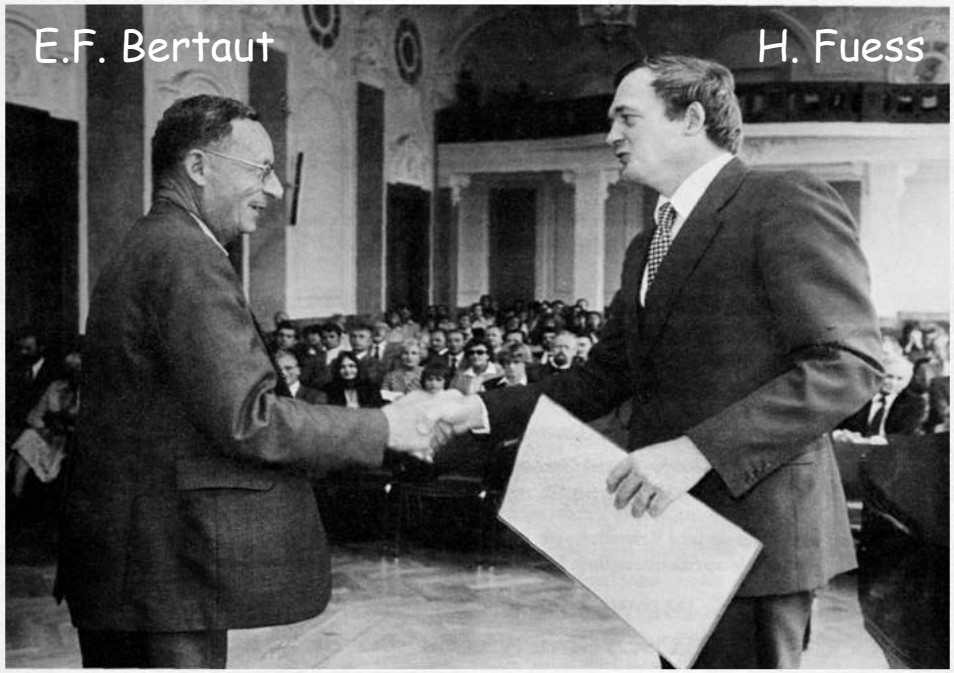
THE FIRST ERWIN FELIX LEWY BERTAUT PRIZE OF THE EUROPEAN CRYSTALLOGRAPHIC AND NEUTRON SCATTERING ASSOCIATIONS

Based on a drawing by V. Plakhty

THE FIRST ERWIN FELIX LEWY BERTAUT PRIZE OF THE EUROPEAN CRYSTALLOGRAPHIC AND NEUTRON SCATTERING ASSOCIATIONS

JOHANN WOLFGANG GOETHE-UNIVERSITÄT
FRANKFURT AM MAIN



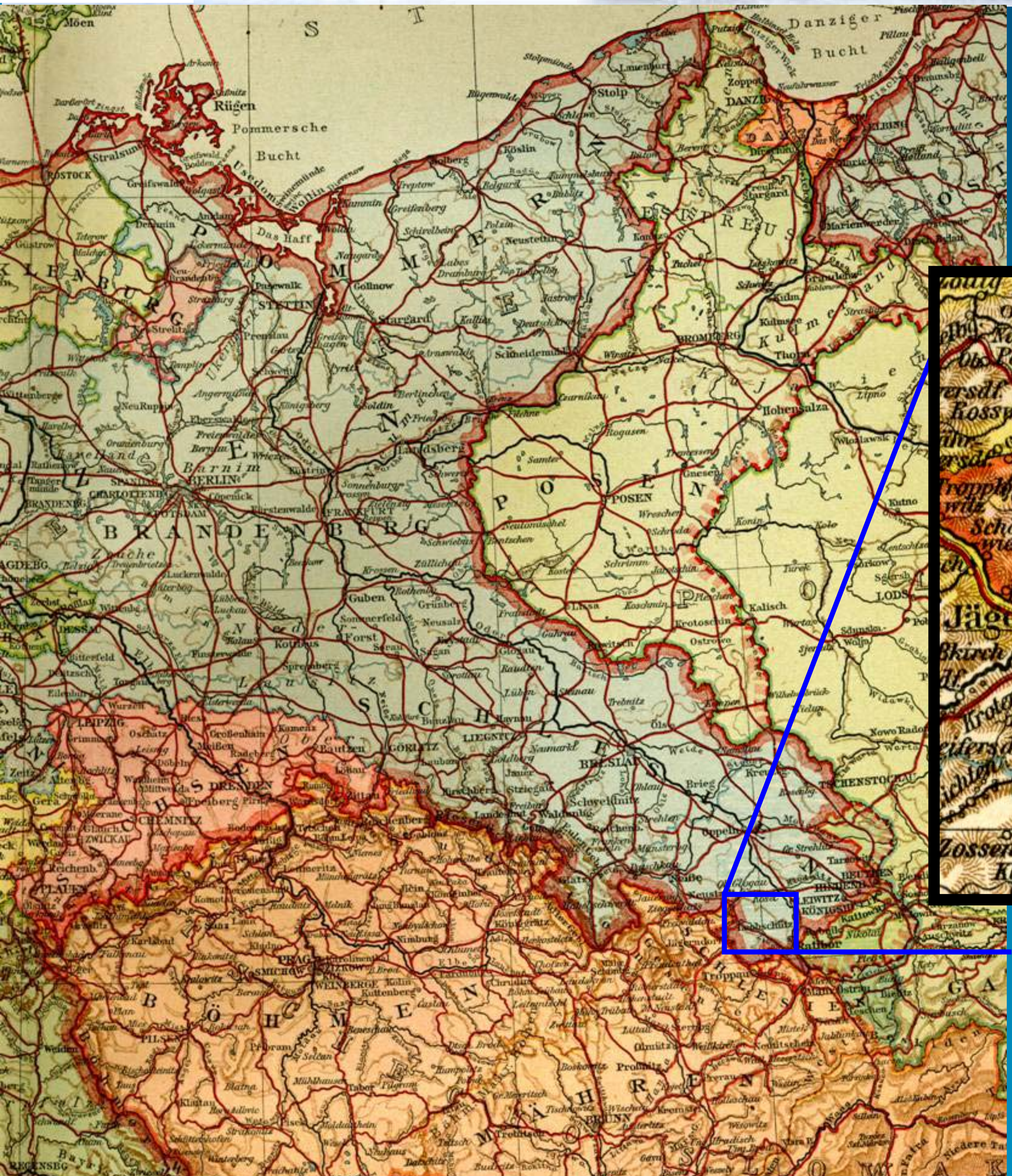
VERLEIHUNG DER EHRENDOKTORWÜRDE AN
PROFESSOR DR. ERWIN FELIX BERTAUT
AM 26. JUNI 1981 IN DER AULA DER UNIVERSITÄT

Who was Monsieur Bertaut ?

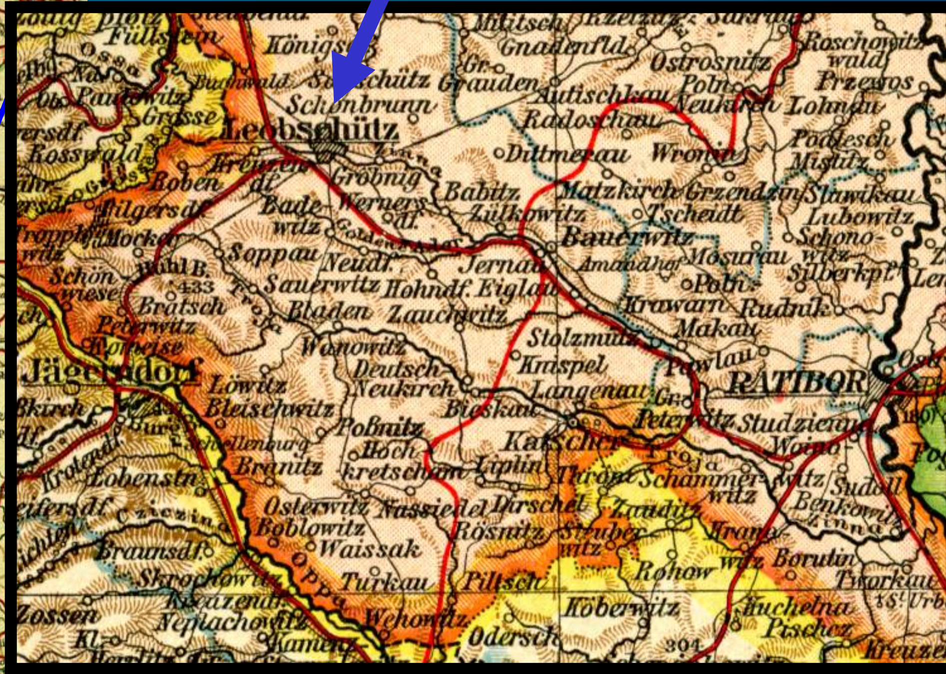
Who was Monsieur Bertaut ?

- The father of neutron diffraction in France
- "A mathematician who does Crystallography" A. Guinier
- Also Law, Greek, Latin, French, English, Music, Chemistry…
- …Mathematics, Crystallography, Magnetism….
- French Academician in Grenoble, with numerous honours…
- Gold medal, Swedish Royal Academy & Honorary Doctorates
- Born Erwin LEWY in Leobschütz, Germany (now Poland)

Who was Monsieur Bertaut ?



Erwin Lewy, born 9 Feb. 1913 at Leobschütz



Haute Silésie, Allemagne (Deutsches Reich)

Who was Monsieur Bertaut ?

Who was Monsieur Bertaut ?

Erwin Lewy, born 9 Fev 1913 at Leobschütz, Germany

- Excluded from university, he left Germany in 1933
- Studied Chemistry at the University of Bordeaux
- Rescued parents and sister 2 months before war in 1939
- Volunteered for French army at the outbreak of war
- On defeat, given papers of a French soldier, Felix Bertaut
- Escaped capture during the occupation, help of A. Kastler…
- But his parents and young sister deported to Auschwitz

Who was Monsieur Bertaut ?

- Himself pursued, fled to Grenoble, protected by Louis Néel
- Studied magnetism with powder diffraction (particle size)
- Thesis in 1949, examined by André Guinier
- 1951,'53 Fullbright in USA with Pepinsky, Corliss, Hastings…
- Created with Neel "Diffraction Neutronique" lab Grenoble
- 1958-1976,-1982 headed labs in both CENG and CNRS
- Returned to Germany to foster German-French exchange

Who was Monsieur Bertaut ?

Thesis February 1949

Texture and structure of magnetic powders using X-rays

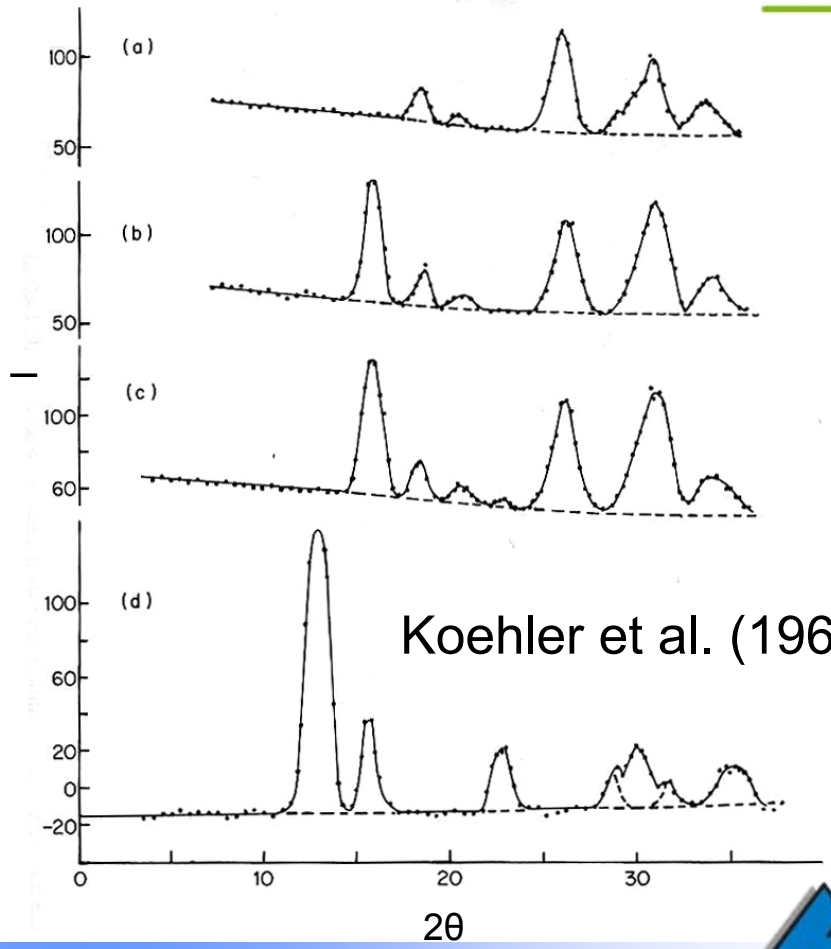
Bertaut was interested in the practical applications of science.
His work on grain size and texture in magnetic materials was stimulated by the need to produce better magnets…
…especially for the dynamos used on war-time bicycles !

1949 Neutron powder diffraction by Smart and Shull
Spectacular confirmation of Neel's magnetic ordering ideas

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Contributions à la Cristallographie

- TRAVAUX METHODIQUES
- Defauts, microstructure
- Energie cristalline
- Méthodes Directes
- Structure et Magnétisme
- Symétrie
- MATERIAUX } (TR – 3d)
- Grénats
- Perovskites
- Oxides doubles (3d-5d)
- Spinelles oxides (3d)
- Spinelles sulfuriques (3d)



Koehler et al. (1960)

Who was Monsieur Bertaut ?

1963 in Grenoble: 1st International Magnetism Conference

Magnetic Space Groups (Bertaut 1963 Magnetism, Vol III)

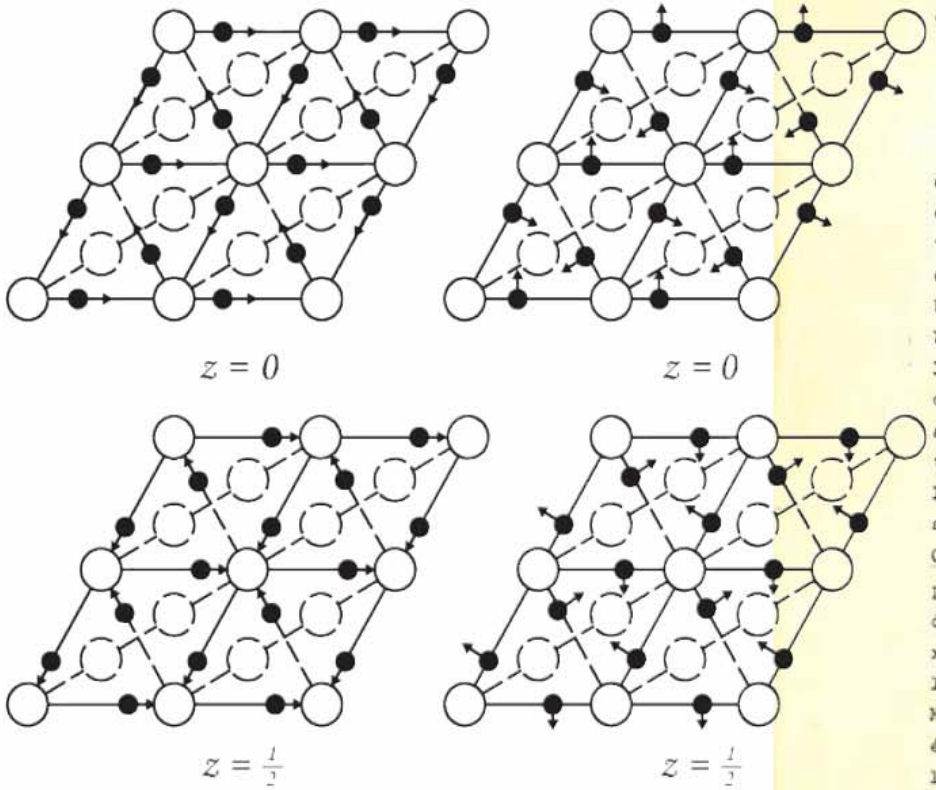
Linear combinations of 12 spins

$$
\begin{aligned}
\mathbf{F} &= \mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 + \mathbf{S}_4 \\
\mathbf{G} &= \mathbf{S}_1 - \mathbf{S}_2 + \mathbf{S}_3 - \mathbf{S}_4 \\
\mathbf{C} &= \mathbf{S}_1 + \mathbf{S}_2 - \mathbf{S}_3 - \mathbf{S}_4 \\
\mathbf{A} &= \mathbf{S}_1 - \mathbf{S}_2 + \mathbf{S}_3 - \mathbf{S}_4
\end{aligned}
$$

$$
\begin{aligned}
\mathbf{V}_1 &= \mathbf{S}_5 + \mathbf{S}_6 + \mathbf{S}_7 + \mathbf{S}_8 + \mathbf{S}_9 + \mathbf{S}_{10} + \mathbf{S}_{11} + \mathbf{S}_{12} \\
\mathbf{V}_2 &= \mathbf{S}_5 - \mathbf{S}_6 + \mathbf{S}_7 - \mathbf{S}_8 + \mathbf{S}_9 - \mathbf{S}_{10} + \mathbf{S}_{11} - \mathbf{S}_{12} \\
\mathbf{V}_3 &= \mathbf{S}_5 + \mathbf{S}_6 - \mathbf{S}_7 - \mathbf{S}_8 + \mathbf{S}_9 + \mathbf{S}_{10} - \mathbf{S}_{11} - \mathbf{S}_{12} \\
\mathbf{V}_4 &= \mathbf{S}_5 - \mathbf{S}_6 - \mathbf{S}_7 + \mathbf{S}_8 + \mathbf{S}_9 - \mathbf{S}_{10} - \mathbf{S}_{11} + \mathbf{S}_{12} \\
\mathbf{V}_5 &= \mathbf{S}_5 + \mathbf{S}_6 + \mathbf{S}_7 + \mathbf{S}_8 - \mathbf{S}_9 - \mathbf{S}_{10} - \mathbf{S}_{11} - \mathbf{S}_{12} \\
\mathbf{V}_6 &= \mathbf{S}_5 - \mathbf{S}_6 + \mathbf{S}_7 - \mathbf{S}_8 - \mathbf{S}_9 + \mathbf{S}_{10} - \mathbf{S}_{11} + \mathbf{S}_{12} \\
\mathbf{V}_7 &= \mathbf{S}_5 + \mathbf{S}_6 - \mathbf{S}_7 - \mathbf{S}_8 - \mathbf{S}_9 - \mathbf{S}_{10} + \mathbf{S}_{11} + \mathbf{S}_{12} \\
\mathbf{V}_8 &= \mathbf{S}_5 - \mathbf{S}_6 - \mathbf{S}_7 + \mathbf{S}_8 - \mathbf{S}_9 + \mathbf{S}_{10} + \mathbf{S}_{11} - \mathbf{S}_{12}
\end{aligned}
$$

Who was Monsieur Bertaut ?
The "Bertaut Method"

Magnetic Space Groups
-> Magnetic Structure Determination



La théorie des groupes
Avec la théorie des groupes, E.F. Bertaut utilisait les symétries du cristal pour prévoir les structures magnétiques possibles. Jour après jour, il prônait sa méthode auprès de ses collaborateurs, et les encourageait à l'utiliser, sans leur laisser vraiment le choix.

$YMnO_3$

Phys. Letters 1963 4 Juin 5 I p. 27-29

1090

STRUCTURE MAGNETIQUE DE $MnYO_3$,

par E.F. BERTAUT et M. MERCIER, Laboratoire d'Electrostatique et de Physique du Métal et Centre d'Etudes Nucléaires, Grenoble.

==========

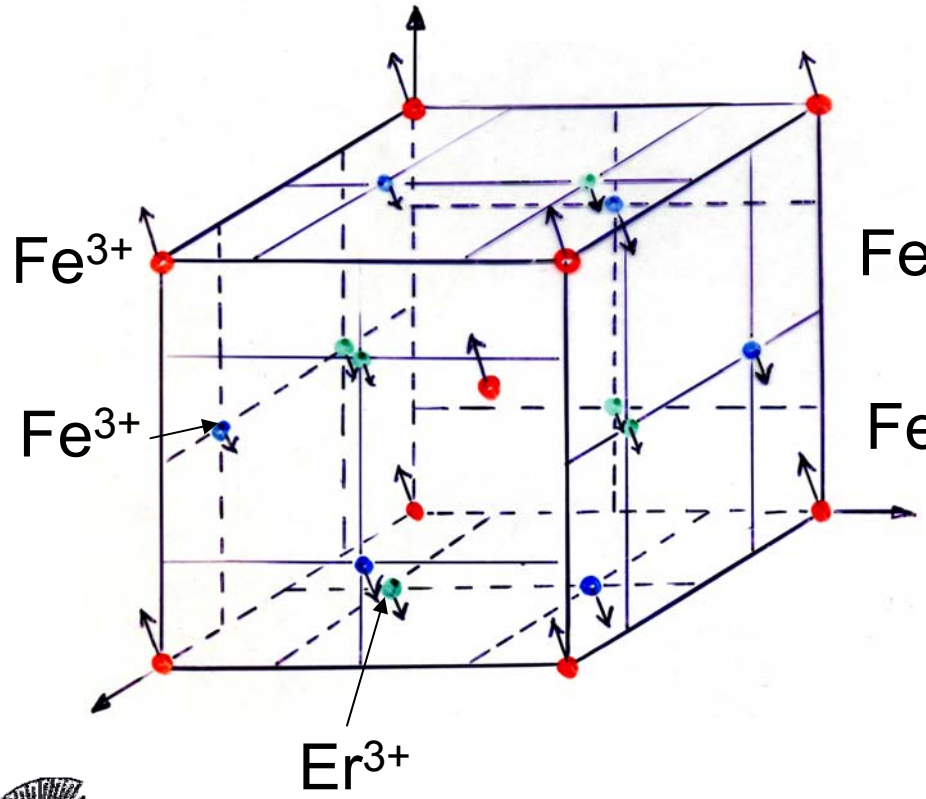
Nous étudions ici la configuration magnétique due à l'ordre des ions Mn^{3+} à 4,2°K dans la forme hexagonale de $MnYO_3$. Dans les composés hexagonaux[1] $MnTO_3$ (T = Ho, Er, Tm, Yb, Lu et Y), appartenant au groupe $P\,6_3\,c\,m$, les ions Mn^{3+} possèdent une coordination de 5 atomes d'oxygène (bipyramide triangulaire), probablement stabilisée par des liaisons d'oxygène covalentes dans les orbites hybridisées 3 d 4 s p^3. On peut donc s'attendre à trouver Mn^{3+} dans la configuration d^4 à spin maximum (S=2). Les paramètres de la maille de $MnYO_3$ sont a = 6.125 ± 0.001 Å ; c = 11,41 ± 0.01 Å; Z = 6. Les atomes de Mn, en position 6c) seront numérotés de 1 à 6. Ils se trouvent dans deux plans. Dans le premier plan, à la cote z = 0, leurs coordonnées sont $X\,0\,0$ (1), $0\,X\,0$ (2) et $\bar{X}\,\bar{X}\,0$ (3); dans le second plan, à la cote $z = \frac{1}{2}$, leurs coordonnées sont $\bar{X}\,0\,\frac{1}{2}$ (4), $0\,\bar{X}\,\frac{1}{2}$ (5) et $X\,X\,\frac{1}{2}$ (6) avec $X \sim \frac{1}{3}$. Les atomes d'oxygène dans le plan des Mn forment un assemblage hexagonal presque compact, mais dilaté (d(0-0) ~ 3.5 Å) par la présence des ions Mn^{3+} qui, approximativement, centrent un triangle sur deux d'atomes d'oxygène. Les liaisons magnétiques dans un plan sont du type superéchange négatif Mn-O-Mn, tandis que, entre plans, elles sont du type super-superéchange Mn-O-O-Mn, donc probablement faibles. Le tableau 1 résume les voisinages et interactions de l'atome $X\,0\,0$ (1).

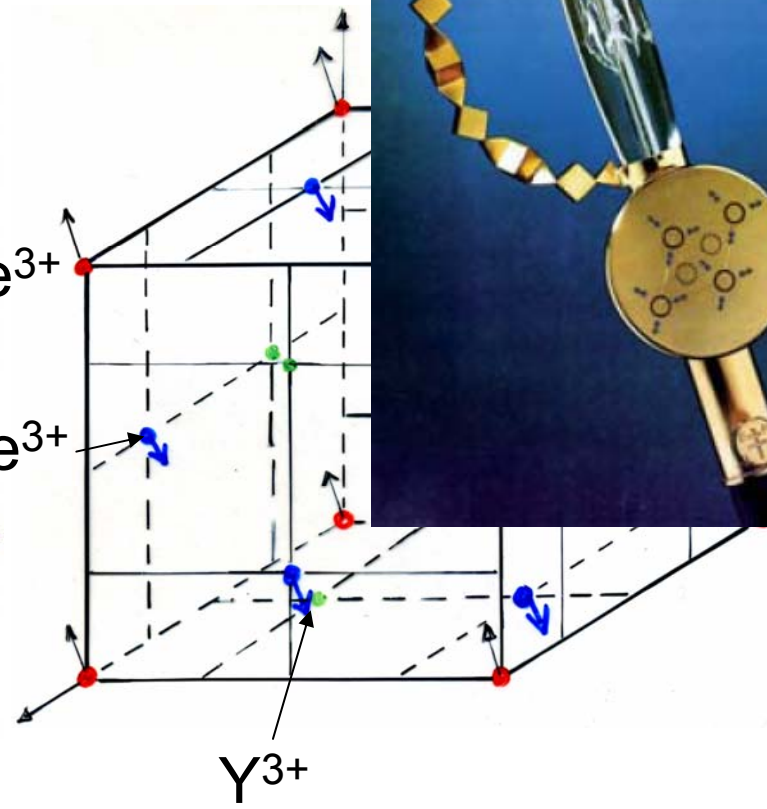
Le diagramme de diffraction neutronique, pris à la température ambiante (fig. 1a) est en accord avec les intensités nucléaires $I_N = p\,|F_N|^2$ (p = multiplicité; F_N = facteur de structure nucléaire), calculées à partir des données de rayons-X[1] (voir tableau 2).

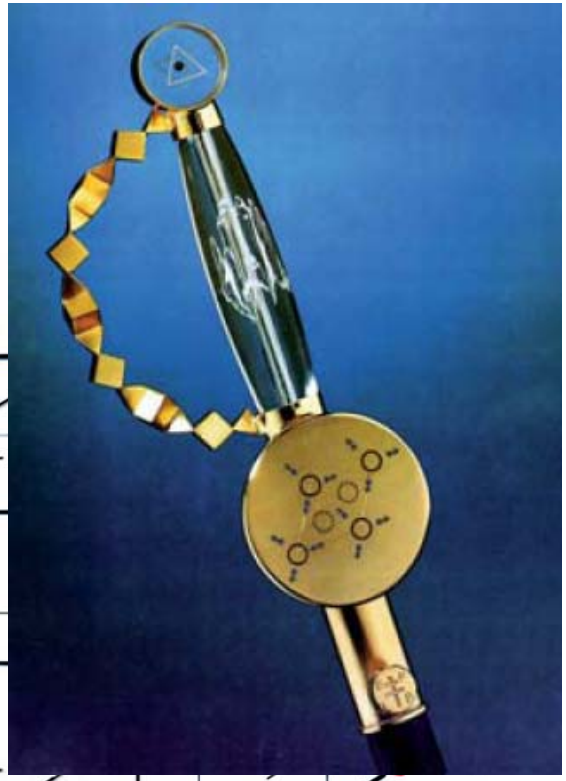
Who was Monsieur Bertaut ?

1956 Ferrimagnetic Garnets

$TR_3Fe_2Fe_3O_{12}$ TR= Y ou Er, Ho etc

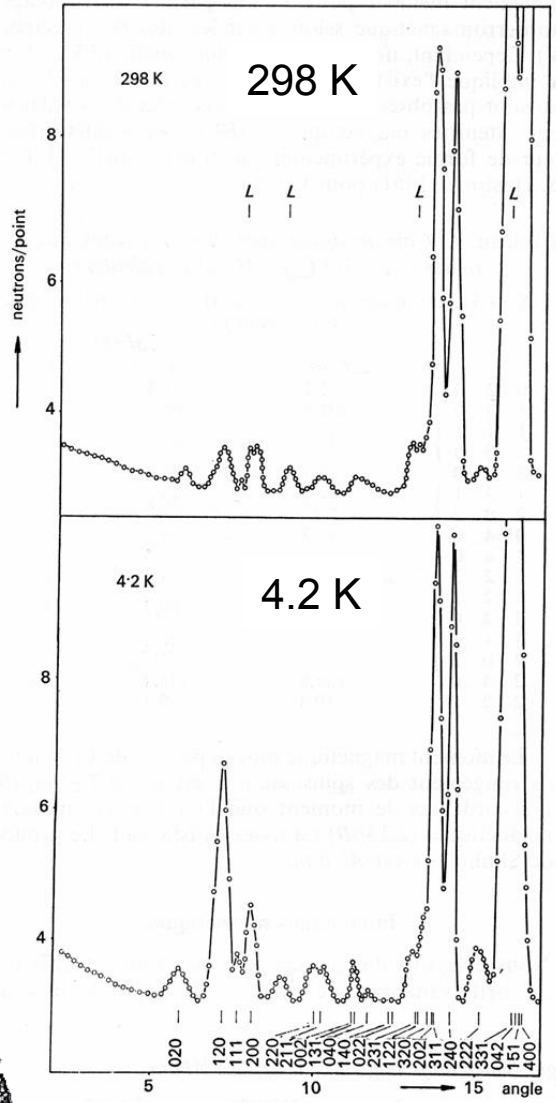






Acta Cryst. (1970). B26, 2036

Structure aux Rayons X, Neutrons et Propriétés Magnétiques des Orthovanadates de Nickel et de Cobalt



Acta Cryst. (1970). B26, 2036

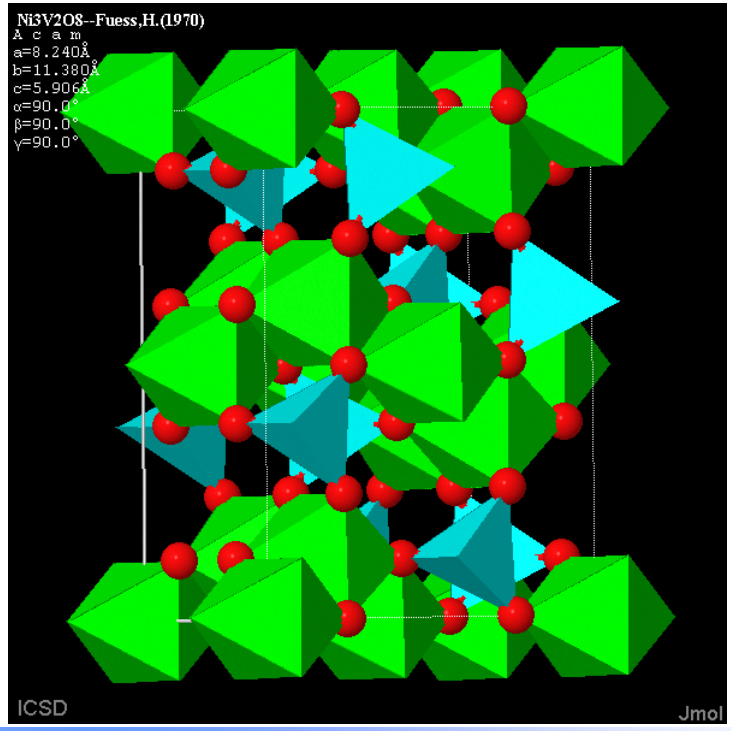
Structure aux Rayons X, Neutrons et Propriétés Magnétiques des Orthovanadates de Nickel et de Cobalt

PAR H. FUESS* ET E. F. BERTAUT

Centre d'Etudes Nucléaires, Cedex No 85, 38-*Grenoble-Gare, France*

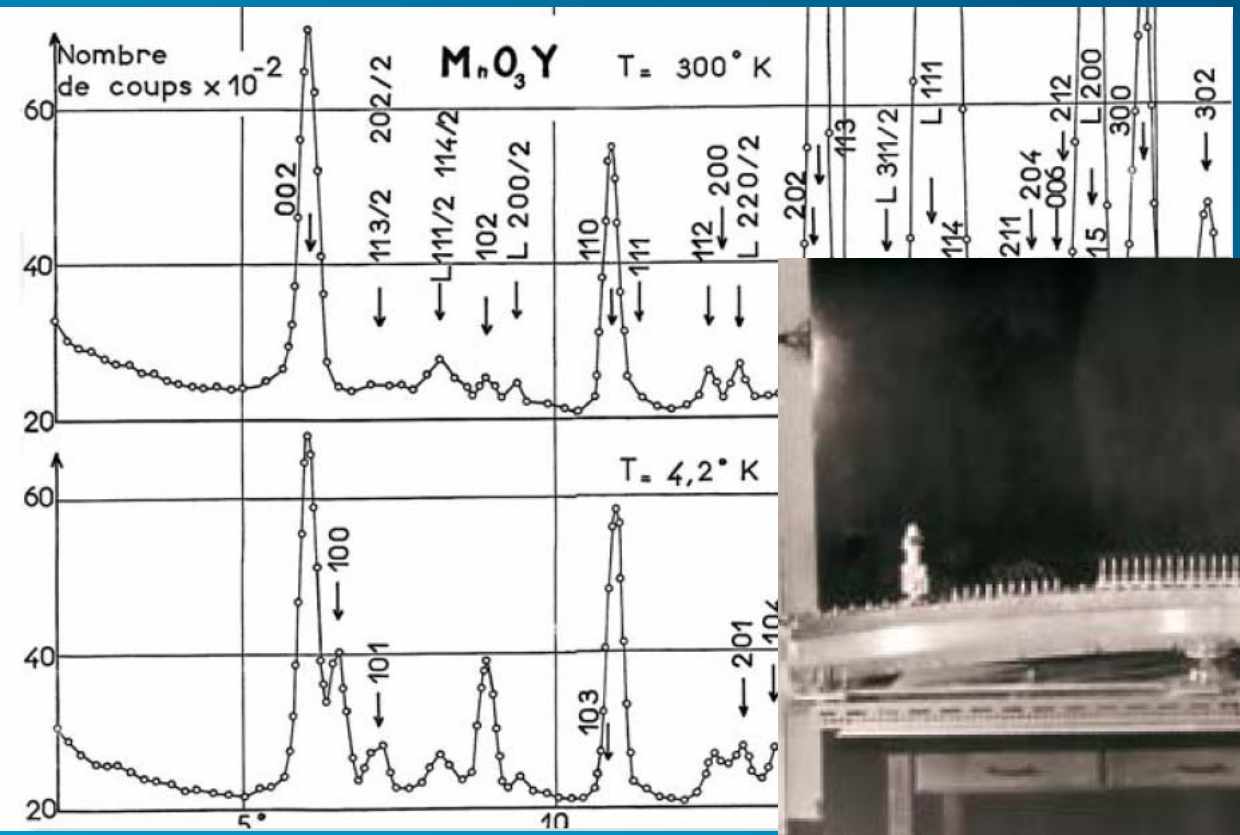
ET R. PAUTHENET ET A. DURIF

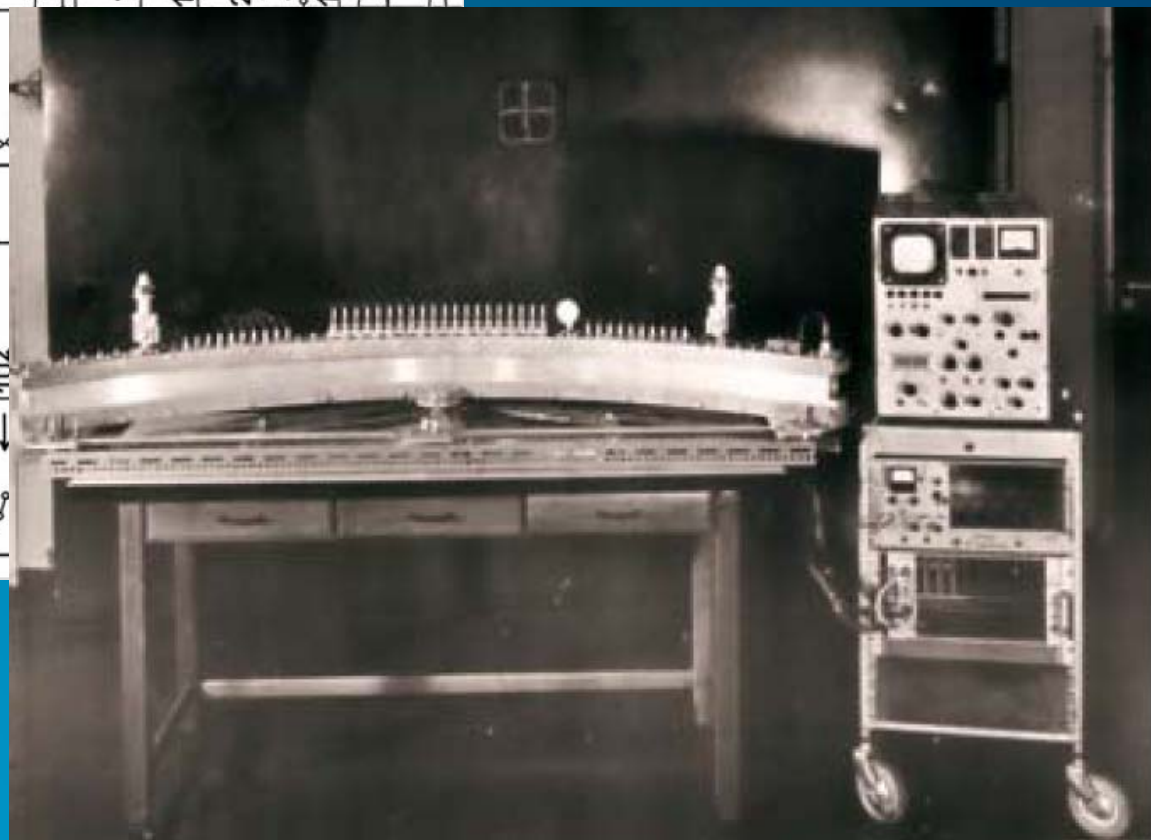
Centre National de la Recherche Scientifique, Cedex No 166, 38-*Grenoble-Gare, France*



Who was Monsieur Bertaut ?

First neutron position sensitive detectors at Siloe (CENG) and ILL (D1B)





1963 Treaty between France and Germany
Scientific exchange programmes established

Who was Monsieur Bertaut ?
1967 Franco-German treaty to establish ILL

A gentle man, but also determined and persistent

Without Bertaut, there would have been no ILL diffractometers

(or perhaps only one… using TOF…)

Dear Professor Maier-Liebnitz,

… You may sometimes have the impression that I write to you using sulphuric acid… that was not my intention…

E.F. Bertaut

Who was Monsieur Bertaut ?
ILL Science Council, November 1973

POINT 5 OF THE AGENDA

Lomer referred to his paper "Progress on Instruments", mentioned the forthcoming instrument meeting in January 1974 and discussed especially page 7, § 10 New Instruments.
In connection with this item

Abragam asked for the price of the six hexapole sections for the spin echo spectrometer (§ 10 f.).

Mössbauer and Lomer gave a figure of 1.6 million francs. For the time being only one section of hexapoles will be constructed.

Bertaut asked for explanations of the plans for D-2 B.

Replying to this query

Lomer pointed out that the proposed plan for this instrument would be very difficult to implement from the view-point of space allocation and shielding. He suggested that for the time being the idea of accommodating such a spectrometer in the reactor hall should be abandoned and that efforts should be concentrated on the improvement of D-1 A.

Mössbauer then reported on § 10 m) - ultra-cold neutrons -

He first gave a brief summary on the technique of producing ultra-cold neutrons and then quoted some examples of application:

1) Measurement of the electric dipole moment of the neutron:
The present limit for μ_e is about 10^{-23} - 10^{-25} cmxe with cold neutrons. A gain of 100 will be possible with ultra-cold neutrons

Who was Monsieur Bertaut ?
ILL Science Council, November 1973

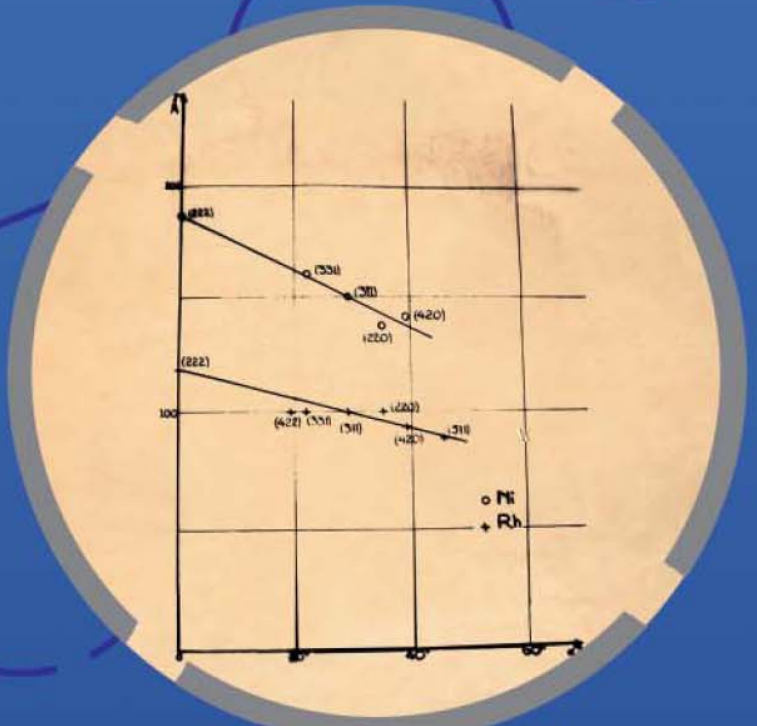
Abragam	asked for the price of the six hexapole sections for the spin echo spectrometer
Mössbauer	gave a figure of 1.6 million…
Bertaut	asked for explanations of the plans for D2B
Lomer	…the proposed plan… would be very difficult… He suggested that for the time being the idea …should be abandoned…
Mössbauer	reported on ultra-cold neutrons… quoted some examples…

1) Measurement of the electric dipole moment of the neutron

2) …etc

Who was Monsieur Bertaut ?

Monsieur Bertaut died 6 November 2003, aged 91



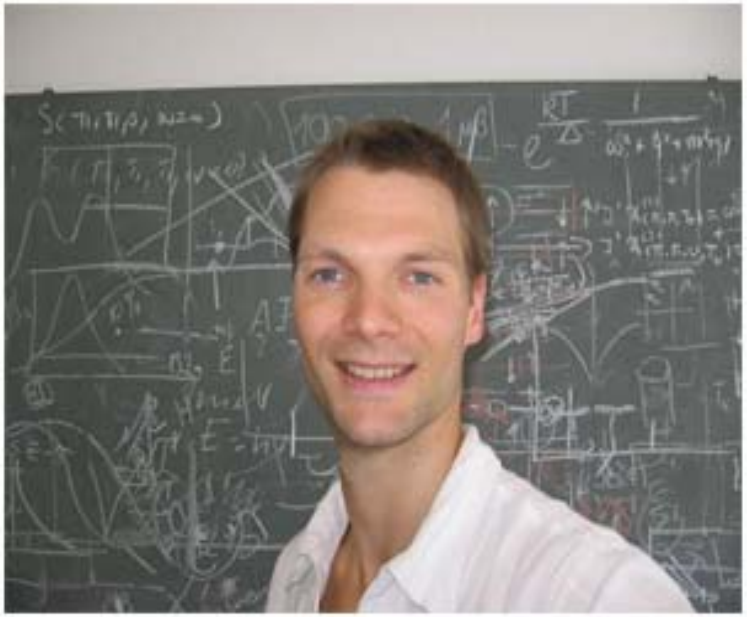
THE FIRST ERWIN FELIX LEWY BERTAUT PRIZE OF THE EUROPEAN CRYSTALLOGRAPHIC AND NEUTRON SCATTERING ASSOCIATIONS

Announcing the winner of the Lewy-Bertaut prize of European Crystallographic Association and European Neutron Scattering Association

The prize committee set up by the two associations has decided unanimously to award the first Lewy-Bertaut prize to **Henrik M. Rønnow**

Henrik M. Rønnow has a brilliant track record that illustrates a truly successful career of a young European scientist. His work has concentrated on experimental and theoretical aspects of quantum magnetism (spin dynamics in the two-dimensional magnet CFTD, in copper germanate as well as high Tc cuprates). He has also been involved in development of neutron instrumentation as well as simulation and data analysis software. Despite his yet early career, he has contributed significantly to neutron scattering science and he has become a renowned expert in polarized neutron scattering techniques. His major publications in the highest ranking journals are frequently cited and brought up considerable esteem among peers.

After a thesis work at the University of Copenhagen, followed by a post-doctoral period with international mobility (Grenoble, France; Princeton&Chicago, USA) Henrik Rønnow spent some time at the Neutron Scattering Laboratory of ETH-Zürich and Paul Scherrer Institute, and has now settled at the Ecole Polytechnique Fédérale de Lausanne (Switzerland) where he holds a tenure track professor position and continues to contribute to the progress of neutron scattering science in Europe.



Henrik M. Rønnow
Presented by
Hannu Mutka
Vice-Chairman ENSA

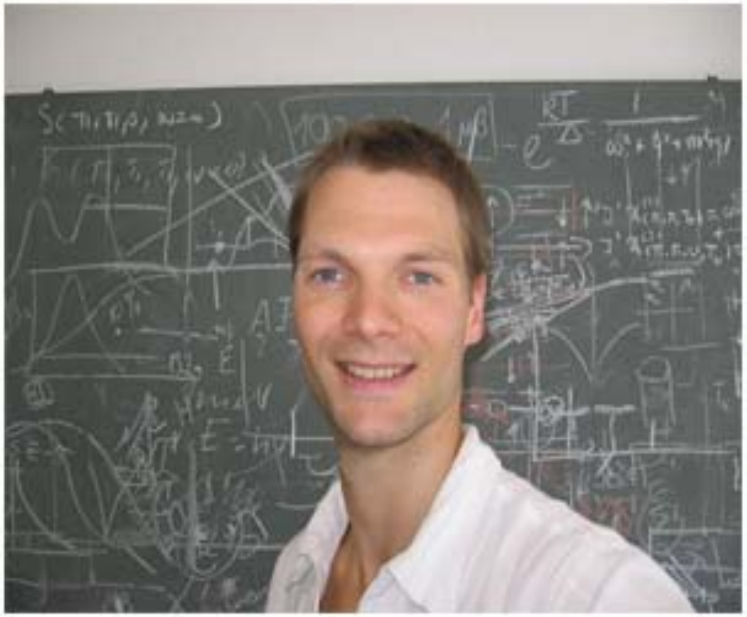
THE FIRST ERWIN FELIX LEWY BERTAUT PRIZE OF THE EUROPEAN CRYSTALLOGRAPHIC AND NEUTRON SCATTERING ASSOCIATIONS

Announcing the winner of the Lewy-Bertaut prize of European Crystallographic Association and European Neutron Scattering Association

Abstract:

People should be judged by their actions not their appearance…

…we often learn more about (quantum magnets) by studying their excitations than by solving their structure…



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