Hw 2

Group 2

Problem 14:

Calculate the Fermi (*F*) and Gamow-Teller (*GT*) beta decay of ^{22}O. The experimental energy of the lowest 1+ state in ^{22}F is 1.627 MeV. You will need to put this in the xxx.beq file and rerun the beta program (see the end of the xxx.bat file for how to do this). Compare the summed *B*(*F*) and *B*(*GT*) values to that expected from the sum-rules. What fraction of the *GT* sum-rule is in the transition to the lowest energy 1+ state?

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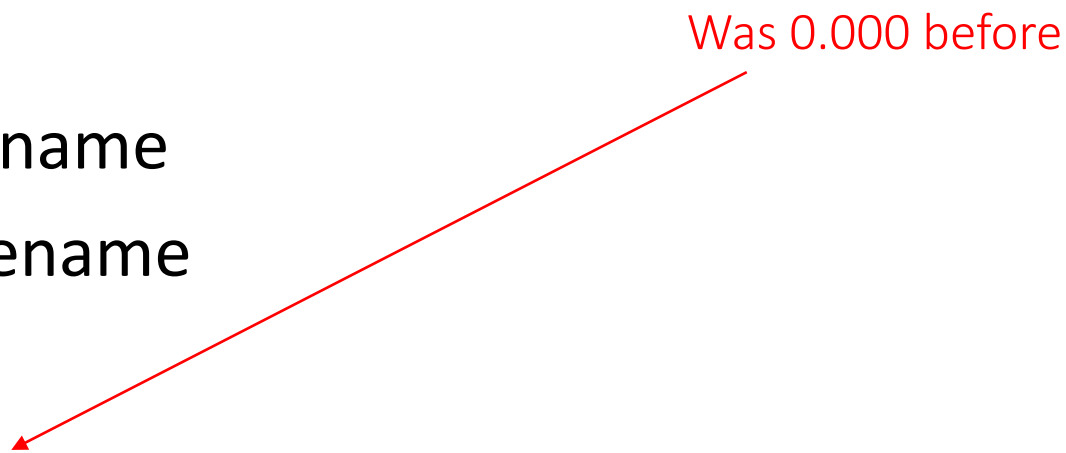
----------------------------------------------------
lpe,   0          ! option (lpe or lan), neig (zero=10)
sd                ! model space (*.sp) name (a8)
n                 ! any restrictions (y/n)
usdb              ! interaction (*.int) name (a8)
 8                ! number of protons
 22               ! number of nucleons
 0.0, 0.0, 1.0,   ! min J, max J, del J
 0                ! parity (0 for +) (1 for -) (2 for both)
----------------------------------------------------
lpe,   0          ! option (lpe or lan), neig (zero=10)
 9                ! number of protons
 22               ! number of nucleons
 0.0, 4.0, 1.0,   ! min J, max J, del J
 0                ! parity (0 for +) (1 for -) (2 for both)
----------------------------------------------------
den               ! option
t                 ! 1, 2 or t
bb0600            ! initial file name (default from lpe above)
  1               ! max number (-1 for all)
bb1600            ! final file name (default = from lpe above)
 -1               ! max number (-1 for all)
 0.0, 0.0, 1.0,   ! min, max J, del J for bb0600
 0.0, 1.0, 1.0,   ! min, max J, del J for bb1600
y                 ! restrict coupling for operator
 0.0, 1.0,        ! min,max delta-J for operator
----------------------------------------------------
st        '       ! option
```

- ----------
- Calculation of the 22-O nucleus (8p, 14n)
- No restrictions
- Our g.s. is 0+, so we only need to put in 0 for our min J, max J
- ----------
- Calculation of the 22-F nucleus (9p, 13n)
- I calculated J 0 to 4, even though only 0, 1 are needed in β decay
- ----------
- This will run the “dens” program
- T- is for the One-body transition density (OBTD)
- We put in the g.s. (00) file from 22-O
- 1 is input because we only want it from the g.s.
- This is the first file from 22-F (it will be overwritten later)
- -1 Runs all options
- g.s. of 22-O is 0+
- Range of J values allowed in 22-F

- By running dens, we
  - create intermediary files
    - .ben – input to dens, tells where to write the output file of matrix elements, and where the OBTD files are created
    - .bei – output of dens
    - .beq – allows input of Q value, an experimental energy
  - create output file
    - .beo – beta decay final output

O_220b.beq file:



- o_220b *.bei filename
- o_220b *.beo filename
- o_220 f_220
- sd usdb
- 8., 9., 22., 0.000, 1.627, 0.60 ! zi, zf, a, q, exf, 0.60 is the quenching factor
- 0.0, 0.0, 0.0 ! texp(s), percent non-GT, texp-err(s)
- END

o_220 f_220

sd usdb

experimental q-value = 6.489 MeV

theoretical q-value = 8.437 MeV

calculated t1/2 = 0.2620E+01 sec

experimental t1/2 = 0.0000E+00 (+/-) 0.0000E+00 sec

ji,ti = 0.0 3.0

non gamow-teller br = 0.00%

ft = 6177/[qf*(1.260**2.)b(gt)+b(f)] where qf = 0.60 for the quenching factor

sum b(gt) b(f) = 3.72285 6.00000

centroid = 5.75152

sum b(gt)/3|n-z| = 0.20682 for o_220b

th [br*b(gt)/3|n-z|] = 0.04060

exp [br*b(gt)/3|n-z|] = 0.00000

					sum		sum		
jf	tf	nf	ex(MeV)	br(%)	br(%)	log(ft)	qf*b(gt)	qf*b(gt)	log(fa)	b(f)
1	2	1	1.627	21.4811	78.519	4.800	0.0616	0.0616	3.714	0.00000
1	2	2	2.605	72.4648	6.054	3.829	0.5766	0.6382	3.271	0.00000
0	2	1	3.046	0.0000	6.054	13.595	0.0000	0.6382	3.036	0.00000
1	2	3	3.313	5.2595	0.795	4.577	0.1030	0.7412	2.880	0.00000
1	2	4	4.373	0.0008	0.794	7.652	0.0001	0.7413	2.112	0.00000
1	2	5	4.832	0.7916	0.002	4.184	0.2546	0.9959	1.664	0.00000
0	2	2	5.504	0.0000	0.002	14.138	0.0000	0.9959	0.748	0.00000
1	2	6	5.694	0.0000	0.002	9.137	0.0000	0.9959	0.385	0.00000
1	2	7	6.075	0.0021	0.000	4.412	0.1508	1.1467	-0.675	0.00000
0	2	3	6.609	0.0000	0.000	15.681	0.0000	1.1467	0.000	0.00000
1	2	8	6.807	0.0000	0.000	6.858	0.0005	1.1473	0.000	0.00000
1	2	9	7.258	0.0000	0.000	4.664	0.0844	1.2317	0.000	0.00000
1	2	10	8.124	0.0000	0.000	3.589	1.0020	2.2337	0.000	0.00000
0	2	4	8.588	0.0000	0.000	14.311	0.0000	2.2337	0.000	0.00000
0	2	5	9.282	0.0000	0.000	3.013	0.0000	2.2337	0.000	6.00000
0	2	6	9.572	0.0000	0.000	16.089	0.0000	2.2337	0.000	0.00000
0	2	7	10.174	0.0000	0.000	13.669	0.0000	2.2337	0.000	0.00000
0	2	8	10.915	0.0000	0.000	16.236	0.0000	2.2337	0.000	0.00000
0	2	9	12.714	0.0000	0.000	14.127	0.0000	2.2337	0.000	0.00000
0	2	10	13.048	0.0000	0.000	15.270	0.0000	**2.2337**	0.000	0.00000

- Notice– value for B(F)= 6.. Which is exactly N-Z!! So that is okay.
- Our B(GT) = 3(N-Z), so theoretically it should be 18…. But we only get 3.72285.

- Where did the other 14.3 go?

- The reason is 2-fold
  - Recall we have a quenching factor of 0.6
  - Also, we have only calculated 10 states (the automatic input)– this value changes as we change lpe, 0 to lpe, 50 or lpe, 100