We are currently using xrt to simulate some setup we want to test at the LCLS free-electron laser. In this setup, we have a pair of parabolic mirrors as shown below. The idea is to first focus the beam with the first mirror and have a second mirror to restore the initial properties (divergence mainly) of the beam. The overall setup is much more complex, but we identified some issues with this particular subsystem.

In order to simulate the LCLS beam, we simply use a GeometricSource with dx=0.02, dy=0.02, dxprime=4E-6 and dzprime=4E-6. To our surprise, we realized that there is a strong dependence on the distance at which the setup is placed from the source. As can be seen in the second figure below, the divergence of the beam gets more and more distorted as the setup is moved further away from the source. Note that the distance between the two mirror is kept constant at d=2f. Note that in our simulation, the setup will be at more than 100m from the source, where this effect becomes dramatic and quickly alters the beam shape as it propagates.

We checked using ray transfer matrix analysis of the setup and expect to recover the initial divergence, without any dependence on the source-setup distance.

Is this a normal behavior and there is something we don’t understand in this setup, or is this an artefact of the simulation? We also checked whether there is some beam size dependence by slitting the beam down to its initial size, but the results remain the same.



