http://www.hmi.de/projects/ess/vitess/

- VITESS team
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Virtual Instrumentation Tool for the E S S

History of VITESS

- Origin
  - Idea of Ferenc Mezei to realize a package well suited to simulate instruments on neutron spallation sources, especially for the 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 (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 (TOF) instruments on other sources
  - 2004: VITESS supported by SCANS successor MCNSI
  - 2005: Collaborattion with McStas in VnCS
  - 2006: published under GNU public license

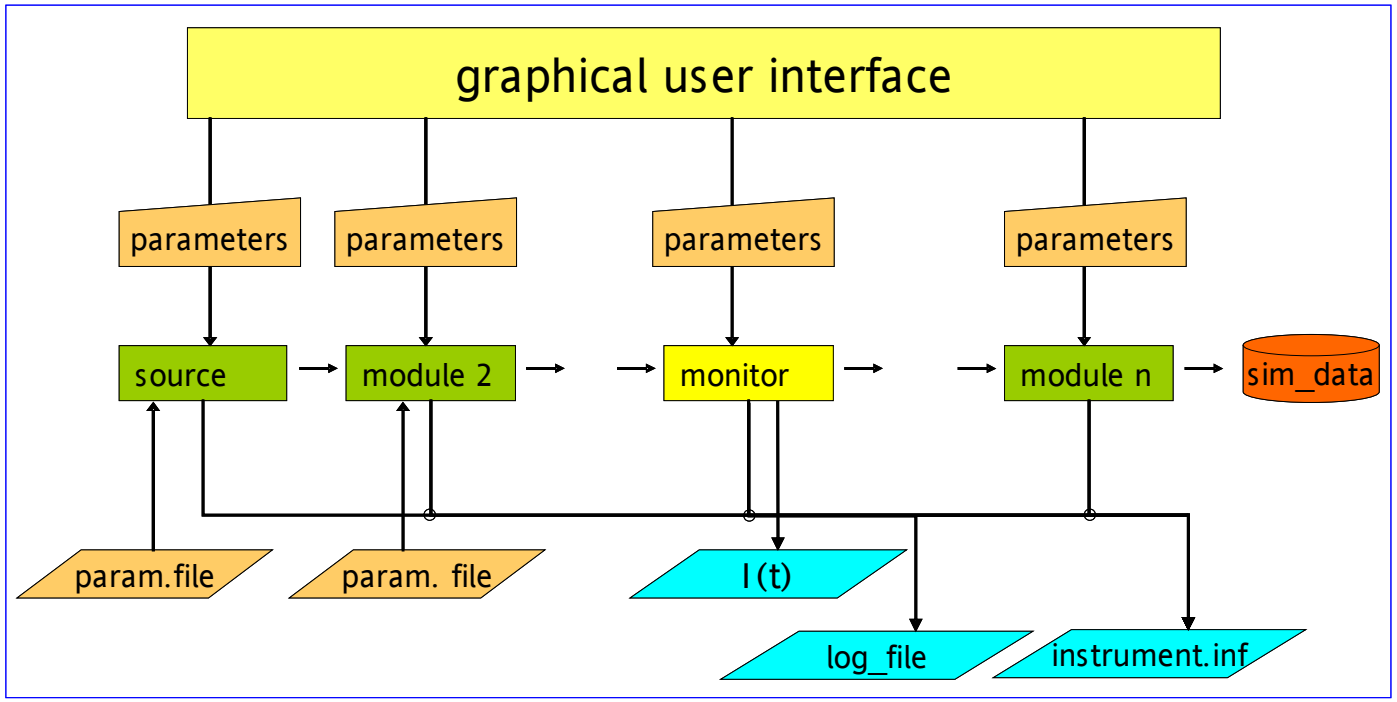
Some general features

- Staff
  - 9 persons from 6 different facilities in the development team
  - Open to new members
- Published under GNU public licence
  - Free of charge
  - Can be downloaded from internet
  - Code developed by a limited number of persons
- Program and platforms
  - Written in C
  - Executables for Windows/DOS, Linux 32 bit and 64 bit
  - Macintosh support on demand
- Version 2.7 currently under test
- A few hundred downloads
- Collaborations
  - Supported by European Commission in MCNSI
  - Collaboration with McStas in VnCS

Why using VITESS ?

- VITESS is easy to install
  - Download includes everything needed for simulations and basic visualisation
- VITESS is easy to use
  - Practically everything can be done from a graphical user interface
  - Simulation can be run without writing any code or using any meta-language
  - Components automatically positioned
  - Advanced users can write own modules or change existing ones
- VITESS has all essential features
  - TOF option (even on constant wave sources)
  - Many modules treating polarisation
  - Gravity is included
- VITESS is ideal for small projects (and powder diffraction)

Concept of Vitess

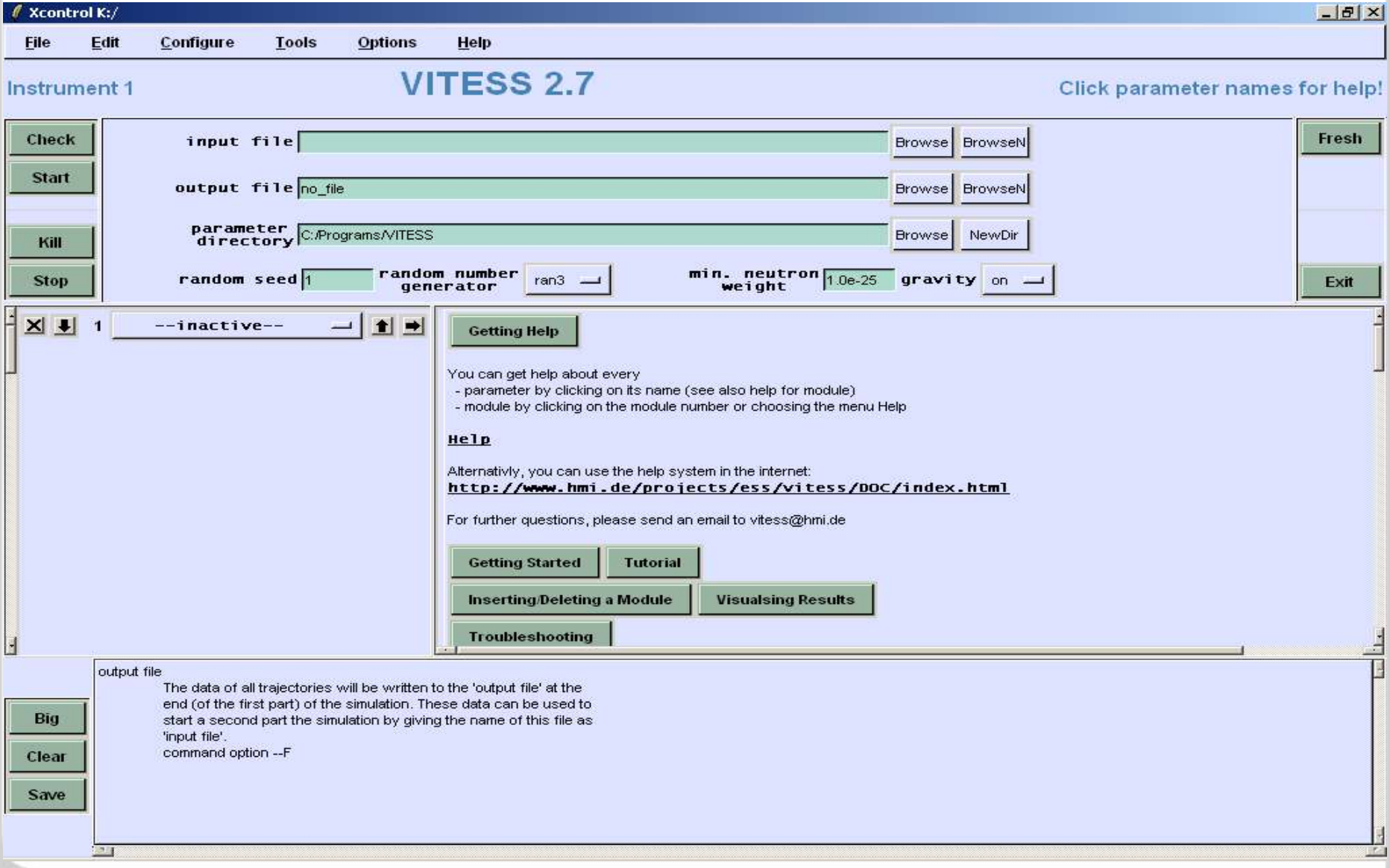


- Advantages of the piping concept:
  - No need of large memories
  - Shorter calculations times
  - Instrument can easily be split
- Challenges
  - Information about the whole instrument
  - Calculation of dependent parameters

Parameter set transferred

- criterion ‘ray tracing’
- ID
- Time of flight t [ms]
- wavelength λ [Å]
- probability/current p [n/s]
- location of neutron x [cm]
- location of neutron y [cm]
- location of neutron y [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 S_x
- Spin S_y
- Spin S_z

GUI after Starting the Program



Help

Module Source - Microsoft Internet Explorer

File Edit View Favorites Tools Help

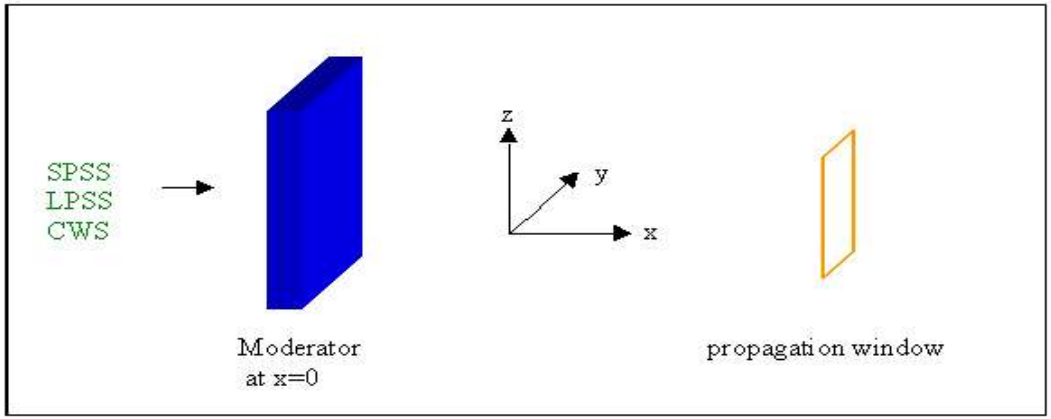
Back Search Favorites

Address K:\WWW\source.html Go Links

VITESS Module Source

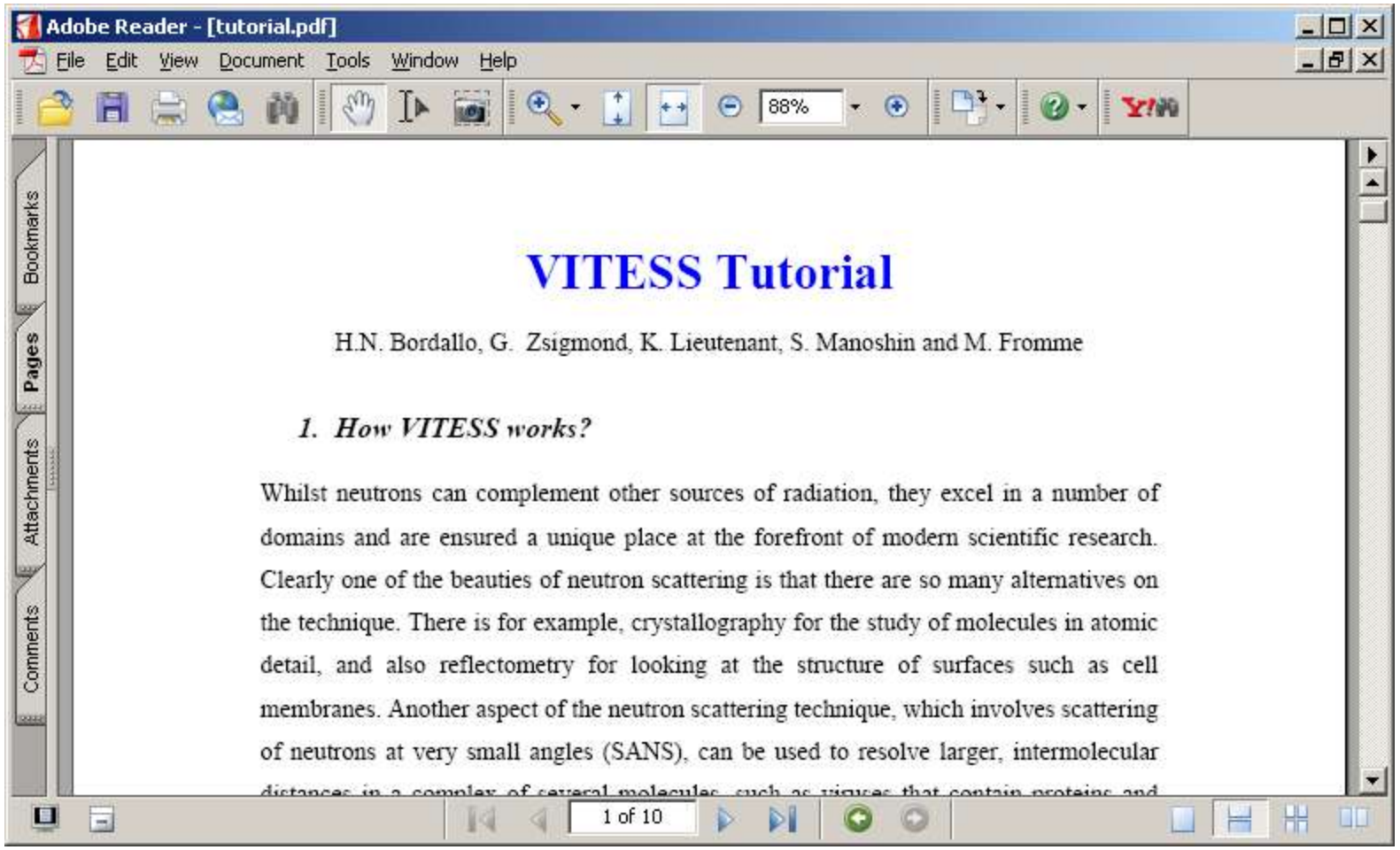
The module **source** initialises neutrons originated at a short pulsed (SPSS), long pulsed (LPSS), or a continuous source (CWS). Their starting positions are randomly distributed over a rectangular moderator surface. Further parameters like wavelength, divergence and time at the moderator are determined at random, too.

This module simulates also subsequent free propagation which can be limited in such a way, that only neutrons reaching a certain region of space are considered further on. The coordinate system is oriented as illustrated in the figure, it is centered in the middle of the moderator surface and shifted parallel to the x-axis to the position of the propagation window (i.e. the x-coordinate of each neutron which hit the propagation window is zero).



Done My Computer

Tutorial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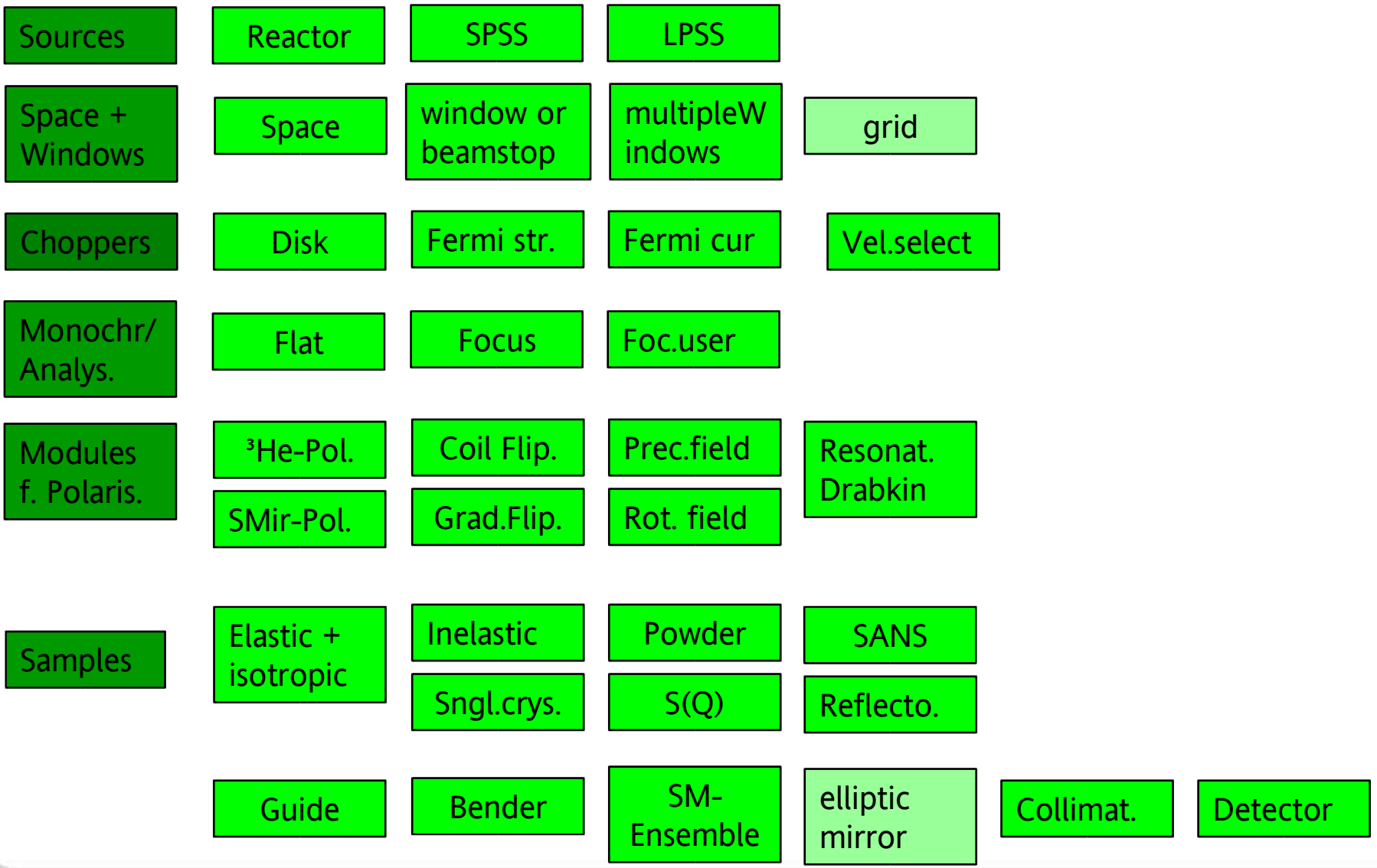
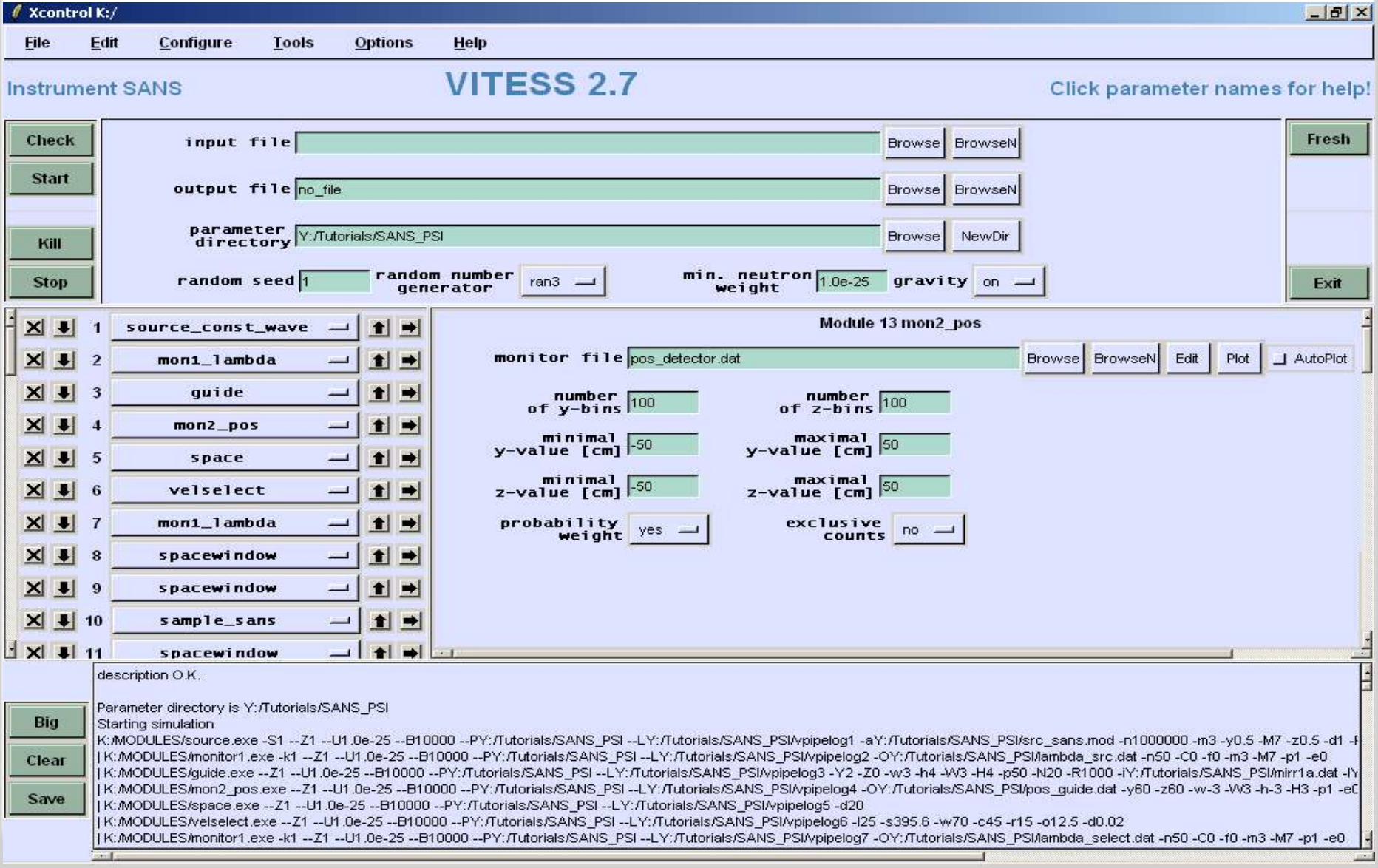
VITESS Tutorial
H.N. Bordallo, G. Zsigmond, K. Lieutenant, S. Manoshin and M. Fromme
1. How VITESS works?
Whilst neutrons can complement other sources of radiation, they excel in a number of domains and are ensured a unique place at the forefront of modern scientific research. Clearly one of the beauties of neutron scattering is that there are so many alternatives on the technique. There is for example, crystallography for the study of molecules in atomic detail, and also reflectometry for looking at the structure of surfaces such as cell membranes. Another aspect of the neutron scattering technique, which involves scattering of neutrons at very small angles (SANS), can be used to resolve larger, intermolecular
1 of 10

Modules representing Hardware

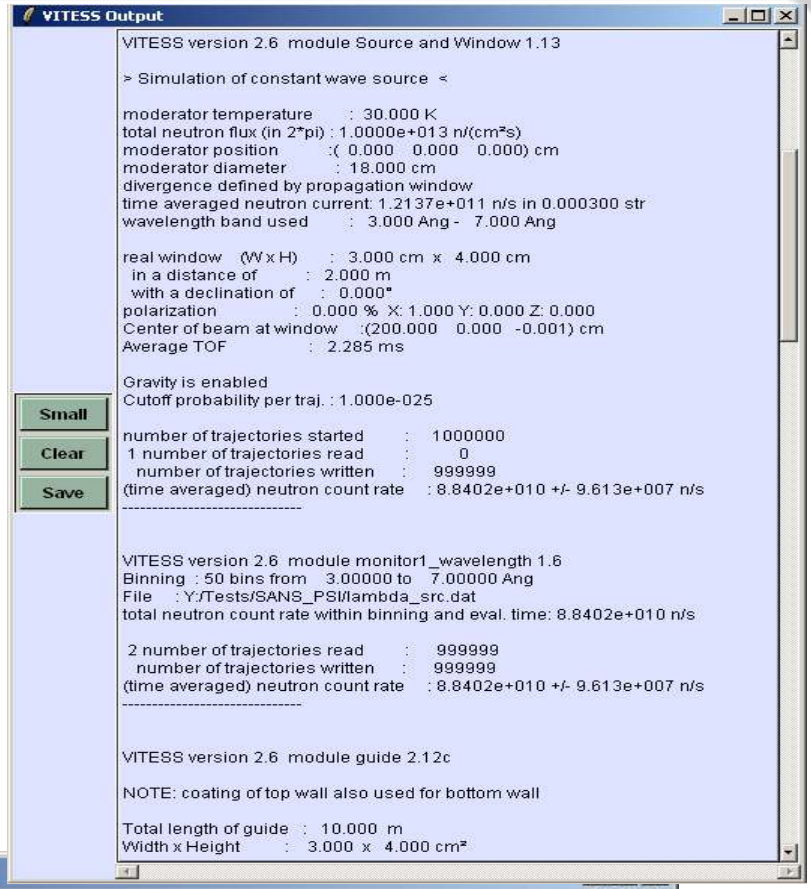


GUI after loading of an instrument



Output

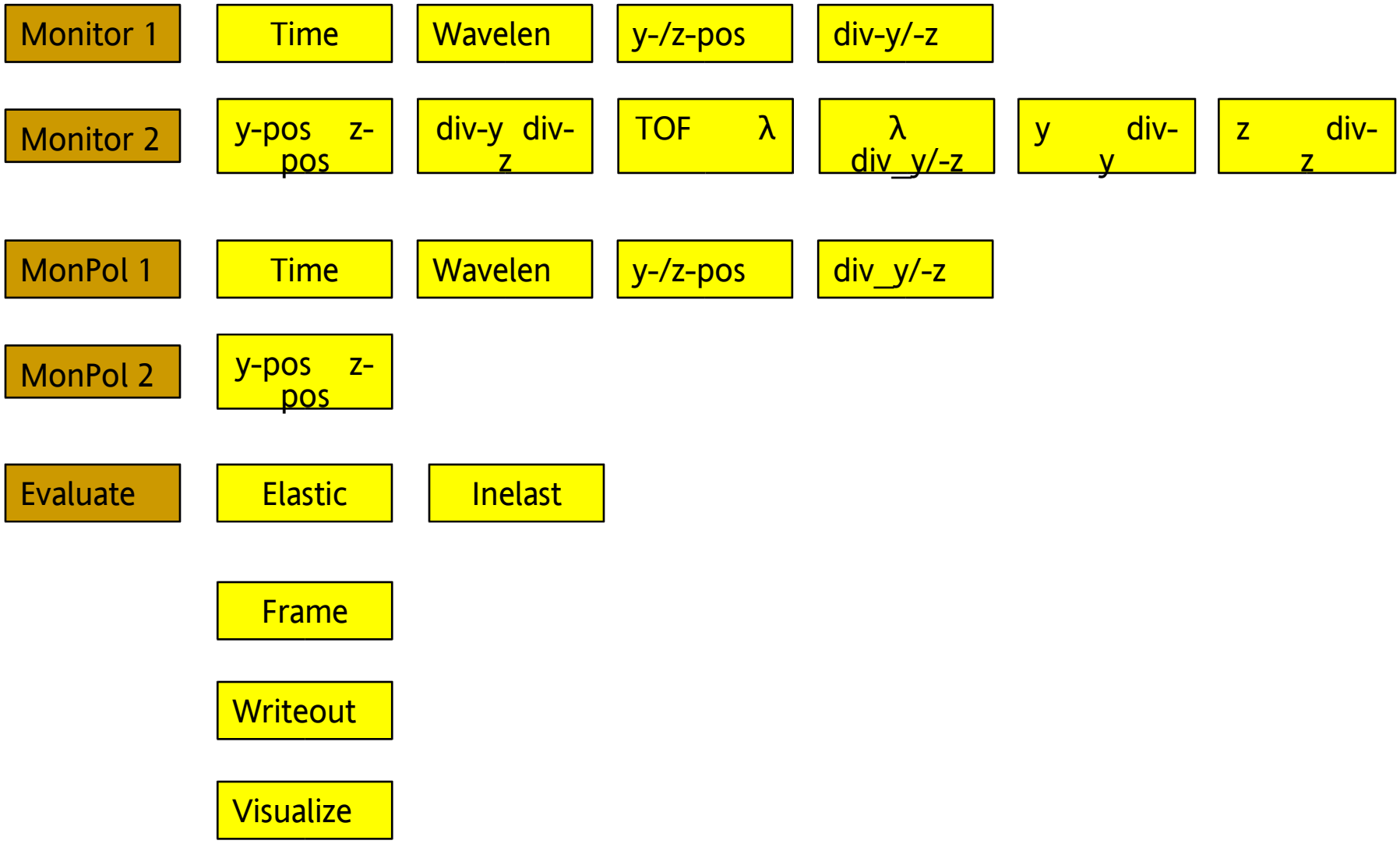
- Every module writes to log file and instrument file
- This output comes for free



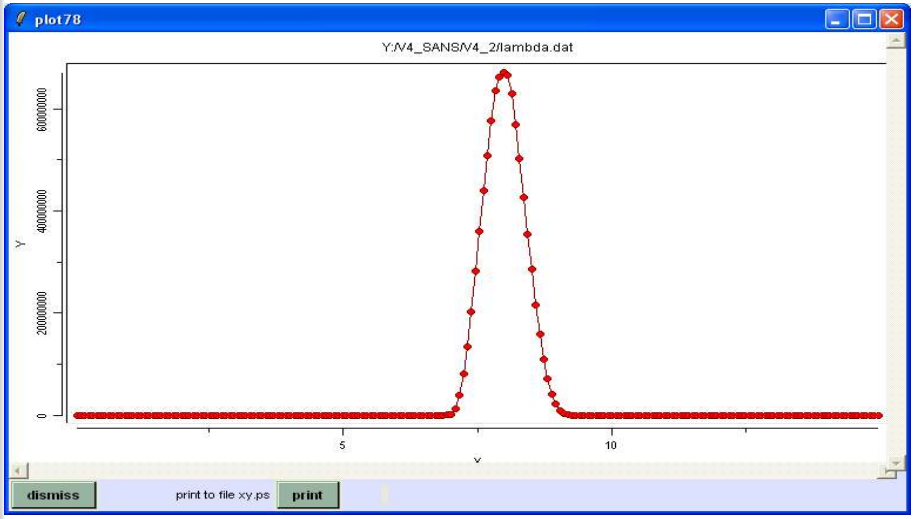
Edit Instrument File

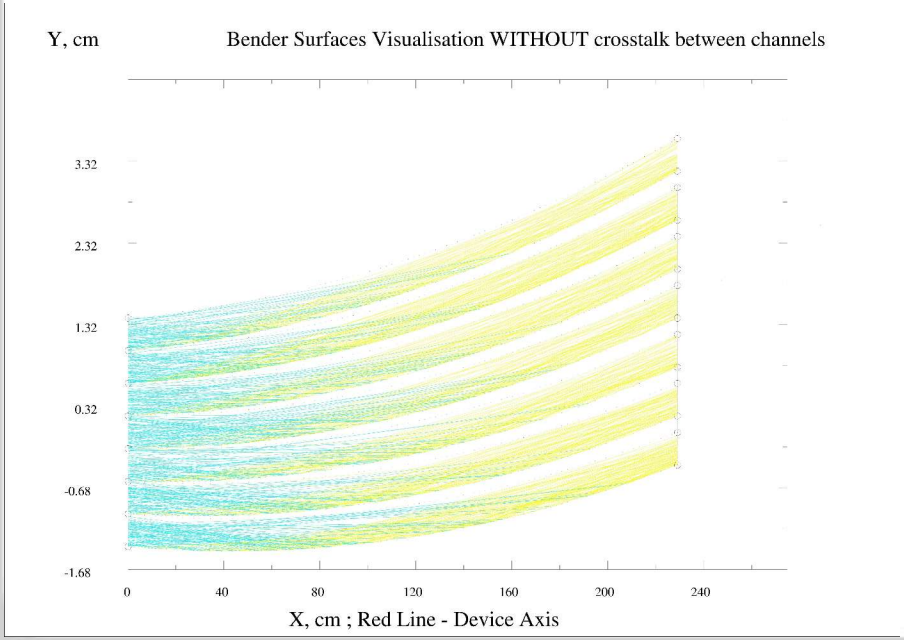
# No	ID	module	len [m]	x [m]	y [m]	z [m]	hor. [deg]	ver.	W-Par.	H-Par.	R-Par	number	type	Descr
0	1	Source and Window	0.000	0.000	0.000	0.000	0.000	0.000	1.8000e+001	0.0000e+000	0.0000e+000	1	1	30.0 K
1	1	Source and Window	2.000	2.000	0.000	0.000	0.000	0.000	3.0000e+000	0.0000e+000	0.0000e+000	0	0	
2	101	monitor1_wavelengt	2.000	2.000	0.000	0.000	0.000	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	1	
3	11	guide	12.000	12.000	0.047	0.000	0.544	0.000	3.0000e+000	3.0000e+000	1.0000e+003	20	20	
4	102	mon2_pos	12.000	12.000	0.047	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
5	20	Space	12.200	12.200	0.049	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
6	41	velselect	12.450	12.450	0.051	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
7	101	monitor1_wavelengt	12.450	12.450	0.051	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	1	
8	21	Window	12.450	12.450	0.051	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
9	21	Window	20.450	20.450	0.127	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
10	87	sample_sans	20.500	20.500	0.127	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	1	
11	21	Window	28.400	28.400	0.202	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000 F	1	0	
12	71	detector	28.500	28.500	0.203	0.000	0.544	0.000	1.0000e+002	1.0000e+000	8.0000e+002	1	2	
13	102	mon2_pos	28.500	28.500	0.203	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	0	
14	111	eval_elast	28.500	28.500	0.203	0.000	0.544	0.000	0.0000e+000	0.0000e+000	0.0000e+000	1	2	

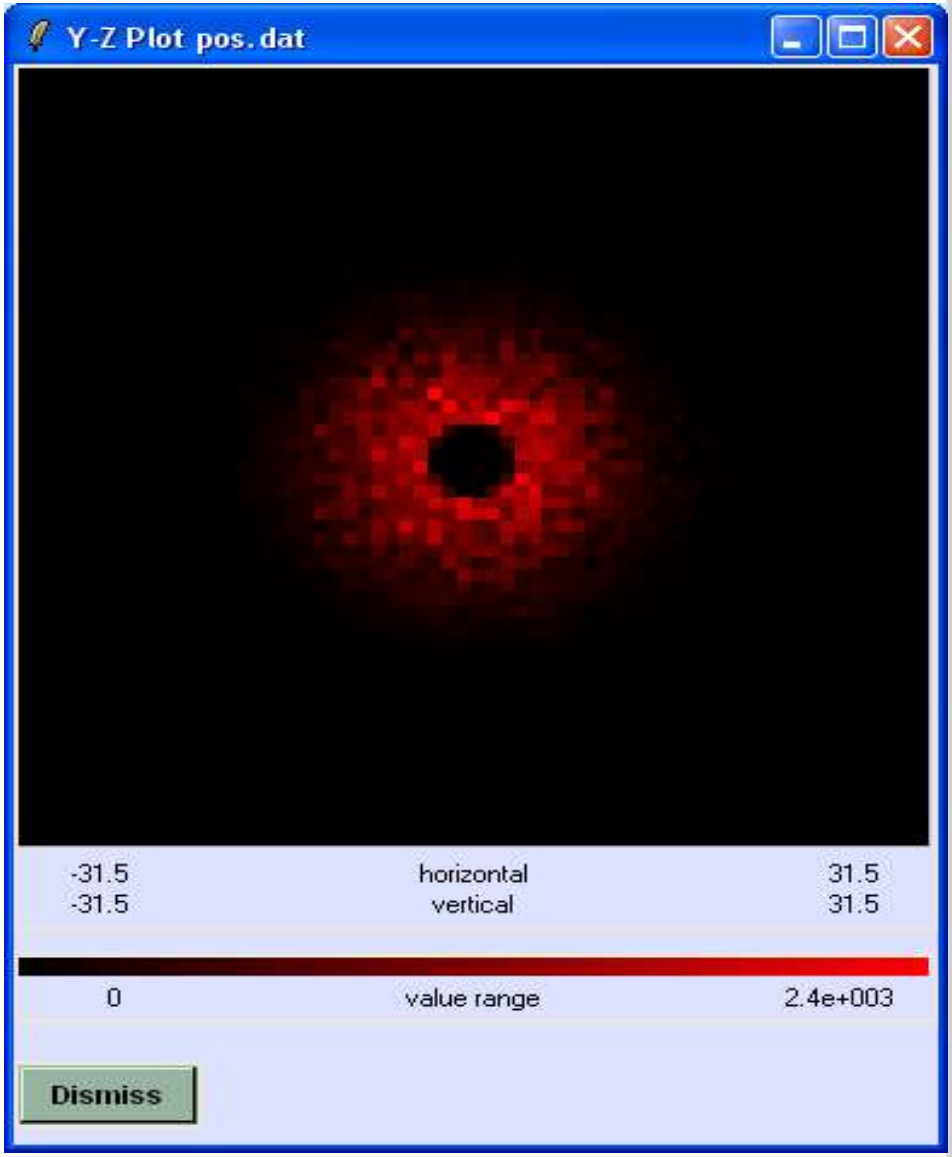
Modules for Monitoring



Graphical output

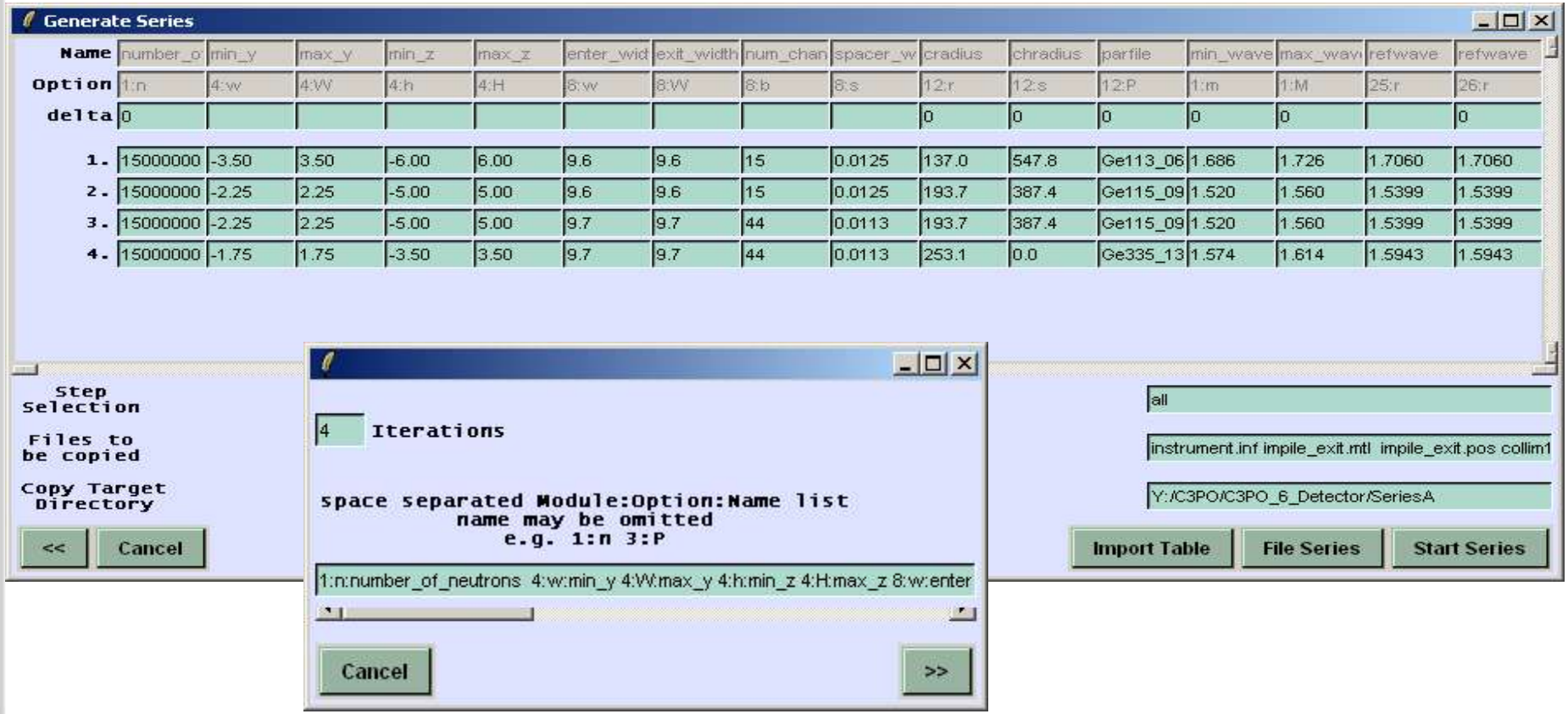






Series of Simulations

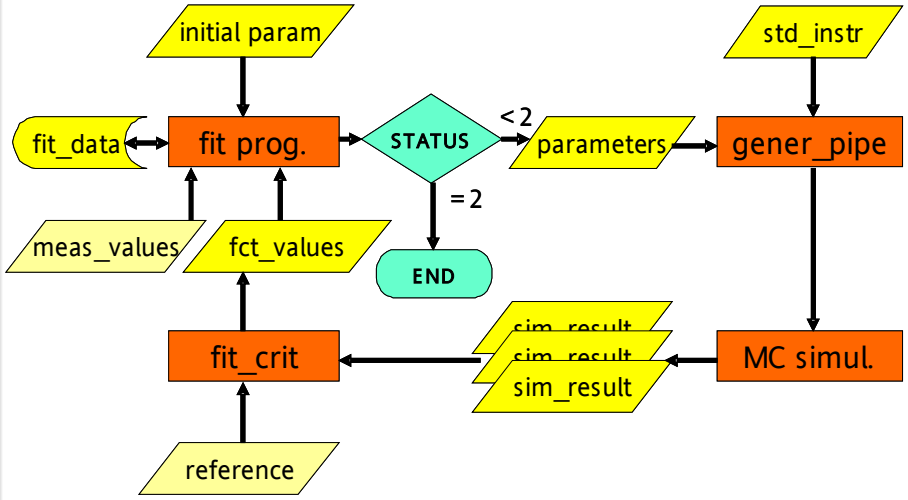
L_eff [cm]	take-off [deg]	h	k	l	coll 1 [min]	num traj.	impile window 2				coll. 1				mono.			lambda		
137.0	60.0	1	1	3	30.0	15000000	-3.50	3.50	-6.00	6.00	9.6	9.6	15	0.0125	137.0	547.8	Ge113_060.par	1.686	1.726	1.7060
137.0	90.0	1	1	5	30.0	15000000	-2.25	2.25	-5.00	5.00	9.6	9.6	15	0.0125	193.7	387.4	Ge115_090.par	1.520	1.560	1.5399
137.0	90.0	1	1	5	10.0	15000000	-2.25	2.25	-5.00	5.00	9.7	9.7	44	0.0113	193.7	387.4	Ge115_090.par	1.520	1.560	1.5399
137.0	135.0	3	3	5	10.0	15000000	-1.75	1.75	-3.50	3.50	9.7	9.7	44	0.0113	253.1	0.0	Ge335_135.par	1.574	1.614	1.5943

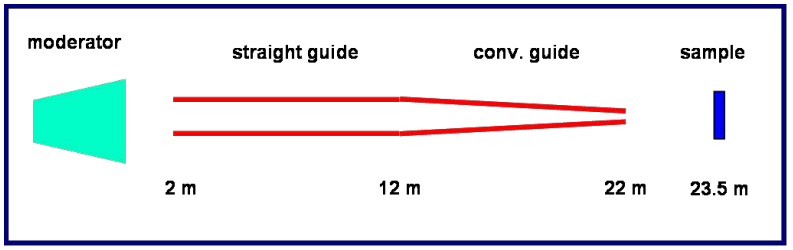


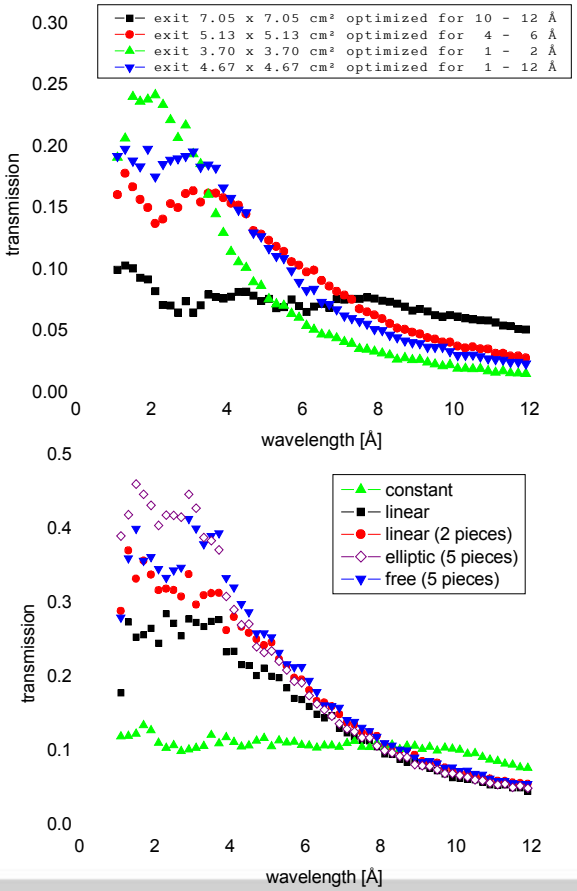
Additional Features

- Tools can be used
  - to generate input files
  - to visualize output data
  - to help designing the instrument
- Splitting of the simulation possible
- Treatment of dependent parameters possible
- Special ray tracing options (to follow individual trajectories)
- Option to mark and identify trajectories by ‘colour’

Optimization (of guide exits)







- MC simulation and numerical optimisation combined
  - Instrument split into 2 parts
  - About 500000 trajectories treated in the 2nd part of the simulation
  - Exit varied and MC simulation performed for each set-up
- Calculations performed on model instrument and real instruments

K. Lieutenant, G. Zsigmond, Physica B 350, Suppl. 1 (2004) E687-689.
K. Lieutenant et al., SPIE Proc. 5536 (2004) 134-145.
K. Lieutenant, J. Phys.: Cond. Matter17 (2005) S167-S174.

New features in VITESS 2.7

- Numerical optimization
- Double (or single) focusing monochromator with slabs in a flat plane
- ISIS source improved
- Virtual propagation window

To come soon

- 3D instrument visualisation
- Time dependent magnetic fields
- Modules for ultra-cold neutrons

- We continue with
  - A demonstration of the new tool to visualize the instrument by Phillip Bentley
  - Examples of using polarized neutrons by Sasha Ioffe and Sergey Manoshin