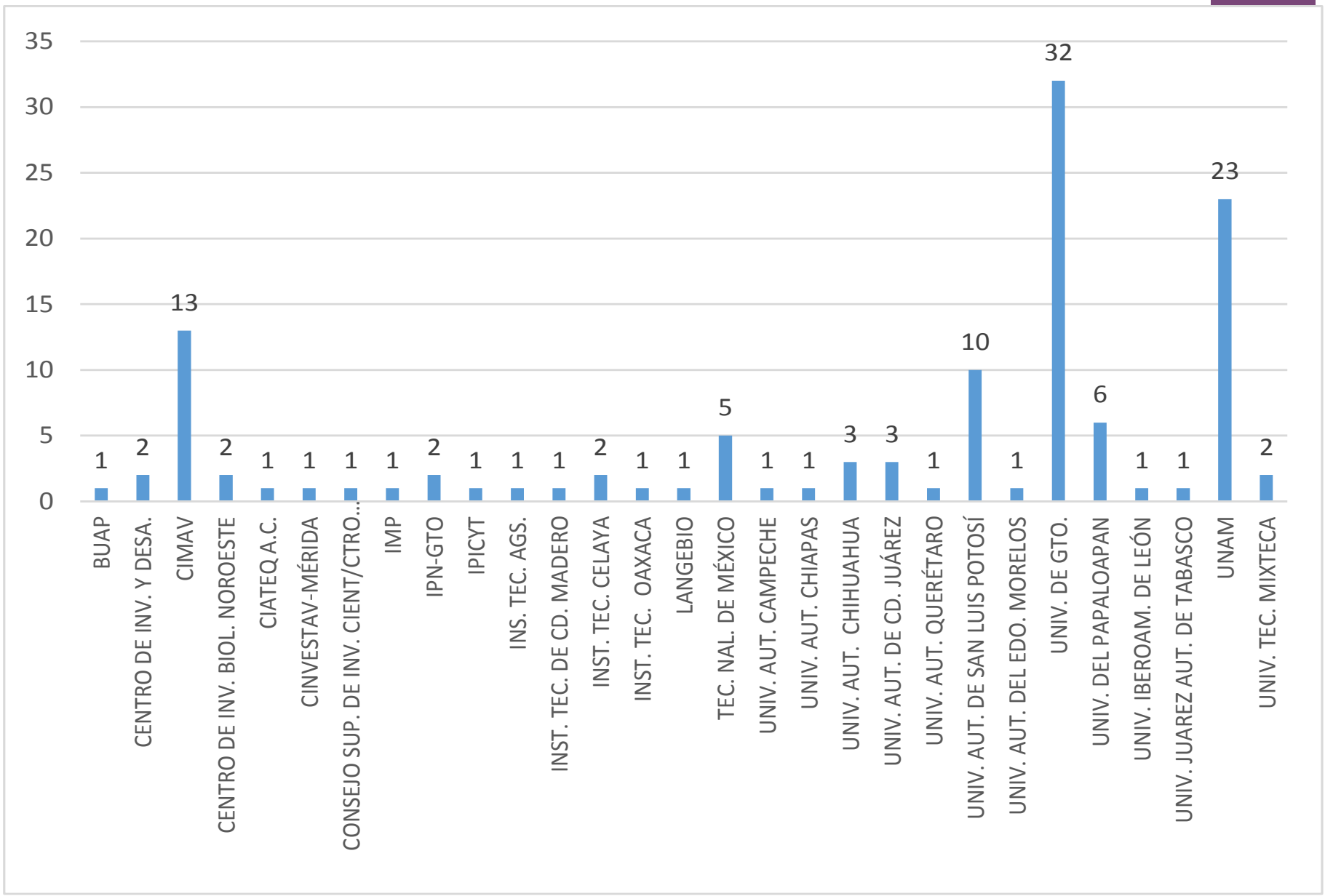
18 States


Baja California
Sonora
Chihuahua
Baja California Sur
Coahuila de Zaragoza
Nuevo León
Durango
Sinaloa
Zacatecas
Tamaulipas
Ag.
San Luis Potosi
Nayarit
Guanajuato
Querétaro
Estado de Hidalgo
Veracruz de Ignacio de la Llave
Yucatán
Jalisco
Co.
Michoacán
Estado de México
DF
Tl.
Mo.
Puebla
Quintana Roo
Campeche
Tabasco
Guerrero
Oaxaca
Chiapas
300 km
200 mi
© d-maps.com

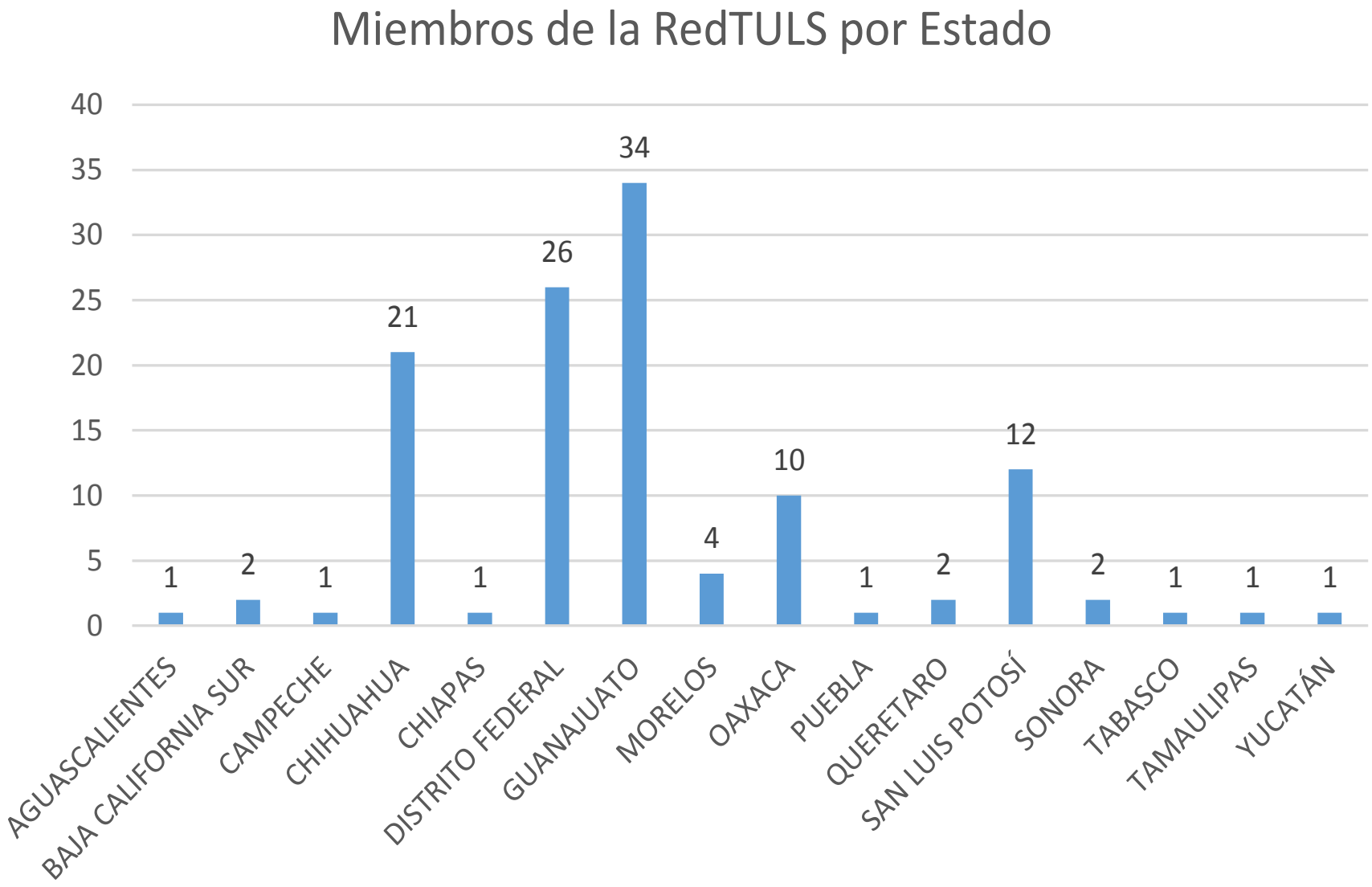
NATIONAL CENTERS

BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA
CENTRO DE INVESTIGACIÓN EN ALIMENTACIÓN Y DESARROLLO A.C.
CENTRO DE INVESTIGACIÓN EN MATERIALES AVANZADOS
CENTRO DE INVESTIGACIONES BIOLÓGICAS DEL NOROESTE
CIATEQ A.C.
CINVESTAV-UNIDAD MÉRIDA
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS, CENTRO DE INVESTIGACIONES BIOLÓGICAS
INSTITUTO MEXICANO DEL PETRÓLEO
INSTITUTO POLITÉCNICO NACIONAL
INSTITUTO POTOSINO DE INVESTIGACIÓN CIENTÍFICA Y TECNOLÓGICA
INSTITUTO TECNOLÓGICO DE AGUASCALIENTES
INSTITUTO TECNOLOGICO DE CD. MADERO
INSTITUTO TECNOLOGICO DE CELAYA
INSTITUTO TECNOLÓGICO DE OAXACA
LANGEBIO
TECNOLÓGICO NACIONAL DE MÉXICO
UNIVERSIDAD AUTONOMA DE CAMPECHE
UNIVERSIDAD AUTONOMA DE CHIAPAS
UNIVERSIDAD AUTONOMA DE CHIHUAHUA
UNIVERSIDAD AUTÓNOMA DE CIUDAD JUAREZ
UNIVERSIDAD AUTONOMA DE QUERETARO
UNIVERSIDAD AUTONOMA DE SAN LUIS POTOSI
UNIVERSIDAD AUTÓNOMA DEL ESTADO DE MORELOS
UNIVERSIDAD DE GUANAJUATO
UNIVERSIDAD DEL PAPALOAPAN
UNIVERSIDAD IBEROAMERICANA DE LEÓN
UNIVERSIDAD JUÁREZ AUTÓNOMA DE TABASCO
UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO
UNIVERSIDAD TECNOLÓGICA DE LA MIXTECA

REDTULS – 29 INSTITUTIONS



REDTULS – 16 ESTADOS



RedTULS and the people

1. Coordinador General de la Red. Dra. Ma. Guadalupe De la Rosa Álvarez
2. Coordinador de Investigación Básica: Dr. Juan Carlos Fierro.
3. Coordinador de Investigación aplicada y vinculación con la industria. Dr. Abel Moreno
Cárcamo
4. Coordinador de Infraestructura: Dr. Erick Adrián Juárez-Arellano
5. Coordinador de Divulgación y Comunicación. Dr. Daniel Hernández Cruz
6. Coordinador de Ingreso y permanencia: Dr. Gustavo Cruz Jiménez
7. Coordinadora de Movilidad: Dra. María Elena Montero Cabrera
8. Coordinadora de Asuntos relacionados con la propiedad intelectual: Dra. Mayra Cuéllar
Cruz
9. Coordinador para el estudio de factibilidad: Dr. Ibrahim Serroukh


Red Temática Usu
de Luz Sincrotrón
RedTULS

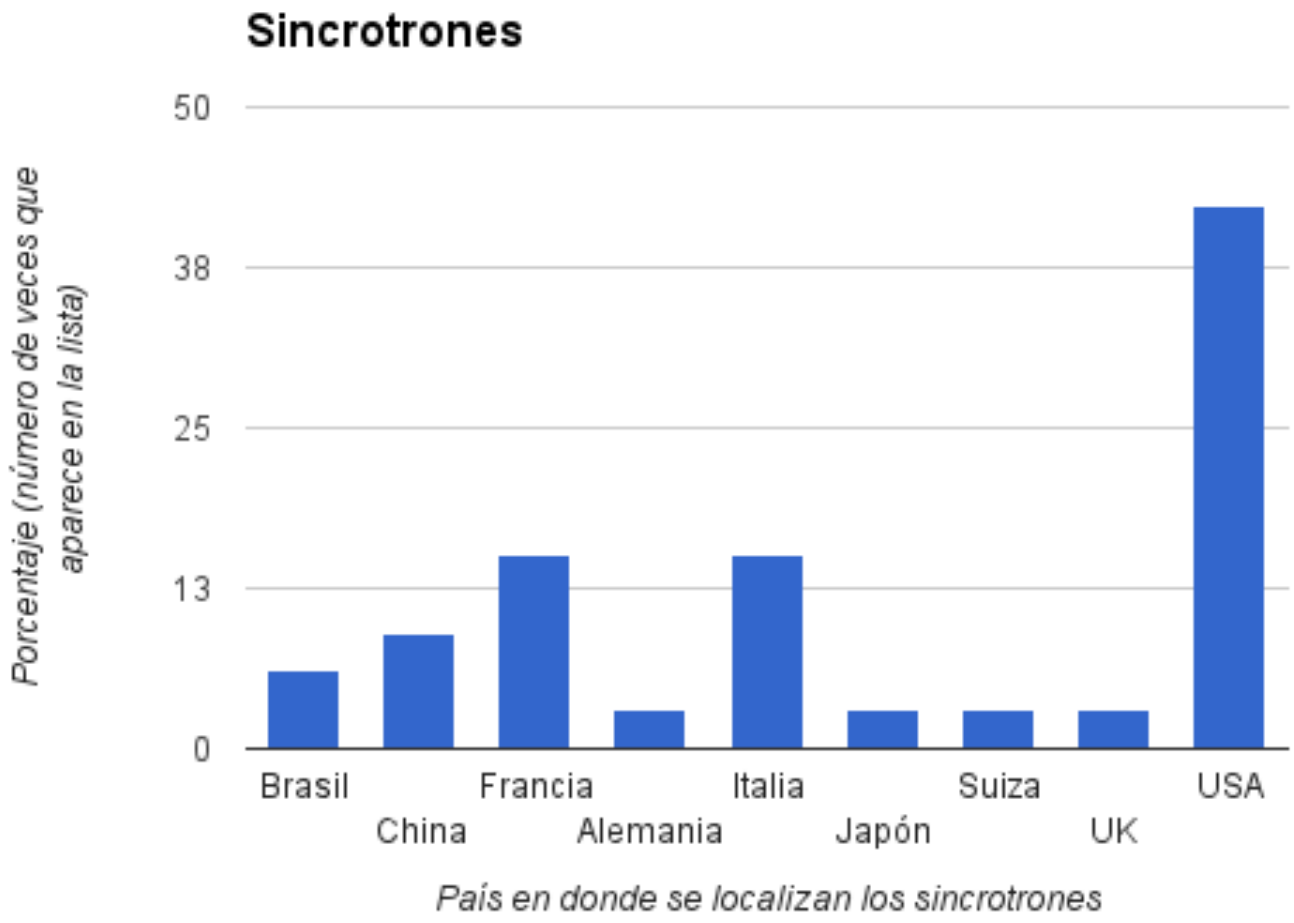
MESYRUM

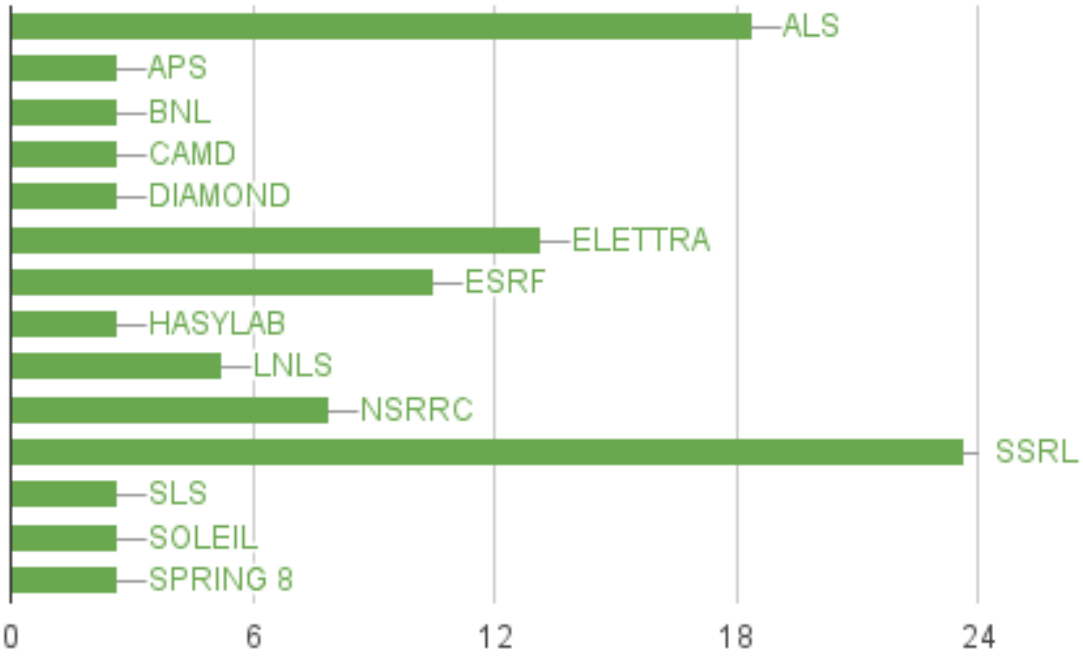
Mexican users, synchrotrons and beamlines .....

Mexican users, synchrotrons and beamlines .....

Mexican users, synchrotrons and beamlines .....

Mexican users, synchrotrons and beamlines .....


Sincrotrones
50
38
25
13
0
Porcentaje (número de veces que aparece en la lista)
Brasil
China
Francia
Alemania
Italia
Japón
Suiza
UK
USA
País en donde se localizan los sincrotrones


ALS
APS
BNL
CAMD
DIAMOND
ELETTRA
ESRF
HASYLAB
LNLS
NSRRC
SSRL
SLS
SOLEIL
SPRING 8
0
6
12
18
24

FOR MEXICO: WHAT TYPE OF BEAMLINE?: ID 21 ESRF

Techniques

- XANES - X-ray absorption near-edge structure
- XRF - X-ray fluorescence
- FTIR - Fourier transform infrared spectroscopy/microscopy
- microXRF - micro X-ray fluorescence
- microXANES - micro X-ray absorption near-edge structure
- XRD - X-ray diffraction
- XAS - X-ray absorption spectroscopy

STRENGHTENING HUMAN RESOURCES

- Specific agreements
  - Membresía (Miembro/Asociado) en el *European Synchrotron Radiation Facility*
  - Asociación a ALBA
  - Sincrotrón Australiano
  - Colaboración con APS (Excelente opción)
- Proyectos de colaboración para adecuación de líneas con beneficios para los investigadores mexicanos
- Construir una o varias líneas en un sincrotrón extranjero
- Sincrotrón mexicano

Mexicans in syncrotrons

RedTULS
TEMÁTICA DE USUARIOS DE LUZ SINCROTRÓN

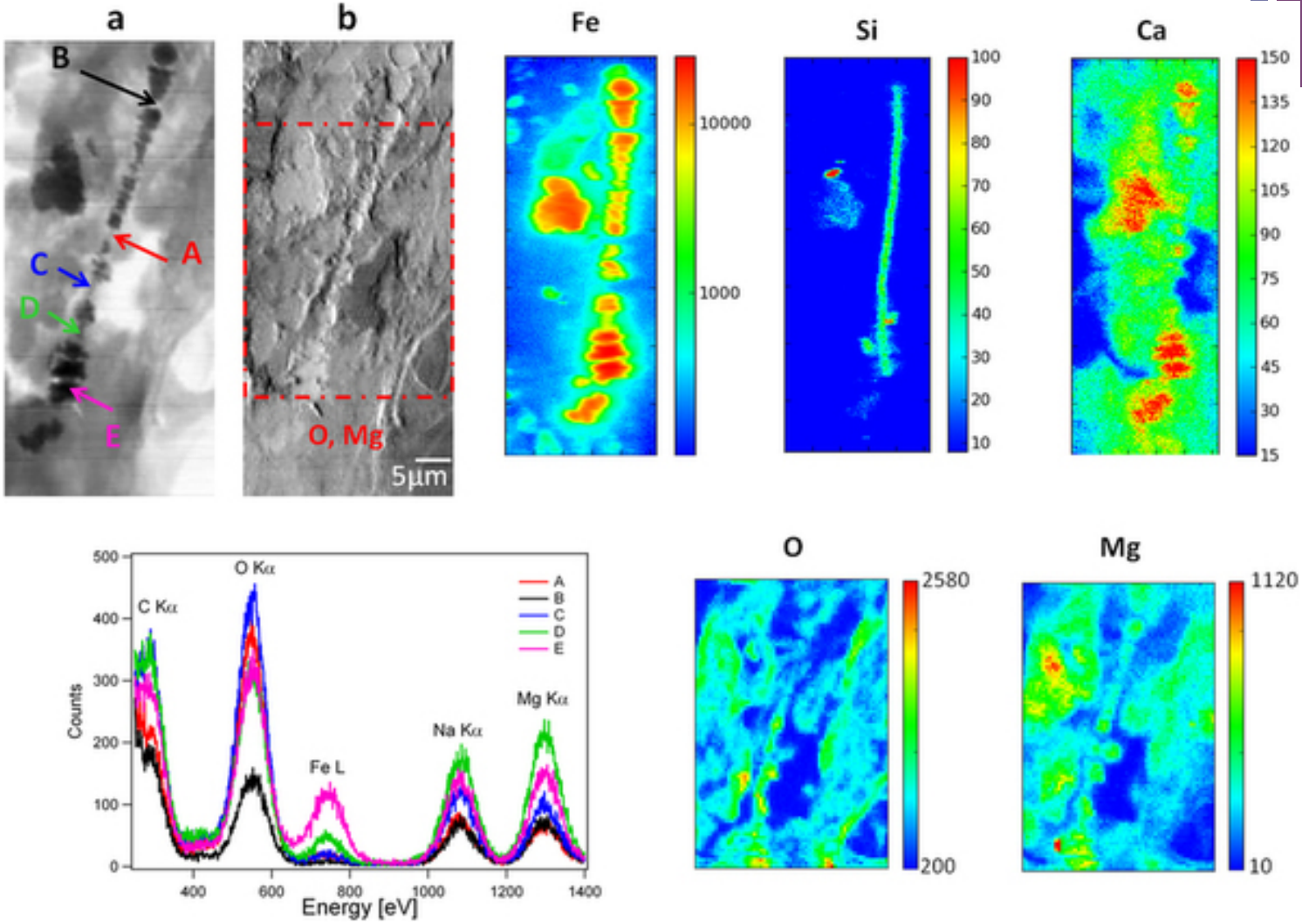
ICN UNAM

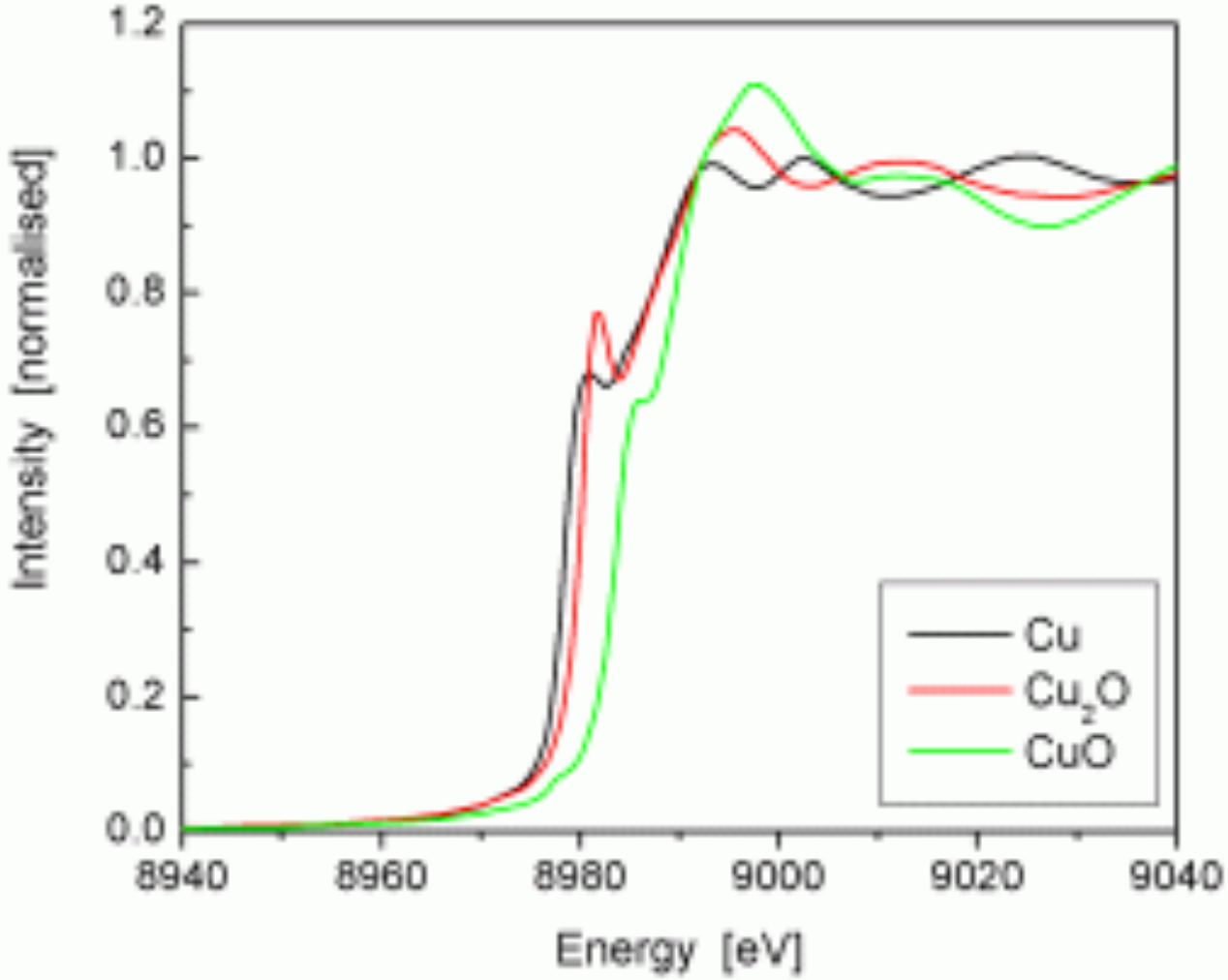
Presented by: José Jimenez Mier y Terán before the mexican Senate

Synchrotron light enlightens important problems:

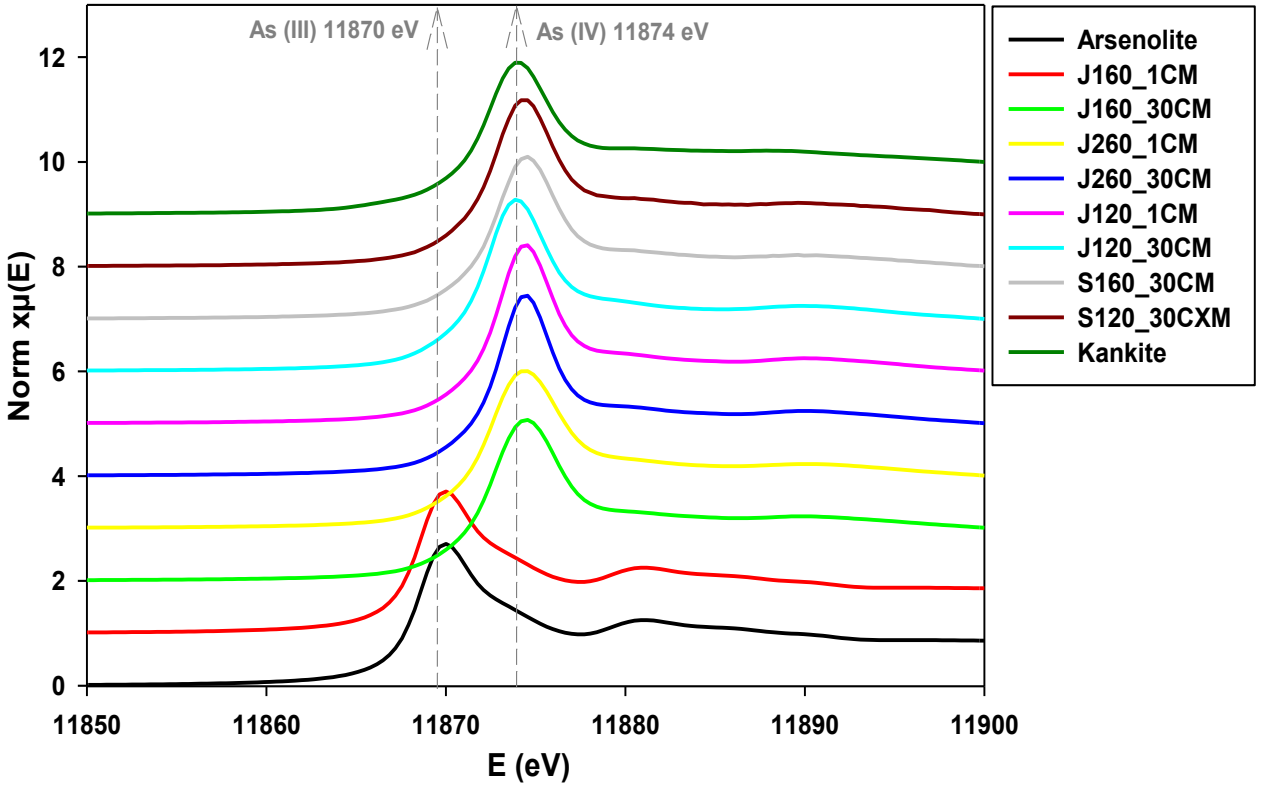
- Environment: pollution in soils, water, air, plants..
- Health.
- New Materials.
- Catalisis, energy, batteries, biomaterials
- Cultural Heritage
- High level computing

X-ray identifies elements



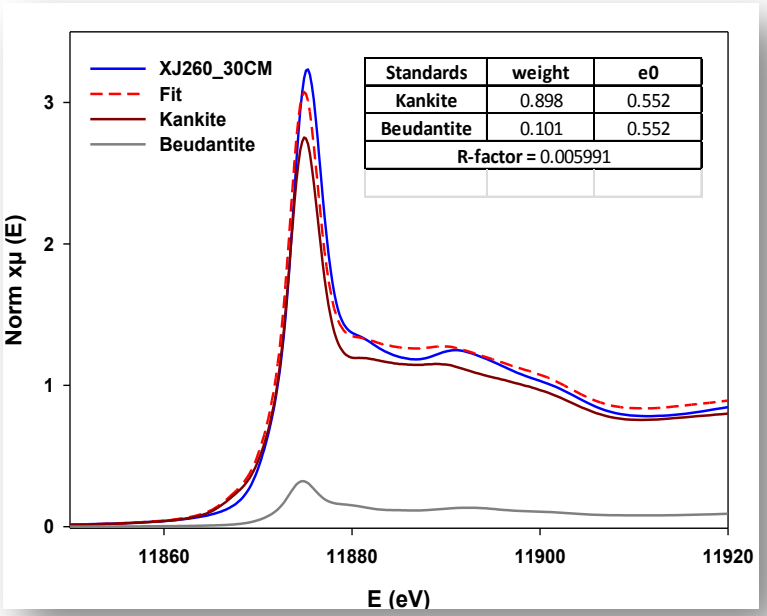

1.2
1.0
0.8
0.6
0.4
0.2
0.0
Intensity [normalised]
8940
8960
8980
9000
9020
9040
Energy [eV]
Cu
Cu2O
CuO

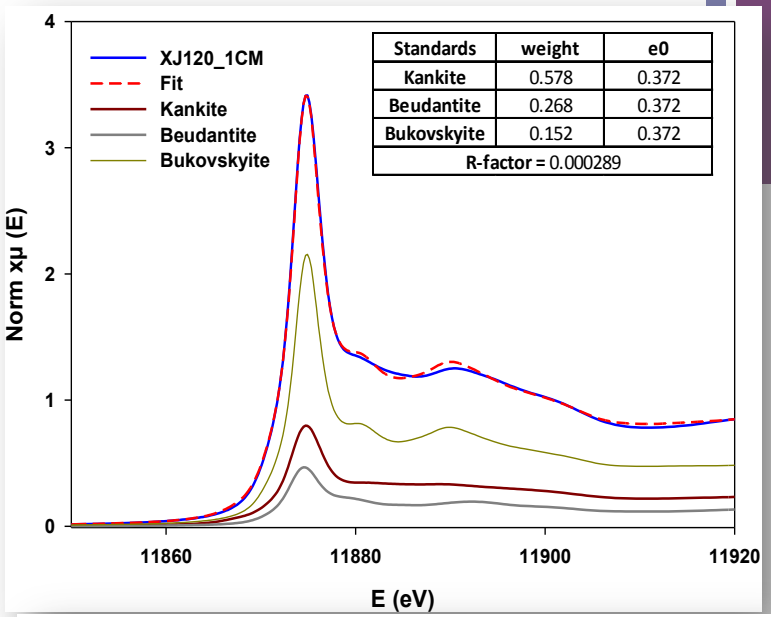
XANES de As



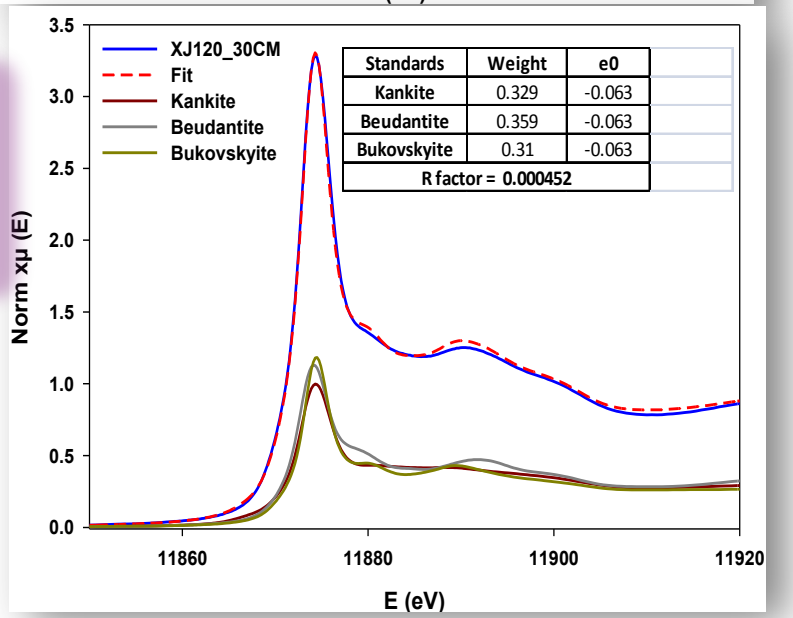
Espectros de XANES de As de algunas muestras representativas de los jales mineros y suelos en la zona de la mina “La Aurora. Las flechas marcan la energía de compuestos modelo de As (III) y As(V).

Análisis de combinación lineal

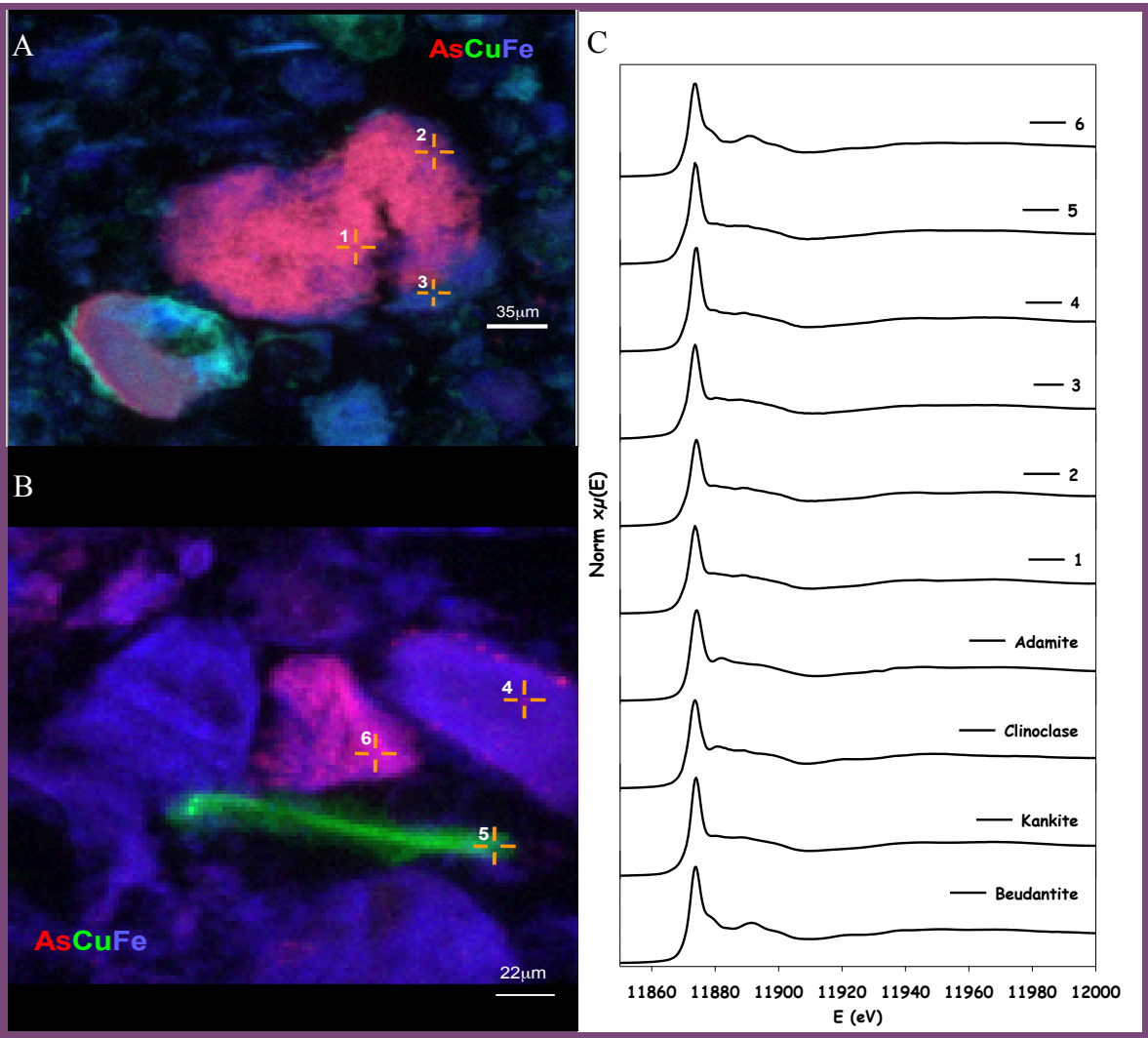




Kankita ($FeAsO_4 \cdot 3.5H_2O$)
Beudantita (PbFe3(AsO4)(OH)6)
BukovskyitaFe2(AsO4)(SO4)(OH)·7H2O)

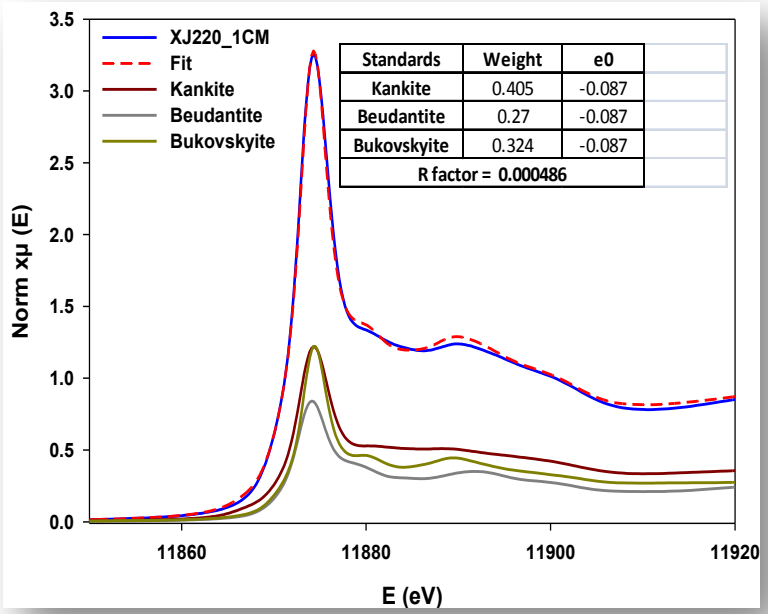


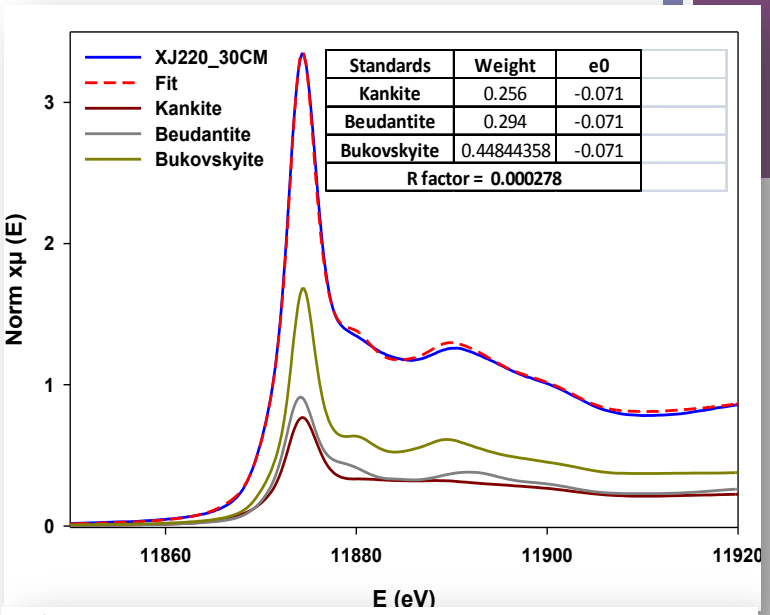
Análisis de combinación lineal de las muestras de suelos y jales mineros de la zona de la mina “La Aurora”. Los análisis se realizaron empleando el software Athena 0.8.056 (Brucel Ravel 2001-2008).



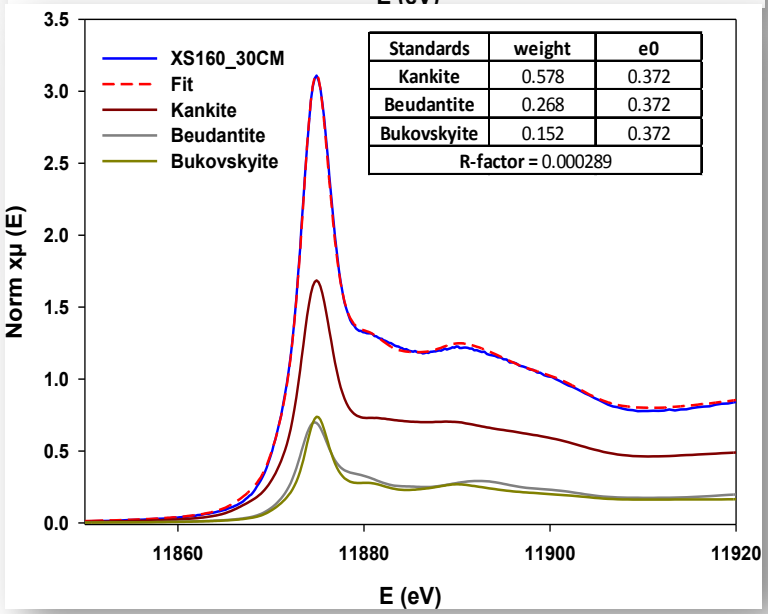
μXRF maps A) and B) from a tailing sample Ps <0.25mm. C) μ-XANES of marked points on A and B, and model compounds kankite [Kankite [$FeAsO_4 \cdot 5H_2O$]; Beudantite; [$PbFe_3(AsO_4)(SO_4)(OH)_6$]; Adamite [$Zn_2(AsO_4)OH$] and Clinoclase [$Cu_3AsO_4(OH)_3$]

Análisis de combinación lineal



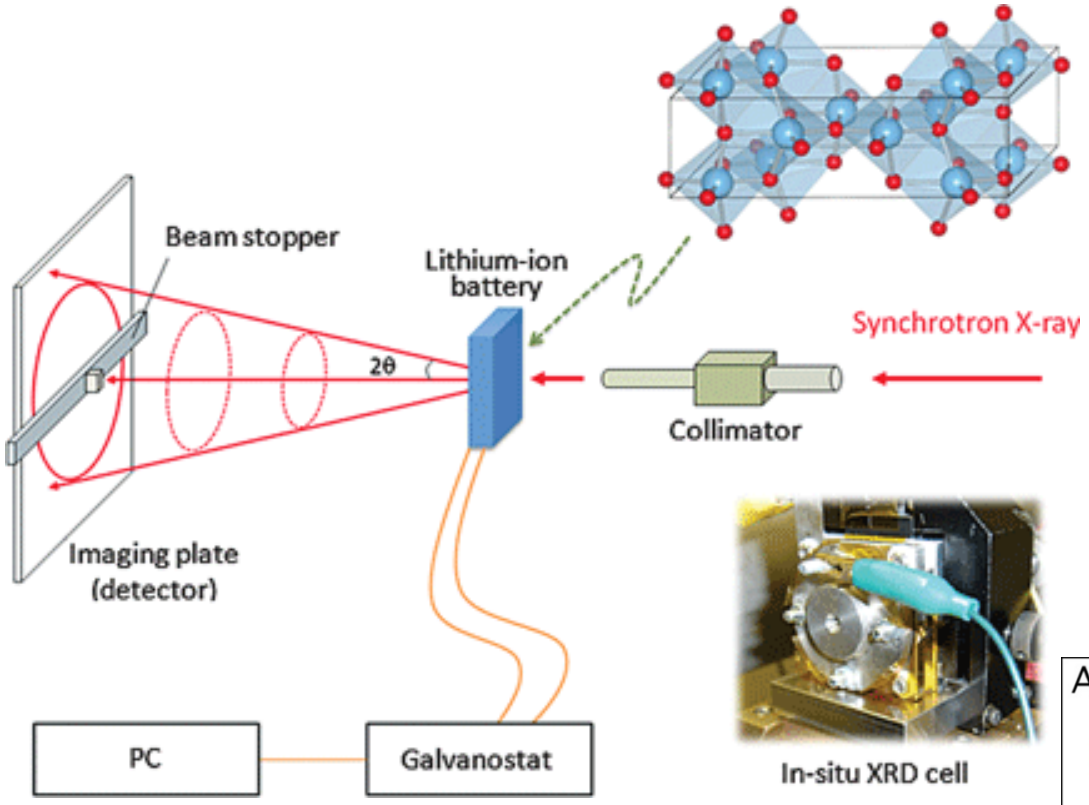


Kankita ($FeAsO_4 \cdot 3.5H_2O$)
Beudantita ($PbFe_3(AsO_4)(OH)_6$)
BukovskyitaFe2(AsO4)(SO4)(OH)·7H2O)

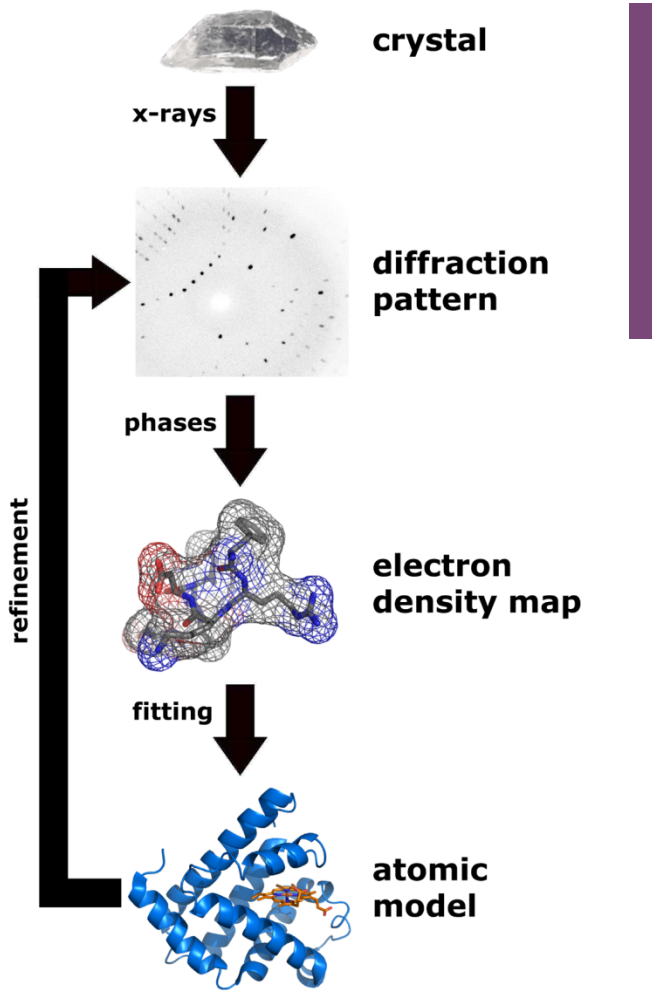


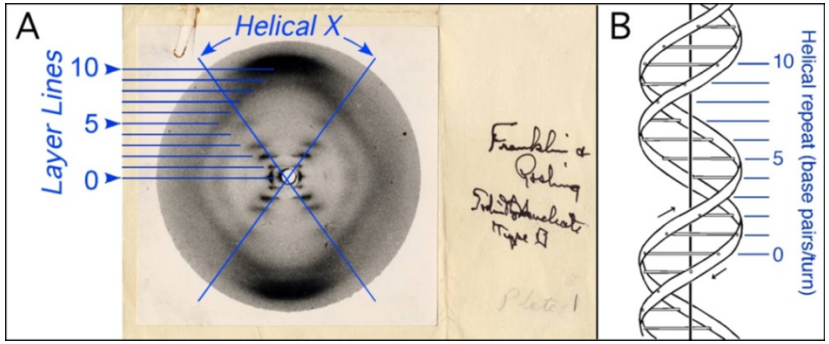
Análisis de combinación lineal de las muestras de suelos y jales mineros de la zona de la mina “La Aurora”. Los análisis se realizaron empleando el software Athena 0.8.056 (Brucel Ravel 2001-2008).

Rayos x: ¿dónde están los átomos?



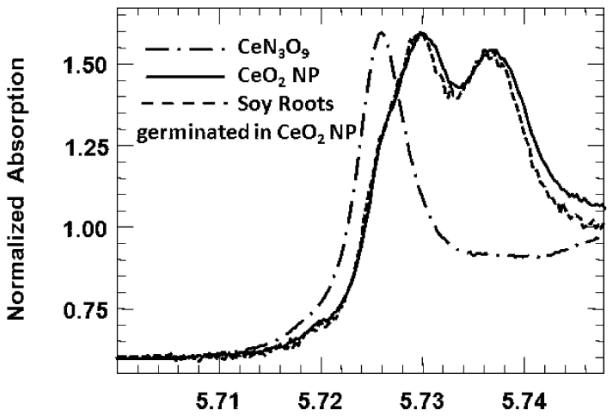
In-situ XRD cell



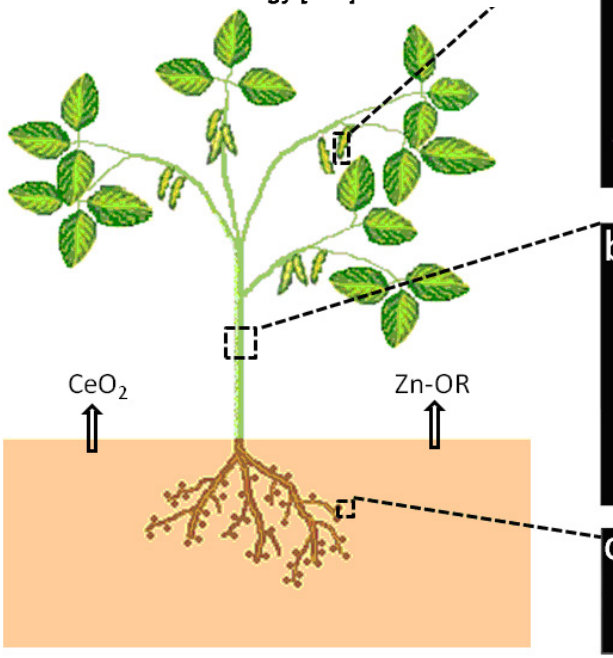


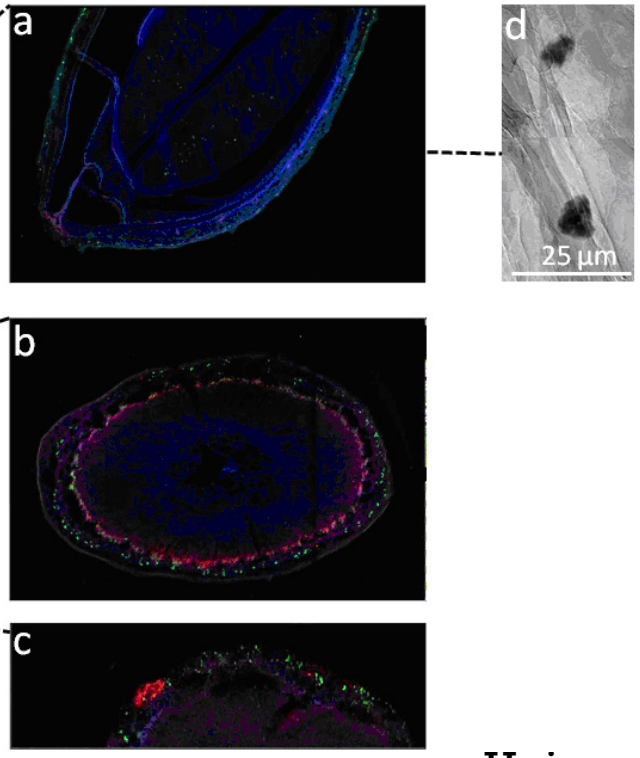
LIFE AND HEALTH

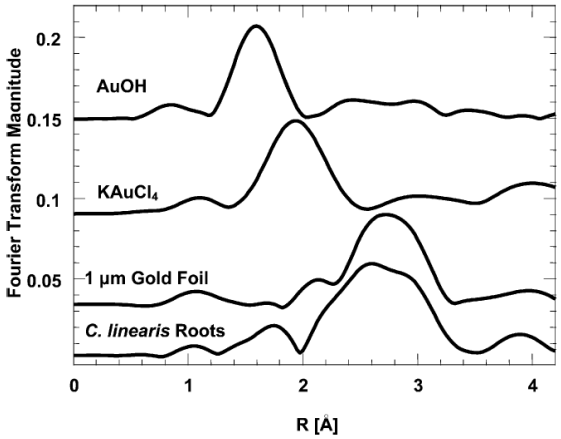
Acumulación de metales en plantas.



Transformación de nanopartículas (NP) tóxicas en plantas comestibles.



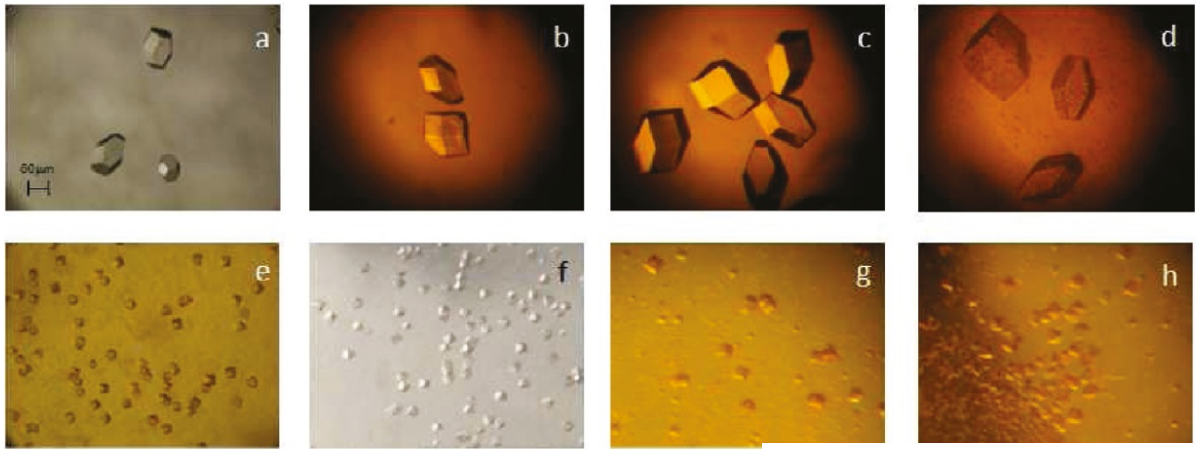




Efecto de agentes químicos en la fitoextracción de oro mediante plantas.

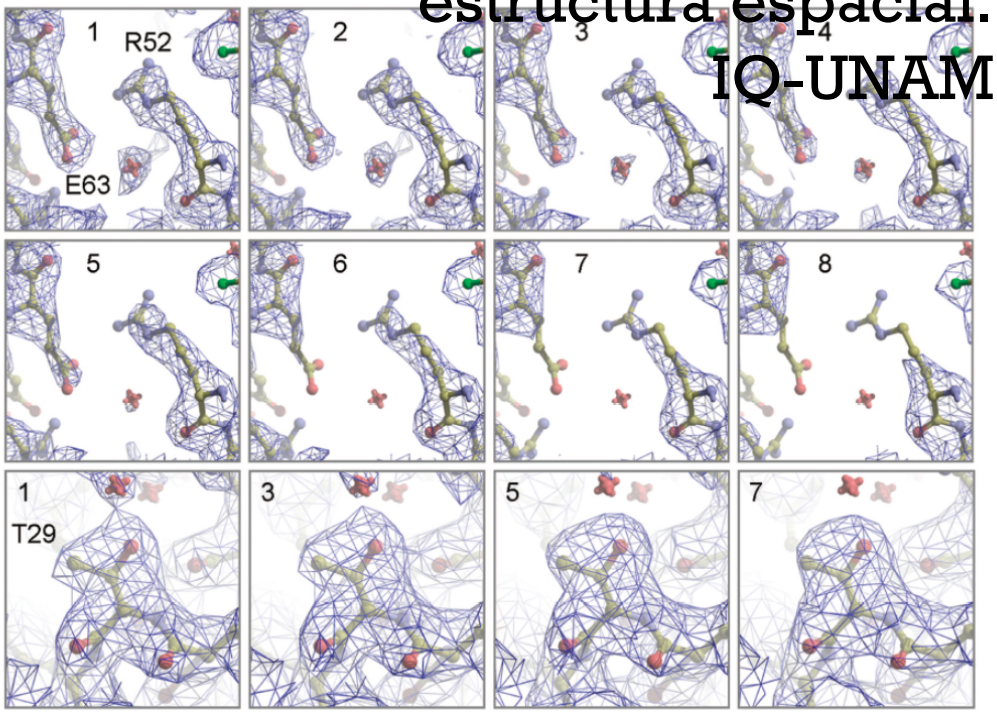
Universidad de Guanajuat

Estudio de las moléculas de la vida.



Nuevos métodos de producir cristales con moléculas complejas para estudiar su estructura espacial.

IQ-UNAM

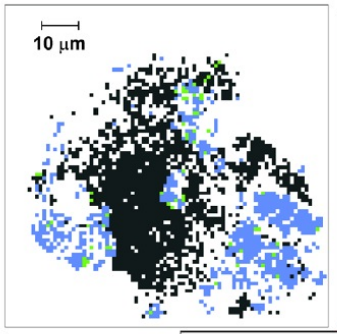


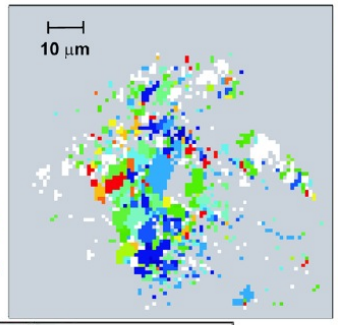
Los rayos x pueden dañar los cristales. Es importante medir ese daño para identificar las dosis que se deben emplear en experimentos .

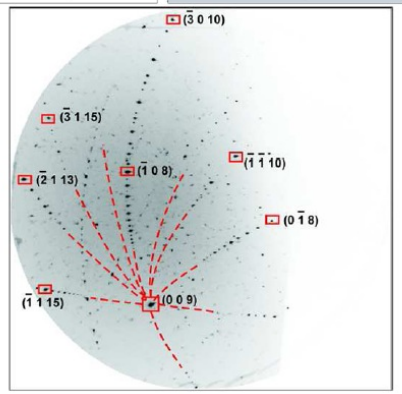
IBt-Cuernavaca

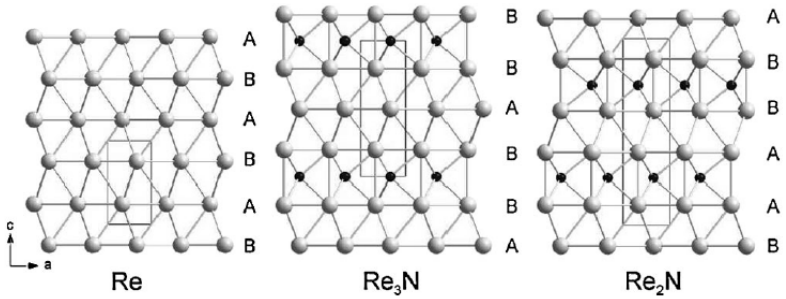
Nuevos materiales.

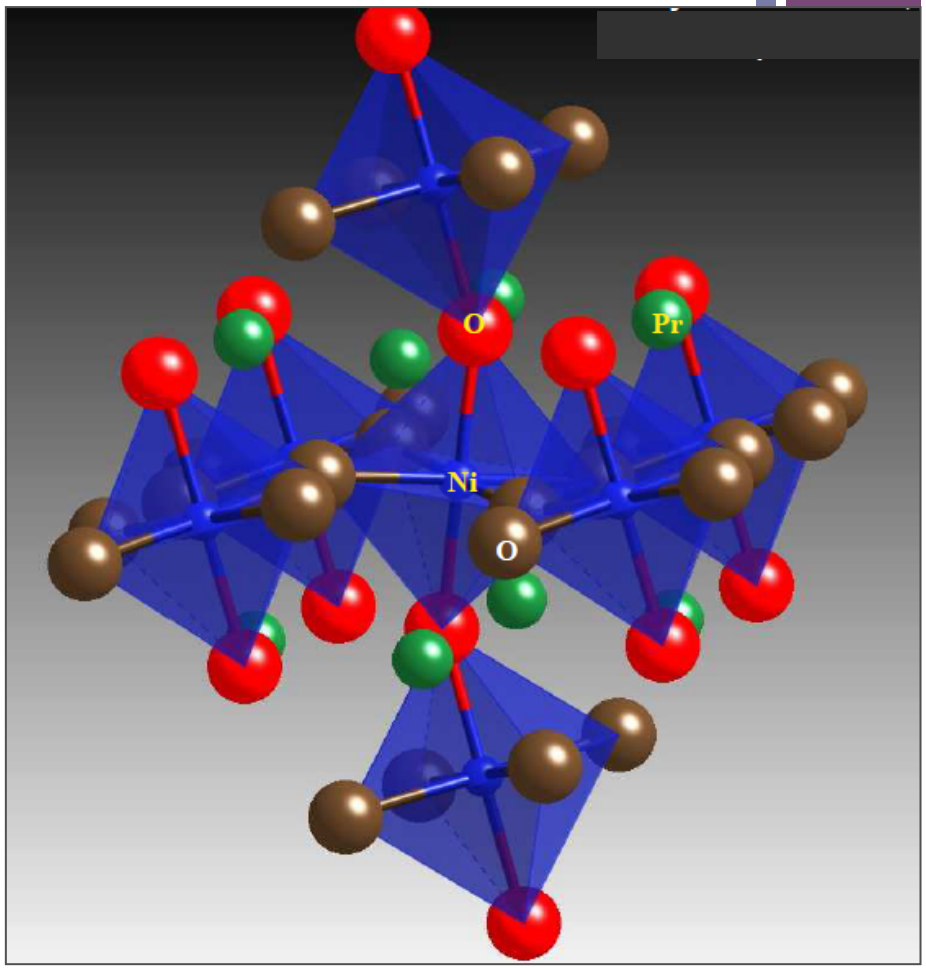
+Diseño bajo pedido.









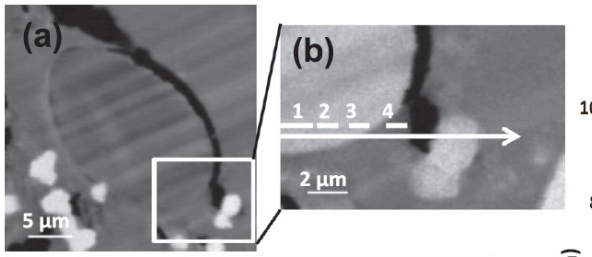


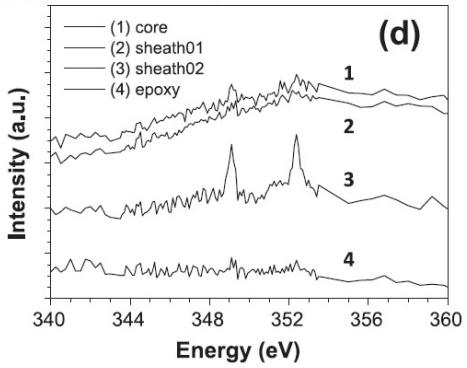
Universidad del Papaloapan, Oaxaca.

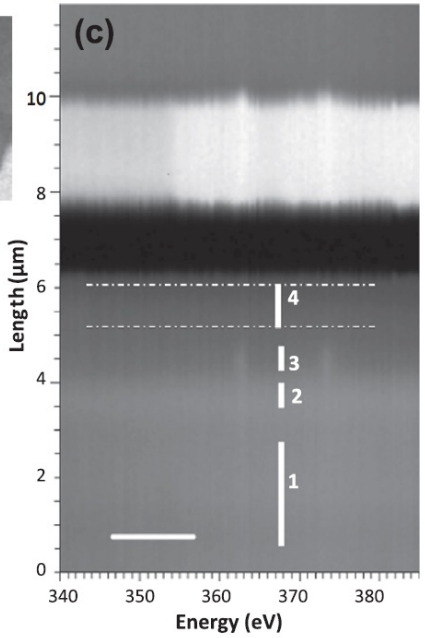
CINVESTAV Mérida

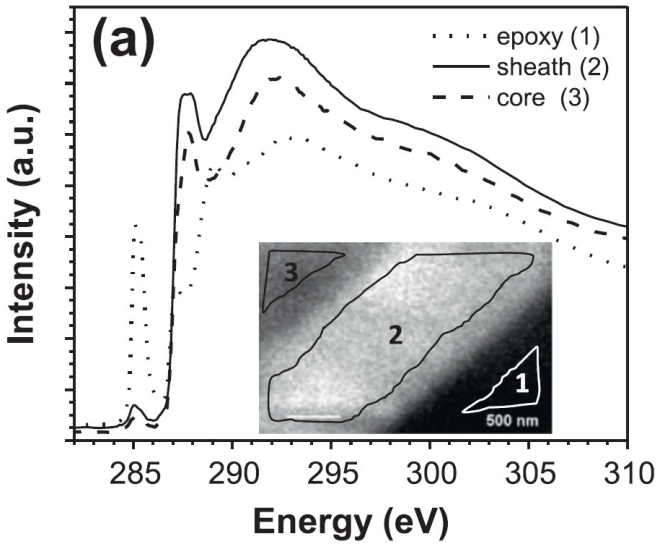
Cinvestav

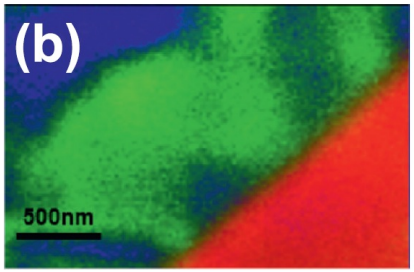
+ Materiales para infraestructura.









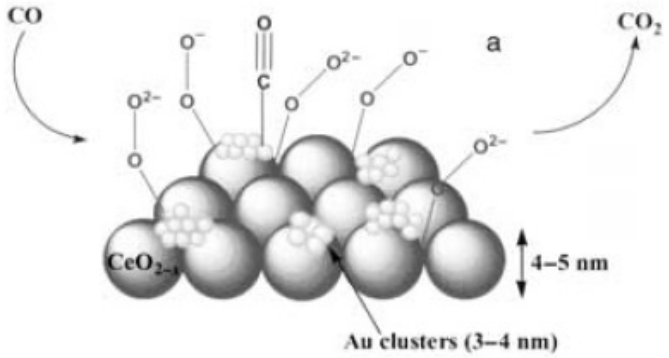


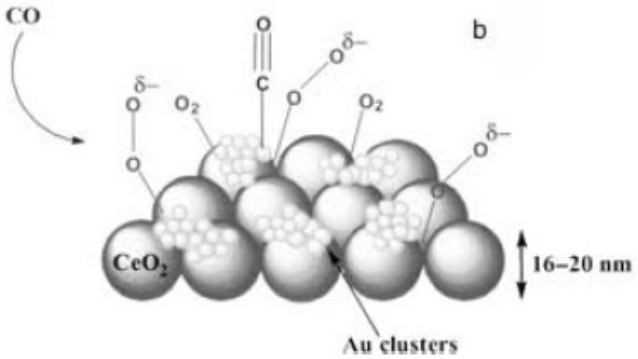
Efecto de añadir fibras epóxicas al cemento. Estudio de microfacturas en cemento.

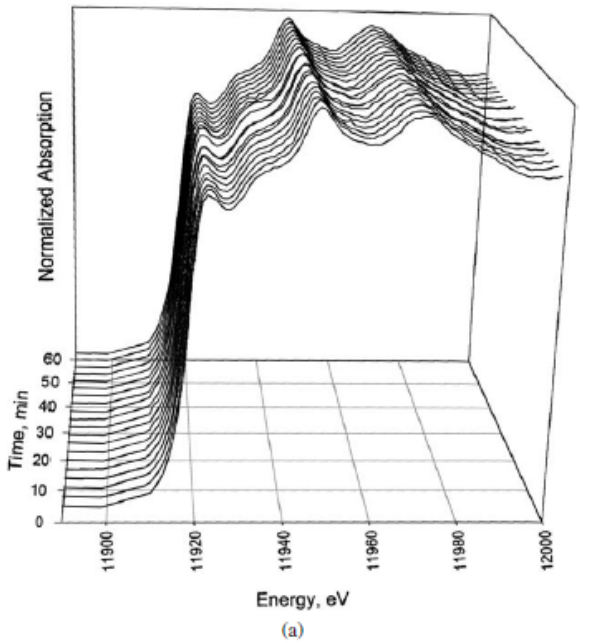
Universidad Autónoma de Chiapas.

CATALYSIS AND ENERGY

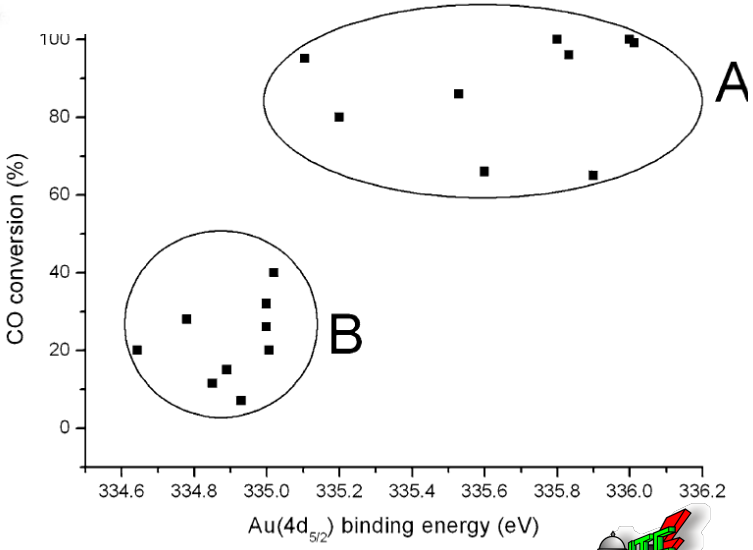
Catálisis.

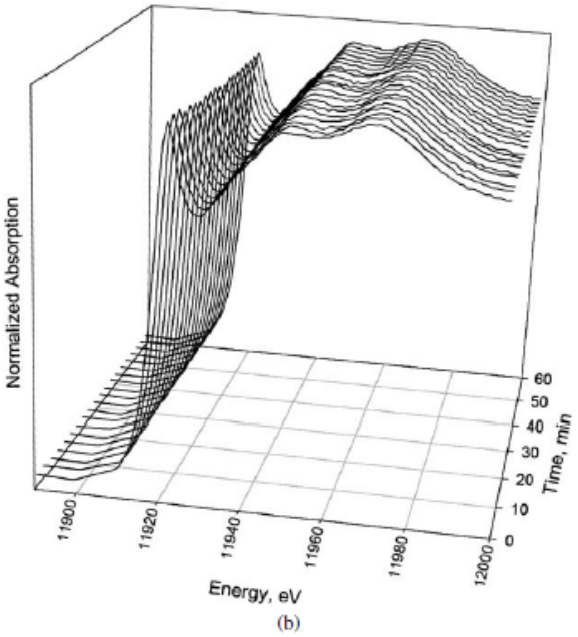




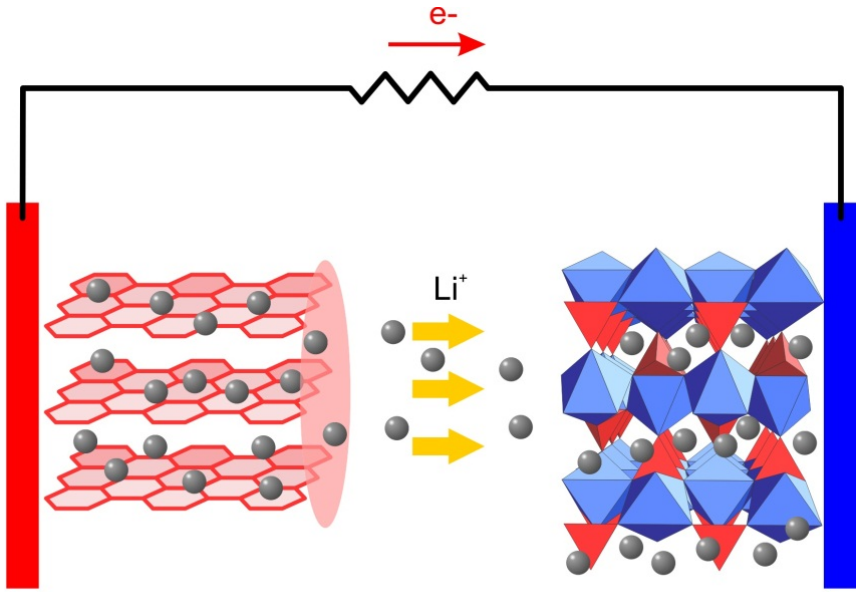


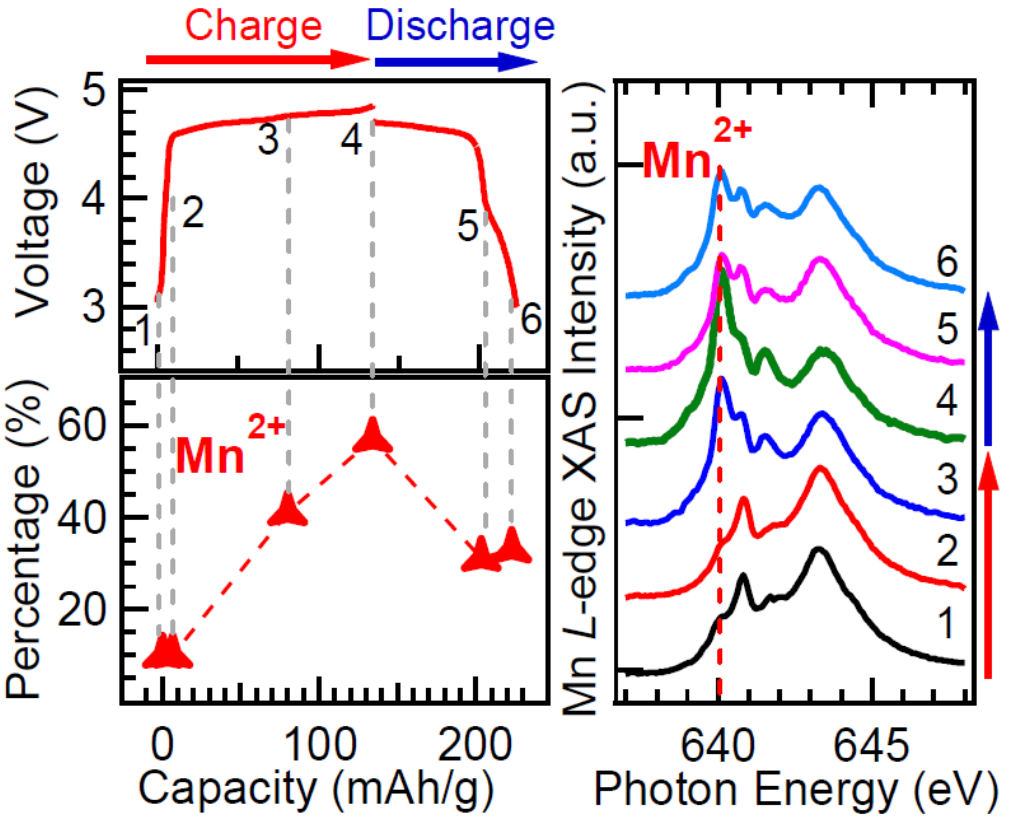
Oxidación de CO: usar oro como catalizador. Comparar sustratos y procesos de preparación.





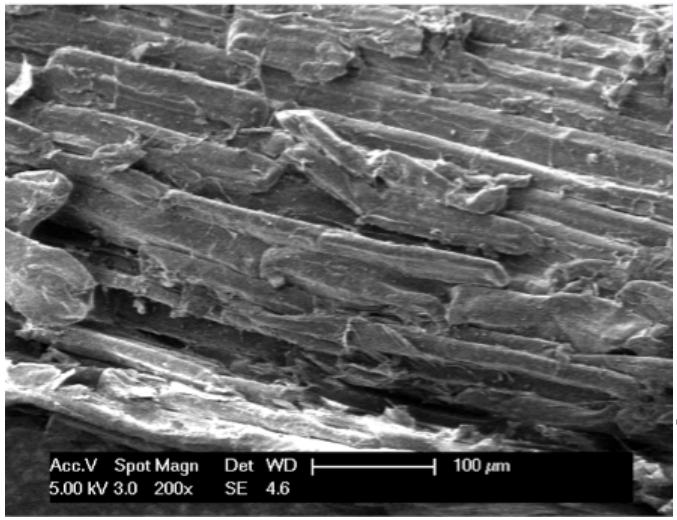
Baterías de Litio



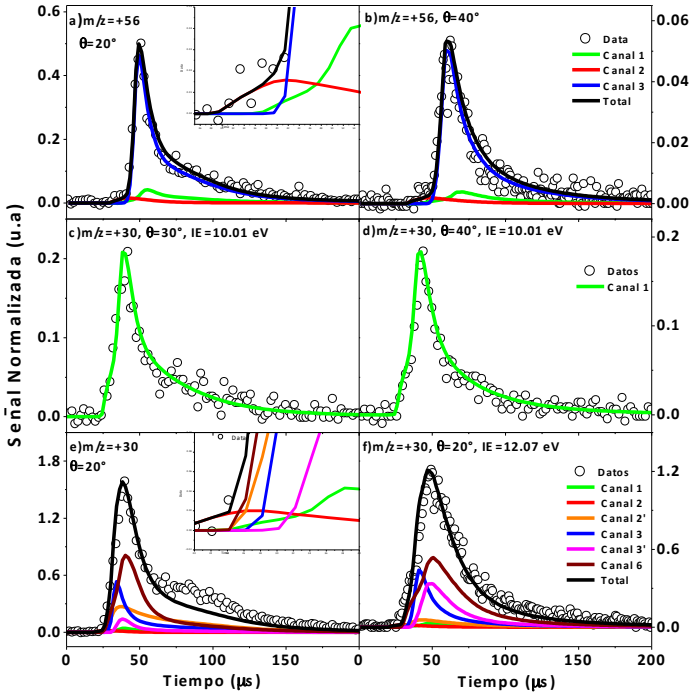


+ Biomateriales. Química verde.

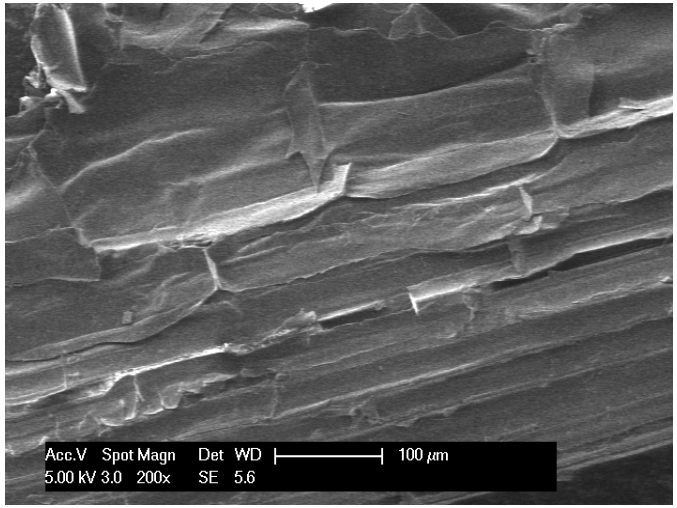
Taiwán



Bagazo de caña de azúcar para producir etanol.



Dinámica de descomposición de biodiesel.

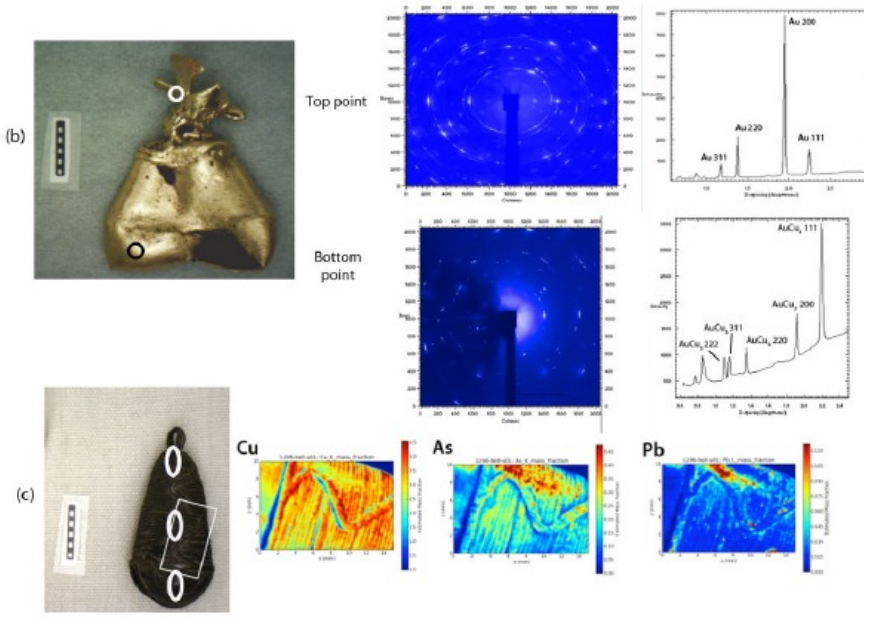


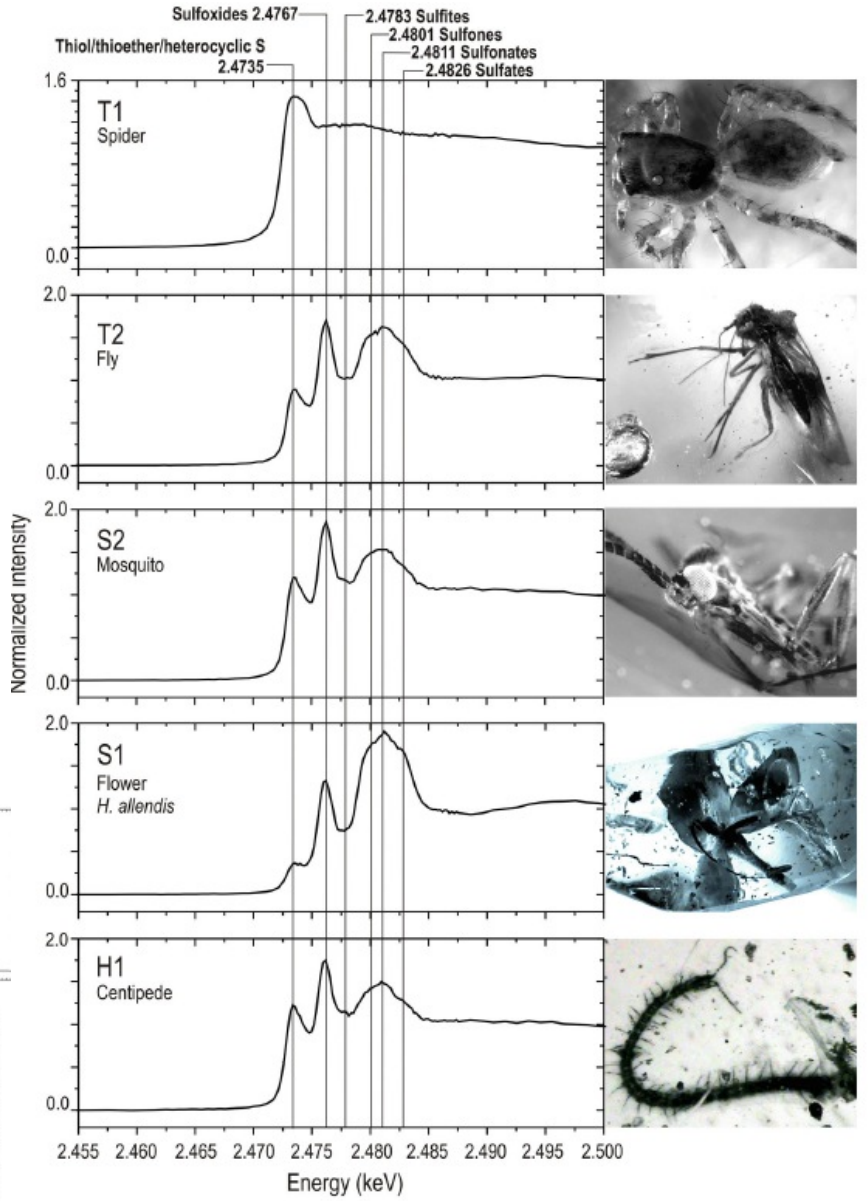
Instituto Tecnológico de Zacatepec.

+

CULTURAL HERITAGE

Joyas extraídas del cenote de Chichén Itzá.





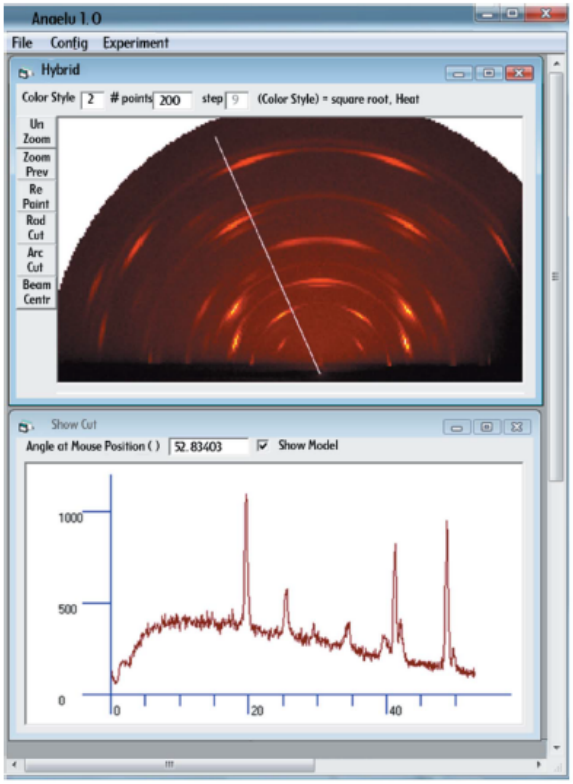
Fósiles atrapados en ámbar de Chiapas.

Instituto de Física, UNAM.

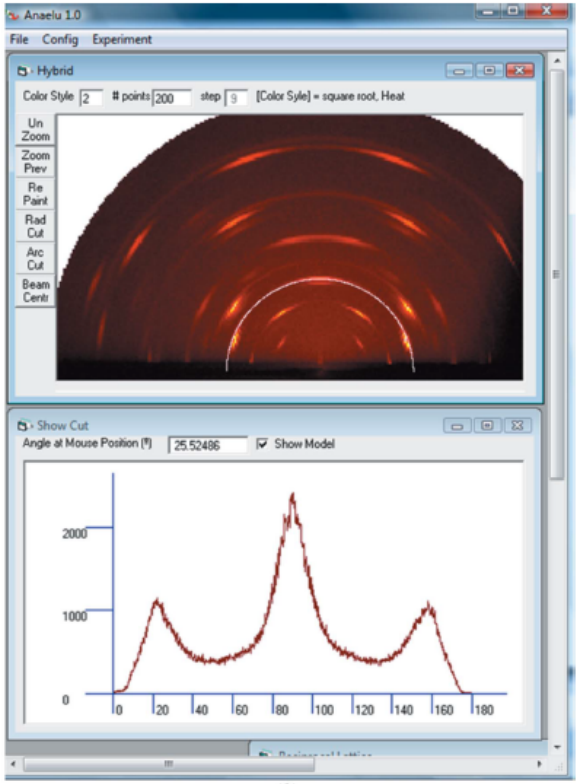
Instituto de Física

Cómputo de alto rendimiento

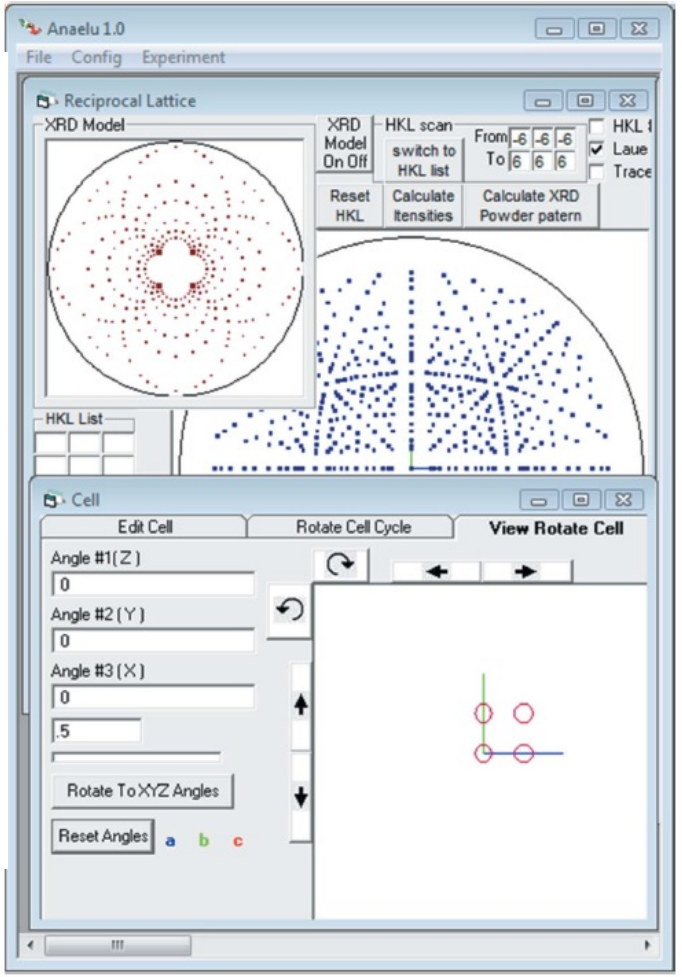
Para procesar gigas y gigas de datos.



(a)

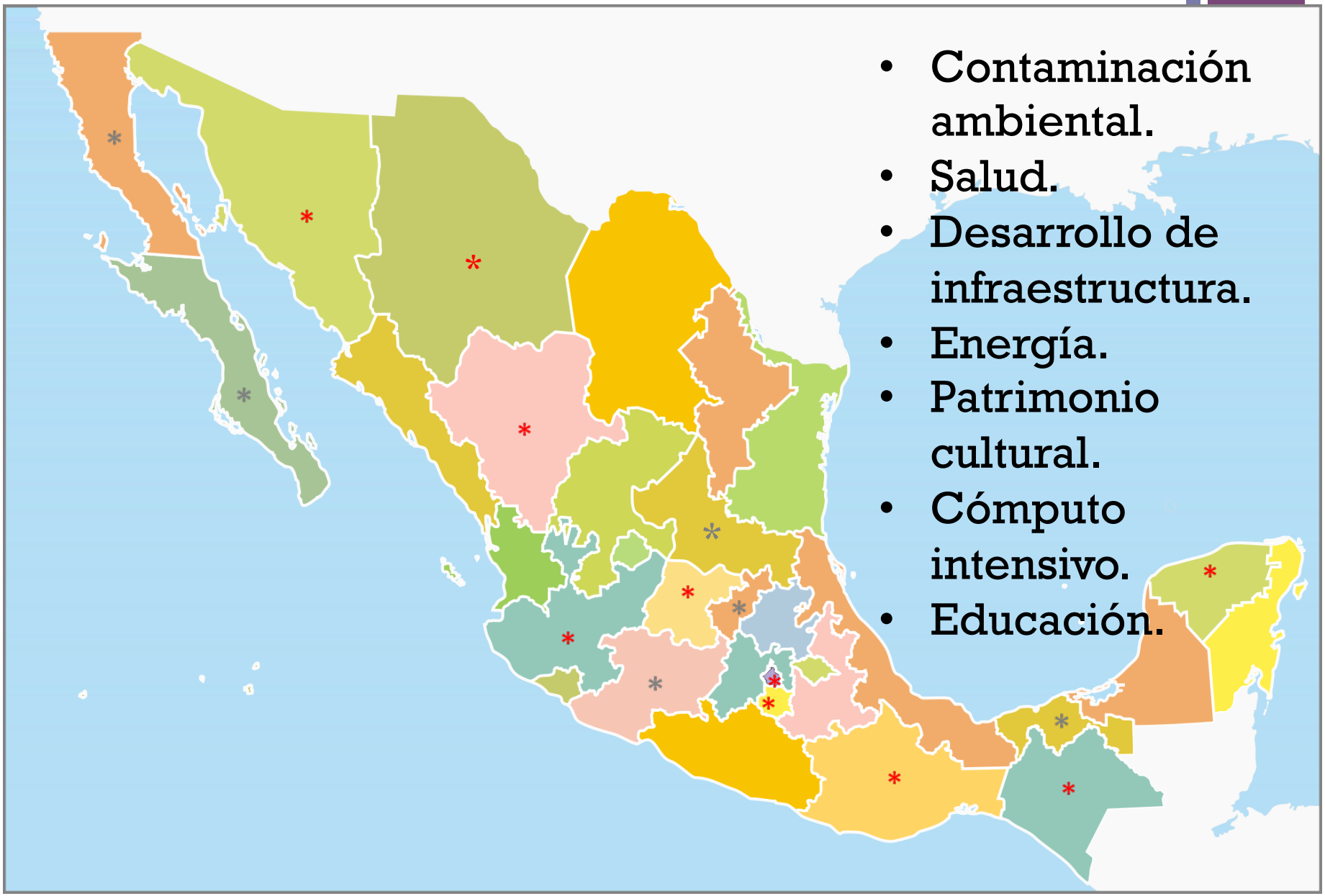


(b)



CIMAV Chihuahua.

Mapa - resumen



Pregunta final.

Si como usuarios hemos logrado muy buenos resultados ¿qué será cuando tengamos el ***Sincrotrón Mexicano***?

José Jiménez Mier y Terán

Primer Usuario mexicano de Luz Sincrotrón