Subject: antineutrino rate prediction: a "how to" approach
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Hi there,
During the SoLid people today, some people (Antonin, Nick, may be others too) were interested on the details of the antineutrino rate estimation for a given detector, in this case, Nemenix. As I suggested during the meeting, the procedure is based on a multiplication between different parameters which I describe in the following:

1) Number of fissions produced in the reactor core
2) Mean IBD cross-section per fission
3) The number of targets in the detector
4) Flux correction
5) Livetime
6) Detection efficiency which I will neglect here in order to make happy some collaborators 😃

Let's discuss each of one:
1) Number of fissions is equal with the reactor power divided by mean energy release per fission. Be careful, you have to transform the reactor power in MeV. Let's take for example BR2 with P=55MW; in this case the no. of fissions is 6.241E18*55/201.92 = 1.7E18 fissions *per second*. The number 201.92 is the energy release per fission *for 235U* measured by Kopeikin et al.

2) Mean IBD cross-section per fission represents what Antonin asked me during meeting, meaning the cross-section of IBD multiplied with the reactor flux of 235U emitted by reactor. The IBD cross-section has been computed by Vogel et al. and the flux of antineutrinos coming from 235U could be delivered using the parametrization from Mueller et al. If I understood well, Antonin had some troubles for computing this parameter, so I provide here a simplified version (which gives excellent results however) of this quantity:

```
TF1* f = new TF1("" ,"exp(3.21651 - 3.11124*x + 1.39471*x*x - 0.368959*pow(x,3) + 0.0444515*pow(x,4) - 0.00205352*pow(x,5))*0.951*(x-1.29333)*sqrt(pow((x-1.29333),2)-pow(0.511,2))",1.8,10);
```

If you make just f->Integral(1.8,10), you'll get 6.64 which is very close from what I use. You must take into account a factor E-47 multiplied with this number since the IBD X-section is very tiny ... So 6.64E-47 represents the mean X-section per fission of 235U in m^2

3) The number of targets is equal with the number of protons per unit volume times the detector volume. I don't enter into details, for Nemenix I compute (always in m^3) 0.008*5.17E28

4) Flux correction is $1/(4 * pi * L^2)$ = 0.0026 for L = 5.5 m

5) Livetime day = 24*3600 = 86400

Finally, let's multiply all these quantities: 1.7E18 * 6.64E-47 * 0.008 * 5.17E28 * 0.0026 * 86400 = 10.5 antineutrinos per day.

Finally I would like to emphasize that in this calculus, some simplifications were

taken into account. For example I supposed a pure 235U core, etc; please see our talk for all of them and for some plots with the results.

Greetings.
Andi