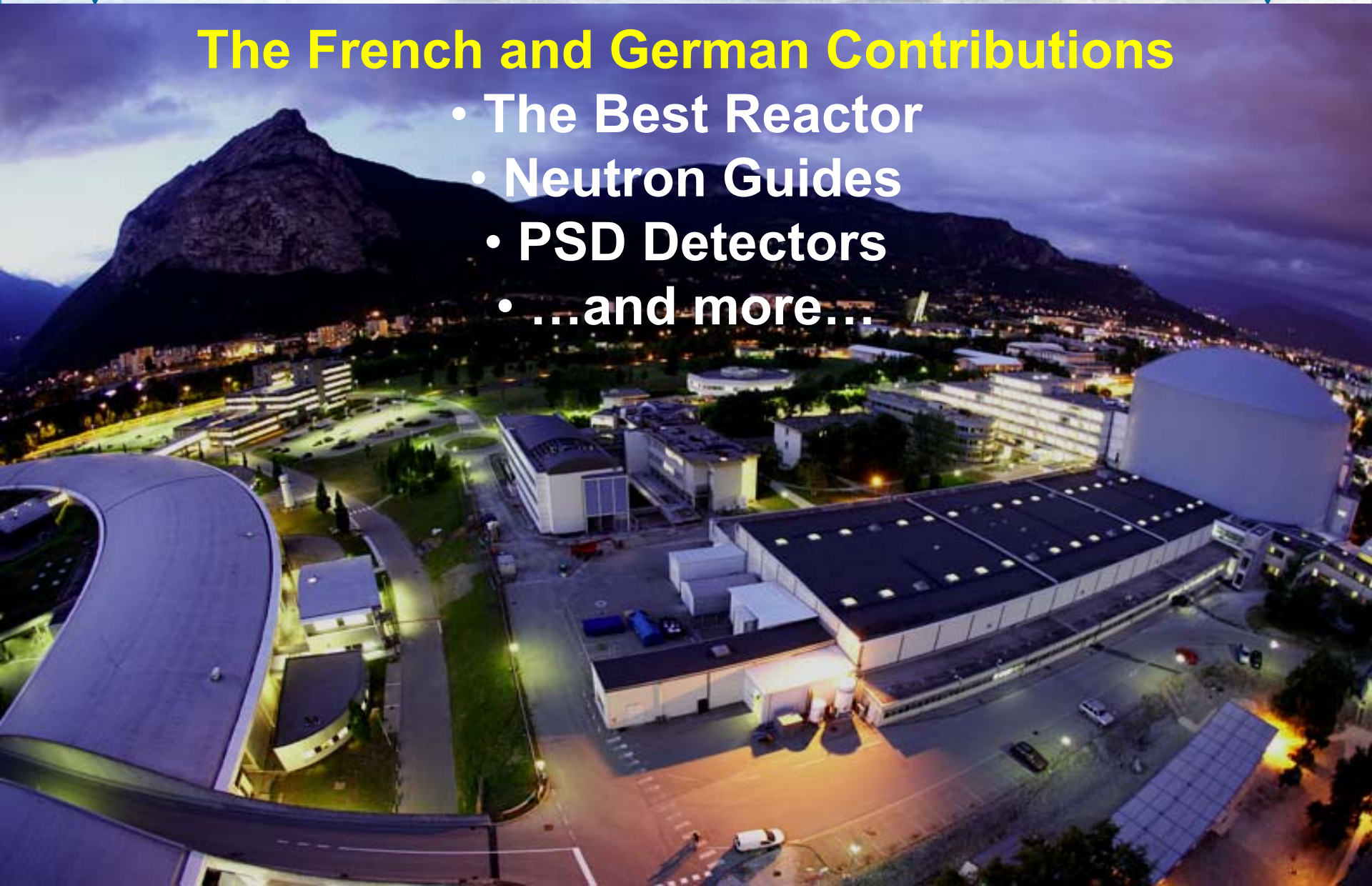
The UK Contribution to ILL since 1973

Alan Hewat, ILL and NeutronOptics Grenoble



The French and German Contributions

- The Best Reactor
- Neutron Guides
- PSD Detectors
- …and more…

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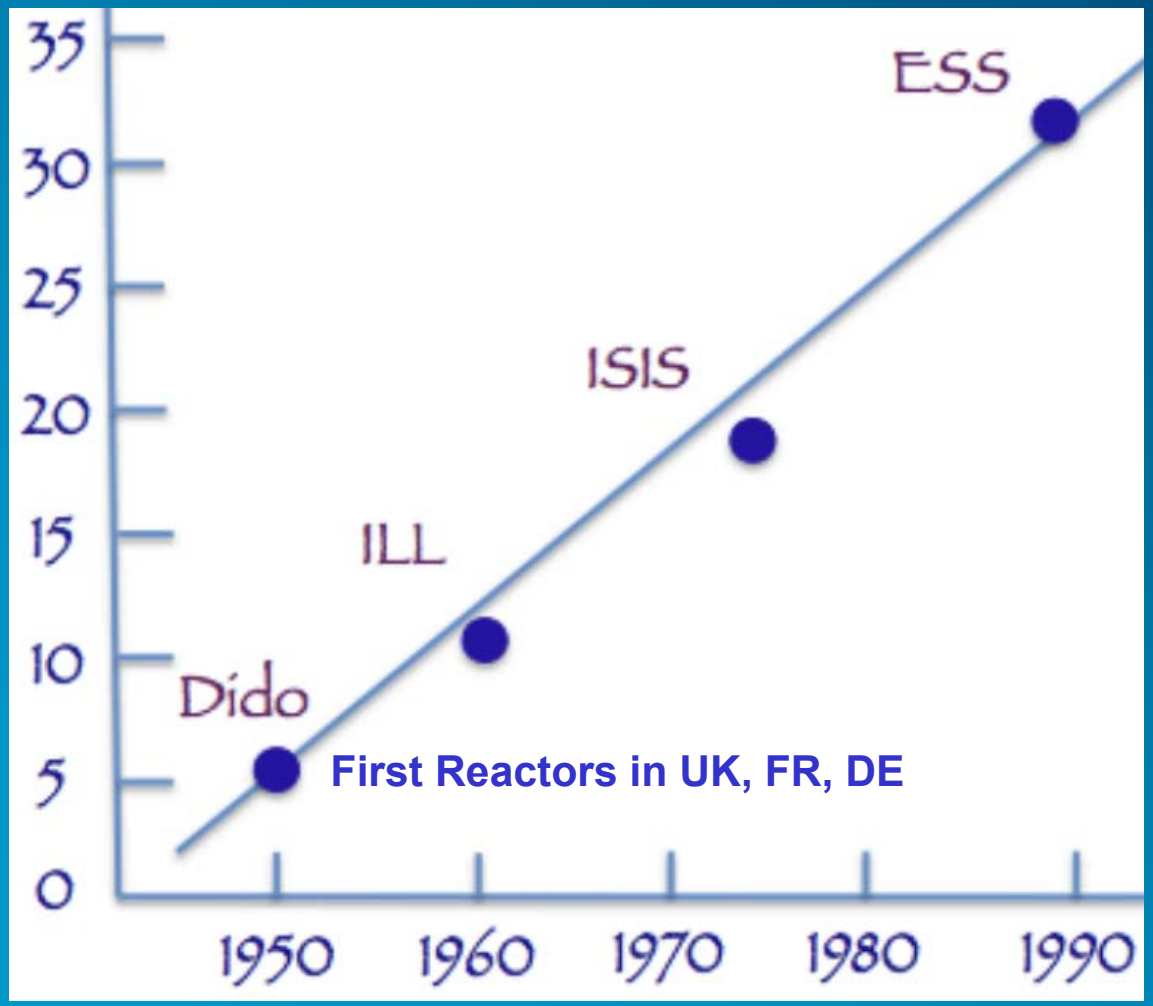
Neutron Sources - the Time it Takes & the Cost

K Andersen & C Carlile 2016 – Egelstaff's Rule of Increasing Delay

Delay (years) & Cost?



ILL Intensity Dido ~ x 10

ILL Construction ~ 2 years

ILL Cost (€ 2023) ~ 320 M€

A Small Modular Reactor

Location near a city

SMAs the Future ?

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What's left for the UK Contribution – in 10 minutes ?

1972 – I was working at Harwell – with Joe Zaccai (the next speaker)

ILL Director Mossbauer visits – Wants to change the ILL's emphasis

Unique in the World → Useful for University Users

The UK had the world's first Neutron User system (after Australia)

The UK Contribution was the University User system

User demand -> better instruments (x100 to x1000 efficiency c.f. x10 source intensity)

Huge increase in scientific output → User System copied by all neutron labs.

Increased budget for instrument improvement – "2nd Souffle" J White, B Fender

Instrument Improvement more Important than Source Flux

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My First ILL Job – D2B – Mission Impossible

1973 – I was recruited to ILL from Harwell (UK Director - Mick Lomer from Harwell)
My job was to build a new high resolution diffractometer D2B (Brian Fender)

But soon after I arrived - a meeting of the ILL Science Council

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 D2B plan… would be “very difficult”... “For the time being” the idea should be abandoned…
Mössbauer	Reported on ultra-cold neutrons… quoted some examples…

D2B was NOT to be

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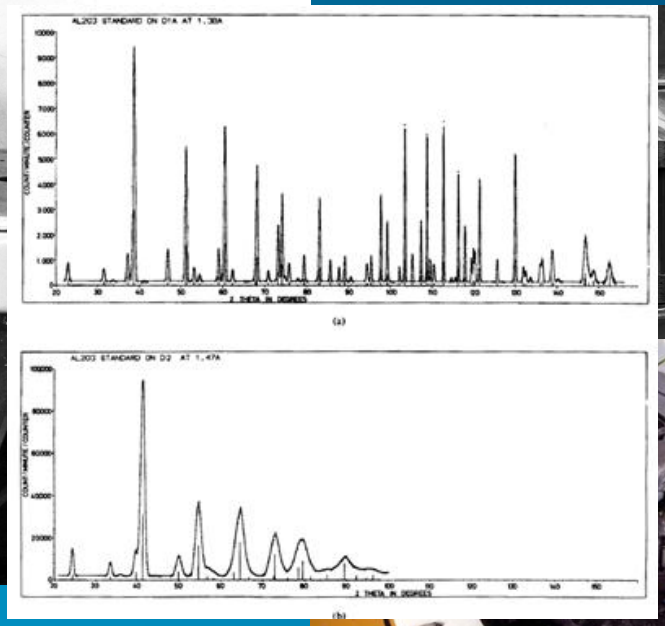
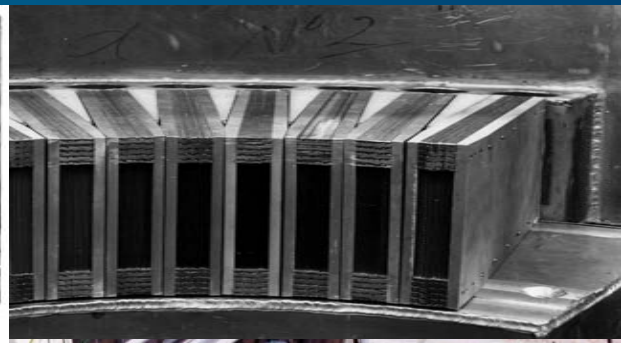
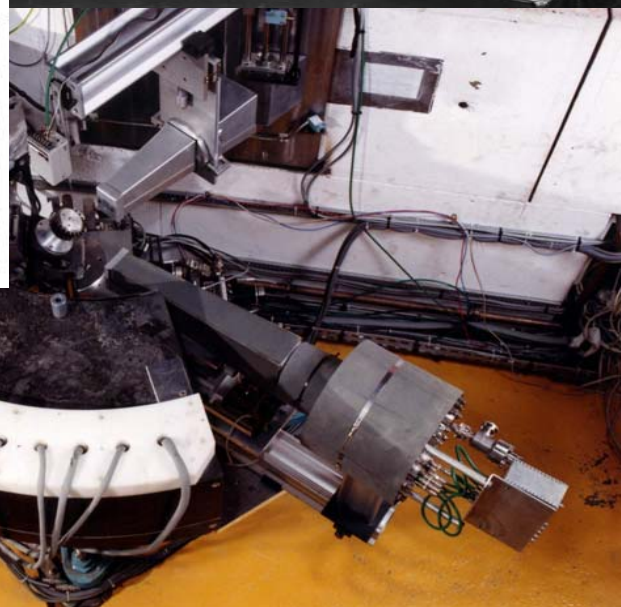
My First ILL Job – L'Impossible n'est pas Française

x500 intensity gain with Ian Bailey (1975)

- ILL Focussing Monochromators x5 (Andreas Freund)
- Rutherford Lab Mylar Collimators x4x25 (Colin Carlile)







Original D1A detector (1973)

- **Report**: Hans Dachs & B Forsyth
- Very high resolution
- Very low intensity - **Unusable**
- My first ILL job – **Make it work** (3 year contract)

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x1000 gains in instrument performance to satisfy users

The CEA/LETI development of Position sensitive Neutron Detectors

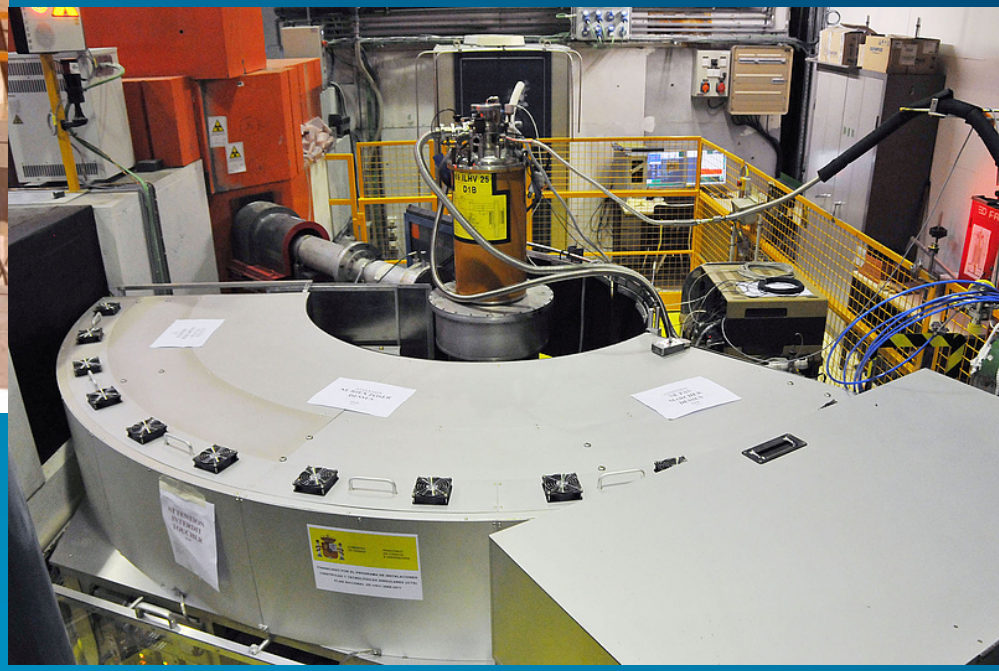
Original D1B detector (1973)

CEA PSDs E Roudaut, R Allemand, J Jacobe

Pierre Convert (1970) ILL BF3 “banana”

New He3 D1B (Convert, MICINN)

x100 intensity gain



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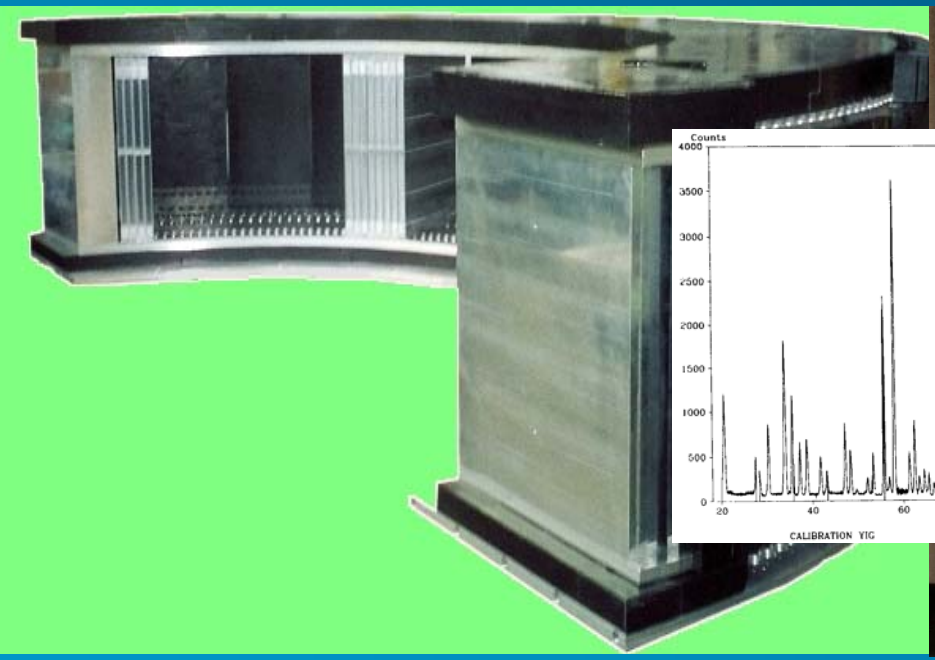
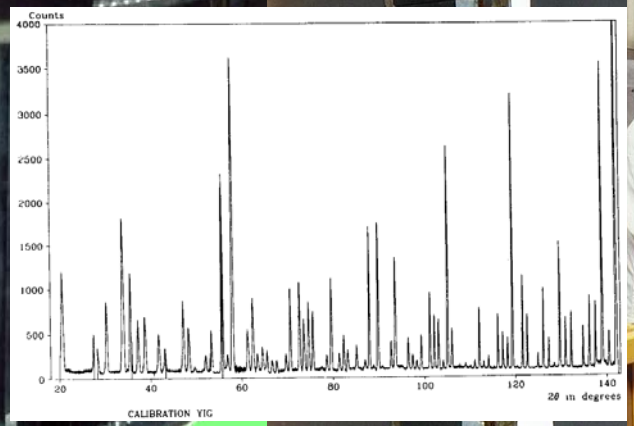
ILL 2nd Souffle – First UK Director, John White

D2B 1980 + 2003 Paul Attfield EPSRC grant - 128 Mylar Collimators, He3 Linear PSDs





X128 EuroCollimators (UK) + He3 Detectors + Focusing Monochromator

Peter Cross, Alan Hewat on D2B

Brian Fender 1973 project, delayed 7 years by “budget priorities”

John White † 15Aug23 with Jenny Stirling

1st UK Director at UK50@ILL lunch, 15June23, Grenoble

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4π Position Sensitive Detector-Laue Diffraction

The Hedgehog Multi-Detector

B. Klar, 9th Int. Congr. of Crystallography, Kyoto (1972)

"Ingenious, but Impractical – Use a PSD"

R. Mossbauer (1975)

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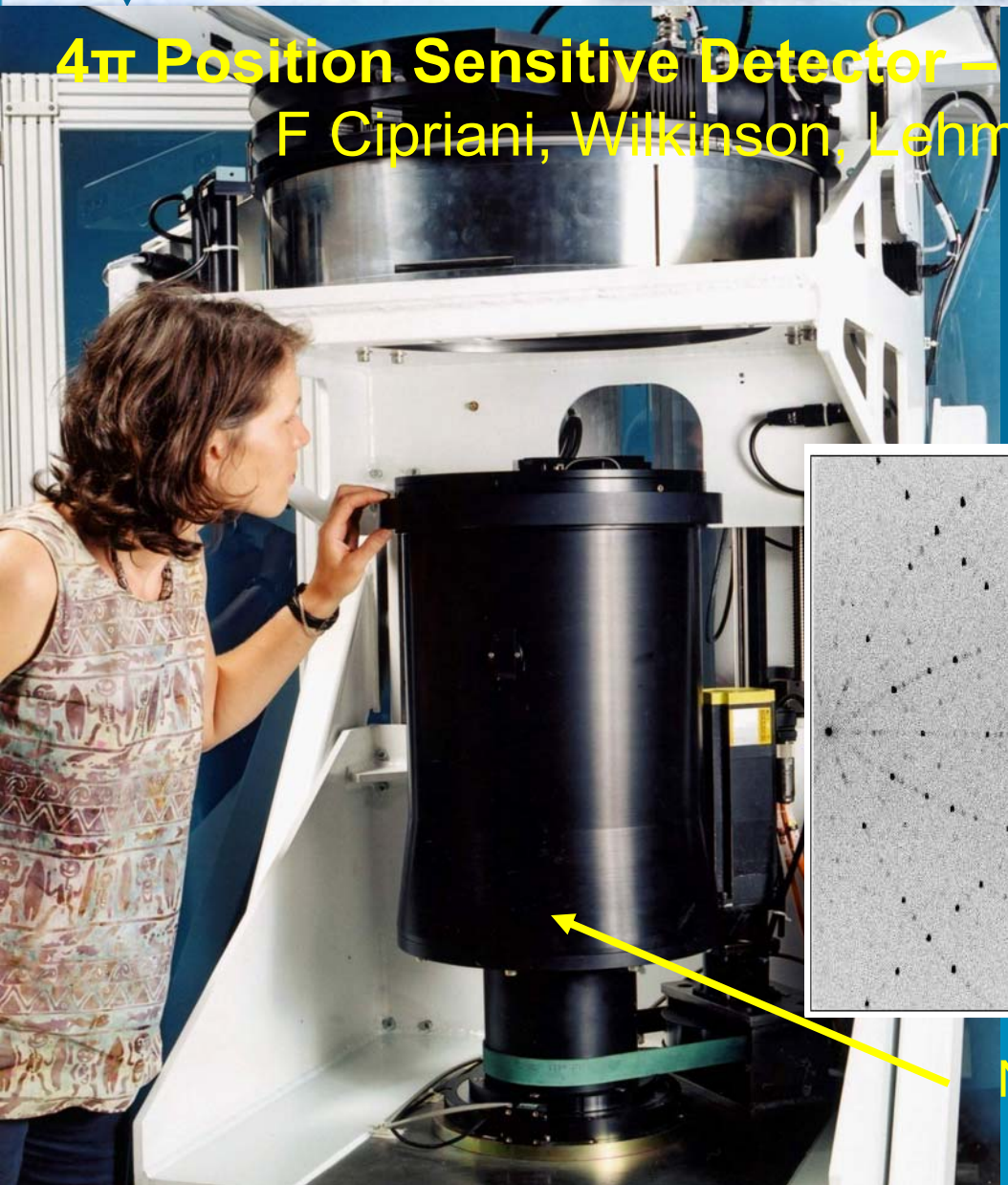
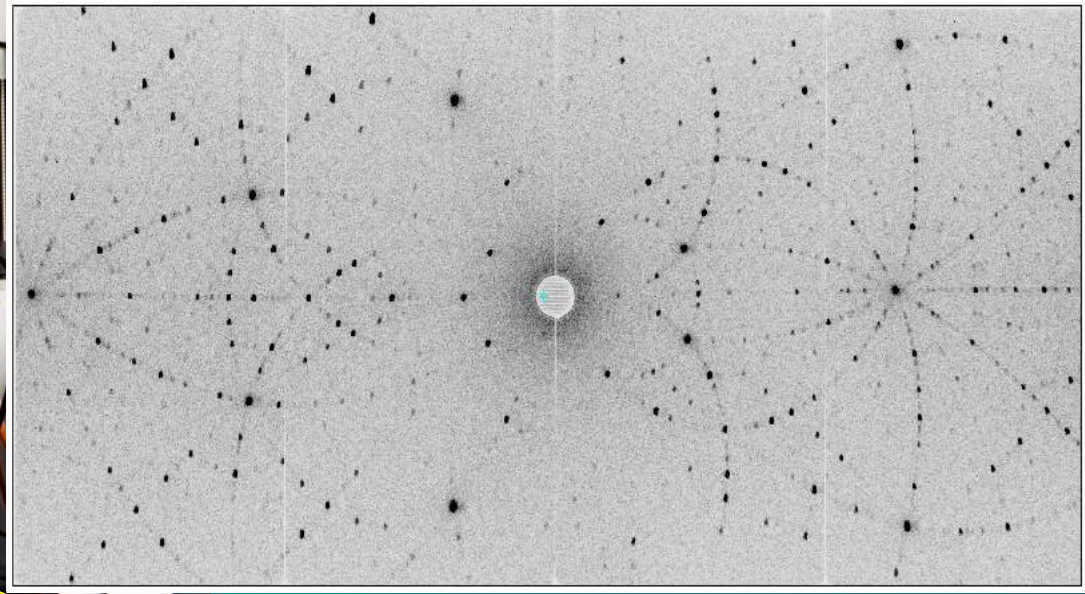
4π Position Sensitive Detector – LADI (1996) Vivaldi (2005)

F Cipriani, Wilkinson, Lehmann, McIntyre et al.

Neutron Image Plate (NIP)

High Resolution 2D - PSD





NIPs inside cylinder, Laser readout

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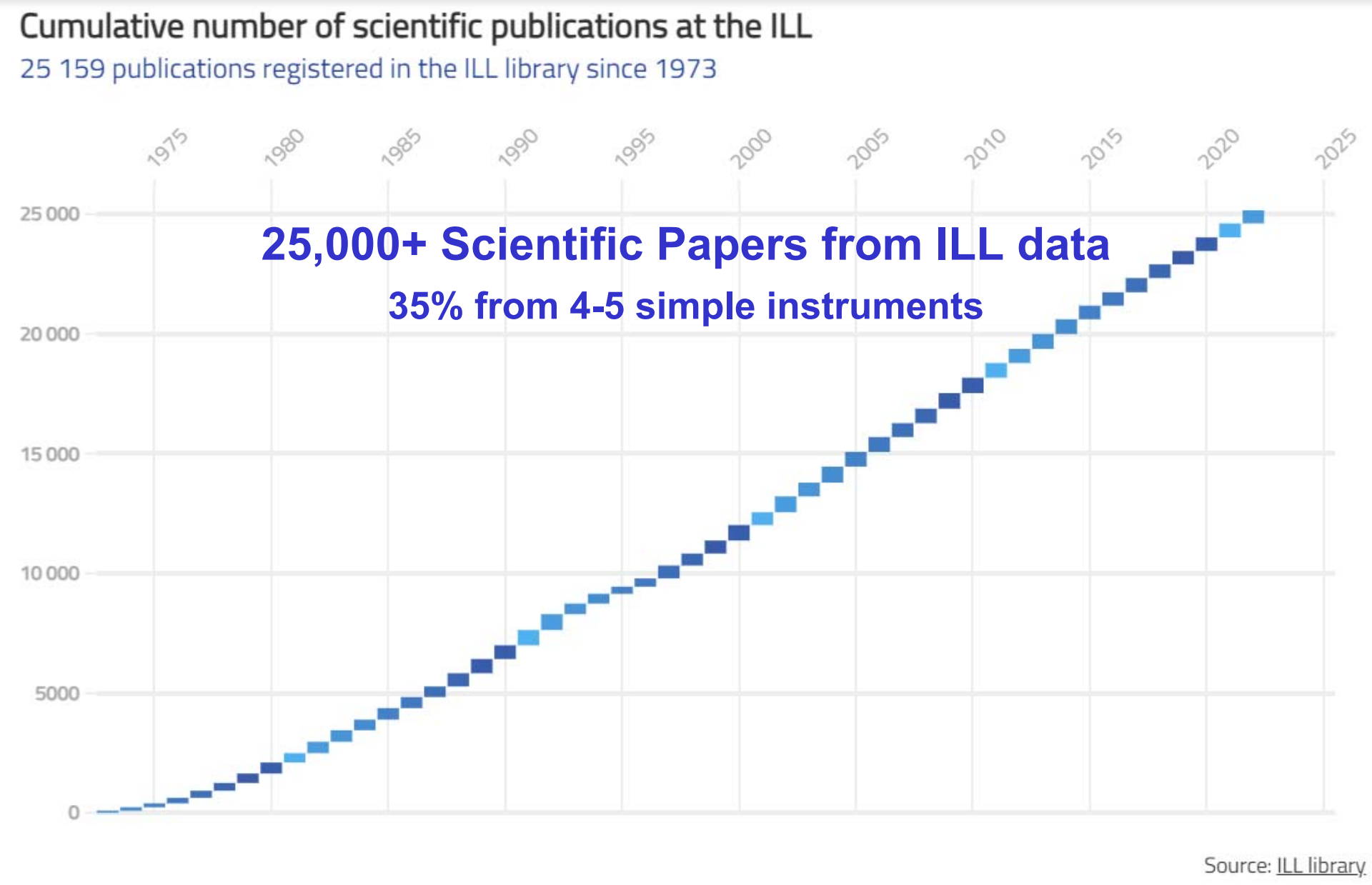

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ILL Impact - Most Cited ILL Papers (Fischer & Rodriguez)

Instrument	Pubs 2007-'16	All Cites 2007-'16	100+Cites 2007-'16	100+Cites to 2016	Note
DIFFRACTION					
D1A powder	266	3207	3	28	Closed
D1B powder	476	4202	6	39	CRG
D2B powder	543	7262	6	58	
D20 powder	383	4801	3	24	
XtremeD pressure					New CRG
SALSA strain	160	1198	0	0	
D4 Liq/Amor	129	1804	1	34	50%
D3 Hot polar	50	437	0	4	
D7 Cold Diffuse	62	1035	2	4	
D9 Hot Single-X	52	476	0	10	
D10 Single-X	67	1150	2	12	
D19 Single-X	64	967	1	12	
D23 Single-X	59	865	0	2	CRG
VIVALDI	59	717	1	2	Closed
OE+CYCLOPS					New Test
DIFFRACT total	**23T0**	**28121**	**25**	**229**	

Instrument	Pubs 2007-'16	All Cites 2007-'16	100+Cites 2007-'16	100+Cites to 2016	Note
INELASTIC					
BRISP TOFSANS	25	203	0	0	Closed
IN4 Thermal TOF	135	1721	2	8	Closed
IN5 TOF	194	3005	1	21	
IN6 SHARP TOF	226	3850	5	40	CRG
IN10 TOF	78	971	0	16	Closed
IN13 TOF	124	1780	2	18	CRG
IN16B TOF	150	2242	2	8	
IN11 SpinEcho	64	992	1	14	
IN15 SpinEcho	73	1325	1	3	
WASP SpinEcho					New
IN3 3-axis Test	28	235	0	2	Test
IN1/Lagrange 3Ax	54	467	0	5	50%
IN8 3-Axis	86	1944	4	18	
IN12 3-Axis	69	1275	2	11	
IN20 3-Axis	74	1290	1	12	
IN22 3-Axis	66	1142	0	3	CRG

More Citations for Simple Instruments
Unexpected ?

LS STRUCTURE					
D11 SANS	357	6371	6	71	
D22 SANS	351	5678	2	20	
D33 SANS	32	218	0	0	60%
D16 Cold LSS	84	1059	0	12	
LADI(-I,-III) Laue	57	908	0	1	
DALI Cold Laue					New
D17 Reflect	142	1506	0	33	
FIGARO Reflect	81	780	0	0	60%
ADAM Reflect	67	603	0		CRG
NeXT imaging					New CRG
LSS total	**1171**	**17123**	**8**	**137**	

INELASTIC total	**1516**	**24010**	**24**	**189**	
NUCLEAR PP					
PF1 Cold Polar	91	916	1	4	
PF2 UCN	90	1098	1	2	
SuperSUN UCN					Test
PN1/Lohengrin	75	604	0	1	
PN2					Closed
PN3/GAMS	17	214	1	4	
FIPPS					New
S18 Interferometer	49	483	1	3	CRG
GRANIT Gravity	34	326	0	0	80%
NPP total	**356**	**3641**	**4**	**14**	
ILL total	**5393**	**72813**	**61**	**569**	

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Only 4 out of 25,000+ ILL Papers with >1000 Citations
All on Simple Instruments

D19 - Sax Mason, Judith Howard (EPSRC grant)

D11 - Peter Timmins (2nd Souffle)

D19 **Crystal Structure & Hydrogen-Bonding in Cellulose… Fibres**
Yoshiharu Nishiyama, Paul Langan, and Henri Chanzy
(2002) J. Am. Chem. Soc. 124, 9074–9082

D11 **Phase Diagrams & Aggregation Behavior of... Triblock Copolymers..**
G. Wanka, H. Hoffmann, and W. Ulbricht
(1994) Macromolecules 27, 4145–4159

D2B **Lattice Effects on the Magnetoresistance in Doped LaMnO3**
H.Y. Hwang, S-W. Cheong, P.G. Radaelli, M. Marezio, and B. Batlogg
(1995) Phys. Rev. Lett. 75, 914

D2B **Structural anomalies, Oxygen & Superconductivity in... Ba2YCu3Ox**
R.J. Cava, A. Hewat, E. Hewat, B. Batlogg, M. Marezio…
(1990) Physica C: Superconductivity 165, 419-433

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The UK Contribution was the University User system

User Demand → Instrument Investment

Instrument Investment >> Source Flux

Simple Instruments → Most Papers & Citations