Scintillator Simulations in GEANT4

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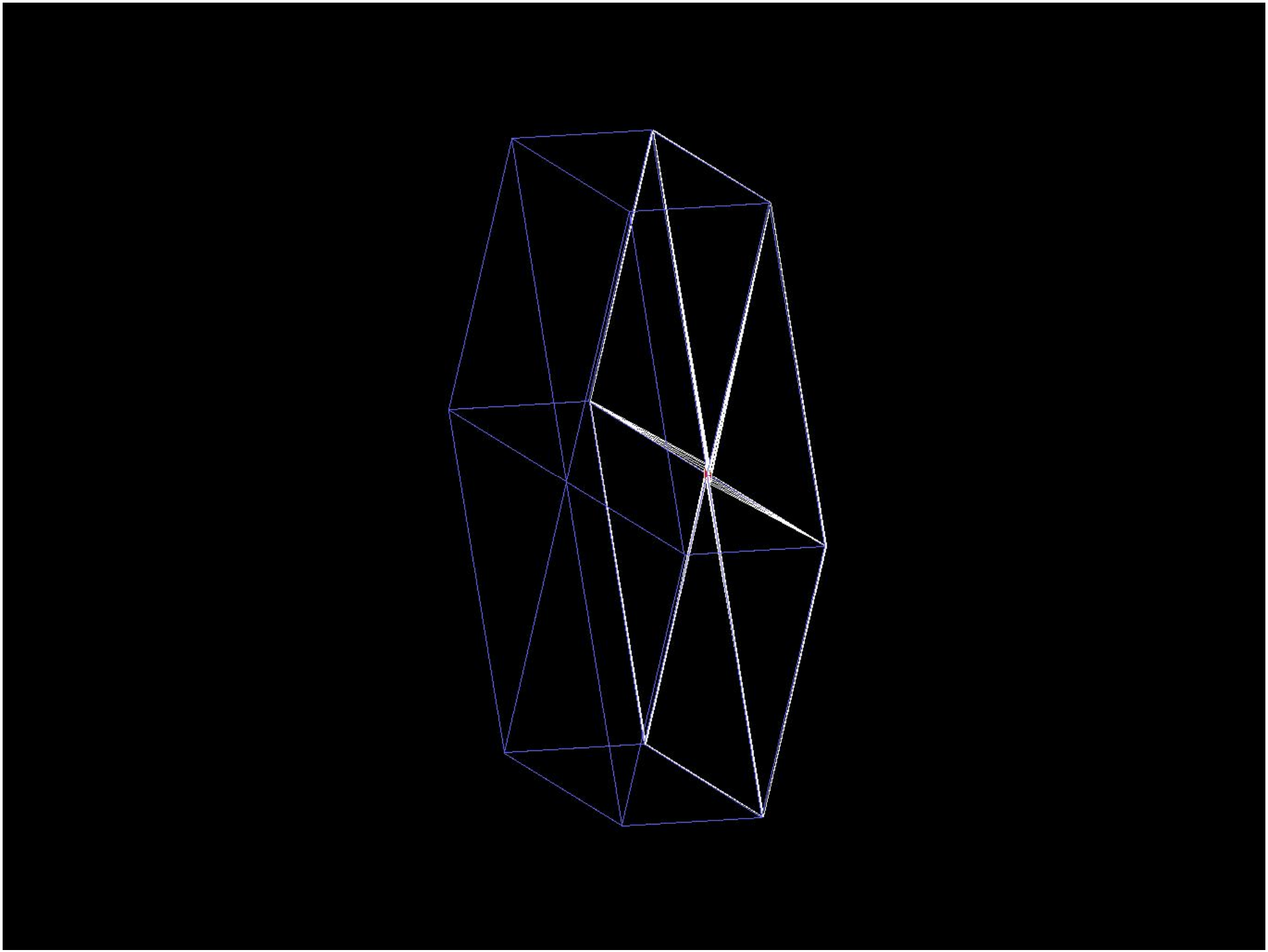
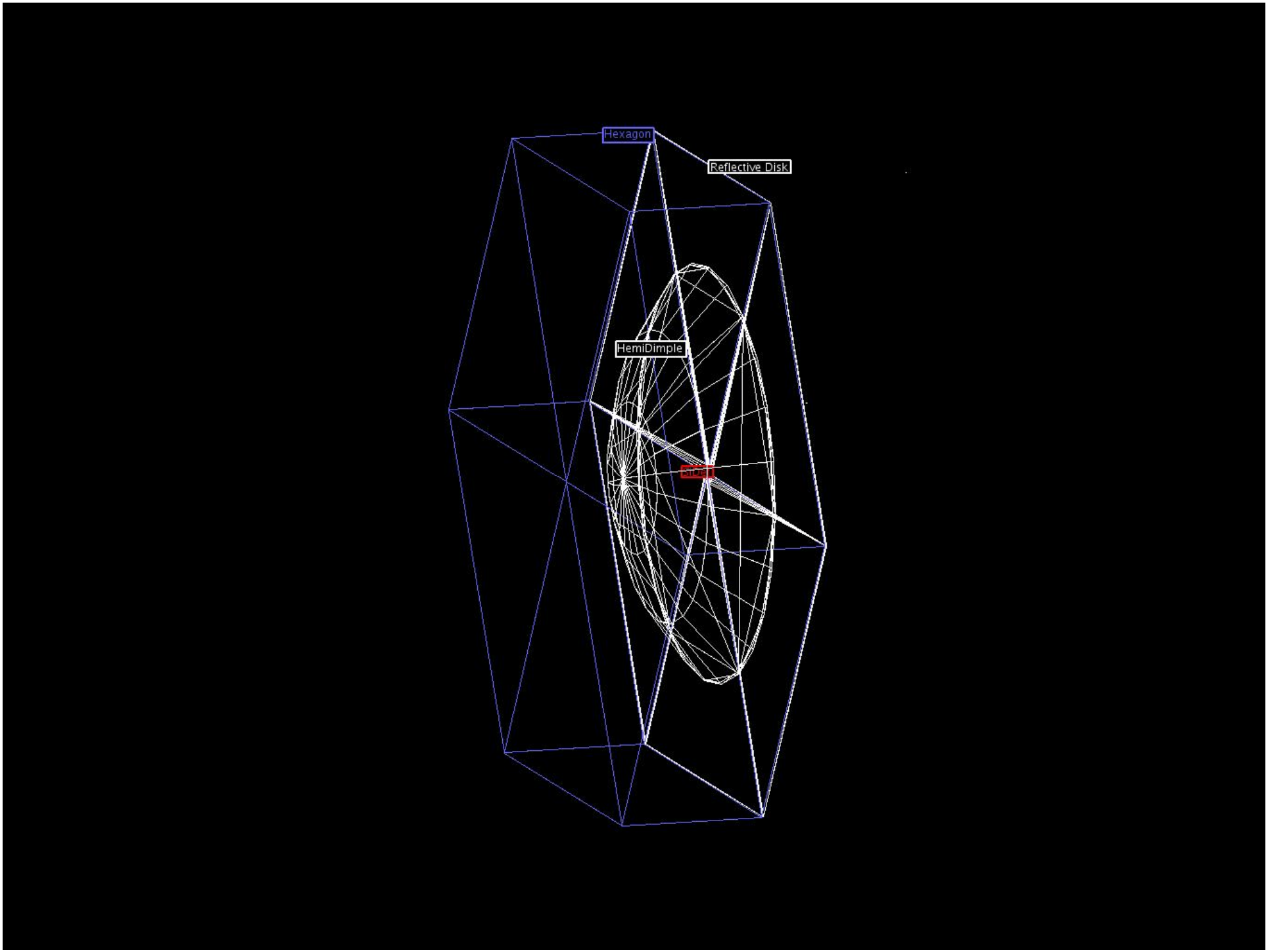
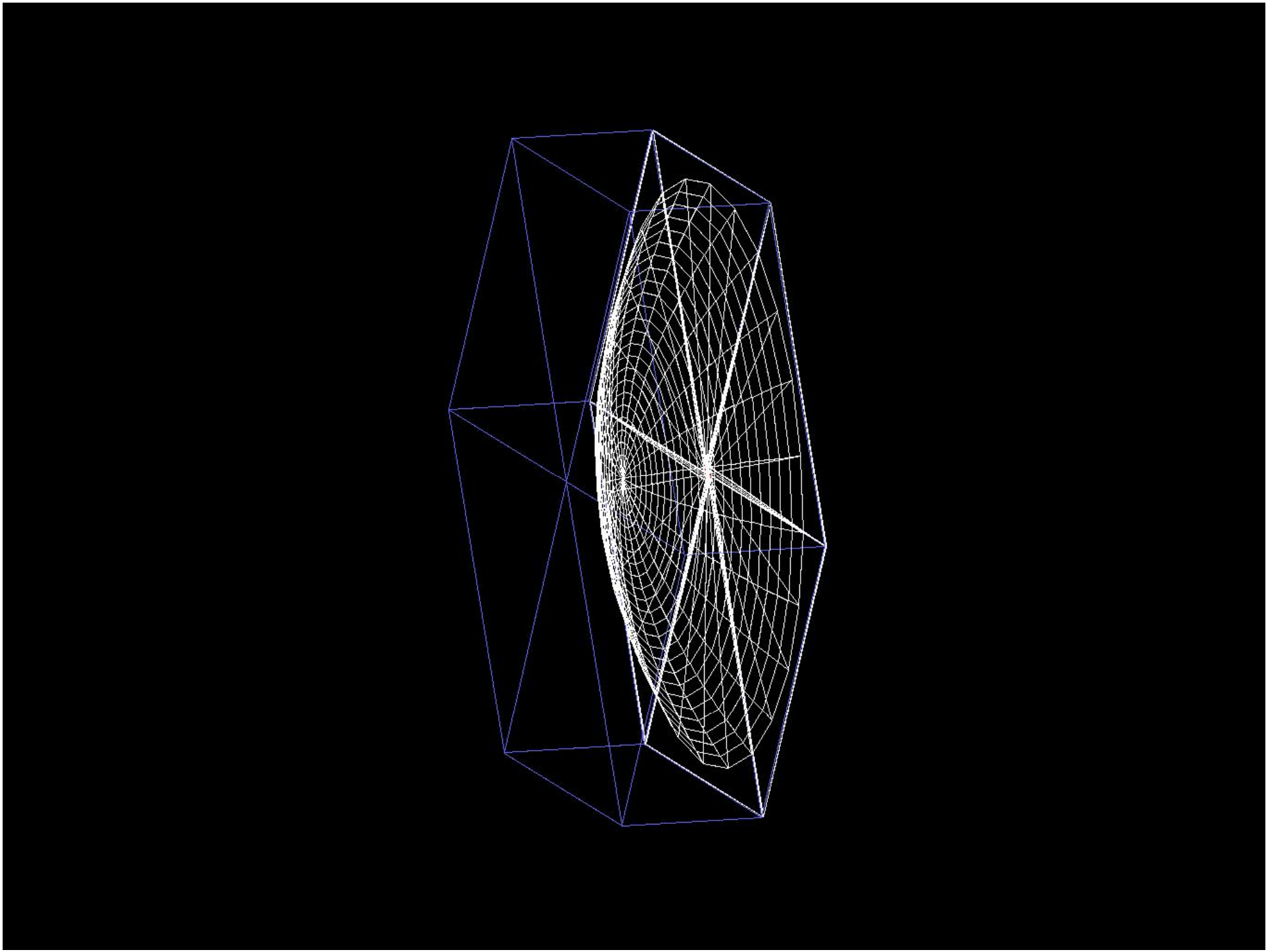
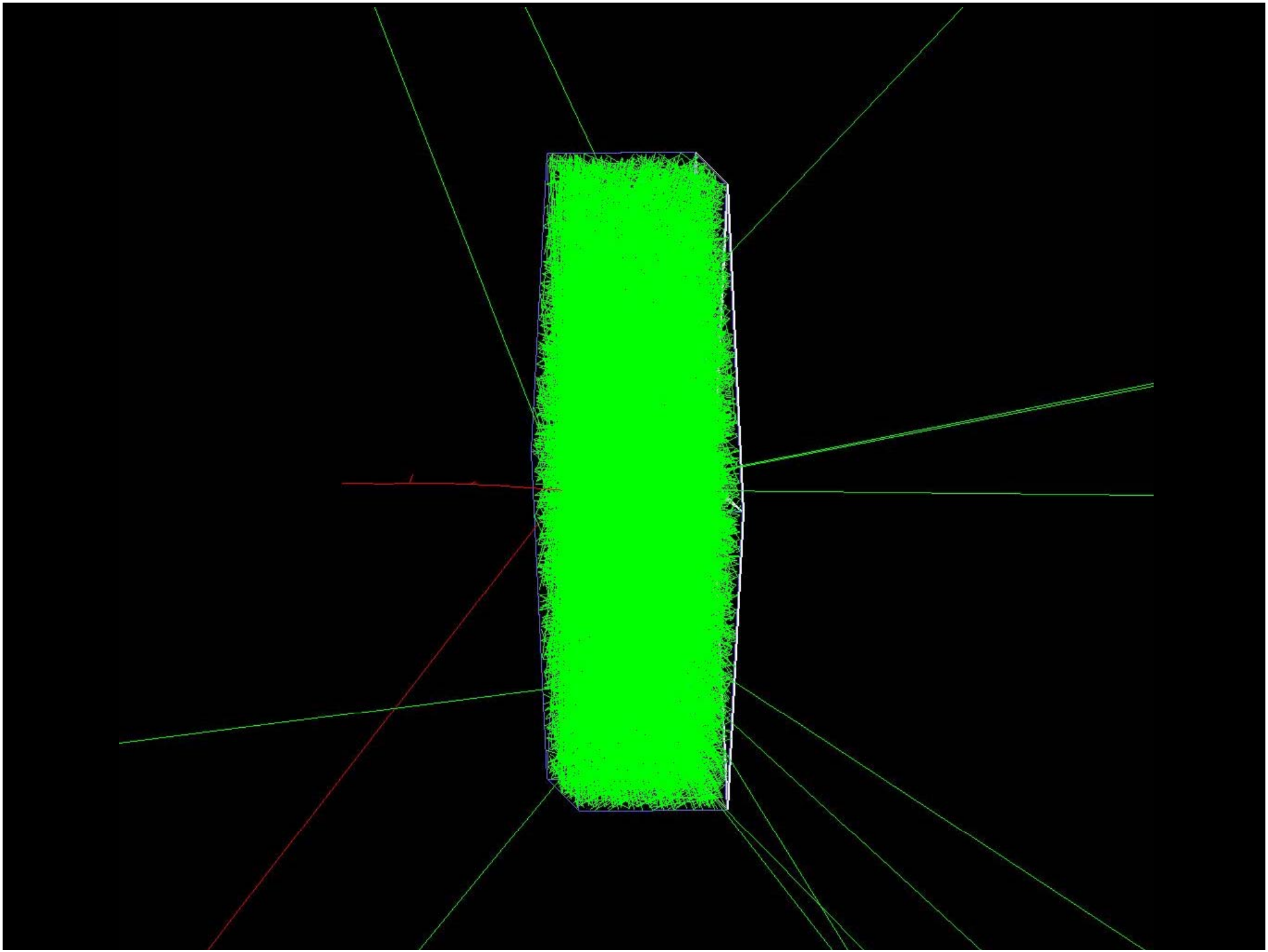
Simulation Changes

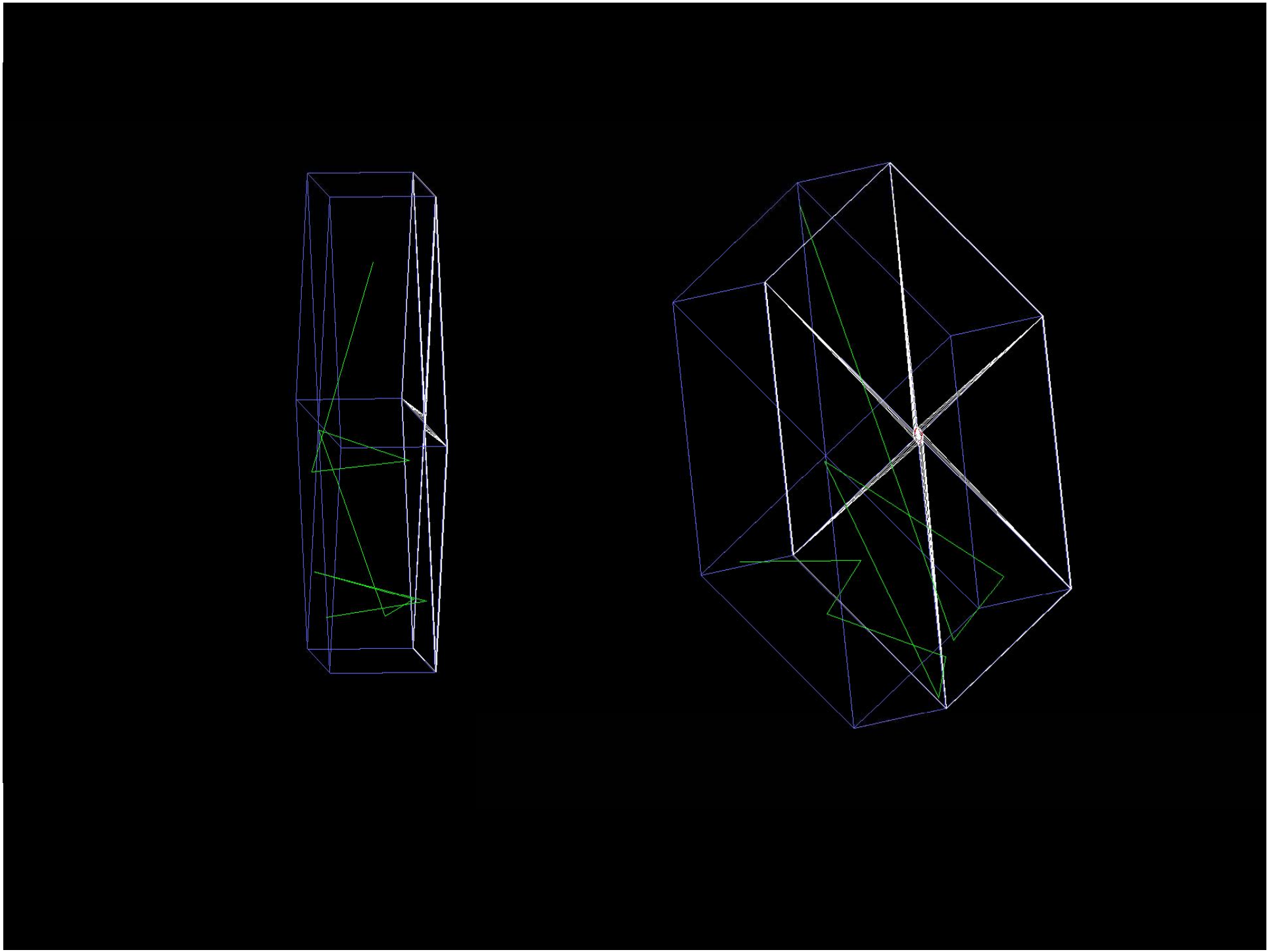
- The geometry of the scintillator is now customizable at runtime.
  - The shape of the scintillator can be set to: Hexagon, box, or disk. The reflective disk will match the shape of the scintillator.
  - The dimensions of all three shapes can be altered. All three shapes use the same variables to determine their dimensions.
  - The dimple can be set to hemisphere, parabolic, or none.
  - The dimensions of the dimple can also be changed at run time. Both dimple shapes share the same variables for their dimensions.
  - A command was added that when used will tell the user what the current dimensions of the detector are.
- Arrays of detectors can also be defined at runtime.
  - All the detectors in the array are identical.
  - Current maximum of 9 scintillators can be placed in x and y.

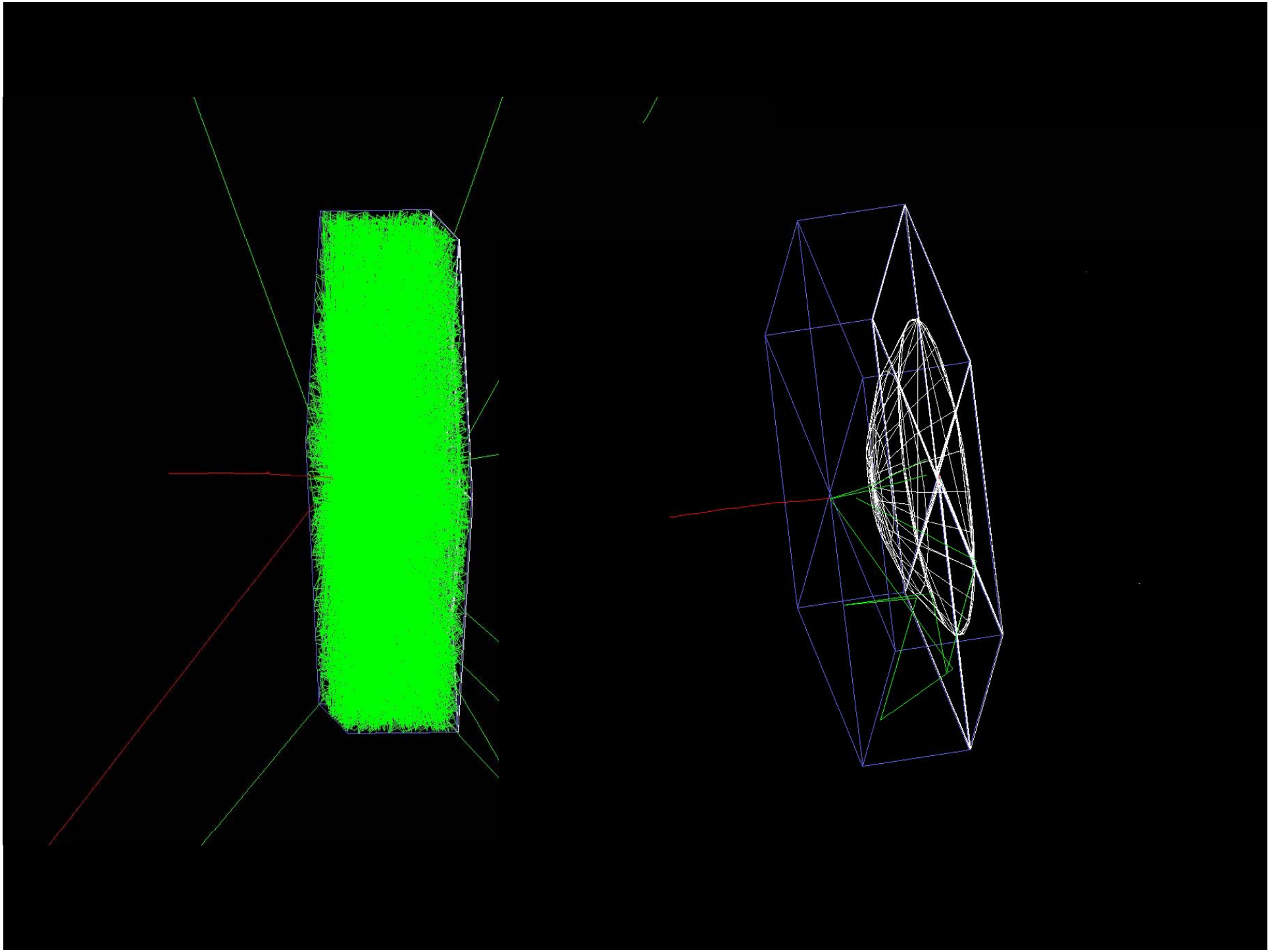


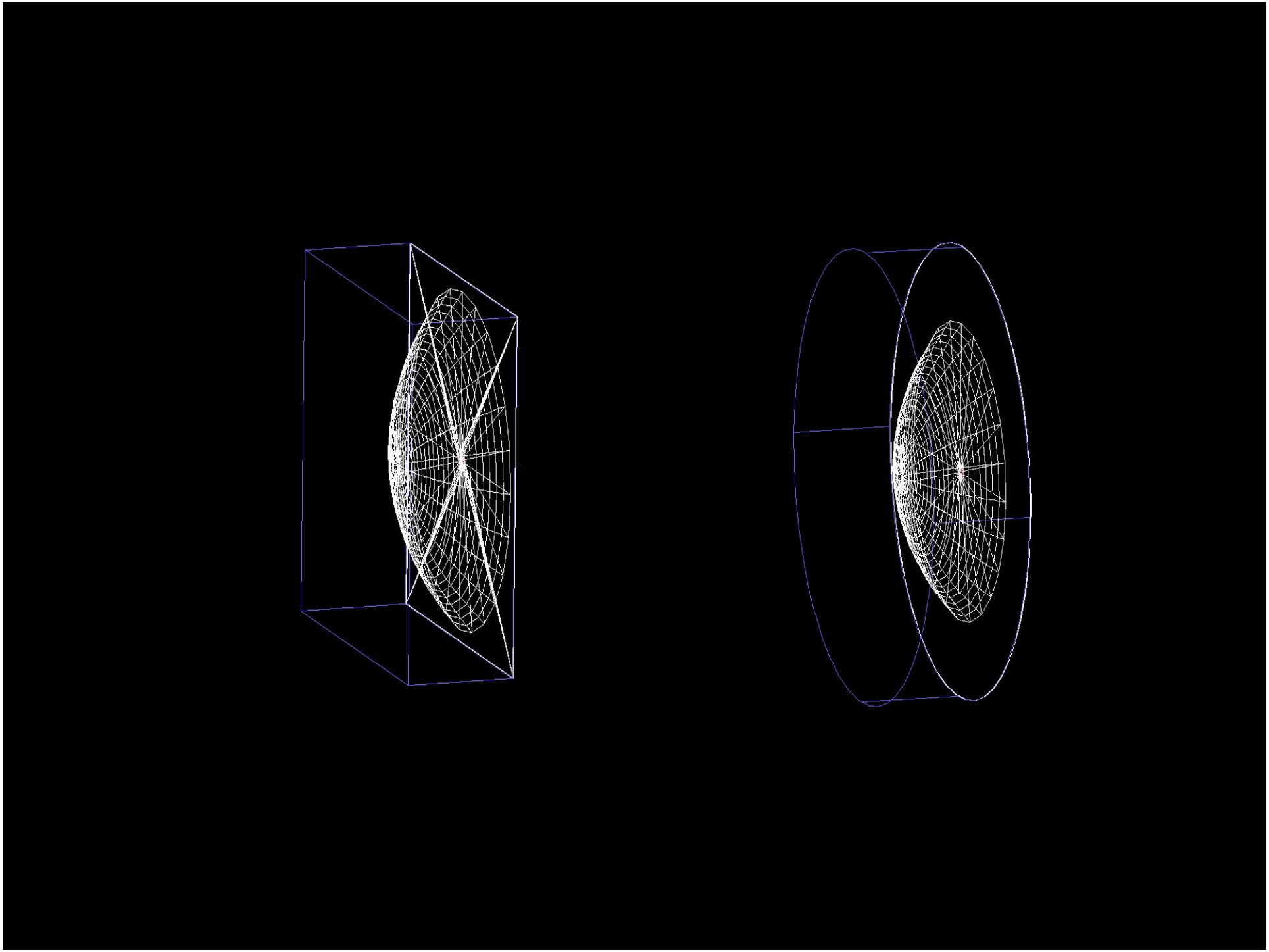

Hexagon
Reflective Disk
HemiDimple

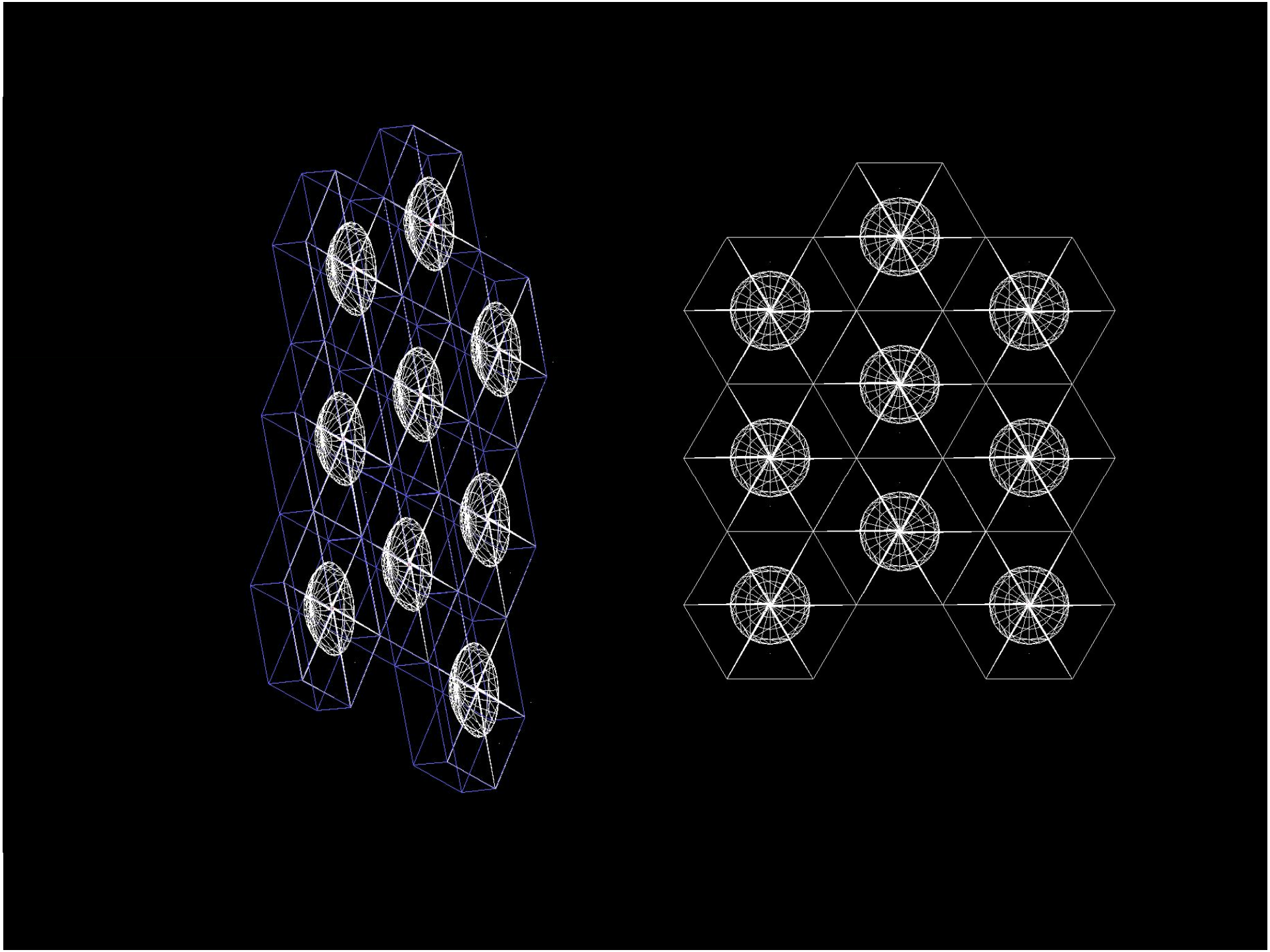


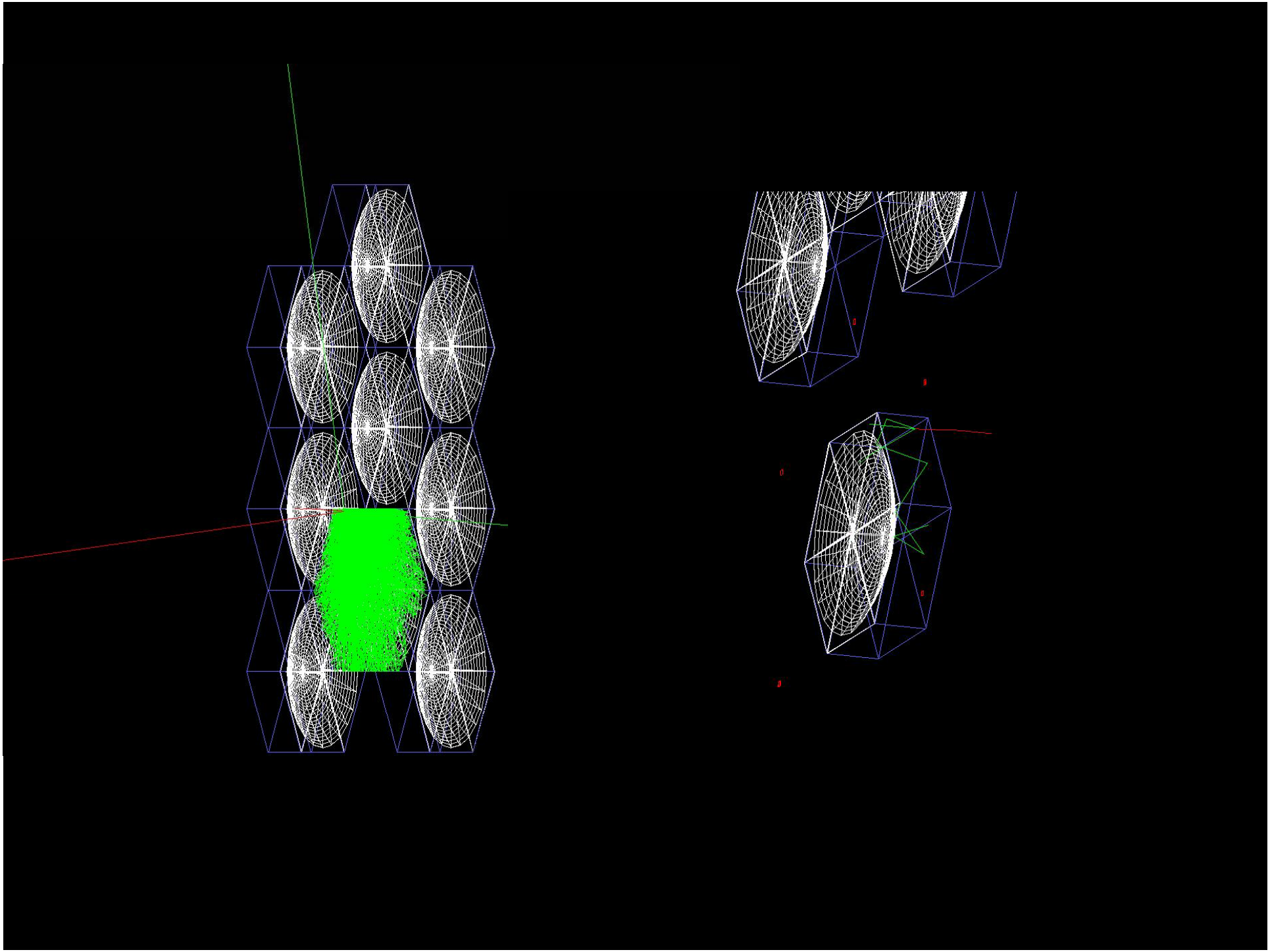






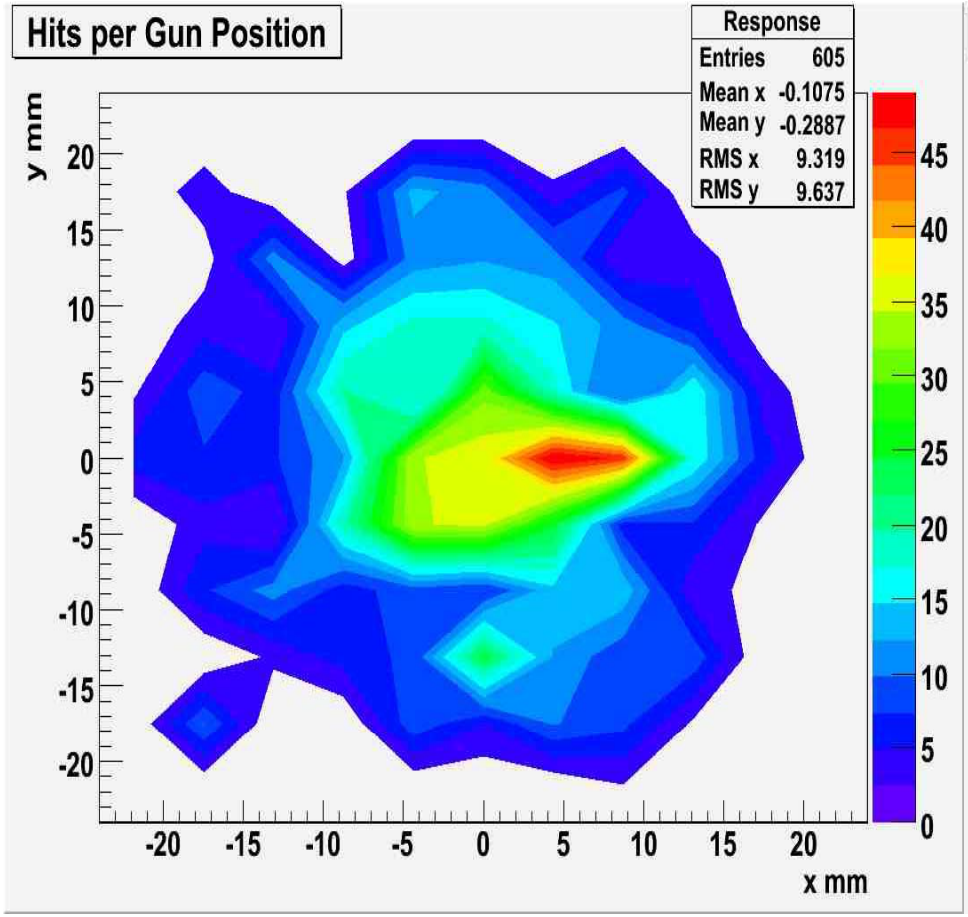




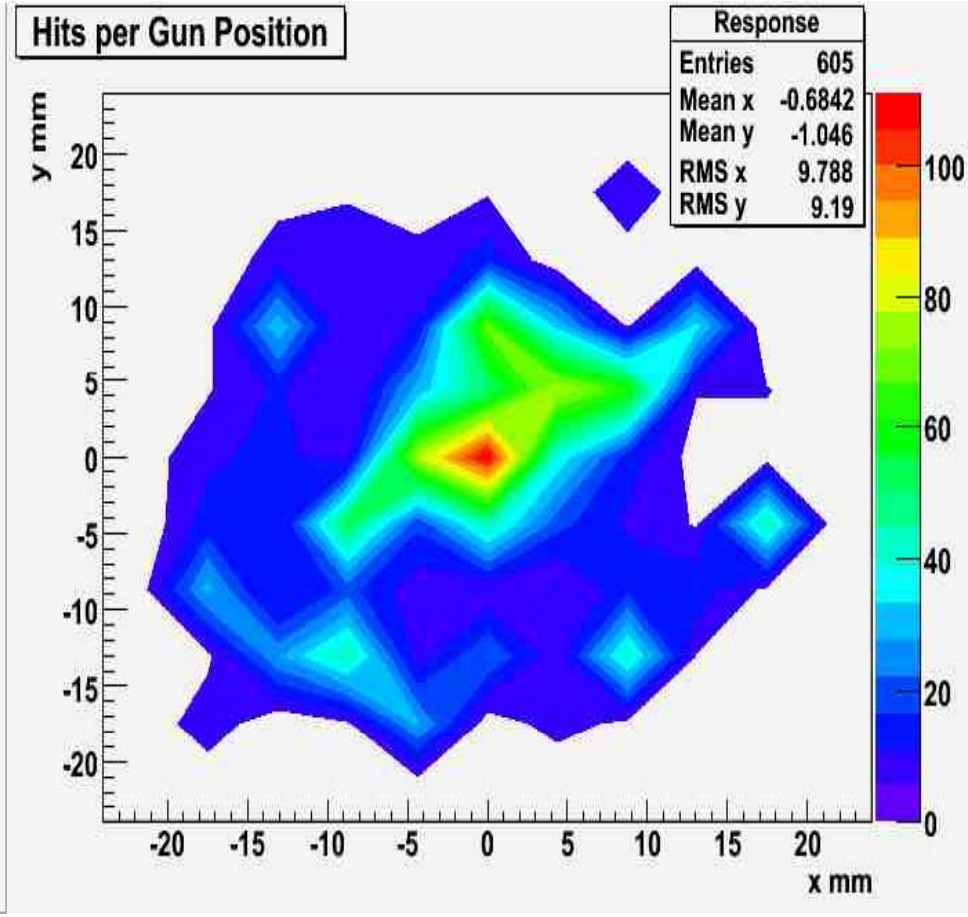


Problem!

Dimple



No Dimple



Problem Assessment

- Probably comes from too high of an absorption chance at the boundaries of the scintillating cell.
  - The actual reflection chance is ~96%.
  - Scan of two adjacent cells showed little to no cross-talk.
  - That is closer to the settings I used in the first test scans.
- I believe the reason the first scan looked much more uniform than the scan from the real scintillator was that my simulated scan had far fewer events than the actual cell.

Current Plan

- Simplify the simulation.
  - Use the GLISUR boundary model and polished sides.
  - Decrease the scintillation photon yield and use a higher energy primary generator to minimize/eliminate the chance of the primary generator changing direction within the cell.
- Scan the cell without a dimple added and plot the primary generator x y position vs the percentage of the total optical photons that reach the SPD.
- Fit a surface to the plot and use a dimple geometry that mimics that surface.

Current Roadblocks

- I'm encountering strange behaviour when I lower the scintillation yield.
  - Each event started producing far fewer photons than the setting and particle energy suggest. Ex.: Yield set at 1 photon/MeV. Observed production: ~150 photons for a 1 GeV e- or mu-.
  - Increasing the energy of the primary generator did NOT increase the number of photons produced. Possibly due to –dE/dx~1/v^2.
- With the reflectivity set at 96%, the simulation is very slow and the datafile it produces is very large.

Questions?