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Compact Photon Source Simulations

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Thu, Mar 30, 2017 at 5:18 PM

To: Cynthia Keppel <keppel@jlab.org>, Tanja Horn <hornt@jlab.org>, Rolf Ent <ent@jlab.org>, Bogdan Wojtsekhowski <bogdanw@jlab.org>, Gabriel Niculescu <gabriel@jlab.org>, Donal Day <dbd@virginia.edu>, Dustin Keller <dustin@jlab.org>, Igor Strakovski <igor@jlab.org>

Hi All,

Here is the suggestion on how to proceed with the Compact Photon Source simulations.

As we agreed during the last meeting, I'm trying to come up with a minimalistic set of problems that we should address, and agree about the results, to be able to convince ourselves and others that the Compact Photon Source can be built and used in a real experiment in Halls A and/or C at JLab. From the radiological protection point of view the following set of limitations should be satisfied, conservatively assuming typical expected experimental run conditions:

Beam energy: 11.5 GeV

Beam current: 2.6 microA (Beam Power = 30 kW)

Run time: 1000 hours

The radiation dose rate parameters must stay within limits typical for a high current experiment in the Halls:

dose rates in the Hall should be under several rem/h at 10 m from the device;

dose rates at the boundary should be under 1 microrem/h during the run;

dose rates outside the device envelope at a foot distance from the device should be under several mrem/h after one hour following the end of the 1000 hour run.

We have decided to start with the simple test geometries of the CPS that could be simulated by different groups using different software tools.

The tools available for the prompt dose calculations around the device are GEANT3, Geant4, and FLUKA.

For the activation evaluation problem only FLUKA is available, but different independent calculations by different groups are possible and will be useful.

For the dose rates at the boundary we only have one tool, based on the GEANT3 package that we typically use at RadCon for the Radiation Budget calcs. FLUKA-based Rad.Budget tool is under development, but not ready yet.

There are the two simple device geometries to start with:

1) "Iron" (density 7.8 g/cm³) sphere with the diameter of 300 cm, centered at (0,0,0), with the beam origin at (0, 0, -30 cm), to take into account, to some extent, the development of the cascade along 'z', and the need of more shielding in forward (z) direction.

2) a similar sphere but made of "Tungsten powder" (density of 15.6 g/cm³) with the diameter 150 cm, centered at (0,0,0), and with the beam origin at (0, 0, -15 cm)

It would be nice if different groups could evaluate the prompt gamma and neutron dose rates in rem/h around these toy devices, either in the mesh in (z,y) with the limits on x: -15 cm < x < 15 cm, -1500 cm < y < 1500 cm, and -1500 cm < z < 1500 cm, with the bin size of 30 by 30 by 30 cm, or just at a distance of, say, 3 m from the center, function of theta polar angle, using the azimuthal symmetry of the problem (or may be just using a corresponding radial and polar angle binning).

The second problem would be to evaluate the dose rates around these toy devices using the same mesh, after 1 hour, 24 hour, 7 days, and 30 days following the end of the 1000 hour run.

And I would start my runs to see if the thickness of the devices provides enough self-shielding to make the boundary radiation acceptable, assuming that the devices are placed in the Halls a couple meters upstream of the pivot.

My understanding is that the CPS for the K0L project has somewhat less strict requirements, as there should be no

problem with the dose rates at the boundary, due to the large roof thickness in the Hall D Tagger facility. However, the requirements on the prompt dose rates and the activation may be about the same.

With my best regards,
Pavel

On 03/27/2017 03:00 PM, Cynthia Keppel wrote:

Hi all,

This is just a reminder note about our meeting tomorrow at 11:30 AM as a small(er) group to follow up on our discussions at the "New Opportunities with High-Intensity Photon Sources" workshop, specifically to move towards an apples to apples comparison of options and issues for source development and a collaborative, one/best source approach.

We will meet at JLab in CEBAF Center room F326/327 and here, below, is the BlueJeans contact information. If you will be presenting slides at all, please make sure that they can be shared easily via BlueJeans.

Thanks - looking forward to talking with you all tomorrow,
Thia

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