**Activity Code User Manual**



Version 0.5 February 2014

# Contents

# Introduction

The Activity code is used to calculate the ion induced radioactivity of a sample material in an ion beam.

The ion trajectory data (energy,x,y,z ion coordinates) are supplied by the user, using the SRIM ion transport code to generate the exyz file. The reaction cross section data has already been prepared for the user, and is taken from the TALYS TENDL-2013 cross section database. Decay path/mode/half-life data from work by Tuli and Sonzogni has also been prepared for the user and included with the code, as well as general isotope/element data (mass, charge, isotopic composition etc) from the nist.gov website.

The code tallies the amounts of each starting isotope then calculates the reaction rates of the starting isotope conversion to product isotopes due to the ion beam. Finally, the code calculates the expected tally of isotopes after the required amount of time, after taking into consideration:

* the loss of starting isotopes due to the ion beam
* the creation of product isotopes due to the beam
* the loss and creation of radioactive isotopes due to decay

# Input & Data Files

The activity code has several data files already prepared in the data directory:

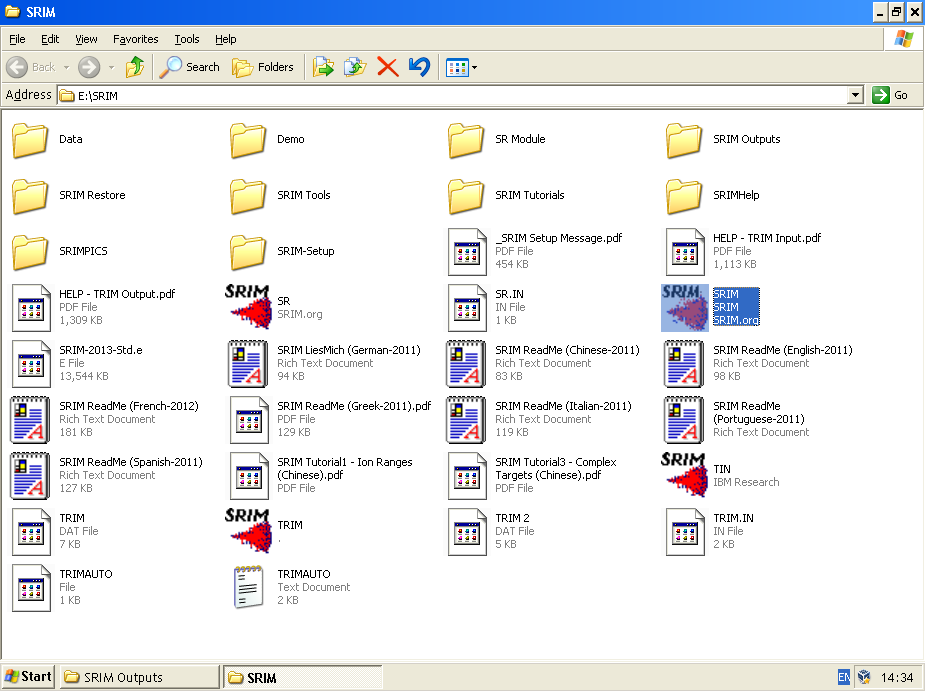
1. decaymodes.txt
2. gammaenergies.txt
3. isotopes.txt
4. xs directory containing xs data files

The user must prepare an ion exyz datafile using SRIM. The file output by SRIM (named EXYZ.txt) should not be modified. A final file must be created by the user that contains all the parameters needed by the code.

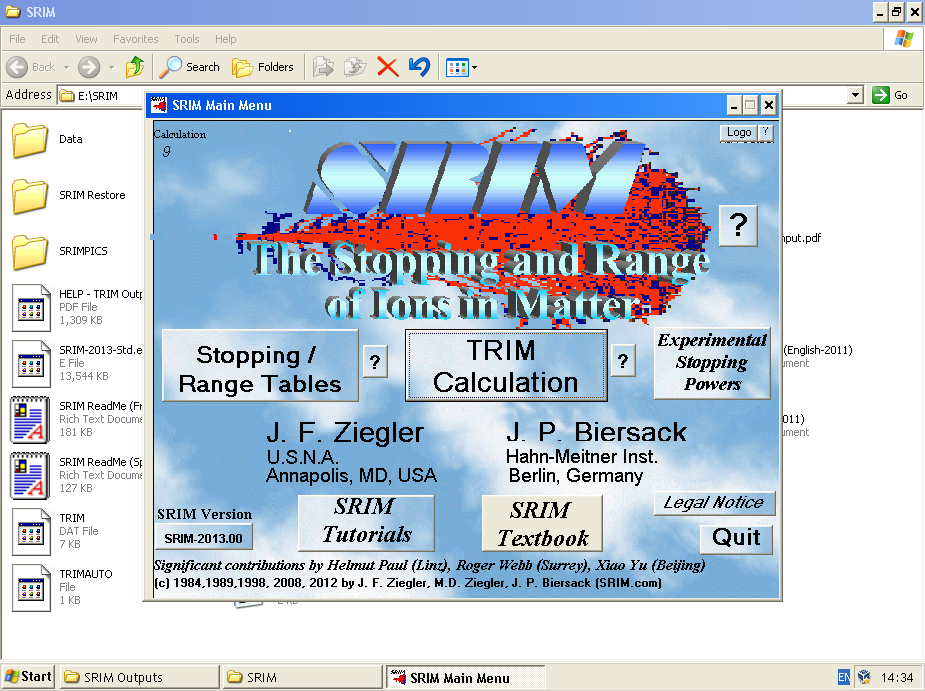
# How to Use

## SRIM EXYZ File

Install SRIM on a Windows computer and run the SRIM.exe file

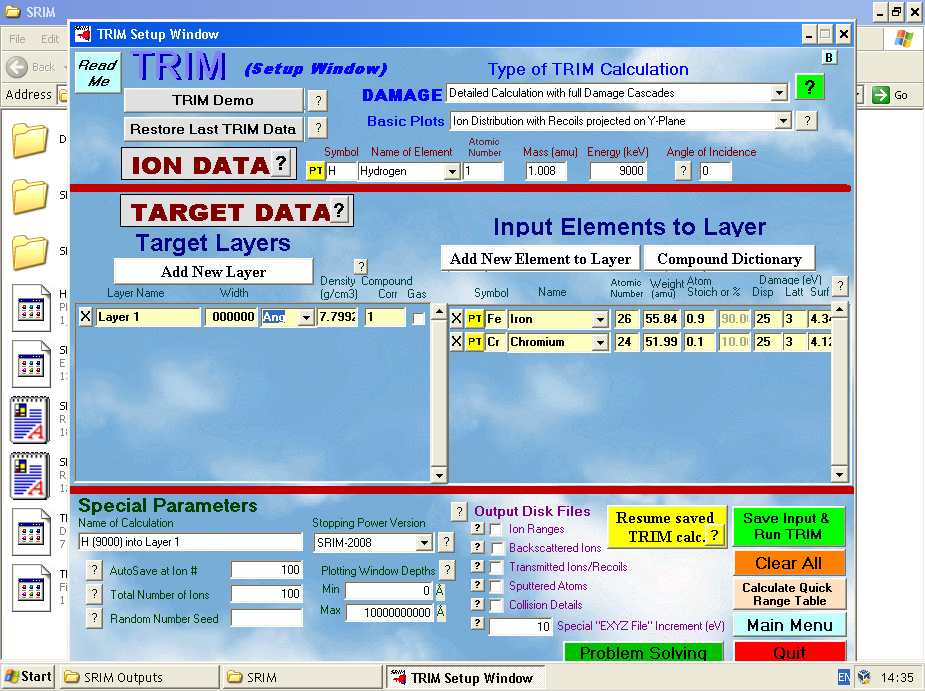


Run “TRIM Calculation”

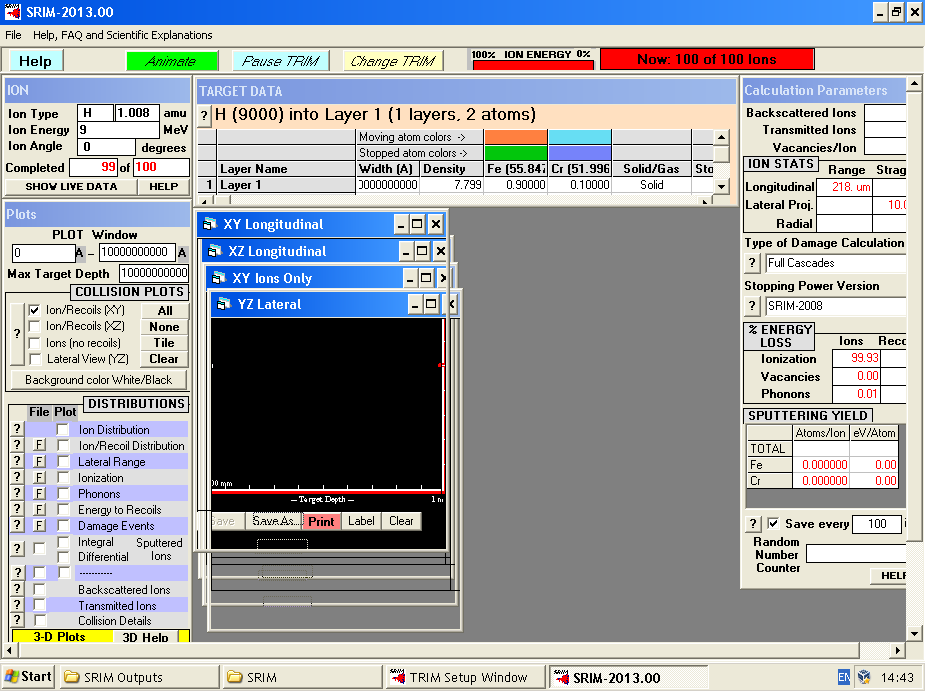


Set the TRIM calculation:

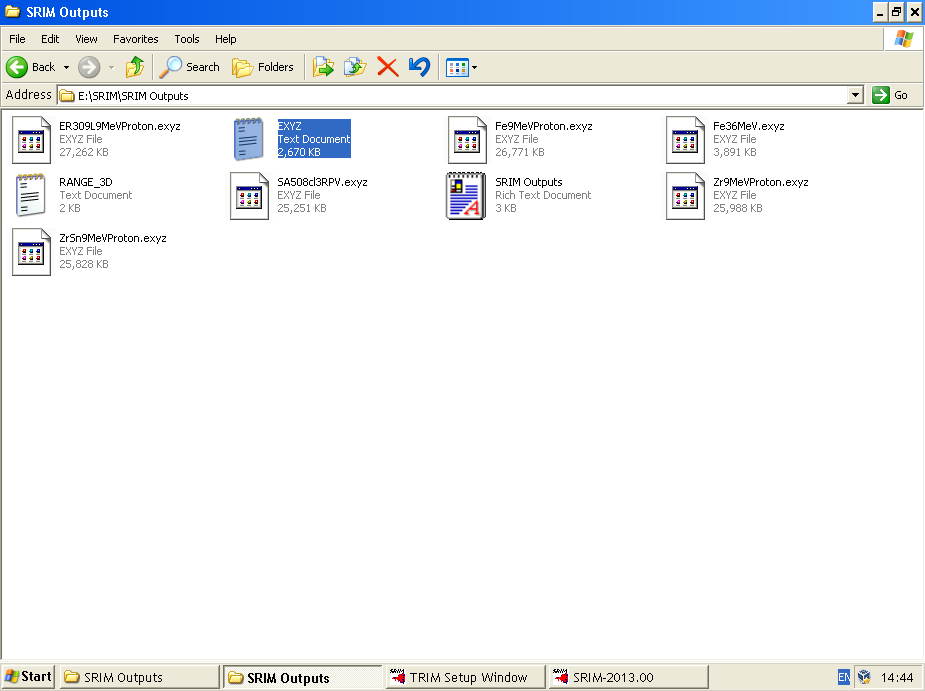
* Detailed Calculation with full Damage Cascades
* Set the ion energy (in KeV)
* Set a reasonable target width that will stop all ions (I usually use 1E10 angstroms)
* Add elements to the layer/layers and set the stoichiometry
* Set the number of ions (100 to 1000 will give a file size of 20-100Mb, otherwise the data file will be very large)
* Enter the EXYZ increment in eV (10-50eV are reasonable values)



Wait for the calculation to run:



Go the the “SRIM Outputs” folder in the SRIM installation directory, and the EXYZ.txt data file will be output there.



## Compiling The Activity Code

Log on to a Linux computer or virtual computer (these notes are specific to Linux Mint, but aren’t too different to any other Linux OS).

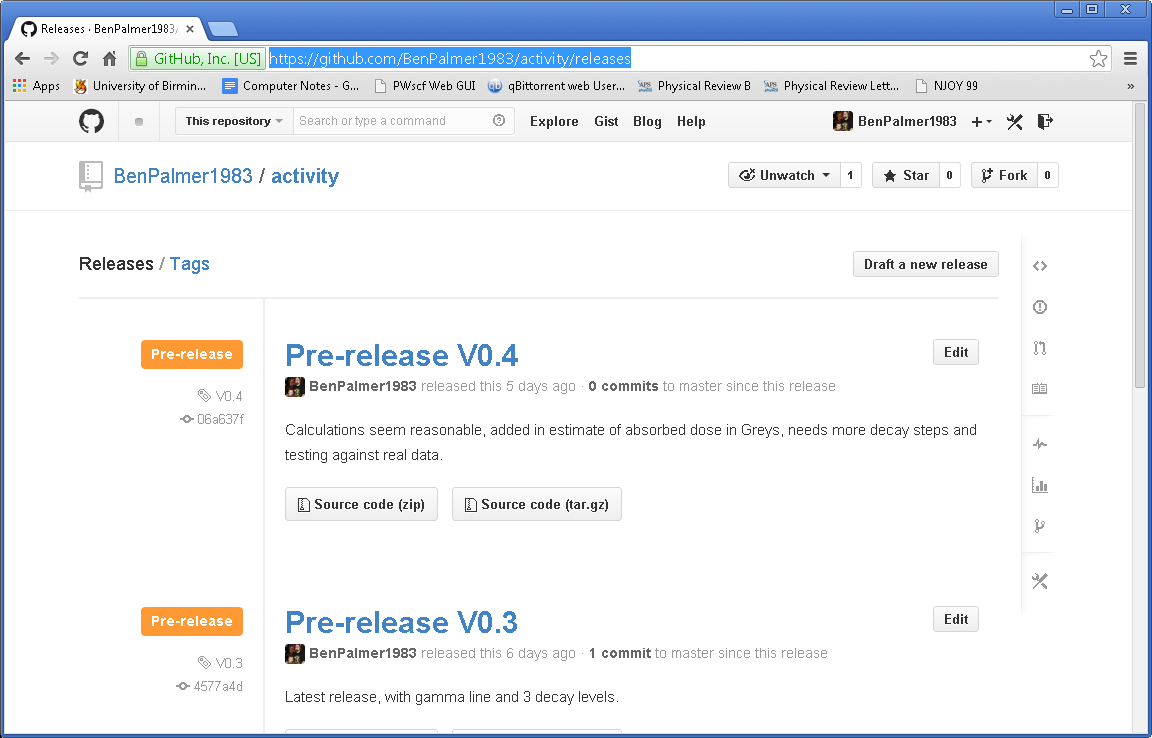
**Install required packages**

In the terminal type:

$ sudo apt-get install -y wget gfortran

**Download the Source Code**

Download the latest release from https://github.com/BenPalmer1983/activity/releases either through the web or with wget to the home directory:



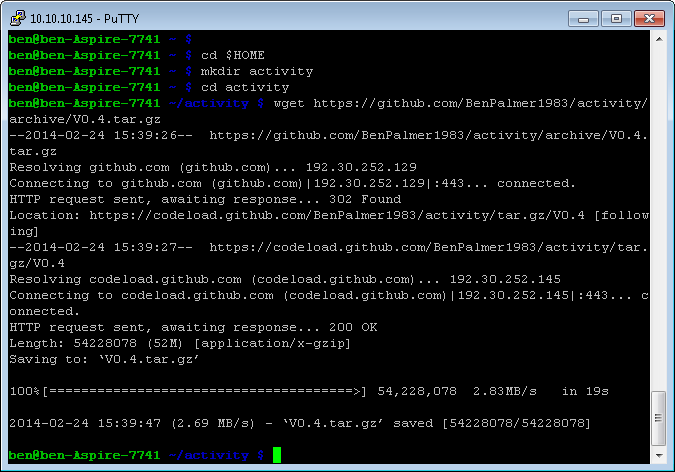
In the terminal:

$ cd $HOME

$ mkdir activity

$ cd activity

$ wget https://github.com/BenPalmer1983/activity/archive/V0.4.tar.gz

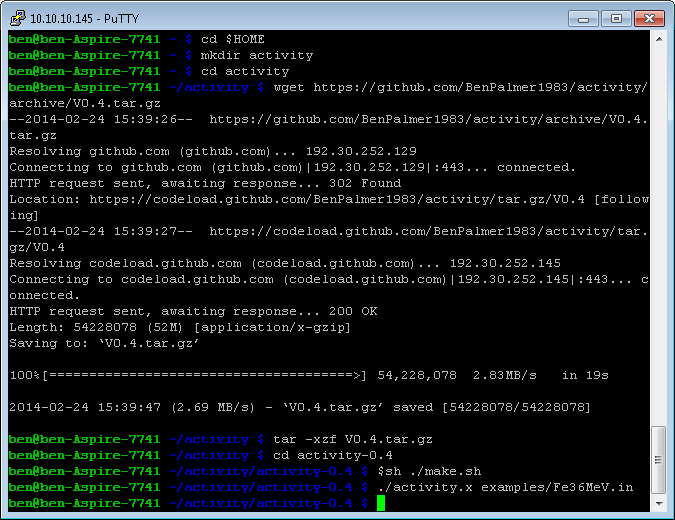


Now in the terminal, extract the files and compile:

$ tar -xzf V\*.tar.gz

$ cd activity\*

$ $sh ./make.sh



The make.sh script makes the activity.x program. To run the example Iron input file, run the activity program followed by the name of the input file:

$ ./activity.x examples/Fe36MeV.in

This will produce several output files in the directory the activity.x is run in:

* activityHistory.dat
* output.dat

The activityHistory.dat contains the activity calculated at different times, from the start of the simulation to the end. The output.dat file contains a log of the calculation process, the start/end tallies of isotopes, the activities of these isotopes and also the predicted gamma energies and counts at the end of the simulation.

# Activity Equations