Installing and Running

FLUKA Beginner's Course

How to download and install FLUKA

Two ways of downloading the FLUKA software:

- From the FLUKA website http://www.fluka.org
- From NEA databank http://www.nea.fr through the liaison officer from your institute

It is mandatory to be registered as FLUKA user.
Follow the link:

http://www.fluka.org/download.html

After registration (or using your user-id and password) you can proceed in downloading the latest official release version.

How to download and install FLUKA

First identify the location of the FLUKA distribution file: fluka2011.2-linuxAA.tar.gz

Depending on the operating system and the method you used most probably will be located in one of the following directories:

```
        /media/FLUKA/Software          # in case you are using the USB stick
or      $HOME                          # if you downloaded from the web
        $HOME/Desktop                  # depending on your browser
```

We will create a directory FLUKA under your home directory to install FLUKA.

The following commands issued from a terminal/console window will perform the entire installation.

```
        cd                             # changes directory to your home
        mkdir FLUKA                    # creates a directory called FLUKA
        cd FLUKA                       # changes to the FLUKA directory
        tar xzf /media/FLUKA/Software/fluka2011.2-linuxAA.tar.gz
                                       # expands the FLUKA package

        # set FLUPRO environment variable
        export FLUPRO=$HOME/FLUKA      # sets FLUPRO in bash shell or similar
or      setenv FLUPRO $HOME/FLUKA      # sets FLUPRO in tcsh shell or similar
        make                           # compiles a FLUKA executable and
                                         auxiliary programs
```

Persistent settings

To make these settings persistent on your computer, *i.e.*, you don't have to set the FLUPRO environment variable again when you open a new terminal or log into your computer, we will add the following lines into your shell configuration file in your main directory.

bash users:

```
cd
emacs [or any editor] .bashrc
```

add the following:

```
export FLUPRO=${HOME}/FLUKA
export PATH=${PATH}:$FLUPRO:$FLUPRO/flutil
```

tcsh users:

```
cd
emacs [or any editor] .tcshrc
```

add the following:

```
setenv FLUPRO ${HOME}/FLUKA
setenv PATH ${PATH}:$FLUPRO:$FLUPRO/flutil
```

The changes will be activated on the next login or if you type the command

```
source .bashrc
source .tcshrc
```

FLUKA release: main directory $FLUPRO

Main Library:

libflukahp.a (object collection)

Physics data files:

sigmapi.bin
elasct.bin
brems_fin.bin
cohff.bin
gxsect.bin
neuxsc-ind_260.bin
nuclear.bin
fluodt.dat
e6r1nds3.fyi
jef2.fyi
jendl3.fyi
xnloan.dat
Fad/*
DDS/*

Basic Scripts: (in $FLUPRO/flutil)

rfluka
lfluka
fff

Random Number seed

random.dat

Important Directories

flukapro/	all FLUKA commons
usermvax/	user routines
flutil/	general utilities

What's inside the physics data files:

sigmapi.bin:	pion-N double-diff. cross sections
elasct.bin:	elastic scattering cross sections
brems_fin.bin:	Bremsstrahlung cross sections
cohff.bin:	atomic form factor tabulations
gxsect.bin	photon cross sections
neuxsc-ind_260.bin:	low energy neutron multi-group cross sections (260 groups)
nuclear.bin:	nuclear masses, mass excesses, levels, and many other nuclear data for evaporation, pre-equilibrium, Fermi break up and photonuclear cross sections gamma and beta databases
fluodt.dat:	Fluorescence data (photoelectric effect)
e6r1nds3.fyi:	Fission products (for neutrons with E<20 MeV)
jef2.fyi:	
jendl3.fyi:	
xnloan.dat:	
Fad/* :	BME pre-equilibrium particle angular distribution
DDS/* :	BME pre-equilibrium particle energy spectra

Available Documentation

- fluka2011.manual ASCII version of the manual (easy to edit)
- FM.pdf current version of the FLUKA manual
- CERN-2005-10.pdf official reference for FLUKA (manual not up to date)
- or navigate the manual, online version (www.fluka.org)

- or (when using FLAIR) press F1 to get an interactive manual (which can be also called on prompt level by calling '*fm.py*')

- or (at a further stage) the FAQ available at: http://www.fluka.org/fluka.php?id=faq&mm2=3
- or (at a further stage) the archive of fluka-discuss: http://www.fluka.org/MailingList.html
- Release notes

A New Way to “Go FLUKA” - **FLUPIX**

Besides the current FLUKA distribution you also got the current version of FLUPIX distributed on your USB stick.

FLUPIX

(FLUka in knopPIX)

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FLUPIX is a Fedora (originally **KNOPPIX**, www.knoppix.org) based version of the Live CD, with pre-installed FLUKA and flair and all the necessary tools in for performing FLUKA runs.

FLUPIX can run from a CD/DVD, bootable USB or through any virtual machine from any host operating system (Ms Windows, Mac OS, Linux, Solaris etc.). FLUPIX includes all the additions of VirtualBox (www.virtualbox.org) a free and open source Virtual machine supported by Sun, that provides easy installation and high performance.

Introduction

- FLUPIX (FLUKA in KNOPPIX*) is a bare-bones Live ISO containing:
  - **FLUKA**
  - **Flair**
  - All necessary tools for analysis (gnuplot, processing programs...)
  - **LXDE** – Lightweight Desktop
  - VirtualBox additions
- Minimal size of ~300MB
- The ISO is specially mastered to run under VirtualBox (www.virtualbox.org) an open source virtual machine by Sun. It is available under many platforms:
  - all Linux
  - MS Windows
  - Mac OS
  - OpenSolaris

http://www.fluka.org/content/tools/flupix/index.html

* Originally it was based on knoppix. The present version is based on Fedora

VirtualBox

- **VirtualBox** is an x86 virtualization software package originally created by Innotek and now being developed by Sun Microsystems as part of its Sun xVM virtualization platform.
- It is installed on an existing host operating system (OS); within this application, additional operating systems, each known as a *Guest OS*, can be loaded and run, each with its own virtual environment.
- For example, Linux can be guest hosted on a single virtual machine running Microsoft Windows XP as the *Host OS* ; or, XP and Windows Vista can run as guest operating systems on a machine running OpenSolaris.

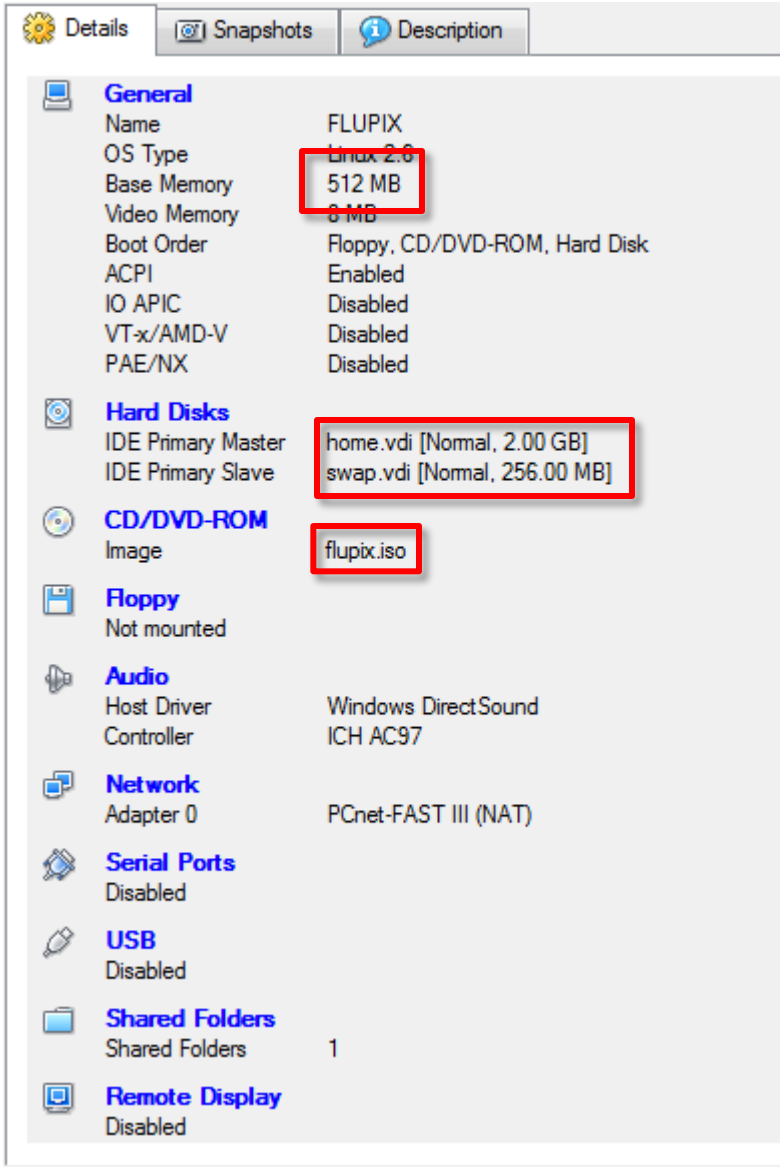
Installation of FLUPIX for VirtualBox

- You will need the following packages
  1. VirtualBox-X.Y.Z-#-Win.exe / -OSX.dmg / .deb / ...
     The windows setup program of VirtualBox. Install this program in your Windows OS or Mac OS.
  2. flupix-*20XX-YYY*.iso
     The FLUPIX bootable CD-ISO image.
  3. flupix-vdi.zip
     The default configuration of FLUPIX for VirtualBox. Unpack the content of the zip file to copy them to
     C:\Documents And Settings*username*\.VirtualBox
     or
     C:\Users*username*\.VirtualBox

Setting up

- The flupix-vdi.zip contains a predefined VM named FLUPIX that is attaching two Virtual disks
  - home.vdi — Dynamic size disk up to 8 Gb, formatted in ext4 used for working space
  - swap.vdi — Fixed size disk of 256MB used for swapping
- Set the location of the ISO image
  - Select the CD/DVD Images tab.
  - Select the flupix iso image (if present) and click on Release button, then click on Remove button
  - Click on Add button and locate the correct ISO image
- Then on the CD/DVD Rom tab
  - Check the Mount CD/DVD Drive
  - Check the ISO Image File
  - Select the flupix ISO image

FLUPIX Settings



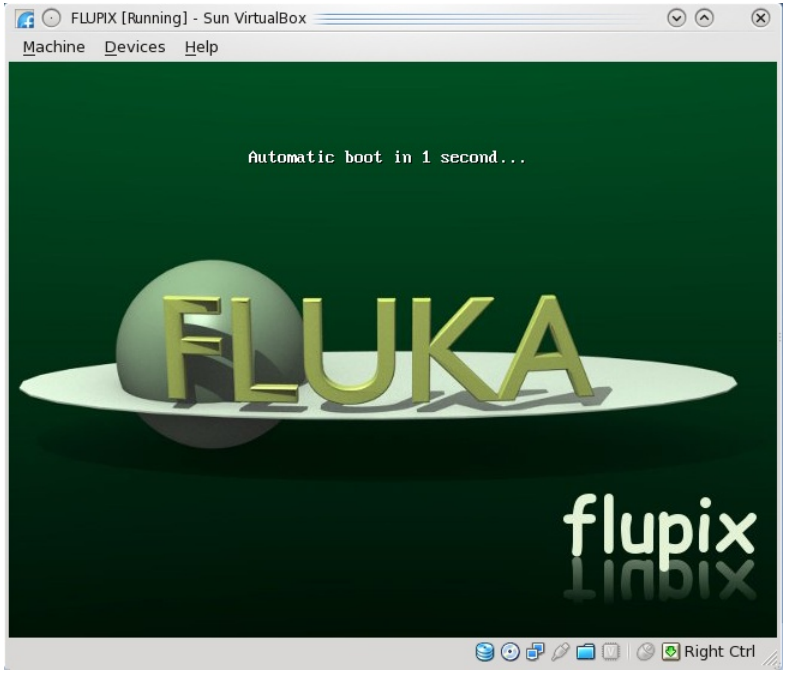
Memory Settings:

- Minimum requirement
  RAM: 512 Mb
  Swap: 256 Mb
- Recommended:
  RAM: 1 Gb
  Swap: 512 Mb

- Linux needs at least 256MB to run
- FLUKA needs ~400 Mb with DPMJET ~500 Mb
- Some FLUKA tools need ~500Mb
- FLAIR memory is dynamic

Starting the VM

- Select the FLUPIX VM and click on the Start button



- It will start the boot in 1s.
  [If you want to change the parameters press Tab]
- Booting will take about 20-30s

Working space

- The linux root directory “/” is mounted as readonly from the FLUPIX iso file.
- However you have the possibility of writing and installing extra programs on the “/” ONLY temporary for the session
- You can use super-user priviliges with the “sudo” command with no password
- The home.vdi if flagged with a label “/home” and will be mounted as /home and it contains the following:
  - flupix: your persistent user flupix home directory.
  - The swap.vdi contains a memory swap disk of 256MB

Interface

- FLUPIX has precompiled the utilities from VirtualBox that allows
  - Mouse integration (only in X11). The mouse of the host is used as such from the guest system. In all other displays the guest is getting the FULL control of the mouse
  - A special driver for X11 video, for faster, smoother and hardware accelerated graphics.
  - Time synchronization with the host system
  - Folder sharing from the host to the guest system.

- Remember the “Right-Ctrl” key is the default Host key of your Virtual Machine. With the use of this key you can redirect all input (keyboard+mouse) from your host to your guest system and many other.

Accessing your host directories

- There are several ways of accessing directories from the host system.
- The easiest way is through the use of a Shared Folder
- Create a Shared folder from your VirtualBox and give a name e.g. *home*
- From FLUPIX call the command

  vboxmount *home* ~/home
- The command will create a directory ~/home and mount the Shared folder *home* to it
- Add the command to your profile script to be executed on every login.
- You cannot run FLUKA inside a shared folder since symbolic links (needed by FLUKA) are not supported

Shutting down FLUPIX

- Always try to shutdown correctly the VirtualMachine, from the menu.
  Otherwise you can end up with a corrupted persistent image.
- You can even save the machine state, which is equivalent like StandBy. It will create a file equal to the size of the RAM defined 512MB

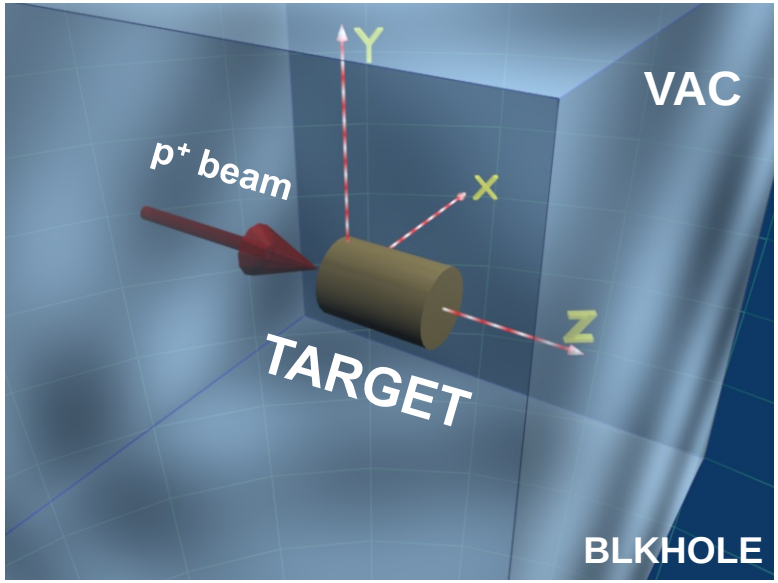
Input example

- FLUKA is driven by the user almost completely by means of an input file (.inp) which contains directives issued in the form of DATA CARDS
- The standard release provides a simple case to test the installation: example.inp *(Production of particles in p-Be collisions with a 50GeV/c proton beam.)*
- Different examples are used along this course, which will be varied in different ways for didactic reasons
- We will start with a minimum input file and after each lecture we will enhance our example with more and more functionality
- It is strongly recommended that for every exercise you create a subdirectory *i.e.,* ex1, ex2, ex3 where all the necessary input and output file will be stored
- For better clarity before starting a new exercise you will get the solution of the previous one, to be picked up at the course website: http://www.fluka.org/fluka.php?id=course&sub=program&navig=2&which=nea2013

A Simple Example

```
TITLE
FLUKA Course Exercise
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....*
DEFAULTS                                                          NEW-DEFA
BEAM            -3.5 -0.082425      -1.7       0.0       0.0       1.0PROTON
BEAMPOS          0.0       0.0       0.1       0.0       0.0       0.0
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....*
GEOBEGIN                                                          COMBNAME
    0    0                    Cylindrical Target
SPH BLK 0.0  0.0  0.0  10000.
* vacuum box
RPP VOI -1000. 1000. -1000. 1000. -1000. 1000.
* Lead target
RCC TARG 0.0 0.0 0.0 0.0 0.0 10. 5.
END
* Regions
* Black Hole
BLKHOLE 5   +BLK -VOI
* Void around
VAC     5   +VOI -TARG
* Target
TARGET  5   +TARG
END
GEOEND
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....*
ASSIGNMA    BLCKHOLE   BLKHOLE
ASSIGNMA      VACUUM       VAC
ASSIGNMA        LEAD    TARGET
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....*
RANDOMIZ         1.0
START           10.0       0.0
STOP
```

Geometry



Prepare the working space

- We don't want to run inside the $FLUPRO directories therefore:
- Go to your home directory and create a subdirectory named ex1:

```
cd
mkdir ex1
cd ex1
```

- Get the source example file from the course website (copy all the ex1* files to your subdirectory: **ex1**)

  http://www.fluka.org/fluka.php?id=course&sub=program&navig=2&which=nea2013

```
download ex1*
```

Now let's test the installation

After you have created your standard FLUKA we can run the first example:

No. of previous cycle (default is 0)

No. of Last cycle (default is 5)

$FLUPRO/flutil/rfluka -e $FLUPRO/flukahp -N0 -M1 ex1

Specifies the executable name: if it is flukahp in $FLUPRO (default) then it can be omitted

Name of the input file. It must be a file named ****.inp and .inp has to be omitted.

What rfluka does:

It creates a temporary subdirectory: $PWD/fluka_nnnn
($PWD means the current directory)
where nnnn is the system process-id assigned to FLUKA.
There all necessary assignments are defined and output files are written.

elasct.bin	→	$FLUPRO/elasct.bin
fluodt.dat	→	$FLUPRO/fluodt.dat
fort.1	→	../ranex_1001
fort.11	→	ex_1001.out
fort.12	→	libec_thihecufealw_10t.pemf
fort.15	→	ex_1001.err
fort.16	→	“geometry scratch”
fort.2	→	ranex_1002
neuxsc.bin	→	$FLUPRO/neuxsc-ind_260.bin
nuclear.bin	→	$FLUPRO/nuclear.bin
sigmapi.bin	→	$FLUPRO/sigmapi.bin
xnloan.dat	→	$FLUPRO/xnloan.dat

At the end of the FLUKA run:

If everything is OK the temporary directory disappears
And the relevant results are copied in the start directory:

Removing links

by default you have ex100n.log, ex100n.out, ex100n.err and ranex100m (seed for cycle m = n+1)

Removing temporary files

Saving output and random number seed

Saving additional files from scoring requested by the user

```
Moving fort.33 to /home/username/work/ex1/ex1001_fort.33
Moving fort.47 to /home/username/work/ex1/ex1001_fort.47
Moving fort.48 to /home/username/work/ex1/ex1001_fort.48
Moving fort.49 to /home/username/work/ex1/ex1001_fort.49
Moving fort.50 to /home/username/work/ex1/ex1001_fort.50
```

End of FLUKA run

Checking FLUKA during the run

Look in the temporary directory:

a) Initialization phase ends when the *.err file is created.

b) Inside *.err file and (at the end of *.out file) the progress in the number of events is given in the line immediately following the one which starts by "NEXT SEEDS":

```
NEXT SEEDS:  C8888D      0      0      0      0      0 33B49B1      0      0      0
         1                9                9        0.0000000E+00        1.0000000E+30
0
 NEXT SEEDS:  C88894      0      0      0      0      0 33B49B1      0      0      0
         2                8                8        5.0010681E-03        1.0000000E+30
0
 NEXT SEEDS:  C8889A      0      0      0      0      0 33B49B1      0      0      0
         3                7                7        3.3340454E-03        1.0000000E+30
0
 .....
```

EVENTS ALREADY COMPLETED

EVENTS TO BE COMPLETED

AVERAGE CPU TIME CONSUMED PER EVENT

Tips & Tricks

How to make a "clean" stop of FLUKA run

- Here "clean" means closing all files, writing scoring output and removing the temporary directory and files.
- In the temporary run directory:

	touch fluka.stop	To stop the present cycle
or	touch **r**fluka.stop	To stop all remaining cycles

- The clean stop will occur at the next CPU-time check, *i.e.*, at the same time when printing the random number calls : see START card instructions (5th parameter) for the frequency of these checks!!

- If the check is never performed it means that the program has entered an infinite loop (probably a fault in user code)