Worked example using MCSHAPE

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MCSHAPE

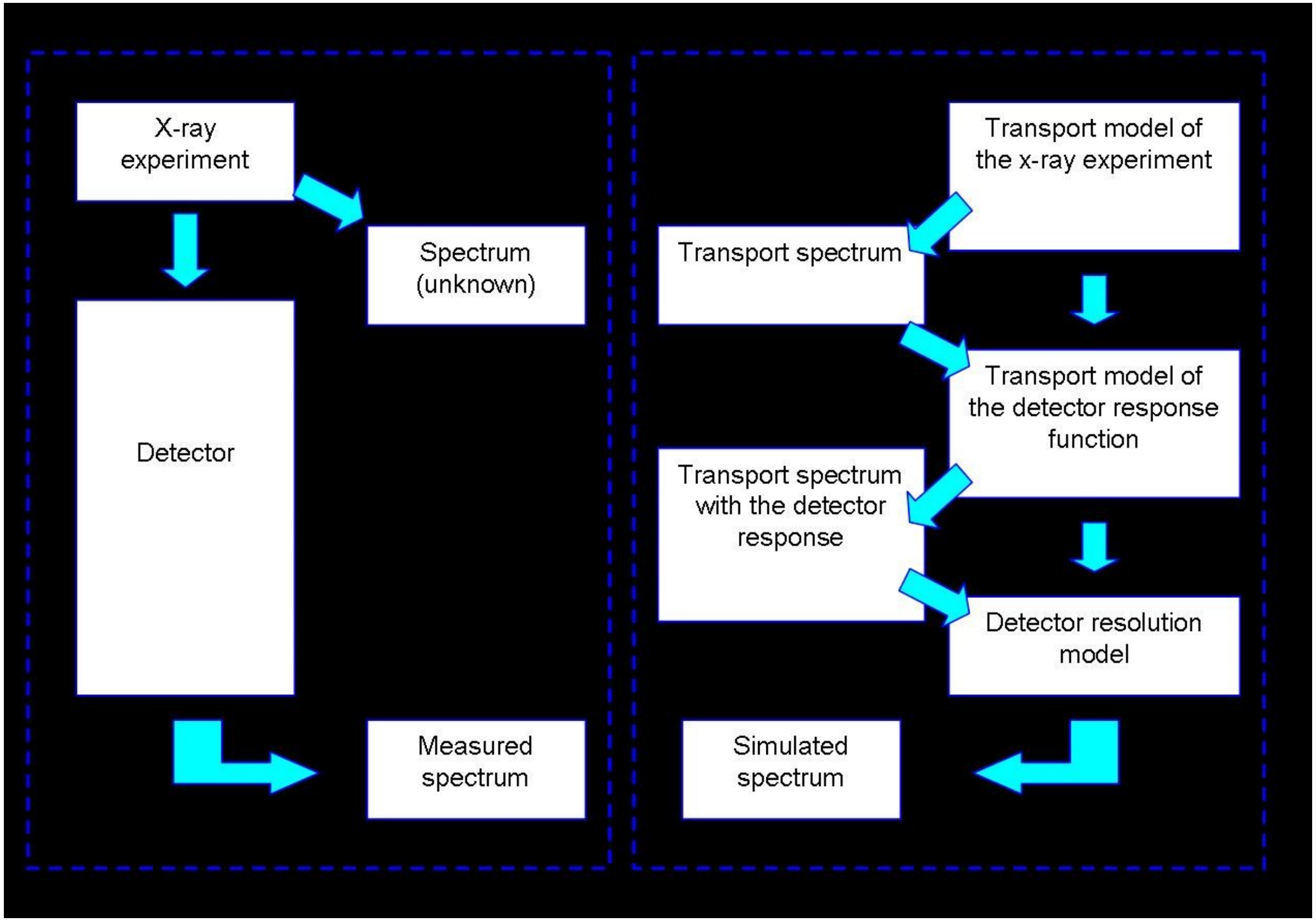
MCSHAPE is a Monte Carlo code developed at the University of Bologna which can simulate the diffusion of photons with arbitrary polarization state and has the unique feature of describing the evolution of the polarization state along the interactions with the atoms.

The adopted transport model is derived from the so called Boltzmann-Chandrasekhar 'vector' transport equation. The polarization state of the photons is described by using the Stokes parameters I, Q, U and V, having the dimension of intensities and containing the physical information about the polarization state.

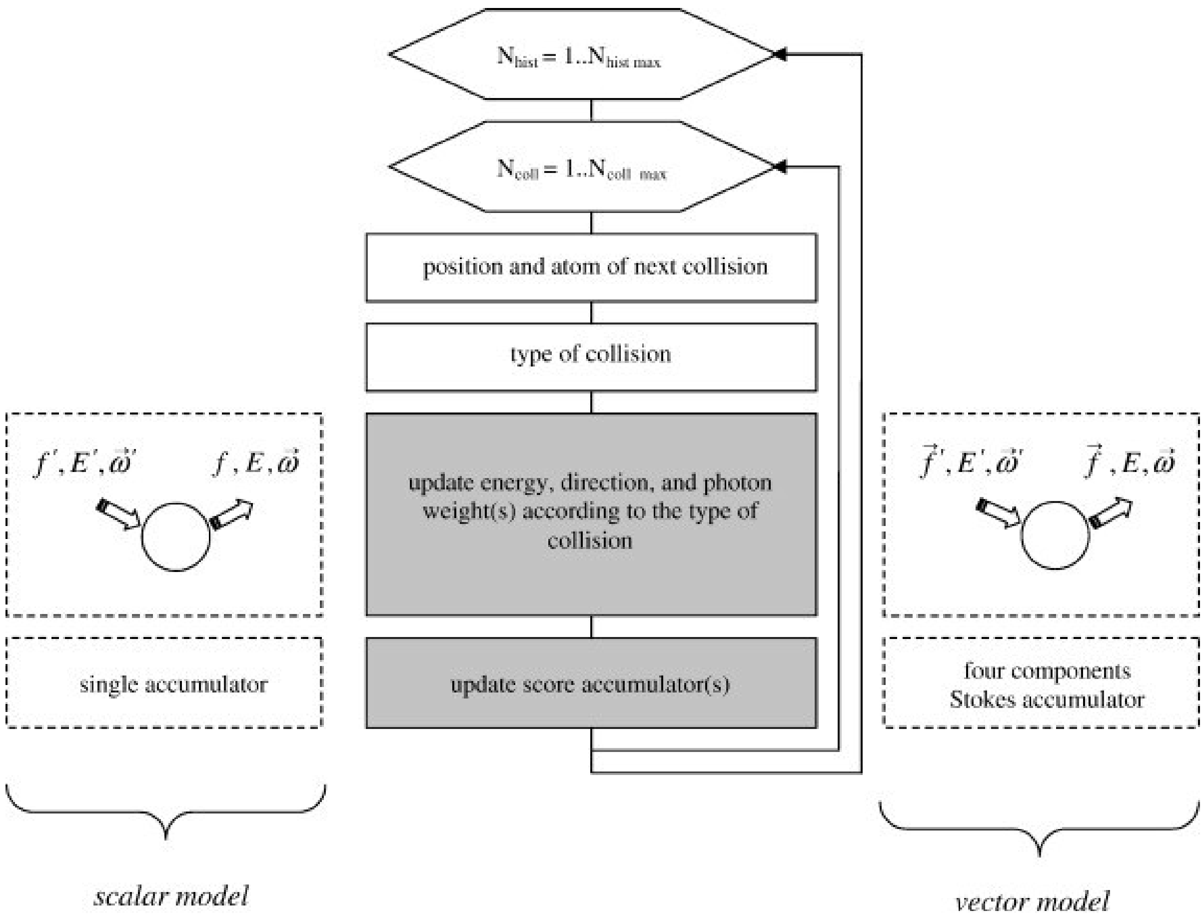
This code simulates the propagation in heterogeneous media of photons injected by either polarized (i.e., synchrotron) or unpolarized sources (x-ray tubes).

- Website: http://shape.ing.unibo.it

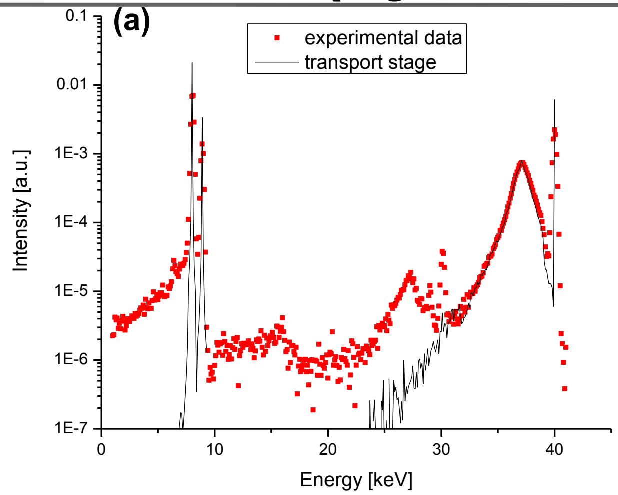
Schematic diagram of a simulation with MCSHAPE, compared with the experimental steps for a spectrum measurement.



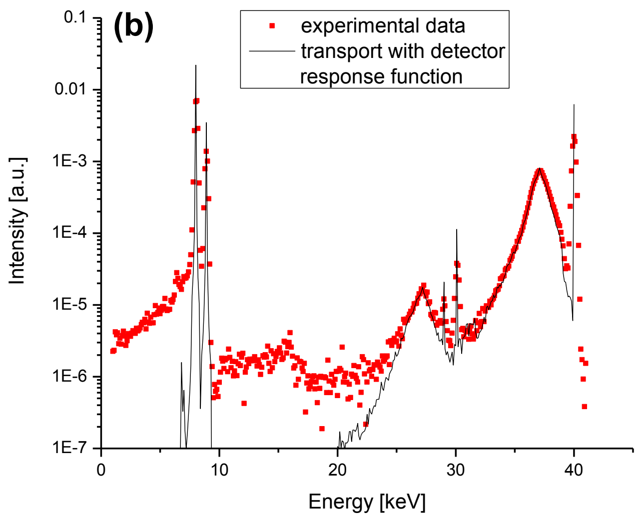
Differences between the computational structures of scalar and vector MC models

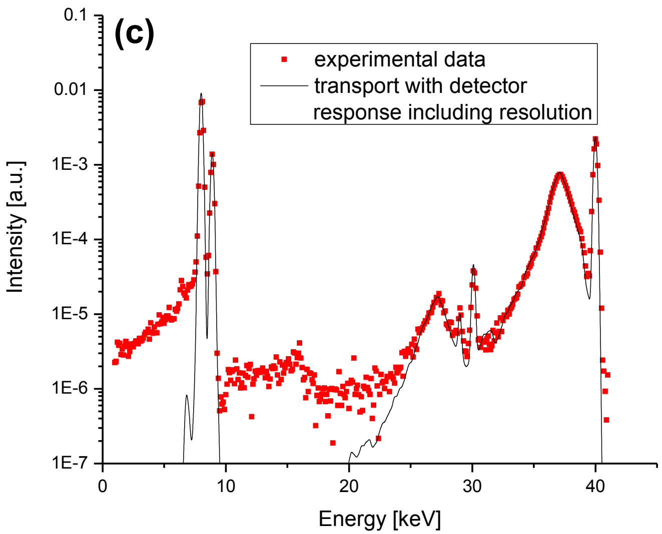


Comparison with experimental data (synchrotron experiment)



- Sample: Cu
- Energy: 40 keV
- Linearly polarized source with polarization degree P= 0.885
- Scattering angle: 90°



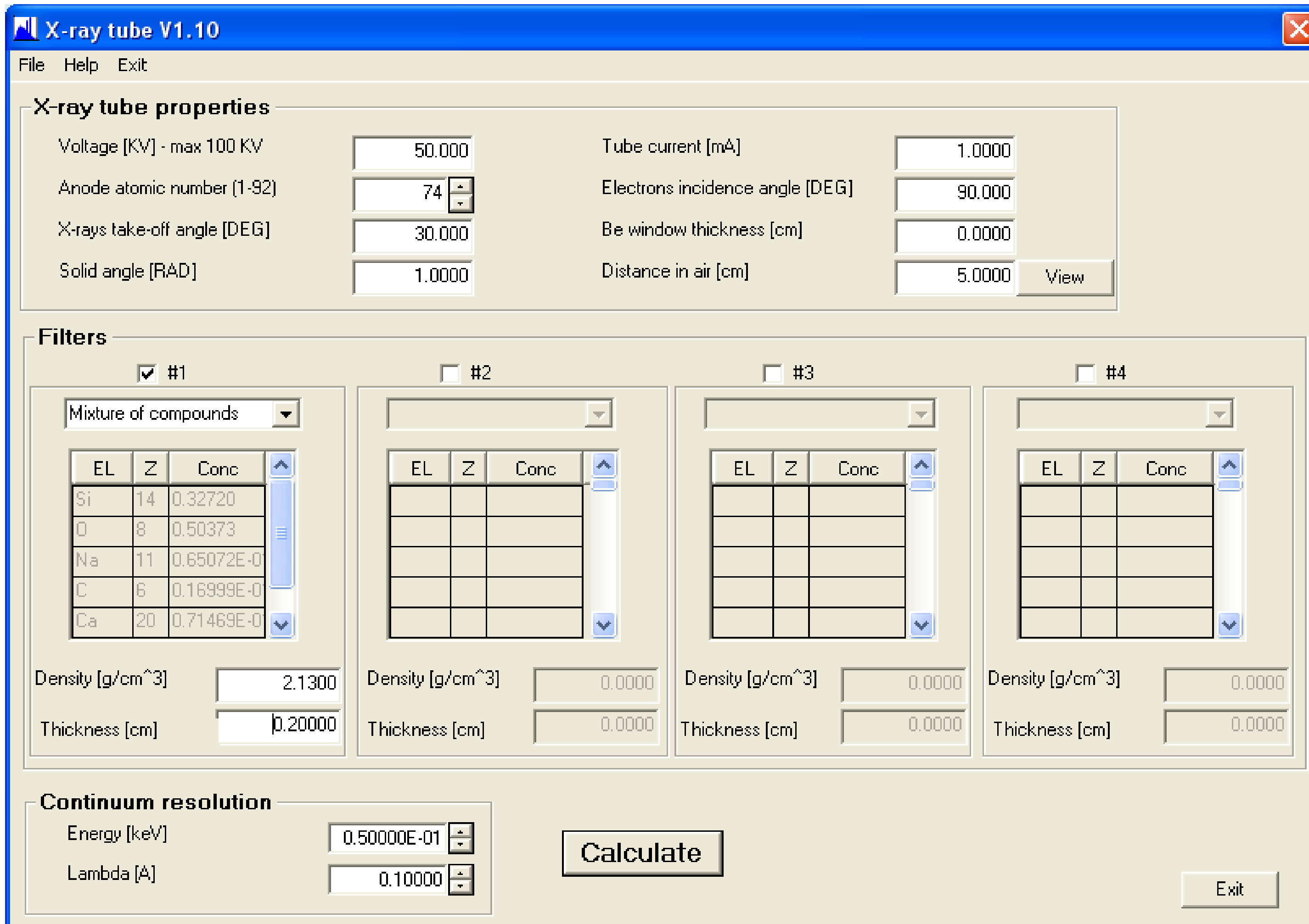


Simulation of the x-ray tube spectrum

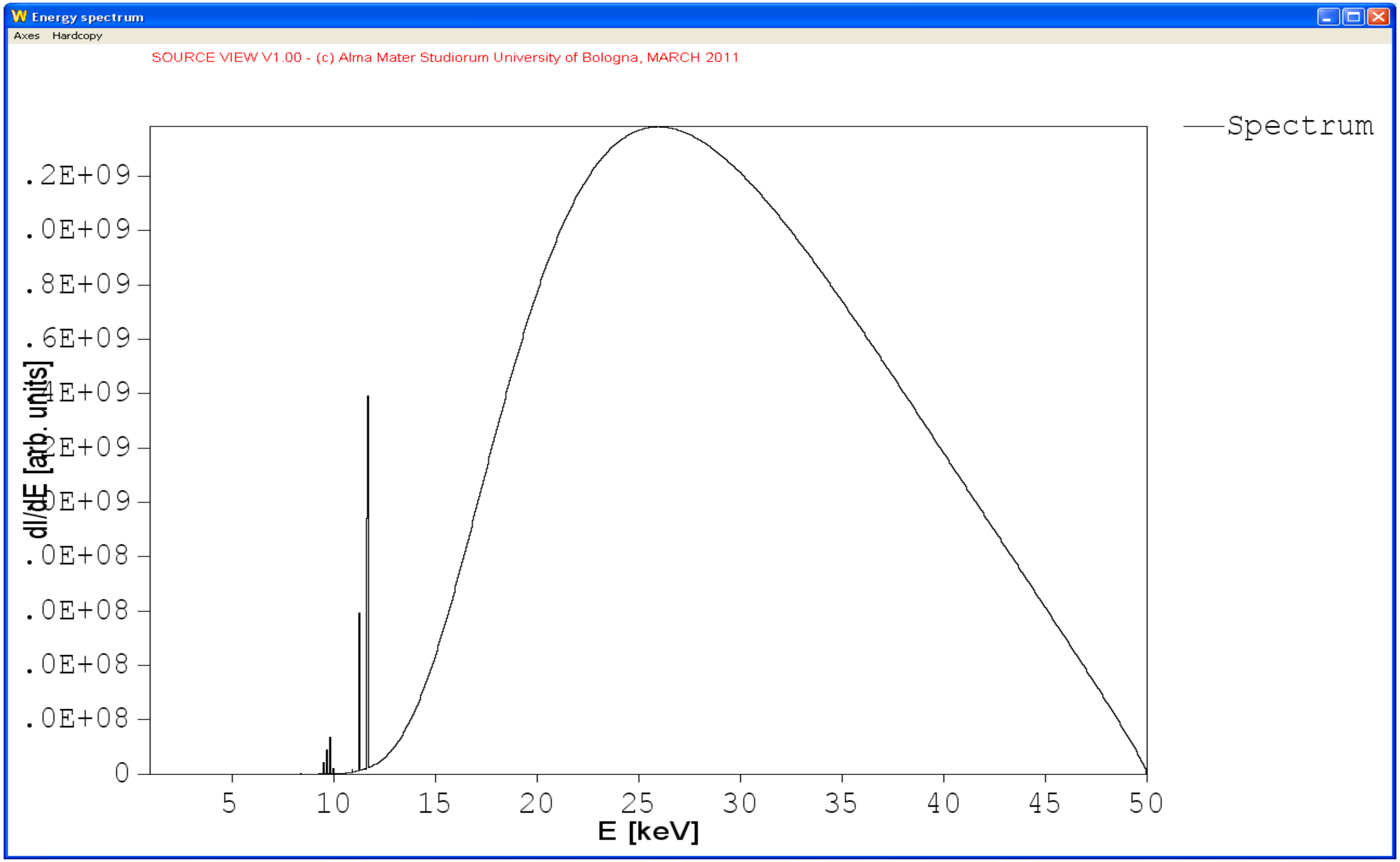
Hamamatsu Tube
with glass window
operated at 50 kV

Glass Composition:

SiO2 (silice)	70%
Na2CO3 (soda)	15%
CaO (calce)	10%
B2O3 (altro)	5%

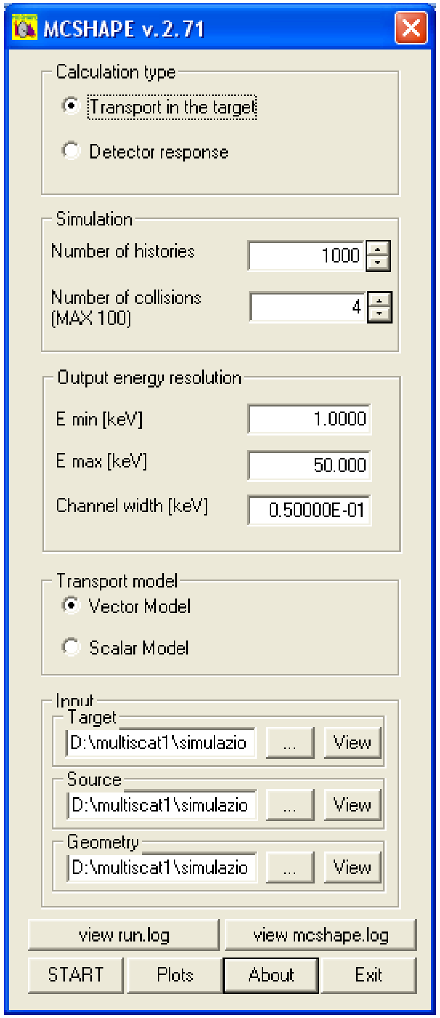


X-ray source

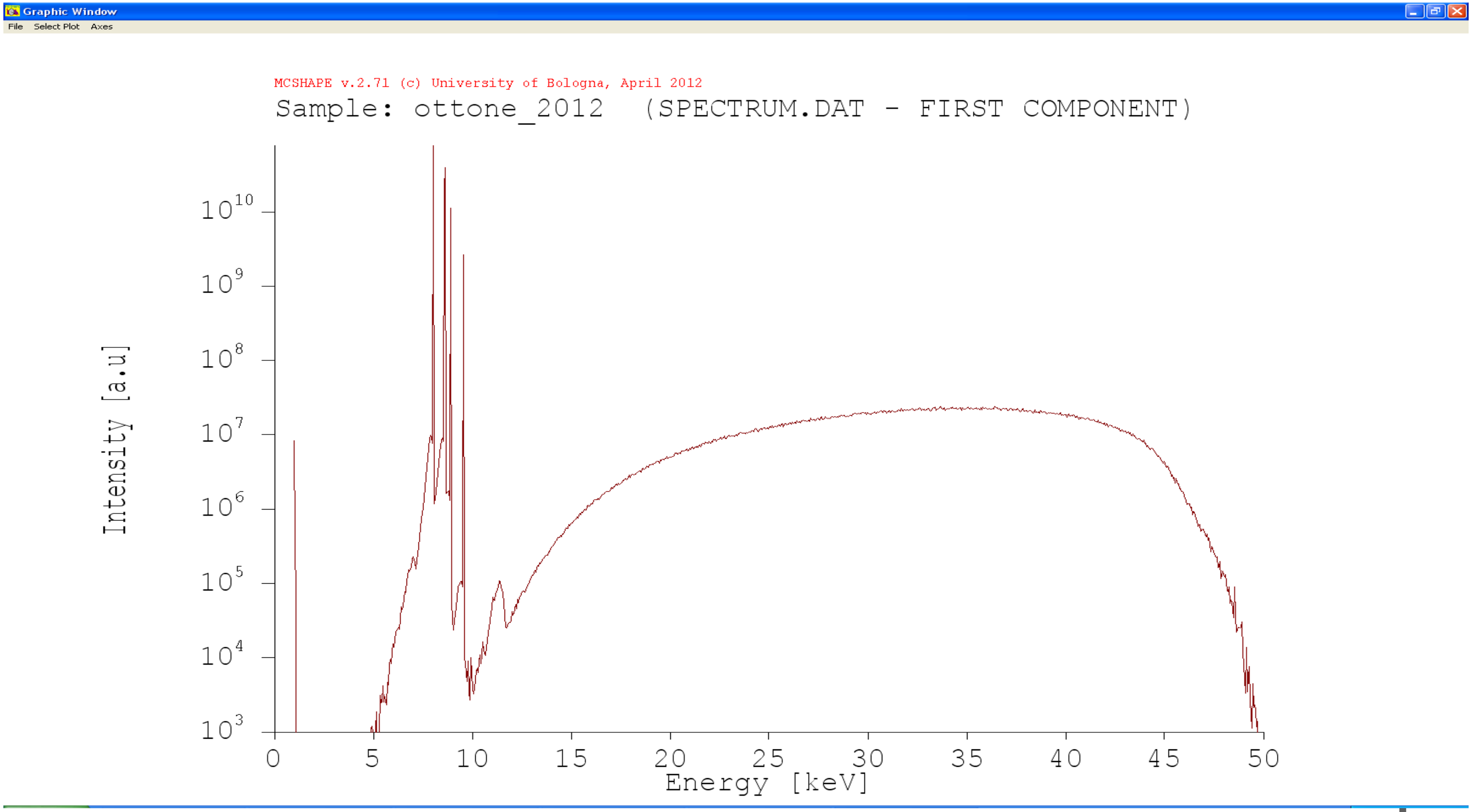

Energy spectrum
Axes Hardcopy
SOURCE VIEW V1.00 - (c) Alma Mater Studiorum University of Bologna, MARCH 2011
Spectrum
dI/dE [arb. units]
.2E+09
.0E+09
.8E+09
.6E+09
.4E+09
.2E+09
.0E+09
.0E+08
.0E+08
.0E+08
.0E+08
0
5
10
15
20
25
30
35
40
45
50
E [keV]

Simulation of transport in brass

- Source: SpectrumS_MCSHAPE.dat
  Hamamatsu x-ray tube at 50kV
- Target: brass_2012
  Cu 64 %
  Zn 36 %
  density 8.5 g/cm^3
  thickness 0.05 cm
- Geometry: geo45_45.DAT
  scattering angle 90 degrees



Transport in brass



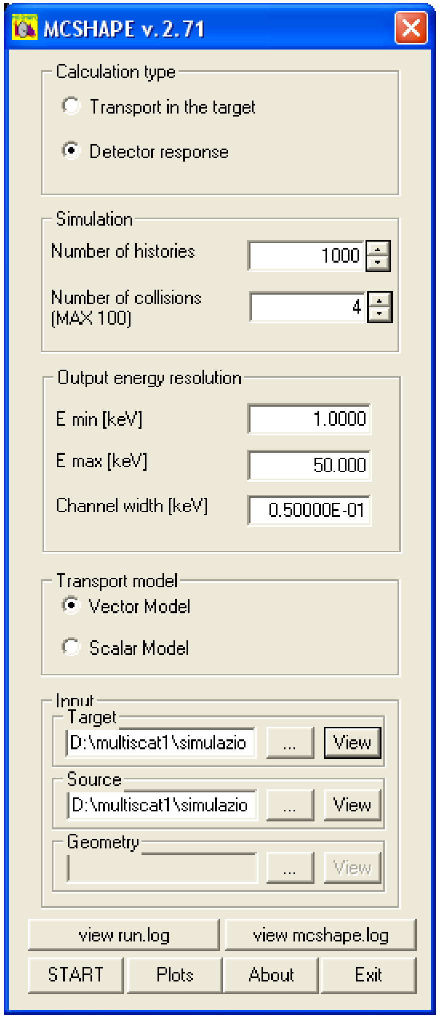
Computation of the detector response

- Source: S_ottone_2012.dat
- Target: Si_05mm

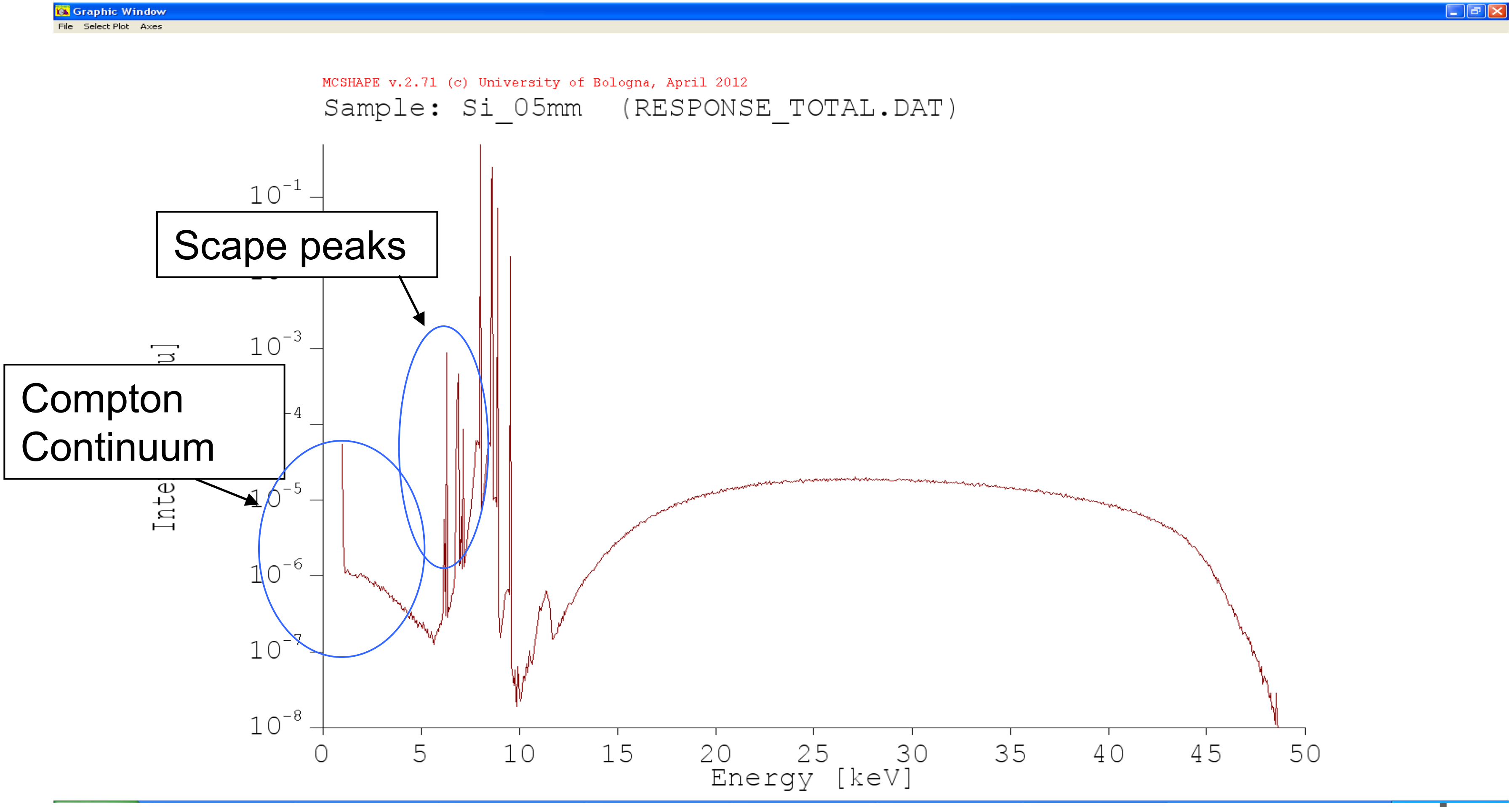
  Si 100 %

  density 2.33 g/cm^3

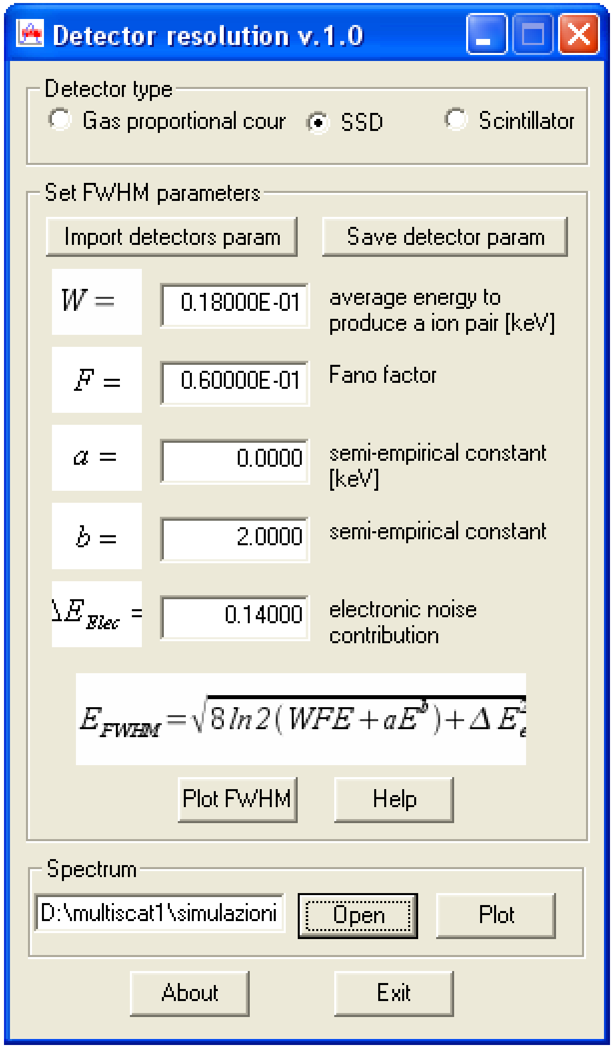
  thickness 0.05 cm
- Geometry: photons undergone normal to the detector

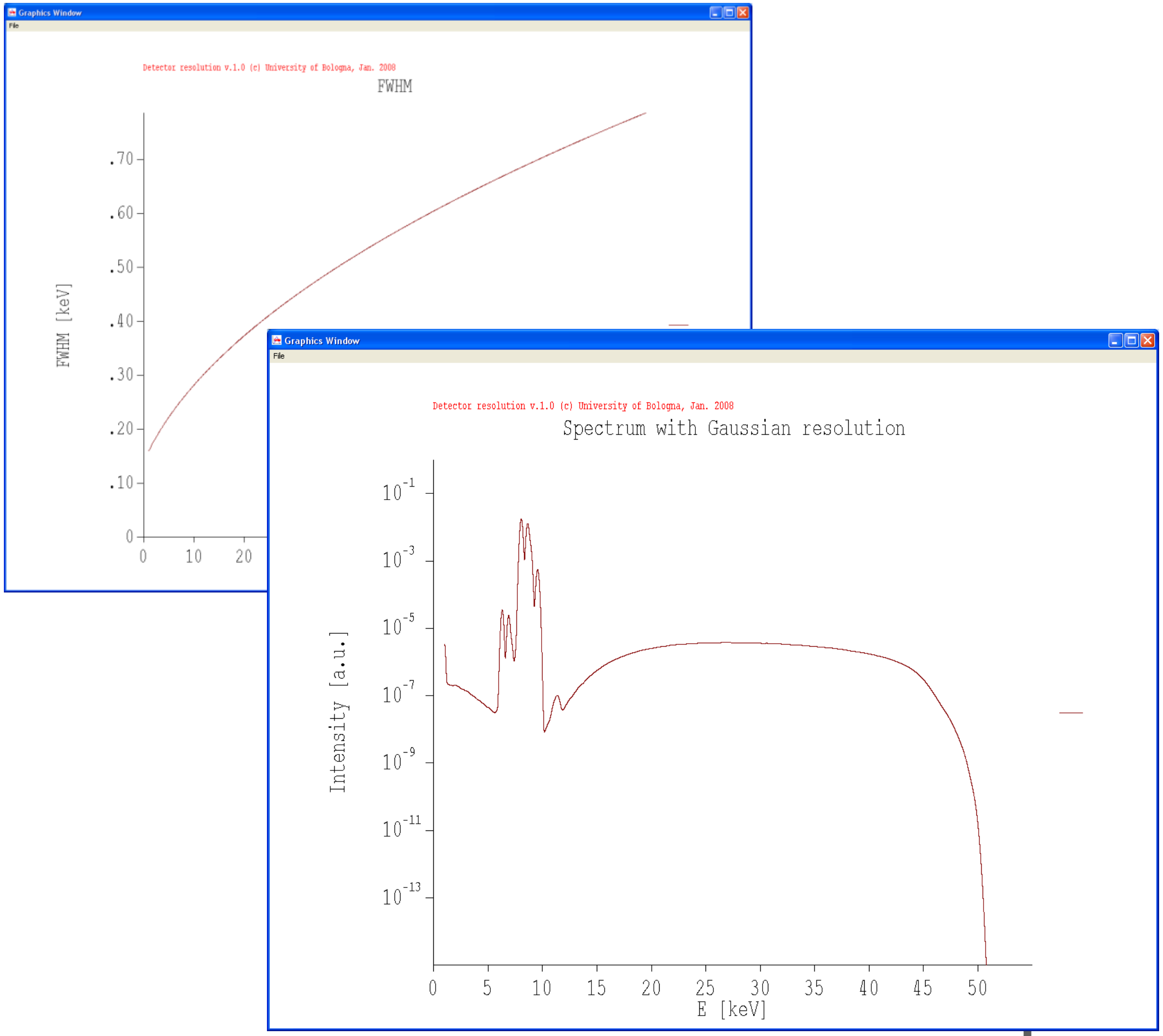


Let us analyse the detector response



Detector Resolution





Comparison with a measured spectrum

Very good agreeement for the peak ratio

The background is slightly greater in the measurement…

Perhaps the wood support behind the brass is missing!