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ABSTRACT

TASKO is installed on the thermal beam tube 2T1 at the ORPHEE Reactor/CEN Saclay. This conventional Triple Axis Spectrometer on air cushions with variable incident energy is designed for inelastic neutron scattering experiments over a wide range of energy and momentum transfers. Various components as monochromator, analyzer, detector assembly and collimations can be changed rapidly without the need of readjustments in order to meet any special experimental requirement.

BESCHREIBUNG DES DREIACHSEN-SPEKTROMETERS TASKO VOM KERNFORSCHUNGSZENTRUM KARLSRUHE AM ORPHEE-REAKTOR/CEN SACLAY

ZUSAMMENFASSUNG

TASKO wurde an dem thermischen 2T1 Strahlkanal am ORPHEE-Reaktor/CEN Saclay aufgestellt. Dieses konventionelle Dreiachsen-Spektrometer mit variabler Einfallsenergie fährt auf Luftkissen. Es ist für unelastische Neutronenstreuexperimente in einem großen Bereich von Energie- und Impulsüberträgen bestimmt. Zahlreiche Komponenten, wie Monochromatoren,Analysatoren, Detektor-Einheiten und Kollimatoren lassen sich schnell - ohne die Notwendigkeit von Nachjustierungen - auswechseln, um spezielle Meßbedingungen rasch einstellen zu können.

CONTENTS

I. SHORT DESCRIPTIONS

A. Use of the Spectrometer Control Program

NEVER : Give (RETURN) (↵) after a typing error for numbers (always (ESC)) - statements are deleted.

"RUN"↵ : All variables are set to zero
- control parameters for the measurement must be redefined
- necessary if BASIC statements have been changed.

"RUN 500"↵: Program asks for console commands (OPTION:)

(ESC) : Program asks for console commands (OPTION:) and stops moving motors after a short period of slowing down.

NOTATIONS :

Monochromator	Θ_M	: Motor: 4, Encoder: 4
Monochromator	$2\Theta_M$	: Motor: 0, Encoder: 0
Analyzer	Θ_A	: Motor: 5, Encoder: 5
Detector	$2\Theta_A$	: Motor: 2, Encoder: 2, valve: 2
Sample	ψ	: Motor: 3, Encoder: 3, valve: 3
Scatt. angle	ϕ	: Motor: 1, Encoder: 1, valve: 1

B. Console Commands (OPTIONS)

Two letters "CC" followed by (RETURN) (↵)

ST : STop - Return to BASIC
DP : Define Parameters for the measurement
LP : Listing of Parameters for the measurement
TI : TItle of measurement
BP : Move to the Bragg-Point, defined by "DP"
BX : X-scan trough the Bragg-point
BY : Y-scan trough the Bragg-point
ES : Energy Scan at the Bragg-point
EI : Set the primary spectrometer to a certain energy EI
EO : Set the secondary spectrometer to a certain energy EO
SP : Input - Single Phonon scan
PP : Input - Phonon Parameters for a scan list
LS : List of phonon Scans, defined by "PP"
PC : Correct phonon Parameters, defined by "PP"
SS : Select phonon Scans (defined by "PP") for measurement
RP : Run Phonon scans, defined by "SS"
DR : DRrive a motor to a certain position
RS : Rocking Scan of motors
DS : Debye-Scherrer scans
DE : Determine the Energy from Debye-Scherrer angles (cubic substances)
DA : Calculation of Debye-Scherrer Angles
HO : Calculation of Higher Order contaminations
RE : Read out of Encoders
LL : Listing of software Limits
LZ : Listing Zeros for the motors
ZZ : Emergency - stop of all
HP : HelP for the experimentators (alphabetic list of "CC"s)

C. Control Parameters for the Measurement (PARAMETERS)

- the console command "DP" is used for definition

MO : Monochromator crystal: "1" = PG(002), "2"=Cu(111), "3" = Cu 220)

AN : Analysator crystal: "-1" = PG (002), "-2" = Si(111)

AC : Lattice spacing of the sample, X-direction

BC : Lattice spacing of the sample, Y-direction

WØ : Angle between X and Y axes

SØ : Zero angle for the sample rotation, ψ_o

XØ : X-Coordinate of the reference Bragg

YØ : Y-Coordinate of the reference Bragg

EØ : Calibration energy

MØ : 2Θ Monochromator ($2\Theta_M$), UNIFIXED = 1000, FIXED ≠ 1000

M1 : Scattering angle (ϕ) , UNIFIXED = 1000, FIXED ≠ 1000

M2 : Detector angle ($2\Theta_A$) , UNIFIXED = 1000, FIXED ≠ 1000

M3 : Sample (ψ) , UNIFIXED = 1000, FIXED ≠ 1000

M4 : Θ-Monochromator (Θ_M) , UNIFIXED = 1000, FIXED ≠ 1000

M5 : Analyzer (Θ_A) , UNIFIXED = 1000, FIXED ≠ 1000

ST : Stop - Program asks for console commands (OPTION:)

II. DETAILED DESCRIPTIONS

A. Instrument Specifications

a) General

TASKO is a conventional Triple-Axis-Spectrometer with variable incident energy installed at the thermal neutron beam 2T1. It is designed for inelastic measurements over a wide range of energy and momentum transfers. Various components as monochromator, analyzer, detector assembly and collimations can be changed rapidly without the need of readjustments in order to meet any special experimental requirements. The principal features of the instrument are shown in Fig. 1

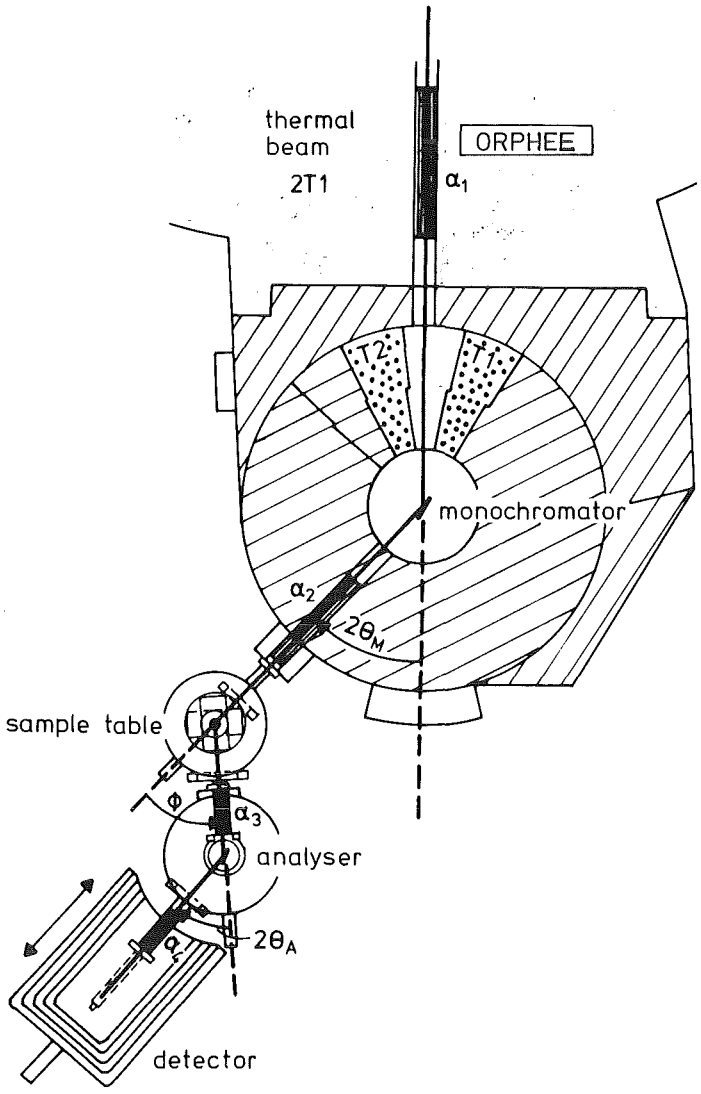


Fig. 1
Triple-Axis-Spectrometer TASKO at the ORPHEE-Reactor/Saclay

b) The monochromator part

The shielding drum of the primary spectrometer consists of two fixed upper and lower parts and one central part which rotates when ever the incident energy is changed. A system of two movable blocks in the central scattering plane guarantees an effective shielding in the whole range of monochromator angles: $18^{o} \leq 2\,\Theta_{M} \leq 75^{o}$. The movement of this blocks is fully automatic and controlled by endswitches. The status of these blocks can be read by the computer and in the automatic mode counting is delayed until the blocks have been positioned. The $2\Theta_{M}$-angle is varied by a step motor and a reduction gear and is measured by an absolute encoder (resolution 1/100 deg.) which is mounted directly on the rotational axis. If necessary, a movement in a fully manual mode (without motor) is possible. A demountable insert on top of the drum carries a turning table with a monochromator exchange unit. This device allows the selection of a particular monochromator crystal (PG (002)/(004), Cu (111), Cu (220)). Each of these crystals is aligned on its own goniometer and is moved into the beam by one vertical and one horizontal displacement. The "up" and "down" positions are fixed by endswitches and the horizontal displacement is registered by an encoder. At present the exchange of monochromator crystals is performed semiautomatically from the control pannel of the instrument, but a fully automatic operation could be achieved easily. The beam tube is constructed to give a geometrical focussing at a position of about 600 mm in front of the monochromator drum. Therefore, focussing onto the sample position by curved monochromator crystals is less important. Presently all monochromators have a fixed curvature which is optimized for an $2\Theta_{M}$-angle in the middle of the useful region. The inpile collimation α_1 can be varied by means of a collimation drum which is mounted within the reactor shielding (positions: 58' 25', 15', beam shutter). At present one monochromator to sample collimator α_2 with boron coated steel plates is available. By the exchange of plates it is possible to vary the collimation in steps of 15'. A short optical bench in front

of this collimator can be used to mount special equipment, e.g., filters, diaphragms, beam shutter etc. The neutron beam size at the monochromator position is 40 x 75 mm^2 and the distance between core and monochromator about 4840 mm.

c) The sample table

It is recommended to use a monochromator to sample distance of about 1400 mm in view of the geometrical focussing provided by the special dimensions of the beam tube (symmetrical case). In order to realize this short distance, the sample table is built on standard Tanzboden elements of 600 mm Ø (Franke & Heydrich). A special experimental setup with heavy outloading magnets or cryostats might require a larger support than the present one. Otherwise the instrument is highly flexible concerning a substantial variation of distances. A standard turning table and a manual goniometer which allows tilds up to + 15^o at both cradles (the center of rotation is 96 mm above the platform) are provided.

d) The analyzer and the detector stage

Both units use the same Franke & Heydrich elements than the sample table. All modules are interconnected by sliding arms which allow to adjust the intermodule distances. For an effective shielding the detector unit is placed close to the analyzer drum. The sliding option of the units allows an easy access to the analyzer to detector collimator α_4. Analyzer and detector modules are driven by standard turning rings (Huber) which offered the possibility to reduce the costs considerably. A disadvantage is that the encoders are connected to the worm drives and not to the moving arms directly. In order to protect the mechanics in the case of a sudden stop of the motors while the air is still on, a special coupling piece allows the sliding arms to bend off if a maximum torque is exceeded. An effective shielding of the analyzer crystal is provided by 15 vertically

movable blocks of borated araldite which open only a slit for the α_4 collimator in front of the detector. The up and down movement of the blocks is fully automatic and is controlled by air pressure and magnetic switches. Endswitches will stop the movement of the detector unit if the slit for the α_4 collimator is not opened correctly. The shielding blocks can also be moved manually (electric switches) in order to have an easy access to the analyzer crystal. Each analyzer crystal is mounted on its own cradle and sliding table and is fixed on a short optical bench. Therefore, a rapid and reproducible exchange of analyzer crystals is possible. Two sets of collimators are available for α_3 (sample to analyzer) and α_4 (analyzer to detector): Rutherford collimators with 20' and 40' divergency and flexible units with boron coated slidable steel plates (3o', 60', ...). All collimators are separately oriented on their supports by which they are fixed on optical benches. Thus, no alignment is necessary after an exchange. The detector shielding consists of two parts: A housing build from borated polyethylene plates, which for an easy access can be opened at one side. Different shielding blocks with different detector arrangements can be moved in. By taking out a small piece of shielding material on the backside a view is opened for an optical alignment of the whole spectrometer in its "straight" position.

e) Instrumental details

- Beam tube: 2T1 (thermal)
- Monochromator:

  Neutron flux at sample position for different collimations (all measurements were performed at a reactor power of 13.5 MW).

PG(002) : E_1 = 14.7 meV	(α_1=58'/α_2=60')	: 2.79 x 10^7	n/cm^2s
	(25'/30')	: 0.77 x 10^7	n/cm^2s
	(15'/30')	: 0.52 x 10^7	n/cm^2s
25.3 meV	(58'/60')	: 4.04 x 10^7	n/cm^2s
	(25'/30')	: 1.09 x 10^7	n/cm^2s
40 meV	(58'/60')	: 4.88 x 10^7	n/cm^2s
Cu(111) : 35 meV	(58'/60')	: 1.30 x 10^7	n/cm^2s
60 meV	(58'/60')	: 1.36 x 10^7	n/cm^2s
	(25'/30')	: 0.51 x 10^7	n/cm^2s
Cu(220) : 100 meV	(58'/60')	: 0.51 x 10^7	n/cm^2s
	(25'/30')	: 0.16 x 10^7	n/cm^2s

- Analysers : PG(002)/(004), Cu(111), Zn(002), Si(111)
- Beam size at specimen: 50 x 40 mm^2
- Useful range of incident energy:

$$5 \lesssim E\ [meV] \lesssim 160;\quad 4.05 \lesssim \lambda[\mathring{A}] \lesssim 0.7$$

- Momentum transfer : $0.12 \lesssim Q\ [\mathring{A}^{-1}] \lesssim 16$
- Energy resolution : $1\ \% \lesssim \Delta E/E \lesssim 15\ \%$
- Energy transfer : $\lesssim 100$ meV
- Range of Scattering angle:

  Monochromator : $18^\circ \leq 2\theta_M \leq 75^\circ$

  Specimen : $-10^\circ \quad (-140^\circ) \leq \phi \leq 140^\circ$

  Analyser : $-100^\circ \leq 2\theta_A \leq 100^\circ$
- Range of Sample Orientation:

$$-180^\circ < \psi < 180^\circ$$

- Detector (available): ^{3}He counter 50 mm ∅ window, 100 mm length; vertical or horizontal
  BF_3 counter 50 mm ∅ window; horizontal

- Background : < 2 cpm
  without sample, with $\phi = 90^o$ and the spectrometer in "elastic" position

f) Technical details

Mechanics:

For the motors the following "save" speeds have been determined:

Θ_M	(Motor 4) :	no particular limit, v = 60 deg/min.
$2\Theta_M$	(Motor 0):	v = 6 deg/min, may be increased with another reduction gear to v ≃ 12 deg/min.
$2\Theta_A$	(Motor 2):	v = 60 deg/min.
Θ_A	(Motor 5):	no particular limit, v = 75 deg/min.
ψ	(Motor 3):	v = 75 deg/min.
ϕ	(Motor 1):	v = 50 deg/min.

The maximum speed as well as the ramps for acceleration and slowing down of each motor are controlled by software and can be modified easily.

The maximum torque at the turning rings (maximum value D ∿ 6 m kp) is adjustable by the prestress on the springs. Make sure that the pressure on the worm drive is suitable (no backlash, not too much friction).

Electronics:

(1) The spectrometer is controlled by its own NOVA II (32 K) computer. It contains the following extensions:
   a) Television, which uses a special and additional memory (standard card)
   b) Counter input, 16 counters at maximum can be connected. Direct connections between computer and a pannel on the backside are installed. Positive pulses with

$2V \leq$ pulse height [V] ≤ 5 V are required
(standard card)

(c) Single-bit-control-unit (multiplexer, 16 bit words)
Each card contains plugs for 4 input and output addresses (8 plugs, one plug corresponds to 8 bits, see the schemes shown in Appendix I). The logic used is TTL positive (standard card).

(d) For the step motor drives the internal clock in the computer has been modified to 8 kHz in order to supply sufficient high frequencies. Therefore, any change of computers requires the exchange of the corresponding card (special).

(2) Step motor drive (power units)

(a) Chassis I: 4 connections for motors HS50L
2 connections for motors HS25

(b) Chassis II: 1 connection for motor Sanjo ...
1 connection for motor HS25

Additional input plugs for endswitches "left" and "right" are provided. A motor can move only if the endswitch corresponding to the turning sense is closed.

Internal mode:
An adjustable oscillator provides the possibility for a manual drive (one general switch on the front pannel and individual switches "on"/"off" and "left"/"right" for each motor).

External mode:
The motors are fully controlled by the input signals from the single-bit-control (TTL positive connections see Appendix I).

(3) Air control
The valves (24 V ≃) are controlled by solid state switches

(a) manual operation

(b) automatic operation uses direct input signals (5 V) from the single-bit-control (connections see Appendix I).

(4) Control unit for mobile blocks (monochromator drum)
The unit contains the logic to position the mobile blocks (left or right side of the incoming beam) dependent on the monochromator scattering angle $2\Theta_M$ and provides 24 V = for the DC-motors. Start and stop are initialized by end-switches on the drum and the blocks. The actual position of the blocks can be read from control lights at the pannel and a signal indicating the actual status is provided and fed to the single-bit-control.

(5) Control unit for monochromator exchange
The unit provides 12 V = for the small DC-motors necessary for the "up" and "down" movement and a change of the horizontal tild for each monochromator. The endpositions are determined by switches and indicated by lights on the front pannel. In the "down" position the monochromators are on one level with the neutron beam. Intermediate positions are not registered. The movements are controlled by switches on the front pannel and two DC-meters which indicate the flow of current. (The horizontal translation of the monochromator crystals is controlled by a step motor and connected to chassis II of the step-motor-drive).

(6) Connection unit for encoders
In general absolute encoders with a resolution of 0.01 deg are used. The unit provides the power supply and the display of the actual positions. It connects the BCD encoder output signals to the single-bit-control chassis (TTL positive). The conversion into decimal numbers is a matter of software.

a) Encoder on the axis of the monochromator drum (Baldwin)
Resolution: 1 turn = 36000 counts (360°)
It contains an optical system which requires a "Takt"-generator which is built into the encoder housing.

b) Other encoders (Moore Reed 23FF184) mounted on the worm drives
Resolution: 360 turns = 36000 counts (360°)
The encoders work with a reduction gear and etched slices with a binary pattern which are scanned by contact springs.

(c) Encoder for the horizontal translation of monochromators
Resolution: 1 turn $\triangleq$ 360 counts (1^{o})
Full degrees are counted in both directions by a special electronics. At present it is not connected to the single-bit-control.

B. The Spectrometer Control Program

a) General information

The Spectrometer Control Program (User Program) is written in the programming language EXTENDED BASIC and runs on a 32 K NOVA II computer. For a rapid processing special assembler subroutines are embedded in the BASIC, which are executed via CALL statements. Therefore the computer must be loaded with a particular version of BASIC (BASIC-INTERPRETER). Loading of the computer proceeds in two steps (1. BASIC-INTERPRETER, 2. User Program in BASIC). A description of the procedure is given in Appendix II.

b) The User Program

For the definition of constants 3 different levels have been introduced:

1. All constants fixed and those which do not change for every experiment like zeros, software limits, motor velocities etc. are loaded together with the program. A list is provided at page containing the appropriate statement numbers.
2. Constants fixed for one experiment are input data and defined by the user. Typical examples are title, lattice parameters, etc.
3. Constants which change frequently are required as input data whenever needed, e.g., parameters for phonon scans.

The use of the Spectrometer Control Program starts with the command "RUN" (↵). As a consequence all variables are set to zero and the constants of type 2 and 3 must be defined. The command "RUN 500" (↵) starts at a position where type 2 parameters are not lost and asks for further Console Commands (CC). The command ESC stops the execution of the running program immediately. The motors will stop after a short period of slowing down. The CC "ST" (↵) (stop) causes the return to BASIC.

Two things are very important to remember

- Any typing of numbers followed by a pressing of (RETURN) (↵) will delete one or more lines in the BASIC program. This can happen accidentally in the case of typing errors.
- After every change in the BASIC program one should start with "RUN" (↵). Otherwise fields in core space are overwritten which

can cause a crash down of the computer system.

After "RUN" (↵) or "RUN 500" (↵) the User Program remains in a modus where it is guided by console commands (CC) unless it is stopped by "ST" (↵) or the occuring of a BASIC error. The CCs (asked by OPTION:) enable the user to run a variety of auxiliary programs.

c) The console commands (CC)

These commands consist of two letters as input. After a carriage (RETURN) (↵) the computer will perform the requested operation. In principle the console commands can be given in any order. A wrong command will cause an error message together with a new request. By (ESC) it is possible to interrupt at any time and to return to a position where a new console command is requested.

Description of console commands (OPTION: "CC")

ST (STop) : The system corresponds with STOP AT ...
*
Now the whole assembly of commands possible in EXTENDED BASIC can be performed.
Return to the Spectrometer Control Program either by "RUN" (↵) (all variables are set to zero) or "RUN 500" (↵).

DP (Define Parameters) : The basic parameters for an experiment (type 2 parameters) are read in. These parameters are known to the system by two letters:

MØ : type of monochromator
"1" = PG(002)
"2" = Cu(111)
"3" = Cu(220)

AN : type of analyser
"-1" = PG(002)
"-2" = Si(111)
any value >0 means the lattice spacing of another type of analyser

AC : lattice spacing in X-direction

BC : lattice spacing in Y-direction
All definitions in reciprocal space concerning phonon parameters etc. are done relative to the vectors

$$a^* = (\frac{2\pi}{AC},0,0) \; ; \; b^* = (0,\frac{2\pi}{BC},0)$$

WØ : angle between X and Y axis

SØ : zero for the sample rotation ψ_o corresponds to the encoder reading of motor 3 for the Bragg reflection defined by XØ, YØ

XØ : X-coordinate of the reference Bragg in units of $\frac{2\pi}{AC}$

YØ : Y-coordinate of the reference Bragg in units of $\frac{2\pi}{BC}$

EØ : callibration energy used for the measurement of the reference Bragg

MØ : 2Θ monochromator ($2\Theta_M$), UNFIXED = 1000, FIXED ≠ 1000

M1 : scattering angle (ϕ), UNFIXED = 1000, FIXED ≠ 1000

M2 : detector angle ($2\Theta_A$), UNFIXED = 1000, FIXED ≠ 1000

M3 : sample angle (ψ), UNFIXED = 1000, FIXED ≠ 1000

M4 : Θ-monochromator (Θ_M), UNFIXED = 1000, FIXED ≠ 1000

M5 : analyser (Θ_A), UNFIXED = 1000, FIXED ≠ 1000

The option "FIXED" means that the corresponding motor remains in a special angular position (≠ 1000, e.g. 90.00 $\hat{=}$ 90 deg.) during a scan.

The following dialog will define parameters (machine text is underlined, possible answers by the user are given in quotationmarks).

OPTION : "DP"↵

PARAMETER : "MO"↵ = ? "1"↵

The parameter can be defined in any order or single parameters can be changed if necessary. The reply "ST"↵ (stop) causes the system to ask for a new CC (OPTION:).

LP (Listing of Parameters): The system will respond LISTING OF PARAMETERS, FIRST, LAST: "1,15"↵ is a possible answer

TI (TItle) : Possibility to define a title which appears on a top of each phonon scan

BP (Bragg-Point) : Causes the spectrometer to move to the Bragg position defined by XØ, YØ and EØ

BX (Bragg, X-scan) : Standard q-scan through the Bragg-point with 11 points and 0.01 (AC)* stepwidth

BY (Bragg, Y-scan) : The same scan in Y-direction

ES (Energy Scan) : Standard E-scan through the Bragg-point with 11 points and 0.1 meV stepwidth

EI (Energy, Incident) : The primary spectrometer is set to a fixed energy. The system will respond:

ADJUSTMENT OF PRIM. SPECTRO TO E(MEV) = "14.7"↵ is a possible answer

EØ (Energy, Outgoing) : The same for the secondary spectrometer (according to the normal W-configuration of the spectrometer a negative energy value is demanded).

SP (Single Phonon) : The system will respond: (An example is given for an const. energy scan (energy loss) with fixed 14.7 meV incident energy)
NUMBER OF STEPS (ONE SIDE): "5"↵ MONITOR COUNTS: "1000"↵
QX : "2.1"↵ DELTA-QX : "0.02"↵
QY : " 0 "↵ DELTA-QY : " 0 "↵

PHONON ENERGY (MEV) : "-2"↵ DELTA-E : " 0 "↵

INC. ENERGY : "14.7"↵ CONST. KI = 0, KF = 1 : " 0 "↵

PP (Put in Phonons) : Input of a list of up to 20 phonon scans for automatic measurement. Monitor number = 0 stops input and a new CC is required. 11 numbers are demanded for input, separated by comma (,).

(1) NR : number of the phonon scan
(2) NP : number of points on one side
(3) MN : monitor counts (a negative monitor rate defines a pre-set time in sec.)
(4) QX : X-component of Q in reciprocal space
(5) DX : increment for QX
(6) QY : Y-component of Q in reciprocal space
(7) DY : increment for QY
(8) $\hbar\omega$: phonon energy ("-" for energy loss)
(9) D$\hbar\omega$: increment of $\hbar\omega$
(10) EI: incident energy
(11) KI/KF : scan mode (KI = const.: "0", KF = const.: "1")

For the example given above the input would be:
"1, 5, 1000, 2.1, 0.02, 0, 0, -2, 0, 14.7, 0"↵

SS (Select Scans) : The command is required for the execution of phonon scans defined by "PP". O(K) = " 0 "↵ will suppress scan number K. If O(K) ≠ " 0 " the scan K is accepted for execution.

LS (List Scans) : This command causes a print out of the scan parameters.

PC (Parameter Corrections) : The program asks for further specifications

"OK"↵ means no correction, return to input mode for further CC (OPTION:).
"LI"↵ means a whole line will be corrected. The program asks for the line number and 10 new phonon parameters.
"SV"↵ means a single parameter will be corrected. The program asks for the line- and parameter number.

RP (Run Phonon scans) : The scans selected by "SS" will be performed automatically after the execution mode has been defined

" Ø "↵ means start of the measurement

" 1 "↵ means scan calculation for 3 points only. QXE and QYE define the endpoint of the elastic scattering vector $\vec{Q}$ in reciprocal space. If it coincides with a lattice point a contamination of the phonon scan may result.

" 2 "↵ has the same meaning as "1" but the calculation is performed for all points.

DR (DRive motors) : The command is used to drive a motor to a certain position (input of physical angles).

RS (Rocking Scan of motors) : The program requires as input

- the number of the motor : "V"↵
- the center of the scan : "W"↵
  (input of physical angles)
- the monitor counts : "X"↵
  if X < 0, the measuring time for each point is X sec.
- the number of steps : "Y"↵
  (one side) ("0" is possible)
- the step width : "Z"↵

DS (Debye-Scherrer scans) : A number of scans (≤ 5) can be performed subsequently. The program requires as input

- the total number of scans : "V"↵
- the center of the scan : "W"↵
- the step width : "X"↵
- the number of steps on one side : "Y"↵
- the monitor counts : "Z"↵
  if Z < 0, the measuring time for each point is Z sec.

DE (Determine Energy) : The input energy and the zero of the scattering angle is determined from a series of Debye-Scherrer scans (for cubic substances only). The input parameter are
- lattice constant of the substance
- zero shift of the scattering angle ϕ_o (may be given as "O")
- the number of measurements.

Then the program requests the Miller indices h,k,l of a reflection and the measured peak position and prints out the incident energy, the zero shift of the scattering angle and finally the mean values.

DA (Determine Angles) : The routine calculates Debye-Scherrer angles for various substances. The first input parameter (one letter) defines the crystal symmetry system: "C" (cubic), "H" (hexagonal), "T" (tedrahedric), "R" (rhombohedric), "O" (orthorhombic) and "M" (monoclinic). The program asks further for the required lattice parameters and prints out the scattering angle for each desired reflection (hkl).

HO (Higher Order contaminations) : Energy transfers $\hbar\omega$ are calculated for which the analyser will be in a reflection position for a higher order energy of the incident neutron beam. Only the cases where the order (n) of reflections for the analyser and monochromator differ by 1 are treated. Input parameter is the incident energy "E_o"

-upscattering:

$$(E_o+\hbar\omega)n^2 = E_o(n+1)^2 \quad \searrow \quad \hbar\omega = \frac{2n+1}{n^2} E_o$$

-downscattering

$$(E_o-\hbar\omega)\ (n+1)^2 = E_o \cdot n^2 \quad \searrow \quad \hbar\omega = \frac{2n+1}{n+1} E_o \ .$$

RE (Read out of Encoders) : The program prints out the actual encoder reading and the zero for all motors.

LL (Listing of software Limits) : The program prints out the software limits for all motors.

LZ (Listing Zeros) : The program prints out the zeros for all motors.

ZZ (Emergency - stop of all) : The motors are forced into a slowing-down-sequence till a complete stop. The system will ask for a new CC (OPTION:).

HP (HelP for the experimentator) : An alphabetic list of console commands (CC) is shown on the television screen.

d) Definition of general constants

statement numbers	constants
40 - 72	software limits
83 - 112	encoder zeros
170 - 174	spectrometer configuration
175 - 232	addresses-definition
244 - 298	step motor functions
500 - 508	default values for scans
641 - 668	monochromator lattice constants
671 - 704	analyser lattice constants

e) Special subroutines

1022 - 1475	phonon program
4502	auxiliary programs
5090 - 5240	conversion BCD-DEC for encoder
5250 - 5310	status of pre-warn-switches
5320 - 5360	skip of motors
5370 - 5620	date after C1 seconds
5630 - 5740	check software limits
5750 - 5840	ASIN
5850 - 6050	energency-stop of all-interrupt of endswitches
6060 - 6120	field X(I), Y(I) = 0
6130 - 6660	plot routines
6670 - 6700	positioning of motors
7100 - 7350	rocking scan of motors
7360 - 7620	monitor subroutine

C. Error Handling

a) Error messages
(the meaning of the error numbers is given in Appendix IV)

- Error numbers n < 70 refer to BASIC errors
- Error numbers 75 < n < 100 refer to system interrupts
- Error numbers 100 $\leq$ n < 200 refer to the counter input
- Erorr numbers 600 $\leq$ n < 760 refer to the single-bit-control (essentially end- and pre-warn-switches)
- Error number 300 $\leq$ n $\leq$ 400 refer to the television system.

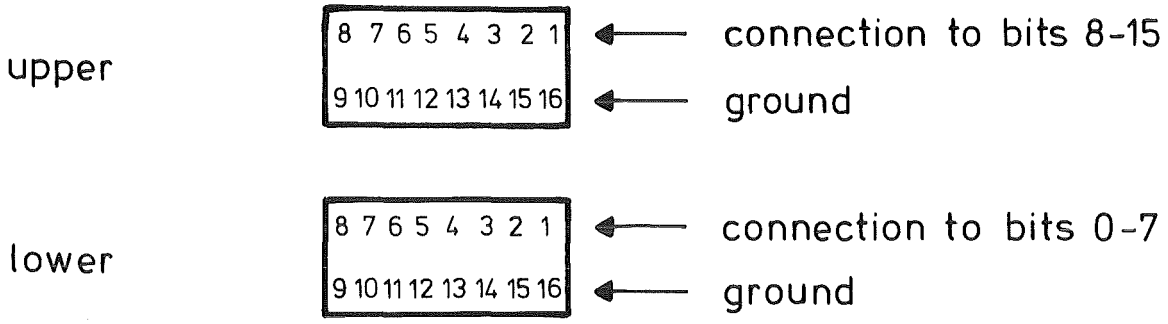
b) How to recover the operational status of the instrument again

- BASIC errors:
  "RUN500"↵ , "RUN"↵ , reload the computer
- Errors connected with the interrupt handling:
  check plugs, start again with "RUN"↵ or "RUN500"↵
- Input - output errors at the single-bit control, possible checks:
  "CALL 64, address, number"↵
  The appearing of the number (binary form) at the corresponding plug can be checked by a meter or a set of luminescent diodes
  "CALL 62, address, variable"↵
  With a special cable the output- and input plugs can be connected and the output address can be reread.

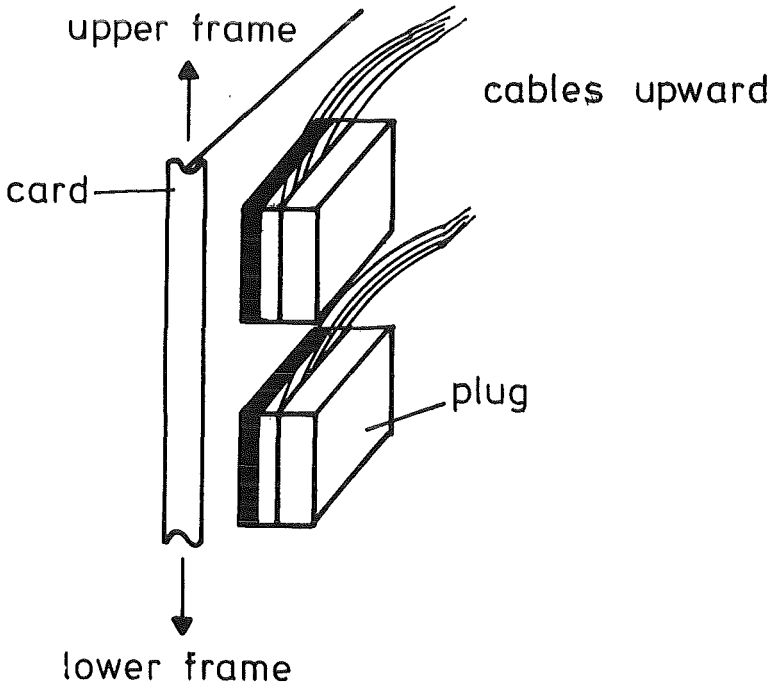
Appendix I:

Connections to the SINGLE-BIT-CONTROL-UNIT

General: One address corresponds to two plugs

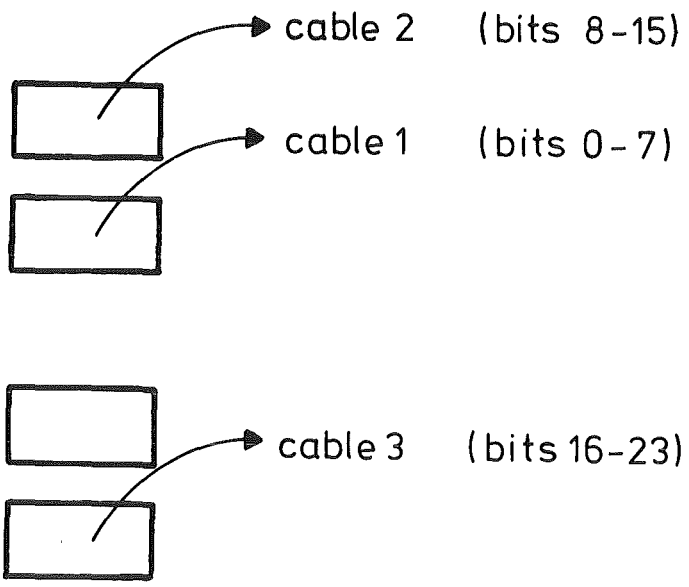


The plugs have been pressed such that the connections are correct if the following scheme is maintained:

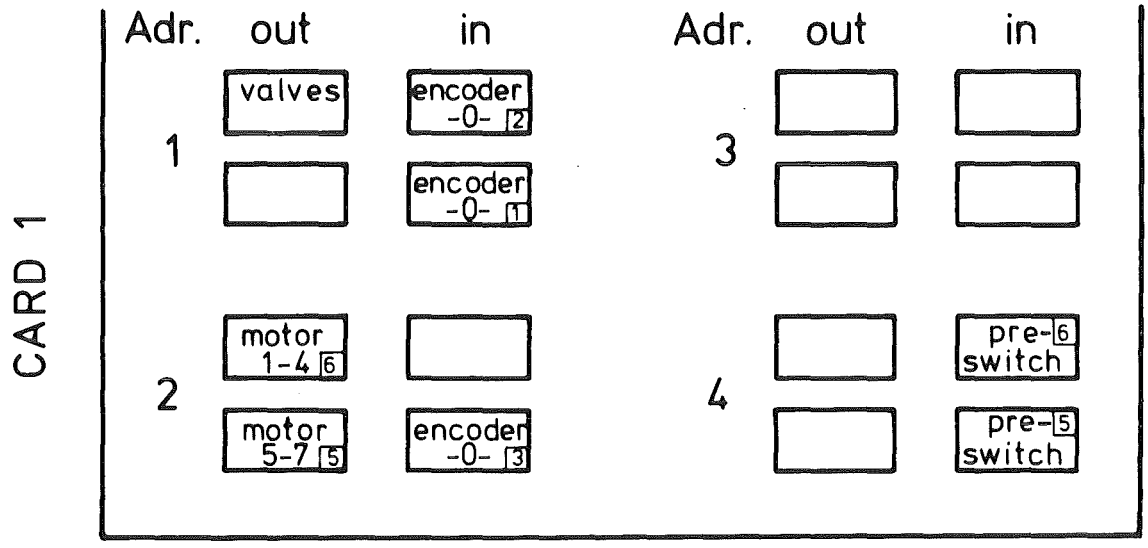


If a component needs more than one plug (8 bits) the cables have been numbered.

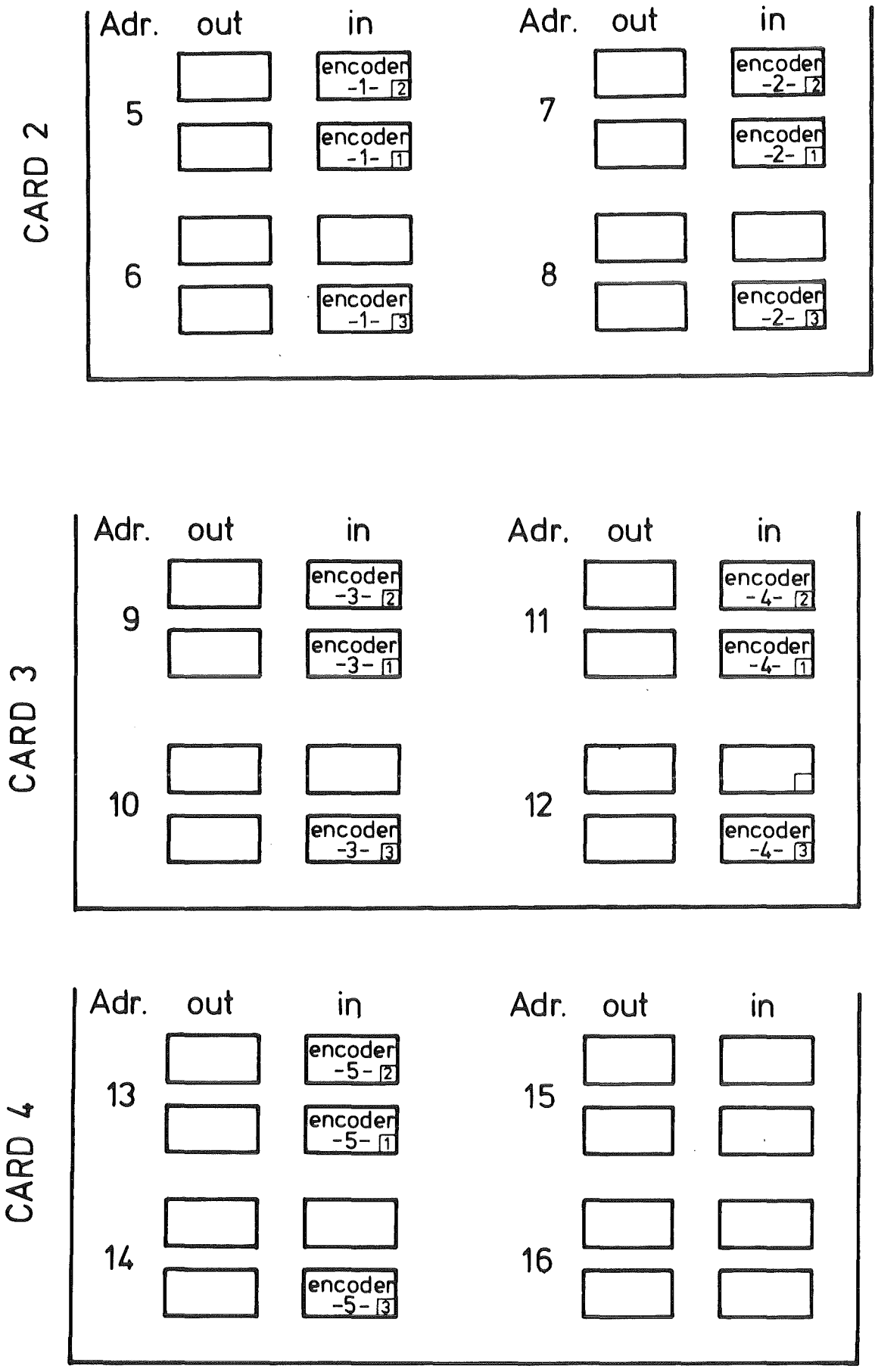
Scheme:



The encoder of motor "0" needs for the display the plug on the card backside. In the case of changements notice that only the two lower addresses (one card contains 4 addresses) are connected to the pins on the backside.



out for external control of encoder "0": plug behind


CARD 2
Adr.
out
in
5
encoder -1- 2
encoder -1- 1
6
encoder -1- 3
Adr.
out
in
7
encoder -2- 2
encoder -2- 1
8
encoder -2- 3
CARD 3
Adr.
out
in
9
encoder -3- 2
encoder -3- 1
10
encoder -3- 3
Adr.
out
in
11
encoder -4- 2
encoder -4- 1
12
encoder -4- 3
CARD 4
Adr.
out
in
13
encoder -5- 2
encoder -5- 1
14
encoder -5- 3
Adr.
out
in
15
16

Appendix II:

```
*****************************************************************;
*                                                                ;
*      COLD START OF A COMPUTER FROM CASSETTE 25.4.80            ;
*      ***********************************************           ;
*                                                                ;
*****************************************************************;
;                                                                ;
================================================================;
                    INSTRUCTION MANUAL                          ;
                                                                ;
                    Meaning of R and S:                         ;
 --> R:   this must be manipulated at the COMPUTER.             ;
 --> S:   this must be manipulated at the SILENT.               ;
================================================================;
                                                                ;
1.) R  Turn POWER KEY into the  "ON" position                   ;
2.) S  POWER ON                                                 ;
3.) S  put cassette "BASIC*INTERPRETER" into right              ;
       cassette station                                         ;
        (if SILENT is equipped with RDC OPTION, turn it         ;
         "OFF". (RDC = REMOTE DEVICE CONTROL)                   ;
4.) S  press PLAYBACK, REWIND and LOAD/FF                       ;
       [upper three switches (from middle to the right)]        ;
        (if you use the left cassette station, proceed          ;
         in an analog way)                                      ;
5.) R  switch 12 in upper position                              ;
6.) R  toggle PROG LOAD upward                                  ;
7.) S  switch SPEED on HI (high)                                ;
8.) S   for EXPERTS in order to accelerate the reading          ;
         process by a factor of 2:                              ;
        press the 3-position switch downward on STOP            ;
        and upward on CONT START in field "PLAY BACK            ;
        CONTROL" in the middle                                  ;
9.) --> wait a long time until the computer stops with          ;
        077741(octal) in the lights                             ;
        (if 077727 is in the ligths -> PARITY ERROR,            ;
         repeat the procedure starting with 4.))                ;
10.)S  SPEED on LO (low)                                        ;
11.)S  press REWIND                                             ;
12.)R  all data switches in downward position                   ;
13.)R  toggle RESET and START upward                            ;
14.)S  reply the question "ERROR MESSAGE TEXT" with "Y"         ;
15.)S  type the date as proposed                                ;
16.)S  insert "BASIC*PROGRAMM" cassette instead of              ;
        "BASIC*INTERPRETER" cassette                            ;
17.)S  press PLAYBACK, REWIND, LOAD/FF                          ;
18.)S  SPEED on HI (high)                                       ;
19.)S  press any key (e.g. blank key)                           ;
20.)--> wait a long time until the cassette is moving           ;
         continuously                                           ;
21.)S  in field "PLAYBACK/CONTROL" - press switch STOP          ;
22.)S  press switch REWIND                                      ;
23.)S  switch SPEED on LO (low)                                 ;
24.)S  press ESC-switch                                         ;
25.)S  the SILENT must now print a star (*).                    ;
                                                                ;
*****************************************************************;
```

**********;
;
;
SHUT DOWN OF THE COMPUTER ;
********** ;
1.) R turn POWER switch anticlockwise to the "OFF" ;
position ;
;
**********;
;
;
RESTART of the COMPUTER ;
********** ;
;
1.) R all data switches should be in a downward ;
position ;
;
2.) R toggle RESET and START upwards ;
;
**********;
;
----------;
For EXPERTS : ;
How to restart (hopefully!!) after a system crash ;
----------;
;
1.).R Switch 0 till 7 down and 8 till 15 in upper ;
position ;
2.) R toggle RESET and START upward ;
The user-programm will be erased. ;
Date and time is requested if OK. ;
;
**********;

Appendix III:

User Program (BASIC) of TASKO

Contents:

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 12:59 SEITE   1
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
0001 ON ESC THEN GOTO 0500
0006 DIM V[30],A[18],P[11],G[12],W[6],R[11],M[16]
0007 DIM Y$[82],B$[2],E[15],Z$[40],C[40],U[20],Q[6]
0010 DIM T[20,10],O[20],X$[6]
0013 LET Y$[1,30]="MOANACBCWOSOXOYOEOMOM1M2M3M4M5"
0016 LET Y$[31,78]="LPTILLLZBPBXBYESRSREEIEODSDEHODADPPPPCSSLSSPRPDR"
0017 LET Y$[79,82]="HPZZ"
0019 LET E[10]=1000
0022 LET E[11]=1000
0025 LET E[12]=1000
0028 LET E[13]=1000
0031 LET E[14]=1000
0034 LET E[15]=1000
0037 DEF FNT(I)=INT(N6/2^I)-2*INT(N6/2/2^I)

0040 REM# SOFTWARELIMITS, MOTOR 0: G(0)=, G(1)=, ETC.
0043 LET G[0]=197.5
0046 LET G[1]=253.8
0049 LET G[2]=177.8
0052 LET G[3]=306
0055 LET G[4]=87.9
0058 LET G[5]=190.7
0061 LET G[6]=10
0064 LET G[7]=350
0067 LET G[8]=230.65
0070 LET G[9]=298.45
0071 LET G[10]=0
0072 LET G[11]=350
0073 LET W1=3.14153/2
0074 LET A1=6.2832/5.43
0075 LET E[7]=1
0076 LET E[8]=-1
0077 LET B1=A1*SQR(2)
0078 LET D0=3.615/SQR(8)
0079 LET D1=3.3535
0080 LET D1=D1/2
0081 LET E[9]=40
0082 LET P[1]=179.8

0083 REM# ZEROS OF ENCODERS
0084 LET P[1]=179.8
0085 LET P[2]=179.04
0088 LET P[0]=178.64
0091 LET P[6]=298
0094 LET P[7]=295.87
0097 LET P[8]=295.93
0100 LET P[4]=P[8]
0103 LET P[9]=249.28
0106 LET P[10]=249.28
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
0109 LET P[5]=P[9]
0112 LET P[3]=179.98

0115 REM# CONST. FOR SWITCHES
0118 LET N1=0
0121 LET N3=0
0124 LET I0=0

0170 REM# SPECTRO.CONFIGURATION - SCATT.ANGLE: C2=, DET.ANGLE: C3=
0173 LET C2=1
0174 LET C3=-1

0175 REM# CORRELATION TABLE FOR ADRESSES, C(I)<30 INPUT ADR.

0177 REM# END-SWITCHES
0178 LET C[1]=4
0181 LET C[2]=2

0184 REM# ENCODERS: MOTOR1= 5,6  ETC.  MOTOR6= 15,16
0187 LET C[5]=5
0190 LET C[6]=6
0193 LET C[7]=7
0196 LET C[8]=8
0199 LET C[9]=9
0202 LET C[10]=10
0205 LET C[11]=11
0208 LET C[12]=12
0211 LET C[13]=13
0214 LET C[14]=14
0217 LET C[15]=15
0220 LET C[16]=16

0223 REM# VALVES 1 TO 5
0226 LET C[30]=1

0229 REM# STEP MOTOR CONTROL
0232 LET C[31]=2

0235 REM# INITIALISATION OF END-SWITCHES
0238 CALL 60,C[1],-1,-1
0241 ON ERR THEN GOSUB 5970

0244 REM# TABLES OF STEP-FUNCTIONS FOR MOTOR DRIVE

0247 REM# WRITE ZERO AT THE END OF EACH TABLE

0250 REM# SCATT. ANGLE M1
0253 DATA 2,800,3,500,4,320,5,200,6,140,7,100,8,70,9,50
0256 DATA 10,40,11,32,12,24,0,0
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 12:59 SEITE   3
##############################################################################
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
0259 REM# DET.  ANGLE M2
0262 DATA 2,800,3,500,4,320,5,200,6,140,7,100,8,70,9,50
0265 DATA 10,40,11,32,12,24,12,20,0,0

0268 REM# SAMPLE M3
0271 DATA 2,200,2,100,2,50,2,32,2,20,3,16,0,0

0274 REM# MONOCHROMATOR M4
0277 DATA 2,200,3,100,4,50,5,32,5,20,0,0

0280 REM# ANALYSER M5
0283 DATA 2,40,3,24,4,16,0,0

0286 REM# M6 NOT USED
0289 DATA 33,5,30,5,0,0

0292 REM# M0(2TETA-MONOCHR.)
0295 DATA 2,800,2,500,3,320,3,200,3,160,4,100,4,80,4,50
0298 DATA 5,40,5,32,5,24,5,20,0,0

0301 REM# DEFINITION OF ADRESS FOR MOTORS
0304 RESTORE
0307 LET V[0]=2+64
0310 CALL 161,0,V
0313 LET J=0

0316 REM# CREATION OF FIELD S(K) FOR MOTOR DRIVE
0319 FOR M=1 TO 7
0322   LET K=1
-> 0325   READ V[K],V[K+1]
0328   IF V[K]=0 THEN GOTO 0340
0331   LET K=K+2
0334   GOTO 0325
-> 0340   CALL 161,M,V[1]
0355 NEXT M
0356 GOTO 0400

0360 REM# SETUP OF TV ON A  NOVA 3/4 WITH AT LEAST 128 KBYTE
0361 DIM B[20500]
0363 CALL 31,1,0,0
0364 CALL 30,B,B
0366 GOTO 0417

-> 0400 REM# TV SETUP
0405 LET A2=0
0408 CALL 31,1,0,1
0411 CALL 30,A2,A2
0414 IF A2<>0 THEN PRINT "ERROR IN TV STORAGE"
```

```
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13: 0 SEITE   4
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
-> 0417 CLOSE
   0420 OPEN FILE[6,1],"$LPT"
   0423 CALL 130,6
   0426 CALL 131,0
   0429 CALL 138
   0432 PRINT FILE[6]," "
   0435 PRINT FILE[6]," <14>S T A R T  -T A S-  P R O G R A M"
   0438 PRINT FILE[6]," "
   0441 PRINT FILE[6],"    <14>HIT  HP  FOR HELP ON DISPLAY"
   0444 FOR K=0 TO 255 STEP 16
   0447   FOR I=K TO 255 STEP 16
   0450     CALL 32,K,I,A2
   0453     CALL 32,I,K,A2
   0456   NEXT I
   0459   CALL 32,255,K,A2
   0462   CALL 32,K,255,A2
   0465 NEXT K
   0466 CALL 32,255,255,A2

-> 0500 REM# OPTION (CC) INPUT, DEFAULT VALUES
   0501 LET H=0
   0502 LET X2=0
   0503 LET Y2=0
   0504 LET E1=0
   0505 LET E2=0
   0506 LET E4=0
   0507 LET N9=5
   0508 LET M3=-1
   0509 LET CO=LEN(Y$)/2
   0510 PRINT
   0511 INPUT "<13> OPTION: ",B$
   0512 IF B$<>"ST" THEN GOTO 0515
   0514 STOP
-> 0515 LET X1=E[7]
   0516 LET Y1=E[8]
   0517 LET E3=E[9]
   0518 CALL 508,0
   0520 FOR I=16 TO CO
   0521   IF B$=Y$[2*I-1,2*I] THEN GOTO 0533
   0524 NEXT I
   0527 PRINT "NOT AN OPTION";
   0530 GOTO 0500
-> 0533 LET B$="  "
   0536 ON I-15 THEN GOTO 0821, 0548, 0557, 0575, 3000, 3050, 3100, 3150
   0539 ON I-23 THEN GOTO 3200, 3230, 3320, 3410, 3500, 3910, 4110, 4290
   0542 ON I-31 THEN GOTO 0602, 0884, 0983, 0914, 0944, 0860, 1022, 1500
   0543 ON I-39 THEN GOTO 1600, 5850
   0545 GOTO 0500
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13:  0 SEITE    5

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

-> 0548 REM# TITLE OF MEASUREMENT    TI
   0551 INPUT "<13> TITLE:  ",Z$;
   0554 GOTO 0500

-> 0557 REM# LIST SOFTWARE LIMITS    LL
   0560 PRINT "<13> SOFTWARE LIMITS OF MOTORS <13>"
   0563 FOR I=1 TO 6
   0566   PRINT " MOTOR";I-1;" = ";G[2*I-2];G[2*I-1]
   0569 NEXT I
   0572 GOTO 0500

-> 0575 REM# LIST ZEROS OF MOTORS    LZ
   0578 PRINT "<13> ZEROS OF MOTORS <13>"
   0581 FOR I=0 TO 5
   0584   PRINT " MOTOR";I;
   0587   IF I=4 THEN PRINT P[6],P[7],P[8]
   0590   IF I=5 THEN PRINT P[9],P[10]
   0593   IF I<4 THEN PRINT P[I]
   0596 NEXT I
   0599 GOTO 0500

-> 0602 REM# DEFINE PARAMETERS    DP
-> 0605 INPUT "<13>  PARAMETER:  ",B$;
   0608 IF B$="ST" THEN GOTO 0500
   0611 PRINT " = ";
   0614 FOR I=1 TO 15
   0617   IF B$=Y$[2*I-1,2*I] THEN GOTO 0629
   0620 NEXT I
   0623 PRINT "NOT A PARAMETER"
   0626 GOTO 0605
-> 0629 LET B$="  "
   0632 ON I THEN GOTO 0641, 0671, 0707, 0719, 0731, 0743, 0755, 0764
   0635 ON I-8 THEN GOTO 0773, 0785, 0791, 0797, 0803, 0809, 0815
   0638 GOTO 0605

-> 0641 REM# MONOCHROMATOR: PG(002)= 1, CU(111)= 2, CU(220)= 3    MO
   0644 INPUT E[1];
   0647 LET P[4]=P[E[1]+5]
   0650 ON E[1] THEN GOTO 0653, 0659, 0665
-> 0653 LET D0=3.3535
   0656 GOTO 0605
-> 0659 LET D0=3.615/SQR(3)
   0662 GOTO 0605
-> 0665 LET D0=3.615/SQR(8)
   0668 GOTO 0605

-> 0671 REM# ANALYSER: PG(002)= -1, SI(111)= -2, >0 =LATTICE SPACING    AN
   0674 INPUT E[2];
   0677 IF E[2]<0 THEN GOTO 0689
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                              9/ 9/1982 13: 0 SEITE   6
##############################################################################

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

   0680 INPUT P[5];
   0683 LET D1=E[2]
   0686 GOTO 0605
-> 0689 LET P[5]=P[-E[2]+8]
   0692 ON -E[2] THEN GOTO 0695, 0701
-> 0695 LET D1=3.3535
   0698 GOTO 0605
-> 0701 LET D1=5.4301/SQR(3)
   0704 GOTO 0605

-> 0707 REM# LATTICE SPACING IN X-DIR.    AC
   0710 INPUT E[3];
   0713 LET A1=6.2832/E[3]
   0716 GOTO 0605

-> 0719 REM# LATTICE SPACING IN Y-DIR.    BC
   0722 INPUT E[4];
   0725 LET B1=6.2832/E[4]
   0728 GOTO 0605

-> 0731 REM# ANGLE BETWEEN X,Y-AXES    WO
   0734 INPUT E[5];
   0737 LET W1=E[5]*1.74533E-02
   0740 GOTO 0605

-> 0743 REM# ZERO FOR SAMPLE (M3)    SO
   0746 INPUT E[6];
   0749 LET P[3]=E[6]
   0752 GOTO 0605

-> 0755 REM# X-COORD. OF REFERENCE BRAGG    XO
   0758 INPUT E[7];
   0761 GOTO 0605

-> 0764 REM# Y-COORD. OF REFERENCE BRAGG    YO
   0767 INPUT E[8];
   0770 GOTO 0605

-> 0773 REM# ENERGY FOR CALIBRATION    EO
   0776 INPUT E[9];
   0779 GOTO 0605

   0782 REM# FIXED ANGLE OF MOTORS (NOT FIXED= 1000)    MI
-> 0785 INPUT E[10];
   0788 GOTO 0605
-> 0791 INPUT E[11];
   0794 GOTO 0605
-> 0797 INPUT E[12];
   0800 GOTO 0605
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13: 0 SEITE   7

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

-> 0803 INPUT E[13];
   0806 GOTO 0605
-> 0809 INPUT E[14];
   0812 GOTO 0605
-> 0815 INPUT E[15];
   0818 GOTO 0605

-> 0821 REM# LISTING OF PARAMETERS   LP
   0824 PRINT "<13> LISTING OF PARAMETERS, FIRST, LAST :";
   0827 INPUT L,K
   0830 PRINT
   0833 FOR I=L TO K STEP 4
   0836   PRINT  TAB(5);Y$[2*I-1,2*I];" =";  TAB(10);E[I];
   0839   IF I<K THEN PRINT  TAB(20);Y$[2*I+1,2*I+2];" =";  TAB(25);E[I+1];
   0842   IF I+1<K THEN PRINT  TAB(35);Y$[2*I+3,2*I+4];" =";
   0845   IF I+1<K THEN PRINT  TAB(40);E[I+2];
   0848   IF I+2<K THEN PRINT  TAB(50);Y$[2*I+5,2*I+6];" =";  TAB(55);E[I+3]
   0851 NEXT I
   0857 GOTO 0500

-> 0860 REM# SINGLE PHONON SCAN   SP
   0863 INPUT "   NUMBER OF STEPS (ONE SIDE): ",N9," MONITOR COUNTS: ",M3
   0866 INPUT "   QX : ",X1,"   DELTA-QX : ",X2
   0869 INPUT "   QY : ",Y1,"   DELTA-QY : ",Y2
   0872 INPUT "   PHONON ENERGY (MEV) : ",E1,"   DELTA-E : ",E2
   0875 INPUT "   INC. ENERGY : ",E3," CONST. KI=0, KF=1 : ",E4
   0878 LET N4=-1
   0881 GOTO 1073

-> 0884 REM# PHONON PARAMETERS   PP
   0887 PRINT "<13>  PHONON PARAMETERS"
   0890 FOR K=1 TO 20
   0893   LET K0=K-1
   0896   PRINT "<13>  ";K;":  ";
   0899   INPUT T[K,1],T[K,2],T[K,3],T[K,4],T[K,5];
   0902   INPUT T[K,6],T[K,7],T[K,8],T[K,9],T[K,10];
   0905   IF T[K,2]=0 THEN GOTO 0500
   0908 NEXT K
   0911 GOTO 0500

-> 0914 REM# SELECTION OF PHONON SCANS   SS
   0917 PRINT "<13> SELECTION OF PHONON SCANS(0(K)=0 NO MEASUREMENT)<13>"
   0920 IF K0=0 THEN GOTO 0500
   0923 FOR K=1 TO K0
   0926   LET O[K]=0
   0929   PRINT " O(";K;")";
   0932   INPUT O[K];
   0935 NEXT K
   0941 GOTO 0500
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13: 0 SEITE   8
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
-> 0944 REM# LIST OF PHONON SCANS   LS
   0947 PRINT "<13> LIST OF PHONON SCANS (ALL=0, SELECTED=1): ";
   0950 INPUT K1
   0953 PRINT
   0956 FOR K=1 TO K0
   0959   IF K1=0 THEN GOTO 0965
   0962   IF O[K]=0 THEN GOTO 0977
-> 0965   PRINT "  ";K;": ";
   0968   PRINT T[K,1];" ";T[K,2];" ";T[K,3];" ";T[K,4];" ";T[K,5];" ";
   0971   PRINT T[K,6];" ";T[K,7];" ";T[K,8];" ";T[K,9];" ";T[K,10];
   0974   PRINT
-> 0977 NEXT K
   0980 GOTO 0500

-> 0983 REM# PHONON PARAMETER CORRECTIONS   PC
   0986 PRINT "<13> PHONON PARAMETER CORRECTIONS"
-> 0989 INPUT "  OK= NO CORRECTION, LI= LINE, SV= SINGLE VALUE: ",B$
   0992 IF B$="OK" THEN GOTO 0500
   0995 IF B$="LI" THEN GOTO 1010
   0998 IF B$="SV" THEN INPUT "<13> LINE = ",K," PARAMETER = ",I;
   1001 IF B$="SV" THEN INPUT " VALUE = ",T[K,I]
   1004 PRINT
   1007 GOTO 0989
-> 1010 INPUT "<13> LINE NO.  ",K,":  ",T[K,1],T[K,2],T[K,3],T[K,4];
   1013 INPUT T[K,5],T[K,6],T[K,7],T[K,8],T[K,9],T[K,10]
   1016 PRINT
   1019 GOTO 0989

-> 1022 REM# RUN PHONON PROGRAM   RP
   1025 INPUT " EXECUTION MODE (MEASURE:0, CHECK:1,2): ",N3
   1028 IF N3>0 THEN GOSUB 7360
   1031 FOR K9=1 TO K0
   1032   LET K=K9
   1034   IF O[K]=0 THEN GOTO 1469
   1037   LET N9=T[K,1]
   1040   LET M3=T[K,2]
   1043   LET X1=T[K,3]
   1046   LET X2=T[K,4]
   1049   LET Y1=T[K,5]
   1052   LET Y2=T[K,6]
   1055   LET E1=T[K,7]
   1058   LET E2=T[K,8]
   1061   LET E3=T[K,9]
   1064   LET E4=T[K,10]
   1067   LET F=N3
   1068   LET N4=0
   1070   GOTO 1076
-> 1073   LET F=0
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13:  1 SEITE   9

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

-> 1076    LET N2=N2+1
   1079    GOSUB 5320
   1082    PRINT
   1085    PRINT N9; M3; X1; X2; Y1; Y2; E1; E2; E3; E4
   1088    PRINT
   1091    PRINT Z$
   1094    PRINT
   1097    LET C1=0
   1100    PRINT "SCAN NO. : "; N2;
   1103    GOSUB 5370
   1106    PRINT
   1115    LET A[3]=.69424*SQR(E3)
   1118    LET A0=3.14159/(D1*A[3])
   1121    GOSUB 5750
   1124    LET A[4]=.01*INT(A0*5729.6)
   1127    LET C1=0
   1130    PRINT
   1133    IF E4=1 THEN GOTO 1148
   1136    PRINT "        E0="; E3"      K0="; A[3]"      AN. ANGLE EL. ="; A[4]
   1139    PRINT
   1142    PRINT " I      SEC       PR. W.    STR. W.   DET.    QX       QY";
   1145    GOTO 1172
-> 1148    LET A[5]=E3+E1
   1151    LET A[6]=.69424*SQR(A[5])
   1154    LET A0=3.14159/(D0*A[6])
   1157    GOSUB 5750
   1160    LET A[7]=.01*INT(A0*5729.6)
   1163    PRINT "     E1="; A[5]"     KF="; A[6]"    MO. ANGLE EL. ="; A[7]
   1166    PRINT
   1169    PRINT " I      SEC       PR. W.    STR. W.   MO. W.   QX       QY";
-> 1172    ON F+1 THEN GOTO 1181, 1175, 1175, 1181, 1181
-> 1175    PRINT  TAB(52);"  QXE        QYE"
   1178    GOTO 1190
-> 1181    PRINT  TAB(52);"  E    COUNTS"
   1184    LET H=2*N9+1
   1187    IF H<21 THEN LET H=21
-> 1190    GOSUB 6060
   1193    FOR I9=-N9 TO N9
   1196      ON F+1 THEN GOTO 1208, 1199, 1208, 1430, 0500
-> 1199      IF ABS(I9)=N9 THEN GOTO 1208
   1202      IF I9=0 THEN GOTO 1208
   1205      GOTO 1430
-> 1208      LET A[8]=E3+(E1+I9*E2)*E4
   1211      LET A[9]=E3-(E1+I9*E2)*(1-E4)
   1214      LET A0=3.14159/(D1*.69424*SQR(A[9]))
   1217      GOSUB 5750
   1220      LET A[1]=A1
   1223      LET R[5]=A0*57.296*C3
   1226      LET R[2]=2*R[5]
```

```
T A S K 0 == BASIC-SYSTEM                                  9/ 9/1982 13:  1 SEITE  10
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
 1229      LET A[2]=B1
 1232      LET A0=3.14159/(D0*.69424*SQR(A[8]))
 1235      GOSUB 5750
 1238      LET R[4]=-A0*57.296
 1241      LET R[0]=-2*R[4]
 1244      LET A[3]=A[1]*(X1+I9*X2)
 1247      LET A[4]=A[2]*(Y1+I9*Y2)
 1250      LET A[5]=A[3]*A[3]+A[4]*A[4]+2*A[3]*A[4]*COS(W1)
 1253      LET A[9]=.69424*SQR(A[9])
 1256      LET A[8]=.69424*SQR(A[8])
 1259      LET A0=(A[9]*A[9]+A[8]*A[8]-A[5])/(2*A[9]*A[8])
 1262      GOSUB 5750
 1265      LET R[1]=(90-A0*57.296)*C2
 1268      LET A[6]=E[7]*A[1]
 1271      LET A[7]=E[8]*A[2]
 1274      LET A[10]=SQR(A[6]*A[6]+A[7]*A[7]+2*A[6]*A[7]*COS(W1))
 1277      LET A0=A[10]/(2*.69424*SQR(E[9]))
 1280      GOSUB 5750
 1283      LET A[11]=90-A0*57.296
 1286      IF ABS(A[10]*A[6])>1E-10 THEN GOTO 1295
 1289      LET A0=0
 1292      GOTO 1301
-> 1295    LET A0=(A[10]*A[10]+A[6]*A[6]-A[7]*A[7])/(A[10]*A[6]*2)
 1298      GOSUB 5750
-> 1301    LET A[6]=SGN(A[7])*(E[5]-A0*57.296)-A[11]
 1304      LET A0=(A[5]+A[8]*A[8]-A[9]*A[9])/(2*A[8]*SQR(A[5]))
 1307      GOSUB 5750
 1310      LET A[10]=90-A0*57.296
 1313      IF ABS(A[3])>1E-10 THEN GOTO 1322
 1316      LET A0=0
 1319      GOTO 1328
-> 1322    LET A0=(A[3]*A[3]+A[5]-A[4]*A[4])/(2*A[3]*SQR(A[5]))
 1325      GOSUB 5750
-> 1328    LET A[10]=SGN(A[4])*(90-A0*57.296)-A[10]
 1331      LET R[3]=A[10]-A[6]
 1334      LET U[3]=.01*INT(.5+100*R[3])
 1337      LET U[4]=.01*INT(.5+100*R[1])
 1340      LET U[5]=.01*INT(.5+100*R[2])
 1343      IF E4=1 THEN LET U[5]=.01*INT(.5+100*R[0])
 1346      LET A[9]=.01*INT(.5+100*(E1+E2*I9))
 1349      LET U[1]=.001*INT(.5+1000*A[3]/A[1])
 1352      LET U[2]=.001*INT(.5+1000*A[4]/A[2])
 1355      FOR I=0 TO 5
 1358        IF E[10+I]<>1000 THEN LET R[I]=E[10+I]
 1361        IF E[10+I]<>1000 THEN PRINT " MOTOR ";I;" FIXED AT ";E[10+I]
 1364        LET R[I]=P[I]+R[I]
 1367      NEXT I
 1370      IF F>0 THEN GOSUB 5630
 1373      IF F=0 THEN GOSUB 6670
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                                 9/ 9/1982 13:  2 SEITE  11
##############################################################################

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

   1376      ON F+1 THEN GOTO 1379, 1394, 1394, 1412, 0500
-> 1379      GOSUB 7360
-> 1382      PRINT I9; TAB(6);M[0]; TAB(15);U[3]; TAB(22);U[4];
   1383      PRINT  TAB(30);U[5];
   1385      PRINT  TAB(38);U[1]; TAB(45);U[2]; TAB(52);A[9]; TAB(61);M[2]
   1388      IF F=0 THEN GOTO 1412
   1391      GOTO 1430
-> 1394      LET A[6]=(180+A[10]-A[11])*.01745
   1397      LET A[9]=A[8]*(COS(A[10]*.01745)+COS(A[6]))/A[1]
   1400      LET A[9]=.001*INT(.5+1000*A[9])
   1403      LET M[2]=A[8]*(SIN(A[10]*.01745)+SIN(A[6]))/A[2]
   1406      LET M[2]=.001*INT(.5+1000*M[2])
   1409      GOTO 1382
-> 1412      LET I=N9+I9+1
   1415      IF E2<>0 THEN LET X[I]=A[9]
   1418      IF Y2<>0 THEN LET X[I]=U[2]
   1421      IF X2<>0 THEN LET X[I]=U[1]
   1424      LET Y[I]=M[2]
   1427      LET F=N3
-> 1430    NEXT I9

   1433    REM# IF F>0 THEN GOTO 2303
   1436    IF N9>0 THEN GOSUB 6130
   1439    IF N4=-1 THEN GOTO 0500
   1442    IF N3=0 THEN GOTO 1469
   1445    IF F=0 THEN GOTO 1469
   1448    LET C1=(2*N9+1)*(M[0]+.01)*M3/10+N1
   1451    LET N1=C1
   1454    PRINT "     FINISHED AT:  ";
   1457    GOSUB 5370
   1460    PRINT
   1463    PRINT
   1466    PRINT
-> 1469  NEXT K9
   1472  PRINT "     END OF DATA !!!  "
   1475  GOTO 0500

-> 1500  REM# DRIVE    DR
   1503  INPUT "<13> DRIVE MOTOR:  ",N5," TO:  ",E2
   1506  LET R[N5]=E2+P[N5]
   1509  GOSUB 6670
   1512  GOTO 0500

-> 1600  REM# HELP FOR THE EXPERIMENTATOR    HP
   1605  CALL 138
   1610  PRINT FILE[6]," ---> ALPHABETIC LIST OF COMMANDS"
   1615  PRINT FILE[6],"      ============================"
   1620  PRINT FILE[6],"AC..LATTICE SPACING IN X-DIR.  ...AC"
   1625  PRINT FILE[6],"AN..ANALYSER:  PG(002)=-1,  SI(111)=-2";
```

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##############################################################################
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13: 2 SEITE  12
##############################################################################

  LISTING DES PROGRAMMES SACLAYDOKU.BA
  ====================================

  1630 PRINT FILE[6],"      >0 =LATTICE SPACING .........AN"
  1632 PRINT FILE[6],"BC..LATTICE SPACING IN Y-DIR. ...BC"
  1635 PRINT FILE[6],"BP..BRAGG POINT ..................BP"
  1640 PRINT FILE[6],"BX..BRAGG SCAN X-DIR. ............BX"
  1645 PRINT FILE[6],"BY..BRAGG SCAN Y-DIR. ............BY"
  1650 PRINT FILE[6],"DA..CALCULATION OF DEBYE SCHERRER"
  1655 PRINT FILE[6],"      ANGLES .....................DA"
  1665 PRINT FILE[6],"DE..DETERMINATION OF ENERGY FROM"
  1670 PRINT FILE[6],"      CUBIC SUBSTANCES ...........DE"
  1680 PRINT FILE[6],"DP..DETERMINATION OF PARAMETERS .DP"
  1685 PRINT FILE[6],"DR..DRIVE ........................DR"
  1687 PRINT FILE[6],"DS..DEBYE SCHERRER SCANS .........DS"
  1690 PRINT FILE[6],"EO..ENERGY FOR CALIBRATION .......EO"
  1695 PRINT FILE[6],"EI:.FIXED INC. ENERGY ............EI"
  1700 PRINT FILE[6],"EO..FIXED OUTGOING ENERGY ........EO"
  1705 PRINT FILE[6],"ES..ENERGY SCAN ..................ES"
  1710 PRINT FILE[6],"HO..HIGHER ORDER CONTAMINATIONS .HO"
  1715 PRINT FILE[6],"LL..LIST SOFTWARE LIMITS .........LL"
  1720 PRINT FILE[6],"LP..LISTING OF PARAMETERS ........LP"
  1725 PRINT FILE[6],"LS..LIST OF PHONON SCANS .........LS"
  1730 PRINT FILE[6]," "
  1735 PRINT FILE[6]," <14>HIT  -RETURN-  TO GET NEXT PICTURE<15>"
  1736 PRINT FILE[6]," <14>HIT -A+RETURN- TO GO TO OPTIONS...";
  1740 INPUT "HIT RETURN TO CONTINUE ",B$
  1744 IF LEN(B$)<>0 THEN GOTO 0500
  1745 CALL 138
  1750 PRINT FILE[6]," ---> ALPHABETIC LIST OF COMMANDS"
  1755 PRINT FILE[6],"      ============================"
  1760 PRINT FILE[6],"LZ..LIST ZEROS OF MOTORS .........LZ"
  1765 PRINT FILE[6],"MI..FIXED ANGLE OF MOTORS"
  1770 PRINT FILE[6],"      (NOT FIXED= 1000) ..........MI"
  1775 PRINT FILE[6],"MO..MONOCHROMATOR.  PG(002)= 1,"
  1780 PRINT FILE[6],"      CU(111)= 2, CU(220)= 3 ....MO"
  1785 PRINT FILE[6],"PC..PHONON PARAMETER CORRECTIONS PC"
  1790 PRINT FILE[6],"PP..PHONON PARAMETERS ............PP"
  1795 PRINT FILE[6],"RE..READING OF ENCODERS ..........RE"
  1800 PRINT FILE[6],"RP..RUN PHONON PROGRAM ...........RP"
  1805 PRINT FILE[6],"SO..ZERO FOR SAMPLE (M3) .........SO"
  1810 PRINT FILE[6],"SP..SINGLE PHONON SCAN ...........SP"
  1815 PRINT FILE[6],"SS..SELECTION OF PHONON SCANS ...SS"
  1820 PRINT FILE[6],"TI..TITLE OF MEASUREMENT .........TI"
  1825 PRINT FILE[6],"WO..ANGLE BETWEEN X,Y-AXES .......WO"
  1830 PRINT FILE[6],"XO..X-COORD. OF REFERENCE BRAGG .XO"
  1835 PRINT FILE[6],"ZZ..EMERGENCY-STOP OF ALL ........ZZ"
  1840 PRINT FILE[6]," "
  1845 PRINT FILE[6],"              THE END"
  1850 GOTO 0500

-> 3000 REM# BRAGG POINT   BP
```

```
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13: 2 SEITE  13
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
   3010 PRINT
   3015 PRINT "   BRAGG POINT"
   3020 LET N9=0
   3030 LET N4=-1
   3040 GOTO 1073

-> 3050 REM# BRAGG SCAN X-DIR.    BX
   3060 PRINT
   3065 PRINT "   BRAGG SCAN X-DIR."
   3070 LET X2=.01
   3080 LET N4=-1
   3090 GOTO 1073

-> 3100 REM# BRAGG SCAN Y-DIR.    BY
   3110 PRINT
   3115 PRINT "   BRAGG SCAN Y-DIR."
   3120 LET Y2=.01
   3130 LET N4=-1
   3140 GOTO 1073

-> 3150 REM# ENERGY SCAN   ES
   3160 PRINT
   3165 PRINT "   ENERGY SCAN"
   3170 LET E2=.1
   3180 LET N4=-1
   3190 GOTO 1073

-> 3200 REM# ROCKING SCAN OF MOTORS   RS
   3210 GOSUB 7100
   3220 GOTO 0500

-> 3230 REM# READING OF ENCODERS  RE
   3240 PRINT "<13>  READING OF ENCODERS"
   3250 FOR K=0 TO 5
   3260   GOSUB 5100
   3270   PRINT
   3280   PRINT "  MOTOR: ";K;" POSITION: ";W[K];" ZERO: ";P[K];
   3290 NEXT K
   3310 GOTO 0500

-> 3320 REM# FIXED INC. ENERGY   EI
   3330 INPUT "   ADJUSTMENT OF PRIM. SPECTRO TO E(MEV)= ",E3
   3340 GOSUB 5320
   3350 LET A0=3.14159/(D0*.69424*SQR(E3))
   3360 GOSUB 5750
   3370 LET R[4]=-A0*57.296+P[4]
   3380 LET R[0]=2*A0*57.296+P[0]
   3390 GOSUB 6670
   3400 GOTO 0500
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                                  9/ 9/1982 13: 2 SEITE  14
##############################################################################

  LISTING DES PROGRAMMES SACLAYDOKU.BA
  ====================================


-> 3410 REM# FIXED OUTGOING ENERGY   EO
   3420 INPUT "   ADJUSTMENT OF SECOND. SPECTRO TO E(-MEV)= ",E1
   3430 GOSUB 5320
   3440 LET A0=3.14159/(D1*.69424*SQR(E1*C3))
   3450 GOSUB 5750
   3460 LET R[5]=C3*A0*57.296+P[5]
   3470 LET R[2]=2*A0*57.296*C3+P[2]
   3480 GOSUB 6670
   3490 GOTO 0500

-> 3500 REM# DEBYE SCHERRER SCANS   DS
   3510 GOSUB 5320
   3520 PRINT "   DEBYE SCHERRER SCANS"
   3530 INPUT "    NUMBER OF SCANS (<=5): ",N5
   3540 DIM U[20]
   3550 FOR I=1 TO N5
   3560   PRINT "  SCAN ";I;" CENT.AT ";
   3570   INPUT U[I]," WIDTH:",U[I+5]," STEPS:",U[I+10]," MONITOR:",U[I+15]
   3580   LET H=H+2*U[I+10]+1
   3590 NEXT I
   3600 LET A0=3.14159/(D1*.69424*SQR(E[9]))
   3610 GOSUB 5750
   3620 PRINT
   3630 GOSUB 6060
   3640 INPUT "   DET.ANGLE (ELAST.>0): ",R[2],"  ANALYSER (EL.>0): ",R[5]
   3650 IF R[2]>0 THEN LET R[2]=-2*A0*57.296+P[2]
   3660 IF R[5]>0 THEN LET R[5]=-A0*57.296+P[5]
   3670 IF R[2]<=0 THEN LET R[2]=R[2]+P[2]
   3680 IF R[5]<=0 THEN LET R[5]=R[5]+P[5]
   3690 PRINT
   3700 FOR L=1 TO N5
   3750   PRINT "              ANGLE                COUNTS"
   3760   FOR I=-U[L+10] TO U[L+10]
   3770     LET R[1]=U[L]+I*U[L+5]+P[1]
   3780     GOSUB 6670
   3790     LET M3=U[L+15]
   3800     GOSUB 7360
   3810     LET K=1
   3820     GOSUB 5100
   3825     LET W[1]=W[1]-P[1]
   3830     PRINT  TAB(10);W[1]; TAB(30);M[2]
   3840     LET Y[I+U[L+10]+1]=M[2]
   3850     LET X[I+U[L+10]+1]=W[1]
   3860   NEXT I
   3870   GOSUB 6130
   3880   PRINT
   3890 NEXT L
   3900 GOTO 0500
```

```
T A S K O == BASIC-SYSTEM                                   9/ 9/1982 13:  2 SEITE  15

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================


-> 3910 REM# DETERMINATION OF ENERGY FROM CUBIC SUBSTANCES   DE
   3920 PRINT " DETERMINATION OF ENERGY(MEV) FOR CUBIC CRYSTALS"
   3930 INPUT " LATTICE CONST.: ",U[1]," DELTA ZERO (2 THETA): ",U[2]
   3940 INPUT "   NUMBER OF MEASUREMENTS: ",U[3]
   3950 LET U[4]=0
   3960 FOR I=1 TO U[3]
   3970   PRINT
   3980   INPUT "   H, K, L : ",U[5],U[6],U[7],"   2 THETA: ",U[8]
   3990   LET U[9]=U[1]/SQR(U[5]*U[5]+U[6]*U[6]+U[7]*U[7])
   4000   LET U[10]=3.14159/(U[9]*SIN((U[8]-U[2])/114.592))
   4010   LET E1=2.0748*U[10]*U[10]
   4020   PRINT "      E= ";E1;"      KO= ";U[10]
   4030   LET U[4]=U[4]+E1
   4040 NEXT I
   4050 LET E1=U[4]/U[3]
   4060 LET U[10]=.69424*SQR(E1)
   4070 PRINT
   4080 PRINT
   4090 PRINT "   MEAN VALUE:      E= ";E1;"      KO= ";U[10]
   4100 GOTO 0500

-> 4110 REM# HIGHER ORDER CONTAMINATIONS   HO
   4120 PRINT
   4130 PRINT "   HIGHER ORDER CONTAMINATIONS"
   4140 PRINT
   4150 INPUT "    EO= ",E3
   4160 PRINT
   4170 PRINT "    UPSCATTERING"
   4180 FOR K=1 TO 4
   4190   LET E1=(2*K+1)*E3/K/K
   4200   PRINT "    N= ";K;"    PHONON ENERGY= ";E1
   4210 NEXT K
   4220 PRINT
   4230 PRINT "    DOWNSCATTERING"
   4240 FOR K=1 TO 4
   4250   LET E1=(2*K+1)*E3/(K+1)^2
   4260   PRINT "    N= ";K;"    PHONON ENERGY= ";E1
   4270 NEXT K
   4280 GOTO 0500

-> 4290 REM# CALCULATION OF DEBYE SCHERRER ANGLES   DA
   4300 PRINT "    CALCULATION OF DEBYE SCHERRER ANGLES"
-> 4320 PRINT
   4330 PRINT "CUB.=C, HEX.=H, TETR.=T, RHOBOHED.=R, ORTHORHOM.=O ";
   4340 INPUT "MONOCL.=M  : ",X$
   4350 PRINT
   4360 IF X$<>"C" THEN GOTO 4366
   4362 INPUT "LATTICE CONST.  A= ",A[1]," ENERGY= ",E1
```

```
T A S K O == BASIC-SYSTEM                                  9/ 9/1982 13: 3 SEITE  16
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
   4364 GOTO 4430
-> 4366 IF X$<>"T" THEN GOTO 4372
   4368 INPUT "LATTICE CONST.  A= ",A[1]," C= ",A[3]," ENERGY= ",E1
   4370 GOTO 4432
-> 4372 IF X$<>"O" THEN GOTO 4378
   4374 INPUT "LATTICE CONST.  A= ",A[1]," B= ",A[2]," C= ",A[3];
   4375 INPUT " ENERGY= ",E1
   4376 GOTO 4434
-> 4378 IF X$<>"M" THEN GOTO 4384
   4380 INPUT "LATTICE CONST.  A= ",A[1]," B= ",A[2]," C= ",A[3]
   4381 INPUT " BETA= ",A[5]," ENERGY= ",E1
   4382 GOTO 4436
-> 4384 IF X$<>"H" THEN GOTO 4400
   4386 INPUT "LATTICE CONST.  A= ",A[1]," C= ",A[3]," ENERGY= ",E1
-> 4388 INPUT "<13>MILLERINDICES: H, K, L :    ",A[7],A[8],A[9];
   4390 LET A[10]=4/3*(A[7]*A[7]+A[7]*A[8]+A[8]*A[8])+(A[1]*A[9]/A[3])^2
   4391 IF A[10]<.000001 THEN GOTO 4500
   4392 LET A[10]=A[1]/SQR(A[10])
   4394 GOSUB 4460
   4396 GOTO 4388
-> 4400 IF X$<>"R" THEN GOTO 4480
   4402 INPUT "LATTICE CONST.  A= ",A[1]," ALPHA= ",A[4]," ENERGY= ",E1
   4404 LET A[4]=A[4]*1.74533E-02
-> 4406 INPUT "<13>MILLERINDICES: H, K, L :    ",A[7],A[8],A[9];
   4408 LET A[10]=A[1]*SQR(1-3*COS(A[4])^2+2*COS(A[4])^3)
   4410 LET A[11]=(A[7]*A[7]+A[8]*A[8]+A[9]*A[9])*SIN(A[4])^2
   4412 LET A[11]=A[11]-2*(A[7]*A[8]+A[8]*A[9]+A[9]*A[7])*COS(A[4])
   4414 LET A[11]=A[11]-COS(A[4])^2
   4415 IF A[11]<.000001 THEN GOTO 4500
   4416 LET A[10]=A[10]/SQR(A[11])
   4418 GOSUB 4460
   4420 GOTO 4406
-> 4430 LET A[3]=A[1]
-> 4432 LET A[2]=A[1]
-> 4434 LET A[5]=90
-> 4436 LET A[5]=A[5]*1.74533E-02
-> 4438 INPUT "<13>MILLERINDICES: H, K, L :    ",A[7],A[8],A[9];
   4440 LET A[10]=(A[7]/A[1])^2+(A[8]*SIN(A[5])/A[2])^2
   4442 LET A[10]=A[10]+(A[9]/A[3])^2
   4444 LET A[10]=A[10]-2*A[7]*A[9]*COS(A[5])/A[1]/A[3]
   4445 IF A[10]<.000001 THEN GOTO 4500
   4446 LET A[10]=SIN(A[5])/SQR(A[10])
   4448 GOSUB 4460
   4450 GOTO 4438
=> 4460 LET E2=4.52524/SQR(E1)
   4462 LET A0=E2/A[10]
   4464 GOSUB 5750
   4466 PRINT "   2 THETA= ";114.592*A0
   4468 RETURN
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13:  3 SEITE  17
##############################################################################

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

-> 4480 PRINT "<13> CRYSTAL SYMMETRY NOT CORRECTLY DEFINED"
   4482 GOTO 4320
-> 4500 PRINT "    -> MILLERINDICES 0,0,0 SELECTED !!!"
   4502 GOTO 4320

=> 5050 REM# PAUSE, CA 1-2 SEC
   5060 LET A[1]=SYS(0)
-> 5070 IF SYS(0)<A[1]+2 THEN GOTO 5070
   5080 RETURN

   5090 REM# CONVERSION FOR BCD- ANGLE ENCODERS INPUT:K, OUTPUT:W(K)
=> 5100 CALL 69
   5110 IF K=0 THEN CALL 262,1,W[K]
   5120 IF K=0 THEN CALL 262,2,A[6]
   5130 IF K>0 THEN CALL 262,2*K+4,A[6]
   5140 IF K>0 THEN CALL 262,2*K+3,W[K]
   5150 CALL 60,C[1],-1,-1
   5220 LET W[K]=W[K]+A[6]*10000
   5230 LET W[K]=W[K]/100
   5240 RETURN

=> 5250 REM# PREWARN SWITCHES
   5260 LET J=K
   5270 IF K=0 THEN LET J=7
   5280 LET N6=0
   5290 LET I0=(J-1)*2+.5-SGN(Q[K])/2
   5300 CALL 62,C[1],N6
   5310 RETURN

=> 5320 REM# SKIP OF MOTORS, R(I)=1000
   5330 FOR I=0 TO 5
   5340   LET R[I]=1000
   5350 NEXT I
   5360 RETURN

=> 5370 REM# DATE AFTER C1 SEC., INPUT C1
   5380 LET A[1]=SYS(2)
   5390 LET A[2]=SYS(1)
   5400 LET A[3]=SYS(0)+C1
   5410 LET A[4]=31
   5420 IF A[2]=4 THEN LET A[4]=30
   5430 IF A[2]=6 THEN LET A[4]=30
   5440 IF A[2]=9 THEN LET A[4]=30
   5450 IF A[2]=11 THEN LET A[4]=30
   5460 IF A[2]=2 THEN LET A[4]=28
   5470 LET A[5]=INT(A[3]/3600)
   5480 LET A[6]=INT(A[3]/60)-A[5]*60
   5490 IF A[6]>60 THEN LET A[5]=A[5]+1
   5500 IF A[6]>60 THEN LET A[6]=A[6]-60
```

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13: 3 SEITE  18
##############################################################################

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

-> 5510 IF A[5]>24 THEN LET A[1]=A[1]+1
   5520 IF A[5]>24 THEN LET A[5]=A[5]-24
   5530 IF A[5]>24 THEN GOTO 5510
-> 5540 IF A[1]>A[4] THEN LET A[2]=A[2]+1
   5550 IF A[1]>A[4] THEN LET A[1]=A[1]-A[4]
   5560 IF A[1]>A[4] THEN GOTO 5540
   5570 IF A[2]>12 THEN LET A[2]=A[2]-12
   5580 IF A[6]<60 THEN GOTO 5610
   5590 LET A[6]=A[6]-60
   5600 LET A[5]=A[5]+1
-> 5610 PRINT  TAB(40);A[1]".";A[2]".";SYS(3)"     ";A[5]".";A[6]" UHR"
   5620 RETURN

=> 5630 REM# CHECK WETHER R(J) IS WITHIN THE SOFTWARE LIMITS
   5640 FOR J=0 TO 5
   5650   IF R[J]=1000 THEN GOTO 5680
   5660   IF R[J]<=G[J*2] THEN GOTO 5700
   5670   IF R[J]>=G[J*2+1] THEN GOTO 5700
-> 5680 NEXT J
   5690 RETURN
-> 5700 PRINT "    ANGLE  ";J"  NOT WITHIN THE SOFTWARE LIMITS"
   5710 PRINT "   CALC. ANGLE  ";R[J]
   5720 LET R[J]=1000
   5730 LET F=3
   5740 GOTO 5680

=> 5750 REM# CALCULATION ASIN: I/O= A0/A0
   5760 IF ABS(A0)>1.0001 THEN GOTO 5800
   5770 IF ABS(A0)>.99999 THEN GOTO 5830
   5780 LET A0=ATN(A0/SQR(1-A0*A0))
   5790 RETURN
-> 5800 PRINT "     ERROR IN CALCULATION OF ANGLES "
   5810 LET F=3
   5820 RETURN
-> 5830 LET A0=1.5708*SGN(A0)
   5840 RETURN

-> 5850 REM# EMERGENCY-STOP OF ALL   ZZ
   5860 PRINT "STOP"
   5870 CALL 162,A[8],A[9]
   5880 IF A[8]=0 THEN GOTO 0500
   5882 PRINT "--->";A[8];"MOTOR(S) FORCED INTO A SLOWING-DOWN-SEQUENCE"
   5890 FOR K=1 TO 7
   5900   CALL 169,K
   5910 NEXT K
-> 5920 CALL 162,A[8],A[9]
   5930 IF A[8]<>0 THEN GOTO 5920
   5940 CALL 64,1,0
   5960 GOTO 0500
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13: 4 SEITE  19

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================


=> 5970 REM# INTERRUPT OF END-SWITCHES
   5980 LET N7=-SYS(7)-600
   5990 IF N7>15 THEN IF N7<40 THEN GOTO 6040
   5995 IF N7>=0 THEN IF N7<16 THEN GOTO 6020
   6000 PRINT " ----> BASIC ERROR:   ";SYS(7);
   6002 CALL 507,A2,N7
   6004 PRINT "BEFORE STATEMENT";N7
   6010 STOP
-> 6020 LET N7=8-INT(N7/2+.1)
   6030 CALL 169,N7
   6033 PRINT "***** MOTOR";N7;"SHUTDOWN DUE TO PRE-WARN SWITCH"
-> 6040 CALL 61,C[1]
   6050 RETURN

=> 6060 REM# FIELD X(I),Y(I)=0
   6070 DIM X[H],Y[H]
   6080 FOR I=1 TO H
   6090   LET X[I]=0
   6100   LET Y[I]=0
   6110 NEXT I
   6120 RETURN

=> 6130 REM# PLOT
   6140 LET A[1]=0
   6150 LET A[3]=0
   6160 FOR I=1 TO H
   6170   IF ABS(X[I])+ABS(Y[I])=0 THEN GOTO 6210
   6180   IF Y[I]>A[1] THEN LET A[1]=Y[I]
   6190   LET A[3]=A[3]+1
   6200 NEXT I
-> 6210 IF A[1]=0 THEN GOTO 6490
   6220 LET A[4]=INT(LOG(A[1])/2.30258)-1
   6230 LET A[2]=A[1]/10^A[4]
   6240 FOR I=0 TO 100 STEP 10
   6250   IF I>A[2]-.01 THEN GOTO 6270
   6260 NEXT I
-> 6270 IF A[2]<15 THEN LET I=15
   6280 FOR K=6 TO 11
   6290   LET A[K]=(K-6)*I/5*10^A[4]
   6300 NEXT K
   6310 IF A[3]<102 THEN GOSUB 6510
   6320 PRINT
   6330 PRINT  TAB(8);A[6]; TAB(18);A[7]; TAB(28);A[8]; TAB(38);A[9];
   6340 PRINT  TAB(48);A[10]; TAB(58);A[11]
   6350 PRINT  TAB(10);"I---------I---------I---------I---------I---------I";
   6360 PRINT "---------I"
   6370 FOR I=1 TO A[3]
   6380   LET Y1=Y[I]*50/A[11]+11
```

```
T A S K 0 == BASIC-SYSTEM                                  9/ 9/1982 13:  4 SEITE  20
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
   6390    IF Y1<1 THEN LET Y1=1
   6400    LET A[4]=INT(A[3]/2+.5)
   6410    LET A[2]=ABS(I-A[4])/5+1
   6420    IF A[2]-INT(A[2])=0 THEN GOTO 6450
   6430    PRINT  TAB(10);"I";  TAB(Y1);"*"
   6440    GOTO 6470
-> 6450    LET X[I]=INT(100*X[I]+.5)*.01
   6460    PRINT  TAB(2);X[I];  TAB(10);"+";  TAB(Y1);"*"
-> 6470 NEXT I
   6480 GOTO 6500
-> 6490 PRINT "       NO PLOT: FIELD Y(I)=0 "
-> 6500 RETURN

=> 6510 REM# TELEVISION PLOT
   6520 CALL 38
   6530 LET I=1
   6540 LET B2=0
   6550 CALL 33,X,Y,-A[3]-1,0,0,A[3],A[1],I
   6560 FOR I=0 TO 100
   6570    LET B2=A[3]/2^I
   6580    IF B2<1 THEN GOTO 6600
   6590 NEXT I
-> 6600 CALL 332,0,0,255*A[3]/2^I,0,I
   6610 FOR I=0 TO 100
   6620    LET B2=A[1]/2^I
   6630    IF B2<1 THEN GOTO 6650
   6640 NEXT I
-> 6650 CALL 332,0,0,0,255*A[1]/2^I,I
   6660 RETURN

=> 6670 REM# POSITIONING OF MOTORS
   6680 GOSUB 5630
   6690 LET N=0
-> 6700 FOR K=0 TO 5
   6710    LET Q[K]=0
   6720    IF R[K]=1000 THEN GOTO 6790
   6730    GOSUB 5100
   6740    LET Q[K]=200*(W[K]-R[K])
   6750    IF K=5 THEN LET Q[K]=-Q[K]
   6760    IF ABS(Q[K])<3.5 THEN LET Q[K]=0
   6770    IF K=0 THEN LET Q[K]=10*Q[K]
   6780    IF Q[K]=0 THEN LET R[K]=1000
-> 6790 NEXT K
   6800 IF N>0 THEN GOTO 6890
   6810 IF Q[0]=0 THEN GOTO 6840
   6820 CALL 64,1,1792
   6830 GOTO 6890
-> 6840 IF Q[1]=0 THEN GOTO 6870
   6850 CALL 64,1,1536
```

```
T A S K 0 == BASIC-SYSTEM                                   9/ 9/1982 13:  4 SEITE  21

   LISTING DES PROGRAMMES SACLAYDOKU.BA
   ====================================

   6860 GOTO 6890
-> 6870 IF Q[2]=0 THEN GOTO 6890
   6880 CALL 64,1,1024
-> 6890 FOR K=0 TO 5
   6900   IF Q[K]=0 THEN GOTO 6950
   6910   IF N<7 THEN GOTO 6980
   6920   PRINT "  ERROR IN POSITIONING OF MOTOR: ";K;
   6930   GOSUB 5100
   6940   PRINT " CALC.: ";R[K];"  REACHED: ";W[K]
-> 6950 NEXT K
   6960 CALL 64,1,0
   6970 RETURN
-> 6980 FOR K=0 TO 5
   6990   IF Q[K]=0 THEN GOTO 7050
   7000   GOSUB 5250
   7010   IF FNT(IO)=1 THEN IF K>0 THEN CALL 160,K,Q[K]
   7020   IF FNT(IO)=1 THEN IF K=0 THEN CALL 160,7,-Q[0]
   7030   IF K=0 THEN GOSUB 5050
   7040   IF K=1 THEN GOSUB 5050
-> 7050 NEXT K
-> 7060 CALL 162,A[8],A[9]
   7070 IF A[8]<>0 THEN GOTO 7060
   7080 LET N=N+1
   7090 GOTO 6700

=> 7100 REM# ROCKINGSCAN OF MOTORS
   7110 GOSUB 5320
   7120 INPUT " ROCKING SCAN MOTOR: ",N5," CENT.AT: ",E2," MONITOR: ",M3
   7130 INPUT "    NUMBER OF STEPS: ",N9,"  WIDTH:",X2
   7140 LET H=2*N9+1
   7150 IF H<21 THEN LET H=21
   7160 GOSUB 6060
   7170 PRINT
   7180 PRINT "            ANGLE              COUNTS"
   7190 PRINT
   7200 FOR I=-N9 TO N9
   7210   LET R[N5]=E2+I*X2+P[N5]
   7220   GOSUB 6670
   7230   GOSUB 7360
   7240   LET K=N5
   7250   GOSUB 5100
   7260   LET W[K]=W[K]-P[K]
   7270   PRINT  TAB(10);W[K]; TAB(30);M[2]
   7280   LET X[I+N9+1]=W[K]+P[K]
   7290   LET Y[I+N9+1]=M[2]
   7300 NEXT I
   7310 GOSUB 6130
   7320 PRINT
   7330 PRINT "    FOR CALLIBRATION : NEW ZERO = MEASURED (ABOVE) - ";
```

```
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13:  4 SEITE  22
```

LISTING DES PROGRAMMES SACLAYDOKU.BA

```
 7340 PRINT "CALCULATED VALUE"
 7350 RETURN

=> 7360 REM# MONITOR -- RETURN ONLY IF M(0)=M3

 7370 REM#              PRESET COUNT: M3>0, PRESET TIME (SEC.):M3<0
 7380 CALL 138
 7390 LET I0=0
 7400 CALL 11,8+4+2,0,0
 7410 CALL 10,0,15
 7420 CALL 17,0
 7430 CALL 118,M[0],0,15,1
 7440 LET N0=SYS(0)
 7450 IF M3>=0 THEN CALL 314,M3,1,1,1
 7460 CALL 17,-1
-> 7470 CALL 112,M[0],0,15,1
 7480 CALL 312,M[1],1,1,1
 7490 IF M[1]<0 THEN LET M[1]=0
 7500 CALL 237,4,3,I0
 7510 IF M3<0 THEN LET M[0]=SYS(0)-N0
 7520 IF I0<>0 THEN PRINT "    ERROR -- TV SYSTEM"
 7530 IF I0<>0 THEN STOP
 7540 PRINT FILE[6],"MONITOR 1:";M[0]
 7550 PRINT FILE[6],
 7560 PRINT FILE[6],"MONITOR 2:";M[1]
 7570 PRINT FILE[6],
 7580 PRINT FILE[6],"DETECTOR :";M[2]
 7590 IF M3<0 THEN IF SYS(0)<N0-M3 THEN GOTO 7470
 7600 IF M3>=0 THEN IF M[1]>0 THEN GOTO 7470
 7610 LET M[0]=SYS(0)-N0
 7620 RETURN
```

```
T A S K O == BASIC-SYSTEM                                   9/ 9/1982 13:  5 SEITE  23

GOTO KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA
====================================================

 0325  :  0334
 0340  :  0328
 0400  :  0356
 0417  :  0366
 0500  :  0001  0530  0545  0554  0572  0599  0608  0857  0905
          0911  0920  0941  0980  0992  1196  1376  1439  1475
          1512  1744  1850  3220  3310  3400  3490  3900  4100
          4280  5880  5960
 0515  :  0512
 0533  :  0521
 0548  :  0536
 0557  :  0536
 0575  :  0536
 0602  :  0542
 0605  :  0626  0638  0656  0662  0668  0686  0698  0704  0716
          0728  0740  0752  0761  0770  0779  0788  0794  0800
          0806  0812  0818
 0629  :  0617
 0641  :  0632
 0653  :  0650
 0659  :  0650
 0665  :  0650
 0671  :  0632
 0689  :  0677
 0695  :  0692
 0701  :  0692
 0707  :  0632
 0719  :  0632
 0731  :  0632
 0743  :  0632
 0755  :  0632
 0764  :  0632
 0773  :  0635
 0785  :  0635
 0791  :  0635
 0797  :  0635
 0803  :  0635
 0809  :  0635
 0815  :  0635
 0821  :  0536
 0860  :  0542
 0884  :  0542
 0914  :  0542
 0944  :  0542
 0965  :  0959
 0977  :  0962
 0983  :  0542
 0989  :  1007  1019
 1010  :  0995
```

GOTO KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA

1022	:	0542				
1073	:	0881	3040	3090	3140	3190
1076	:	1070				
1148	:	1133				
1172	:	1145				
1175	:	1172	1172			
1181	:	1172	1172	1172		
1190	:	1178				
1199	:	1196				
1208	:	1196	1196	1199	1202	
1295	:	1286				
1301	:	1292				
1322	:	1313				
1328	:	1319				
1379	:	1376				
1382	:	1409				
1394	:	1376	1376			
1412	:	1376	1388			
1430	:	1196	1205	1391		
1469	:	1034	1442	1445		
1500	:	0542				
1600	:	0543				
3000	:	0536				
3050	:	0536				
3100	:	0536				
3150	:	0536				
3200	:	0539				
3230	:	0539				
3320	:	0539				
3410	:	0539				
3500	:	0539				
3910	:	0539				
4110	:	0539				
4290	:	0539				
4320	:	4482	4502			
4366	:	4360				
4372	:	4366				
4378	:	4372				
4384	:	4378				
4388	:	4396				
4400	:	4384				
4406	:	4420				
4430	:	4364				
4432	:	4370				
4434	:	4376				
4436	:	4382				
4438	:	4450				
4480	:	4400				
4500	:	4391	4415	4445		

```
################################################################################
T A S K O == BASIC-SYSTEM                              9/ 9/1982 13:  5 SEITE  25
################################################################################
```

GOTO KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA

5070	:	5070			
5510	:	5530			
5540	:	5560			
5610	:	5580			
5680	:	5650	5740		
5700	:	5660	5670		
5800	:	5760			
5830	:	5770			
5850	:	0543			
5920	:	5930			
6020	:	5995			
6040	:	5990			
6210	:	6170			
6270	:	6250			
6450	:	6420			
6470	:	6440			
6490	:	6210			
6500	:	6480			
6600	:	6580			
6650	:	6630			
6700	:	7090			
6790	:	6720			
6840	:	6810			
6870	:	6840			
6890	:	6800	6830	6860	6870
6950	:	6900			
6980	:	6910			
7050	:	6990			
7060	:	7070			
7470	:	7590	7600		

GOSUB KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA

4460	:	4394	4418	4448						
5050	:	7030	7040							
5100	:	3260	3820	6730	6930	7250				
5250	:	7000								
5320	:	1079	3340	3430	3510	7110				
5370	:	1103	1457							
5630	:	1370	6680							
5750	:	1121	1157	1217	1235	1262	1280	1298	1307	1325
		3360	3450	3610	4464					
5970	:	0241								
6060	:	1190	3630	7160						
6130	:	1436	3870	7310						
6510	:	6310								
6670	:	1373	1509	3390	3480	3780	7220			
7100	:	3210								
7360	:	1028	1379	3800	7230					

```
################################################################################
T A S K O == BASIC-SYSTEM                                 9/ 9/1982 13: 5 SEITE  27
################################################################################

  VARIABLEN KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA
  ========================================================

  A      :  0006  1115  1118  1124  1136  1148  1151  1154  1160  1163
            1208  1211  1214  1220  1229  1232  1244  1247  1250  1253
            1256  1259  1268  1271  1274  1277  1283  1286  1295  1301
            1304  1310  1313  1322  1328  1331  1346  1349  1352  1385
            1394  1397  1400  1403  1415  4362  4368  4374  4380  4381
            4386  4388  4390  4391  4392  4402  4404  4406  4408  4410
            4412  4414  4415  4416  4430  4432  4434  4436  4438  4440
            4442  4444  4445  4446  4462  5060  5070  5120  5130  5220
            5380  5390  5400  5410  5420  5430  5440  5450  5460  5470
            5480  5490  5500  5510  5520  5530  5540  5550  5560  5570
            5580  5590  5600  5610  5870  5880  5882  5920  5930  6140
            6150  6180  6190  6210  6220  6230  6250  6270  6290  6310
            6330  6340  6370  6380  6400  6410  6420  6550  6570  6600
            6620  6650  7060  7070
  A0     :  1118  1124  1154  1160  1214  1223  1232  1238  1259  1265
            1277  1283  1289  1295  1301  1304  1310  1316  1322  1328
            3350  3370  3380  3440  3460  3470  3600  3650  3660  4462
            4466  5760  5770  5780  5830
  A1     :  0074  0077  0713  1220
  A2     :  0405  0411  0414  0450  0453  0459  0462  0466  6002
  B      :  0361  0364
  B1     :  0077  0725  1229
  B2     :  6540  6570  6580  6620  6630
  C      :  0007  0178  0181  0187  0190  0193  0196  0199  0202  0205
            0208  0211  0214  0217  0220  0226  0232  0238  5150  5300
            6040
  C0     :  0509  0520
  C1     :  1097  1127  1448  1451  5400
  C2     :  0173  1265
  C3     :  0174  1223  3440  3460  3470
  D0     :  0078  0653  0659  0665  1154  1232  3350
  D1     :  0079  0080  0683  0695  0701  1118  1214  3440  3600
  E      :  0007  0019  0022  0025  0028  0031  0034  0075  0076  0081
            0515  0516  0517  0644  0647  0650  0674  0677  0683  0689
            0692  0710  0713  0722  0725  0734  0737  0746  0749  0758
            0767  0776  0785  0791  0797  0803  0809  0815  0836  0839
            0845  0848  1268  1271  1277  1301  1358  1361  3600
  E1     :  0504  0872  1055  1085  1148  1208  1211  1346  3420  3440
            4010  4020  4030  4050  4060  4090  4190  4200  4250  4260
            4362  4368  4375  4381  4386  4402  4460
  E2     :  0505  0872  1058  1085  1208  1211  1346  1415  1503  1506
            3170  4460  4462  7120  7210
  E3     :  0517  0875  1061  1085  1115  1148  1208  1211  3330  3350
            4150  4190  4250
  E4     :  0506  0875  1064  1085  1133  1208  1211  1343
  F      :  1067  1073  1172  1196  1370  1373  1376  1388  1427  1445
            5730  5810
  G      :  0006  0043  0046  0049  0052  0055  0058  0061  0064  0067
            0070  0071  0072  0566  5660  5670
```

VARIABLEN KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA

H	:	0501	1184	1187	3580	6070	6080	6160	7140	7150	
I	:	0037	0447	0450	0453	0456	0520	0521	0524	0536	0539
		0542	0543	0563	0566	0569	0581	0584	0587	0590	0593
		0596	0614	0617	0620	0632	0635	0833	0836	0839	0842
		0845	0848	0851	0998	1001	1355	1358	1361	1364	1367
		1412	1415	1418	1421	1424	3550	3560	3570	3580	3590
		3760	3770	3840	3850	3860	3960	4040	5330	5340	5350
		6080	6090	6100	6110	6160	6170	6180	6200	6240	6250
		6260	6270	6290	6370	6380	6410	6450	6460	6470	6530
		6550	6560	6570	6590	6600	6610	6620	6640	6650	7200
		7210	7280	7290	7300						
I0	:	0124	5290	7010	7020	7390	7500	7520	7530		
I9	:	1193	1199	1202	1208	1211	1244	1247	1346	1382	1412
		1430									
J	:	0313	5260	5270	5290	5640	5650	5660	5670	5680	5710
		5720									
K	:	0322	0325	0328	0331	0444	0447	0450	0453	0459	0462
		0465	0827	0833	0839	0842	0845	0848	0890	0893	0896
		0899	0902	0905	0908	0923	0926	0929	0932	0935	0956
		0962	0965	0968	0971	0977	0998	1001	1010	1013	1032
		1034	1037	1040	1043	1046	1049	1052	1055	1058	1061
		1064	3250	3280	3290	3810	4180	4190	4200	4210	4240
		4250	4260	4270	5110	5120	5130	5140	5220	5230	5260
		5270	5290	5890	5900	5910	6280	6290	6300	6700	6710
		6720	6740	6750	6760	6770	6780	6790	6890	6900	6920
		6940	6950	6980	6990	7010	7020	7030	7040	7050	7240
		7260	7270	7280							
K0	:	0893	0920	0923	0956	1031					
K1	:	0950	0959								
K9	:	1031	1032	1469							
L	:	0827	0833	3700	3760	3770	3790	3840	3850	3890	
M	:	0006	0319	0340	0355	1382	1385	1403	1406	1424	1448
		3830	3840	7270	7290	7430	7470	7480	7490	7510	7540
		7560	7580	7600	7610						
M3	:	0508	0863	1040	1085	1448	3790	7120	7450	7510	7590
		7600									
N	:	6690	6800	6910	7080						
N0	:	7440	7510	7590	7610						
N1	:	0118	1448	1451							
N2	:	1076	1100								
N3	:	0121	1025	1028	1067	1427	1442				
N4	:	0878	1068	1439	3030	3080	3130	3180			
N5	:	1503	1506	3530	3550	3700	7120	7210	7240		
N6	:	0037	5280	5300							
N7	:	5980	5990	5995	6002	6004	6020	6030	6033		
N9	:	0507	0863	1037	1085	1184	1193	1199	1412	1436	1448
		3020	7130	7140	7200	7280	7290				
O	:	0010	0926	0932	0962	1034					
P	:	0006	0082	0084	0085	0088	0091	0094	0097	0100	0103

VARIABLEN KREUZREFERENZLISTE DES PROGRAMMES SACLAYDOKU.BA

		0106	0109	0112	0587	0590	0593	0647	0680	0689	0749
		1364	1506	3280	3370	3380	3460	3470	3650	3660	3670
		3680	3770	3825	7210	7260	7280				
Q	:	0007	5290	6710	6740	6750	6760	6770	6780	6810	6840
		6870	6900	6990	7010	7020					
R	:	0006	1223	1226	1238	1241	1265	1331	1334	1337	1340
		1343	1358	1364	1506	3370	3380	3460	3470	3640	3650
		3660	3670	3680	3770	5340	5650	5660	5670	5710	5720
		6720	6740	6780	6940	7210					
T	:	0010	0899	0902	0905	0968	0971	1001	1010	1013	1037
		1040	1043	1046	1049	1052	1055	1058	1061	1064	
U	:	0007	1334	1337	1340	1343	1349	1352	1382	1383	1385
		1418	1421	3540	3570	3580	3760	3770	3790	3840	3850
		3930	3940	3950	3960	3980	3990	4000	4010	4020	4030
		4050	4060	4090							
V	:	0006	0307	0310	0325	0328	0340				
W	:	0006	3280	3825	3830	3850	5110	5140	5220	5230	6740
		6940	7260	7270	7280						
W1	:	0073	0737	1250	1274						
X	:	1415	1418	1421	3850	6070	6090	6170	6450	6460	6550
		7280									
X1	:	0515	0866	1043	1085	1244					
X2	:	0502	0866	1046	1085	1244	1421	3070	7130	7210	
Y	:	1424	3840	6070	6100	6170	6180	6380	6550	7290	
Y1	:	0516	0869	1049	1085	1247	6380	6390	6430	6460	
Y2	:	0503	0869	1052	1085	1247	1418	3120			
B$	:	0007	0511	0512	0521	0533	0605	0608	0617	0629	0989
		0992	0995	0998	1001	1740	1744				
X$	:	0010	4340	4360	4366	4372	4378	4384	4400		
Y$	:	0007	0013	0016	0017	0509	0521	0617	0836	0839	0842
		0848									
Z$	:	0007	0551	1091							

```
##############################################################################
T A S K 0 == BASIC-SYSTEM                          9/ 9/1982 13:  6 SEITE  30
##############################################################################

  @OSUB LISTE DES PROGRAMMES SACLAYDOKU.BA
  ========================================

   4460  :  ____________________________________________________________

   5050  :  PAUSE, CA 1-2 SEC

   5100  :  CONVERSION FOR BCD- ANGLE ENCODERS INPUT:K, OUTPUT:W(K)

   5250  :  PREWARN SWITCHES

   5320  :  SKIP OF MOTORS, R(I)=1000

   5370  :  DATE AFTER C1 SEC., INPUT C1

   5630  :  CHECK WETHER R(J) IS WITHIN THE SOFTWARE LIMITS

   5750  :  CALCULATION ASIN:  I/O= A0/A0

   5970  :  INTERRUPT OF END-SWITCHES

   6060  :  FIELD X(I),Y(I)=0

   6130  :  PLOT

   6510  :  TELEVISION PLOT

   6670  :  POSITIONING OF MOTORS

   7100  :  ROCKINGSCAN OF MOTORS

   7360  :  MONITOR -- RETURN ONLY IF M(0)=M3
```

Appendix IV: Error messages

******* I / O E R R O S *******

```
  0 ILLEGAL CHANNEL
 -1 ILLEGAL FILE NUMBER
 -2 ILLEGAL SYSTEM COMMAND
 -3 ILLEGAL COMMAND FOR DEVICE
 -4 NOT A SAVED FILE
 -5 FILE ALREADY EXISTS
 -6 END OF FILE
 -7 READ-PROTECTED FILE
 -8 WRITE-PROTECTED FILE
 -9 FILE ALREADY EXISTS
-10 FILE NOT FOUND
-11 PERMANENT FILE
-12 ATTRIBUTES PROTECTED
-13 FILE NOT OPENED
-14 SWAPPING DISK ERROR - PROGRAMM LOST
-15
-16
-17 UFT IN USE
-18 LINE LIMIT
-19 IMAGE NOT FOUND
-20 PARITY
-21 PUSH LIMIT
-22 STORAGE OVERFLOW
-23 NO FILE SPACE
-24 READ ERROR
-25 SELECT STATUS
-26 START ADRESS
-27 STORAGE PROTECT
-28
-29 DIFFERENT DIRECTORIES
-30 DEVICE NAME
-31 OVERLAY NUMBER
-32 OVERLAY FILE ATTRIBUT
-33 SET TIME
-34 NO TCB'S
-35
-36 SQUASH FILE
-37 DEVICE ALREADY EXISTS
-38 INSUFFICIENT CONTIGUOUS BLOCKS
-39 QTY
-40 TASK QUEUE TABLE
-41 NO MORE DCB'S
-42 DIR SPECIFIER
-43 DIR SPECIFIER
-44 DIR TOO SMALL
-45 DIR DEPTH
-46 DIR IN USE
-47 LINK DEPTH
-48 FILE IN USE
-49 TASK ID
```

-50 COMMON SIZE
-51 COMMON USAGE
-52 FILE POSITION
-53 DATA CHANAL MAP
-54 DIR NOT INITALIZED
-55 NO DEFAULT DIR
-56 FG ALREADY ACTIVE
-57 PARTITION SET
-58 INSUFFICIENT ARGUMENTS
-59 ATTRIBUTS
-60 NO DEBUG
-61 NO CONTINUATION ADRESS
-62 NO START ADRESS
-63 CHECKSUM
-64 NO SOURCE FILE
-65 NOT A COMMAND
-66 BLOCK TYPE
-67 NO FILES MATCH
-68 PHASE
-69 EXCESS ARGUMENTS
-70
-71
-72
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---- STANDARD - ERRORS ---

```
 0 ARITHMETIC OPERATORS IN ILLEGAL COMBINATION
 1 INVALID CHARACTER
 2 SYNTAX
 3 [MAT] READ/DATA TYPES INCONSISTENT
 4 INTERNAL SYSTEM FAULT
 5 INVALID STATEMENT NUMBER
 6 ATTEMPT TO DEFINE MORE THAN 93 VARIABLES
 7 ILLEGAL COMMAND (FROM A FILE)
 8 PAGE OR TAB SPECIFICATION ILLEGAL
 9 ILLEGAL RESERVED FILE NAME
10 RESERVED FILE IN USE
11 PARENTHESES NOT PAIRED
12 ILLEGAL COMMAND
13 STATEMENT NUMBER MISSING
14 INSUFFICIENT STORAGE TO ENTER STATEMENT
15 UNSATISFIED [MAT] READ
16 ARITHM. OVERFLOW, UNDERFLOW OR DIVIDE BY ZERO
17 UNDEFINED VARIABLE
18 GOSUB NESTING LIMIT
19 RETURN - NO GOSUB
20 FOR NESTING LIMIT
21 FOR - NO NEXT
22 NEXT - NO FOR
23 INSUFF. STORAGE FOR A VARIABLE OR AN ARRAY
24 LINE NUMBER MISSING
25 MAT  OR  PRU  NOT IN SYSTEM
26 INSUFFICIENT STORAGE TO LOAD SAVE-FILE
27 INVALID FILE REFERENCE
28 ARRAY EXCEEDS INITIAL DIMENSION
29 EXPRESSION TO COMPLEX FOR EVALUATION
30 INVALID FILE MODE
31 SUBSCRIPT EXCEEDS DIMENSION
32 UNDEFINED USER FUNCTION
33 FUNCTION NESTING LIMIT
34 FUNCTION ARGUMENT
35 ILLEGAL EDIT MASK
36 PRINT LINE GREATER THAN PAGE WIDTH
37 USER SUBROUTINE (SBRTB) NOT FOUND
38 UNDIMENSIONED STRING
39 REDUNDANT MATRIX SPECIFICATION
40 MATRICES UNEQUAL SIZE
41 MATRIX HAS ONLY ONE DIMENSION
42 FILE ALREADY OPEN
43 MATRIX NOT SQUARED
44 FILE NOT OPEN
45 NOT A SAVE-FILE
46 INCORRECT RESPONSE TO [MAT] INPUT
47 FILE OPENED IN WRONG MODE
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77 SOS - POWER-FAIL
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91
92
93
94
95
96
97
98 GERAET BELEGT (MULTI-USER-BASIC)
99 INTERRUPTSYSSTEM KAPUTT
```

--- EINZELBIT- INTERRUPTS --

```
600 I* GRUPPE 0-127 BIT 0    1->0 UEBERGANG
601 I* GRUPPE 0-127 BIT 1    1->0 UEBERGANG
602 I* GRUPPE 0-127 BIT 2    1->0 UEBERGANG
603 I* GRUPPE 0-127 BIT 3    1->0 UEBERGANG
604 I* GRUPPE 0-127 BIT 4    1->0 UEBERGANG
605 I* GRUPPE 0-127 BIT 5    1->0 UEBERGANG
606 I* GRUPPE 0-127 BIT 6    1->0 UEBERGANG
607 I* GRUPPE 0-127 BIT 7    1->0 UEBERGANG
608 I* GRUPPE 0-127 BIT 8    1->0 UEBERGANG
609 I* GRUPPE 0-127 BIT 9    1->0 UEBERGANG
610 I* GRUPPE 0-127 BIT 10   1->0 UEBERGANG
611 I* GRUPPE 0-127 BIT 11   1->0 UEBERGANG
612 I* GRUPPE 0-127 BIT 12   1->0 UEBERGANG
613 I* GRUPPE 0-127 BIT 13   1->0 UEBERGANG
614 I* GRUPPE 0-127 BIT 14   1->0 UEBERGANG
615 I* GRUPPE 0-127 BIT 15   1->0 UEBERGANG
616
617 E* ADRESSE ZU GROSS
618 E* UNBEKANNTER IT
619 I* EINZELINTERRUPT
620 I* GRUPPE 0-127 BIT 0    0->1 UEBERGANG
621 I* GRUPPE 0-127 BIT 1    0->1 UEBERGANG
622 I* GRUPPE 0-127 BIT 2    0->1 UEBERGANG
623 I* GRUPPE 0-127 BIT 3    0->1 UEBERGANG
624 I* GRUPPE 0-127 BIT 4    0->1 UEBERGANG
625 I* GRUPPE 0-127 BIT 5    0->1 UEBERGANG
626 I* GRUPPE 0-127 BIT 6    0->1 UEBERGANG
627 I* GRUPPE 0-127 BIT 7    0->1 UEBERGANG
628 I* GRUPPE 0-127 BIT 8    0->1 UEBERGANG
629 I* GRUPPE 0-127 BIT 9    0->1 UEBERGANG
630 I* GRUPPE 0-127 BIT 10   0->1 UEBERGANG
631 I* GRUPPE 0-127 BIT 11   0->1 UEBERGANG
632 I* GRUPPE 0-127 BIT 12   0->1 UEBERGANG
633 I* GRUPPE 0-127 BIT 13   0->1 UEBERGANG
634 I* GRUPPE 0-127 BIT 14   0->1 UEBERGANG
635
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640 I* GRUPPE 128 BIT 0    1->0 UEBERGANG
641 I* GRUPPE 128 BIT 1    1->0 UEBERGANG
642 I* GRUPPE 128 BIT 2    1->0 UEBERGANG
643 I* GRUPPE 128 BIT 3    1->0 UEBERGANG
644 I* GRUPPE 128 BIT 4    1->0 UEBERGANG
645 I* GRUPPE 128 BIT 5    1->0 UEBERGANG
646 I* GRUPPE 128 BIT 6    1->0 UEBERGANG
647 I* GRUPPE 128 BIT 7    1->0 UEBERGANG
648 I* GRUPPE 128 BIT 8    1->0 UEBERGANG
649 I* GRUPPE 128 BIT 9    1->0 UEBERGANG
```

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650 I* GRUPPE 128 BIT 10   1->0 UEBERGANG
651 I* GRUPPE 128 BIT 11   1->0 UEBERGANG
652 I* GRUPPE 128 BIT 12   1->0 UEBERGANG
653 I* GRUPPE 128 BIT 13   1->0 UEBERGANG
654 I* GRUPPE 128 BIT 14   1->0 UEBERGANG
655 I* GRUPPE 128 BIT 15   1->0 UEBERGANG
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660 I* GRUPPE 128 BIT 0    0->1 UEBERGANG
661 I* GRUPPE 128 BIT 1    0->1 UEBERGANG
662 I* GRUPPE 128 BIT 2    0->1 UEBERGANG
663 I* GRUPPE 128 BIT 3    0->1 UEBERGANG
664 I* GRUPPE 128 BIT 4    0->1 UEBERGANG
665 I* GRUPPE 128 BIT 5    0->1 UEBERGANG
666 I* GRUPPE 128 BIT 6    0->1 UEBERGANG
667 I* GRUPPE 128 BIT 7    0->1 UEBERGANG
668 I* GRUPPE 128 BIT 8    0->1 UEBERGANG
669 I* GRUPPE 128 BIT 9    0->1 UEBERGANG
670 I* GRUPPE 128 BIT 10   0->1 UEBERGANG
671 I* GRUPPE 128 BIT 11   0->1 UEBERGANG
672 I* GRUPPE 128 BIT 12   0->1 UEBERGANG
673 I* GRUPPE 128 BIT 13   0->1 UEBERGANG
674 I* GRUPPE 128 BIT 14   0->1 UEBERGANG
675 I* GRUPPE 128 BIT 15   0->1 UEBERGANG
676
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680 I* GRUPPE 129 BIT 0    1->0 UEBERGANG
681 I* GRUPPE 129 BIT 1    1->0 UEBERGANG
682 I* GRUPPE 129 BIT 2    1->0 UEBERGANG
683 I* GRUPPE 129 BIT 3    1->0 UEBERGANG
684 I* GRUPPE 129 BIT 4    1->0 UEBERGANG
685 I* GRUPPE 129 BIT 5    1->0 UEBERGANG
686 I* GRUPPE 129 BIT 6    1->0 UEBERGANG
687 I* GRUPPE 129 BIT 7    1->0 UEBERGANG
688 I* GRUPPE 129 BIT 9    1->0 UEBERGANG
689 I* GRUPPE 129 BIT 9    1->0 UEBERGANG
690 I* GRUPPE 129 BIT 10   1->0 UEBERGANG
691 I* GRUPPE 129 BIT 11   1->0 UEBERGANG
692 I* GRUPPE 129 BIT 12   1->0 UEBERGANG
693 I* GRUPPE 129 BIT 13   1->0 UEBERGANG
694 I* GRUPPE 129 BIT 14   1->0 UEBERGANG
695 I* GRUPPE 129 BIT 15   1->0 UEBERGANG
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700 I* GRUPPE 129 BIT 0    0->1 UEBERGANG
701 I* GRUPPE 129 BIT 1    0->1 UEBERGANG
702 I* GRUPPE 129 BIT 2    0->1 UEBERGANG
703 I* GRUPPE 129 BIT 3    0->1 UEBERGANG
704 I* GRUPPE 129 BIT 4    0->1 UEBERGANG
705 I* GRUPPE 129 BIT 5    0->1 UEBERGANG
706 I* GRUPPE 129 BIT 6    0->1 UEBERGANG
707 I* GRUPPE 129 BIT 7    0->1 UEBERGANG
708 I* GRUPPE 129 BIT 8    0->1 UEBERGANG
709 I* GRUPPE 129 BIT 9    0->1 UEBERGANG
710 I* GRUPPE 129 BIT 10   0->1 UEBERGANG
711 I* GRUPPE 129 BIT 11   0->1 UEBERGANG
712 I* GRUPPE 129 BIT 12   0->1 UEBERGANG
713 I* GRUPPE 129 BIT 13   0->1 UEBERGANG
714 I* GRUPPE 129 BIT 14   0->1 UEBERGANG
715 I* GRUPPE 129 BIT 15   0->1 UEBERGANG
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720 I* GRUPPE 130 BIT 0    1 ->0 UEBERGANG
721 I* GRUPPE 130 BIT 1    1 ->0 UEBERGANG
722 I* GRUPPE 130 BIT 2    1->0 UEBERGANG
723 I* GRUPPE 130 BIT 3    1 ->0 UEBERGANG
724 I* GRUPPE 130 BIT 4    1->0 UEBERGANG
725 I* GRUPPE 130 BIT 5    1->0 UEBERGANG
726 I* GRUPPE 130 BIT 6    1->0 UEBERGANG
727 I* GRUPPE 130 BIT 7    1 ->0 UEBERGANG
728 I* GRUPPE 130 BIT 8    1->0 UEBERGANG
729 I* GRUPPE 130 BIT 9    1->0 UEBERGANG
730 I* GRUPPE 130 BIT 10   1->0 UEBERGANG
731 I* GRUPPE 130 BIT 11   1->0 UEBERGANG
732 I* GRUPPE 130 BIT 12   1->0 UEBERGANG
733 I* GRUPPE 130 BIT 13   1->0 UEBERGANG
734 I* GRUPPE 130 BIT 14   1 ->0 UEBERGANG
735 I* GRUPPE 130 BIT 15   1->0 UEBERGANG
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740 I* GRUPPE 130 BIT 0    0 ->1 UEBERGANG
741 I* GRUPPE 130 BIT 1    0 ->1 UEBERGANG
742 I* GRUPPE 130 BIT 2    0->1 UEBERGANG
743 I* GRUPPE 130 BIT 3    0 ->1 UEBERGANG
744 I* GRUPPE 130 BIT 4    0->1 UEBERGANG
745 I* GRUPPE 130 BIT 5    0->1 UEBERGANG
746 I* GRUPPE 130 BIT 6    0->1 UEBERGANG
747 I* GRUPPE 130 BIT 7    0->1 UEBERGANG
748 I* GRUPPE 130 BIT 8    0 ->1 UEBERGANG
749 I* GRUPPE 130 BIT 9    0 ->1 UEBERGANG
```

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750 I* GRUPPE 130 BIT 10  0->1 UEBERGANG
751 I* GRUPPE 130 BIT 11  0->1 UEBERGANG
752 I* GRUPPE 130 BIT 12  0->1 UEBERGANG
753 I* GRUPPE 130 BIT 13  0->1 UEBERGANG
754 I* GRUPPE 130 BIT 14  0->1 UEBERGANG
755 I* GRUPPE 130 BIT 15  0->1 UEBERGANG
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