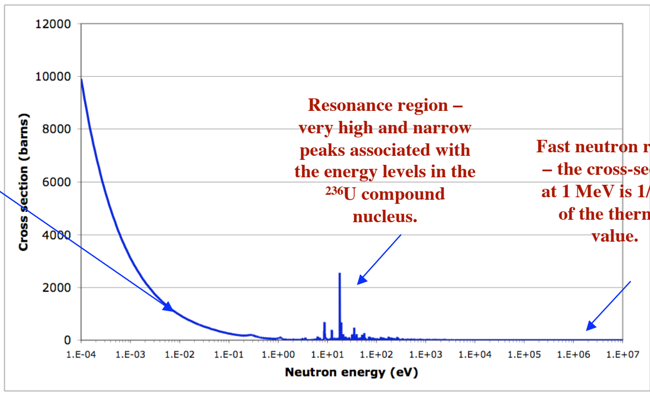
Neutron-induced fission

First let's look in detail at the excitation function – just the cross-section as a function of energy – for ^{235}U(n,f). For us this is the most important cross-section of all. Because of its characteristics the thermal nuclear reactor *works*.

Thermal region. The cross-section is very large



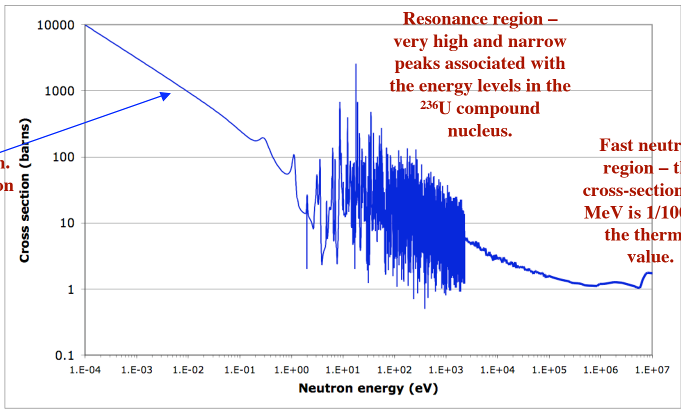
Resonance region – very high and narrow peaks associated with the energy levels in the ^{236}U compound nucleus.

Fast neutron region – the cross-section at 1 MeV is 1/1000 of the thermal value.

Excitation function for the reaction: ^{235}U(n,f) on a *linear-log* scale.

Neutron-induced fission

Let's draw this cross-section again – this time on a log-log scale.



Resonance region – very high and narrow peaks associated with the energy levels in the ^{236}U compound nucleus.

Thermal region. The cross-section is very large

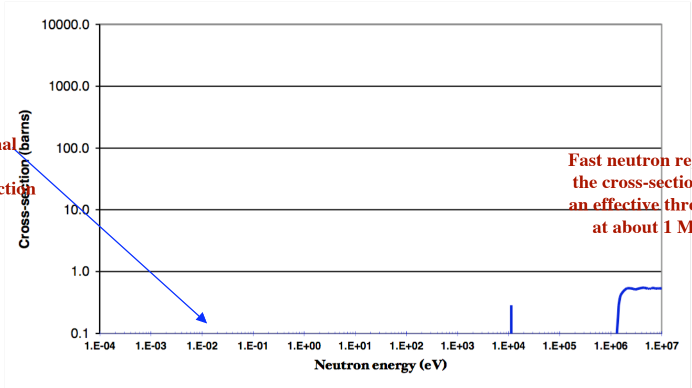
Fast neutron region – the cross-section at 1 MeV is 1/1000 of the thermal value.

Plotting the data using a log-log scale shows much more detail.

Excitation function for the reaction: ^{235}U(n,f) on a *log-log* scale.

Neutron-induced fission

For comparison, here is the $^{238}U(n,f)$ cross-section on the same scale.



Excitation function for the reaction: $^{238}U(n,f)$ on a log-log scale.

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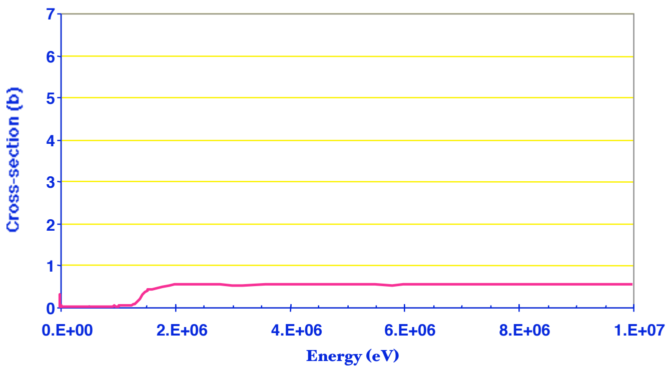
Neutron-induced fission

The contrast between the excitation functions for the reactions: $^{235}U(n,f)$ and $^{238}U(n,f)$ shows the effect of the different binding energies (of the last neutron in $^{236}U^*$ and $^{239}U^*$ respectively).



Excitation function for the reaction: $^{238}U(n,f)$.

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Neutron-induced fission

Is fission the only thing that happens when a neutron interacts with a ^{235}U nucleus?

Not at all.

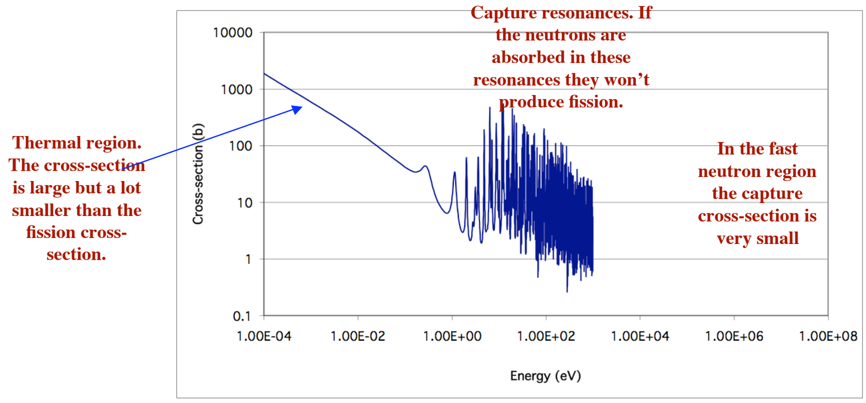
Other reactions take place, such as scattering and radiative capture.

At low energies and energies in the resonance region the most important reaction that absorbs neutrons is radiative capture, the (n,γ) reaction.

The next slide shows part of the cross-section for this reaction.

Neutron capture in U-235

This is the ^{235}U(n,γ)^{236}U cross-section drawn on the same scale as the ^{235}U(n,f) cross-section on the previous slide.



Excitation function for the reaction: ^{235}U(n,f) on a log-log scale.

We will discuss neutron capture later in connection with the slowing down of neutrons.

Neutron induced fission

We can see from the cross-sections that it would be easy to make a reactor work – easy to produce (n,f) reactions – if we had slow (thermal) neutrons.

The next question is what is the energy distribution of the neutrons actually produced in the fission process – the *fission spectrum* neutrons?

