musrSim and musrSimAna – tools for simulating the µSR instruments

Kamil Sedlak

25 June 2012,   PSI

Before Geant4/musrSim istallation

- Install "ROOT" package from root.cern.ch , and set the environment variables:
  - export ROOTSYS="/home/download/Root_5.32.00/root"
  - export PATH=$ROOTSYS/bin:$PATH
  - export LD_LIBRARY_PATH=$ROOTSYS/lib:$LD_LIBRARY_PATH

- Perhaps install vrmlview (to visualise the simulated geometry interactively) – alternatively one can use OpenGL (I think it is natively implemented in Geant4) or other toools.

- Perhaps install "dawn" available at   http://geant4.kek.jp/GEANT4/vis   ← visualises geometry to a nice eps files useful for publications/presentations.

How to install Geant 4.9.5

- Download the source code from   http://geant4.cern.ch . Save it for example as:

/home/install/geant4.9.5/geant4.9.5   ← directory containing the downloaded source
  code

- cmake -DGEANT4_INSTALL_EXAMPLES=ON -DGEANT4_INSTALL_DATA=ON
    -DCMAKE_INSTALL_PREFIX=/home/install/geant4.9.5/install
  /home/install/geant4.9.5/geant4.9.5

- This command will install Geant4 into the directory   /home/install/geant4.9.5/install ,
  and it will also download the data with cross-sections etc. to the directory
  /home/install/geant4.9.5/data/ .

- gmake
- gmake install

- Download the musrSim source code using:

$> cd /afs/psi.ch/user/s/sedlak/geant4

$> svn co file:///afs/psi.ch/project/nemu/svn/lem/trunk/simulation/geant4/musrSim musrSim

$> cd musrSim

$> ls

COPYING   ← file containg the GNU GENERAL PUBLIC LICENSE.

src   ← directory with the source files of musrSim.

include   ← directory with the include files of musrSim.

doc   ← directory with the documentation (manuals).

musrSim.cc   ← main of the musrSim program.

run   ← directory containing the steering files (macro files).

GNUmakefile   ← makefile (probably needed only for Geant4 versions older than 4.9.5).

musrSimAna   ← directory with the musrSimAna files.

How to compile musrSim

- Create a "working directory" mSim :

$> mkdir /afs/psi.ch/user/s/sedlak/geant4/mSim

$> cd /afs/psi.ch/user/s/sedlak/geant4/mSim

$> cmake -DGeant4_DIR=/home/install/geant4.9.5/install/lib/Geant4-9.5.0
   /afs/psi.ch/user/s/sedlak/geant4/musrSim/

$> gmake

- After the last command, the following executable will be created:

    /afs/psi.ch/user/s/sedlak/geant4/mSim/musrSim   ← musrSim executable

How to run musrSim - 1

- Create a data directory, where the simulated data will be saved:

$> cd /afs/psi.ch/user/s/sedlak/geant4/musrSim/run

$> ln –s /home/sedlak/musrSim/data data

- Specify where the Geant4 data are stored. I have it specified in my ~/.bashrc file:

```
alias g495='export G4LEVELGAMMADATA=/home/install/geant4.9.5/data/PhotonEvaporation2.2;
        export G4RADIOACTIVEDATA=/home/install/geant4.9.5/data/RadioactiveDecay3.4;
        export G4LEDATA=/home/install/geant4.9.5/data/G4EMLOW6.23;
        export G4NEUTRONHPDATA=/home/install/geant4.9.5/data/G4NDL4.0;
        export G4ABLADATA=/home/install/geant4.9.5/data/G4ABLA3.0;
        export G4REALSURFACEDATA=/home/install/geant4.9.5/data/RealSurface1.0;
        export G4NEUTRONXSDATA=/home/install/geant4.9.5/data/G4NEUTRONXS1.1;
        export G4PIIDATA=/home/install/geant4.9.5/data/G4PII1.3;
        export G4VRMLFILE_VIEWER="vrmlview"; '
```

So I just issue:

$> g495

How to run musrSim - 2

- Prepare a macro file:

$> emacs 123.mac ← edit macro file, where the geometry is specified

- Run the simulation

$> /afs/psi.ch/user/s/sedlak/geant4/mSim/musrSim 123.mac > data/123.out

- The following files will be created:
  - data/123.out ← text file containing messages from the simulation
  - data/musr_123.root ← "root" file, which contains:
    - the "root tree" called "t1", which is kind of a table containing all event-by event information
    - the "root vector" called "geantParametersD", which contains e.g. number of simulated events and other parameters valid for the whole run

Where musrSim can help

- Simulatin of muSR instruments:
  - HighField, LEM, GPS, GPD, ALC

- Simulation of beam-line elements:
  - Spin rotator 3 &4 + quadrupole triplets

- Simulation of scintillation and subsequent light (photon) transport:
  - Fast timing study, recently submitted to NIM A. (Primary particles: Sr radioactive source of e^+)

- Simulation for slow muon beamlines
  - piE1 experiment of D.Taqqu and A.Antognini
  - P. Bakule at ISIS