Notes on using the
`NuclearProperties`
package

David Harrison

This note is intended to help students use *Mathematica (MMA)* and the locally written `NuclearProperties` package to extract and display information and plots of interest in, for example, PHY453H - Nuclear Physics.

We shall be using the MMA built-in `Map` extensively below; §III of the locally written document **Mathematica & UPSCALE** has an introduction to this operator. This document also contains a bibliography of where you may learn more about MMA. You may also wish to know that the 'bible' of MMA, the book **Mathematica** by Stephen Wolfram, is available from the II Year Lab library.

After loading the package: [1]

```
In[1]:= << NuclearProperties`
```

you can extract a list of all the isotopes with mass number of, say, 67, with:

```
In[2]:= elts = IsotopesFromA[67]

Out[2]= {Ni67, Cu67, Zn67, Ga67, Ge67, As67}
```

You can then use a map to form a list of binding energies

```
In[3]:= bes = Map[BindingEnergy, elts]

Out[3]= {{582620., 19}, {585397., 8}, {585191.6, 1.6},

>      {583408.2, 1.7}, {578404., 5}, {571610., 100}}
```

You can extract the maximum value of the binding energy, by again doing a map:

```
In[4]:= maxbe = Max[ Map[ First, bes ]]

Out[4]= 585397.
```

All of the above could be combined into a single, large, expression:

```
In[5]:= maxbe = Max[ Map[ First, Map[ BindingEnergy,
             IsotopesFromA[67]]]]
```

1. The `In[1]:=` is the prompt from Mathematica; you will not type that in.

```
Out[5]= 585397.
```

One could form, for example, a list of the atomic number *A* and the maximum binding energy for values of *A* from 64 to 68 with:

```
In[6]:= betable = Table[ {a, Max[ Map[ First,
            Map[ BindingEnergy, IsotopesFromA[a]]]]},
            {a,64,68}]

Out[6]= {{64, 561760.5}, {65, 569213.6}, {66, 578139.4},
            {67, 585397.}, {68, 595389.8}}
```

which could then be used, for example, [2] in a `ListPlot[]` or to do a fit with `Fit[]`.

Finally , we have presented the above as a MMA session such as you get by invoking *math* from the *main* menu. Typing commands as complicated as input line 6 above presents a serious challenge to the typist. In addition, it is fairly easy to make mistakes that get MMA confused about the name space it has available. Both of these can be addressed by using the *prog* sub-system to create an *interactive Mathematica* program using the ‘bare bones’ template provided there. It is likely that in the long run using this facility will take you less time than trying to type your commands interactively . This is especially true since forming big tables in the spirit of input line 6 above takes a significant amount of computer time. You should also remember that forming such a big table, you will probably not want it to be listed on your screen; adding a semi-colon `;` to the end of the input line suppresses the listing.

D. Harrison, Oct/93, 1.1, last rev. 10/15/93

---

2. For students in PHY435H this is not exactly what you are being asked to produce for your problem set.