FLUKA Beginners' Online Training

Answers to the questionnaire on Materials

Question 1

In order to define a water region in a FLUKA geometry it is mandatory to use:

A. The `MATERIAL`, `COMPOUND` and `ASSIGNMAt` cards.

B. The `MATERIAL` and `ASSIGNMAt` cards.

C. The `COMPOUND` and `ASSIGNMAt` cards.

D. **The `ASSIGNMAt` card.**

Water is a pre-defined compound of FLUKA. Therefore, the `MATERIAL` and `COMPOUND` cards, which would be used to define a new material or compound, are not required. It suffices to use the `ASSIGNMAt` card with, as parameters, the compound name `WATER` as well as the name of the relevant region.

Question 2

When defining a compound material, which of the following statements is false?

A. The sum of mass or volume fractions does not need to be equal to 1.

B. **The `MATERIAL` card is not necessary.**

C. Compounds with more than 3 components can be defined.

D. All compounds included in another compound do not need to be defined with the same type of abundance fraction.

Each `COMPOUND` card must be associated to a `MATERIAL` declaration through a matching name/identifier. The `MATERIAL` card is necessary even when pre-defined materials are part of the compound. If the name of a pre-defined material is used for a user-defined material, the definition in the user's input file will override the FLUKA definition.

Question 3

In order to define fluorine by means of the `MATERIAL` card, which of the following statements is false?

A. It is recommended to use the `FLUORINE` name.

B. It is mandatory to specify the density.

C. **It is mandatory to specify the mass number.**

D. It is mandatory to specify the atomic number.

When defining a material, if the mass number is not specified by the user, the natural (standard) isotopic composition of the element is used by FLUKA. In addition, the use of the name `FLUORINE` is recommended because it insures the new material will be matched by FLUKA to the corresponding neutron cross-sections dataset. Refer to the *Materials* section of the manual for details.

Question 4

As a proton is transported through a thin gaseous carbon dioxide layer, which of the following statements is false?

A. It may undergo a nuclear reaction with an ^{18}O nucleus.

B. It is unlikely that it will undergo a nuclear reaction.

C. **If it undergoes a nuclear reaction, the latter takes place on an average nucleus representing the two element compound.**

D. It may produce an alpha particle.

FLUKA handles nuclear reactions differently for each isotope. The probability of a nuclear process involving a particular isotope in a material made up of an isotope mixture is proportional to the molar fraction of that isotope in the material.

For example, the probability of a nuclear reaction involving an ^{18}O nucleus depends on the isotopic composition of the oxygen making up the CO_2 molecules. Since the natural abundance of ^{18}O is only 0.2%, nuclear reactions with that isotope are, however, very unlikely compared to nuclear reactions with ^{16}O, the main isotope of oxygen with an abundance of 99.76%.

Nuclear reactions may result in a wide array of different final states. For example, the production of alpha particles is not excluded after the evaporation of a nucleus that was excited following a nuclear reaction.

Nuclear reactions are rather unlikely to occur. The cross-sections for nuclear processes are typically orders of magnitude smaller than other relevant electromagnetic processes.

Question 5

In a vacuum region, which of the following statements is false?

A. A magnetic field can be defined.

B. **A particle necessarily preserves its identity.**

C. No energy deposition can take place.

D. A macroscopic quantity may differ from zero.

Unstable particles travelling in a vacuum region can decay in flight. A notable macroscopic quantity which may be non-zero in vacuum is the particle fluence.