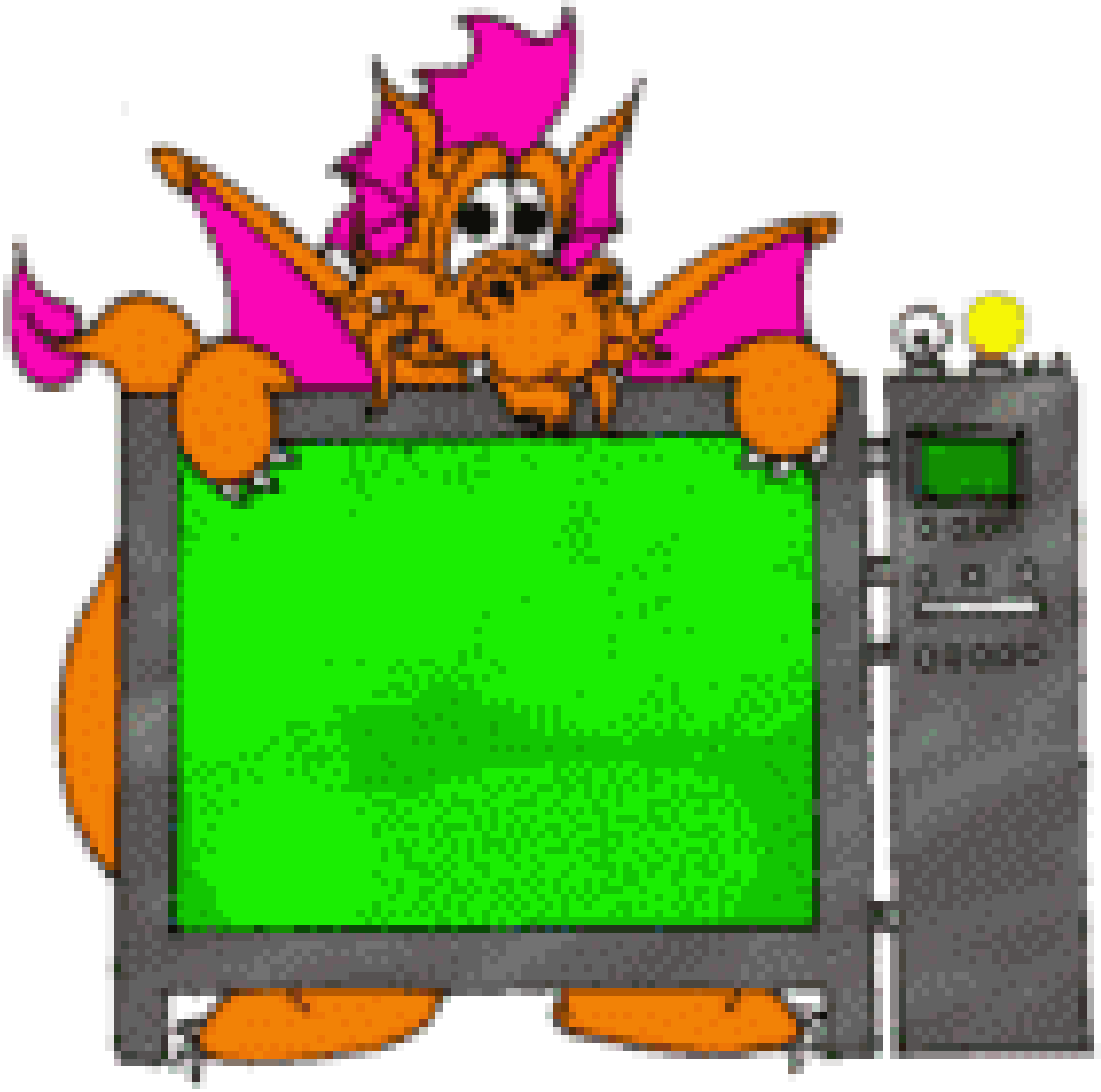
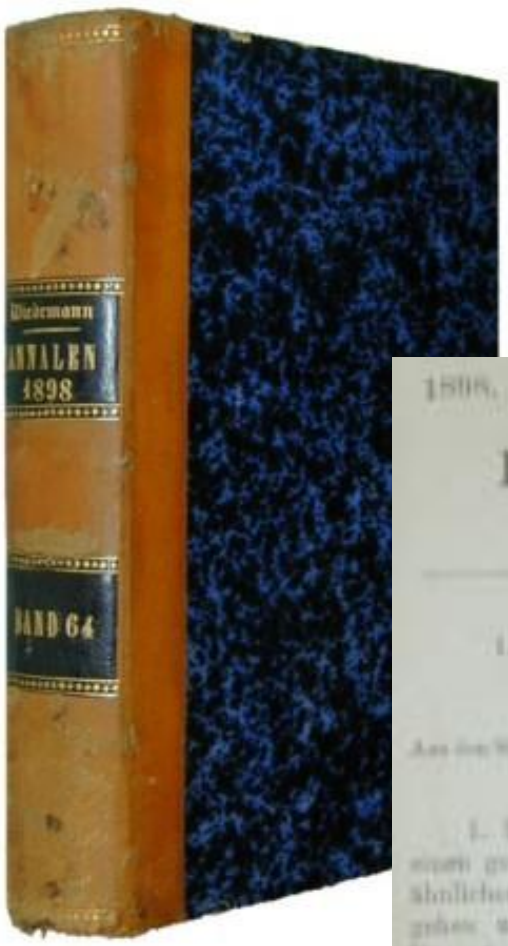
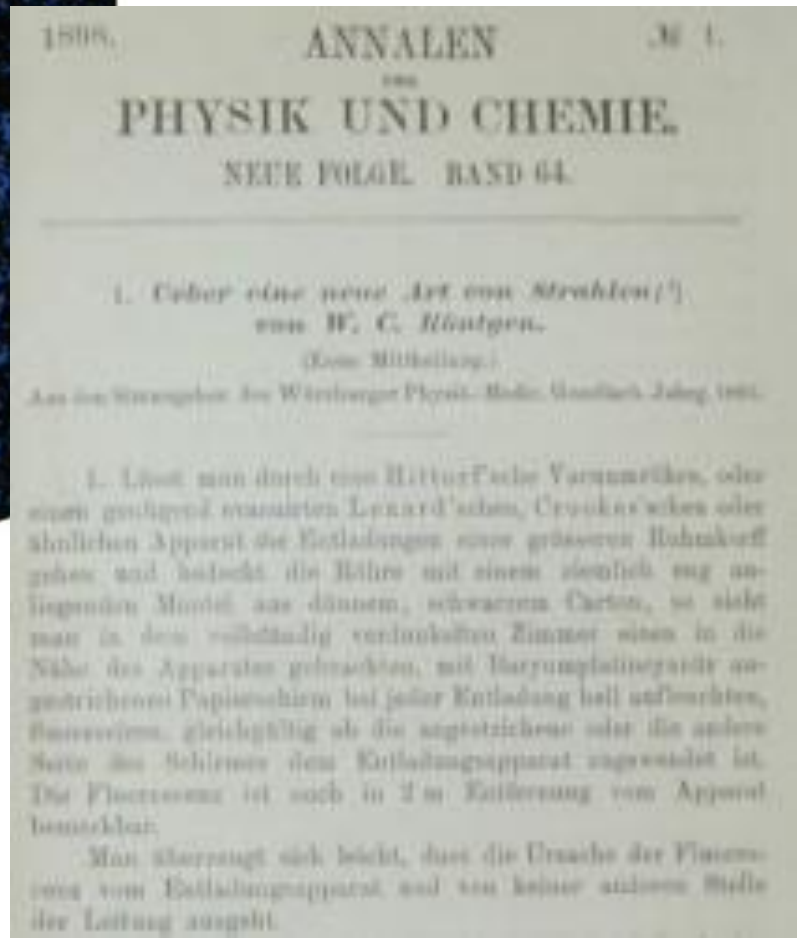





1898. ANNALEN Nº 1.

DER

PHYSIK UND CHEMIE.

NEUE FOLGE. BAND 64.

1. *Ueber eine neue Art von Strahlen*(1).

von *W. C. Röntgen.*

(Vorl. Mittheilung.)

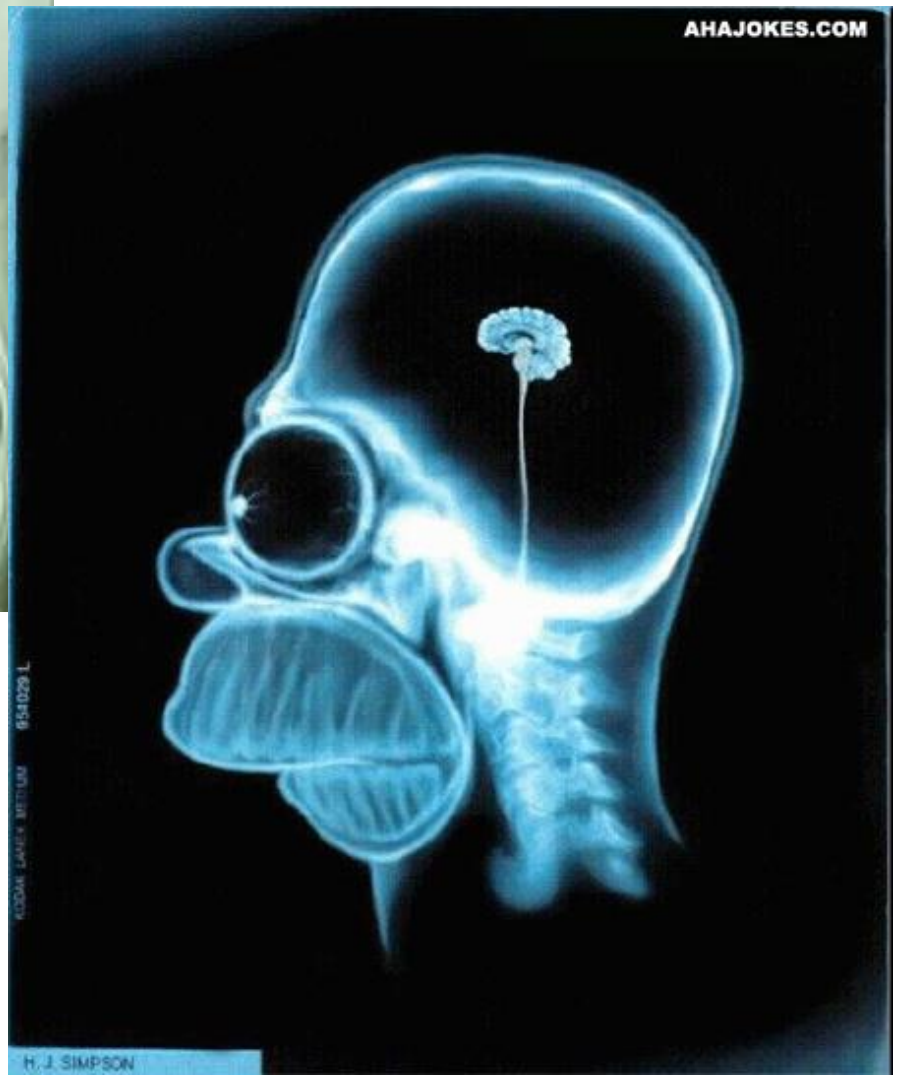
Aus den Sitzungsber. der Würzburger Physik.-Medic. Gesellsch. Jahrg. 1895.

1. Lässt man durch eine Ritter'sche Vacuumröhre, oder einen geeigneten sonstigen Lenard'schen, Crookes'schen oder ähnlichen Apparat die Entladungen eines grösseren Ruhmkorff gehen und belegt die Röhre mit einem ziemlich eng anliegenden Mantel aus dünnem, schwarzem Carton, so sieht man in dem vollständig verdunkelten Zimmer einen in die Nähe des Apparates gebrachten, mit Baryumplatincyanür angestrichenen Papierschirm bei jeder Entladung hell aufleuchten, Fluorescenz, gleichgültig ob die angestrichene oder die andere Seite des Schirmes dem Entladungsapparat zugewendet ist. Die Fluorescenz ist noch in 2 m Entfernung vom Apparat bemerkbar.

Man überzeugt sich leicht, dass die Ursache der Fluorescenz vom Entladungsapparat und von keiner anderen Stelle der Leitung ausgeht.

1895 – Röntgen: descoberta dos raios X

utilização na medicina

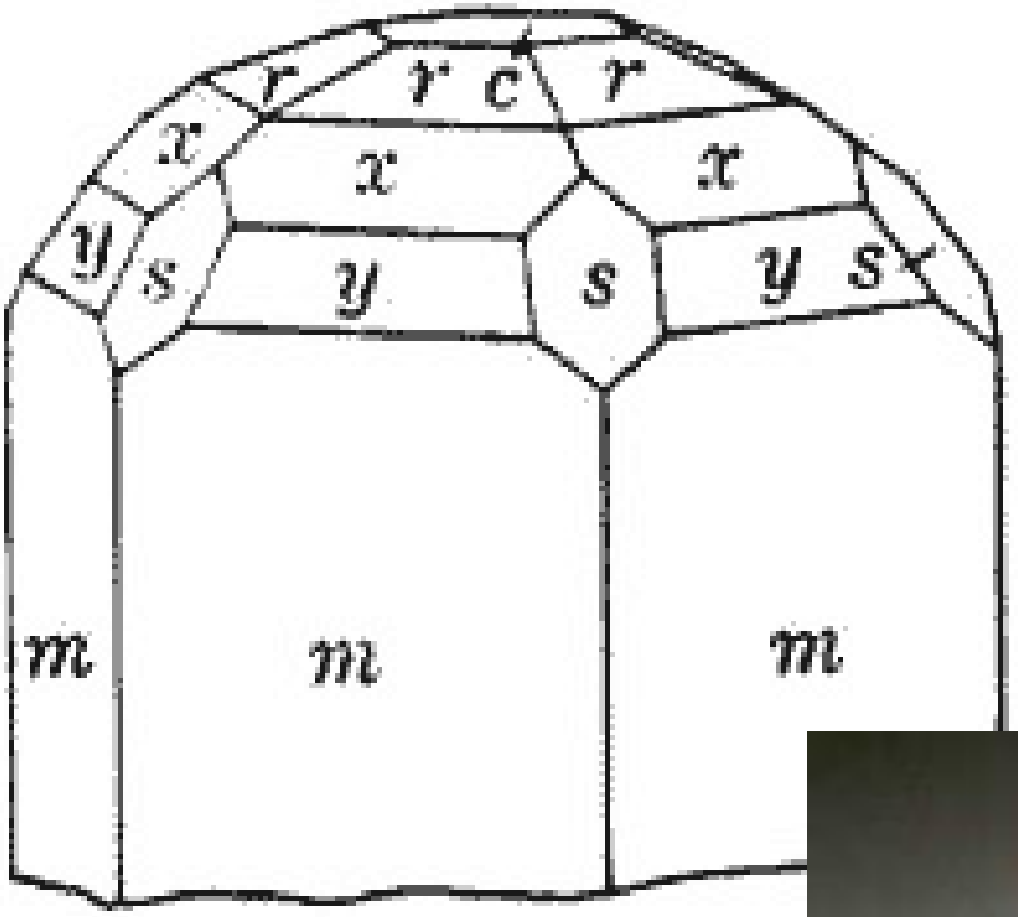

AHAJOKES.COM
H. J. SIMPSON

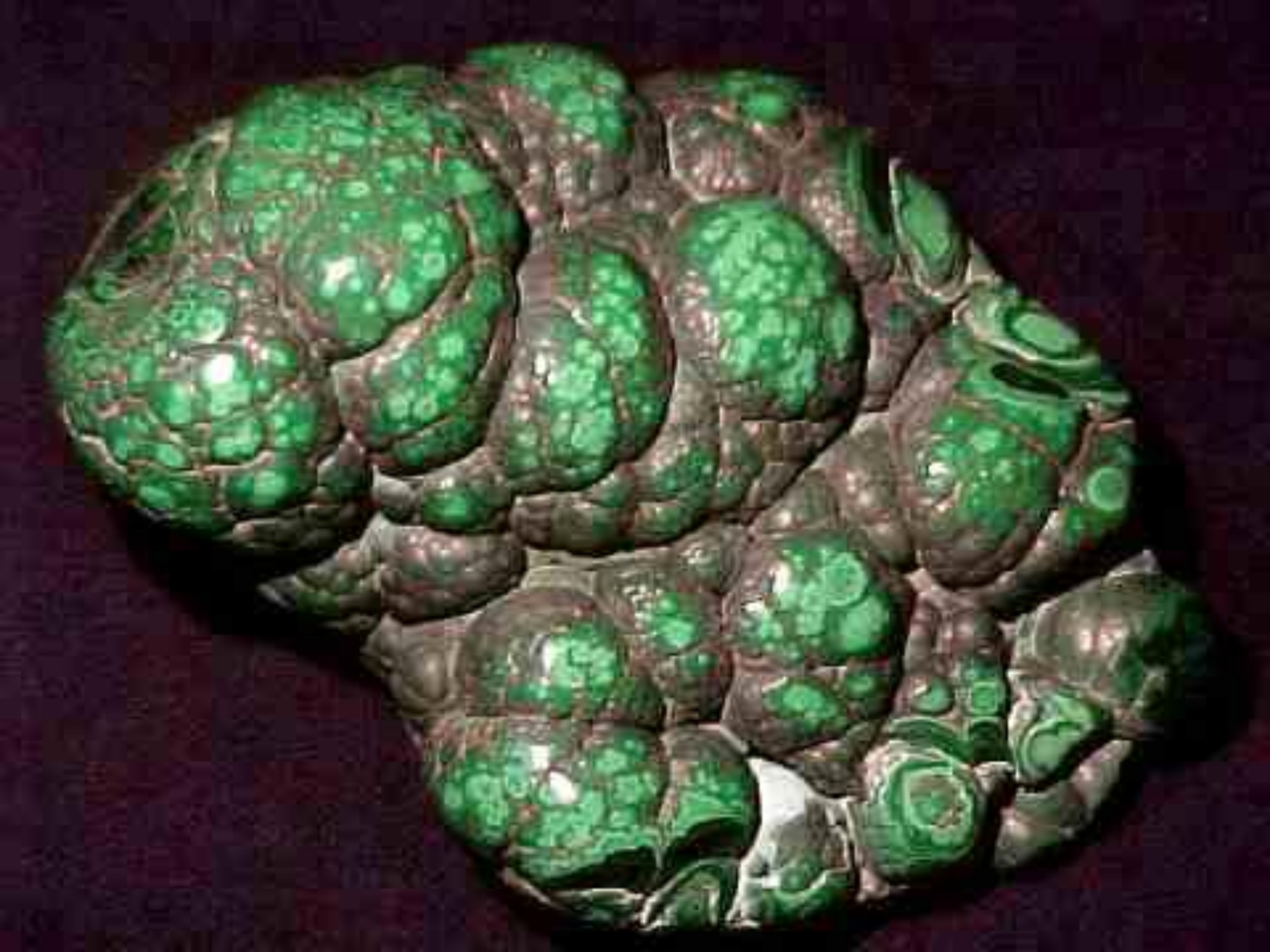

WILHELM
CONRAD RÖNTGEN
1845 - 1923
X
ENTDECKUNG DER
RÖNTGEN-
STRAHLEN
8.11.1895
10
DEUTSCHE MARK
BUNDESREPUBLIK
DEUTSCHLAND
1995

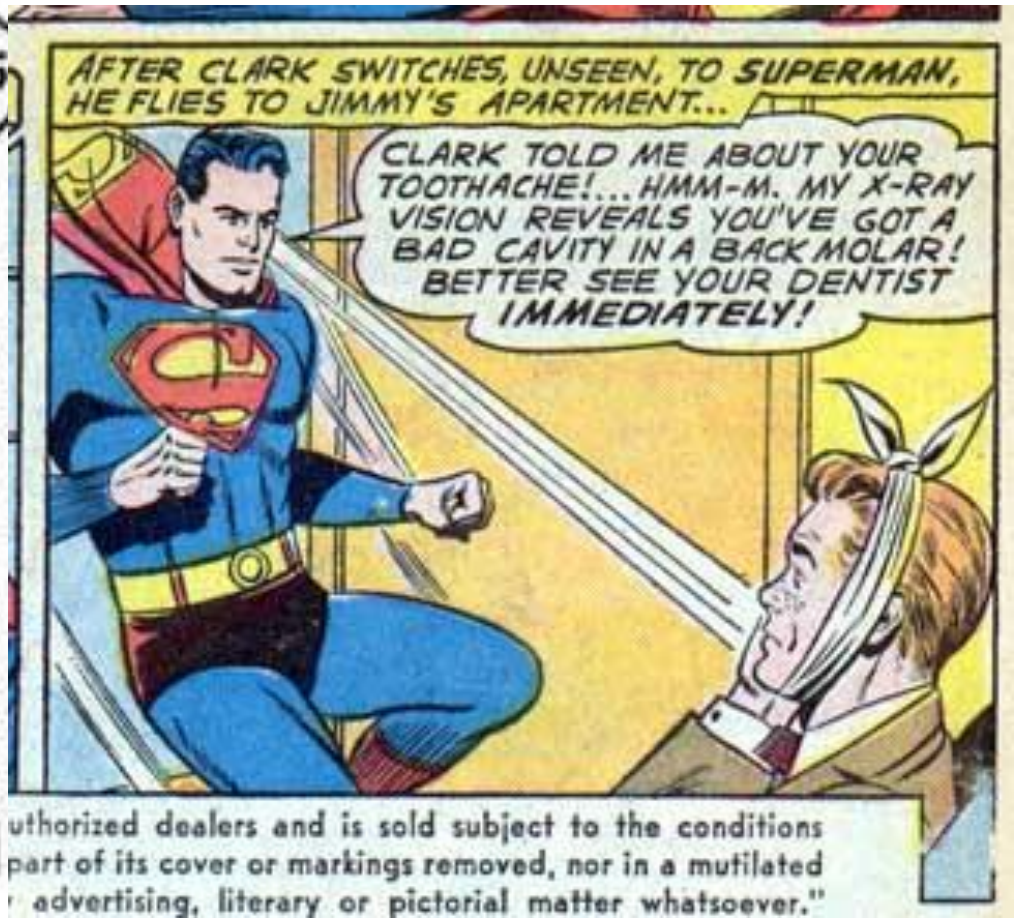

Wilhelm Conrad Röntgen
1845 - 1923
X
100
Deutsche
Bundespost
100 JAHRE ENTDECKUNG DER RÖNTGENSTRAHLEN
1995


HELFER DER MENSCHHEIT
WILHELM CONRAD
RÖNTGEN
Das Buch
Der Film
BAND 1


République Togolaise
200F


r
r
c
r
x
x
x
y
s
y
s
y
s
m
m
m



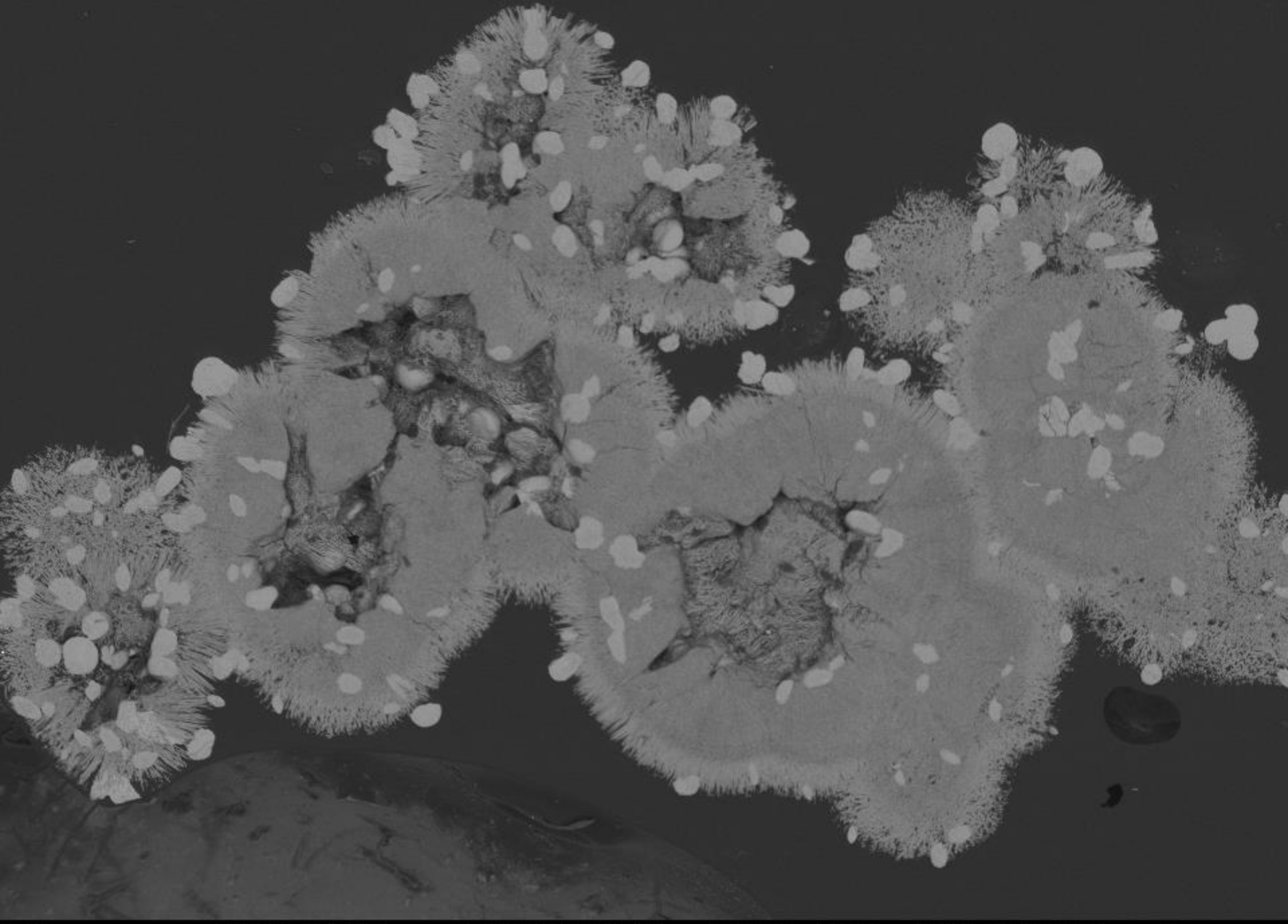


Difração de raios X

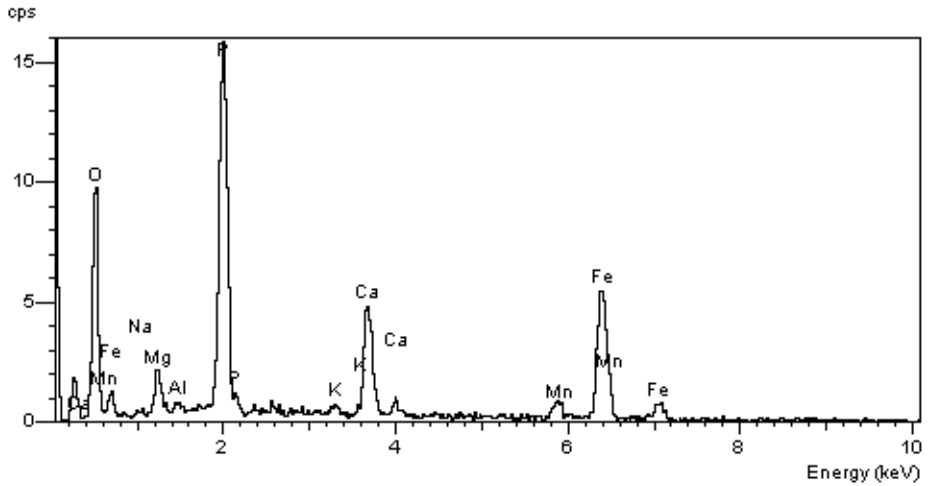
DANIEL ATENCIO

Utilidade:
Desde a simples identificação de substâncias cristalinas, até a determinação da posição de cada átomo na estrutura

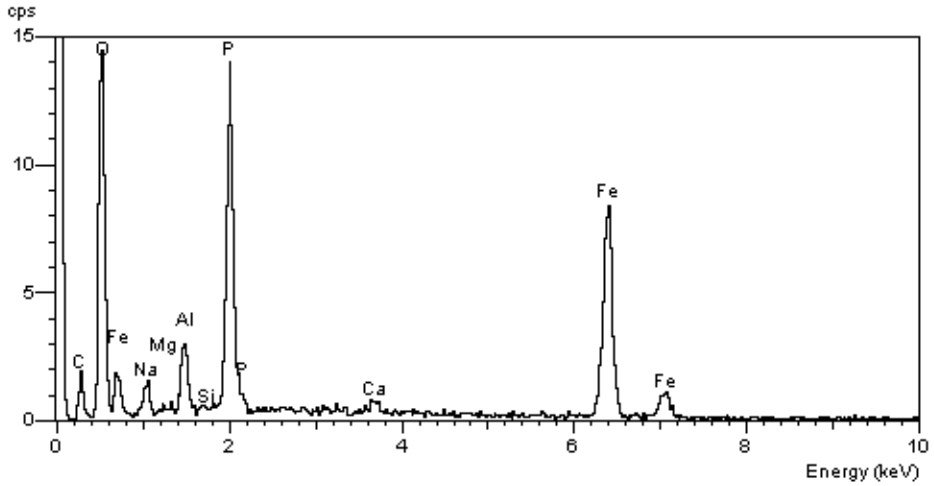

2 mm

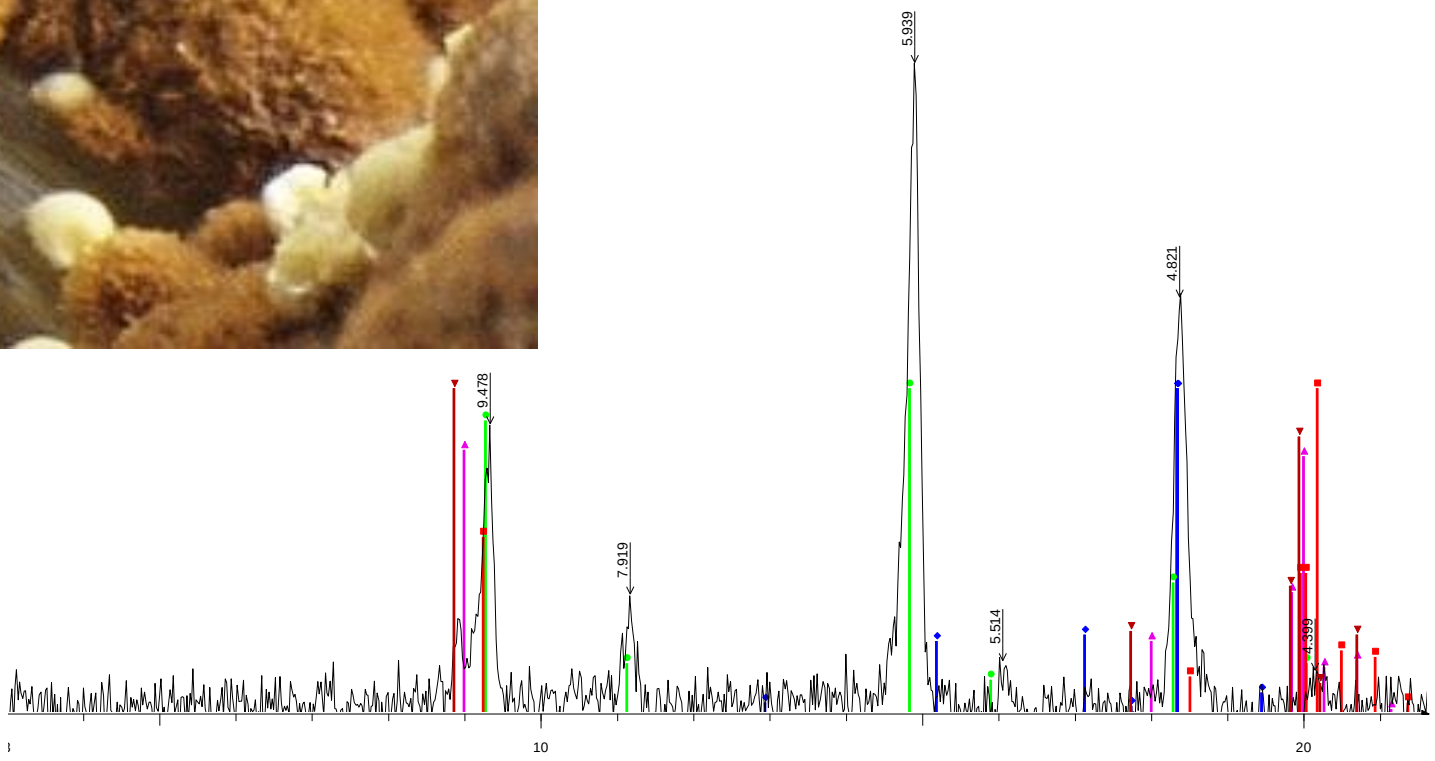

0µm
WD = 25 mm
Detector = QBSD
Mag = 50 X
LCT - LEO 440
S1

Ruifrancoíta, Ca2(□,Mn2+)2 (Fe3+,Mg,Mn2+,Fe2+,Al)4Be4 (PO4)6(OH)4(OH,H2O)2·4H2O

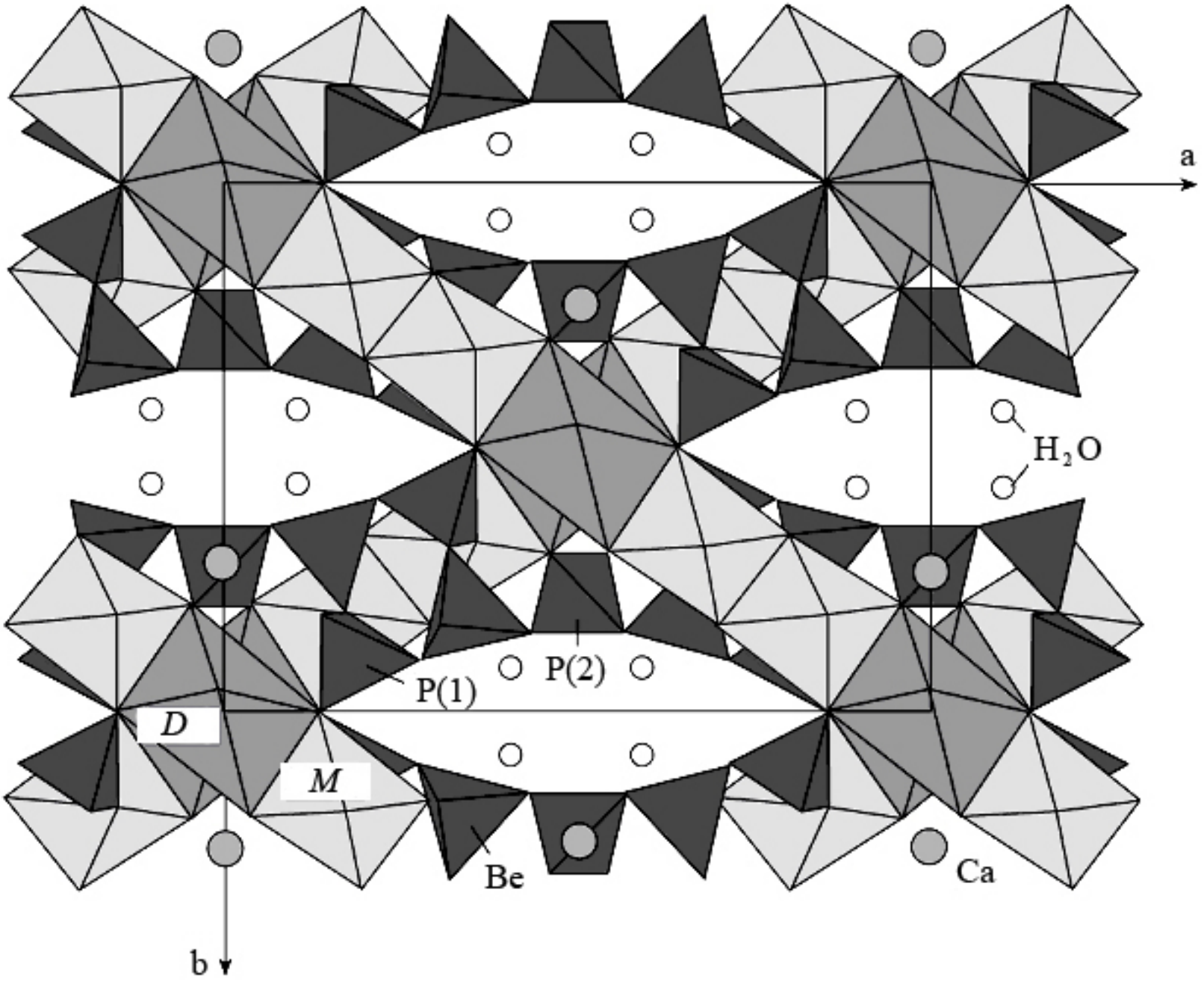


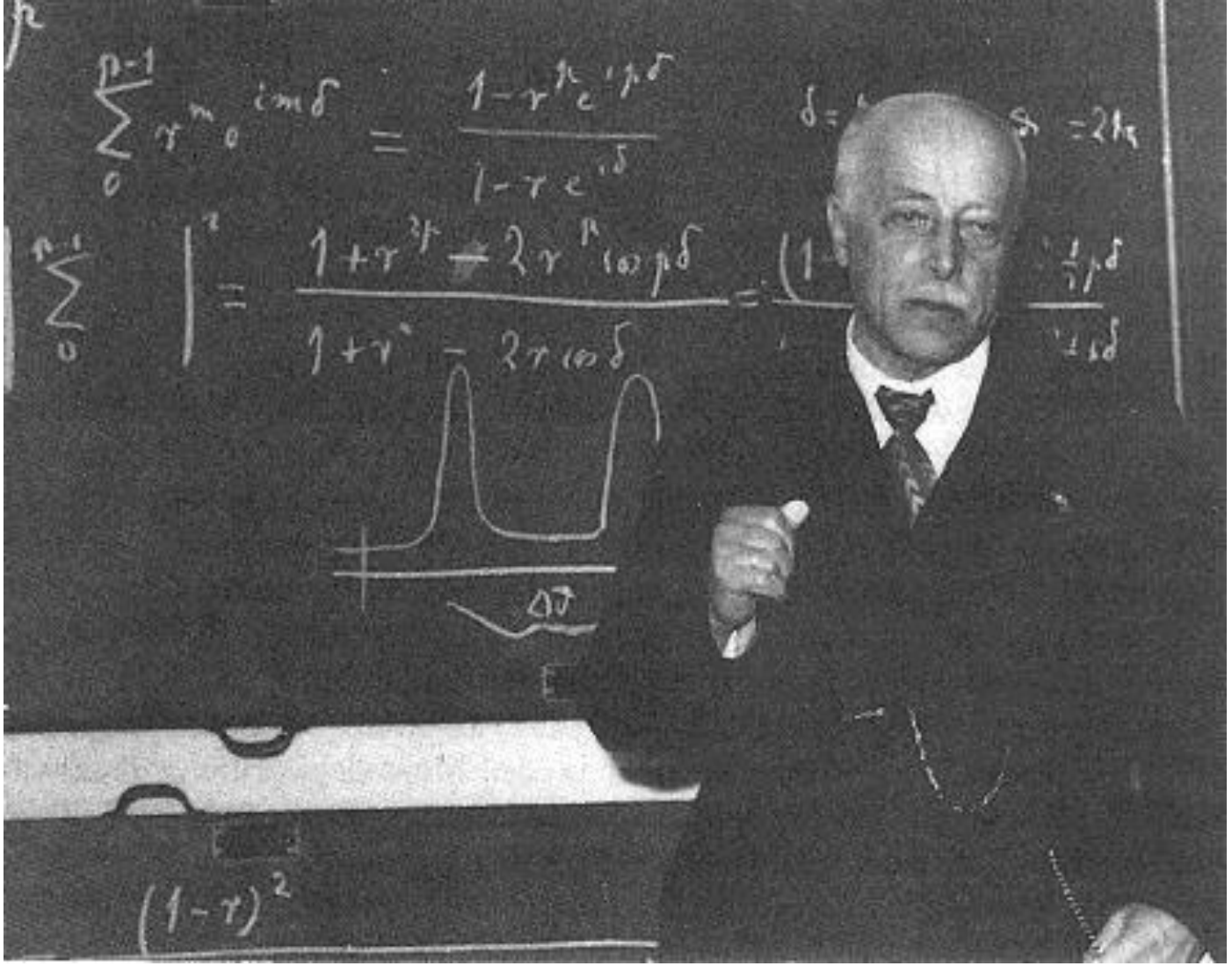
Cyrilovita - NaFe3+3[(OH)2|PO4]2·2H2O





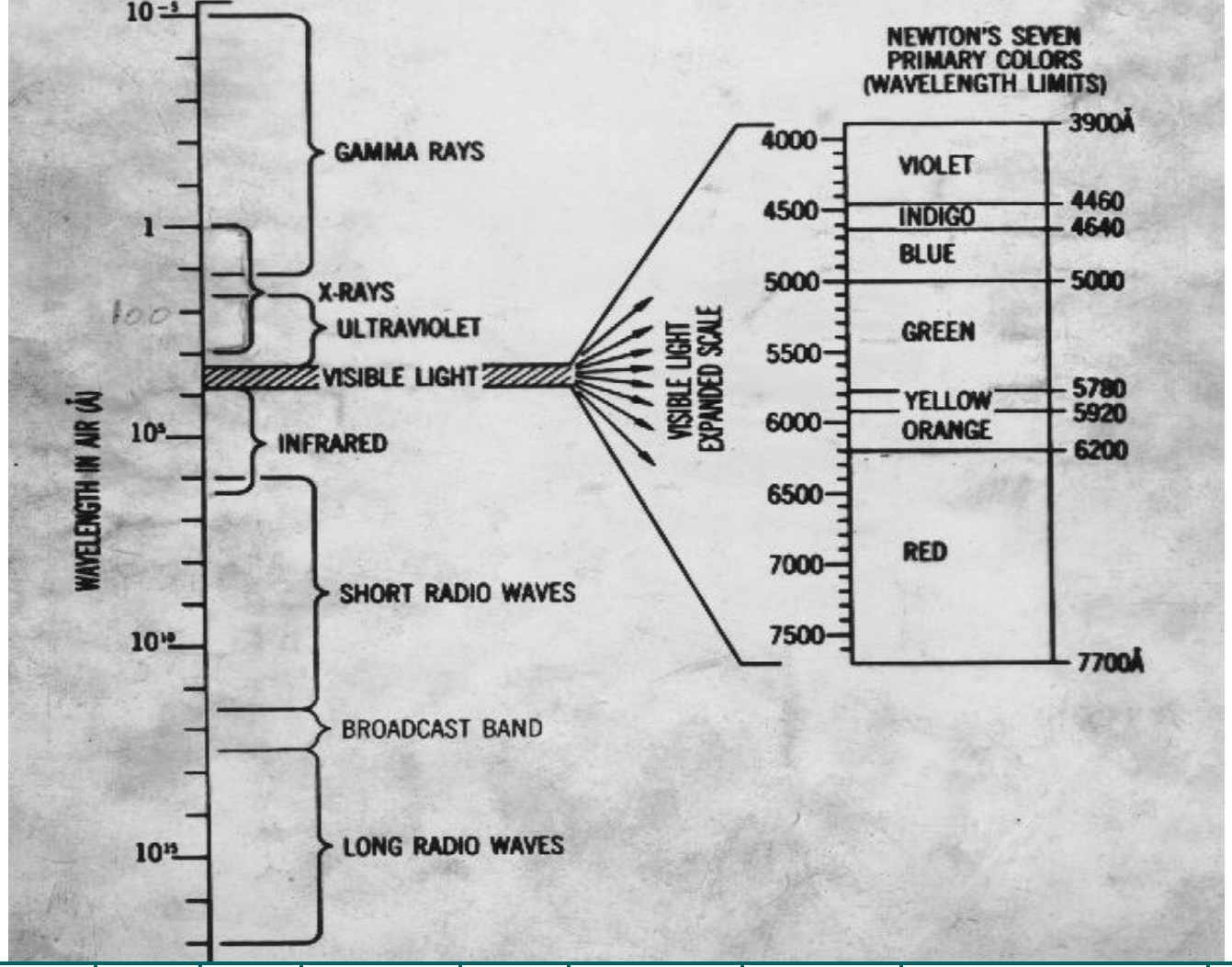
S1lento - File: S1lento.RAW - Type: 2Th/Th locked - Start: 3.00 ° - End: 80.00 ° - Step: 0.02 ° - Step time: 5. s - Temp.: 25 °C (Room) - Time Started: 36 s - 2-Theta: 3.00 ° - Theta: 1.50 ° - Phi: 0.00 ° - Aux1: 0.0 - Aux2: 0.0 - Aux3:
85-1315 (C) - Cyrilovite - NaFe3(OH)4(PO4)2(H2O)2 - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Tetragonal - a 7.31300 - b 7.31300 - c 19.31500 - alpha 90.000 - beta 90.000 - gamma 90.000 - Primitive - P41212 (92) - 4 - 1032.97
11-0355 (I) - Roscherite-M - (Ca,Mn)3Be3(PO4)3OH3·2H2O - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 15.972 - b 11.934 - c 6.622 - alpha 90.000 - beta 95.25 - gamma 90.000 - Base-centred - C2/c (15) - 4 - 1256.9
85-2147 (C) - Muscovite 2M1 - (Na0.37K0.60)(Al1.84Ti0.02Fe0.10Mg0.06)(Si3.03Al0.97)O10(OH)2 - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.174 - b 8.975 - c 19.76999 - alpha 90.000 - beta 95.2 - gamma 90.000
86-1386 (C) - Muscovite 2M1 - K0.94Al1.96(Al0.95Si2.85O10)((OH)1.744F0.256) - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.18050 - b 8.99400 - c 20.08600 - alpha 90.000 - beta 95.740 - gamma 90.000 - Base-ce
82-2452 (C) - Muscovite 2M1 - (Na0.37K0.60)(Al1.84Ti0.02Fe0.10Mg0.06)(Si3.03Al0.97)O10(OH)2 - Y: 50.00 % - d x by: 1. - WL: 1.54056 - Monoclinic - a 5.130 - b 8.886 - c 19.241 - alpha 90.000 - beta 95.5 - gamma 90.000 -

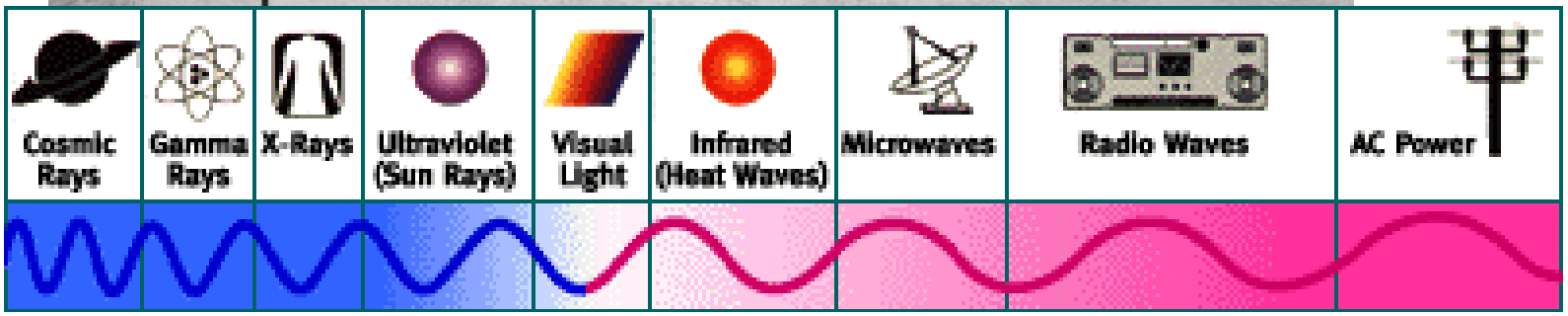

a
b
H2O
P(1)
P(2)
D
M
Be
Ca



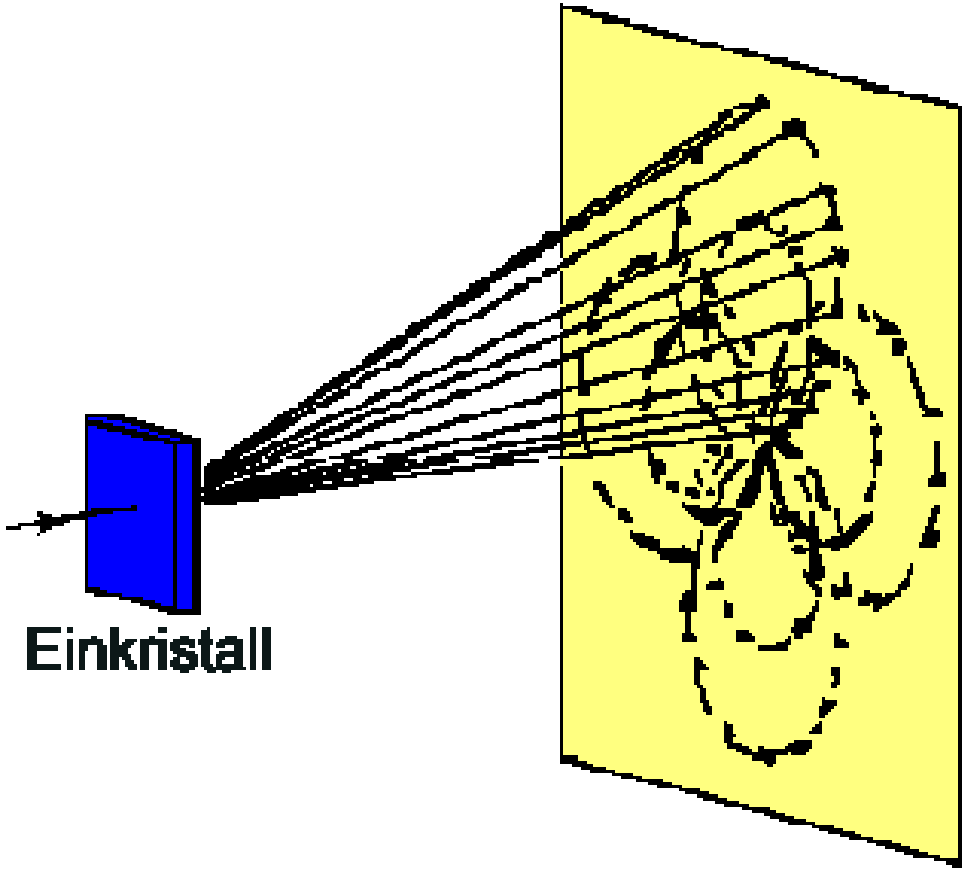
1912 – von Laue – interação raios X - cristais

Interferência:
as ondas produzem efeitos de interferência quando difundidas por objetos separados a distâncias equivalentes ao comprimento das ondas.

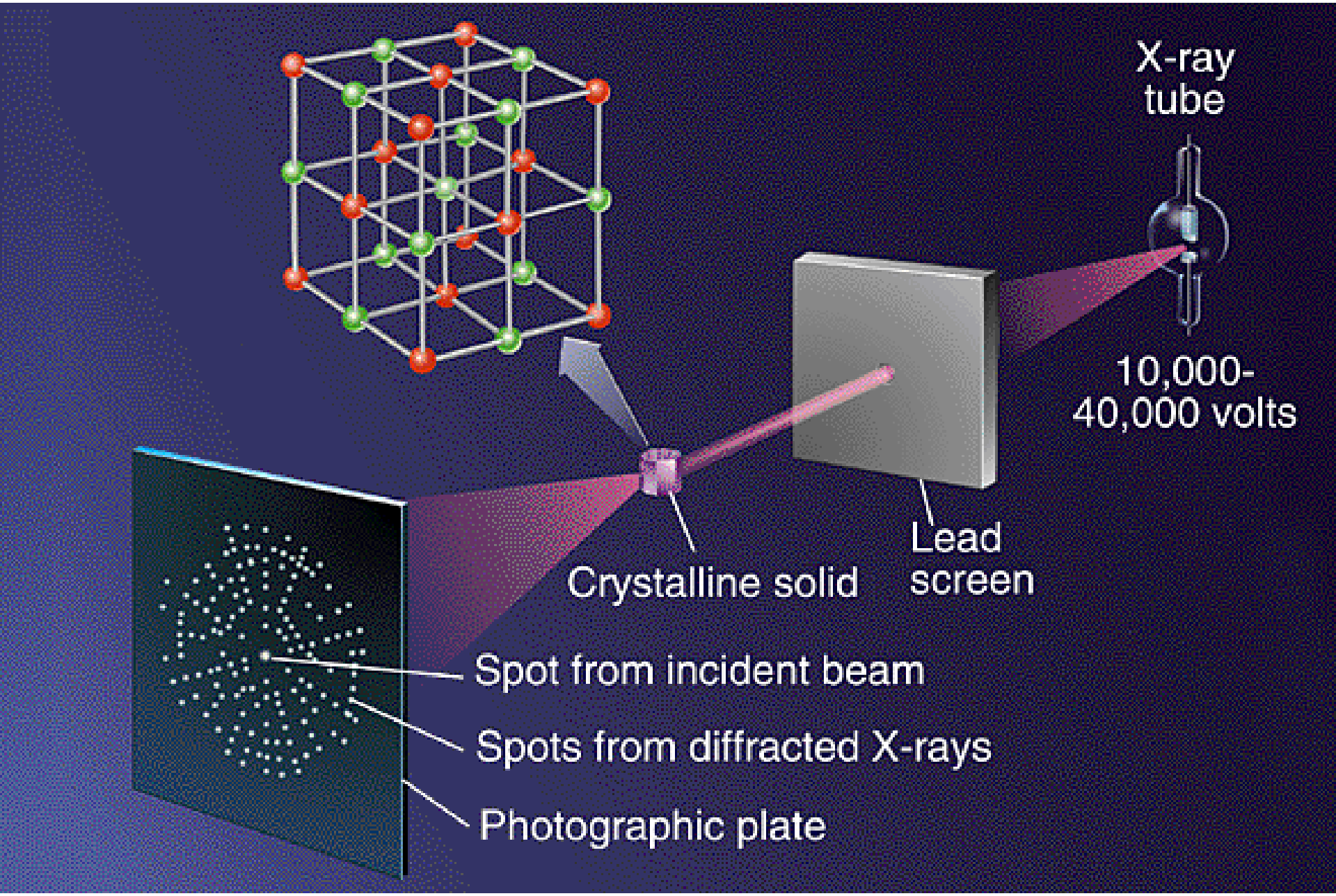

WAVELENGTH IN AIR (Å)
GAMMA RAYS
X-RAYS
ULTRAVIOLET
VISIBLE LIGHT
INFRARED
SHORT RADIO WAVES
BROADCAST BAND
LONG RADIO WAVES
VISIBLE LIGHT EXPANDED SCALE
NEWTON'S SEVEN PRIMARY COLORS (WAVELENGTH LIMITS)
VIOLET
INDIGO
BLUE
GREEN
YELLOW
ORANGE
RED
3900Å
4460
4640
5000
5780
5920
6200
7700Å

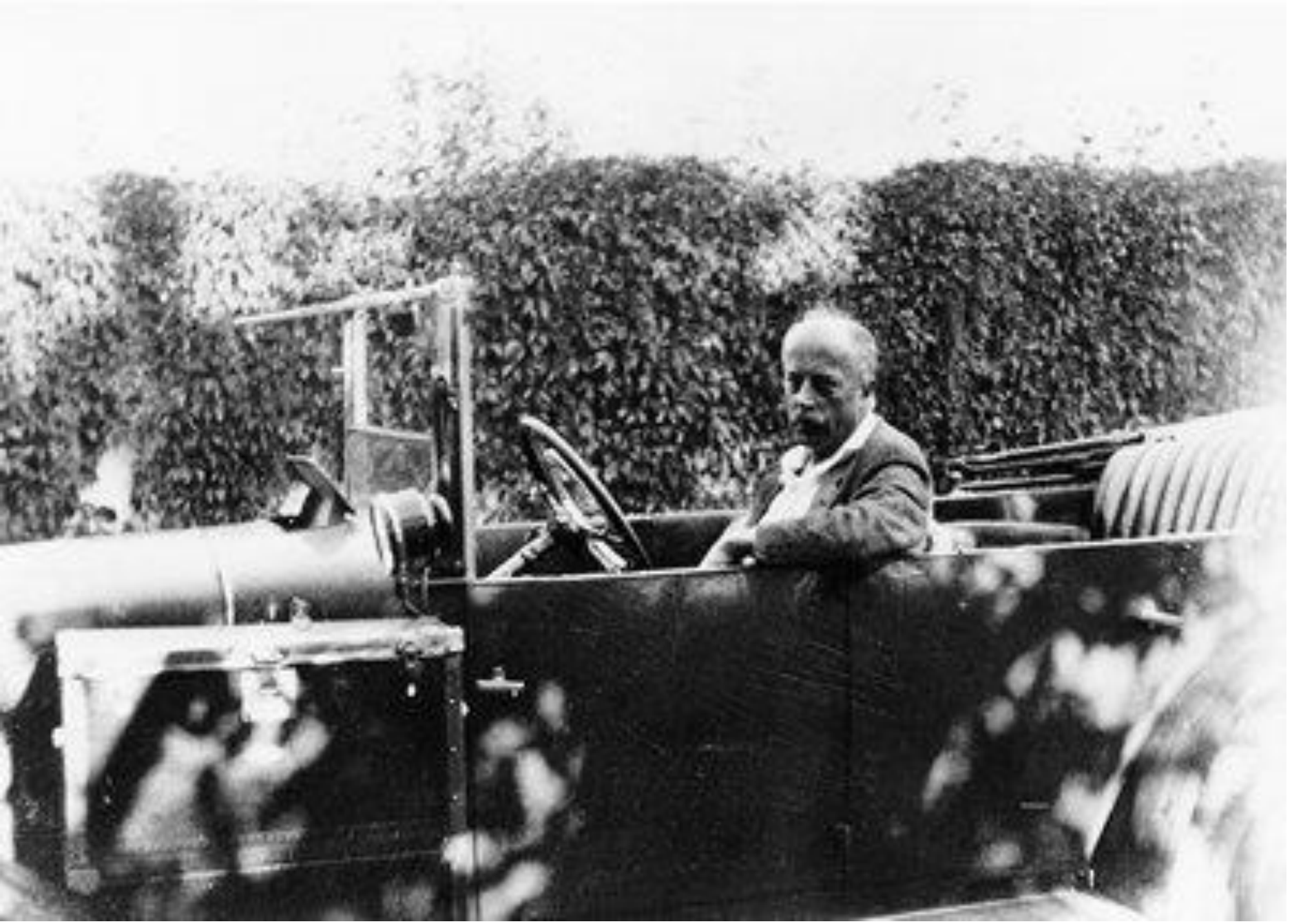

Cosmic Rays
Gamma Rays
X-Rays
Ultraviolet (Sun Rays)
Visual Light
Infrared (Heat Waves)
Microwaves
Radio Waves
AC Power
High Frequency (Short Wavelengths)
Low Frequency (Long Wavelengths)

Experimentos de Laue: calcantita – triclínico

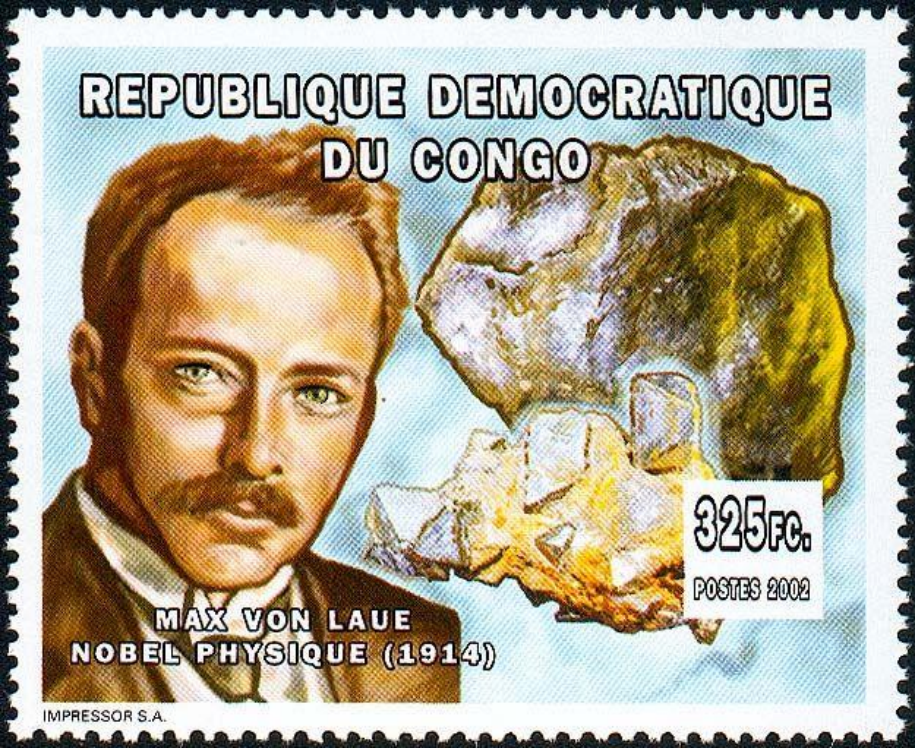


depois: cristais cúbicos


X-ray tube
10,000-40,000 volts
Lead screen
Crystalline solid
Spot from incident beam
Spots from diffracted X-rays
Photographic plate




FREIE UNIVERSITAT BERLIN

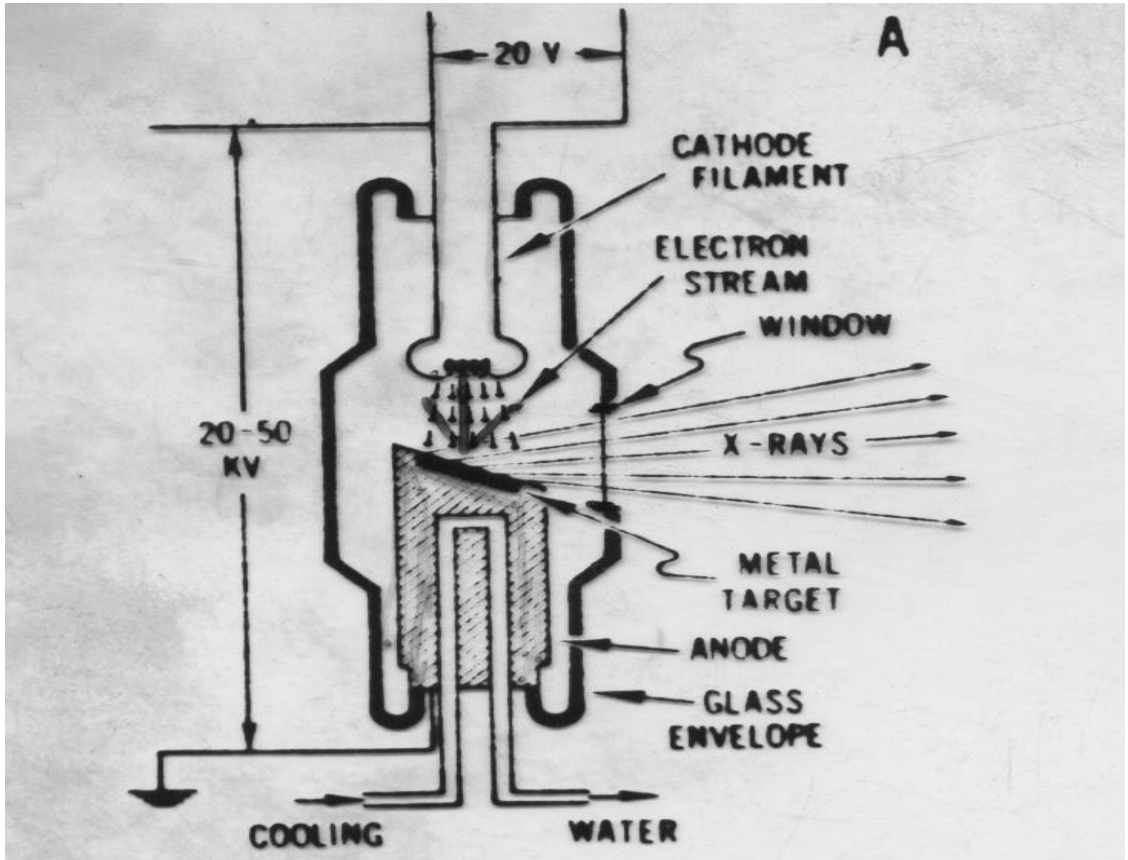

REPUBLIQUE DEMOCRATIQUE
DU CONGO
325FC.
POSTES 2002
MAX VON LAUE
NOBEL PHYSIQUE (1914)
IMPRESSOR S.A.

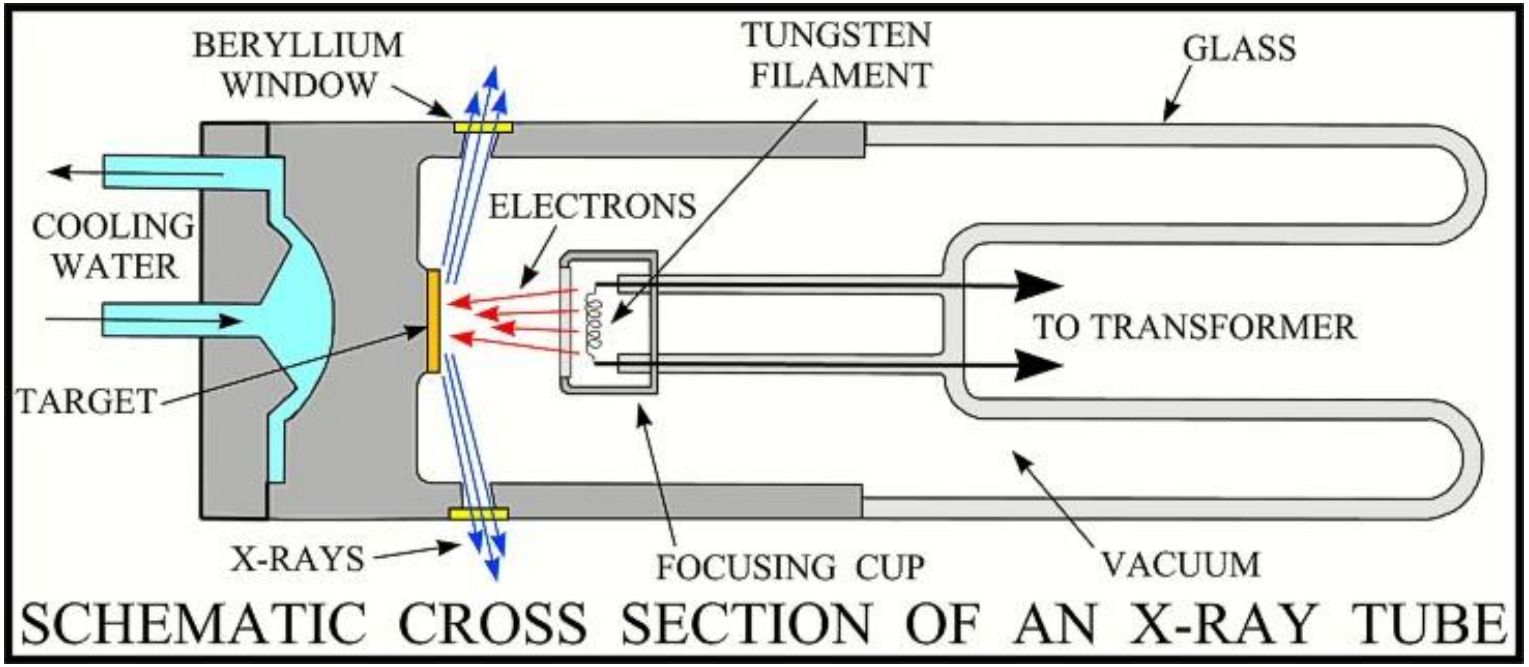

SVERIGE
65
von LAUE
NOBELPRIS 1914


DDR
10

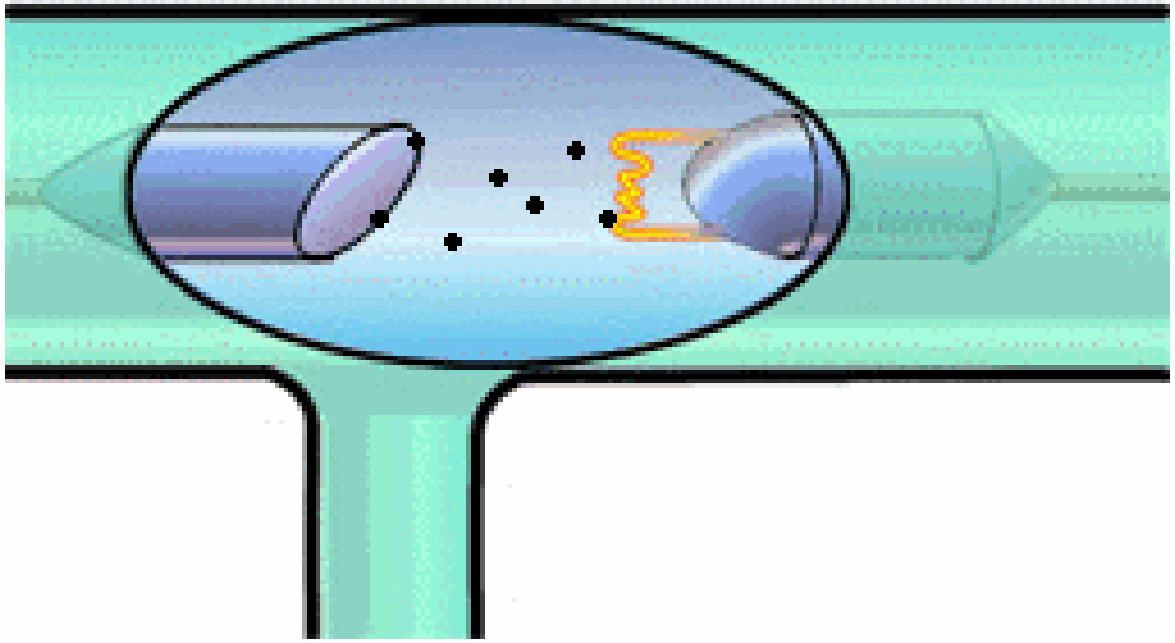

MAX VON LAUE * NOBELPREIS PHYSIK 1914
Röntgenstrahl-Beugung
am Kristallgitter
60
DEUTSCHE BUNDESPOST
1979

Produção de raios X:
Tubo de raios X:
tipos de metais utilizados:
Mo, Cu, Ni, Co, Fe



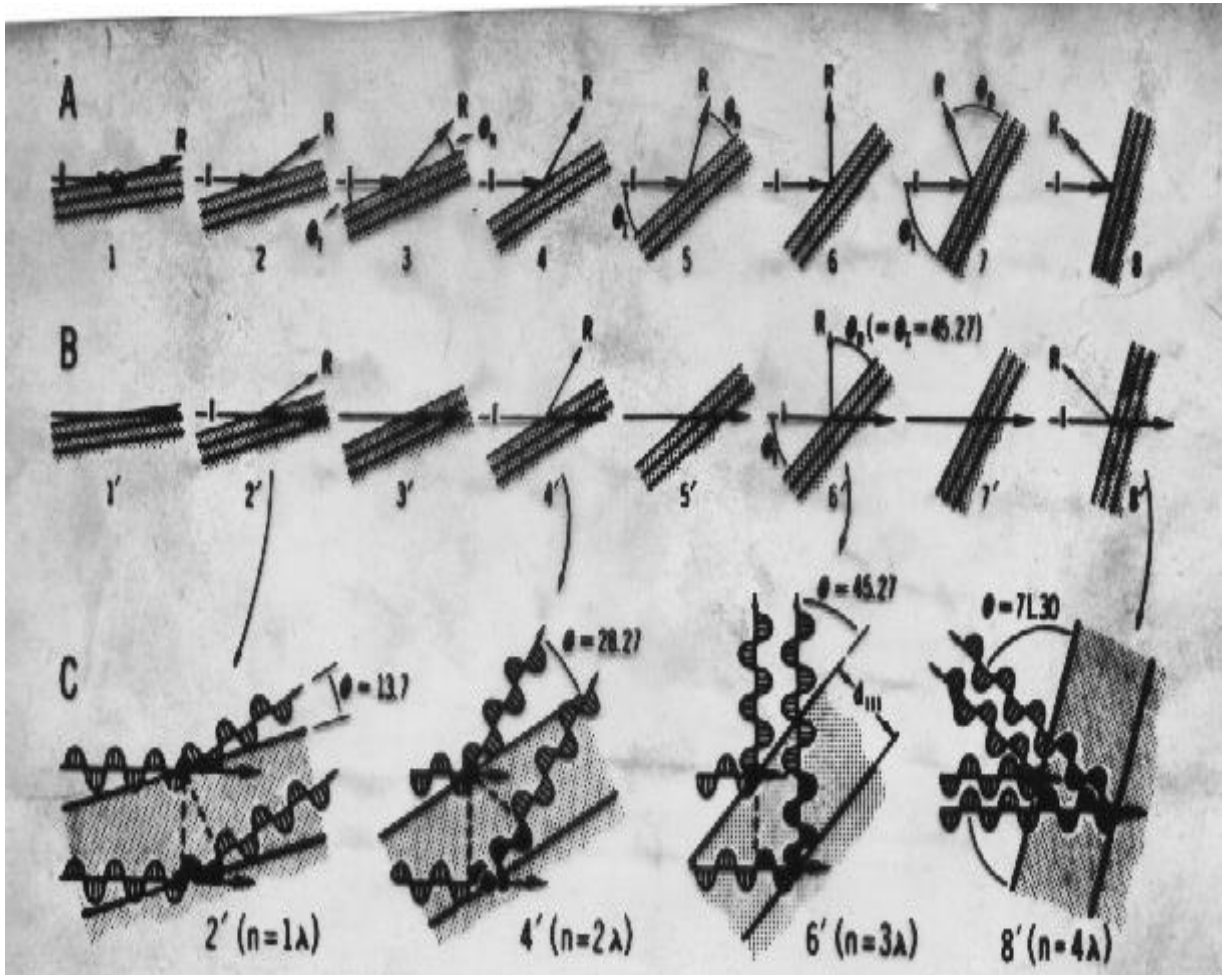


SCHEMATIC CROSS SECTION OF AN X-RAY TUBE

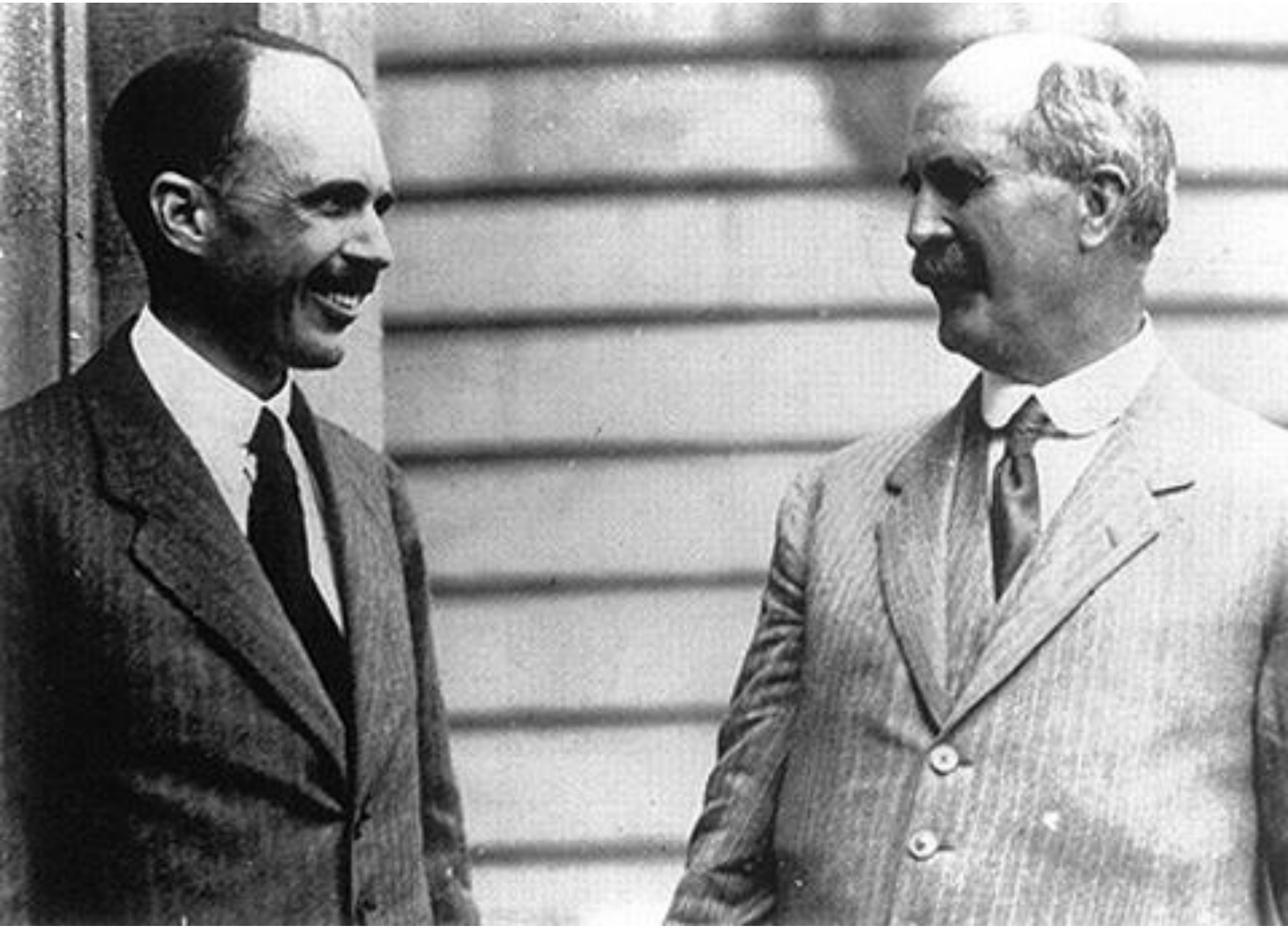


Difração de raios X em retículos cristalinos:

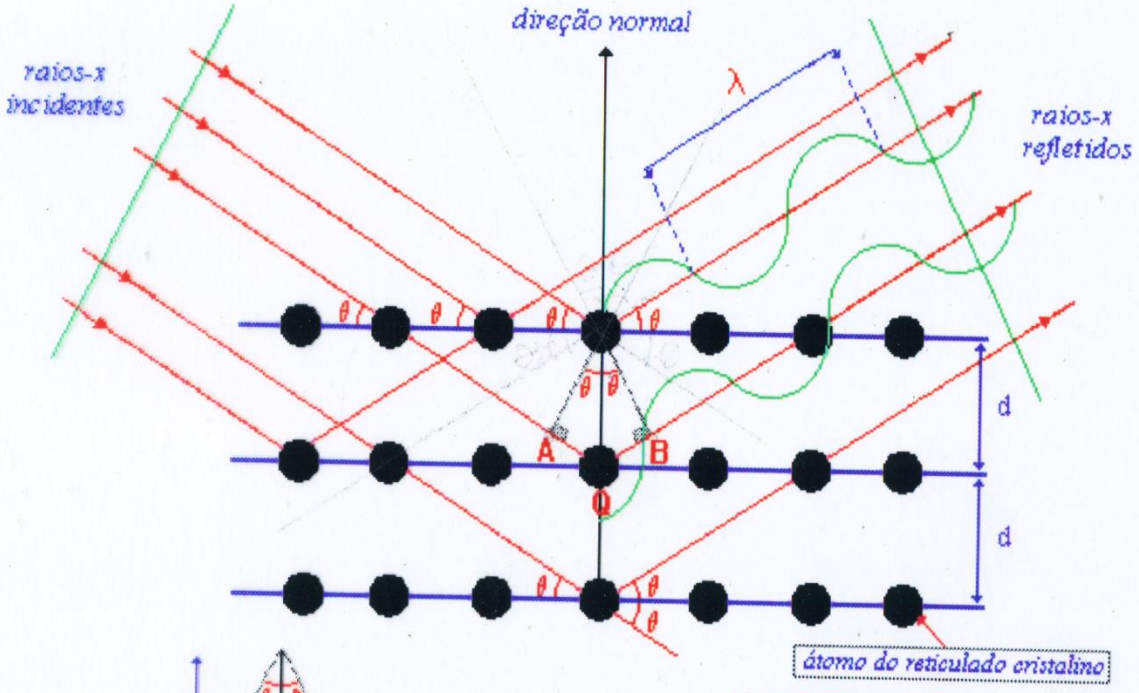
diferença entre reflexão da luz por um espelho e reflexão dos raios X por uma camada de átomos do cristal.

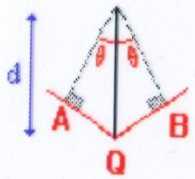


W.H. Bragg and his X-ray spectrometer at University College, London.



Lei de Bragg



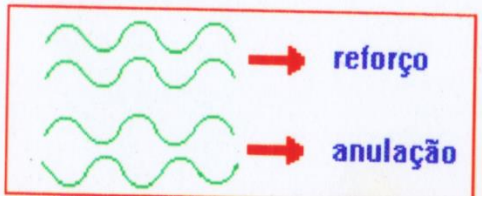


$\overline{AQ} + \overline{QB} = n\lambda \rightarrow 2d \operatorname{sen}\theta = n\lambda$

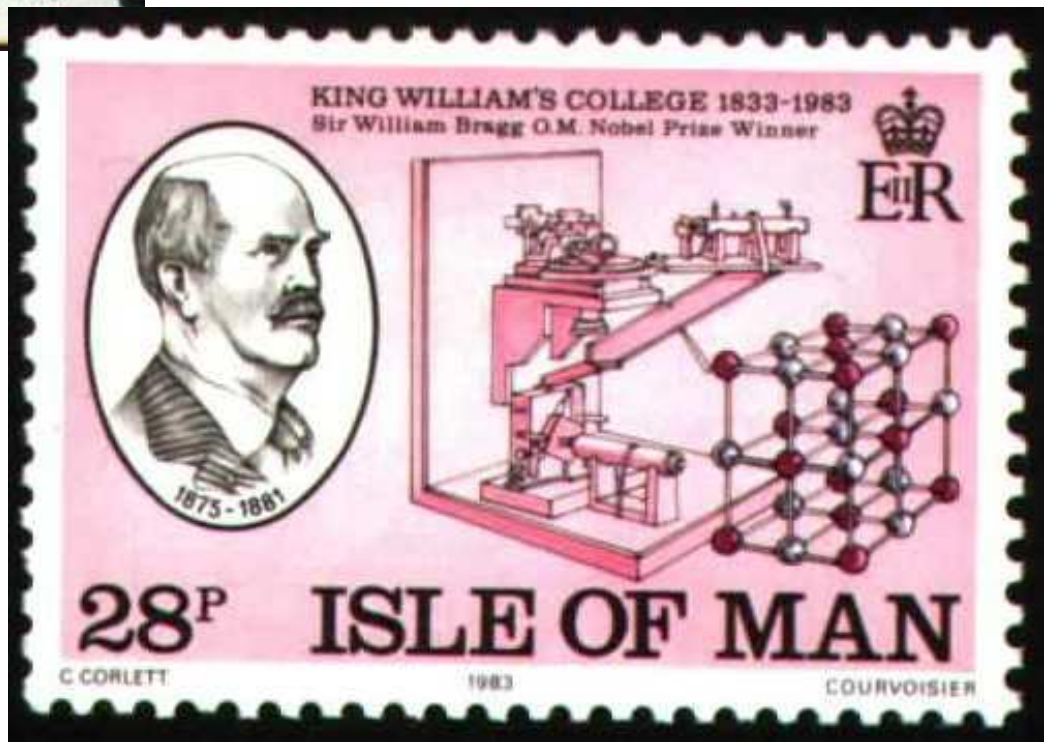
d - distância interplanar

θ - ângulo de incidência do feixe de raios-X

λ - comprimento de onda do feixe de raios-X

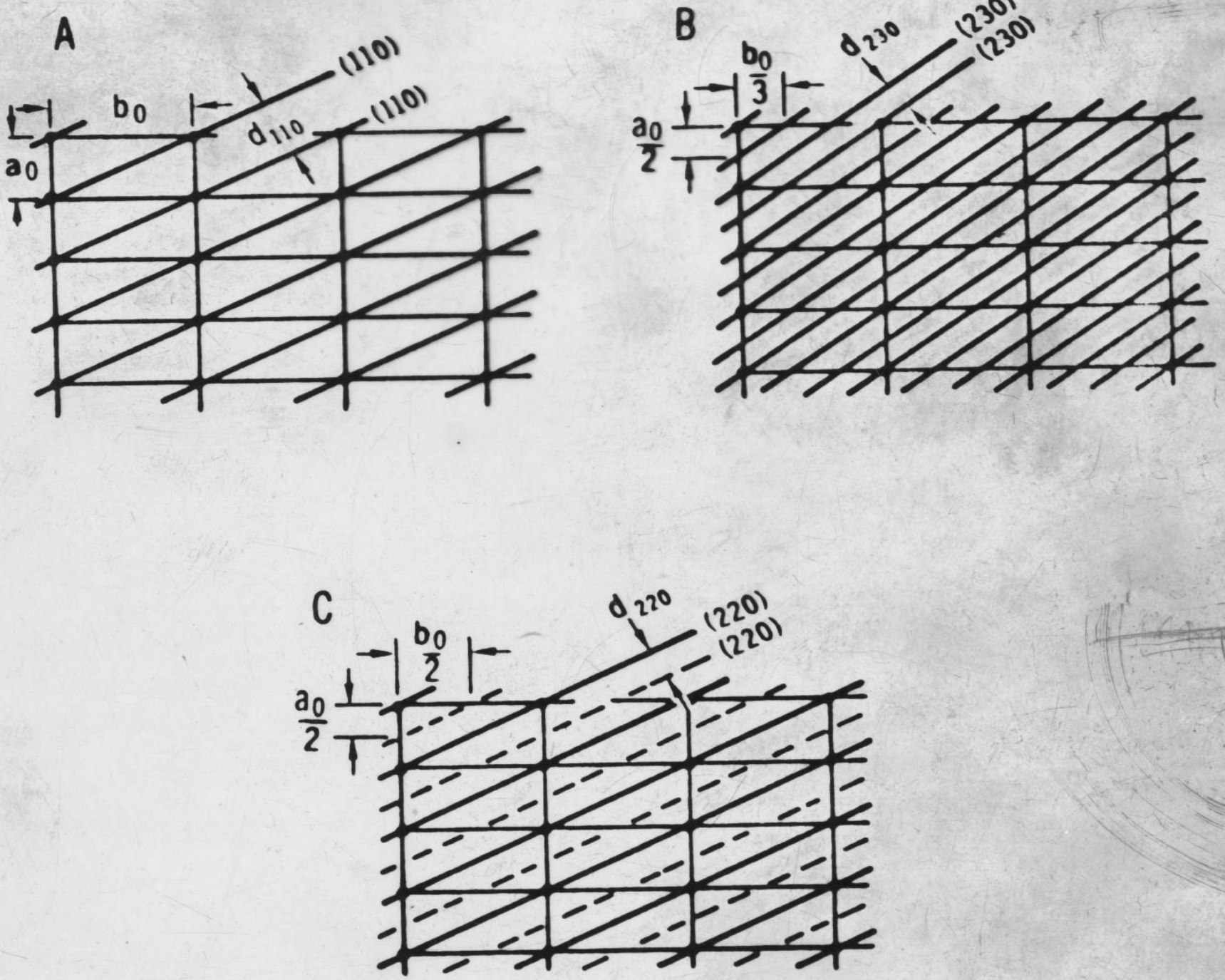



NOBEL PRIS 1915
75
SVERIGE
W.H. BRAGG
W.L. BRAGG
LENNART FORSBERG
1975
ARNE WALLHORN SC

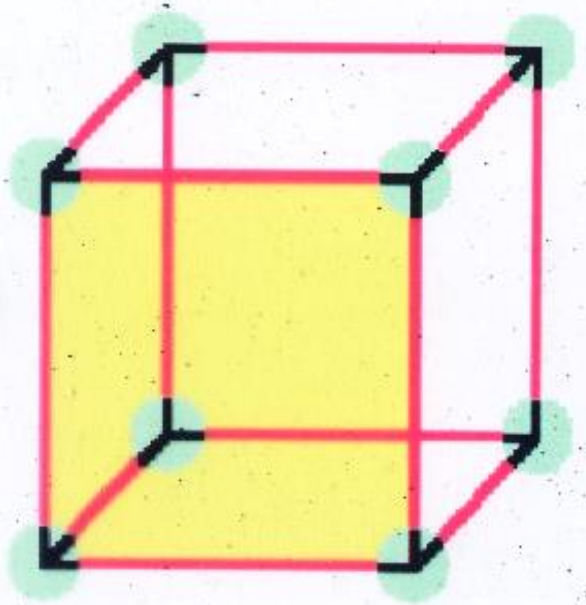

KING WILLIAM'S COLLEGE 1833-1983
Sir William Bragg O.M. Nobel Prize Winner
EIIR
1875 - 1881
28P
ISLE OF MAN
C CORLETT
1983
COURVOISIER

Bragg e Pauling

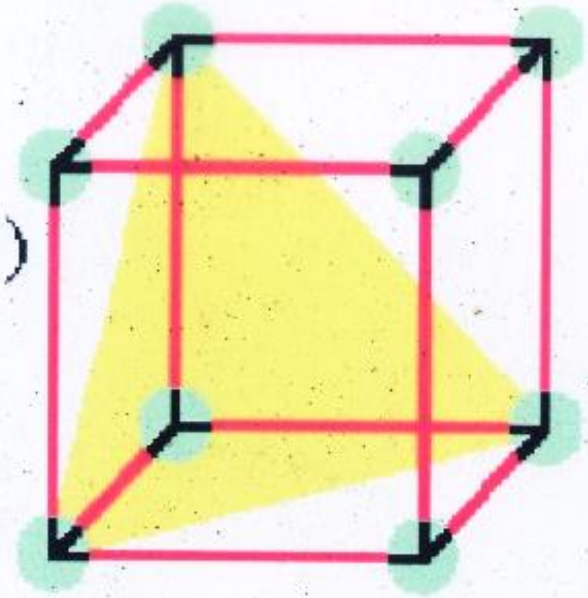
Bragg, Laue, Fankuchen


A
(110)
b_0
d_{110}
(110)
a_0
B
b_0
3
d_{230}
(230)
(230)
a_0
2
C
d_{220}
(220)
(220)
b_0
2
a_0
2

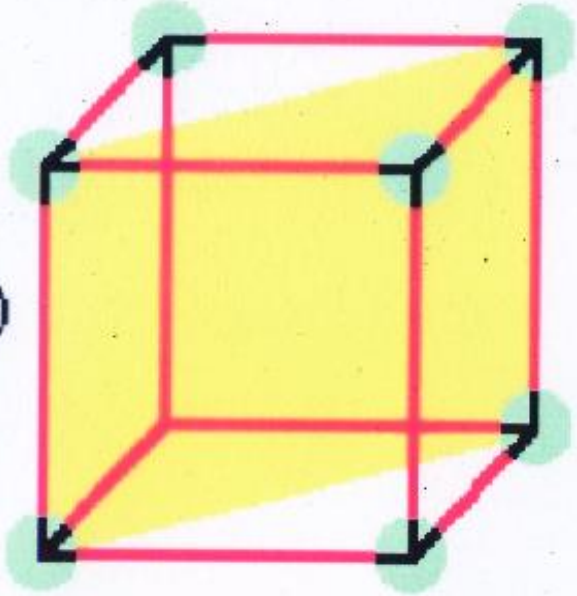
(100)



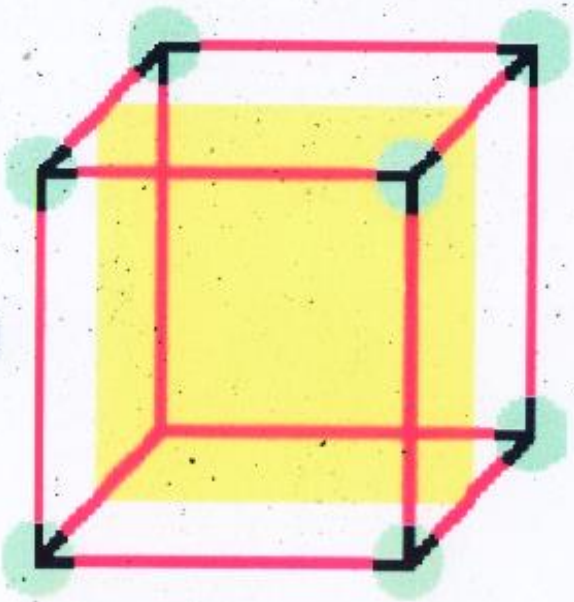
(111)



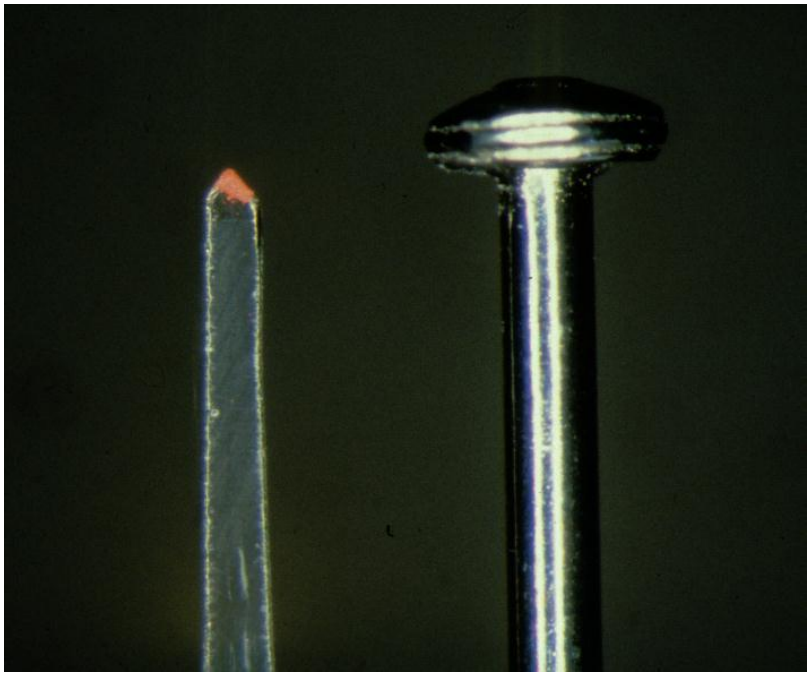
(110)



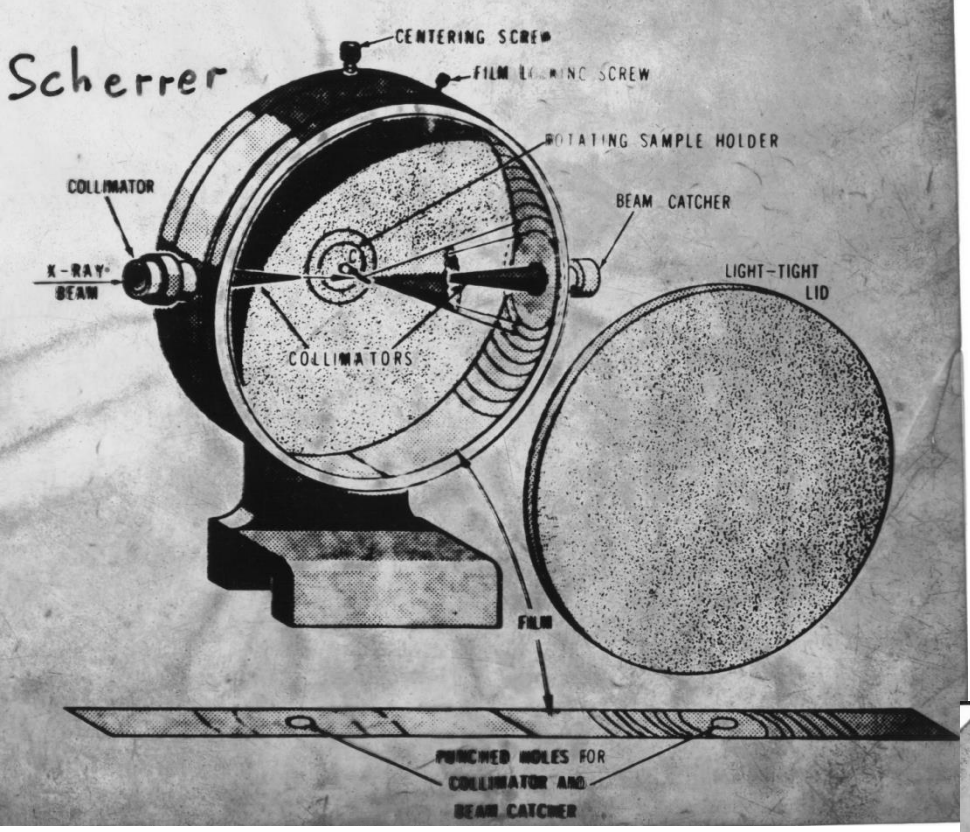
(200)

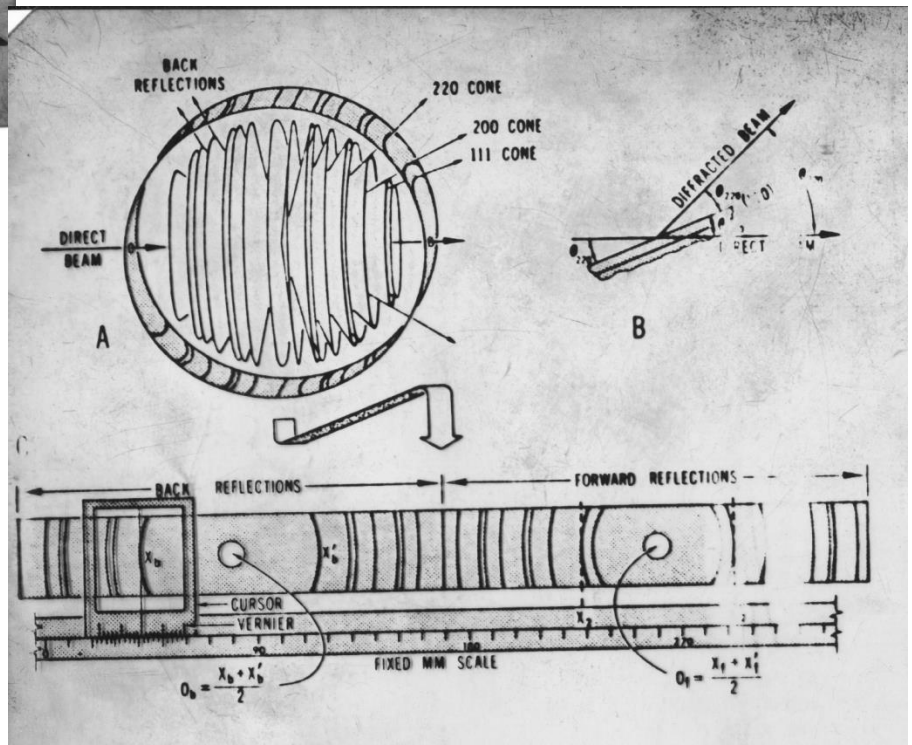


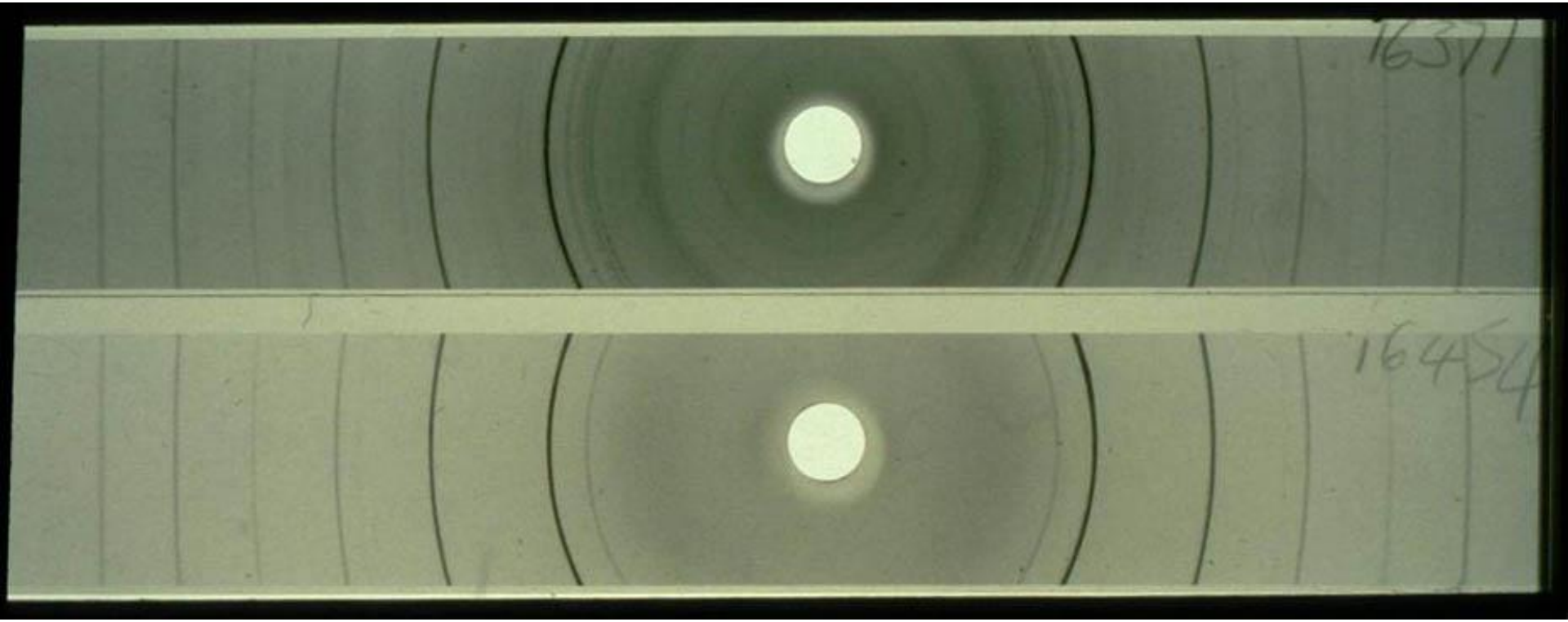
Métodos:
Pó:
Câmara Debye Scherrer



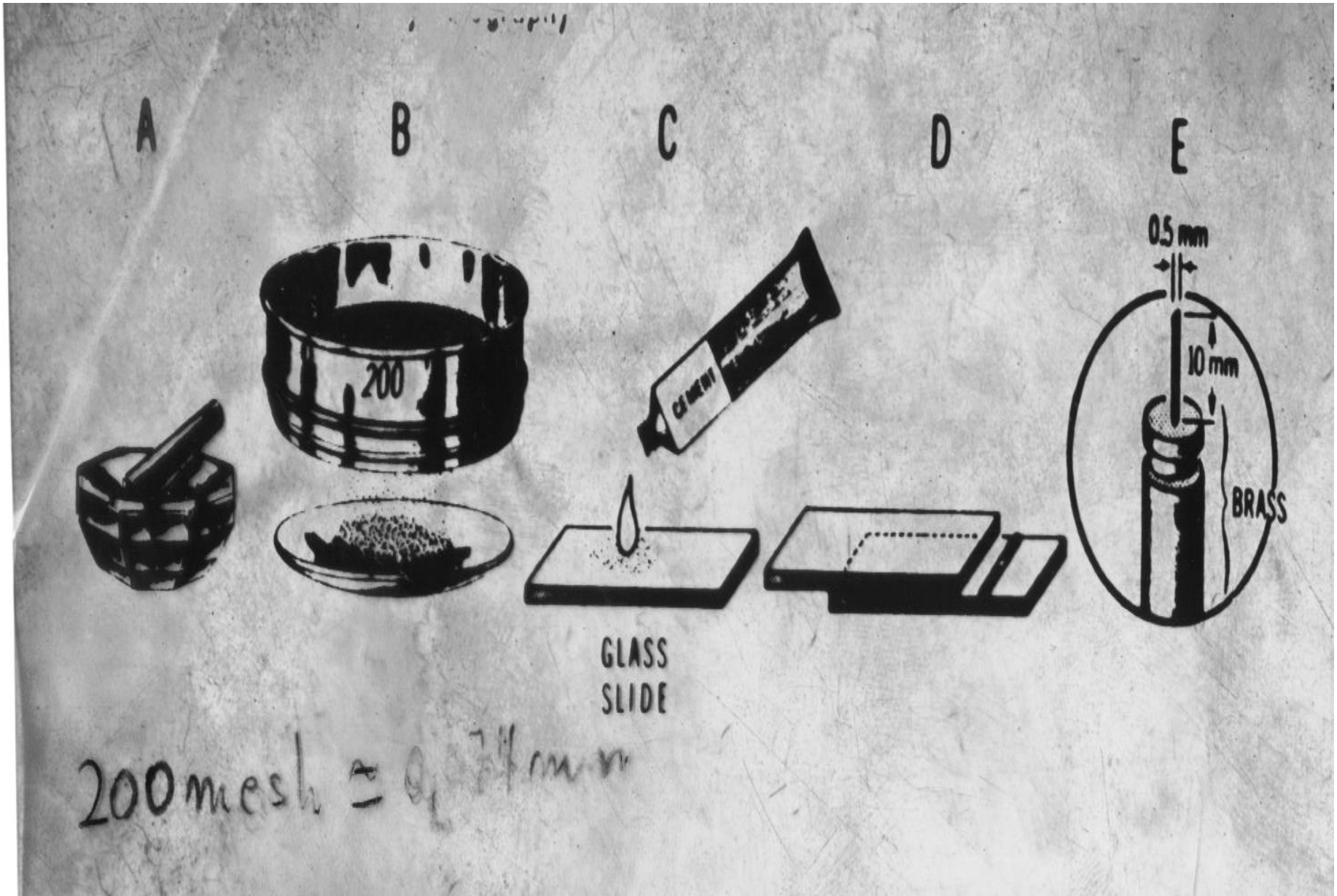

PHILIPS


Scherrer
CENTERING SCREW
FILM LOCKING SCREW
ROTATING SAMPLE HOLDER
COLLIMATOR
BEAM CATCHER
X-RAY BEAM
LIGHT-TIGHT LID
COLLIMATORS
FILM
PUNCHED HOLES FOR COLLIMATOR AND BEAM CATCHER


BACK REFLECTIONS
220 CONE
200 CONE
111 CONE
DIRECT BEAM
A
DIFFRACTED BEAM
B
BACK REFLECTIONS
FORWARD REFLECTIONS
CURSOR
VERNIER
FIXED MM SCALE

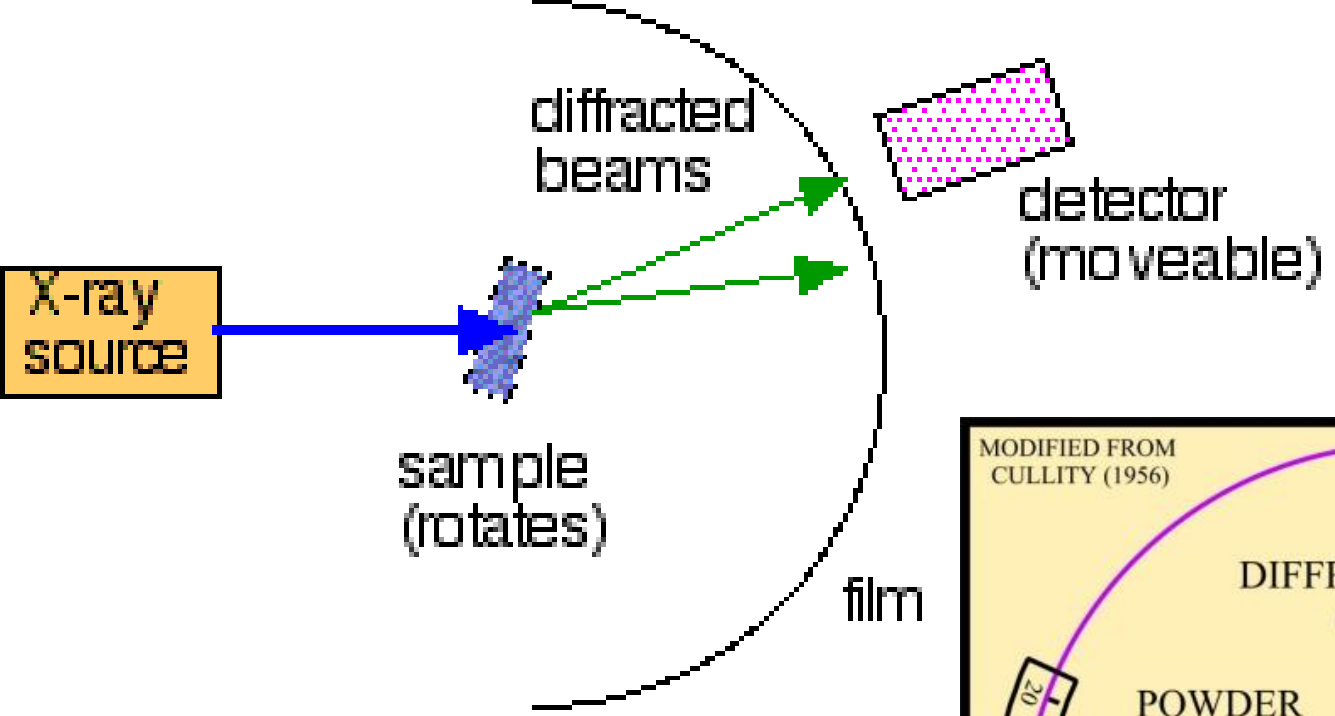

16377
16454

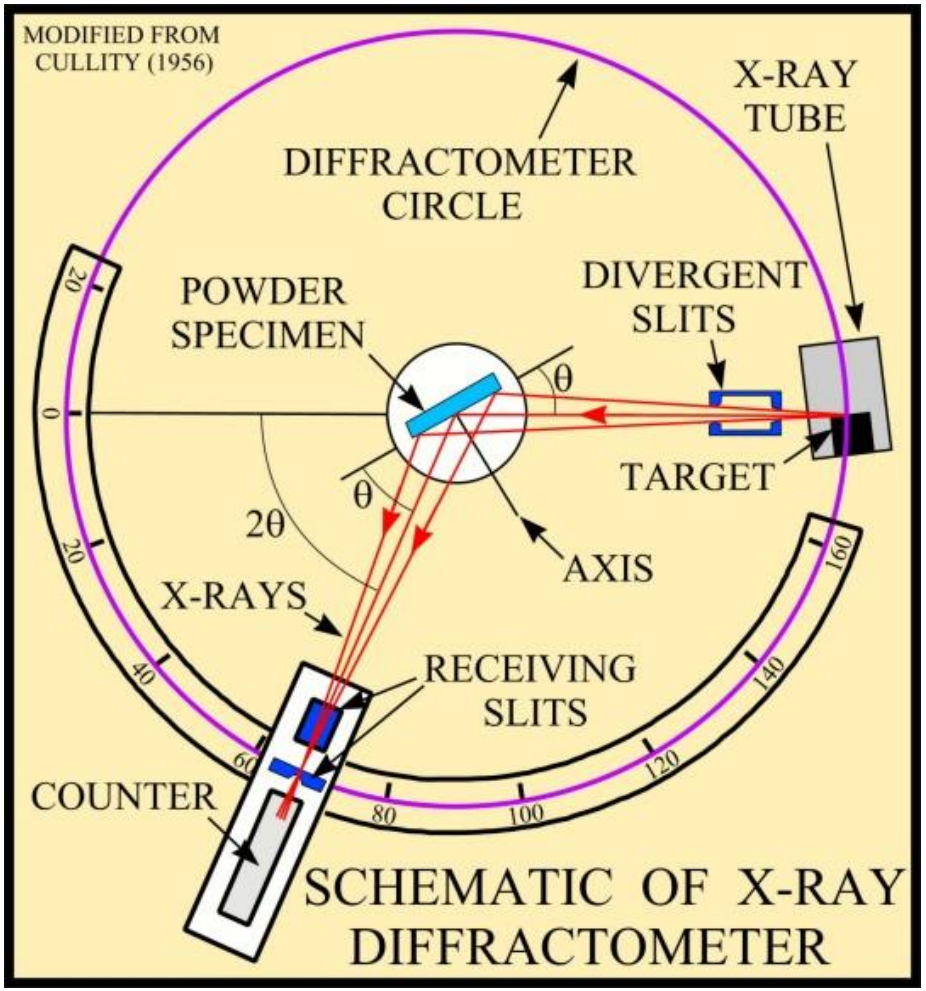
Preparação do material



Preparação do material:
pó prensado em lâmina.

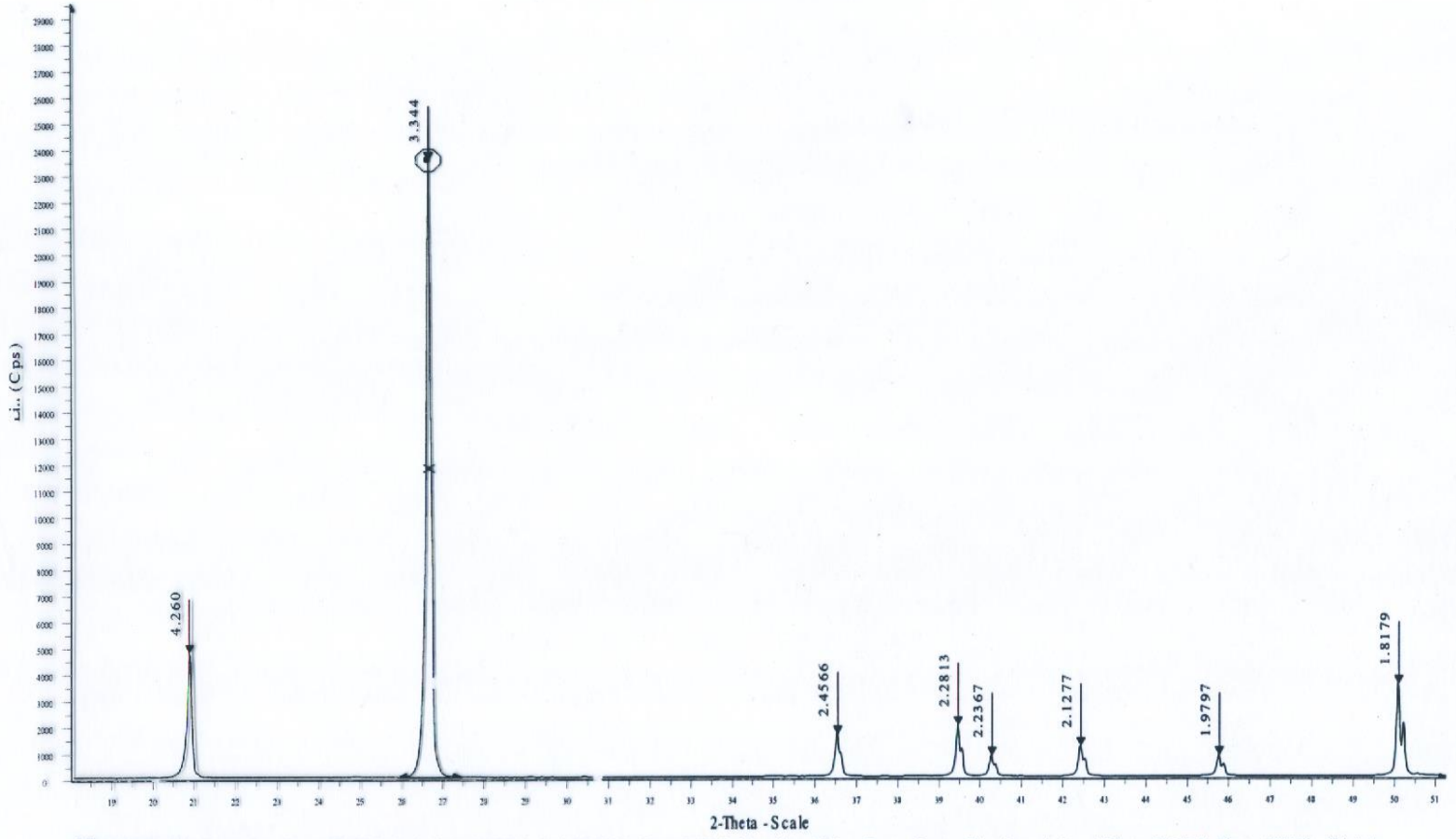
Difratômetro de raios X


diffracted
beams
detector
(moveable)
X-ray
source
sample
(rotates)
film


MODIFIED FROM
CULLITY (1956)
X-RAY
TUBE
DIFFRACTOMETER
CIRCLE
POWDER
SPECIMEN
DIVERGENT
SLITS
θ
TARGET
θ
2θ
AXIS
X-RAYS
RECEIVING
SLITS
COUNTER
SCHEMATIC OF X-RAY
DIFFRACTOMETER

Difratograma de raios X

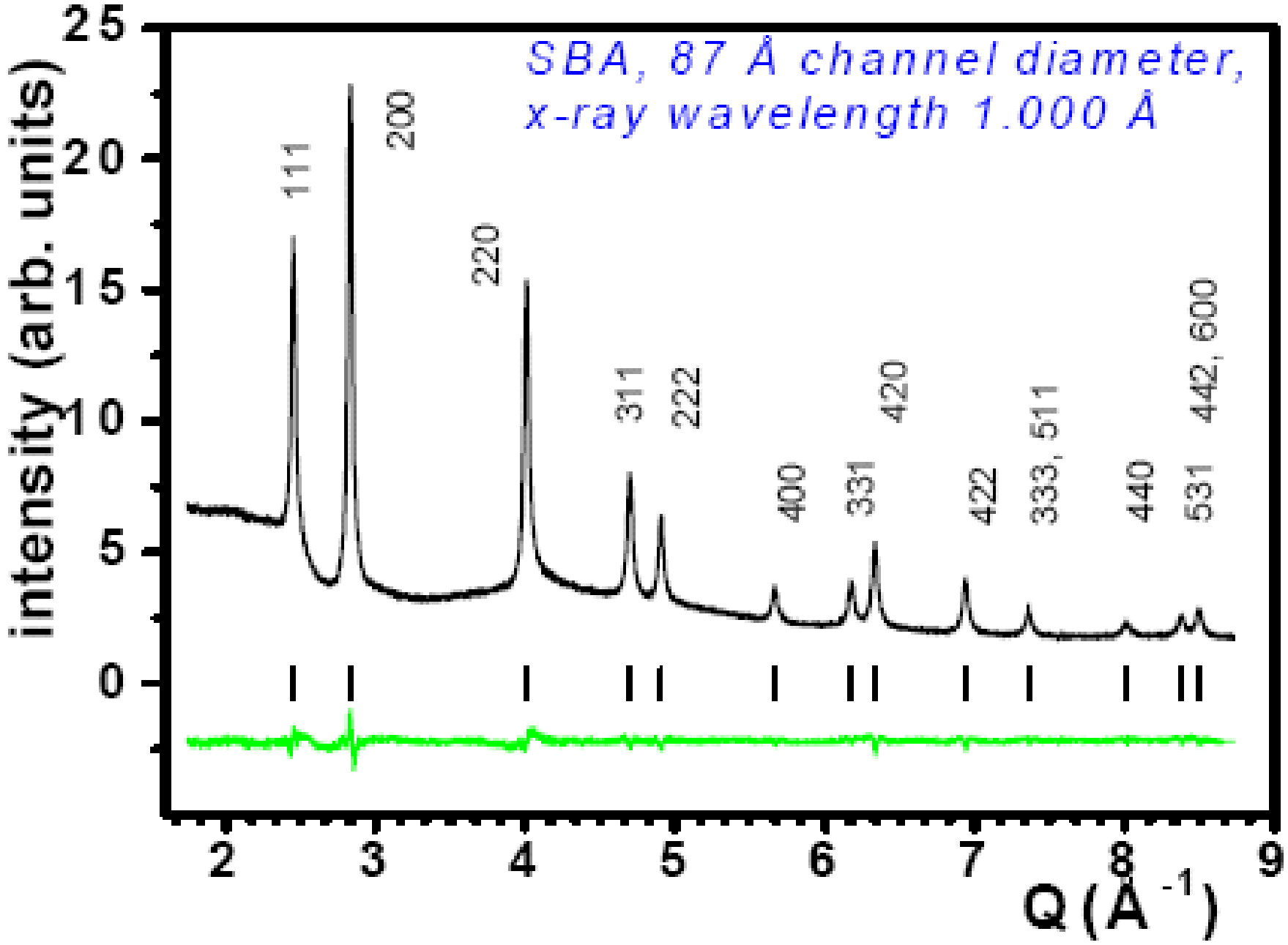
QUARTZ

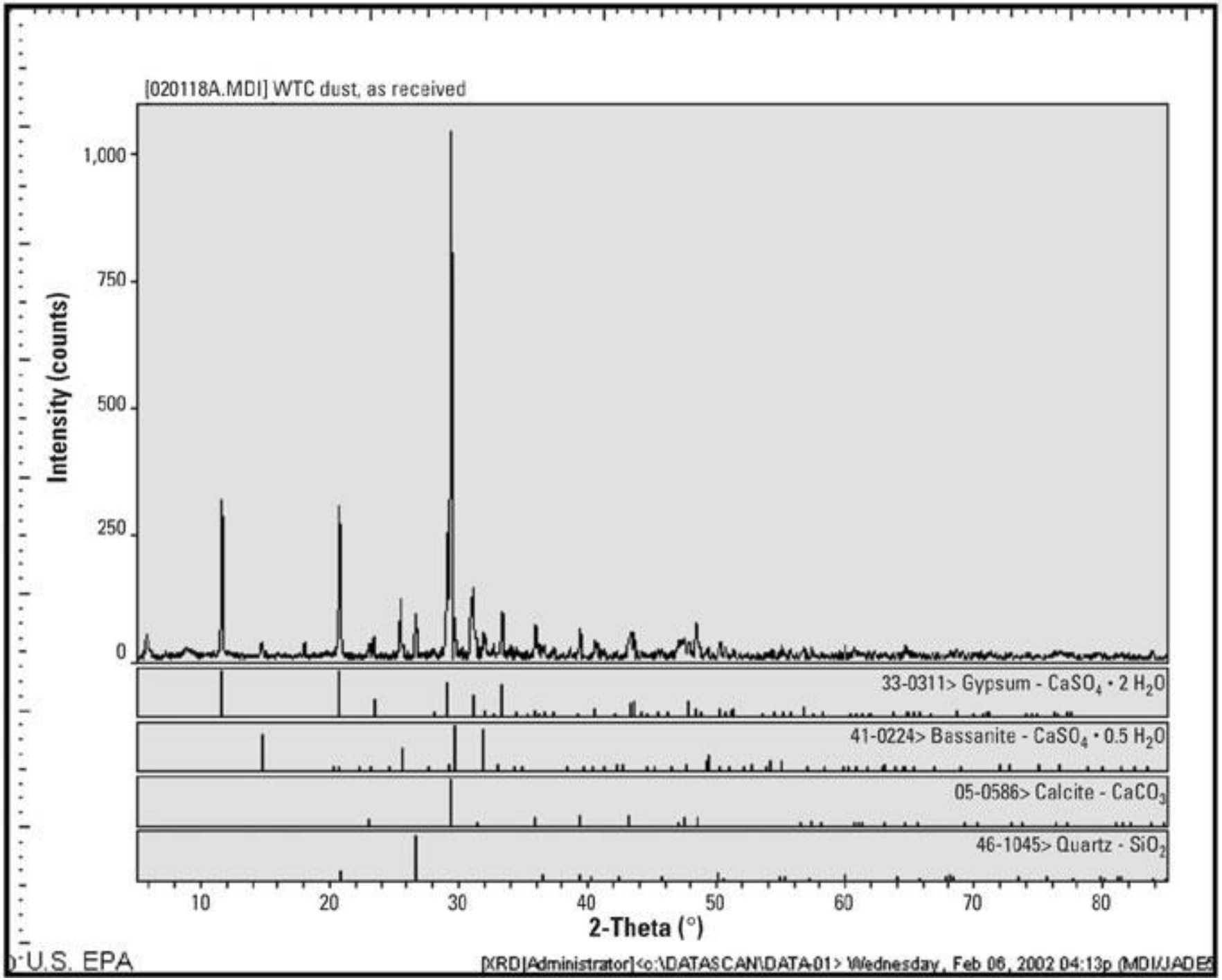


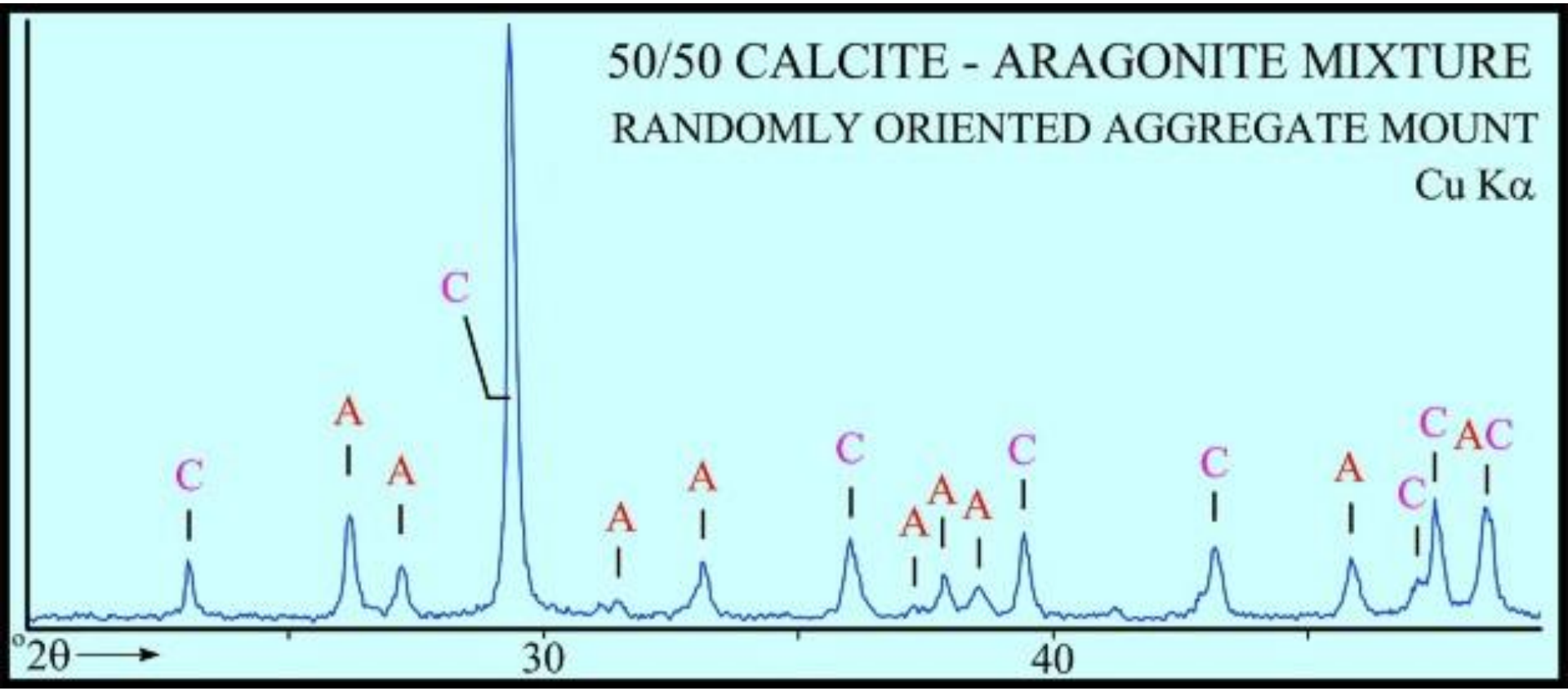
QUARTZ - File: Quartz.raw - Type: 2Th/Th locked - Start: 18.000 ° - End: 90.000 ° - Step: 0.020 ° - Step time: 10.0 s - Temp.: Room - Time Started: 0 s - 2-Theta: 18.000 ° - Theta: 9.000 ° - Chi: 0.0

1) QUARTZ - Left Angle: 25.880 ° - Right Angle: 27.440 ° - Left Int.: 34.957 Cps - Right Int.: 34.414 Cps - Obs. Max: 26.628 ° - d (Obs. Max): 3.345 - Max Int.: 23625.912 Cps - Net Height: 23591.

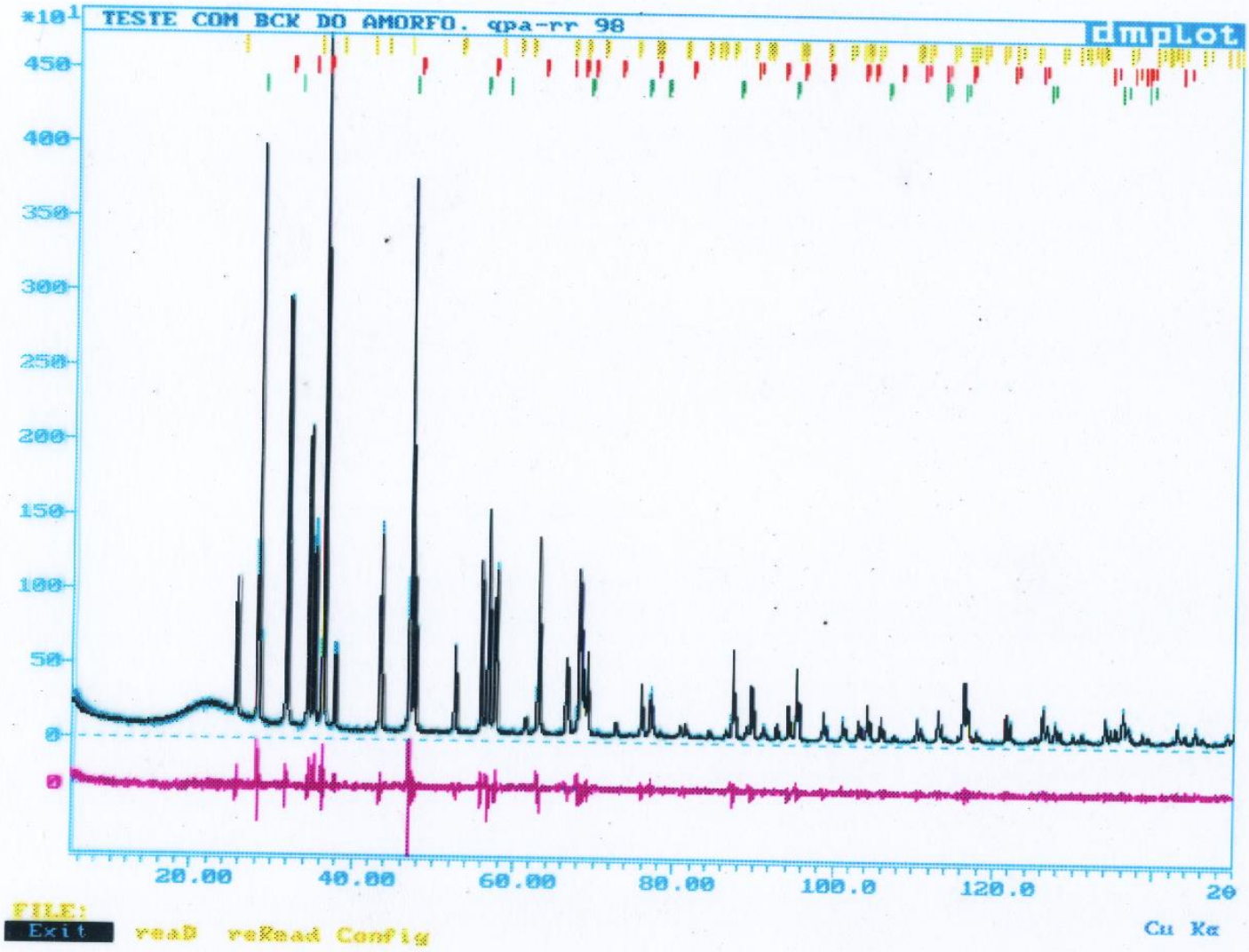
Operations: Import


SBA, 87 Å channel diameter,
x-ray wavelength 1.000 Å
intensity (arb. units)
Q (Å -1)
111
200
220
311
222
400
331
420
422
333, 511
440
531
442, 600
0
5
10
15
20
25
2
3
4
5
6
7
8
9


[020118A.MDI] WTC dust, as received
Intensity (counts)
1,000
750
500
250
0
33-0311> Gypsum - CaSO4 • 2 H2O
41-0224> Bassanite - CaSO4 • 0.5 H2O
05-0586> Calcite - CaCO3
46-1045> Quartz - SiO2
10
20
30
40
50
60
70
80
2-Theta (°)
U.S. EPA
[XRD]Administrator]<o:\DATASCAN\DATA-01> Wednesday, Feb 06, 2002 04:13p (MDI/JADE5


50/50 CALCITE - ARAGONITE MIXTURE
RANDOMLY ORIENTED AGGREGATE MOUNT
Cu Kα
C
A
A
C
A
A
C
A
A
A
C
C
A
C
AC
°2θ
30
40

Resultado final da análise quantitativa de corindon, fluorita, zincita e um vidro



Lewisita

Hussak & Prior (1895)

$CaSb^{3+}_{2/3}(Sb^{5+},Ti^{4+})_2O_6(OH)$, com $Sb^{5+}:Ti^{4+} = 1:1$, cúbico

Dados de difratometria de raios X para lewisita de Tripuí, Ouro Preto, Minas Gerais.

Ficha 7-66

$d_{obs.}$(Å)	$I_{obs.}$(%)	$d_{obs.}$(Å)	$I_{obs.}$(%)	hkl	$d_{calc.}$(Å)
5,794	7	5,84	20	111	5,953
3,069	9	3,08	30	311	3,109
2,9394	97	2,94	100	222	2,9765
2,5415	22	2,55	30	400	2,5777
2,3656	3			331	2,3655
1,9710	6	1,966	30	511	1,9844
1,8097	32	1,813	100	440	1,8227
1,7328	13	1,734	30	531	1,7429
1,5655	4			533	1,5724
1,5434	100	1,548	100	622	1,5544
1,4782	6	1,483	30	444	1,4883
1,4389	10	1,438	30	551	1,4438
1,3364	12	1,337	30	731	1,3424
1,2832	19	1,284	30	800	1,2889

a 10,311(7) Å, *V* 1096,23 Å^3

Interpretação:

JCPDS-ICDD

33-1161 ★

SiO_2

Silicon Oxide

Quartz, syn

Rad. CuKα₁ λ 1.540598 Filter Mono. d-sp Diff.
Cut off Int. Diffractometer $I/I_{cor.}$ 3.6
Ref. *Natl. Bur. Stand. (U.S.) Monogr.* 25, 18 61 (1981)

Sys. Hexagonal S.G. $P3_121$ (154)
a 4.9133(2) b c 5.4053(4) A C 1.1001
α β γ Z 3 mp
Ref. Ibid.

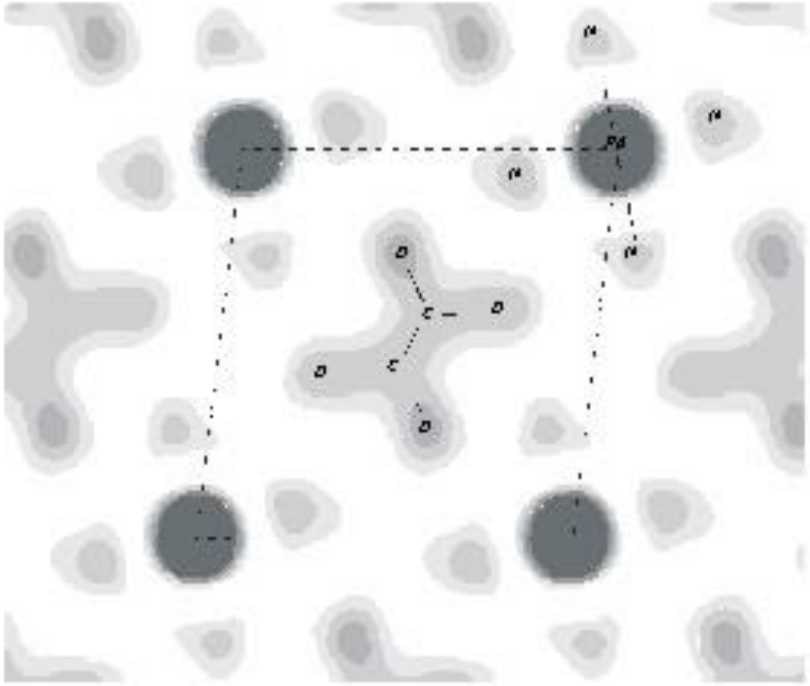
D_x 2.65 D_m 2.66 SS/FOM F_{30}=77(.013,31)

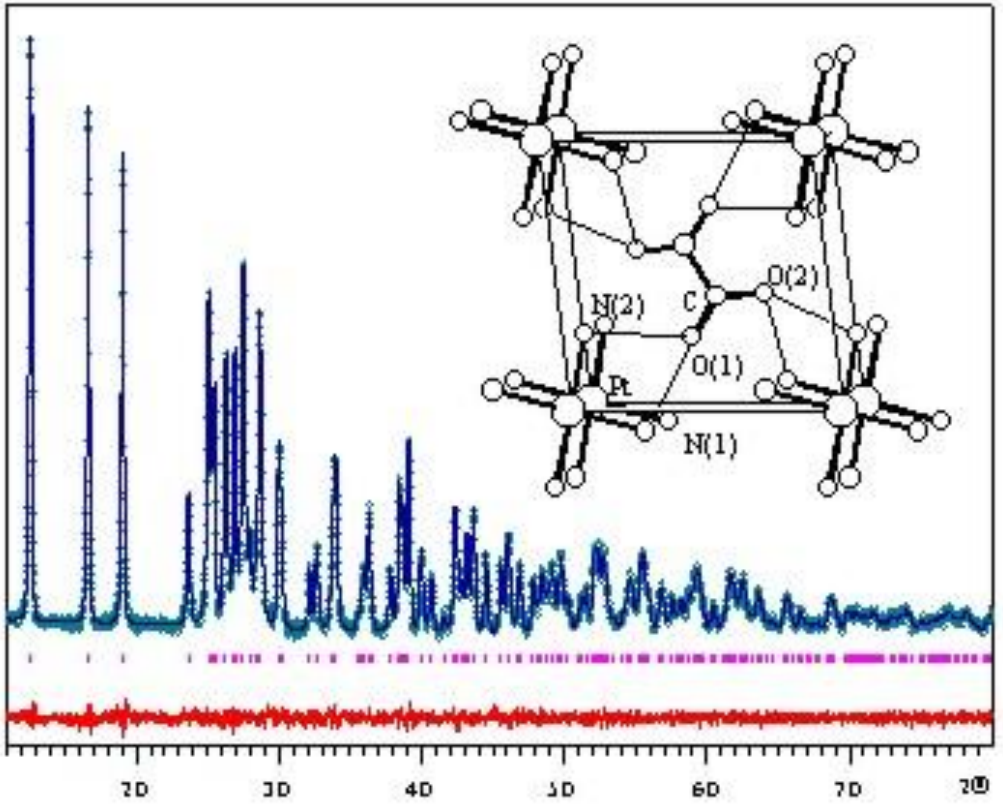
εα nωβ 1.544 εγ 1.553 Sign + 2V
Ref. Swanson, Fuyat, *Natl. Bur. Stand. (U.S.), Circ. 539*, 3 24 (1954)

Color Colorless
Pattern taken at 25 C. Sample from the Glass Section at NBS, Gaithersburg, Maryland, USA, ground single-crystals of optical quality. Pattern reviewed by Holzer, J., McCarthy, G., North Dakota State University, Fargo, North Dakota, USA, *ICDD Grant-in-Aid* (1990). Agrees well with experimental and calculated patterns. O_2Si type. Quartz group. Also called: silica. Also called: low quartz. Silicon used as internal standard. PSC: hP9. To replace 5-490 and validated by calculated pattern. Plus 6 additional reflections to 0.9089.

dÅ	Int	hkℓ	dÅ	Int	hkℓ
4.257	22	100	1.1532	1	311
3.342	100	101	1.1405	<1	204
2.457	8	110	1.1143	<1	303
2.282	8	102	1.0813	2	312
2.237	4	111	1.0635	<1	400
2.127	6	200	1.0476	1	105
1.9792	4	201	1.0438	<1	401
1.8179	14	112	1.0347	<1	214
1.8021	<1	003	1.0150	1	223
1.6719	4	202	0.9898	1	402
1.6591	2	103	0.9873	1	313
1.6082	<1	210	0.9783	<1	304
1.5418	9	211	0.9762	1	320
1.4536	1	113	0.9636	<1	205
1.4189	<1	300			
1.3820	6	212			
1.3752	7	203			
1.3718	8	301			
1.2880	2	104			
1.2558	2	302			
1.2285	1	220			
1.1999	2	213			
1.1978	1	221			
1.1843	3	114			
1.1804	3	310			

Determinação de estrutura cristalina




N(2)
C
O(2)
O(1)
Pt
N(1)
20
30
40
50
60
70

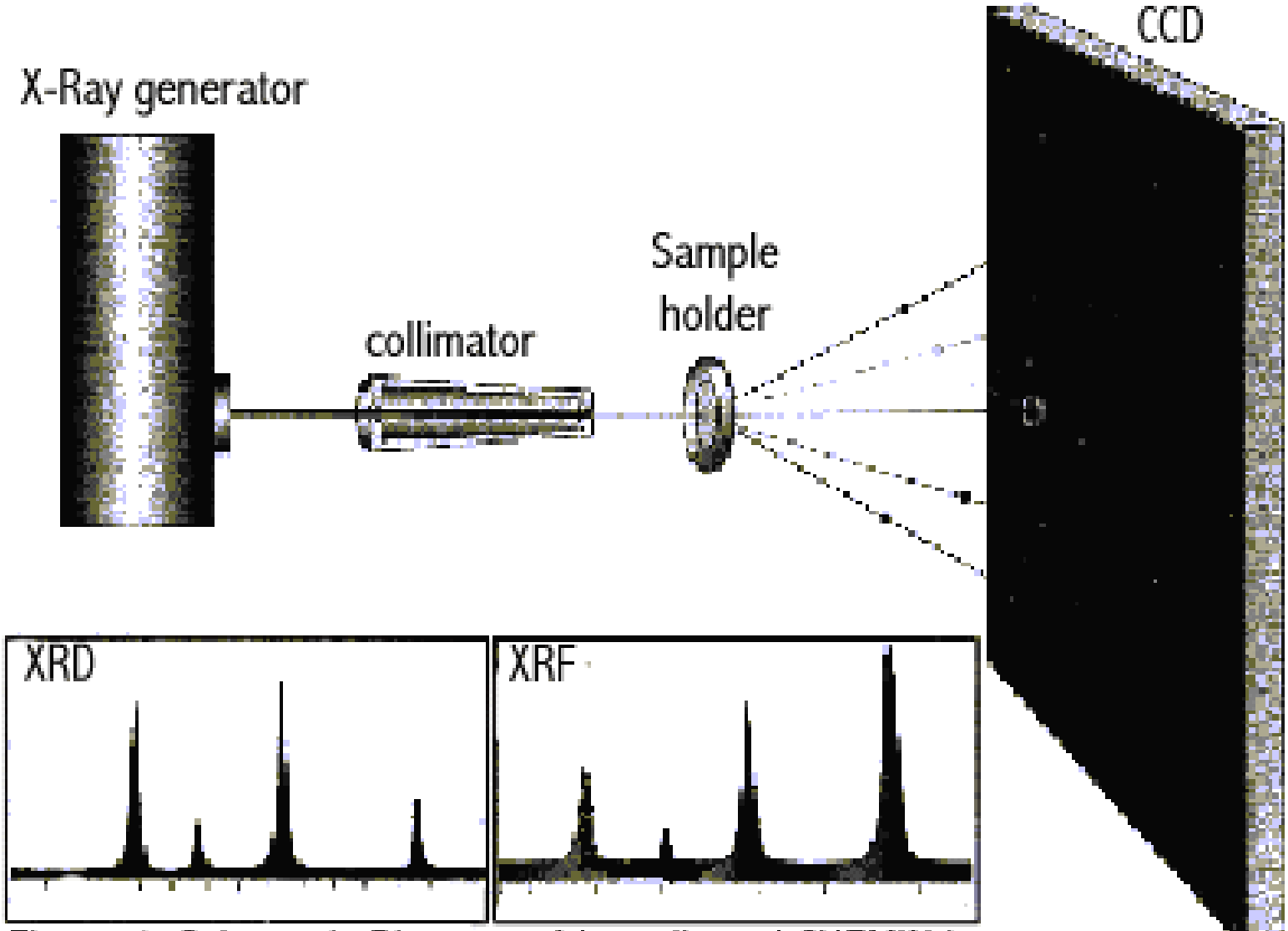


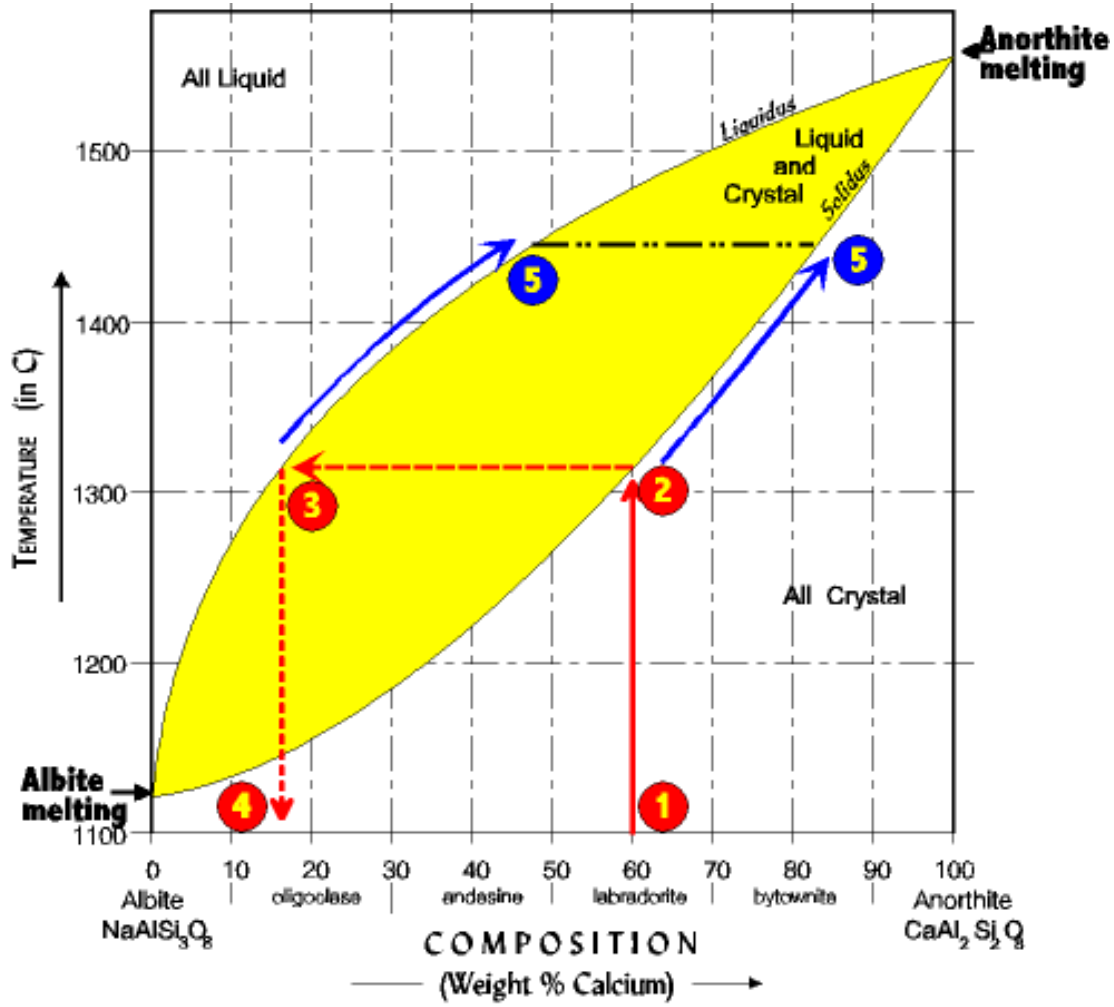
Figure 1. Schematic Diagram of breadboard CHEMIN instrument, showing simultaneous XRD/XRF data.

Principais aplicações:

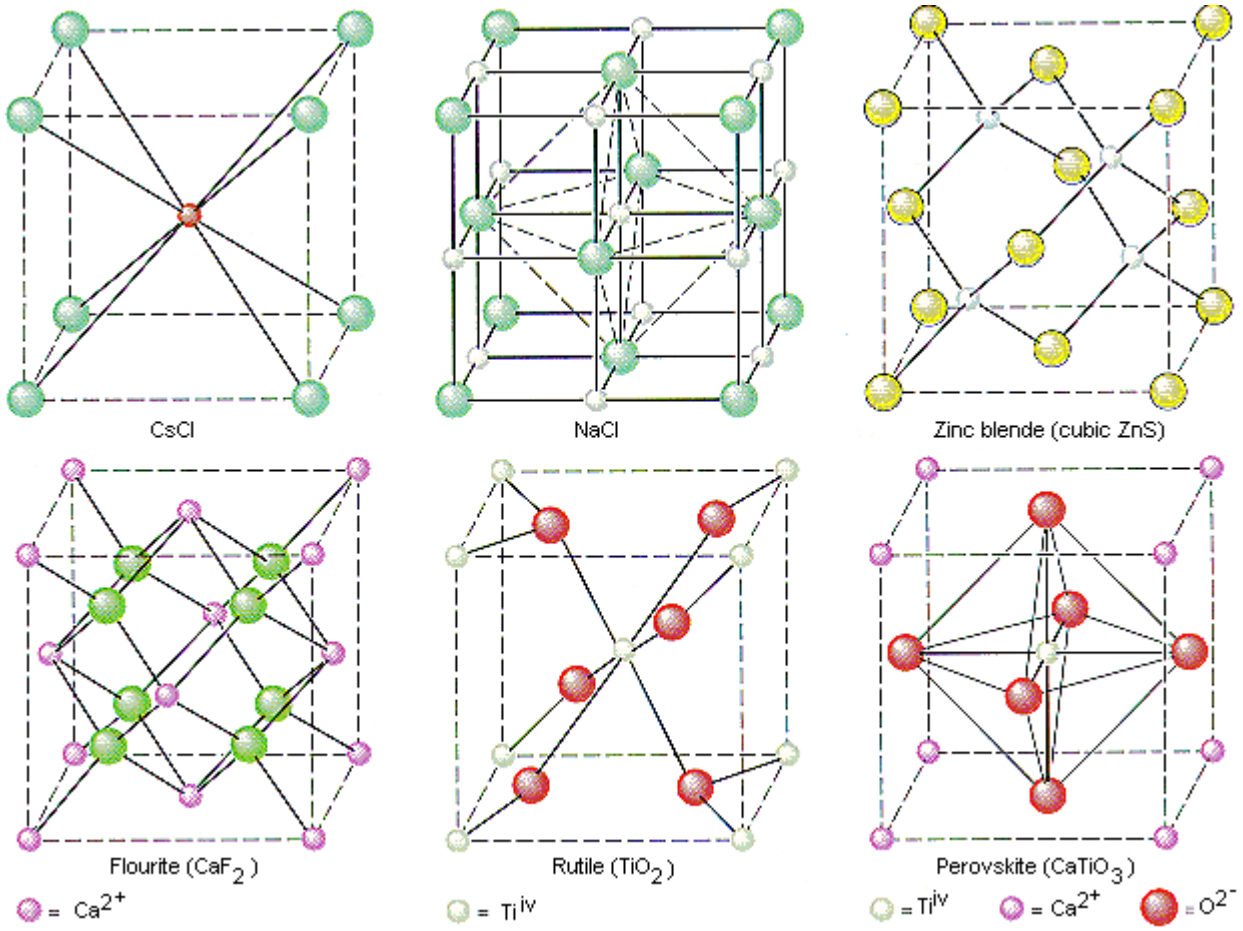
- Determinação qualitativa de minerais;

Determinação semi-quantitativa (proporções relativas de minerais numa amostra)

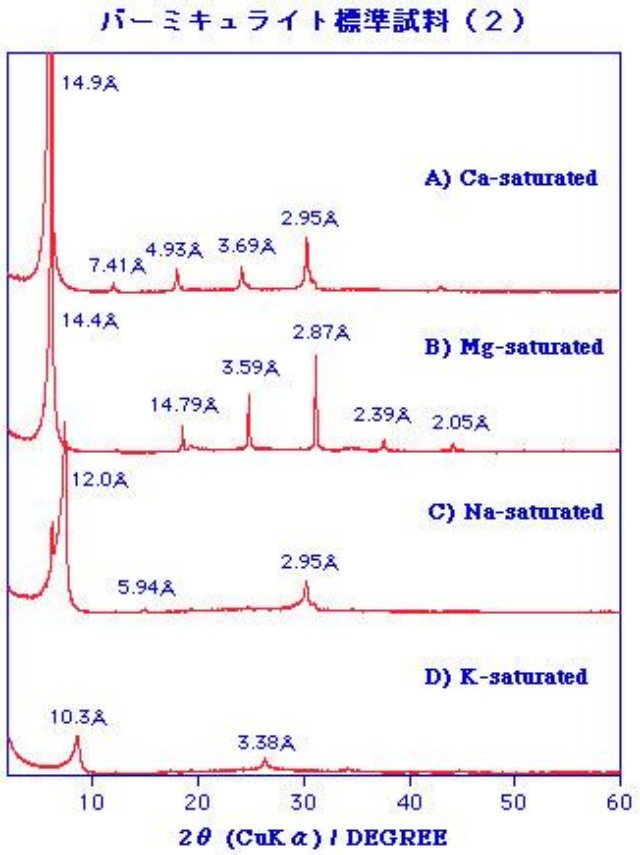
-Composição de séries isomorfas (plagioclásio, olivina, granada)



-Determinação estrutural (parâmetros de cela, grupos espaciais)



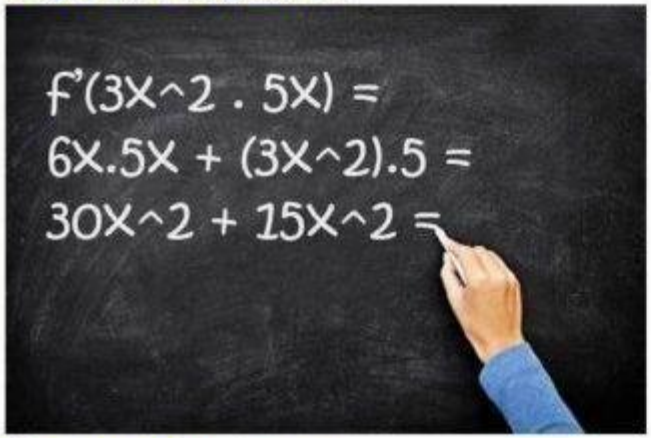
-Estudo de filossilicatos



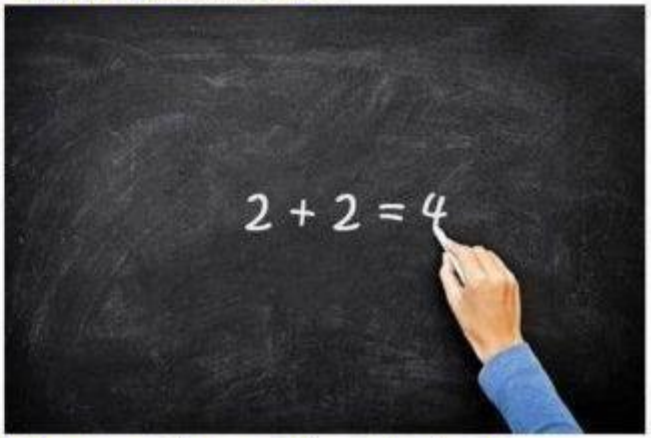
-Minerais de alteração

Bibliografia: Bloss, Bunn, Dana, Técnicas Analíticas...
Mais profundos: Buerger, Azzaroff, Reviews in Mineralogy.

O que está no quadro...



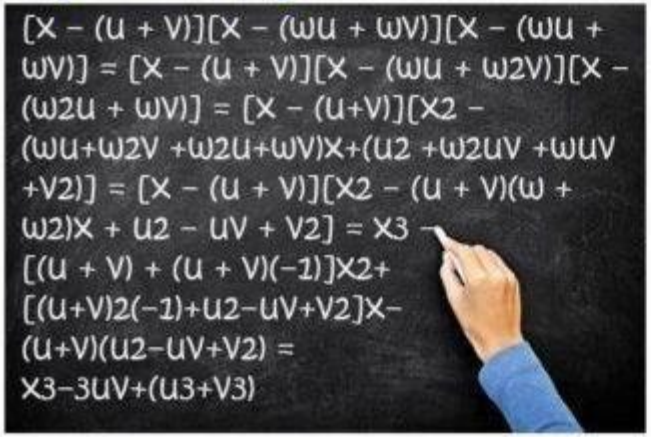
O que o professor vê...



O que os alunos veem...

O que os alunos estão entendendo...

O que vai cair na prova...



A nota da galera!!! Ô.ô