



Physics Presentations of this Tutorial

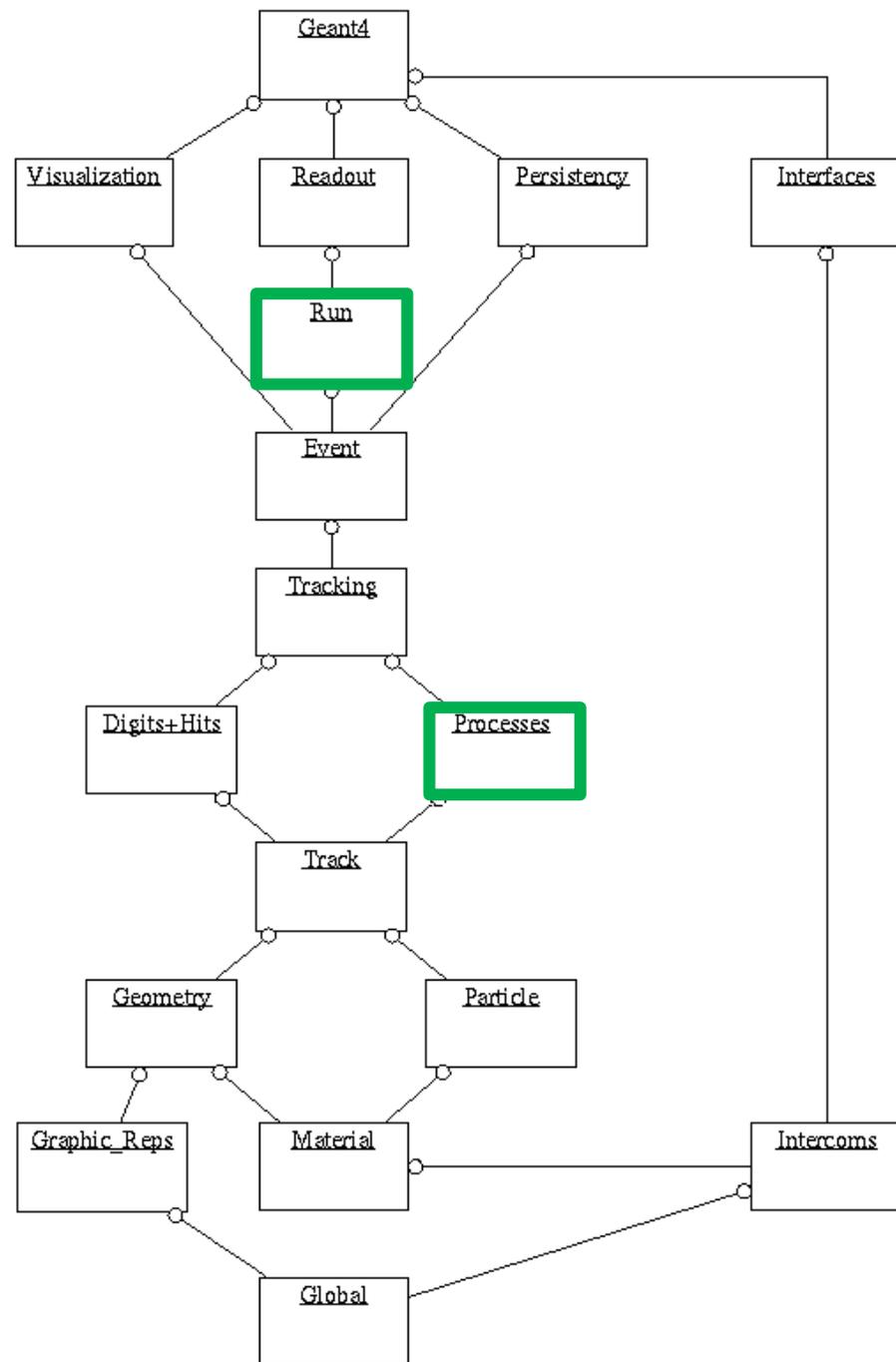
Geant4 PHENIICS & ANF IN2P3 Tutorial,
22 – 26 May 2023,
Orsay

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Where will we look in the toolkit ?

Main categories and directories involved:

- Processes:
 - `geant4/source/processes`
- Run
 - `geant4/source/run`



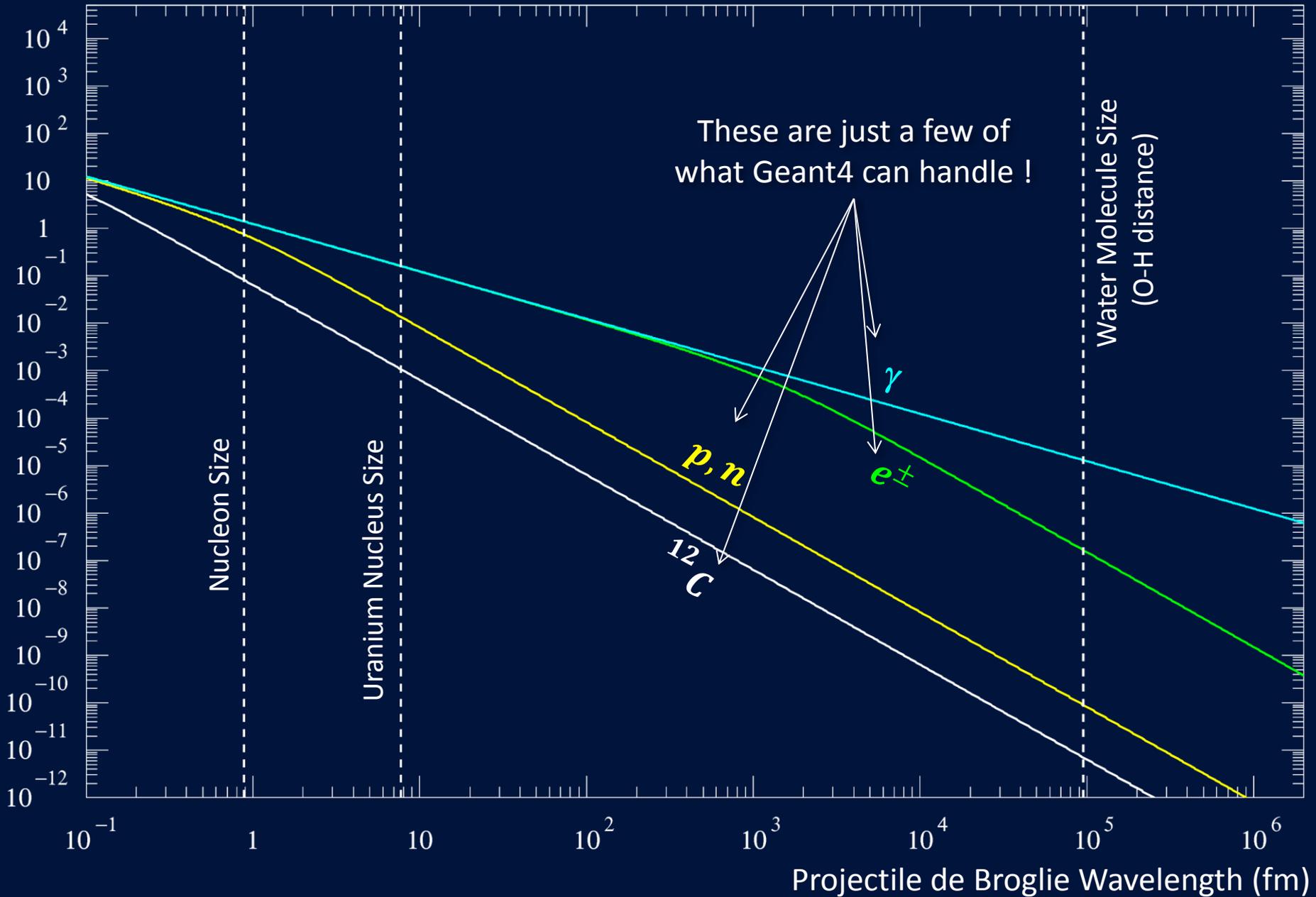
Overview of physics presentations

- › Today, session IV:
 - This introduction
 - A first “technological-like” presentation:
 - › Physics list

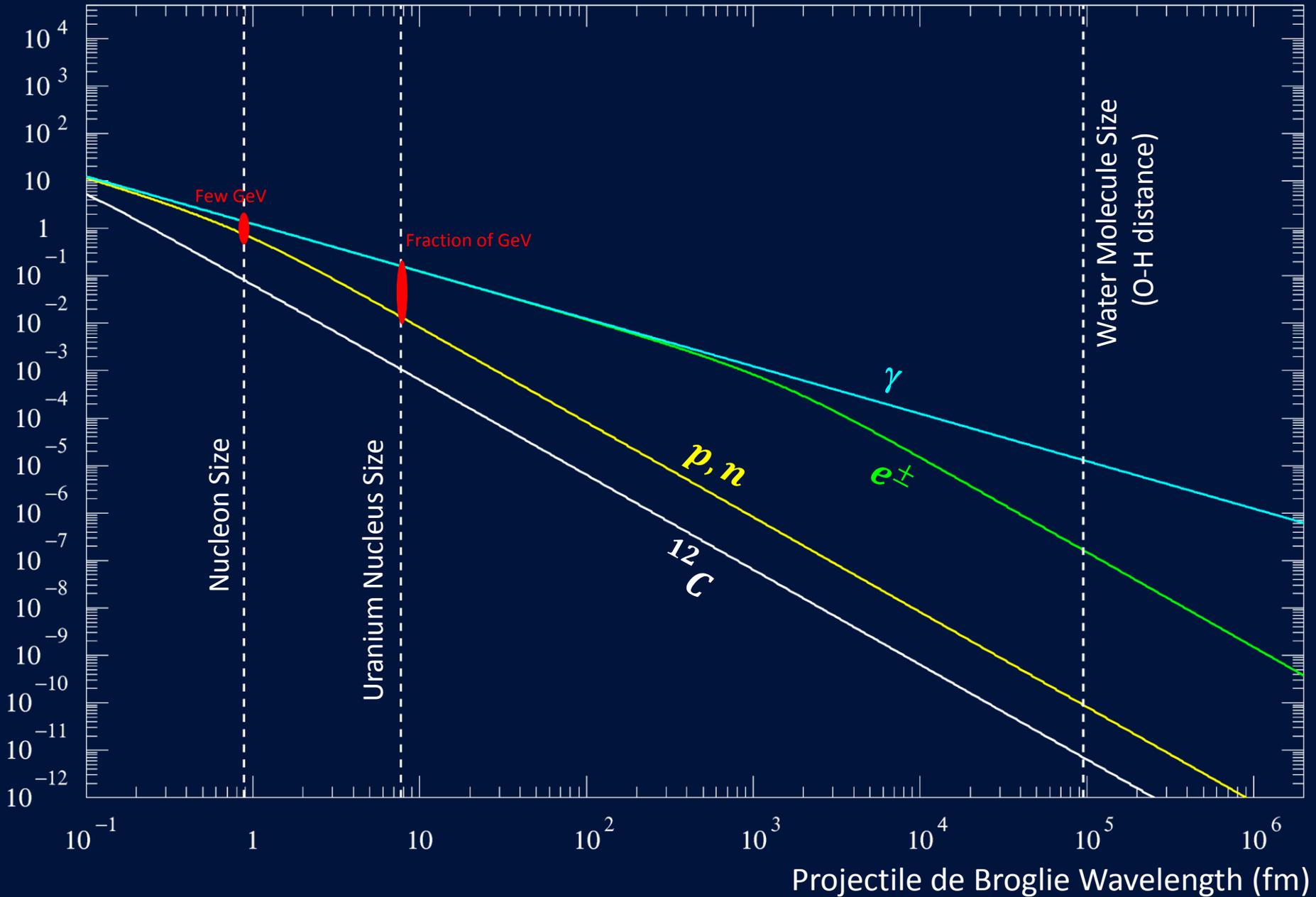
- › Wednesday, session VI:
 - A second “technological-like” presentation:
 - › Physics overview, processes and cuts

- › Thursday & Friday, sessions VII & IX:
 - Actual physics content of Geant4:
 - › “Standard” and “Low Energy” EM physics (Thursday)
 - › Hadronic physics (Friday)
 - A “physics guidance” presentation:
 - › Which Physics List to Use ? (Friday)

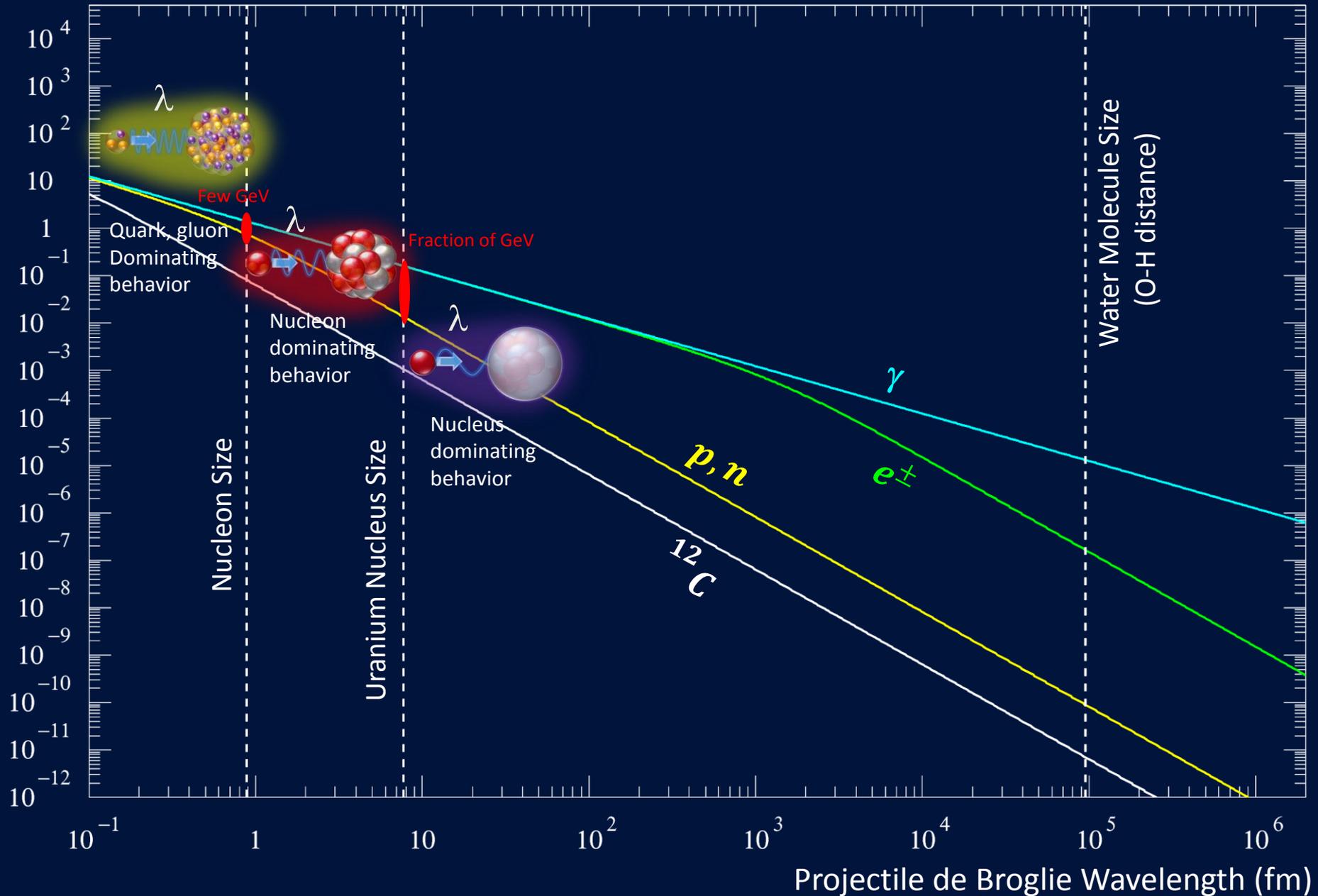
Projectile Kinetic Energy (GeV)



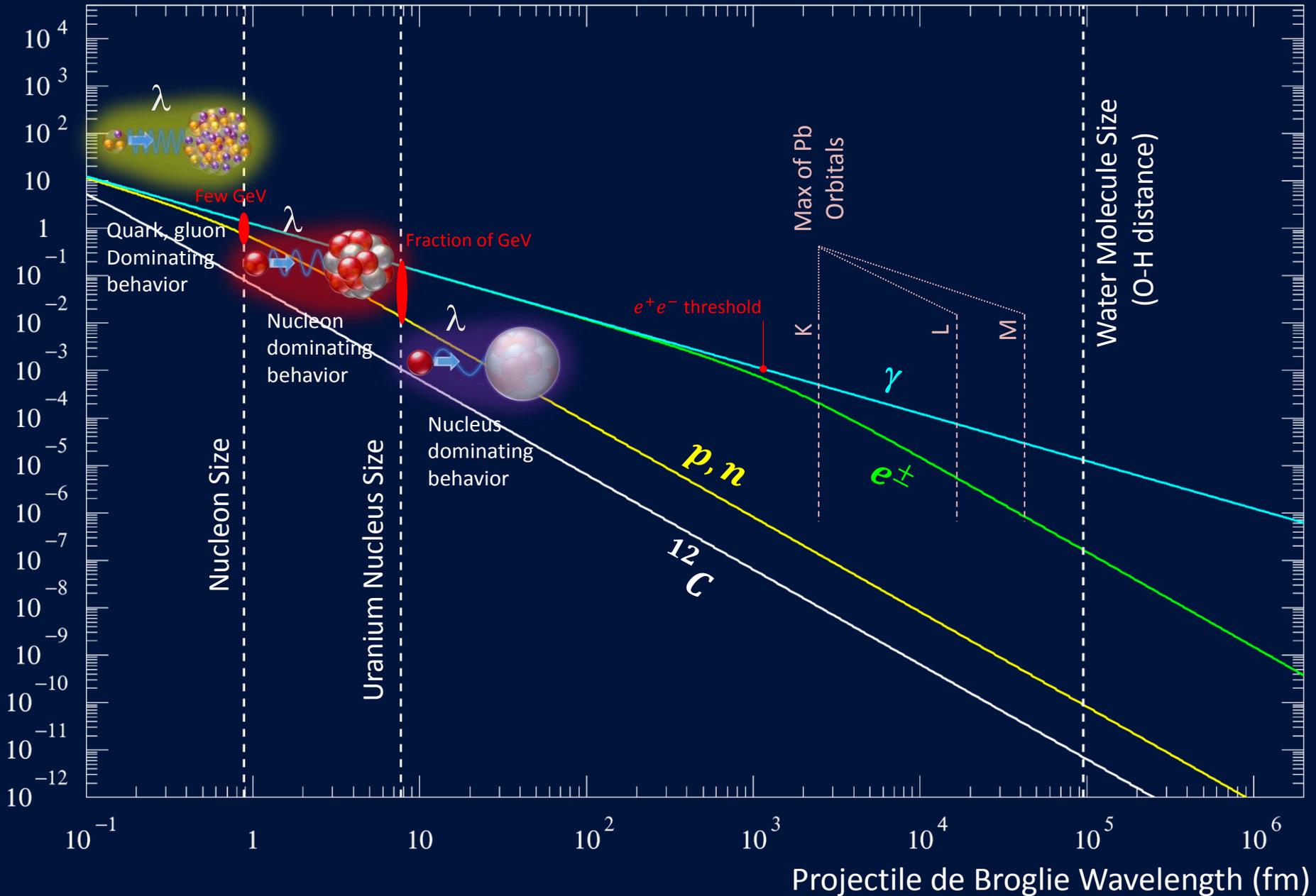
Projectile Kinetic Energy (GeV)



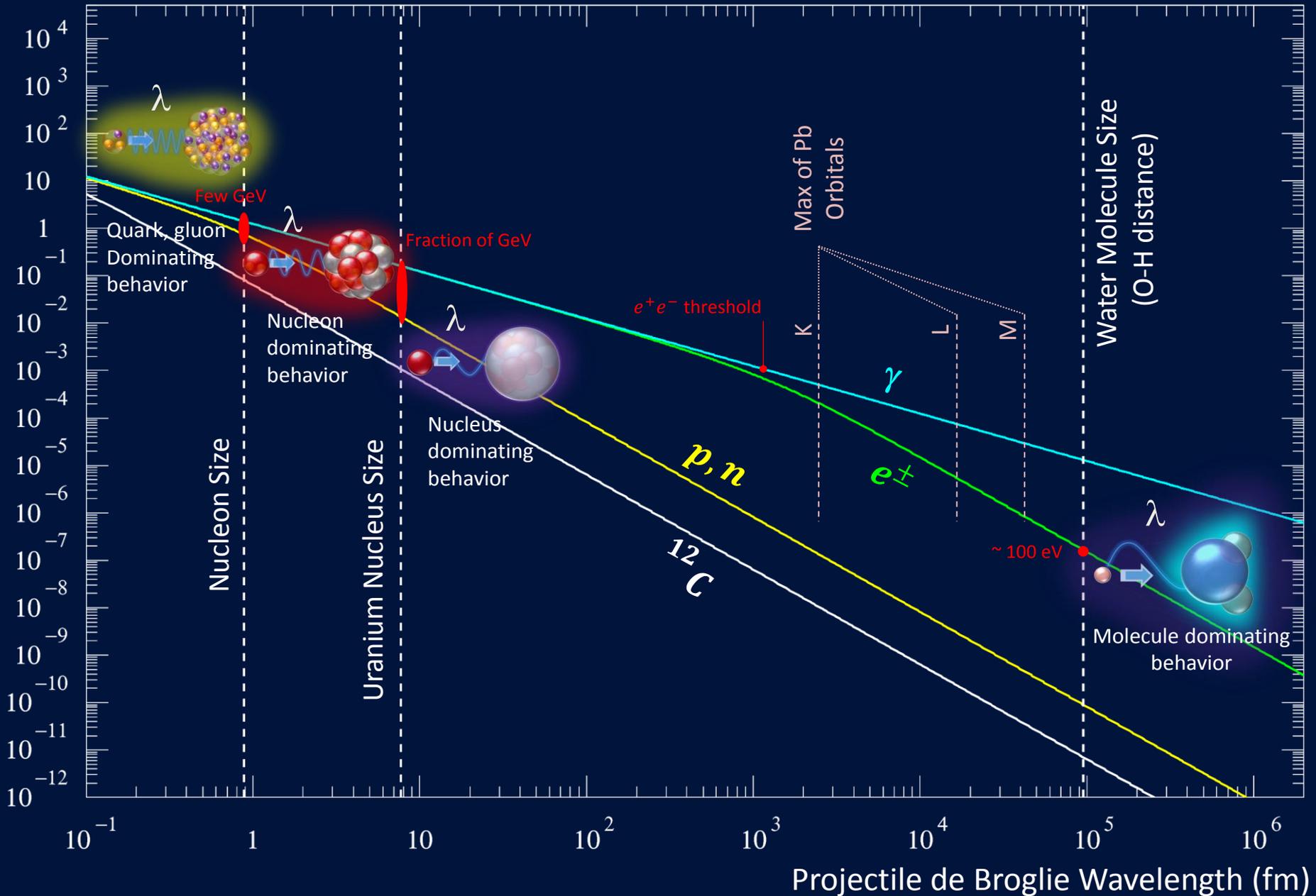
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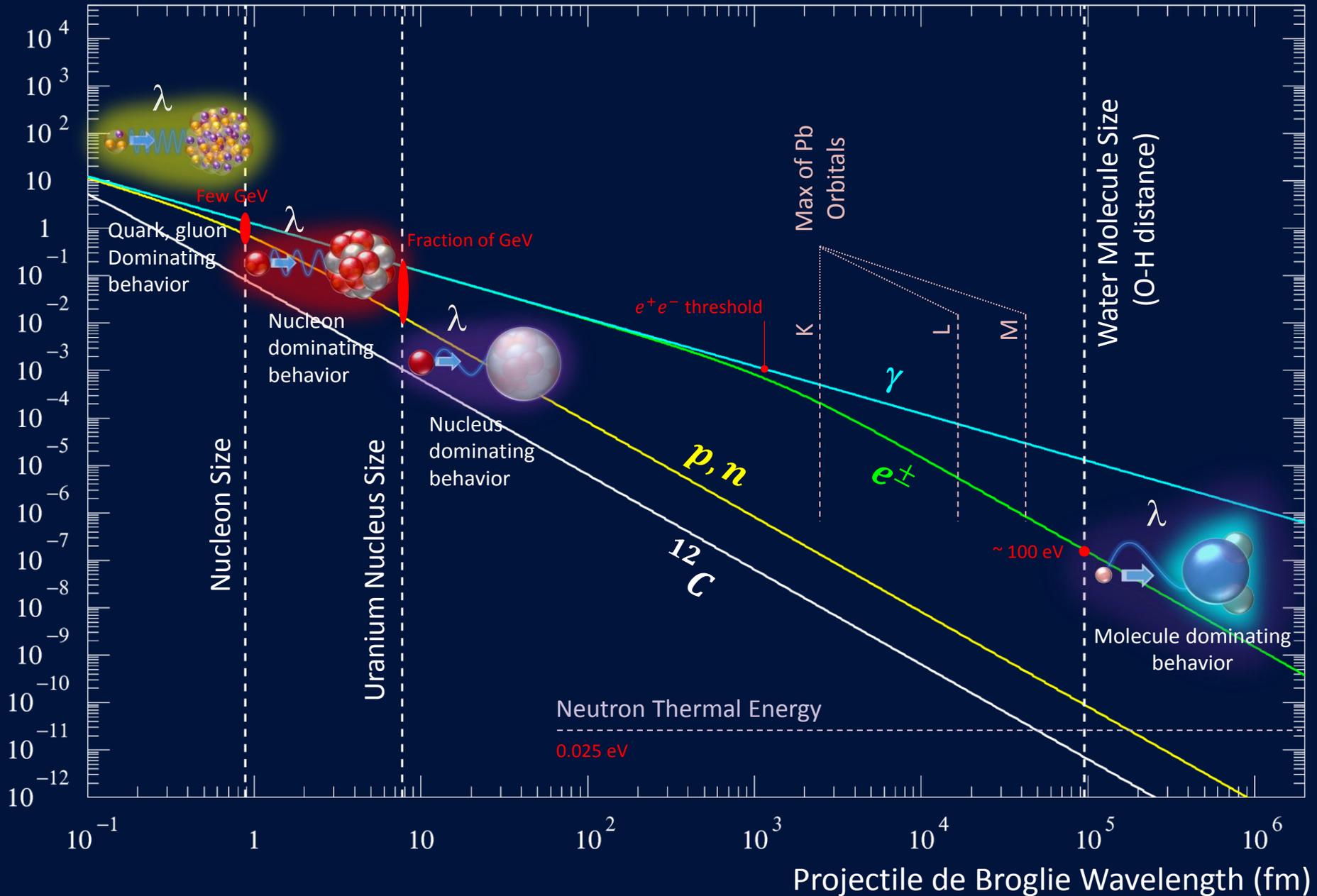
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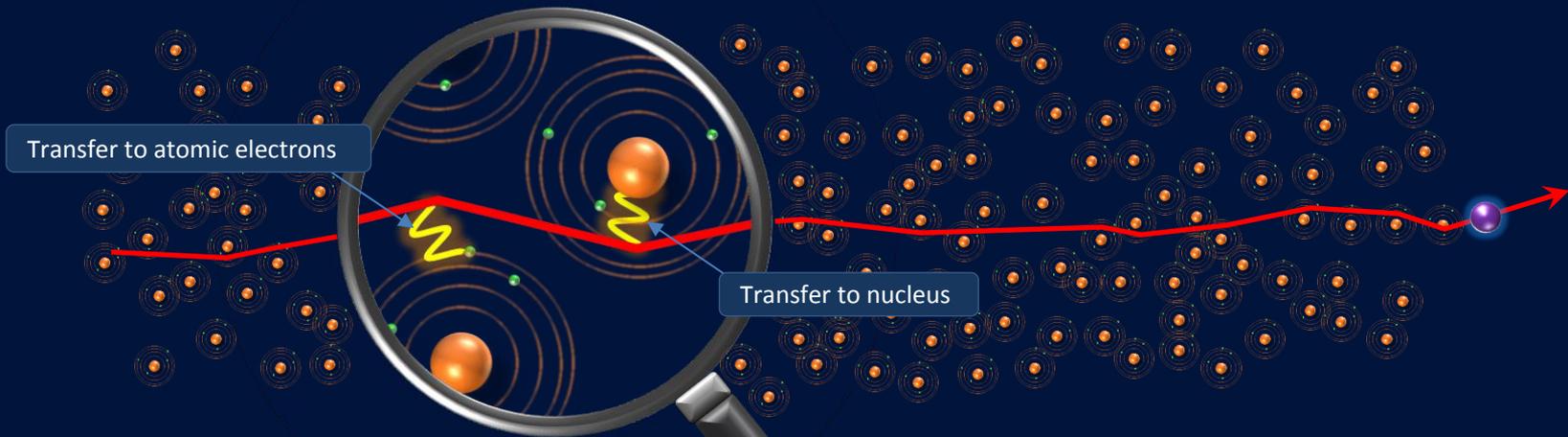


Projectile Kinetic Energy (GeV)



Point-like interactions of charged particles → Condensed history

- In matter, interactions with low momentum transfer can occur MANY times
 - $O(10^6 / \text{mm})$ for multiple scattering, for example !



- Modeling a very low energy problem (eg : microdosimetry) requires to follow each of these interactions to be accurate
- **But unaffordable simulation at high energy !**
- Adopt a “**condensed history**” approach instead
 - Compute theoretical net effect of many interactions
 - Need to compute mean effect **and** fluctuations



Coping with complexity...

- › Physics complexity is large:
 - Lots of particle types
 - Lots of different particle-matter interaction types
 - › And which are totally different depending on energy
- › In a physics code package, we have to decide of
 - how we model the point-like physics interactions
 - how we model the condensed history and under what conditions
 - how we make all these working together in consistent sets of models
- › We resolve that thinking in term of “use cases”:
 - I.e. : what models suite is needed to cover specific physics needs
 - › HEP, medical, space...
 - Use cases are determined by users : you !
- › In most cases, you don't need to create/compose your physics list
 - But you only to select some pre-defined one
- › And for that, you need to have some understanding of the Geant4 logic
 - Which is explained in the next two “technological-like” presentations