QSS30 - Dmitry Budker - Questions & Answers

Dmitry Budker

How much of the characteristics of the atomic transition survive in the gamma rays that are created? For example, can the spectral linewidth of the gamma rays be influenced by working with specific transitions?

DMITRY: In the rest frame of the PSI, we have normal photon scattering. If we go back to the lab frame, there are complications that arise. For instance, the gamma energy depends on the emission angle.

How about bouncing lasers off of antimatter stored in an accelerator ring. Would one expect anything new?

DMITRY: This is a nice idea! The issue is that we do not know how to produce heavy anti-PSI (yet).

Can you provide the main motivation for producing gamma rays: What are they useful for? Have you a particular motivation?

DMITRY: I would say, the main motivation is doing precision nuclear photophysics. One can also produce isotopes and isomers of interest and create “tertiary” beams with unique properties.

Could one use this giant ion trap ring as an interferometer with a huge enclosed area for very precise measurements?

DMITRY: This is an interesting idea. One would need to have a good understanding of what happens with the PSI in terms of the accelerator physics.

What exactly makes the LHC such a good platform for these experiments, compared to one of the existing highly-charged-ion facilities? Is it the higher kinetic energy or also the size of the ring?

DMITRY: I think important parameters include the relativistic factor, number of ions in the ring, as well a their energy spread and emittance. Laser cooling in the ultrarelativistic regime is an interesting physics problem in itself, but also a necessary technology to enable the full potential of the GF.

You have mentioned the study of twisted light in in this gamma ray regime, why is it interesting?

DMITRY: I think that this is a rather interesting basic physics. Also, the hope is that one day it will be possible to use twisted light, for example, to determine the multipolarity of nuclear gamma transitions. We do not yet know how exactly to do it.

Can any ion be stored in this ring or are there lower or higher bounds on the mass?

DMITRY: There is, indeed, a range. Light ions may be more easily stripped and will have reduced lifetime in the ring. For each species, one needs to optimize the stripping process; some people in the GF study group have studied this in detail.

What is the difference between synchrotron radiation and the radiation produced here?

DMITRY: Essentially all characteristics starting with the energy range and spectral fluxes are different. A closer thing to the GF are the “inverse-Compton” sources, where laser photons are

back-scattered from relativistic electrons.

Can you say more about how to build a gamma ray laser (you mentioned this on your last slide)

DMITRY: We do not know yet. One general thought is that with the GF we can produce copious amounts of isomers of interest in a fixed target. We can then try to make a proper “active medium” for the graser. The new thing here is that we can revisit the possible schemes proposed for this and see if the GF can possibly remove some of the past bottlenecks. This is very much work in progress.