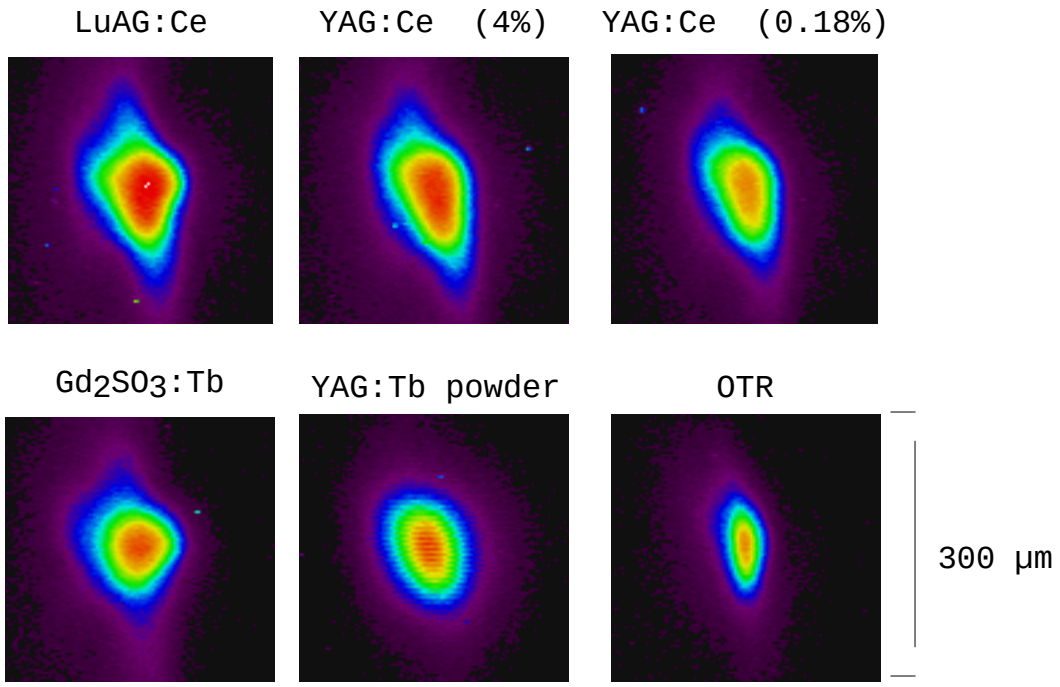
Alex Murokh

Summary of the Results from Diagnostics Test-2 at ATF

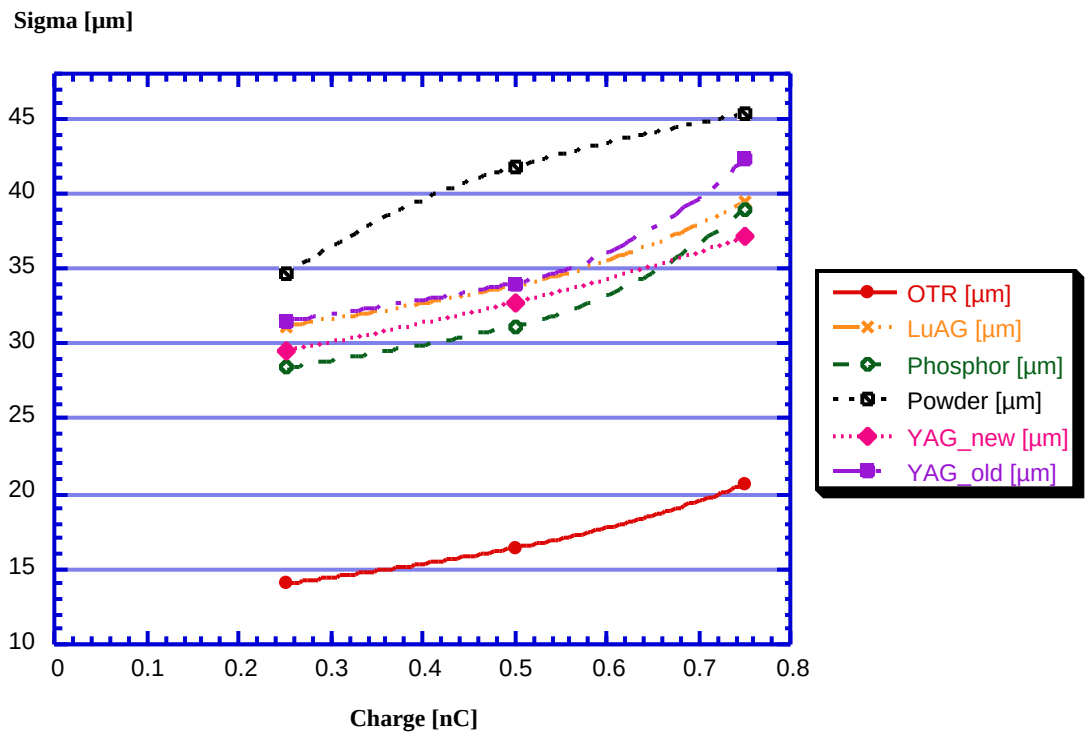
In February we repeated the scintillating diagnostics test from last year. This time in addition to YAG:Ce crystals we tested LuAG:Ce single crystal, YAG:Ce single crystal with the very high (4%) dopant level and YAG:Tb powder. The experimental objective of the test was to confirm the previous results and to get better understanding of the systematics behind “image-blurring” effect.

The results came out very similar to the previous test. All the beam images generated with scintillators were consistently bigger than corresponding OTR image:



This time we have used a beam much smaller than the last time. Permanent quads focusing cell was used to produce spot-sizes as low as 15-µm rms at 0.5 nC charge. It is worth noticing that the ratio of YAG/OTR image sizes is very similar to the previous results obtained under very different beam conditions. Also, the effect is not very sensitive to the type of phosphorescent material used.

We have also performed charge dependent measurements:



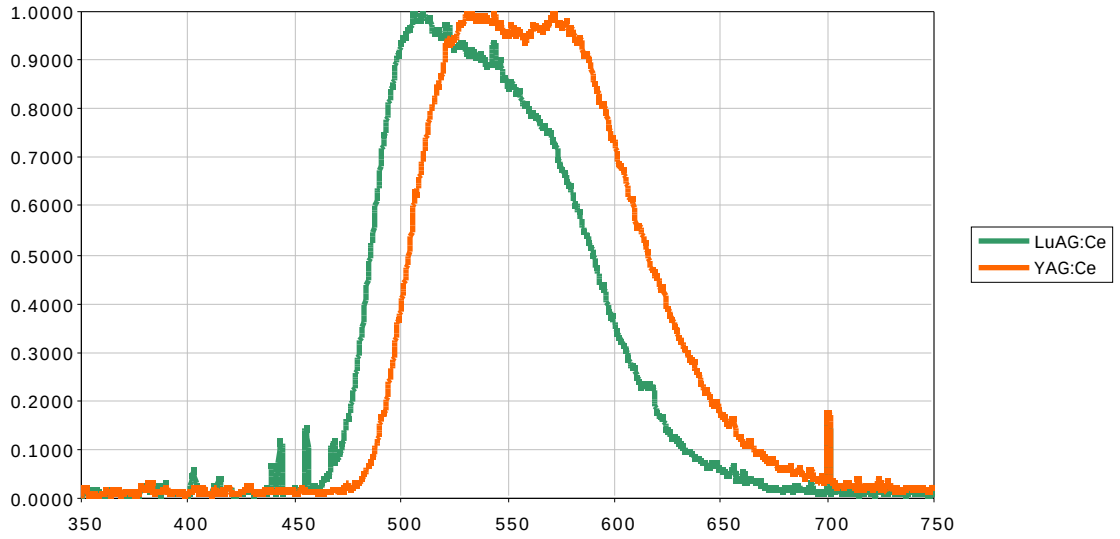
At this point we can briefly discuss differences between the samples:

- New crystals 4% - YAG:Ce and LuAG:Ce indicate very similar behavior, with the image sizes measured within the error bar from each other.

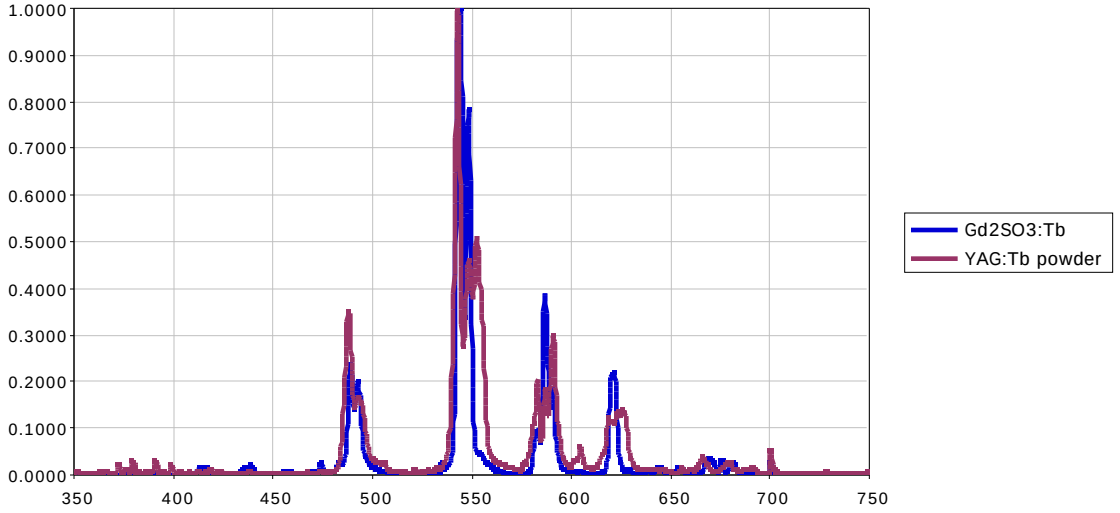
- A common lab phosphor (Gadolinium sulfa-oxide doped with Terbium) was found to be “the best” diagnostics at lower charge. Yet at the higher charge its curve (above) changes the slope. Similar effect is observed in the old 0.18% YAG:Ce. This may be very well an indication of the deficiency in the availability of scintillating sites.

- YAG:Tb powder performance was slightly different from the rest of scintillators. It showed the worst image blurring and the beam images completely lacked the characteristic shape. Also it appeared to have a delayed (or very short) time response, as it was the only diagnostics, which images consistently had only single field per frame.

Since the nature of the observed image “blow-up” is not fully understood yet, we performed the spectrum measurements for all 4 diagnostics. One of the surprises was a repeatedly observed local minimum of the YAG:Ce emission line at 550 nm:



YAG:Tb powder spectrum turned out to be very similar to the one of the regular phosphor:



The experiment was performed at ATF beam line 1, thanks to Karl Kusche and Igor Pogorelsky. All tested crystals were bought from Crytur. The powder sample was shipped from DESY (courtesy of Frank Stephan). Phosphor was made by Bob Harrington, who also got nerves to put all diagnostic pieces together in a very compact assembly.