Sept. 29, 2023

MT=5: (n, anything)
Trouble in Paradise

by
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Overview

First, and most important to understand is**: What is the purpose of ENDF**? Henry Honeck designed it as a simple computer independent text based 80 column format (anybody remember computer cards) to easily exchange nuclear and atomic data between users, initially designed primarily for fission applications. Before ENDF in the U.S. each lab/company had its own data base to meet its individual needs. For example, G.E. and Westinghouse each had its own data base that met its needs, but they were incompatible because they had different needs, e.g., different types of nuclear reactions. ENDF is designed to supply nuclear and atomic data to users in the form USERS NEED/WANT IT. It is equally important to understand **what ENDF is not**: ENDF is NOT designed as a storage area for physics ideas or nuclear model code results that are not currently USED/NEEDED in applications. For so many years the great success of ENDF has been based on focusing on this need, as defined by **ACTUAL DATA USERS**. One reason I am writing this memo is that I fear that recently this focus is being lost, and instead what is being created for use in ENDF is based progressively more on what evaluators can produce or what they are interested in, rather than what USERS NEED and what USERS CAN EASILY UNIQUELY USE. Also, I fear ENDF is being pushed to more and more application areas that it was never intended for, and frankly the ENDF format is not a good fit; I will try to explain this below.

The ENDF Bible: ENDF-102:
An Engineering User's Manual, NOT a Physics Book

When Henry Honeck designed the ENDF system he designed not only a format, but much more importantly he designed the documentation, **ENDF-102; what I call the ENDF Bible**. This documentation never claimed to be the BEST definitions of everything; it merely tried to guarantee that everything was uniquely defined. Until then even something as simple as a Breit-Wigner single level resonance was defined differently in any number of different books. journal articles, etc. The two major goals of ENDF-102 were: 1) Uniquely define everything, and 2) Hope/Insure that everyone agreed with and obeyed all of the rules defined in ENDF-102; here by everyone I mean evaluators, who produce the data, to users, who apply the data. **If these two goals are not met we would never to able to do the meaningful data testing required to iterate and attempt to improve our evaluated data.**

Artificial Intelligence

The other important supporting leg of ENDF is the vast array of supporting software. These days AI is a HOT topic that sounds brand new. But in fact, anyone who has ever written a computer code was using Artificial Intelligence, AI, to translate their ideas into hard results. For ENDF over the last almost 60 years we have invested billions of dollars in supporting software and their use. But it is important to note that this ENDF software is AI ONLY IF THE CODES FOLLOW THE STRICT rules defined in ENDF-102. This is the only way in which these codes can be used to produce accurate data for use in our applications. If you, the data producers and users, do not strictly follow the ENDF-102 rules we have what I refer to as AS: Artificial Stupidity, and our application codes are in what we refer to as "Garbage In = Garbage Out"; **our results from our codes can never be more reliable than the data they use.**

ENDF's Great Success

ENDF is now almost 60 years old and one of its great successes has been due to everyone agreeing to follow the ENDF-102 rules, so that the two major goals, listed above, can be met. I feel that one reason for ENDF's great success has been because the governing body for ENDF, CSEWG, was a good balance between data producers and data users, all pooling together their experience and expressing their needs, to achieve one ultimate goal to improve nuclear data and supply it in a form that it can be uniquely used in applications . As far as the quality of our nuclear data is concerned, compared to where we were 60 years ago today we are today in Paradise.

One of the rules requires that evaluators uniquely define everything needed by users in their variety of applications; this is particularly true to ensure our computer codes can produce accurate results. Here there is a big difference between ENDF's goal and theory and/or measurements. In theory/measurements one can report only what they measure, and maybe also what they do not measure or know. Part of the job of evaluation is to – let me repeat – **uniquely define everything required in a variety of applications**. In evaluation it is not good enough to say "I do not know" – part of the evaluator's job is often to make your best guess, in order to supply complete evaluations that can be used in applications to test and hopefully learn and improve the data; that is the best and easiest way to judge how good or bad any "best guess" is.

Without agreeing to supply complete evaluations we cannot achieve the two major goals of ENDF-102, again, I state they are: 1) Uniquely define everything, and 2) Insure that everyone agreed with, and obeyed all of the rules defined in ENDF-102. **If any evaluation is not complete, it follows that everything calculated based on this data is not uniquely defined**, so that each user is forced to make their own assumptions, making meaningful data testing and comparison impossible. It also makes our wealth of software not only unreliable, but dangerous in that the codes can produce results that might appear reasonable but based on the strict ENDF-102 rules are actually rubbish. We end up comparing the apples that I calculate with my assumptions to the oranges you calculate with your assumptions. **If the evaluators do their job users need not make any assumptions.**

What Happened versus What Resulted

Honeck designed ENDF to mimic how we use the data. Step one is to define **what happened**. As an ENDF user I have always been able to do this using only the cross sections included in ENDF MF=3. When I transport a particle from point A to point B (using the MF=3 total), at B I must first define what happened (using the MF=3 partials) and tally the result (this is often the whole purpose of my application). In order to do this, I must uniquely know what reaction I sampled; only in this way can I tally the results I am interested in and move on to the next step: **What Resulted** = what are ALL of the products of the reaction I sampled? Only then need I consider any other part of ENDF, to sample secondary distributions: MF=4 (angular), MF=5 (energy), MF=6 (correlated), etc. This step by step process worked well for almost 50 years of ENDF.

ENDF Unique Reaction Definition and ENDF Sum Rules

When Honeck defined ENDF it was initially designed to handle fission reactor applications and it had a 10 MeV upper energy limit. Honeck's classification system using a two digit MF, to define types of data, and three digit MT, to define "reactions", was more than adequate to uniquely define all possible reactions below 10 MeV. The average binding energy of a nucleon is roughly 6 MeV, so few reactions are energetically possible below 10 MeV. The same was true after ENDF was extended to 20 MeV, to include fusion, such as the 14.1 MeV fusion peak. Even up to 20 MeV Honeck's classification system works, to uniquely define reactions, and sum rules, e.g., MT=4 (n, n') total = sum the sum of MT=50 through 91 (n, n') level, MT=50, is ground, and MT=91 is continuum = using the ENDF definition of continuum, of everything that is left over after using MT=50 to 90; again, I again mention that this is not necessarily identical to the data theorist or measurer's definition of continuum). **Let me stress that for the entire history of ENDF cross section sums were simple math additions of MF=3 defined MT numbers (see ENDF-102, Appendix B.1); all physics was removed from these definitions = simple math sums based on included MT numbers - cross sections for others MT numbers implicitly assumed = ZERO.**

But we should be aware that Honeck's classification system does not work at higher energies; i.e., sorry to have to write that in my humble opinion **ENDF is NOT a completely general format that allows creators and users to uniquely identify each and every reaction.** For example, if ENDF is extended up to 100 MeV, again assuming a nucleon binding energy of roughly 6 MeV, up to 16 particles could be emitted, which would require far more than the ENDF MT three digits (999 values) to uniquely define all possible "reactions". Personally, I feel that CSWG should have recognized this problem and not allowed the ENDF format that works so well up to 20 MeV, to be – in my words – misused. Instead CSEWG decided to extend ENDF to high energy, but CSEWG did recognize the problem that could occur, and approved the use of MT=5 (n, anything) to define complex reaction at **high energy** – repeat: ENDF-102 say to **use MT=5 only for COMPLEX REACTIONS AT HIGH ENERGY**.

So, What's The Problem

Until recently this was never a problem with ENDF. We had a simple convention to uniquely define the cross section for each processes in MF=3, and we users could add all of these "partial" cross sections together to define a total cross section (MT=1). **Everything was strictly and uniquely defined simply by ENDF MT numbers; any defined MT was actual data, and any MT not defined was implied by the evaluator to be ZERO.** For fission and fusion reactors (that ENDF was designed to handle) the traditional data extended from below thermal (1.0d-5 eV) up to 20 MeV (the extreme end of fission/fusion spectra). For me as a Monte Carlo code user this meant I could use the MF=3 total cross section to sample the distance a particle moves from point A to point B, and at point B I could then use each MF=3 "partial" cross section to sample what reaction occurred. Everything was uniquely defined, so any users knew every reaction, and ENDF-102 listed in an appendix the definition of every possible reaction and uniquely defined all of the products of that reaction. Problem Solved.

This all changed when MT=5 (n, anything) was introduced. This occurred when ENDF was extended to high energies above 20 MeV. With roughly 6 MeV binding energy per nucleon the ENDF MT definitions in ENDF-102 were adequate to uniquely define each reaction releasing 3, 4, 5 particles. But to extend up to 100 MeV, required a more general **MT=5, FOR USE AT HIGHER ENERGIES = REPEAT: ENDF-102 EXPLICITLY RESTRICTS MT=5 TO COMPLEX REACTIONS AT HIGH ENERGY**. I have no idea who proposed that MT=5 be added to ENDF, but my guess is that it was a data producer, rather than a data user; fission and fusion calculations do not require any data over 20 MeV, and below this we either uniquely know each reaction or evaluators can/MUST "guess" to supply complete useful evaluations.

As a user I have no idea how to deal with "(n, anything)", and the ENDF-102 Bible is of little use in explicitly explaining. The word "anything" only appears in ENDF-102 four times, three of these having nothing to do with MT=5, and the fourth merely stating that MT=5 means (n, anything). But this fourth use clearly states that **MT=5 MUST BE ADDED along with all of other "partials" to define total cross section (MT=1).** I hope that evaluators read this last statement – let me repeat: MT=5 is added to the total. MT=5 is discussed elsewhere in ENDF-102, and there it specifically states that **MT=5 may be required for COMPLEX REACTIONS at HIGH ENERGY**, however it does not explicitly state what HIGH ENERGY means; **I suggest ENDF-102 should state above 20 MeV**, where it will not interfere with the fission and fusion applications that ENDF was designed to handle. I am surprised at how many ENDF/B-VIII evaluations that I have examined where it appears evaluators have overlooked this statement and are using MT=5 at lower energies, all the way down to 1.0e-5 eV. **To me MT=5 (n, anything) means the evaluator is saying "I don't know", so I will group together COMPLEX REACTIONS; it would seem to be a contradiction to claim that MT=5 includes some reaction uniquely defined by an ENDF MT number, i.e., you either do not know the MT number, and you can include it in MT=5, or you do know it, and it should not be included in MT=5 – you cannot have it both ways.**

As a data user what am I supposed to do when I am tracking neutrons in say, U235 or U238, after I use the total cross section to transport a neutron from point A to point B, and then use the MF=3 "partials" to define what reaction to sample, when I find the ENDF answer is MT=5 (n, anything)!!!! My AI codes (translating ENDF-102 rules into action) have no idea. Even worse when I spent my time and energy to example current ENDF evaluations in detail I find that maybe I am not the only one confused. It sure looks like evaluators may also be confused, such as MT=107, (n, alpha) and MT=5 (n, anything). See the below plots of ENDF/B-VIII U235 and U238. For U235 MT=5 and MT=107 below the MeV range are very similar. For U238 MT=5 and 107 they have the same energy dependent shape but differ by an order of magnitude; this is highly unlikely for any two independent reactions. Something is wrong here!!!

More to the point, after searching through the ENDF/B-VIII data files to see how MT=5 is being used, I could not find any – repeat ANY – cases where the evaluator could not have "guessed" a reaction below 20 MeV and included a cross section in MF=3 and avoided using MT=5 (n, anything). In almost all cases the mystery cross section is just a neutron in, charged particle out reaction. And rather than help clarify the data, evaluators appear to be just as, if not more, confused than I am, making the situation worse. **The main purpose of this memo is to clarify the ENDF-102 rules concerning MT=5, that I hope both data creators and users WILL obey.**

The MT=5 PARADOX

I asked the ENDF/B-VIII U235 evaluators how they define MT=107 (n, alpha), MT=22 (n, n'alpha) and MT=5 (n, anything); according to ENDF-102 sum rules all three of these contribute to defining MT=1 total cross section, so there cannot be any overlap between them. Only MT=5 is explicitly defined in this evaluation. For over 50 years when they are not explicitly defined in an evaluation, in order to obey ENDF-102 rules I have defined sum cross sections such as MT=107 as the sum of (n, alpha) "levels", MT=800 to 849, whatever is explicitly defined in any evaluation; this is what my plot calls (n, alpha). The U235 evaluators tell me that this is now WRONG! Because there is a (n, alpha) continuum hidden inside MT=5. My question to the evaluators: if you know at low energy MT=5 is only the (n, alpha) continuum why is it in MT=5, as "unknown" instead of MT=849, which would eliminate the use of MT=5 at low energy. Their answer: This was the evaluators choice. So, we are left in the situation where the evaluators and therefore users cannot uniquely define MT=107 (n, alpha) and there is no MT=22 (n, n'alpha), simply because of the evaluator's choice. Right now, this U235 MT=5 hardly qualifies as a COMPLEX REACTION AT HIGH ENERGY; the evaluators admit they uniquely know it well up into the MeV range. It was never the ENDF-102 intent to allow evaluators the option to include a non-unique definition of any cross section, giving the evaluator the choice to either uniquely define a reaction – such as MT=107 – or dump it into MT=5 as unknown. **My proposal to limit the use of MT=5 to above 20 MeV would take his choice out of the evaluators hands, and both MT=107 and MT=22 would be uniquely defined even if the evaluators make a simple "guess" between them.**

One Picture is Worth a Thousand Words

Initially I could not imagine that the evaluators did not "see" that for U235 MT=5 and MT=107 are very similar and for U238 they have the same energy dependent shape. But then I looked at the U235 and U238 ENDF/B-VIII original evaluations in detail. I was shocked to see that in MF=3 these evaluations both include (n, alpha) levels, MT=800 up to 849 as needed, but no MT=107 (n, alpha) total. **So, my guess is the evaluators never saw the below plots of U235 and U238 that include both MT=5 and MT=107.** The dawn broke as I realized that the below plots are of these evaluations are from my POINT2021 ENDF/B-VIII data library. This PREPROCESSED data can optionally add ENDF-102 implicit sum cross sections that we users find useful in our applications; in this case I added to MF=3, the implied MT=107 (n, alpha) total (implied by the explicitly included (n, alpha) levels). **Note, even though MT=107 is not explicitly included in the original ENDF/B-VIII U235 and U238 evaluations as a MF=3 cross section (it is not required), it MUST BE included in defining the total cross section as shown in the below plots.**

Nowhere in ENDF-102 are details provided for MT=5 (n, anything), but the rules for MT=107 (n, alpha) total are clearly defined: It is the sum of (n, alpha) levels, MT=800 through 848, as needed; with MT-849 being the continuum. Here, "continuum" is in the ENDF-102 strictly math sense of what is left over after ground (MT=800), and discrete levels (MT=800 through 848) fits have been defined; this is different from a theory or measurement "continuum" – for **the correct interpretation of the ENDF formatted data by application codes it is imperative that we all use the ENDF-102 definitions = just add up what you see included – it is that simple.**

You might think/hope that MF=5 is only sparingly used by a few evaluators, and even then only at higher energies, where it may be difficult to uniquely define reactions; at least that was my hope. When I checked ENDF-VIII I was shocked to find the below list. Currently MT=5 is used throughout ENDF/B-VIII, with many cross sections extending down to the traditional ENDF lower energy limit, 1.0d-5 eV. And worse, far too many cases at least appear to have very similar cross sections, as we see in the below plots of U235 and U238. Clearly in this case "One picture is Worth a Thousand Words"; at least to me anyone seeing these plots would conclude that MT=5 (explicit) and MT=107 total (implied) are not independent below the MeV energy range.

EXFOR: An Alternative

If you find the **ENDF** rules too restrictive for your use consider using **EXFOR**: The Nuclear Data Center **EX**change **FOR**mat. I designed EXFOR, circa 1970, to be similar in layout to ENDF: EXFOR uses a computer independent, simple text, 80 column format. It is similar to ENDF in that for data it uses six (6) columns each 11 characters wide (a total of 66 columns: identical to ENDF), followed by 14 columns of identification. Unlike ENDF, that uses fixed data units, with EXFOR you can enter data in any units, e.g., for experimental data you can use exactly the units you used in your measurement (the biggest source of mistakes in data entered into the older SCISRS system was that experimental data had to be converted by hand to fixed units on entry while typing the

data). Each column of data includes both a definition (energy, angle, cross section, etc.), followed by units (eV, MeV, keV, etc.), as the first two lines of each column. Unlike ENDF, that was originally designed strictly for fission and then fusion applications, with EXFOR you can include any data without limit as to how it may – or may not – be subsequentially used. This is as close as I could get to an ENDF-like format, without imposing any limitations on its contents, i.e., you can store anything you want here, and include as much simple text to explain the details of your data as needed. Hopefully, you will find ENDF and EXFOR complementary, so that you do not have to try and force everything through ENDF, where your application may not be a good fit. Again, in my fumble opinion, ENDF was never intended for higher energy applications where its MF/MT classification system is not general enough; with EXFOR you can enter anything, in any units, and unlike ENDF it need not be unique.

Bottom Line

Currently I have no idea why evaluators are allowed, or more importantly NEED, to include undefined reactions (MT=5) below the MeV range; **this is strictly at odds with the rules explicitly stated in ENDF-102**. But evaluators claim they have the right to use MT=5 at any neutron incident energy. **I am hoping this memo will make it clear that MT=5 can ONLY BE USED FOR COMPLEX REACTIONS AT HIGH ENERGY 20 MeV AND ABOVE**. With MT=5 at lower energies we can no longer know the traditional unique MF=3 cross sections, based strictly on MT numbers, and all of our summation rules may not apply; how can we expect the billions of dollars of software that have been developed over the last 60 years to understand how to UNIQUELY interpret (n, anything), based strictly on MF=3 defined MT numbers, as we have always done in the past. If evaluators do not strictly follow ENDF-102 rules they cannot expect our codes to understand their INTENT (that is asking too much of our AI codes = they cannot read minds). This seems like we are just asking for disaster.

My Proposal

I propose that MT=5 is NOT allowed in ENDF below 20 MeV; see photo below of ENDF/B-VIII C12 and O16 that already uses this convention, with MT=5 starting at 20 and 30 MeV, respectively; these evaluations were provided by well-known evaluators, who have worked with ENDF for many years, namely: Gerry Hale, Phil Young and Mark Chadwick. So, I cannot take credit for the proposal to only allow MT=5 above 20 MeV, since based on the evaluations Gerry, Phil and Mark recognized this point long before I wrote this memo. I repeat, part of the evaluators job is to uniquely define everything required in our applications. Traditionally for almost 60 years, this has meant uniquely defining each partial cross section in MF=3 based strictly on ENDF MT numbers. If you are not sure: GUESS!! Sorry, but (n, anything) is not NEEDED below 20 MeV. **I suggest that CSEWG at least add to the ENDF-102 Bible the rules that producers and users MUST obey in order to produce useful MT=5 that does not interfere with traditional ENDF applications**. Based on my quick review of the current contents of ENDF/B-VIII it at least appears that the rules are not at all clear to the people producing ENDF evaluations, e.g., U235, MT=5 and

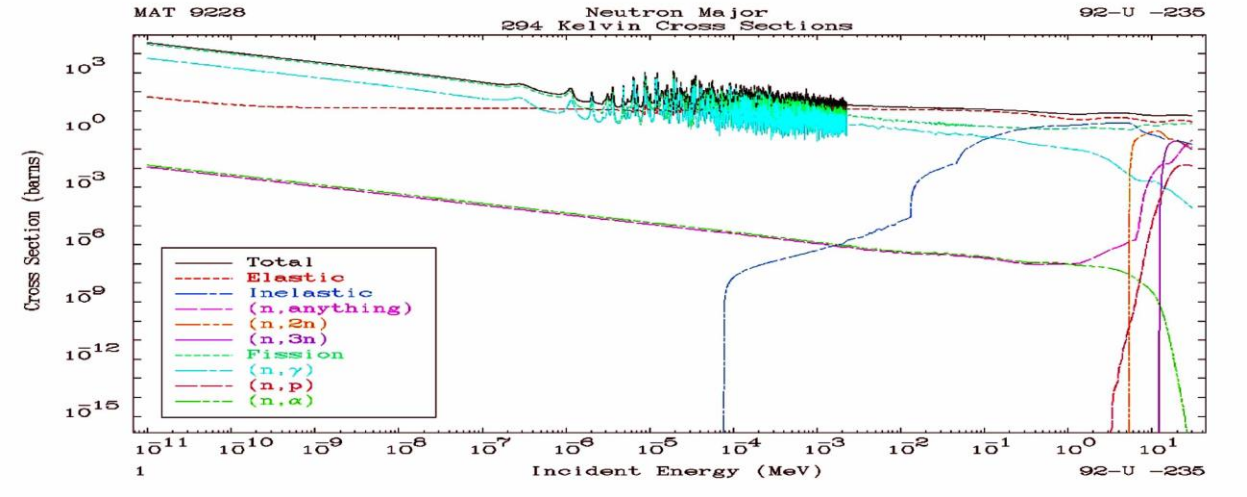
MT=107 definitions. Finally, independent of how MT=5 use may be limited in the future, I hope it is obvious that evaluations must be able to uniquely define ALL reactions based strictly on MF=3 defined MT numbers. Hopefully, this will allow MT=5 to at least be restricted to higher energies, above 20 MeV, so that it does not interfere with fission and fusion reactor calculations. **Finally, just a reminder that ENDF-102 is an Engineering User's Manual, not a Physics Book. The physics in it need not be the BEST, as long as it uniquely defines how to produce and use ENDF data. Do not make the mistake of thinking you know better; you probably do. That does not matter; all that matters is that we all agree to use the same ENDF-102 rules.**

I will add here that I can only hope that CSEWG will continue on the road it has been following for the preceding half century, to continue to improve our nuclear data. One further problem that I see is that the balance of CSEWG has changed. With the great improvements in our nuclear data over the last decades many of our user needs for improved nuclear data have already been met for fission and fusion applications, so that the interest of data users in data changes has decreased and data users have less interest in CSEWG. This means that **I see CSEWG being dominated increasingly by data producers, because this remains their bread and butter.** I am not saying that's today's evaluators are any less skilled and dedicated to improving the data. But what I see is less linkage between data producers and data users. It is imperative that this linkage be maintained to continue closing the loop between data production and testing in real applications. **This is the heart and soul of ENDF, and it is what has made ENDF such a GREAT success**. **I encourage data producers and users to work more closely together, to continue CSEWG in its work to ever improve results. Nuclear Model Codes continue to make great progress, but we MUST AVOID the mistake of adding masses of code results to ENDF simply because we can – instead ENDF MUST CONTINUE TO BE FOCUSSED ON AND DRIVEN BY THE NEEDS OF DATA USERS – NOT SIMPLY THE INTERESTS OF DATA PRODUCERS – FOCUS ON MAKING ENDF-102 THE BEST ENGINEERIING USER'S MANUAL WE CAN PRODUCE.**

POINT2021 ENDF/B-VIII

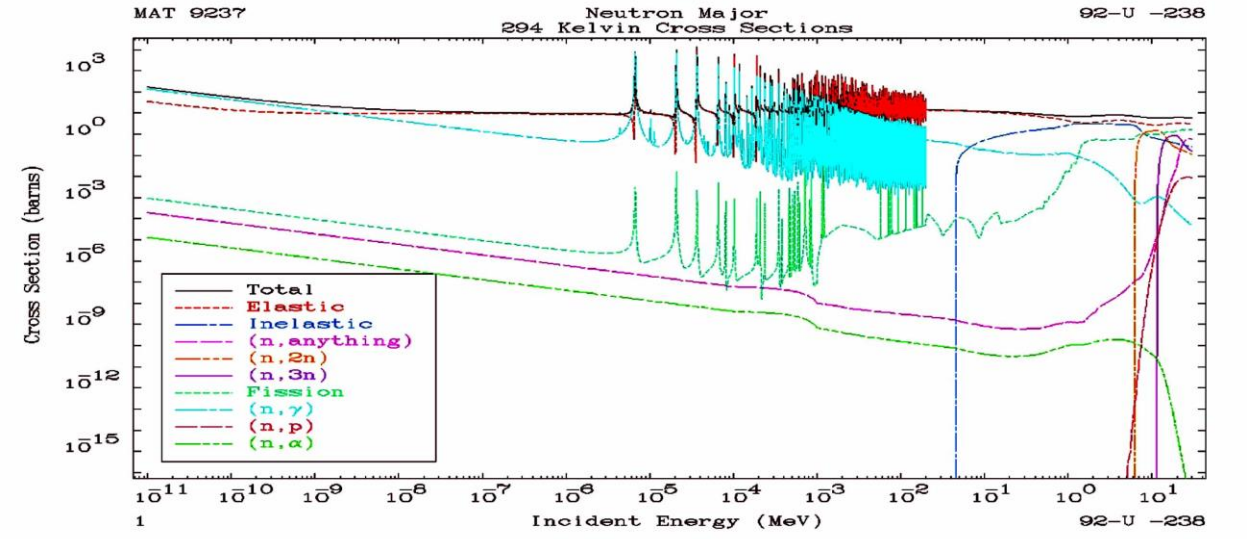
U235

Note that (n, anything) and (n, alpha) below the MeV energy range are very similar. From consulting with the evaluators this is because at low energy MT=5 is (n, alpha) continuum, and in this case it is very close to half the (n, alpha) total, MT=107, here defined using ENDF-102 rules as the sum of the (n, alpha) levels, MT=800 to 849 (as many as are needed). If the evaluator at low energy defined MT=849, instead of MT=5, there would not be any problem, because MT=5 would not start until well into the MeV range. The evaluator claims that based on current ENDF-102 rules, he has a right to make this decision. **I hope this memo makes the ENDF-102 rules clear, that MT=5 NEED NOT AND MUST NOT USED BELOW 20 MeV.**



U238

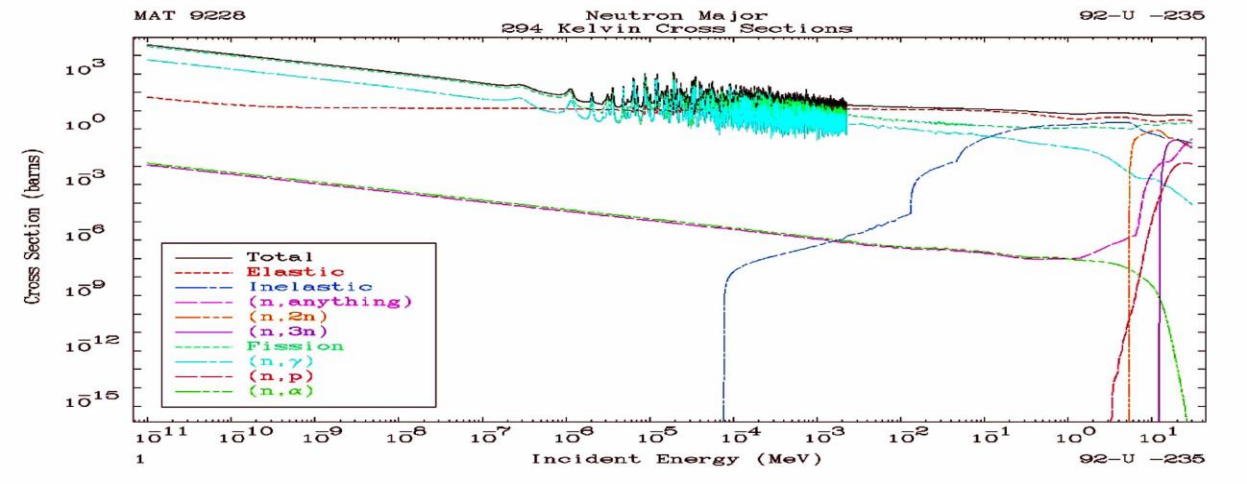
Note that here (n, anything) and (n, alpha) differ by an order of magnitude, but have the same energy dependent shape below the MeV energy range. Unlike U235 where at low energy the (n, alpha) continuum and sum of defined level are similar, here the continuum is an order of magnitude higher than the sum of defined levels; still easily defined by ENDF-102 defined MT numbers.



POINT2021 ENDF/B-VIII

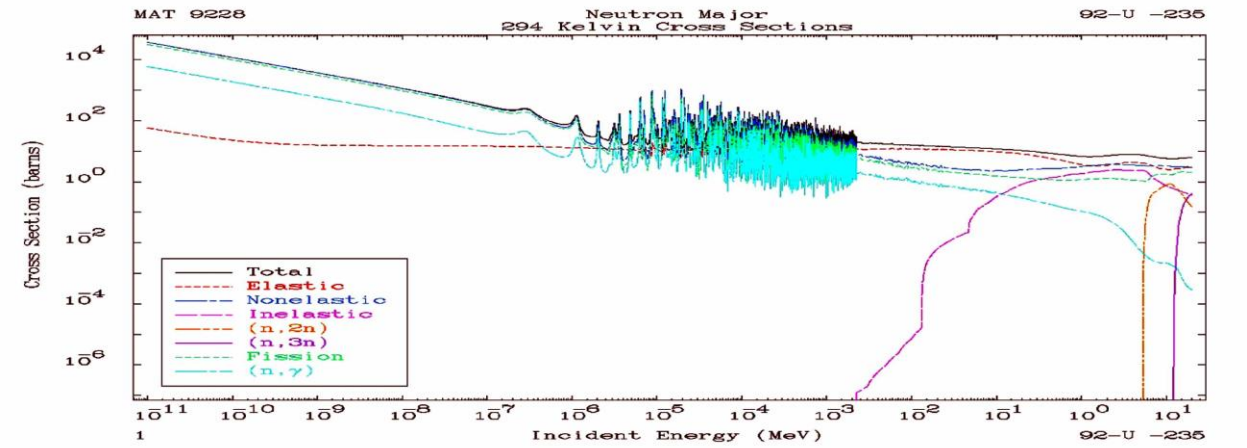
U235

On this page I compare U235 from ENDF/B-VIII to ENDF/B-VII. One obvious difference is that VIII has added information about (n, alpha) which extends all the way down to the lower energy limit at 1.0e-5 eV. As a data user this would not have been a concern of mine if this extension described by the evaluators as (n, alpha) continuum (a measured/theory definition) had used the ENDF-102 definition of (n, alpha) continuum MT=849, instead of MT=5 (with details in MF=6). Then MT=5 would not be necessary until well into the MeV range, as I suggest, and would not interfere with ENDF data used in traditional fission and fusion applications. We must leave it to the evaluator to decide whether this (n, alpha) included in ENDF/B-VIII data is needed in any applications, e.g., at 1.0d-5 eV the MT=18 (fission) cross section is **2,699,950** times the MT-5 (n, anything), which may explain why it has never been included in earlier versions of ENDF/B. U235 ENDF/B-VII was 22 MB, VIII is 36 MB, almost 8 MB are for MT=5 and (n, alpha) levels. **I can only assume/hope that benchmark tests proved this data was needed before it was approved for use in ENDF/B-VIII.**



ENDF/B-VII.1

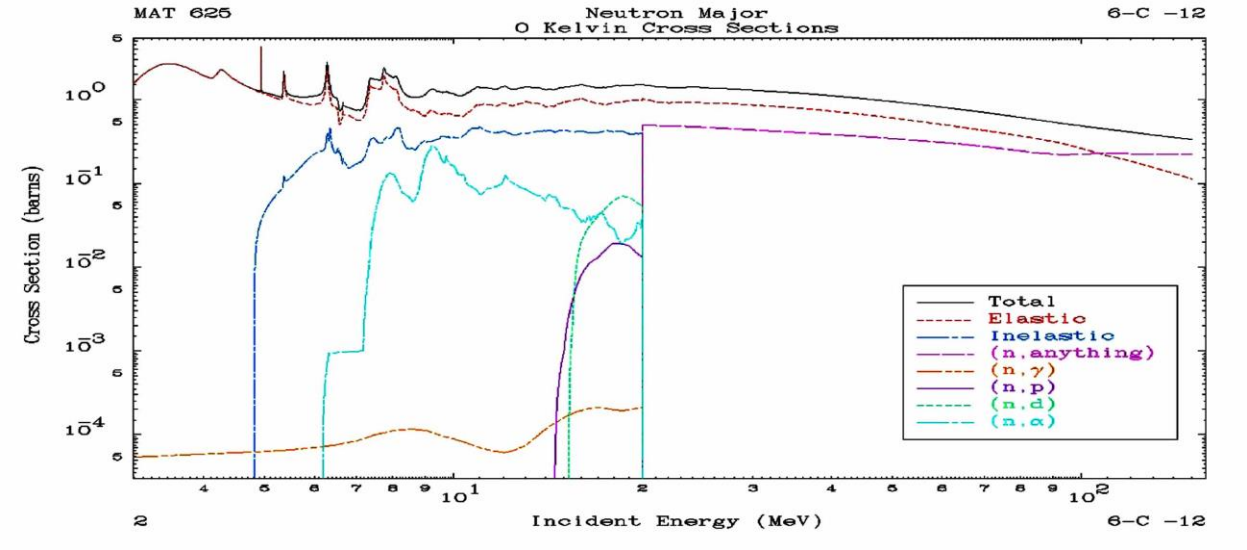
U235

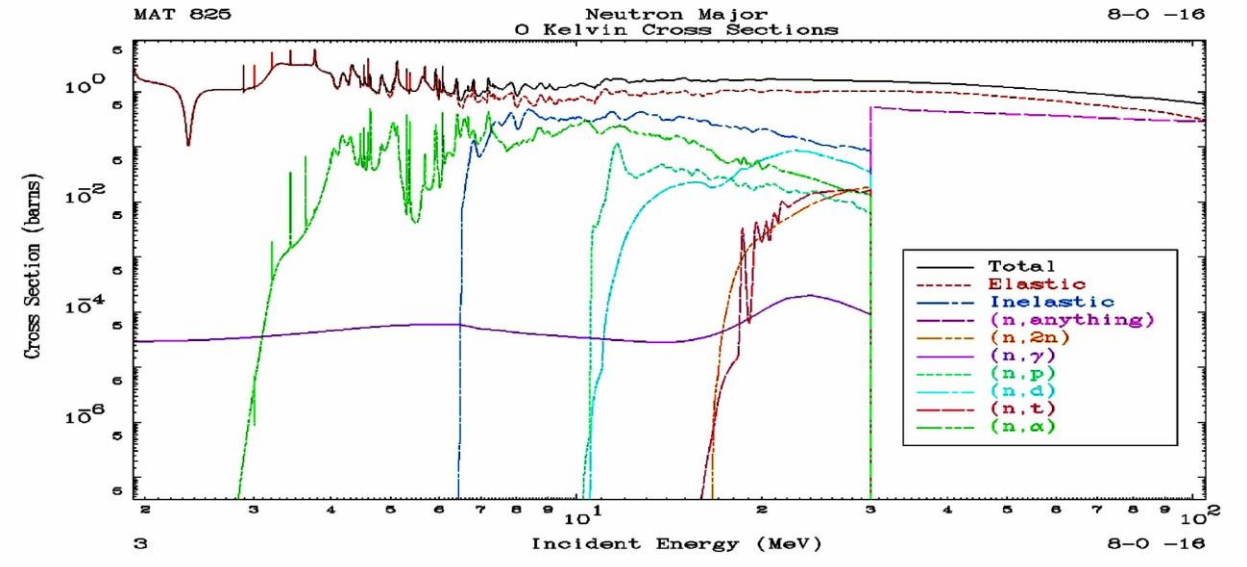


POINT2021 ENDF/B-VIII

C12 and O16

Note, the use of MT=5 (n, anything) starting at 20 MeV for C12 and 30 MeV for O16, as I proposed is used here, and the total has still been correctly, physically defined to be continuous at 20 MeV. To me this illustrate the correct use of MT=5, only at high energy to describe very complex reactions. Thank the evaluators, including Gerry Hale, Phil Young and Mark Chadwick.





POINT2021 ENDF/B-VIII U235

For U235 MT=5 and MT=107 are very similar; far too similar to be completely independent. The evaluator explained to me that the similarity is because they chose to include (n, alpha) continuum in MT=5 (a physics definition), rather than MT=849 (an ENDF-102 definition). If the evaluator had used the ENDF definition of MT=849, the use of MT=5 would not have been necessary until well into the MeV energy range. Again, I will mention that the evaluator claims that according to current ENDF-102 rules this is a legal use of MT=5. **With this memo I hope to make it clear that MT=5 can be used only for COMPLEX REACTIONS AT HIGH ENERGY 20 MeV OR ABOVE.**

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 1.12775E-5 .0134910641.148123E-5 .013370831 1.16821E-5 .0132553819228 3107    6
1.188005E-5 .0131444861.227316E-5 .0129322621.265351E-5 .0127364169228 3107    7
1.302079E-5 .0125555021.337478E-5 .0123882321.371539E-5 .0122334389228 3107    8
1.404259E-5 .0120900791.435642E-5 .011957206 1.46570E-5 .0118339639228 3107    9
1.494451E-5 .0117195771.521917E-5 .0116133461.548124E-5 .0115146289228 3107   10
================================================================================
```

POINT2021 ENDF/B-VIII U238

For U238 MT-5 and MT=107 differ by roughly a decade in magnitude, but both have the same energy dependent shape, and it is worth noting that this shape is the same as we see for U235 MT=5 and MT=107. Here it would appear that the (n, alpha) continuum in MT=5 is an order of magnitude greater than MT=107 (n, alpha), here defined using the ENDF-102 definition of (n, alpha) total as the sum of (n, alpha) levels MT=800 to 849 (a many as needed; the remainder implicitly assumed to be zero).

```
================================================================================
 92238.0000 236.005800          0          0          0          09237 3  5    1
 8700500.00 8700500.00          0          0          1        8349237 3  5    2
        834          2                                          9237 3  5    3
 1.00000E-5 1.93586E-41.021897E-5 1.91500E-41.043567E-5 1.89501E-49237 3  5    4
1.064998E-5 1.87585E-41.086179E-5 1.85747E-41.107099E-5 1.83984E-49237 3  5    5
 1.12775E-5 1.82291E-41.148123E-5 1.80667E-4 1.16821E-5 1.79107E-49237 3  5    6
1.188005E-5 1.77608E-41.227316E-5 1.74741E-41.265351E-5 1.72095E-49237 3  5    7
1.302079E-5 1.69650E-41.337478E-5 1.67390E-41.371539E-5 1.65298E-49237 3  5    8
1.404259E-5 1.63361E-41.435642E-5 1.61566E-4 1.46570E-5 1.59901E-49237 3  5    9
1.494451E-5 1.58355E-41.521917E-5 1.56920E-41.548124E-5 1.55586E-49237 3  5   10
================================================================================
 92238.0000 236.005800          0          0          0          09237 3107    1
 0.0        0.0                 0          0          1        8349237 3107    2
        834          2                                          9237 3107    3
 1.00000E-5 1.31654E-51.021897E-5 1.30236E-51.043567E-5 1.28877E-59237 3107    4
1.064998E-5 1.27573E-51.086179E-5 1.26323E-51.107099E-5 1.25124E-59237 3107    5
 1.12775E-5 1.23973E-51.148123E-5 1.22868E-5 1.16821E-5 1.21808E-59237 3107    6
1.188005E-5 1.20789E-51.227316E-5 1.18838E-51.265351E-5 1.17039E-59237 3107    7
1.302079E-5 1.15376E-51.337478E-5 1.13839E-51.371539E-5 1.12417E-59237 3107    8
1.404259E-5 1.11099E-51.435642E-5 1.09878E-5 1.46570E-5 1.08746E-59237 3107    9
1.494451E-5 1.07695E-51.521917E-5 1.06718E-51.548124E-5 1.05811E-59237 3107   10
================================================================================
```

ENDF/B-VIII Evaluations that use MT=5

Note the MF=3 energy range showing how many of these data extend down to the usual ENDF minimum energy at 1.0d-5 eV, i.e., **obviously MT=5 is not currently restricted to use only at higher energies to describe complex reactions as ENDF-102 explicitly states. This is an obvious violation of the ENDF-102 rule that – need I repeat it again: MT=5 CAN BE USED FOR COMPLEX REACTIONSD AT HIGH ENERGY – here I suggest we define HIGH ENERGY 20 MeV OR ABOVE – how many times need I repeat this to get my point across.**

```
            MAT MF MT
             \red\point.all\point2021-no-zip\endf2c\ZA006012
ZA006012    625  3  5  1.0000D-05  1.5000D+08 eV
ZA006012    625  6  5
ZA006012    625 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA007014
ZA007014    725  3  5  1.0000D-05  1.5000D+08 eV
ZA007014    725  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA008016
ZA008016    825  3  5  1.0000D-05  1.5000D+08 eV
ZA008016    825  6  5
ZA008016    825 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA010020
ZA010020   1025  3  5  1.0000D-05  2.0000D+08 eV
ZA010020   1025  6  5
ZA010020   1025  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA010021
ZA010021   1028  3  5  1.0000D-05  2.0000D+08 eV
ZA010021   1028  6  5
ZA010021   1028  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA010022
ZA010022   1031  3  5  1.0000D-05  2.0000D+08 eV
ZA010022   1031  6  5
ZA010022   1031  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA013026.M
ZA013026.M 1323  3  5  1.0000D-05  2.0000D+07 eV
ZA013026.M 1323  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA013027
ZA013027   1325  3  5  1.0000D-05  1.5000D+08 eV
ZA013027   1325  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA014028
ZA014028   1425  3  5  1.0000D-05  1.5000D+08 eV
ZA014028   1425  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA014029
ZA014029   1428  3  5  1.0000D-05  1.5000D+08 eV
ZA014029   1428  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA014030
ZA014030   1431  3  5  1.0000D-05  1.5000D+08 eV
ZA014030   1431  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA014031
ZA014031   1434  3  5  4.9418D+06  2.0000D+07 eV
ZA014031   1434  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA014032
ZA014032   1437  3  5  1.1849D+07  2.0000D+07 eV
ZA014032   1437  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA015031
ZA015031   1525  3  5  1.0000D-05  1.5000D+08 eV
ZA015031   1525  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA016035
ZA016035   1634  3  5  3.8314D+06  2.0000D+07 eV
ZA016035   1634  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA017036
ZA017036   1728  3  5  5.4826D+06  2.0000D+07 eV
ZA017036   1728  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA018037
ZA018037   1828  3  5  1.0000D-05  2.0000D+08 eV
ZA018037   1828  6  5
ZA018037   1828  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA018039
```

```
ZA018039   1834  3  5  2.4632D+06  2.0000D+07 eV
ZA018039   1834  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA018041
ZA018041   1840  3  5  1.0000D-05  2.0000D+08 eV
ZA018041   1840  6  5
ZA018041   1840  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA020040
ZA020040   2025  3  5  1.0000D-05  2.0000D+08 eV
ZA020040   2025  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020041
ZA020041   2028  3  5  4.8670D+05  2.0000D+07 eV
ZA020041   2028  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020042
ZA020042   2031  3  5  1.0000D-05  2.0000D+08 eV
ZA020042   2031  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020043
ZA020043   2034  3  5  1.0000D-05  2.0000D+08 eV
ZA020043   2034  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020044
ZA020044   2037  3  5  1.0000D-05  2.0000D+08 eV
ZA020044   2037  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020045
ZA020045   2040  3  5  1.0000D-05  2.0000D+08 eV
ZA020045   2040  6  5
ZA020045   2040  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA020046
ZA020046   2043  3  5  1.0000D-05  2.0000D+08 eV
ZA020046   2043  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA020047
ZA020047   2046  3  5  1.0000D-05  2.0000D+08 eV
ZA020047   2046  6  5
ZA020047   2046  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA020048
ZA020048   2049  3  5  1.0000D-05  2.0000D+08 eV
ZA020048   2049  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA023049
ZA023049   2322  3  5  6.8973D+06  2.0000D+07 eV
ZA023049   2322  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA024050
ZA024050   2425  3  5  1.0000D-05  1.5000D+08 eV
ZA024050   2425  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA024051
ZA024051   2428  3  5  1.0000D-05  2.0000D+08 eV
ZA024051   2428  6  5
ZA024051   2428  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA024052
ZA024052   2431  3  5  1.0000D-05  1.5000D+08 eV
ZA024052   2431  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA024053
ZA024053   2434  3  5  1.0000D-05  1.5000D+08 eV
ZA024053   2434  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA024054
ZA024054   2437  3  5  1.0000D-05  1.5000D+08 eV
ZA024054   2437  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA025054
ZA025054   2522  3  5  1.0000D-05  2.0000D+08 eV
ZA025054   2522  6  5
ZA025054   2522  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA025055
ZA025055   2525  3  5  6.3444D+05  6.0000D+07 eV
ZA025055   2525  6  5
ZA025055   2525 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA026054
ZA026054   2625  3  5  1.0000D-05  1.5000D+08 eV
ZA026054   2625  6  5
ZA026054   2625 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA026055
ZA026055   2628  3  5  1.0000D-05  2.0000D+08 eV
ZA026055   2628  6  5
ZA026055   2628  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA026056
```

```
ZA026056   2631  3  5  1.0000D-05  1.5000D+08 eV
ZA026056   2631  6  5
ZA026056   2631 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA026057
ZA026057   2634  3  5  1.0000D-05  1.5000D+08 eV
ZA026057   2634  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA026058
ZA026058   2637  3  5  1.4239D+06  1.5000D+08 eV
ZA026058   2637  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA027058
ZA027058   2722  3  5  1.0000D-05  2.0000D+07 eV
ZA027058   2722  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028058
ZA028058   2825  3  5  1.0000D-05  1.5000D+08 eV
ZA028058   2825  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028060
ZA028060   2831  3  5  1.0000D-05  1.5000D+08 eV
ZA028060   2831  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028061
ZA028061   2834  3  5  1.0000D-05  1.5000D+08 eV
ZA028061   2834  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028062
ZA028062   2837  3  5  1.0000D-05  1.5000D+08 eV
ZA028062   2837  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028063
ZA028063   2840  3  5  7.1106D+06  2.0000D+07 eV
ZA028063   2840  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA028064
ZA028064   2843  3  5  1.0000D-05  1.5000D+08 eV
ZA028064   2843  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA029063
ZA029063   2925  3  5  1.0000D-05  1.5000D+08 eV
ZA029063   2925  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA029064
ZA029064   2928  3  5  4.7888D+06  2.0000D+07 eV
ZA029064   2928  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA029065
ZA029065   2931  3  5  1.0000D-05  1.5000D+08 eV
ZA029065   2931  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA030069
ZA030069   3040  3  5  3.4843D+06  2.0000D+07 eV
ZA030069   3040  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA031070
ZA031070   3128  3  5  3.9019D+06  2.0000D+07 eV
ZA031070   3128  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA032071
ZA032071   3228  3  5  1.0000D-05  2.0000D+07 eV
ZA032071   3228  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA032075
ZA032075   3240  3  5  3.6829D+06  2.0000D+07 eV
ZA032075   3240  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA034075
ZA034075   3428  3  5  1.0000D-05  2.0000D+08 eV
ZA034075   3428  6  5
ZA034075   3428  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA034081
ZA034081   3446  3  5  4.1683D+06  2.0000D+07 eV
ZA034081   3446  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA035080
ZA035080   3528  3  5  3.0008D+06  2.0000D+07 eV
ZA035080   3528  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA036079
ZA036079   3628  3  5  1.0000D-05  2.0000D+07 eV
ZA036079   3628  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA036081
ZA036081   3634  3  5  1.0000D-05  2.0000D+08 eV
ZA036081   3634  6  5
ZA036081   3634  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA038085
ZA038085   3828  3  5  8.1659D+05  2.0000D+07 eV
ZA038085   3828  6  5
```

```
            \red\point.all\point2021-no-zip\endf2c\ZA040090
ZA040090   4025  3  5  1.0000D-05  2.0000D+07 eV
ZA040090   4025  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040091
ZA040091   4028  3  5  1.0000D-05  2.0000D+07 eV
ZA040091   4028  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040092
ZA040092   4031  3  5  1.0000D-05  2.0000D+07 eV
ZA040092   4031  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040093
ZA040093   4034  3  5  1.0000D-05  2.0000D+07 eV
ZA040093   4034  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040094
ZA040094   4037  3  5  1.0000D-05  2.0000D+07 eV
ZA040094   4037  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040095
ZA040095   4040  3  5  1.0000D-05  2.0000D+07 eV
ZA040095   4040  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA040096
ZA040096   4043  3  5  1.0000D-05  2.0000D+07 eV
ZA040096   4043  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA041093
ZA041093   4125  3  5  1.0000D-05  1.5000D+08 eV
ZA041093   4125  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA042093
ZA042093   4228  3  5  1.0000D-05  2.0000D+08 eV
ZA042093   4228  6  5
ZA042093   4228  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA043098
ZA043098   4322  3  5  1.0000D-05  2.0000D+08 eV
ZA043098   4322  6  5
ZA043098   4322  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA044097
ZA044097   4428  3  5  1.0000D-05  2.0000D+08 eV
ZA044097   4428  6  5
ZA044097   4428  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA045104
ZA045104   4528  3  5  1.0000D-05  2.0000D+07 eV
ZA045104   4528  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA046103
ZA046103   4628  3  5  1.0000D-05  2.0000D+07 eV
ZA046103   4628  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA046109
ZA046109   4646  3  5  4.1370D+06  2.0000D+07 eV
ZA046109   4646  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047108
ZA047108   4728  3  5  1.0000D-05  2.0000D+07 eV
ZA047108   4728  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047112
ZA047112   4740  3  5  4.0694D+06  2.0000D+07 eV
ZA047112   4740  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047113
ZA047113   4743  3  5  4.4857D+06  2.0000D+07 eV
ZA047113   4743  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047114
ZA047114   4746  3  5  4.4591D+06  2.0000D+07 eV
ZA047114   4746  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047115
ZA047115   4749  3  5  5.1690D+06  2.0000D+07 eV
ZA047115   4749  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047116
ZA047116   4752  3  5  4.8983D+06  2.0000D+07 eV
ZA047116   4752  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047117
ZA047117   4755  3  5  5.9559D+06  2.0000D+07 eV
ZA047117   4755  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA047118.M
ZA047118.M 4759  3  5  1.0000D-05  2.0000D+07 eV
ZA047118.M 4759  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA048107
ZA048107   4828  3  5  1.0000D-05  2.0000D+07 eV
```

```
ZA048107   4828  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA048109
ZA048109   4834  3  5  1.0000D-05  2.0000D+08 eV
ZA048109   4834  6  5
ZA048109   4834  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA049114
ZA049114   4928  3  5  1.0000D-05  2.0000D+07 eV
ZA049114   4928  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA050121.M
ZA050121.M 5053  3  5  1.0000D-05  2.0000D+07 eV
ZA050121.M 5053  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA051122
ZA051122   5128  3  5  3.2900D+06  2.0000D+07 eV
ZA051122   5128  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA052121
ZA052121   5228  3  5  1.0000D-05  2.0000D+07 eV
ZA052121   5228  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA052121.M
ZA052121.M 5229  3  5  1.0000D-05  2.0000D+07 eV
ZA052121.M 5229  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA052131
ZA052131   5258  3  5  4.1558D+06  2.0000D+07 eV
ZA052131   5258  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA052131.M
ZA052131.M 5259  3  5  1.0000D-05  2.0000D+07 eV
ZA052131.M 5259  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA053128
ZA053128   5328  3  5  1.1581D+06  2.0000D+07 eV
ZA053128   5328  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA053132
ZA053132   5340  3  5  3.5449D+06  2.0000D+07 eV
ZA053132   5340  6  5
              \red\point.all\point2021-no-zip\endf2c\za053132.M
za053132.M 5341  3  5  1.0000D-05  2.0000D+07 eV
za053132.M 5341  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA053133
ZA053133   5343  3  5  3.7049D+06  2.0000D+07 eV
ZA053133   5343  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA053134
ZA053134   5346  3  5  4.0100D+06  2.0000D+07 eV
ZA053134   5346  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA054125
ZA054125   5428  3  5  1.0000D-05  2.0000D+07 eV
ZA054125   5428  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA054127
ZA054127   5434  3  5  1.0000D-05  2.0000D+07 eV
ZA054127   5434  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA056131
ZA056131   5628  3  5  1.0000D-05  2.0000D+07 eV
ZA056131   5628  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA056139
ZA056139   5652  3  5  1.0000D-05  2.0000D+07 eV
ZA056139   5652  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA058137
ZA058137   5828  3  5  1.0000D-05  2.0000D+07 eV
ZA058137   5828  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA058137.M
ZA058137.M 5829  3  5  1.0000D-05  2.0000D+07 eV
ZA058137.M 5829  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA060149
ZA060149   6046  3  5  1.0000D-05  2.0000D+07 eV
ZA060149   6046  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA061143
ZA061143   6137  3  5  1.0000D-05  2.0000D+08 eV
ZA061143   6137  6  5
ZA061143   6137  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA061144
ZA061144   6140  3  5  1.0000D-05  2.0000D+08 eV
ZA061144   6140  6  5
ZA061144   6140  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA061145
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ZA061145   6143  3  5  1.0000D-05  2.0000D+08 eV
ZA061145   6143  6  5
ZA061145   6143  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA061146
ZA061146   6146  3  5  1.0000D-05  2.0000D+07 eV
ZA061146   6146  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA061150
ZA061150   6158  3  5  1.0000D-05  2.0000D+07 eV
ZA061150   6158  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA062145
ZA062145   6228  3  5  1.0000D-05  2.0000D+08 eV
ZA062145   6228  6  5
ZA062145   6228  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA062146
ZA062146   6231  3  5  1.0000D-05  2.0000D+07 eV
ZA062146   6231  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA064159
ZA064159   6446  3  5  8.0105D+05  2.0000D+07 eV
ZA064159   6446  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA065158
ZA065158   6522  3  5  1.0000D-05  2.0000D+07 eV
ZA065158   6522  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA065161
ZA065161   6531  3  5  4.2867D+05  2.0000D+07 eV
ZA065161   6531  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA066155
ZA066155   6622  3  5  1.0000D-05  2.0000D+07 eV
ZA066155   6622  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA066157
ZA066157   6628  3  5  1.0000D-05  2.0000D+07 eV
ZA066157   6628  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA068163
ZA068163   6828  3  5  1.0000D-05  2.0000D+07 eV
ZA068163   6828  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA068165
ZA068165   6834  3  5  1.0000D-05  2.0000D+07 eV
ZA068165   6834  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA068169
ZA068169   6846  3  5  1.0000D-05  2.0000D+07 eV
ZA068169   6846  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA069168
ZA069168   6922  3  5  1.0000D-05  3.0000D+07 eV
ZA069168   6922  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA069169
ZA069169   6925  3  5  1.0000D-05  3.0000D+07 eV
ZA069169   6925  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA069170
ZA069170   6928  3  5  1.0000D-05  3.0000D+07 eV
ZA069170   6928  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA069171
ZA069171   6931  3  5  1.0000D-05  2.0000D+07 eV
ZA069171   6931  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA070169
ZA070169   7028  3  5  1.0000D-05  2.0000D+07 eV
ZA070169   7028  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA070175
ZA070175   7046  3  5  1.0000D-05  2.0000D+07 eV
ZA070175   7046  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA072175
ZA072175   7228  3  5  1.0000D-05  2.0000D+07 eV
ZA072175   7228  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA074180
ZA074180   7425  3  5  1.0000D-05  1.5000D+08 eV
ZA074180   7425  6  5
ZA074180   7425  8  5
ZA074180   7425 10  5
ZA074180   7425 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA074181
ZA074181   7428  3  5  1.0000D-05  2.0000D+07 eV
ZA074181   7428  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA074182
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ZA074182   7431  3  5  1.0000D-05  1.5000D+08 eV
ZA074182   7431  6  5
ZA074182   7431  8  5
ZA074182   7431 10  5
ZA074182   7431 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA074183
ZA074183   7434  3  5  1.0000D-05  1.5000D+08 eV
ZA074183   7434  6  5
ZA074183   7434  8  5
ZA074183   7434 10  5
ZA074183   7434 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA074184
ZA074184   7437  3  5  1.0000D-05  1.5000D+08 eV
ZA074184   7437  6  5
ZA074184   7437  8  5
ZA074184   7437 10  5
ZA074184   7437 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA074185
ZA074185   7440  3  5  1.0000D-05  2.0000D+07 eV
ZA074185   7440  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA074186
ZA074186   7443  3  5  1.0000D-05  1.5000D+08 eV
ZA074186   7443  6  5
ZA074186   7443  8  5
ZA074186   7443 10  5
ZA074186   7443 33  5
           \red\point.all\point2021-no-zip\endf2c\ZA075186.M
ZA075186.M 7529  3  5  1.0000D-05  2.0000D+07 eV
ZA075186.M 7529  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA076185
ZA076185   7628  3  5  1.0000D-05  2.0000D+07 eV
ZA076185   7628  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA076191
ZA076191   7646  3  5  1.0000D-05  2.0000D+08 eV
ZA076191   7646  6  5
ZA076191   7646  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA077192
ZA077192   7728  3  5  1.0000D-05  2.0000D+08 eV
ZA077192   7728  6  5
ZA077192   7728  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA077194.M
ZA077194.M 7735  3  5  1.0000D-05  2.0000D+07 eV
ZA077194.M 7735  6  5
           \red\point.all\point2021-no-zip\endf2c\ZA078190
ZA078190   7825  3  5  1.0000D-05  2.0000D+08 eV
ZA078190   7825  6  5
ZA078190   7825  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078191
ZA078191   7828  3  5  1.0000D-05  2.0000D+08 eV
ZA078191   7828  6  5
ZA078191   7828  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078192
ZA078192   7831  3  5  1.0000D-05  2.0000D+08 eV
ZA078192   7831  6  5
ZA078192   7831  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078193
ZA078193   7834  3  5  1.0000D-05  2.0000D+08 eV
ZA078193   7834  6  5
ZA078193   7834  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078194
ZA078194   7837  3  5  1.0000D-05  2.0000D+08 eV
ZA078194   7837  6  5
ZA078194   7837  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078195
ZA078195   7840  3  5  1.0000D-05  2.0000D+08 eV
ZA078195   7840  6  5
ZA078195   7840  8  5
           \red\point.all\point2021-no-zip\endf2c\ZA078196
ZA078196   7843  3  5  1.0000D-05  2.0000D+08 eV
ZA078196   7843  6  5
ZA078196   7843  8  5
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            \red\point.all\point2021-no-zip\endf2c\ZA078197
ZA078197   7846  3  5  1.0000D-05  2.0000D+08 eV
ZA078197   7846  6  5
ZA078197   7846  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA078198
ZA078198   7849  3  5  1.0000D-05  2.0000D+08 eV
ZA078198   7849  6  5
ZA078198   7849  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA080196
ZA080196   8025  3  5  1.0000D-05  1.5000D+08 eV
ZA080196   8025  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080197
ZA080197   8028  3  5  1.0000D-05  2.0000D+07 eV
ZA080197   8028  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080197.M
ZA080197.M 8029  3  5  1.0000D-05  2.0000D+07 eV
ZA080197.M 8029  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080198
ZA080198   8031  3  5  1.0000D-05  1.5000D+08 eV
ZA080198   8031  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080199
ZA080199   8034  3  5  1.0000D-05  1.5000D+08 eV
ZA080199   8034  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080200
ZA080200   8037  3  5  1.0000D-05  1.5000D+08 eV
ZA080200   8037  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080201
ZA080201   8040  3  5  1.0000D-05  1.5000D+08 eV
ZA080201   8040  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080202
ZA080202   8043  3  5  1.0000D-05  1.5000D+08 eV
ZA080202   8043  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA080203
ZA080203   8046  3  5  1.0000D-05  2.0000D+08 eV
ZA080203   8046  6  5
ZA080203   8046  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA080204
ZA080204   8049  3  5  1.0000D-05  1.5000D+08 eV
ZA080204   8049  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA081204
ZA081204   8128  3  5  1.0000D-05  2.0000D+08 eV
ZA081204   8128  6  5
ZA081204   8128  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA082204
ZA082204   8225  3  5  1.0000D-05  2.0000D+08 eV
ZA082204   8225  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA082205
ZA082205   8228  3  5  1.0000D-05  2.0000D+08 eV
ZA082205   8228  6  5
ZA082205   8228  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA082206
ZA082206   8231  3  5  1.0000D-05  2.0000D+08 eV
ZA082206   8231  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA082207
ZA082207   8234  3  5  1.0000D-05  2.0000D+08 eV
ZA082207   8234  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA082208
ZA082208   8237  3  5  1.0000D-05  1.5000D+08 eV
ZA082208   8237  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA083209
ZA083209   8325  3  5  1.0000D-05  1.5000D+08 eV
ZA083209   8325  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA083210.M
ZA083210.M 8329  3  5  1.0000D-05  2.0000D+07 eV
ZA083210.M 8329  6  5
            \red\point.all\point2021-no-zip\endf2c\ZA084208
ZA084208   8431  3  5  1.0000D-05  2.0000D+08 eV
ZA084208   8431  6  5
ZA084208   8431  8  5
            \red\point.all\point2021-no-zip\endf2c\ZA084209
ZA084209   8434  3  5  1.0000D-05  2.0000D+07 eV
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ZA084209   8434  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA084210
ZA084210   8437  3  5  1.0000D-05  2.0000D+08 eV
ZA084210   8437  6  5
ZA084210   8437  8  5
              \red\point.all\point2021-no-zip\endf2c\ZA090232
ZA090232   9040  3  5  3.9390D+06  6.0000D+07 eV
ZA090232   9040  6  5
ZA090232   9040 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA091231
ZA091231   9131  3  5  1.6846D+07  6.0000D+07 eV
ZA091231   9131  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA091233
ZA091233   9137  3  5  1.6877D+07  6.0000D+07 eV
ZA091233   9137  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA092235
ZA092235   9228  3  5  1.0000D-05  3.0000D+07 eV
ZA092235   9228  6  5
ZA092235   9228 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA092238
ZA092238   9237  3  5  1.0000D-05  3.0000D+07 eV
ZA092238   9237  6  5
ZA092238   9237 33  5
              \red\point.all\point2021-no-zip\endf2c\ZA094245
ZA094245   9455  3  5  1.0000D-05  2.0000D+07 eV
ZA094245   9455  6  5
              \red\point.all\point2021-no-zip\endf2c\ZA098247
ZA098247   9846  3  5  1.0000D-05  2.0000D+07 eV
ZA098247   9846  6  5
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