



Introduction to VITES

V irtual
I nstrumentation
T ool for the
E uropean
S pallation
S ource

Klaus Lieutenant

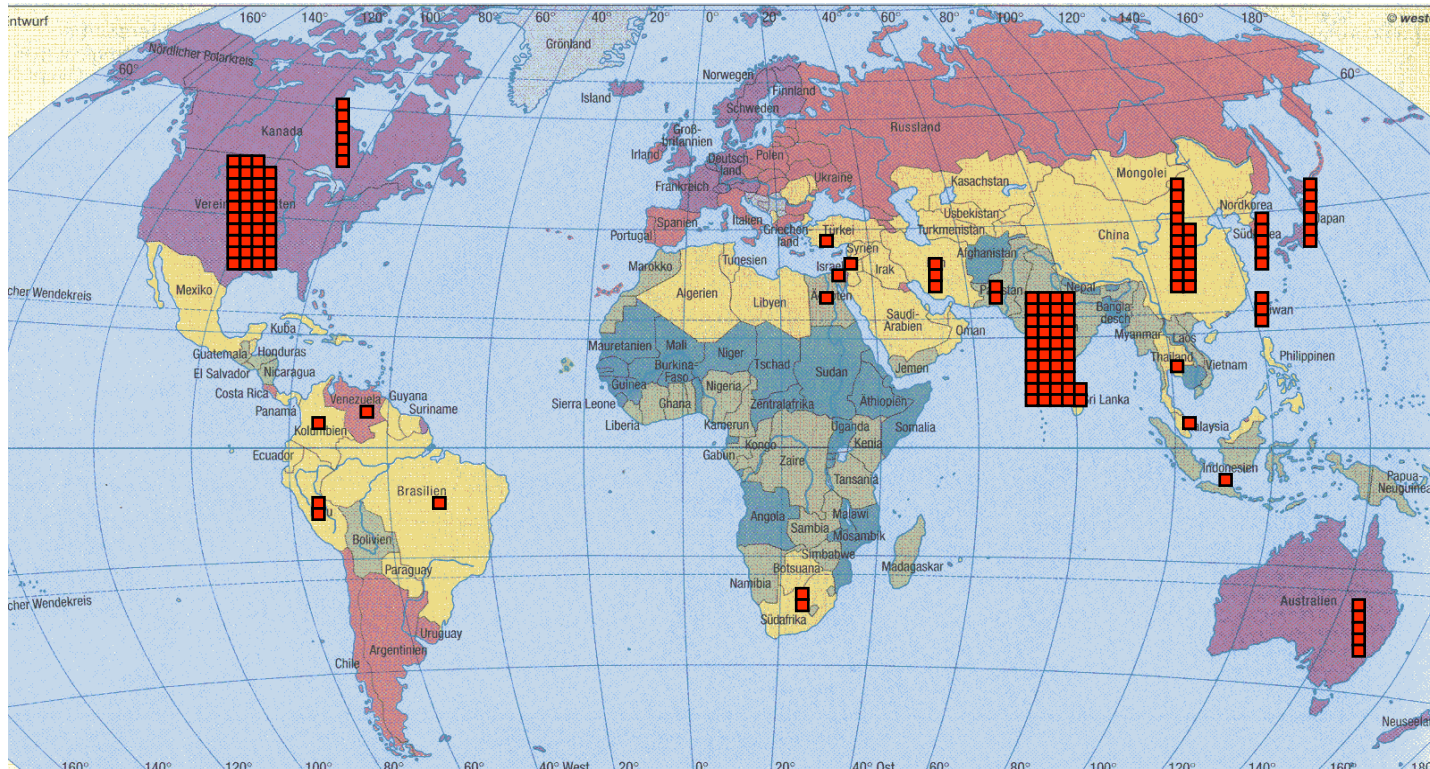
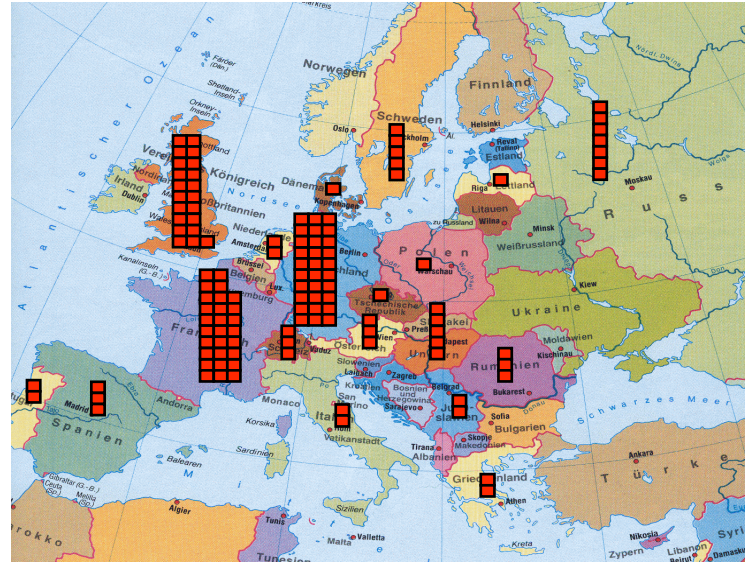
History of VITESS

Idea of Ferenc Mezei to realize a package to simulate all kinds of neutron scattering instruments especially on neutron spallation sources because of the European spallation source (ESS)

Important dates

- 1998: Some existing programs put together, GUI added
- 1999: Release of VITESS 1.0
First complete instruments simulated
- 2000: SCANS collaboration started (followed by MCNSI in FP6)
(McStas, VITESS, ...)
- 2001: Release of VITESS 2.0 containing polarisation, absolute flux values, improved GUI
Several ESS instruments simulated
- 2003: Decision: ESS will not be built in the near future
VITESS will be used for instruments on other sources
- 2005: VITESS group at HMI closed
- 2006: VITESS released under GNU license
larger developer team, all working only partly on VITESS
- 2008: Version 2.8 released
- 2009: Latest version 2.9 released

Distribution of Downloads in 2003



Present Status

Staff

Michael Fromme (HMI; GUI and release of new versions)

Sergey Manoshin (JINR; development of new modules)

Klaus Lieutenant (IFE; module development)

Andreas Houben (RWTH Aachen, module development)

Phillip Bentley (ANSTO; optimisation routine)

Geza Zsigmond (PSI; maintenance of his modules)

Program

Executables for Windows/DOS, Unix (SunOS: versions from 5.6, OSF1 V4.0) and Linux (versions from 2.0.35), Macintosh on demand

free of charge

Can be downloaded from internet address <http://www.helmholtz-berlin.de/vitess/>

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Erweiterte Suche Suche: In allen Bereichen Begriff eingeben, Enter drücken

HZB Hauptseite > Forschung > Großgeräte > Methoden und Instrumente der Neutronenstreuung > Projekte/Kooperationen > VITESS

Methoden und Instrumente der Neutronenstreuung

Virtual Instrumentation Tool for Neutron Scattering at Pulsed and Continuous Sources

VITESS is a virtual instrumentation tool for neutron scattering at pulsed and continuous sources. It is supported by a graphical user interface (GUI) which generates and controls command lines

according to the given input.

VITESS has been partly supported by the SCANS network (FP5) and was supported by the NM13-MCNSI Network (FP6) within the Research Infrastructures Activities of the Research and Technology Development Programme of the European Commission.

Concept of VITESS

A simulation comprises one or more modules co-working sequentially in a pipe:

- Each module processes and then passes neutron data to the following one.
- The first module is a neutron source module, or reads an old simulation output file.
- The last module should be set up to generate an output file, if simulation results are not shown otherwise.

VITESS has a comfortable modular structure consisting of independently executable program components (e.g. source, guide, chopper, polarizer, sample, focussing monochromator/analyser). Each module changes the neutron beam input and the output is a function of the parameters chosen for that respective module.

Vitess 2.9

- Windows Installer
20763453 byte, md5sum
3df0750d3a1c56e5
28ab1955650a417a
- Linux Tar-Ball
8770428 byte, md5sum
c01176bf9d138c03
0bf62357c4f0aa8d

Vitess 2.8

- Windows Installer
- Linux Tar-Ball

GUI after program start



Instrument 1 VITESS 2.9 Click parameter names for help!

input file Browse BrowseN

output file Browse BrowseN

parameter directory Browse NewDir

random seed random number generator min. neutron weight gravity

Check Start Kill Stop

Fresh Exit

Getting Help

You can get help about every

- parameter by clicking on its name (see also help for module)
- module by clicking on the module number or choosing the menu Help

Help

Alternatively, you can use the help system in the internet:
<http://www.hmi.de/projects/ess/vitess/DOC/index.html>

For further questions, please send an email to vitess@hmi.de

Getting Started Tutorial

Inserting/Deleting a Module Visualising Results

Big Clear Save

default parameter file directory has been set to K:/

GUI after loading an instrument

Xcontrol K:/

File Edit Configure Tools Options Help

Instrument EssSansS05 VITESS 2.9 Click parameter names for help!

Check Start Kill Stop

input file Browse BrowseN Fresh

output file no_file Browse BrowseN

parameter directory Y:/ESS/ESS_SANS_Frascati/ESF-1_S05-PulseLen Browse NewDir

random seed 1 random number generator ran3 min. neutron weight 1.0e-10 gravity off Exit

1 source_ESS_LPTS 2 guide 3 bender 4 guide 5 mon1_lambda 6 chopper_disc 7 mon1_divy 8 slit 9 chopper_disc 10 mon1_lambda

Module 2 guide

Shape and size of guide

horizontal shape constant vertical shape constant

guide shape Browse BrowseN Edit Plot Autc

entrance width [cm] 1 entrance height [cm] 1

exit width [cm] 1 exit height [cm] 1

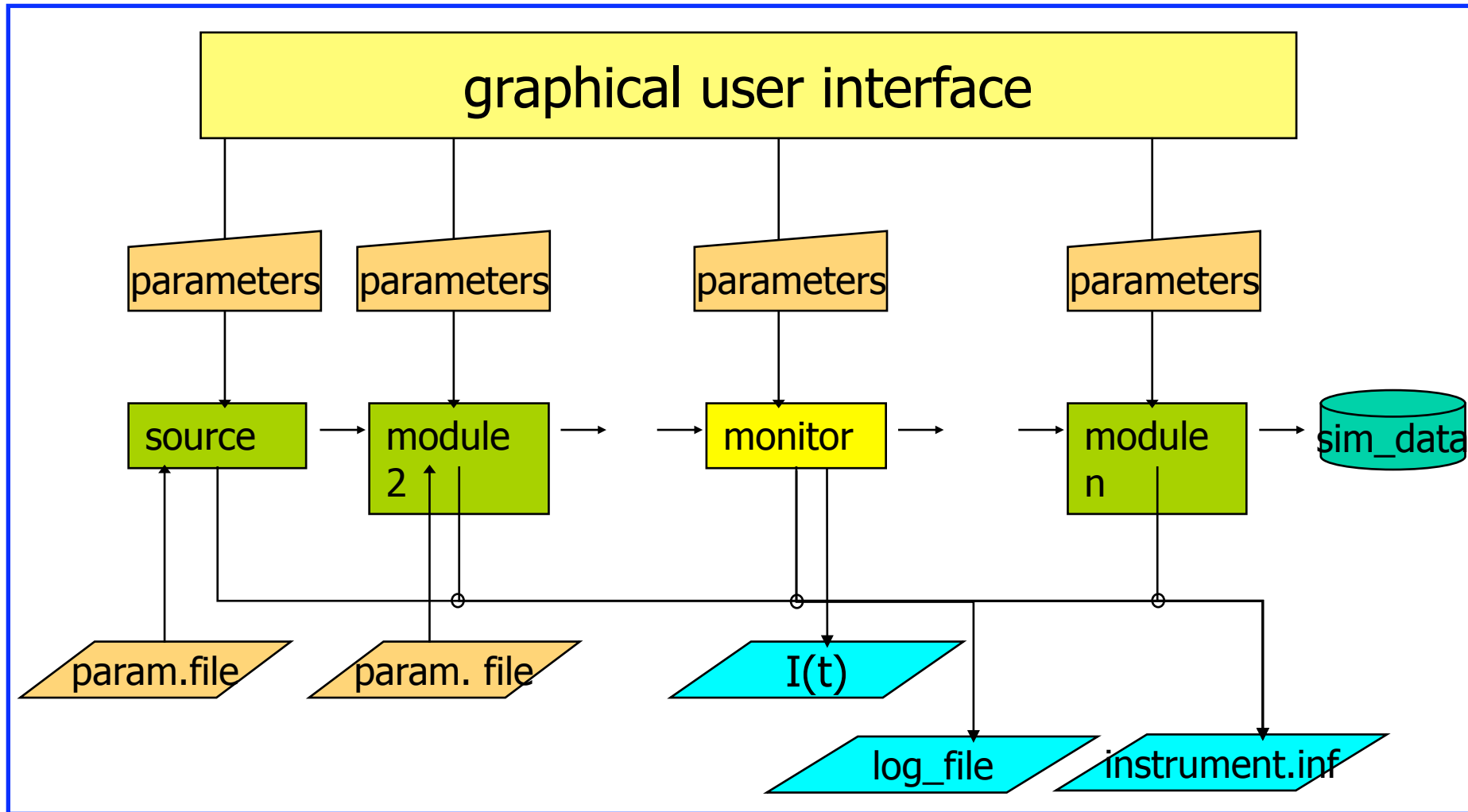
Guide characteristics

piece length [cm] 236 number of pieces 1

Big Clear Save

default parameter file directory has been set to K:/
--- control file Y:/ESS/ESS_SANS_Frascati/ESF-1_S05-PulseLen/EssSansS05.gui successfully loaded ---

Concept of VITESS



Parameter set transferred

Right-handed system

x: along the beamline

y: to the left

z: (vertically) up

ID

criterion 'ray tracing'

'colour'

Time of flight t [ms]

wavelength λ [Å]

count rate p [n/s]

location of neutron x [cm]

location of neutron y [cm]

location of neutron z [cm]

flight direction $v_x/|\underline{v}| = \cos \alpha$

flight direction $v_y/|\underline{v}| = \cos \beta$

flight direction $v_z/|\underline{v}| = \cos \gamma$

Spin P_x

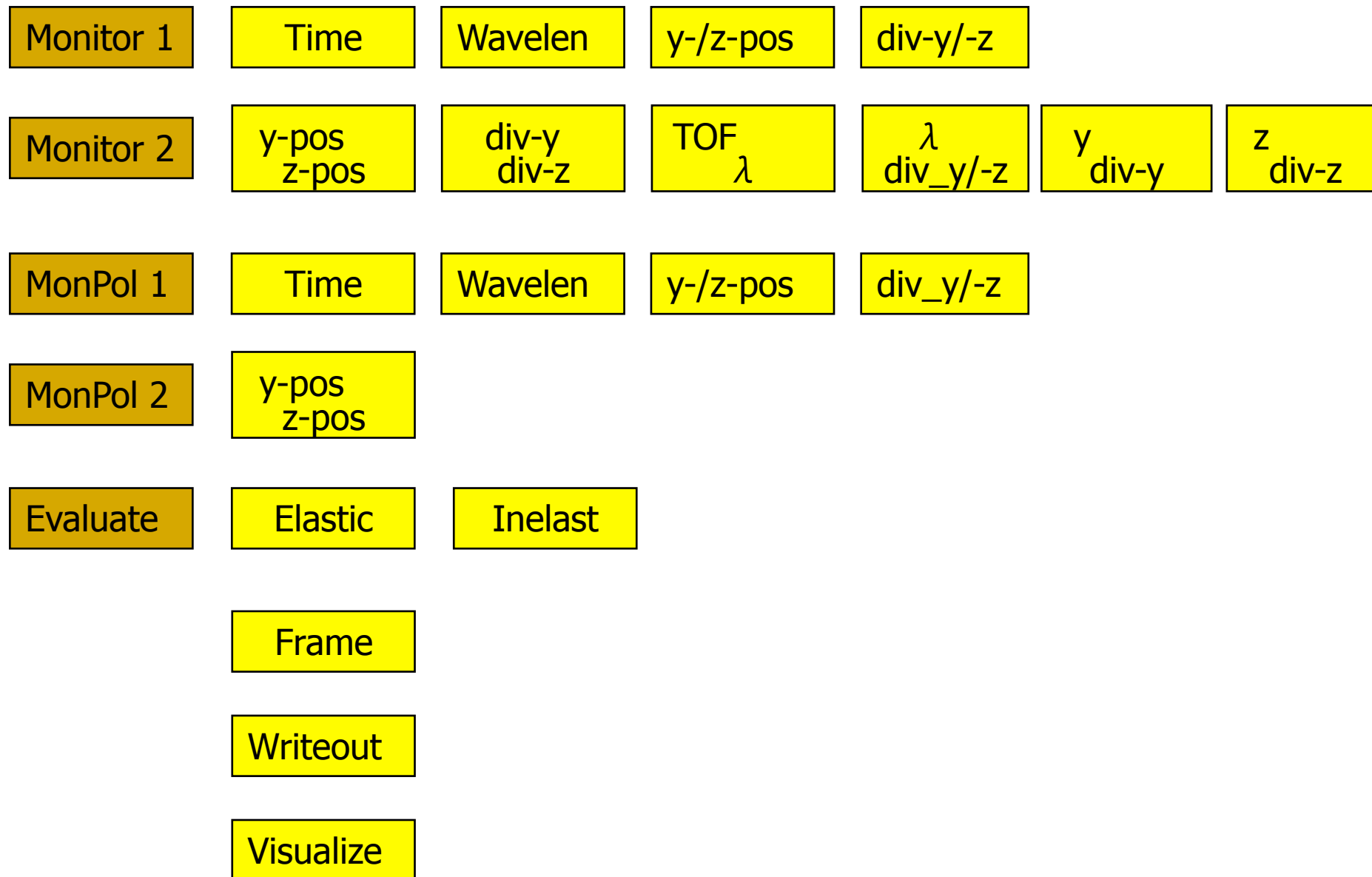
Spin P_y

Spin P_z

Modules representing Hardware

Sources	reactor	SPSS	LPSS		
Space + Windows	space	slit	window/beamstop	multiple windows	grid
Choppers	disk	Fermi str.	Fermi cur		
Mono/Ana	flat	focus	foc.user		
Modules f. Polaris.	³ He-pol.	coil flip.	prec.field	sesansfield	pol. mirror
	SM-polar.	grad.flip.	rot. field	res.Drabkin	
Samples	elast.isot.	powder	SANS	reflecto.	
	inelastic	sngl.crys.	S(Q)	environm	
Collimat.	coll.simpl	coll.soller	coll.radial		
	guide	bender	vel.select	SM-ensmbl	detector

Modules for Data Evaluation



Input Data: Parameter File

Edit IFEtherm.src

Moderator 1

shape

moderator diameter or width [cm] moderator height [cm] spatial order

center of moderator X [cm] center Y [cm] center Z [cm]

total flux at moderator [n/(cm*s)] neutron current [n/s]

user wavelength dist. file

moderator temperature [K] colour

Moderator 2

second moderator shape

moderator diameter or width [cm] moderator height [cm] spatial order

center of moderator X [cm] center Y [cm] center Z [cm]

total flux at moderator [n/(cm*s)] neutron current [n/s]

user wavelength dist. file

moderator temperature [K] colour

Output Data: Log File and Instrument Data

```

VITESS Output
Starting simulation
C:/Programme/VITESS_2_5_1/MODULES/source.exe -S1 --Z5 --G1 --U1.0e-25 --B10000
C:/Programme/VITESS_2_5_1/MODULES/guide.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/guide.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/velselect.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/monitor1.exe -k1 --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/guide.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/spacwindow.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/spacwindow.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/sample_sans.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/spacwindow.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/detector.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/mon2_pos.exe --Z5 --G1 --U1.0e-25 --B10000 --
C:/Programme/VITESS_2_5_1/MODULES/eval_elast.exe --Z5 --G1 --U1.0e-25 --B10000 --
simulation (f00 e80 1d0 104 f7c 33c ac fd4 1b0 2b4 25c fac a8c ) (3840 3712 46

.....

VITESS version 2.5 module Source and Window 1.11

> Simulation of constant wave source <

moderator temperature      : 45.000 K
total neutron flux (in 2*pi) : 3.0000e+013 n/(cm²s)
moderator position        :( 0.000 0.000 0.000) cm
moderator size (W x H)    : 7.500 cm x 7.000 cm
divergence defined by propagation window
time averaged neutron current: 1.6054e+011 n/s in 0.000640 str
wavelength band used      : 6.000 Ang - 10.000 Ang

window (W x H)            : 3.000 cm x 5.000 cm
in a distance of         : 1.530 m
with a declination of    : 0.000°
polarization              : 0.000 % X: 1.000 Y: 0.000 Z: 0.000
Center of beam at window : (153.000 0.000 0.000) cm
Average TOF               : 2.829 ms

Gravity is enabled
Cutoff probability per traj. : 1.000e-025

number of trajectories started : 22000000
1 number of trajectories read  : 0
number of trajectories written : 21999977
(time averaged) neutron count rate : 1.5724e+010 n/s
    
```

Small
Clear
Save

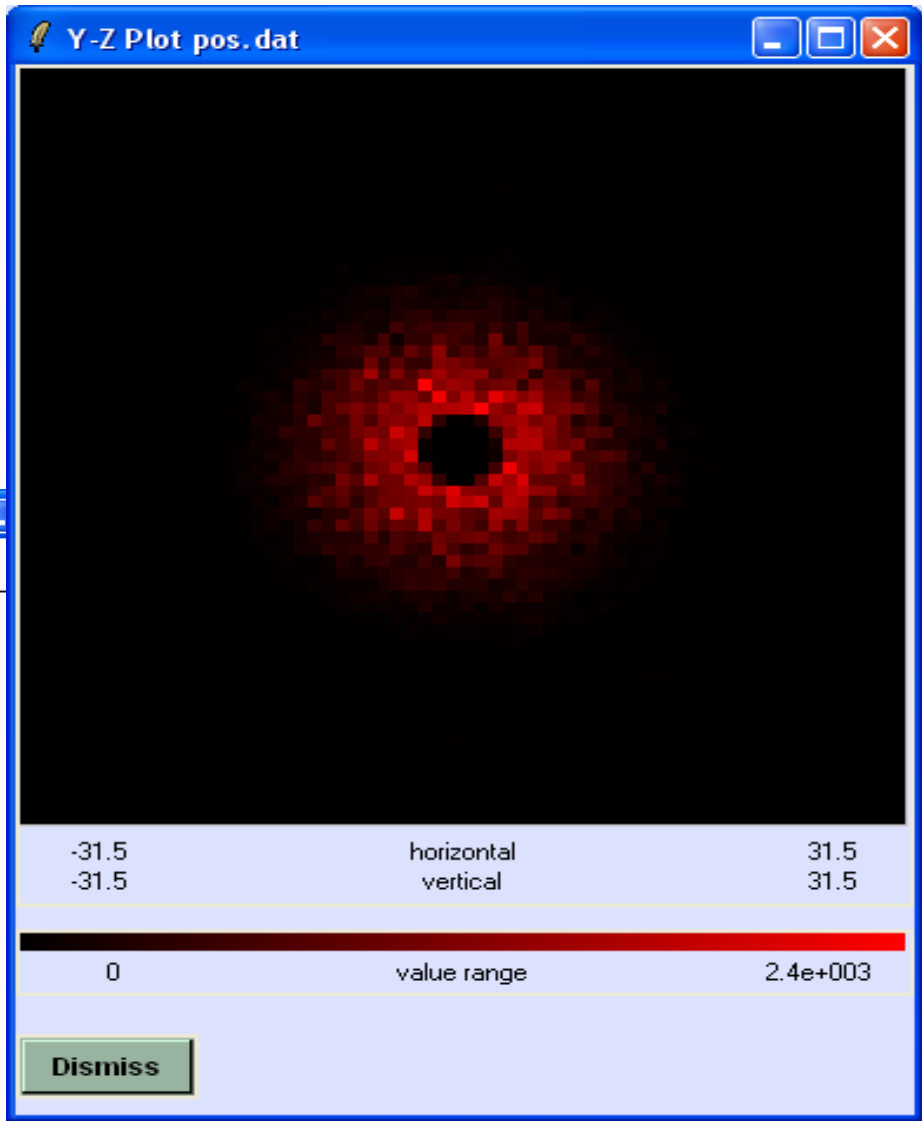
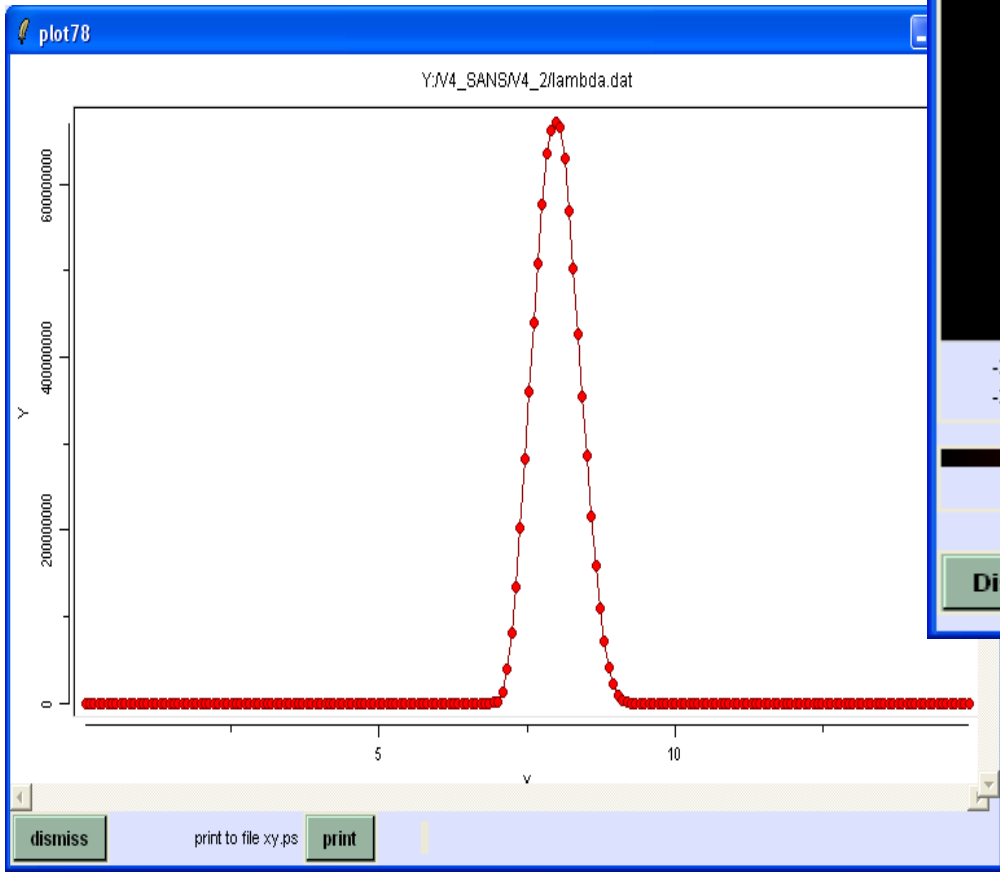
instrument.inf - Editor

Datei Bearbeiten Format Ansicht ?

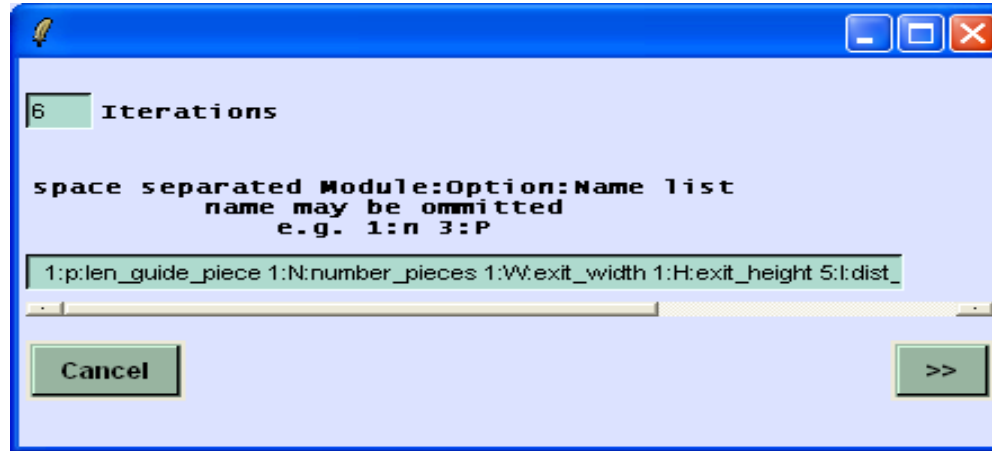
#	No	ID	module	len [m]	x [m]	y [m]	z [m]	hor. [deg]	ver.	W-Par.	H-Par.	R-Par.	number	type	Descrip
0	1		Source and window	0.000	0.000	0.000	0.000	0.000	0.000	7.5000e+000	0.0000e+000	0.0000e+000	1	1	45.0 K
1	1		Source and window	1.530	1.530	0.000	0.000	0.000	0.000	3.0000e+000	0.0000e+000	0.0000e+000	0	0	
2	11		guide	21.530	21.529	0.150	0.000	0.859	0.000	3.0000e+000	3.0000e+000	1.3000e+003	40	20	
3	11		guide	25.530	25.529	0.210	0.000	0.859	0.000	3.0000e+000	3.0000e+000	0.0000e+000	1	0	
4	41		velselect	25.780	25.779	0.214	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
5	101		monitor1	25.780	25.779	0.214	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	1	
6	11		guide	37.780	37.778	0.394	0.000	0.859	0.000	3.0000e+000	3.0000e+000	0.0000e+000	1	0	
7	21		Window	37.780	37.778	0.394	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
8	21		Window	41.780	41.778	0.454	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
9	87		sample_sans	41.790	41.788	0.454	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	2	
10	21		Window	45.740	45.738	0.513	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
11	71		detector	49.740	49.738	0.573	0.000	0.859	0.000	6.4000e+001	1.0000e+000	4.0000e+002	1	2	
12	102		mon2_pos	49.740	49.738	0.573	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
13	111		eval_elast	49.740	49.738	0.573	0.000	0.859	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	2	



Graphical output from Monitors



Generate Series



Generate Series

Name	len_guide_	number_pi	exit_width	exit_heigh	dist_orig_v	max_widht	max_heigh
Option	1:p	1:N	1:W	1:H	5:l	1:y	1:z
delta							
1.	150	3	4.878	7.956	500		
2.	150	2	5.403	8.848	650		
3.	125	6	3	5	200	76.14	75.72
4.	125	3	5.133	8.544	575	76.14	75.72
5.	375	2	3	5	200	75.31	73.50
6.	375	1	5.120	8.490	575	75.31	73.50

Parameter Directory: Y:\NLH2\Exed7

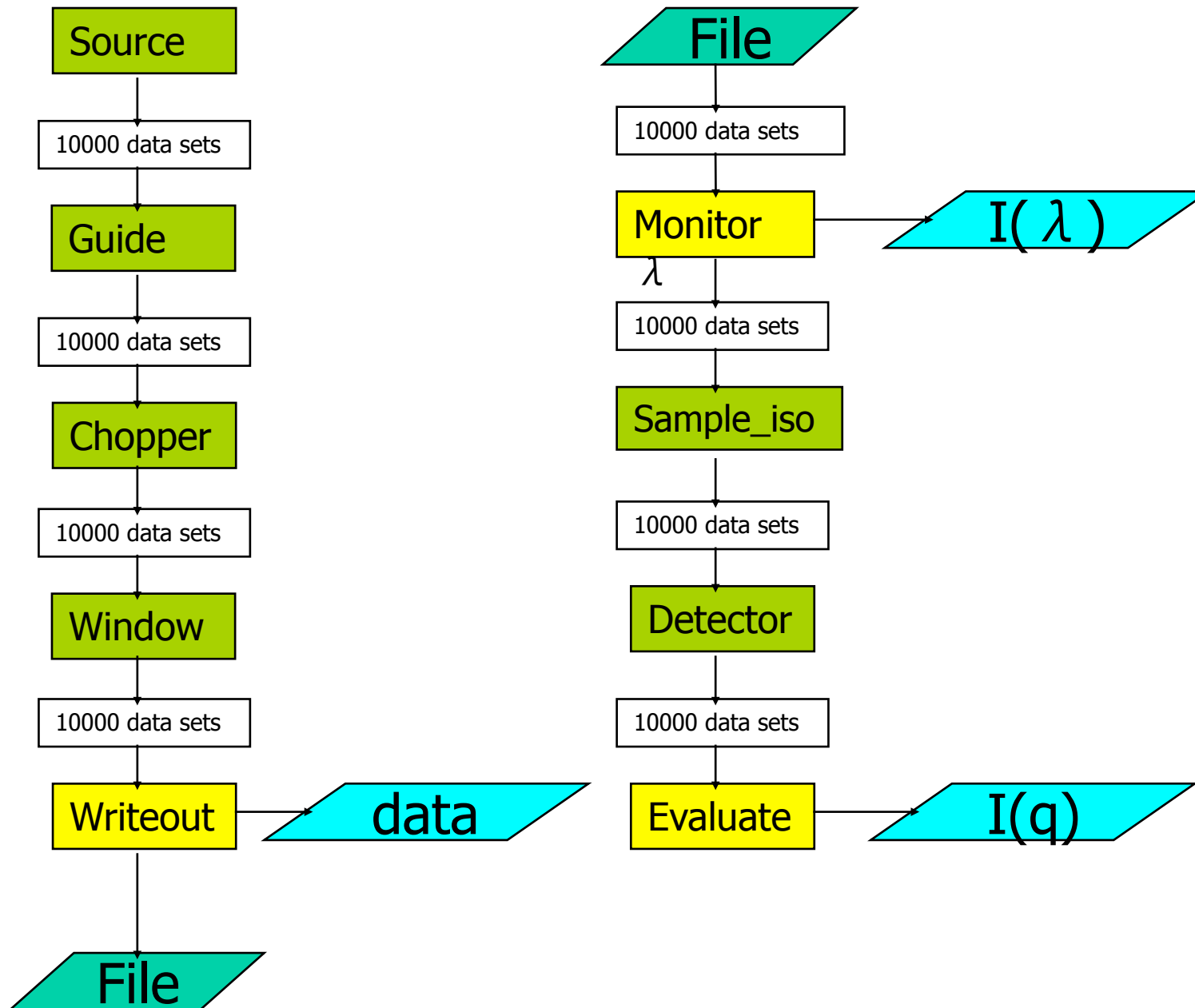
Files to be copied: sample.wdz sample.wdy sample.myz sample.mtl s

Copy Target Directory: Y:\NLH2\Exed7\NumPieces

<< Cancel Save Series Start Series



Splitting of the Simulation



- Most are used to calculate input data

AsciiToBinary

GenerMirrorFile

ChopPhases

DefineDirection

GenerSurfFile

ChopSystem

Direct View

StdDeviation

CrysAnalySpec

GenerateBatch

LatticeDist.

- Others to visualize output

DistTimePlot

VisualOutput



Computer Grids

File|‘Save as Grid Command’

saves the command line in a form that it can be used on computer clusters

Multi-core Processors

Ongoing development

Tests made for

Guide

Fermi chopper

supermirror ensemble

polariser supermirror

Support

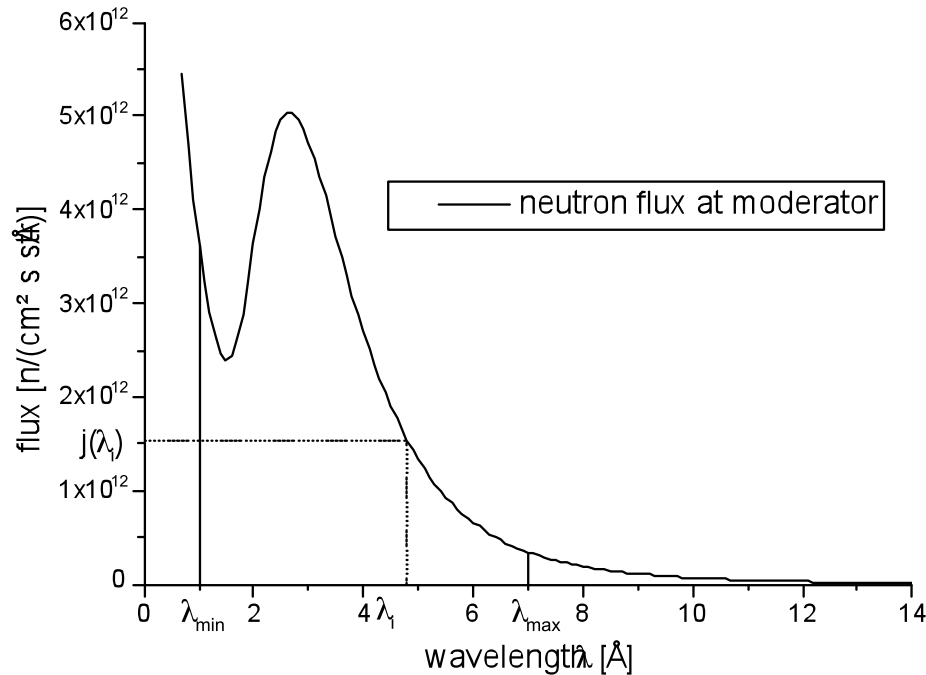
Address to Michael Fromme (fromme@helmholtz-berlin.de)

Thank you for your attention !





Absolute Flux Values



number of trajectories	200000		
min. wave-length [Å]	1.0	min. time [ms]	
		max. divergence x ↔ y [deg]	0.5
max. wave-length [Å]	7.0	max. time [ms]	
		max. divergence x ↔ z [deg]	0.5

- Each trajectory represents a package of a certain number of neutrons with the same starting conditions
- By statistical processes like reflection, the number of neutrons in the package decreases, while the number trajectories remains unchanged
- If the neutron package does not pass a module regularly, the trajectory is taken out of consideration
- A neutron count rate can be calculated from the number of neutrons in a package
- Summing of the count rates of all packages gives the neutron count rate at any point of the instrument

- $$I_{CW} = \int j(\lambda) d\lambda$$

$$\approx (\lambda_{max} - \lambda_{min}) / N \sum_i j(\lambda_i)$$
- $$I_{SS} \approx (\lambda_{max} - \lambda_{min})(t_{max} - t_{min}) / N \sum_j j(\lambda_j, t_j)$$