# Brief introduction to the JupyterLab environment

This notebook was created for the "Hands-on school on nuclear data from Research Reactors" course (organized by the Centre for Energy Research & Institute of Nuclear Techniques, and Budapest University of Technology and Economics, in Budapest, Hungary, September 25-29, 2023) of the "Accelerator and Research reactor Infrastructures for Education and Learning" (ARIEL) project.



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### JupyterLab is a web-based interactive development environment.

### It offers a flexible interface, that helps users to develop open-source software, open standards, and services for interactive computing across multiple (over 40 different) programming languages. Supported languages include Python, R, Julia, Scala, etc.

### We are going to focus (in a non-exhaustive way) on the usage with Python.

For further details, see: jupyter.org

## Installing JupyterLab:

The application requires Python 3.
Enter the following commands in a command line (terminal).
NOTE, that commands containing 'python3' and 'pip3' may have to be switched to 'python' and 'pip' respectively.

- installing pip package manager:

```
sudo apt install python3-pip
```

- installing jupyter package for python:

```
pip3 install jupyter
```

- installing other useful packages:

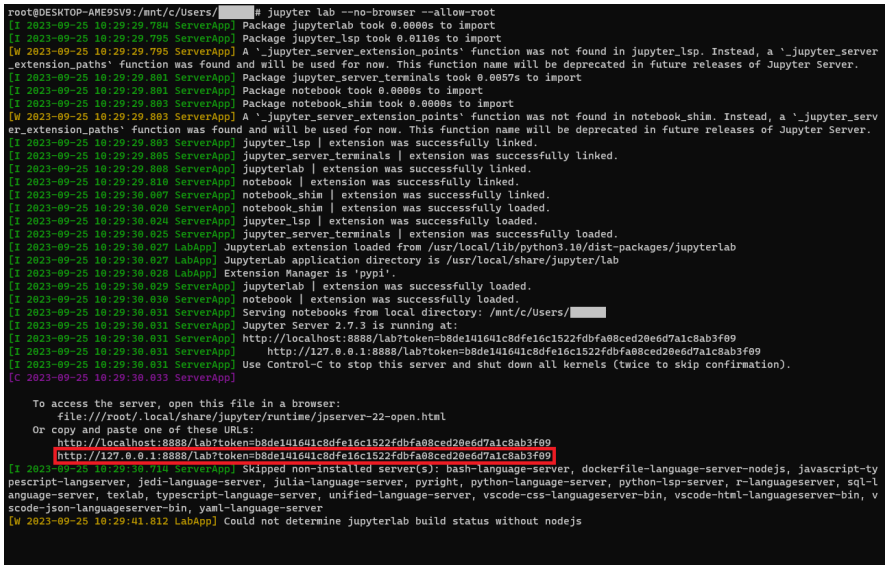
```
pip3 install numpy
pip3 install scipy
pip3 install pandas
pip3 install matplotlib
```

...

## Running JupyterLab:

Execute the following command in the terminal:

```
jupyter lab --no-browser --allow-root
```




Open the link in a browser.

## Lab interface:

- File Browser
  - New Launcher
    - Notebook
      - kernel, cells, cell types
      - preserves input, output and sequence history
    - Python console
    - System terminal

    - Text file
    - Python file
  - New Folder
  - Upload Files
  - Refresh
- Running terminals and kernels
  - Open tabs
  - Kernels
  - Terminals
- some useful menu items (can be in context menu)
  - File -> Download
  - File -> Save and Export Notebook As...
    - (eg. PDF, may need to install: `sudo apt-get install texlive-xetex texlive-fonts-recommended texlive-plain-generic` )
  - File -> Shutdown
  - Edit -> Split Cell

```
- Edit -> Merge...
- View -> Collapse...
-  View -> Expand...
- Run -> ...
- Kernel -> Restart...
- Context -> Show in File Browser
```

In [1]:
```
import numpy
print( "Useful number: ", numpy.sqrt(2) )
```

```
Useful number:  1.4142135623730951
```

In [2]:
```
# Commands can be sent to the operating system
import os
os.system("date")
```

```
Tue Sep 26 13:37:37 UTC 2023
```

Out[2]: 0

## Related to the current course:

Jupyter can be used for visualization of nuclear data.
Eg. with the "ENDF Python Interface" ( `pip3 install endf` ), which can read cross-section data from ENDF6 files (see: online documentation)

In [3]:
```
import endf
from matplotlib import pyplot as plt
```

In [4]:
```
xs_file = './data/n-001_H_001.endf'
os.system('cat '+xs_file)
```

```
 $Rev:: 532      $  $Date:: 2011-12-05#$                          1 0  0    0
 1.001000+3 9.991673-1          0          0          0          5 125 1451    1
 0.000000+0 0.000000+0          0          0          0          6 125 1451    2
 1.000000+0 2.000000+7          1          0         10          7 125 1451    3
 0.000000+0 0.000000+0          0          0         87         10 125 1451    4
  1-H -  1 LANL       EVAL-OCT05 G.M.Hale                          125 1451    5
                      DIST-DEC06                       20111222    125 1451    6
----ENDF/B-VII.1      MATERIAL  125                                125 1451    7
-----INCIDENT NEUTRON DATA                                         125 1451    8
------ENDF-6 FORMAT                                               125 1451    9
                                                                   125 1451   10
 ***************************************************************   125 1451   11
The new R-matrix analysis of the N-N system on which the ENDF/B-   125 1451   12
VII evaluation for 1H is based differs from the previous one use   125 1451   13
for ENDF/B-VI in several respects. Firstly, the n-p capture        125 1451   14
reaction (MT=102), and its inverse, deuteron photo-                125 1451   15
disintegration, were a part of the analysis, rather than added     125 1451   16
later as before. The analysis used a new method for including      125 1451   17
photon channels in R-matrix theory [1], which gave a better        125 1451   18
description of the E1 transitions, in particular.  The data for    125 1451   19
these reactions are mostly integrated and differential cross       125 1451   20
sections, but some information about polarizations was also        125 1451   21
included.  The thermal capture cross section was taken to be       125 1451   22
332.0 mb, as was the recommendation from preliminary data          125 1451   23
testing. Good agreement was obtained with recent cross-section     125 1451   24
measurements [2,3] by astrophysical groups in the 20-550 keV       125 1451   25
range, as well as with earlier measurements that had been done     125 1451   26
mostly as photo-disintegration experiments at energies below 14    125 1451   27
MeV.                                                               125 1451   28
The new analysis includes several additional measurements of the   125 1451   29
total cross section (MT=1).  The evaluated cross section           125 1451   30
deviates at most by about -0.5% around 10 MeV from that of         125 1451   31
ENDF/B-VI.  The estimated uncertainty of the MT=1 cross section    125 1451   32
is given at 2 MeV steps in the following table:                    125 1451   33
           En             Uncert. (%)                              125 1451   34
            0                0.20                                  125 1451   35
            2                0.22                                  125 1451   36
            4                0.30                                  125 1451   37
            6                0.36                                  125 1451   38
            8                0.44                                  125 1451   39
           10                0.50                                  125 1451   40
           12                0.49                                  125 1451   41
           14                0.46                                  125 1451   42
           16                0.40                                  125 1451   43
           18                0.35                                  125 1451   44
           20                0.30                                  125 1451   45
                                                                   125 1451   46
For n-p scattering (MT=2), new information was included about the  125 1451   47
low-energy cross sections (MF=3) and about the angular             125 1451   48
distributions (MF=4).  A new me
```

Out[4]: 0

```
asurement of the angular            125 1451   49
distribution at 10 MeV [4], plus corrections to earlier data at    125 1451   50
14 MeV, moved the back-angle asymmetry in the 10-14 MeV range to   125 1451   51
values that lie between those obtained for ENDF/B-V and ENDF/B-    125 1451   52
VI.  The addition of the latest value of the thermal coherent      125 1451   53
scattering length [5] had the interesting effect of reducing the   125 1451   54
"zero-energy" scattering cross section somewhat to agree           125 1451   55
perfectly with an earlier measurement by Houk [6], and disagree    125 1451   56
with the later, more precise, value of Dilg [7].  The              125 1451   57
covariances for MT=2 will be added later, but the uncertainties    125 1451   58
on the integrated cross section should be similar to those         125 1451   59
listed above for the total cross section.                          125 1451   60
                                                                   125 1451   61
REFERENCES                                                         125 1451   62
                                                                   125 1451   63
[1] G. M. Hale and A. S. Johnson, Proc. 17th Int. IUPAP Conf. on   125 1451   64
    Few-Body Problems in Physics, 5-10 June 2003, Durham NC, W.    125 1451   65
    Gloeckle and W. Tornow,  eds., Elsevier B.V., pp. S120-S122    125 1451   66
   (2004).                                                         125 1451   67
[2] T. S. Suzuki et al., Astrophys. Lett. 449, L59 (1995).         125 1451   68
[3] Y. Nagai et al., Phys. Rev. C 56, 3173 (1997).                 125 1451   69
[4] N. Boukharouba et al., Phys. Rev. C 65, 014004 (2002).         125 1451   70
[5] K. Schoen et al., Phys. Rev. C 67, 044005 (2003).              125 1451   71
[6] T. L. Houk, Phys. Rev. C 3, 1886 (1971).                       125 1451   72
[7] W. Dilg, Phys. Rev. C 11, 103 (1975).                          125 1451   73
 ************************************************************      125 1451   74
                                                                   125 1451   75
Covariances were adopted from COMMARA-2.0 library in July 2011.    125 1451   76
These covariances were obtained at LANL by full scale R-matrix     125 1451   77
analysis of more than 5000 experimental data (chi-square/degree    125 1451   78
of freedom of 0.83). [1] The major channel in this case is elastic 125 1451   79
scattering, often labeled also as ''n-p'' scattering. Elastic      125 1451   80
scattering serves as neutron cross section standard from 1 keV to  125 1451   81
20 MeV, with cross sections well determined. Uncertainties for     125 1451   82
elastic scattering rise from values well below 1%, reach maximum   125 1451   83
at about 8 MeV, then gradually decrease with increasing energy.    125 1451   84
In addition to elastic scattering, covariances are supplied for    125 1451   85
radiative capture.                                                 125 1451   86
                                                                   125 1451   87
REFERENCES                                                         125 1451   88
[1] G. M. Hale, "Covariances from light-element R-matrix           125 1451   89
analyses," Nuclear Data Sheets, 109, 2812 (2008).                  125 1451   90
 ************************************************************      125 1451   91
                              1        451        101          5 125 1451   92
                              2        151          4          0 125 1451   93
                              3          1         35          4 125 1451   94
                              3          2         35          4 125 1451   95
                              3        102         35          5 125 1451   96
                              4          2        196          4 125 1451   97
                              6        102        201          4 125 1451   98
                             33          1          5          5 125 1451   99
                             33          2         21          5 125 1451  100
                             33        102         21          5 125 1451  101
 0.000000+0 0.000000+0          0          0          0          0 125 1  099999
 0.000000+0 0.000000+0          0          0          0          0 125 0  0    0
 1.001000+3 9.991673-1          0          0          1          0 125 2151   1
 1.001000+3 1.000000+0          0          0          1          0 125 2151   2
 1.000000-5 1.000000+5          0          0          0          0 125 2151   3
 5.000000-1 1.276553+0          0          0          0          0 125 2151   4
 0.000000+0 0.000000+0          0          0          0          0 125 2  099999
 0.000000+0 0.000000+0          0          0          0          0 125 0  0    0
 1.001000+3 9.991673-1          0          0          0          0 125 3  1    1
 0.000000+0 0.000000+0          0          0          2         96 125 3  1    2
         30          5         96          2                       125 3  1    3
 1.000000-5 3.713628+1 2.000000-5 3.224498+1 5.000000-5 2.790478+1 125 3  1    4
 1.000000-4 2.571732+1 2.000000-4 2.417056+1 5.000000-4 2.279806+1 125 3  1    5
 1.000000-3 2.210633+1 2.000000-3 2.161720+1 5.000000-3 2.118318+1 125 3  1    6
 1.000000-2 2.096443+1 2.530000-2 2.076834+1 5.000000-2 2.067250+1 125 3  1    7
 1.000000-1 2.060332+1 2.000000-1 2.055439+1 5.000000-1 2.051095+1 125 3  1    8
 1.000000+0 2.048901+1 2.000000+0 2.047341+1 5.000000+0 2.045928+1 125 3  1    9
 1.000000+1 2.045169+1 2.000000+1 2.044545+1 5.000000+1 2.043707+1 125 3  1   10
 1.000000+2 2.042815+1 2.000000+2 2.041317+1 5.000000+2 2.037161+1 125 3  1   11
 1.000000+3 2.030435+1 2.000000+3 2.017221+1 4.000000+3 1.991433+1 125 3  1   12
 6.000000+3 1.966407+1 8.000000+3 1.942096+1 1.000000+4 1.918468+1 125 3  1   13
 1.500000+4 1.862195+1 2.000000+4 1.809600+1 4.000000+4 1.629575+1 125 3  1   14
 6.000000+4 1.486744+1 8.000000+4 1.370595+1 1.000000+5 1.274239+1 125 3  1   15
 1.500000+5 1.092347+1 2.000000+5 9.643237+0 3.000000+5 7.951994+0 125 3  1   16
 4.000000+5 6.876451+0 5.000000+5 6.125481+0 6.000000+5 5.566913+0 125 3  1   17
 7.000000+5 5.132043+0 8.000000+5 4.781603+0 9.000000+5 4.491504+0 125 3  1   18
 1.000000+6 4.246138+0 1.200000+6 3.850489+0 1.400000+6 3.541783+0 125 3  1   19
 1.600000+6 3.291349+0 1.800000+6 3.082224+0 2.000000+6 2.903682+0 125 3  1   20
 2.200000+6 2.748580+0 2.400000+6 2.611955+0 2.600000+6 2.490235+0 125 3  1   21
 2.800000+6 2.380773+0 3.000000+6 2.281558+0 3.200000+6 2.191030+0 125 3  1   22
 3.400000+6 2.107954+0 3.600000+6 2.031337+0 3.800000+6 1.960371+0 125 3  1   23
 4.000000+6 1.894386+0 4.200000+6 1.832823+0 4.400000+6 1.775213+0 125 3  1   24
 4.600000+6 1.721153+0 4.800000+6 1.670299+0 5.000000+6 1.622354+0 125 3  1   25
 5.500000+6 1.513587+0 6.000000+6 1.418191+0 6.500000+6 1.333743+0 125 3  1   26
 7.000000+6 1.258400+0 7.500000+6 1.190730+0 8.000000+6 1.129596+0 125 3  1   27
 8.500000+6 1.074084+0 9.000000+6 1.023447+0 9.500000+6 9.770666-1 125 3  1   28
 1.000000+7 9.344290-1 1.050000+7 8.950999-1 1.100000+7 8.587108-1 125 3  1   29
 1.150000+7 8.249463-1 1.200000+7 7.935351-1 1.250000+7 7.642418-1 125 3  1   30
 1.300000+7 7.368615-1 1.350000+7 7.112148-1 1.400000+7 6.871439-1 125 3  1   31
 1.450000+7 6.645095-1 1.500000+7 6.431880-1 1.550000+7 6.230693-1 125 3  1   32
 1.600000+7 6.040552-1 1.650000+7 5.860577-1 1.700000+7 5.689977-1 125 3  1   33
 1.750000+7 5.528040-1 1.800000+7 5.374121-1 1.850000+7 5.227637-1 125 3  1   34
 1.900000+7 5.088059-1 1.950000+7 4.954905-1 2.000000+7 4.827735-1 125 3  1   35
 0.000000+0 0.000000+0          0          0          0          0 125 3  099999
 1.001000+3 9.991673-1          0          0          0          0 125 3  2    1
 0.000000+0 0.000000+0          0          0          1         96 125 3  2    2
         96          2                                             125 3  2    3
 1.000000-5 2.043634+1 2.000000-5 2.043634+1 5.000000-5 2.043634+1 125 3  2    4
 1.000000-4 2.043633+1 2.000000-4 2.043633+1 5.000000-4 2.043633+1 125 3  2    5
 1.000000-3 2.043633+1 2.000000-3 2.043633+1 5.000000-3 2.043633+1 125 3  2    6
 1.000000-2 2.043633+1 2.530000-2 2.043633+1 5.000000-2 2.043633+1 125 3  2    7
 1.000000-1 2.043632+1 2.000000-1 2.043631+1 5.000000-1 2.043627+1 125 3  2    8
 1.000000+0 2.043620+1 2.000000+0 2.043606+1 5.000000+0 2.043566+1 125 3  2    9
 1.000000+1 2.043499+1 2.000000+1 2.043364+1 5.000000+1 2.042960+1 125 3  2   10
 1.000000+2 2.042288+1 2.000000+2 2.040944+1 5.000000+2 2.036926+1 125 3  2   11
 1.000000+3 2.030269+1 2.000000+3 2.017105+1 4.000000+3 1.991352+1 125 3  2   12
```

```
 6.000000+3 1.966341+1 8.000000+3 1.942040+1 1.000000+4 1.918418+1 125 3  2   13
 1.500000+4 1.862156+1 2.000000+4 1.809567+1 4.000000+4 1.629554+1 125 3  2   14
 6.000000+4 1.486728+1 8.000000+4 1.370583+1 1.000000+5 1.274229+1 125 3  2   15
 1.500000+5 1.092340+1 2.000000+5 9.643178+0 3.000000+5 7.951949+0 125 3  2   16
 4.000000+5 6.876412+0 5.000000+5 6.125445+0 6.000000+5 5.566879+0 125 3  2   17
 7.000000+5 5.132010+0 8.000000+5 4.781570+0 9.000000+5 4.491471+0 125 3  2   18
 1.000000+6 4.246104+0 1.200000+6 3.850454+0 1.400000+6 3.541748+0 125 3  2   19
 1.600000+6 3.291314+0 1.800000+6 3.082187+0 2.000000+6 2.903645+0 125 3  2   20
 2.200000+6 2.748543+0 2.400000+6 2.611918+0 2.600000+6 2.490197+0 125 3  2   21
 2.800000+6 2.380736+0 3.000000+6 2.281521+0 3.200000+6 2.190993+0 125 3  2   22
 3.400000+6 2.107917+0 3.600000+6 2.031301+0 3.800000+6 1.960334+0 125 3  2   23
 4.000000+6 1.894349+0 4.200000+6 1.832787+0 4.400000+6 1.775177+0 125 3  2   24
 4.600000+6 1.721118+0 4.800000+6 1.670264+0 5.000000+6 1.622318+0 125 3  2   25
 5.500000+6 1.513553+0 6.000000+6 1.418157+0 6.500000+6 1.333709+0 125 3  2   26
 7.000000+6 1.258367+0 7.500000+6 1.190697+0 8.000000+6 1.129564+0 125 3  2   27
 8.500000+6 1.074052+0 9.000000+6 1.023415+0 9.500000+6 9.770347-1 125 3  2   28
 1.000000+7 9.343974-1 1.050000+7 8.950685-1 1.100000+7 8.586796-1 125 3  2   29
 1.150000+7 8.249154-1 1.200000+7 7.935044-1 1.250000+7 7.642113-1 125 3  2   30
 1.300000+7 7.368313-1 1.350000+7 7.111848-1 1.400000+7 6.871141-1 125 3  2   31
 1.450000+7 6.644799-1 1.500000+7 6.431586-1 1.550000+7 6.230401-1 125 3  2   32
 1.600000+7 6.040262-1 1.650000+7 5.860290-1 1.700000+7 5.689692-1 125 3  2   33
 1.750000+7 5.527757-1 1.800000+7 5.373840-1 1.850000+7 5.227359-1 125 3  2   34
 1.900000+7 5.087783-1 1.950000+7 4.954630-1 2.000000+7 4.827462-1 125 3  2   35
 0.000000+0 0.000000+0          0          0          0          0 125 3  099999
 1.001000+3 9.991673-1          0          0          0          0 125 3102    1
 2.224631+6 2.224631+6          0          0          2         96 125 3102    2
        30          5         96          2                     125 3102    3
 1.000000-5 1.669994+1 2.000000-5 1.180864+1 5.000000-5 7.468441+0 125 3102    4
 1.000000-4 5.280985+0 2.000000-4 3.734221+0 5.000000-4 2.361728+0 125 3102    5
 1.000000-3 1.669994+0 2.000000-3 1.180864+0 5.000000-3 7.468441-1 125 3102    6
 1.000000-2 5.280985-1 2.530000-2 3.320126-1 5.000000-2 2.361728-1 125 3102    7
 1.000000-1 1.669993-1 2.000000-1 1.180863-1 5.000000-1 7.468415-2 125 3102    8
 1.000000+0 5.280948-2 2.000000+0 3.734168-2 5.000000+0 2.361645-2 125 3102    9
 1.000000+1 1.669877-2 2.000000+1 1.180698-2 5.000000+1 7.465816-3 125 3102   10
 1.000000+2 5.277275-3 2.000000+2 3.728978-3 5.000000+2 2.353460-3 125 3102   11
 1.000000+3 1.658348-3 2.000000+3 1.164526-3 4.000000+3 8.122556-4 125 3102   12
 6.000000+3 6.543522-4 8.000000+3 5.592552-4 1.000000+4 4.937688-4 125 3102   13
 1.500000+4 3.906824-4 2.000000+4 3.283054-4 4.000000+4 2.082663-4 125 3102   14
 6.000000+4 1.550608-4 8.000000+4 1.241126-4 1.000000+5 1.037740-4 125 3102   15
 1.500000+5 7.450778-5 2.000000+5 5.927795-5 3.000000+5 4.460357-5 125 3102   16
 4.000000+5 3.827476-5 5.000000+5 3.529043-5 6.000000+5 3.389904-5 125 3102   17
 7.000000+5 3.334204-5 8.000000+5 3.324413-5 9.000000+5 3.340211-5 125 3102   18
 1.000000+6 3.369898-5 1.200000+6 3.445546-5 1.400000+6 3.521705-5 125 3102   19
 1.600000+6 3.587303-5 1.800000+6 3.638957-5 2.000000+6 3.676631-5 125 3102   20
 2.200000+6 3.701693-5 2.400000+6 3.715993-5 2.600000+6 3.721435-5 125 3102   21
 2.800000+6 3.719773-5 3.000000+6 3.712539-5 3.200000+6 3.701023-5 125 3102   22
 3.400000+6 3.686289-5 3.600000+6 3.669203-5 3.800000+6 3.650457-5 125 3102   23
 4.000000+6 3.630600-5 4.200000+6 3.610063-5 4.400000+6 3.589183-5 125 3102   24
 4.600000+6 3.568218-5 4.800000+6 3.547364-5 5.000000+6 3.526769-5 125 3102   25
 5.500000+6 3.477049-5 6.000000+6 3.430506-5 6.500000+6 3.387418-5 125 3102   26
 7.000000+6 3.347699-5 7.500000+6 3.311084-5 8.000000+6 3.277233-5 125 3102   27
 8.500000+6 3.245788-5 9.000000+6 3.216400-5 9.500000+6 3.188749-5 125 3102   28
 1.000000+7 3.162545-5 1.050000+7 3.137531-5 1.100000+7 3.113485-5 125 3102   29
 1.150000+7 3.090214-5 1.200000+7 3.067552-5 1.250000+7 3.045360-5 125 3102   30
 1.300000+7 3.023518-5 1.350000+7 3.001928-5 1.400000+7 2.980507-5 125 3102   31
 1.450000+7 2.959190-5 1.500000+7 2.937920-5 1.550000+7 2.916656-5 125 3102   32
 1.600000+7 2.895363-5 1.650000+7 2.874018-5 1.700000+7 2.852603-5 125 3102   33
 1.750000+7 2.831107-5 1.800000+7 2.809523-5 1.850000+7 2.787851-5 125 3102   34
 1.900000+7 2.766095-5 1.950000+7 2.744259-5 2.000000+7 2.722354-5 125 3102   35
 0.000000+0 0.000000+0          0          0          0          0 125 3  099999
 0.000000+0 0.000000+0          0          0          0          0 125 0  0    0
 1.001000+3 9.991673-1          0          1          0          0 125 4  2    1
 0.000000+0 9.991673-1          0          2          0          0 125 4  2    2
 0.000000+0 0.000000+0          0          0          1         96 125 4  2    3
        96          2                                             125 4  2    4
 0.000000+0 1.000000-5          0          0          6          0 125 4  2    5
-1.60266-14 5.54677-17 2.13338-17 2.27560-17-7.75773-18-2.23184-17 125 4  2    6
 0.000000+0 2.000000-5          0          0          6          0 125 4  2    7
-3.19039-14 4.35208-17 9.75257-18 2.08597-17-1.39639-17-4.06982-17 125 4  2    8
 0.000000+0 5.000000-5          0          0          6          0 125 4  2    9
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-1.939814-4-8.868372-6                                              125 6102   50
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-2.739385-4-1.774966-5                                              125 6102   52
 0.000000+0 5.000000+2          0          0          2          2 125 6102   53
-4.321803-4-4.447111-5                                              125 6102   54
 0.000000+0 1.000000+3          0          0          2          2 125 6102   55
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 0.000000+0 2.000000+3          0          0          2          2 125 6102   57
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 0.000000+0 4.000000+3          0          0          2          2 125 6102   59
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 0.000000+0 1.500000+4          0          0          2          2 125 6102   67
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 0.000000+0 2.000000+4          0          0          2          2 125 6102   69
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-4.330502-3-4.543273-3                                              125 6102   72
 0.000000+0 6.000000+4          0          0          2          2 125 6102   73
-5.588012-3-7.512594-3                                              125 6102   74
 0.000000+0 8.000000+4          0          0          2          2 125 6102   75
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 0.000000+0 1.000000+5          0          0          2          2 125 6102   77
-7.758366-3-1.463626-2                                              125 6102   78
 0.000000+0 1.500000+5          0          0          2          2 125 6102   79
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-1.140889-2-3.703915-2                                              125 6102   82
 0.000000+0 3.000000+5          0          0          2          2 125 6102   83
-1.266425-2-6.138415-2                                              125 6102   84
 0.000000+0 4.000000+5          0          0          2          2 125 6102   85
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 0.000000+0 5.000000+5          0          0          2          2 125 6102   87
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 0.000000+0 8.000000+5          0          0          2          2 125 6102   93
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 0.000000+0 9.000000+5          0          0          2          2 125 6102   95
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 0.000000+0 1.600000+6          0          0          2          2 125 6102  103
 5.580115-3-1.744435-1                                              125 6102  104
 0.000000+0 1.800000+6          0          0          2          2 125 6102  105
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 0.000000+0 2.600000+6          0          0          2          2 125 6102  113
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 0.000000+0 2.800000+6          0          0          2          2 125 6102  115
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 0.000000+0 3.200000+6          0          0          2          2 125 6102  119
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 0.000000+0 3.800000+6          0          0          2          2 125 6102  125
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 0.000000+0 4.000000+6          0          0          2          2 125 6102  127
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 0.000000+0 4.600000+6          0          0          2          2 125 6102  133
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 0.000000+0 6.000000+6          0          0          2          2 125 6102  141
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 0.000000+0 6.500000+6          0          0          2          2 125 6102  143
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 0.000000+0 7.000000+6          0          0          2          2 125 6102  145
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 1.002000+3 1.996256+0          0          4          1          2 125 6102  199
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 0.000000+0 0.000000+0          0          0          0          0 125 0  0    0
 1.001000+3 9.991673-1          0          0          0          1 12533  1    1
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 1.000000+0 2.000000+0 1.000000+0 1.020000+2                           12533  1    5
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 0.000000+0 0.000000+0          0          2          0          1 12533  2    2
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 1.000000-5 1.000000+5 5.000000+5 1.000000+6 2.000000+6 4.000000+6 12533  2    4
 6.000000+6 8.000000+6 1.000000+7 1.200000+7 1.400000+7 1.600000+7 12533  2    5
 1.800000+7 2.000000+7 8.775421-6 1.388488-5 2.798014-5 3.886612-5 12533  2    6
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 0.000000+0 0.000000+0          0        102          0          1 12533102   2
 0.000000+0 0.000000+0          1          5        105         14 12533102   3
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 6.000000+6 8.000000+6 1.000000+7 1.200000+7 1.400000+7 1.600000+7 12533102   5
 1.800000+7 2.000000+7 6.517639-4 1.140603-3 1.814264-3 1.560636-3 12533102   6
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6.576406-2 5.486746-2 4.664386-2 4.028771-2 3.527584-2 3.120757-2 12533102   18
4.583375-2 3.902245-2 3.376506-2 2.962370-2 2.626567-2 3.328758-2 12533102   19
2.886709-2 2.539081-2 2.257507-2 2.510044-2 2.214385-2 1.975366-2 12533102   20
1.960192-2 1.755105-2 1.577899-2                                  12533102   21
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0.000000+0 0.000000+0          0          0          0          0 125 0  0    0
0.000000+0 0.000000+0          0          0          0          0   0 0  0    0
0.000000+0 0.000000+0          0          0          0          0  -1 0  0    0
```
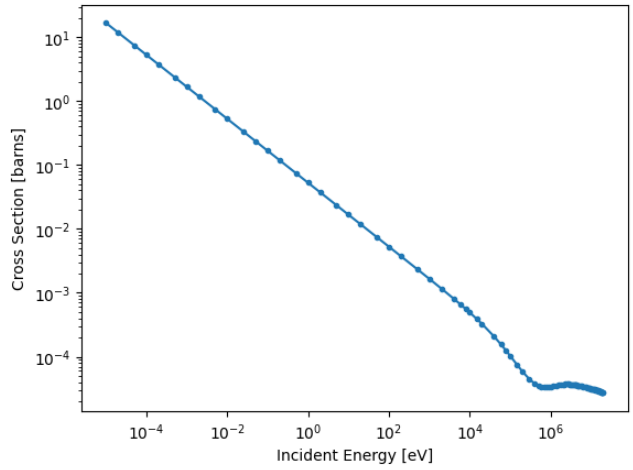

In [6]:
```
plt.loglog(xs.x, xs.y, marker='.', label='(n,g)')

plt.xlabel('Incident Energy [eV]')
plt.ylabel('Cross Section [barns]')
plt.show()
```




In [7]:
```
mat
```

Out[7]:
```
<Incident-neutron data for 1-H-1 ENDF/B>
```

In [ ]:
```
mat
```

In [ ]:
```

```