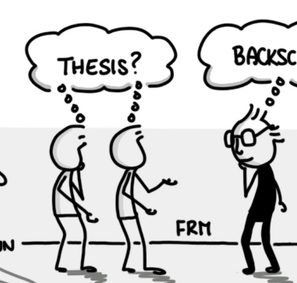
THE BACKSCATTERING STORY
a PERSONAL VIEW

ANTON HEIDEMANN

MUNICH 1965 – 1970

1966 DIPLOMA

A. HEIDEMANN

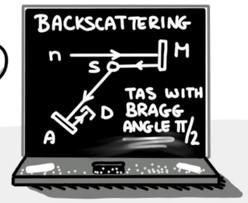


MANFRED BIRR & A. HEIDEMANN

"die Zwillinge" THE TWINS

FRM

HEINZ MAIER-LEIBNITZ "ML"



CHALLENGES

1. LOW INTENSITY → ANALYZER WITH LARGE SOLID ANGLE?
2. HOW TO SEPARATE INCIDENT AND REFLECTED BEAM?
3. HOW TO VARY THE ENERGY?

1970 BSS DISMANTLED

1969

TWINS FINISH THEIR THESES

FIRST MEASUREMENTS

V SPECTRUM - 10 DAYS
S:N ~ 1
RES ~ 0.6 μeV

As_2O_3 – COULDN'T SEE ELASTIC PEAK - WHY?

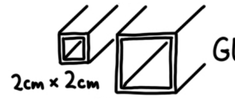
V_2O_3 – INELASTIC SPIN FLIP SCATTERING

BSS INSTRUMENT
FRM

ANALYZER
2000 Si XTALS ALIGNED TO <0.1° ON A CURVED SUPPORT

DISK CHOPPER TO SEPARATE INCIDENT & REFLECTED NEUTRONS

GOOD RELATIONS WITH THE MECHANICAL WORKSHOP!



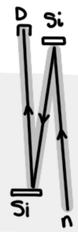
GUIDES

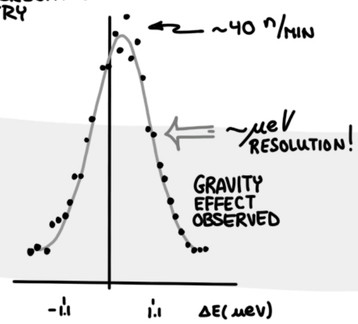
CONVERGING GUIDE

DOPPLER DRIVE

MONOCHROMATOR

1964 DOUBLE X-TAL VERTICAL NEAR BACKSCATTERING GEOMETRY





BERTHOLD ALEFELD "TUTOR"

BACKSCATTERING DIFFRACTOMETER WITH MÖSSBAUER DRIVE

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MEASURE LATTICE PARAMETER CHANGES IN $SrTiO_3$ NEAR PHASE TRANSITION

JÜLICH 1970-1972

COMMISSIONED PI-SPECTROMETER

TRANSPARENT DOPPLER DRIVE

100× FLUX OF MUNICH BSS
PG XTAL DEFLECTOR
MULTI ARM ANALYZER

"π SPECTROMETER"?
- ? → 2θ = π RADS
- ? → $d_{Si(111)}$ = π Å
- ? → λ_{REF} ≈ 2π Å

CRYOSTAT FIXED
V_2O_3 MEASURED WITH POLISHED Si X-TALS
➡ 0.3 μeV RESOLUTION!

MORE SUCCESSFUL V_2O_3 MEASUREMENTS

NEW RESEARCH
- SELF-DIFFUSION IN Na SINGLE X-TAL
- H MOTIONS IN N DOPED Nb
- NH_4 REORIENTATIONS IN NH_4Cl
- TUNNELING OF CH_3 GROUPS

GRENOBLE & ELSEWHERE 1971 – 2014

BSS AT THE ILL?

MÖSSBAUER ILL DIRECTOR

AS LONG AS IT'S CHEAP AND JÜLICH PROVIDES THE DOPPLER DRIVE AND A PDP-11 COMPUTER

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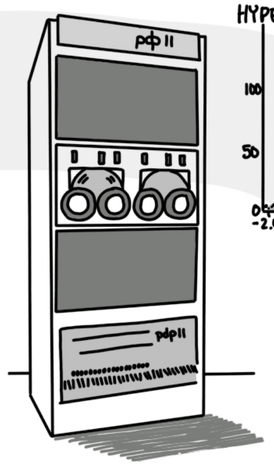
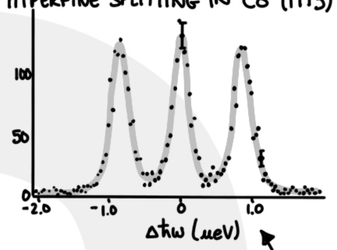
USING THE PDP-11 WAS A NIGHTMARE!

IN10 BUILT IN 2 YEARS
1974 - COMMISSIONED



HYPERFINE SPLITTING IN Co (1975)



MÖSSBAUER WAS IMPRESSED!

BACKSCATTERING BROUGHT NEUTRON SCATTERING FROM... THz → ...TO GHz

...OPENING NEW DOMAINS IN NEUTRON SPECTROSCOPY

THE DEVELOPMENT OF A NEW METHOD, WHENEVER ITS PRECISION, SENSITIVITY OR RESOLUTION IS MUCH BETTER THAN EVERYTHING THAT EXISTED IN THIS FIELD BEFORE, CREATES NEW PHYSICS

– MAIER-LEIBNITZ

MORE BACKSCATTERING

IN10 B – TEMP SCANNING MONOCHROMATOR
IN13 – THERMAL NEUTRON BACKSCATTERING
IN16 – HIGH PERF BACKSCATTERING
NIST HFBS – WITH FIRST PHASE-SPACE TRANSFORM CHOPPER (PST)

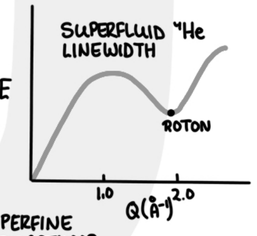
IN16B – PERF UPGRADE INCL/ PST
FRMII SPHERES – HIGH PERF BACKSCATTERING W/PST
IRIS, OSIRIS (ISIS), BASIS (SNS), BL02 DNA (J-PARC)
EMU (ANSTO)

SCIENCE ON IN10

1ST USER EXPERIMENT

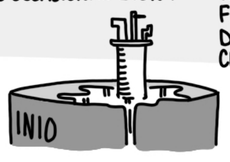
POLYMER DYNAMICS – JULIA HIGGINS

SEARCH FOR NUCLEAR SPIN WAVES



HYPERFINE INTERACTIONS

AND THE OCCASIONAL "EVENT" – WATER LEAK FROM MAGNET DURING LIQUID CRYSTAL EXPT.



LIQUID CRYSTALS

TUNNELING

CH_4 CH_3-GROUPS

SKETCHNOTE: Rob Dimeo SEPT. 02, 2016