Diamond detector simulations with GEANT4

ADAMAS, 10.12.2019

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GEANT4

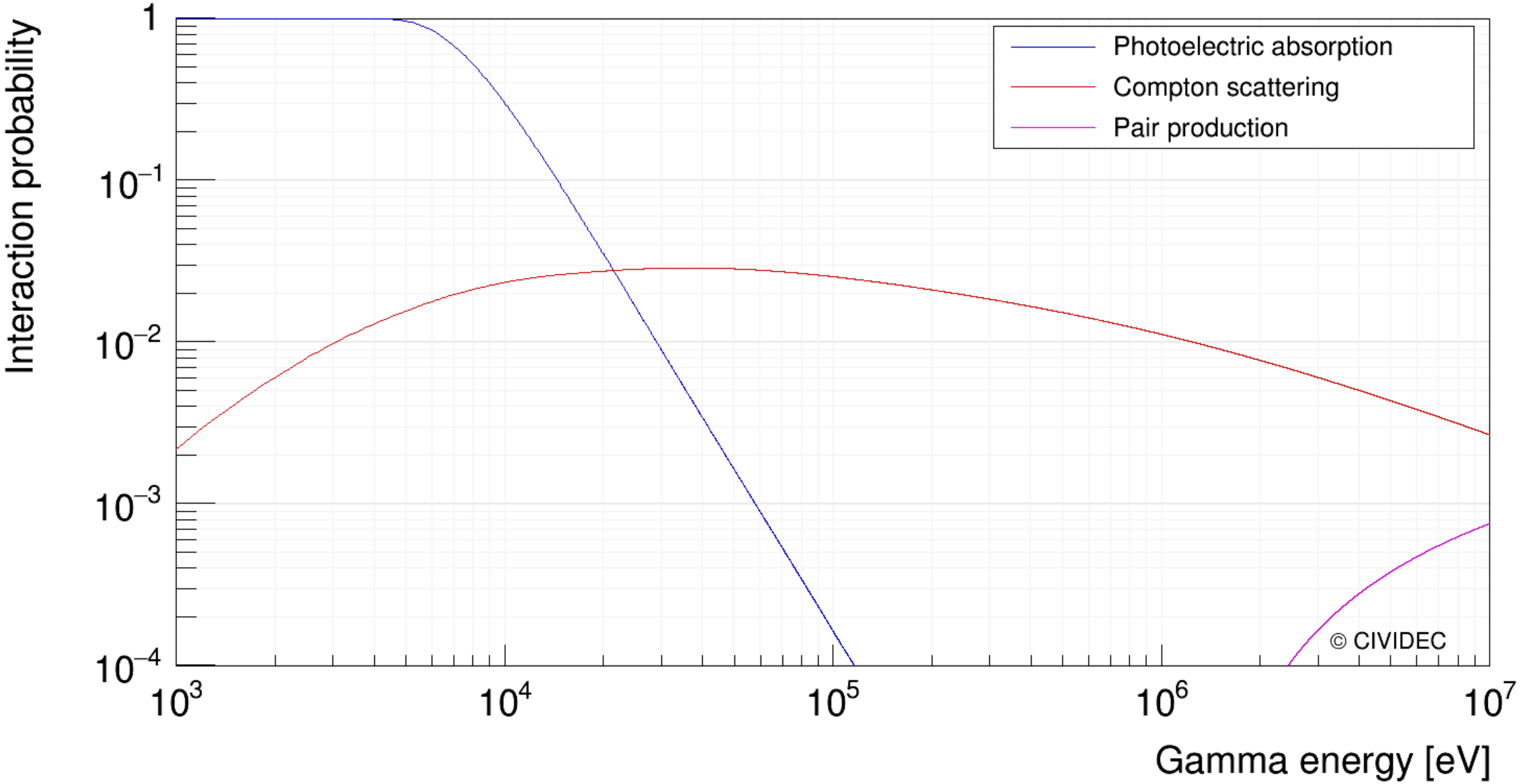
- **GEANT4 GE**ometry **AN**d **T**racking) – Monte-Carlo simulations of radiation transport in matter.
- C++ toolkit which replaced the FORTRAN-based GEANT3.
- Object-oriented design: G4Run, G4Event, G4Track, G4Step…
- Easy access to the information in particle tracks.
- High versatility in design of geometry and physics in simulations.
- Modular approach to the description of the simulated physics.

Photons (I)

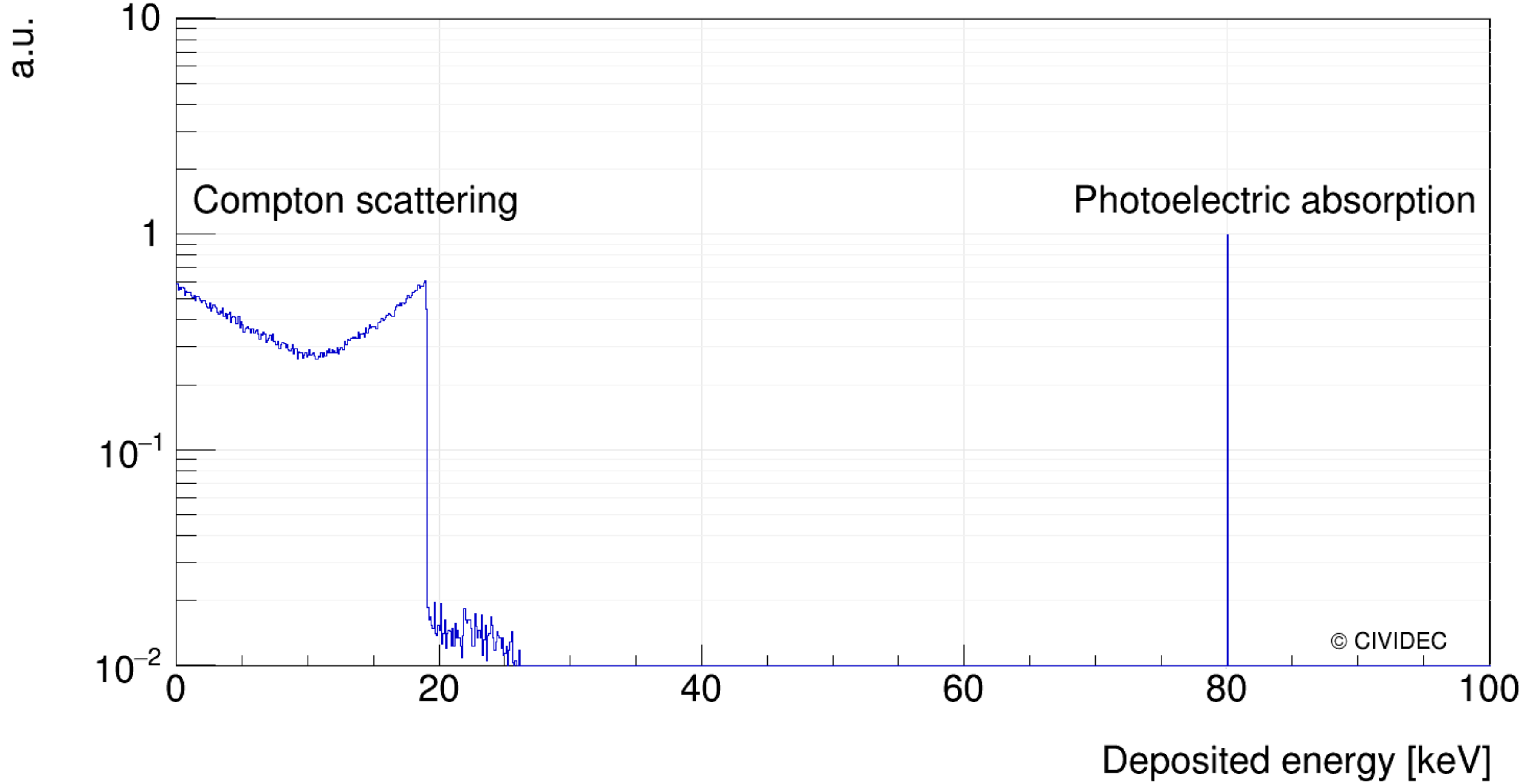
- Included in **Standard EM** physics package:

    1. Photoelectric absorption.
    2. Compton scattering.
    3. Pair production.

Photon interaction probability

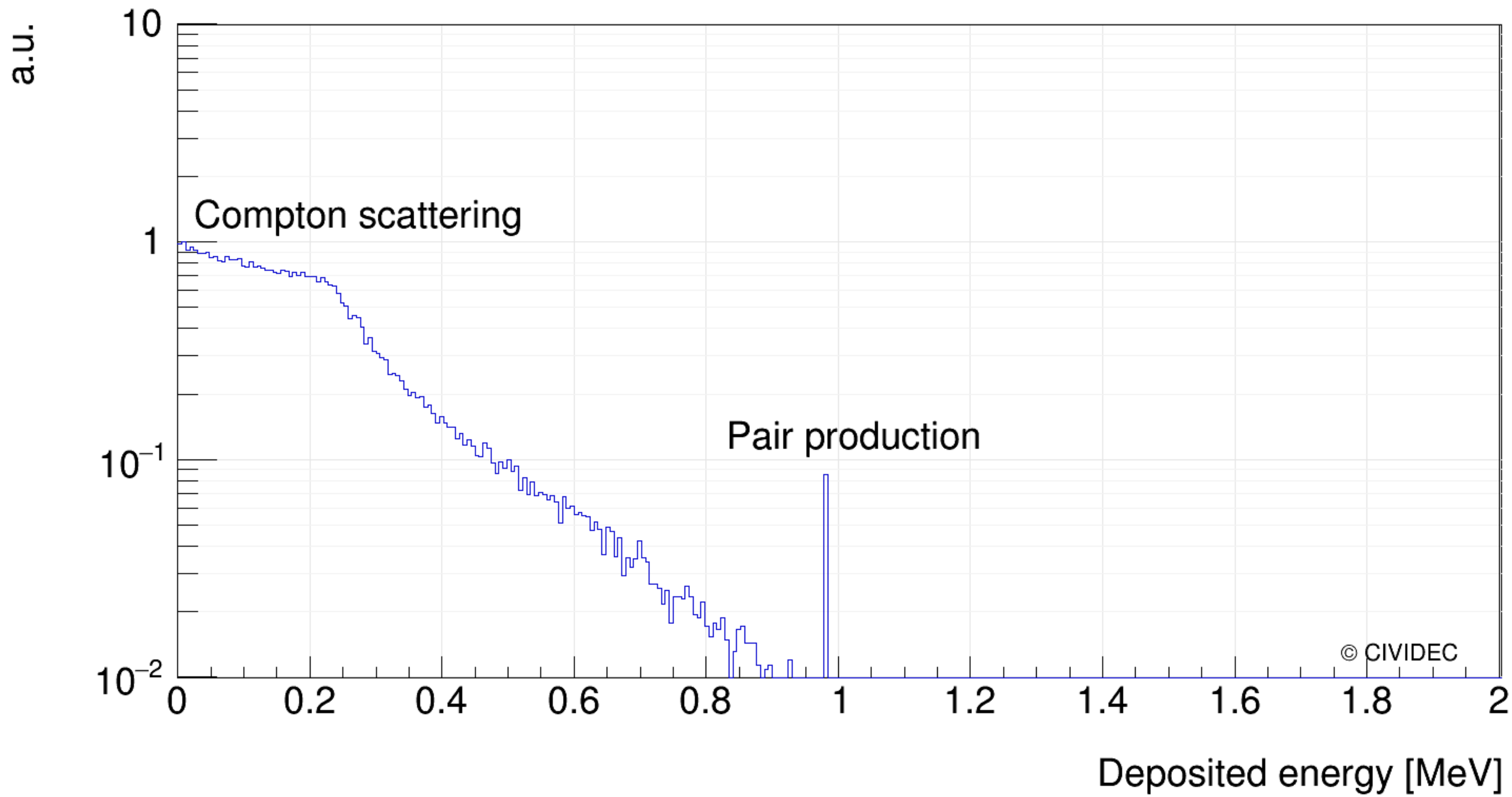


X-ray (80 keV)



a.u.
10
1
10^{-1}
10^{-2}
0
20
40
60
80
100
Compton scattering
Photoelectric absorption
© CIVIDEC
Deposited energy [keV]

Gamma (2 MeV)


a.u.
10
1
10^{-1}
10^{-2}
Compton scattering
Pair production
© CIVIDEC
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Deposited energy [MeV]

Photons (II)

- Included in **Standard EM** physics package:

    1. Photoelectric absorption.
    2. Compton scattering.
    3. Pair production.

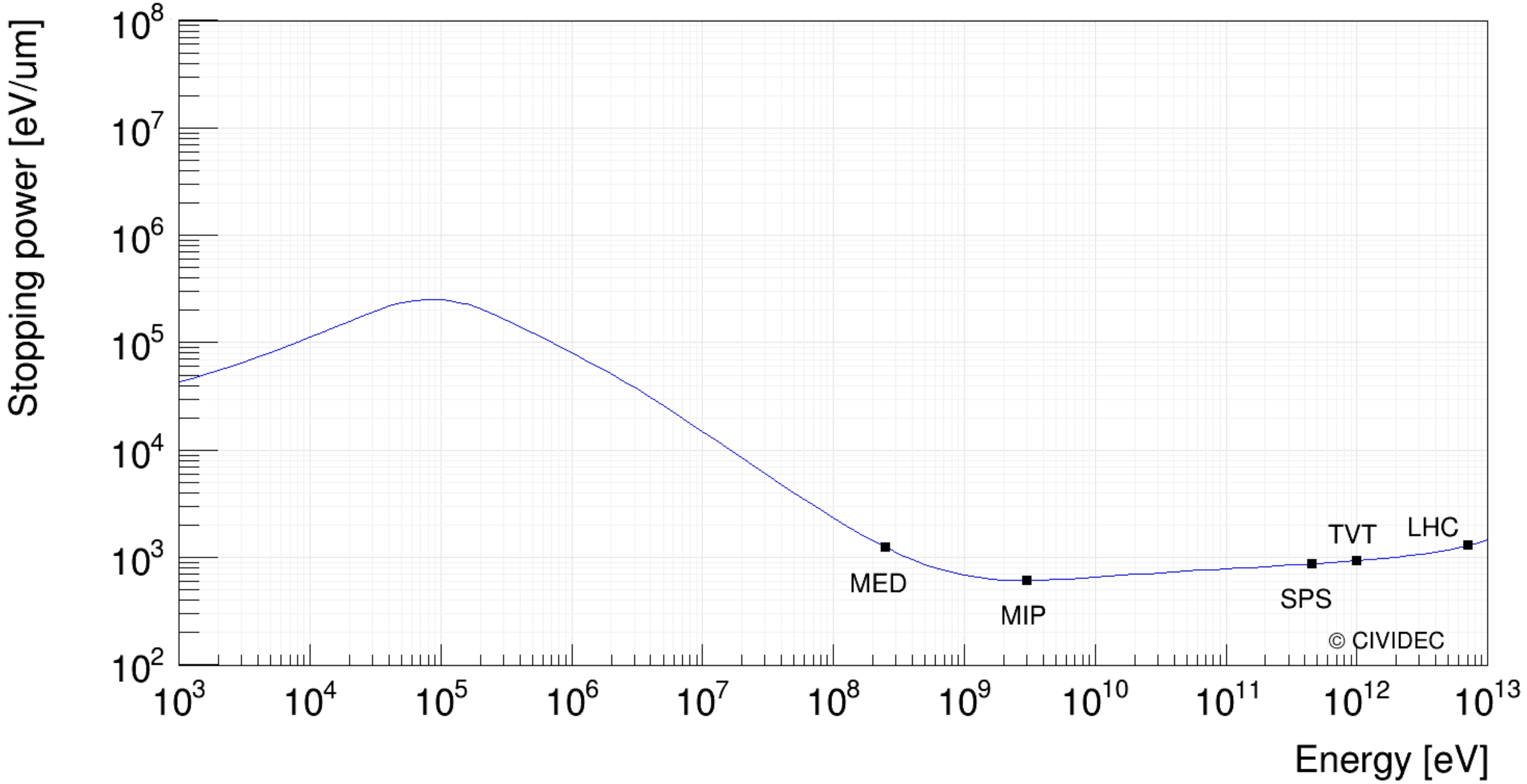
- Influence of multiple processes in a single event.

- Complexity of the simulated geometry.

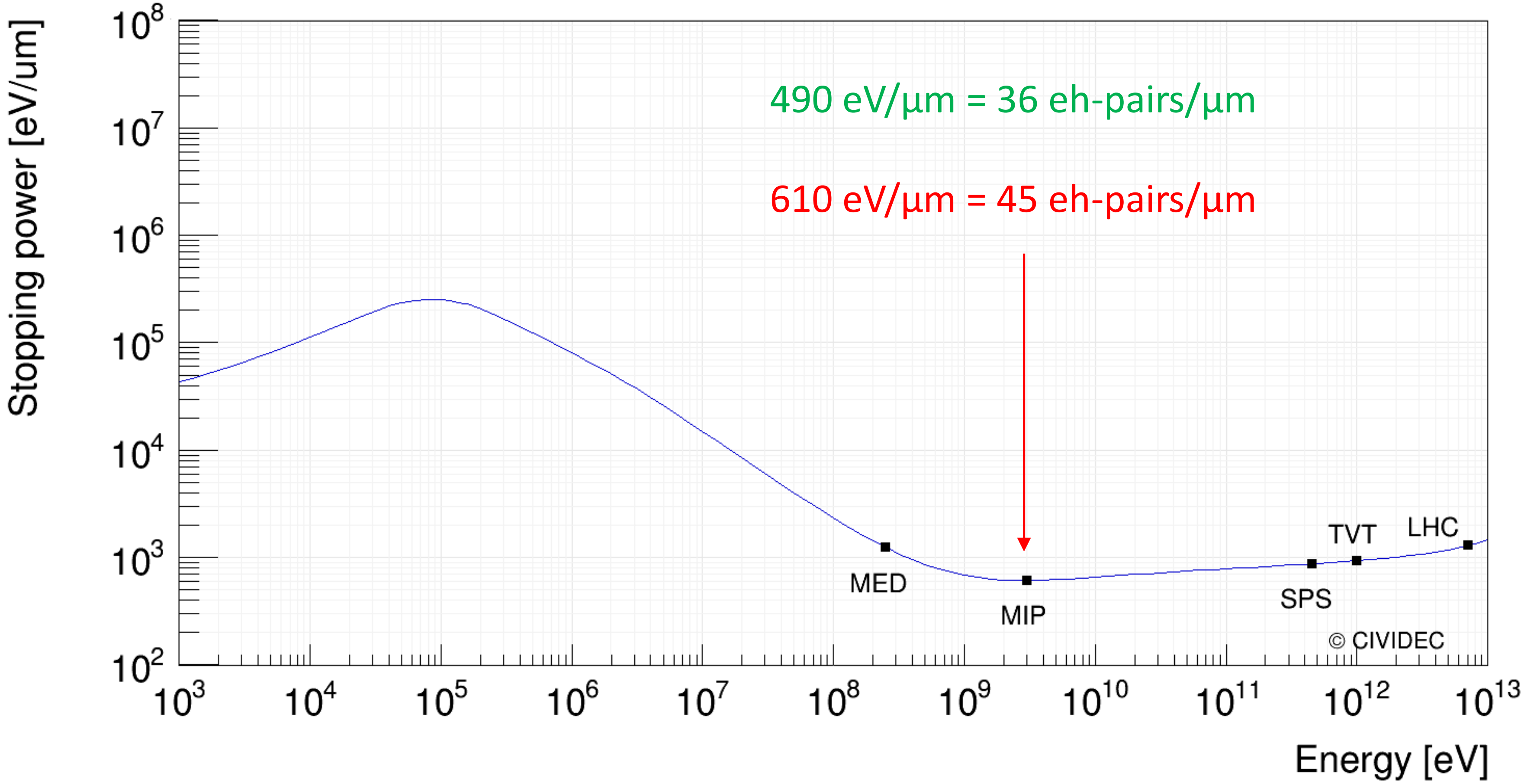
Charged particles (I)

- **Standard EM** physics package.
- One of the standard HEP **physics lists** (QGSP, FTFP, etc.)

Stopping power of proton in diamond



Stopping power of proton in diamond



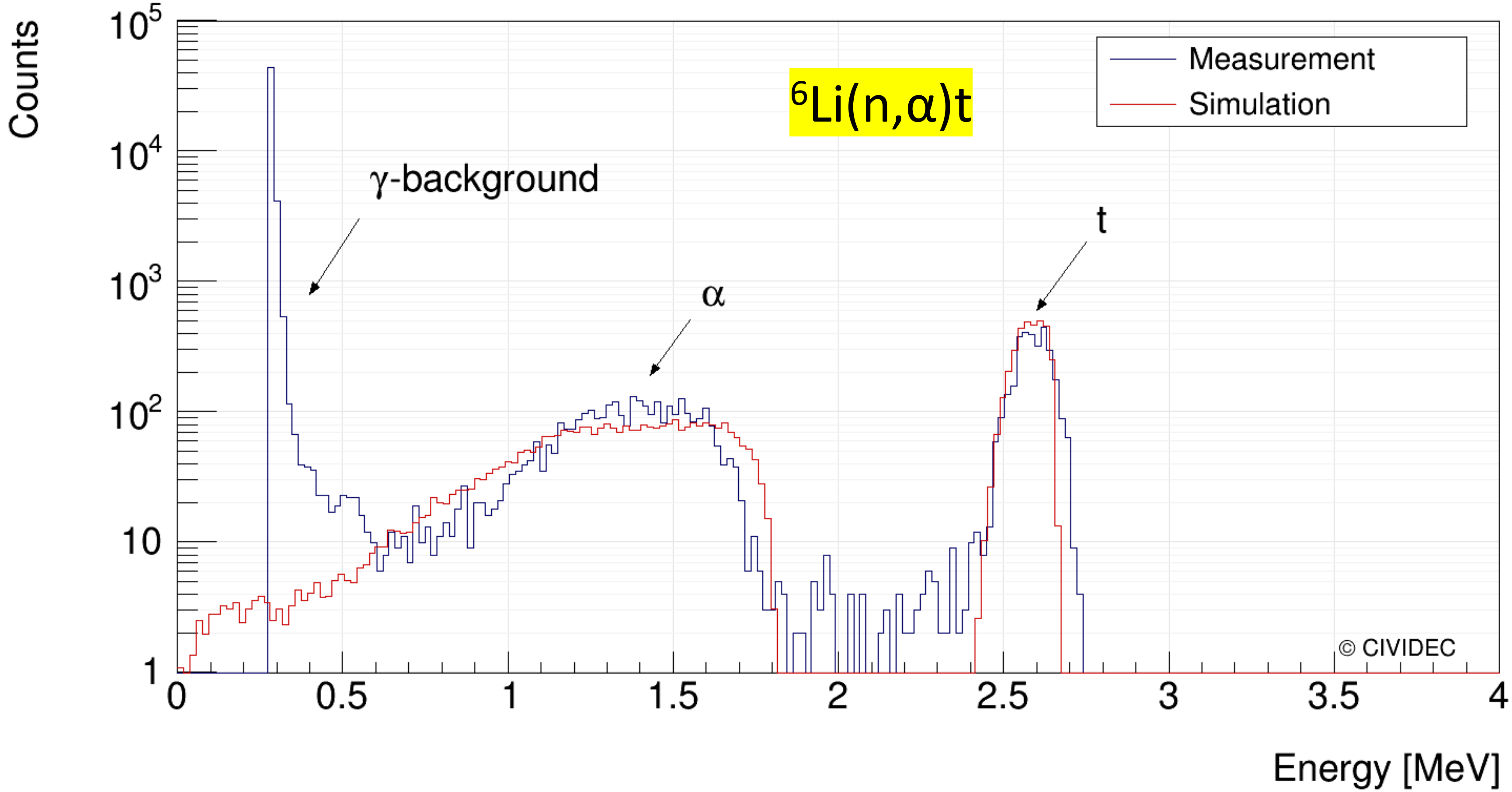
Charged particles (I)

- **Standard EM** physics package.
- One of the standard HEP **physics lists** (QGSP, FTFP, etc.)
- Production of secondaries

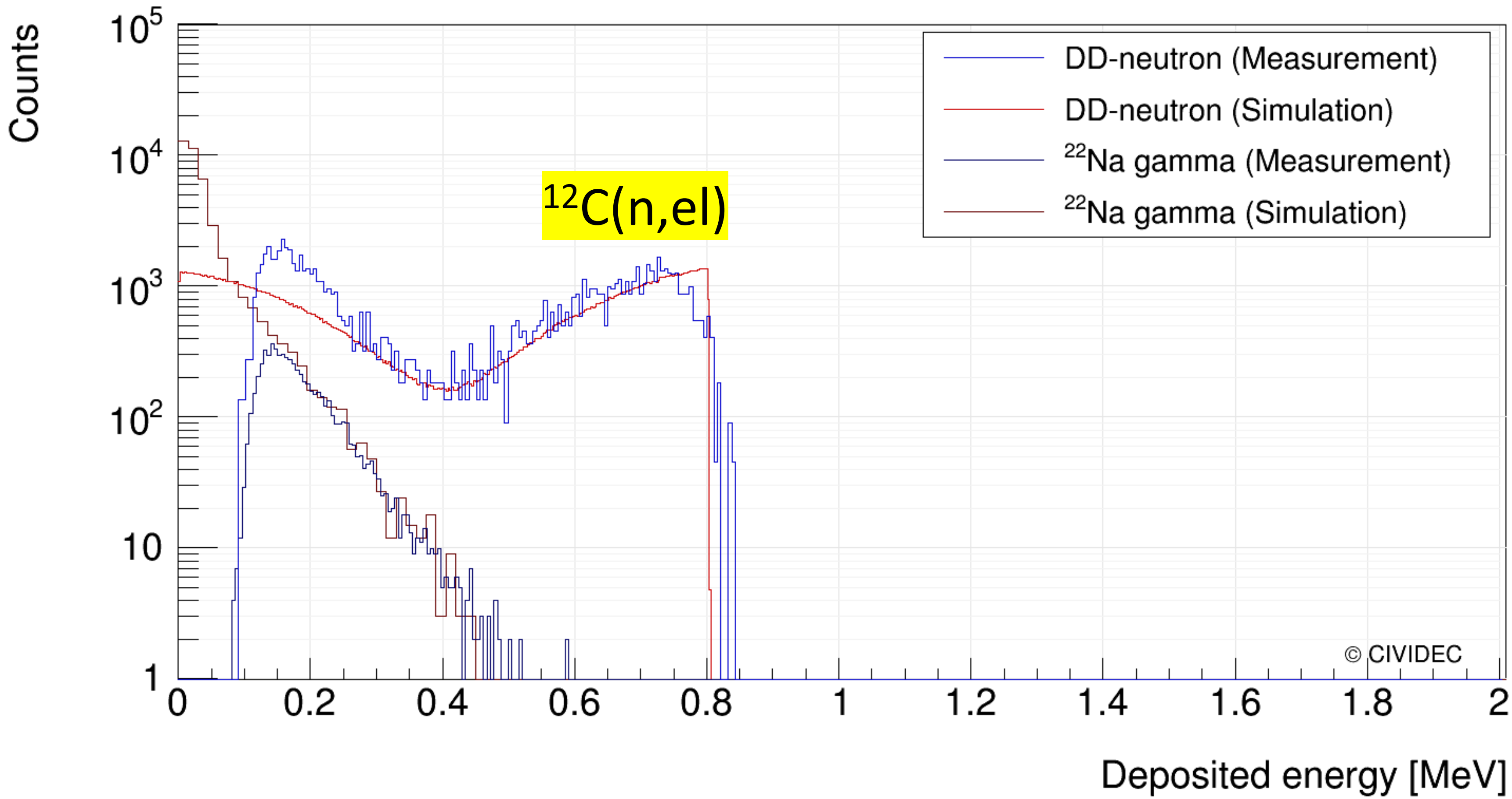
Neutrons (I)

- **Standard EM** physics package.
- One of the standard HEP **physics lists** (QGSP, FTFP, etc.)

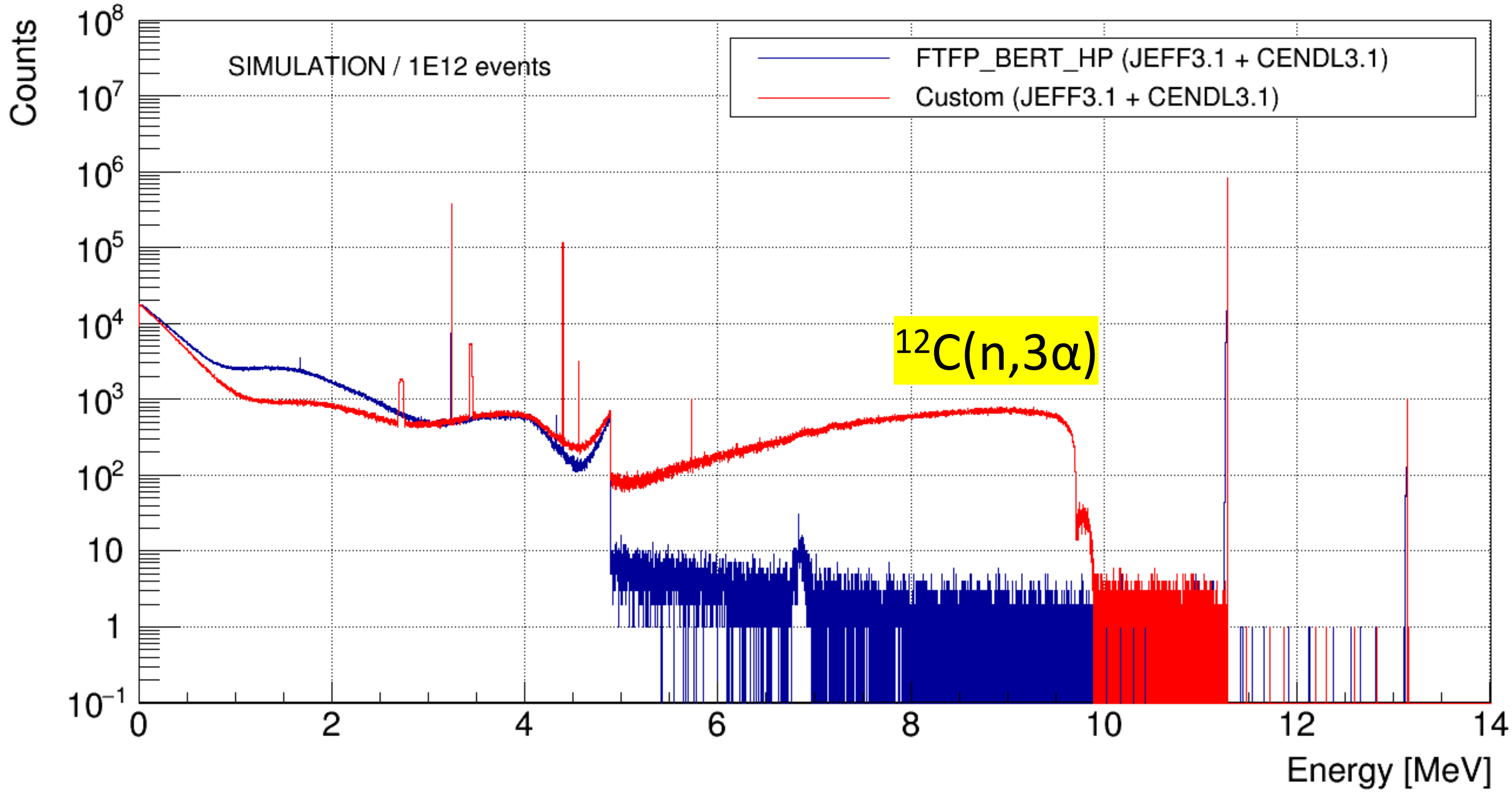
Thermal neutrons (25 meV)



DD-neutrons (2.45 MeV)



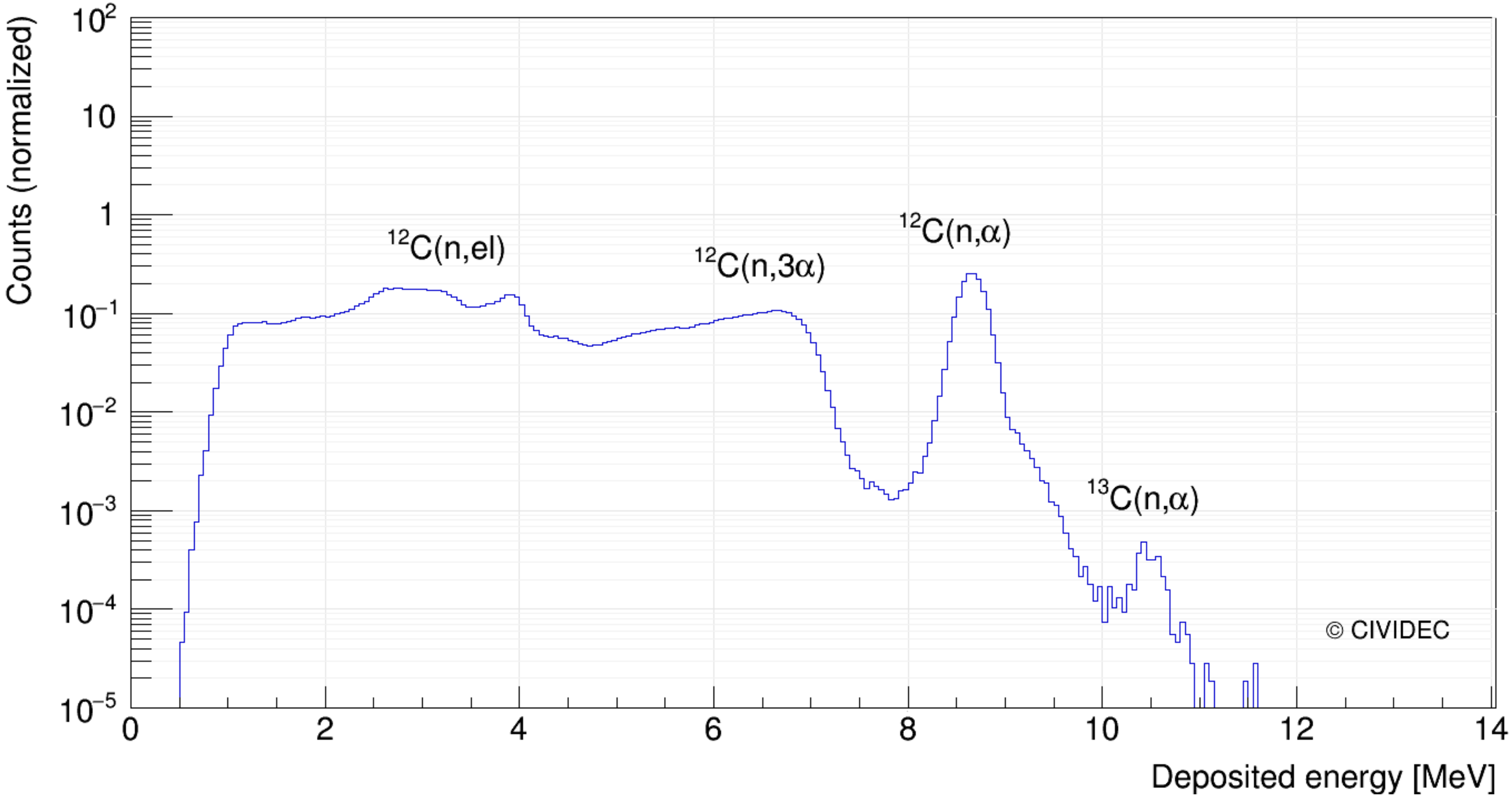
Fast neutrons (17 MeV)



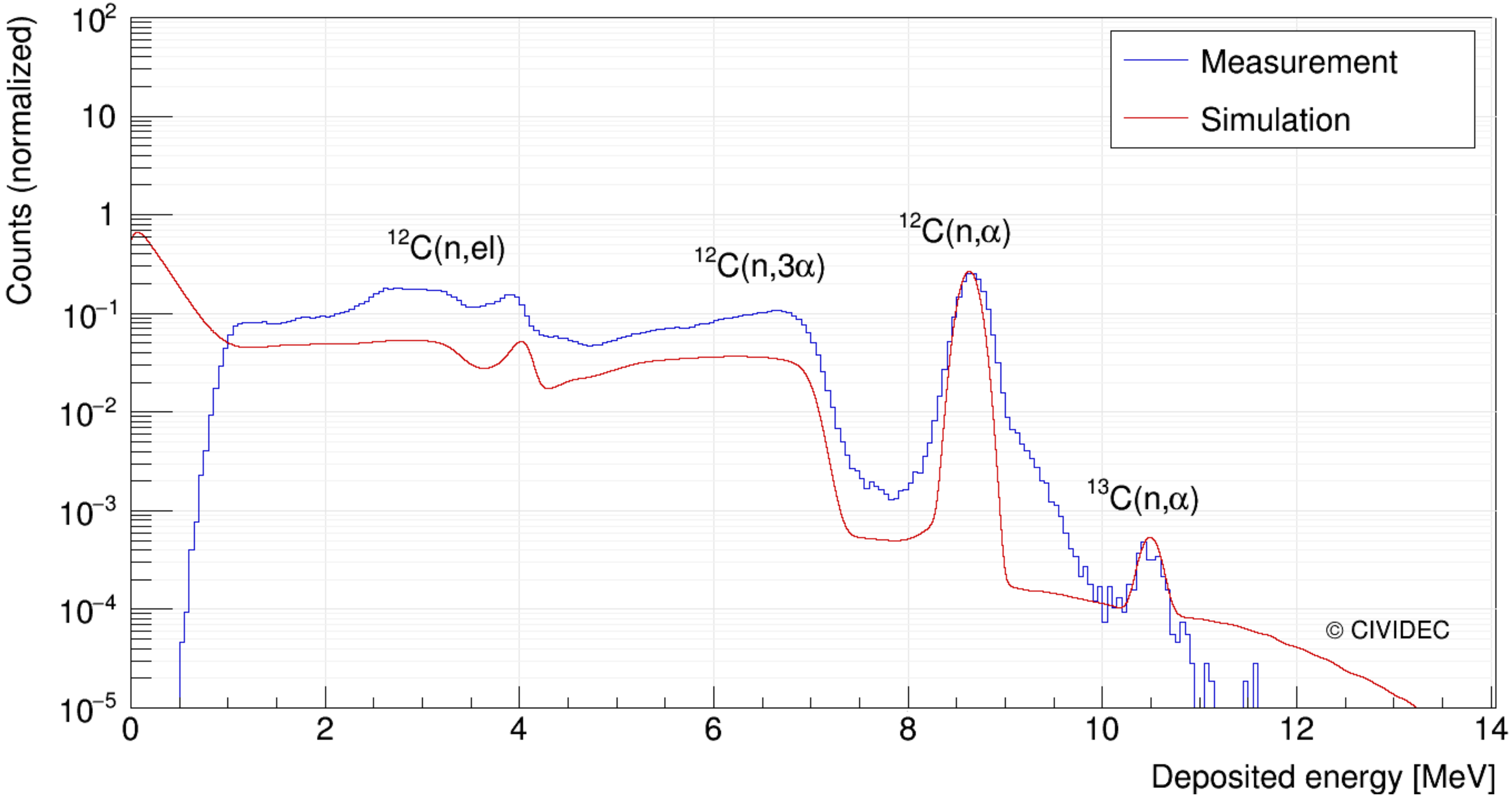
Neutrons (II)

- **Standard EM** physics package.
- One of the standard HEP **physics lists** (QGSP, FTFP, etc.) - ?
- Custom built **physics list**

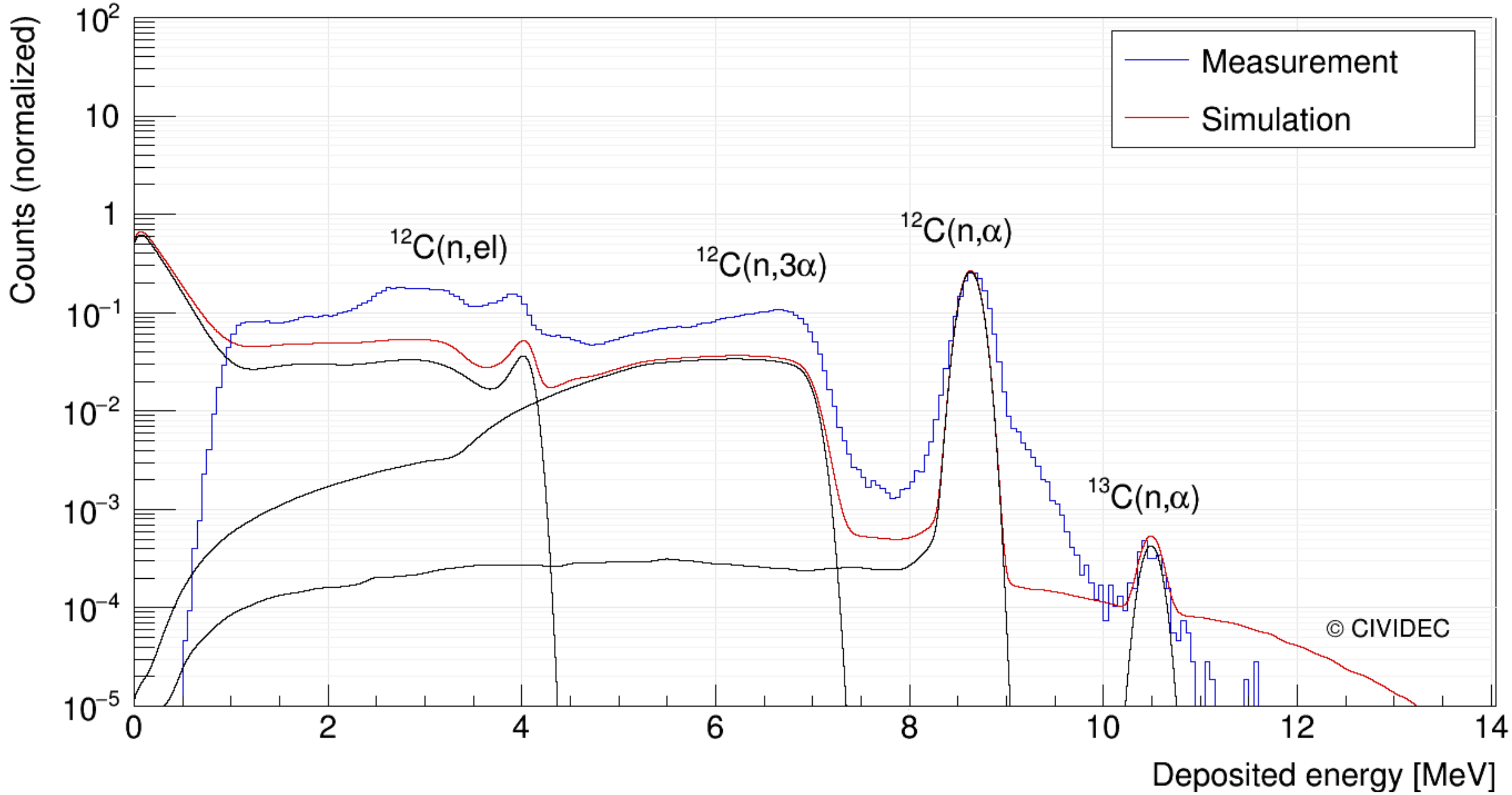
DT-neutrons (14.3 MeV)



DT-neutrons (14.3 MeV)



DT-neutrons (14.3 MeV)



Neutrons (III)

- **Standard EM** physics package.
- One of the standard HEP **physics lists** (QGSP, FTFP, etc.) - ?
- Custom built **physics list**
- Validation of cross sections

Conclusions

- GEANT4 is a convenient tool for diamond detector simulations.
- Studies of detector efficiency, detector response functions and detailed examination of interaction processes is possible.
- Simulations are in a close agreement with measurements.
- The list of physics models in simulations must be set up with caution.

Thank you!