Electron Expulsion of Plasmonic Nanoparticles

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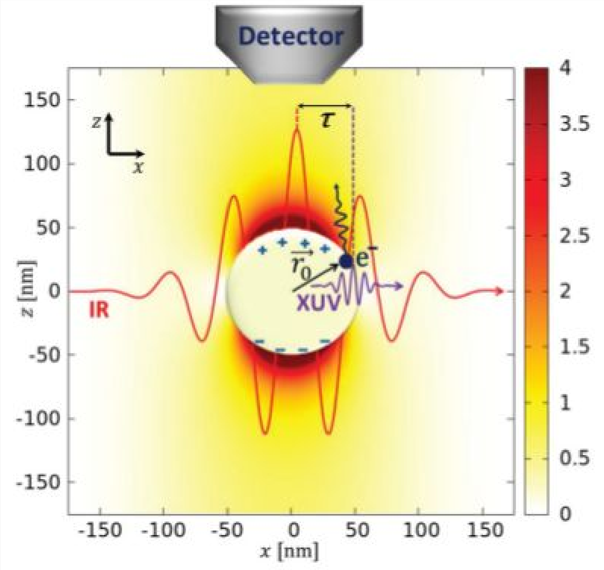
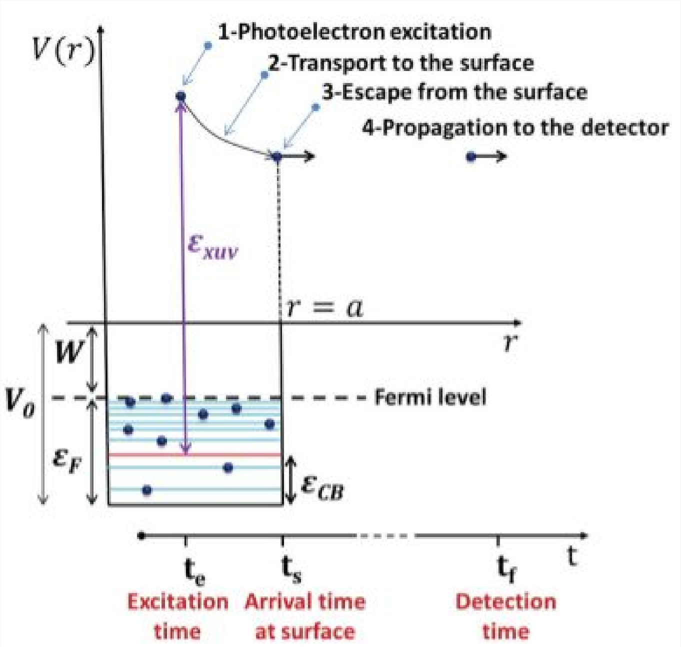
Background

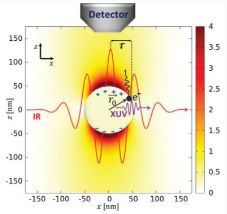
- Model gold nanospheroids
  - Hit them with an IR pulse inducing plasmonic field
    - Enhances field
    - This is calculable
  - Hit them with an XUV pulse to excite electron
  - Known as streaking - vary τ



Calculate Electron Trajectory

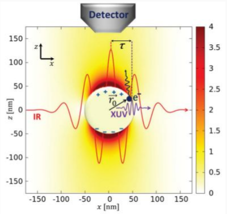


1. Excitation
   a. Initial energy from XUV
2. Transport to the surface
   a. Analytic
   b. Could change direction through collisions
3. Escape from the surface
   a. Overcome potential barrier $V_0 = \varepsilon_F + W$
4. Propagation to detector
   a. In E-field, this is numeric



Sampling Trajectories

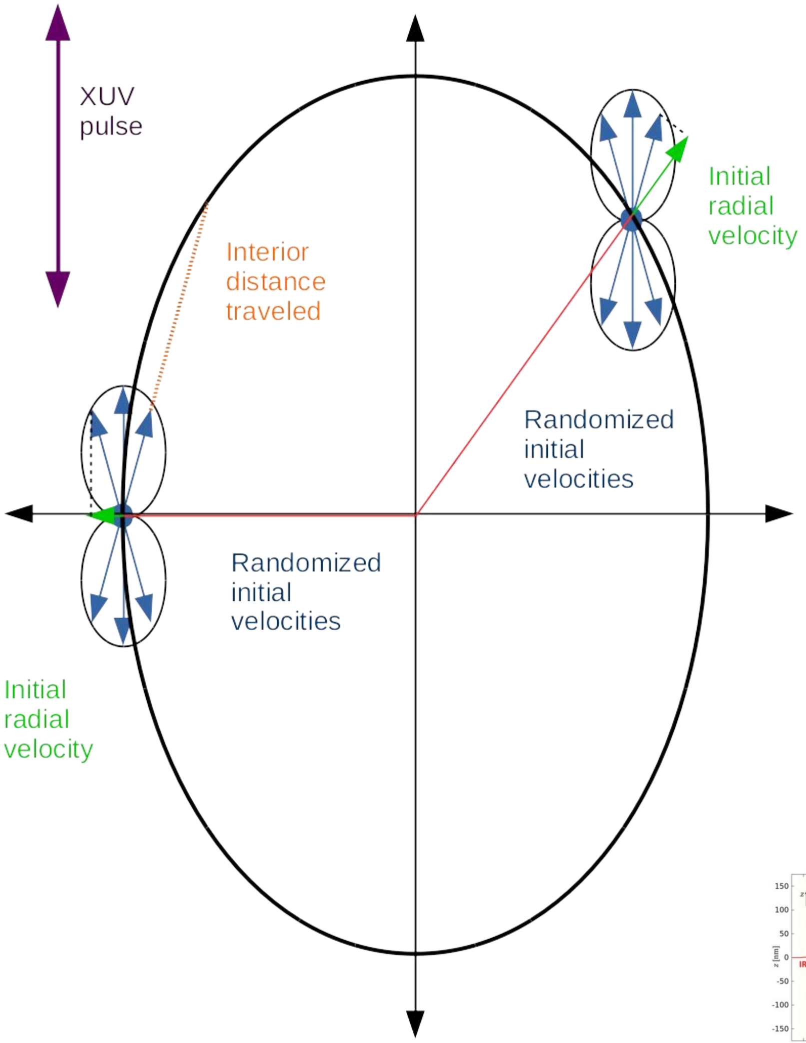
- Use Monte Carlo
  - Normalized to maximum yield
  - ~4,400 trajectories per time delay
- Have an initial probability density function (PDF)
  - $\rho(\mathbf{r_0},\mathbf{v_0}) = \rho_{pos}(\mathbf{r_0})\rho_{vel}(\mathbf{v_0})$

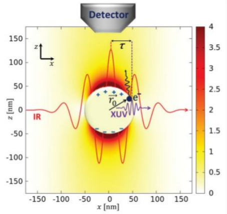


Surface and Transport Effects

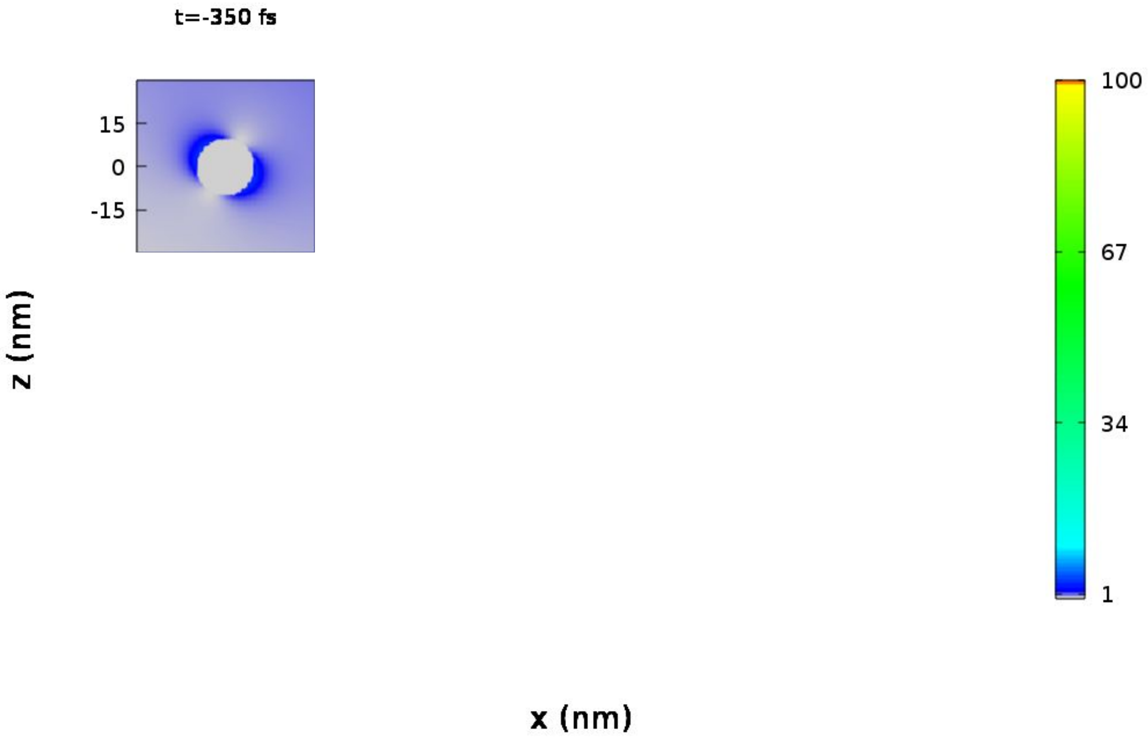
- Surface Effect
    - Initial radial velocity determines escape
- Transport Effect
    - Greater interior distance means more collisions

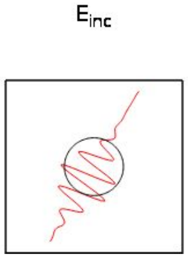
They combine to make escape at the poles much more likely.



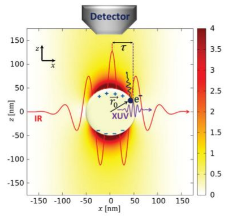


Intensity Enhancement in Space





IR pulse not to scale



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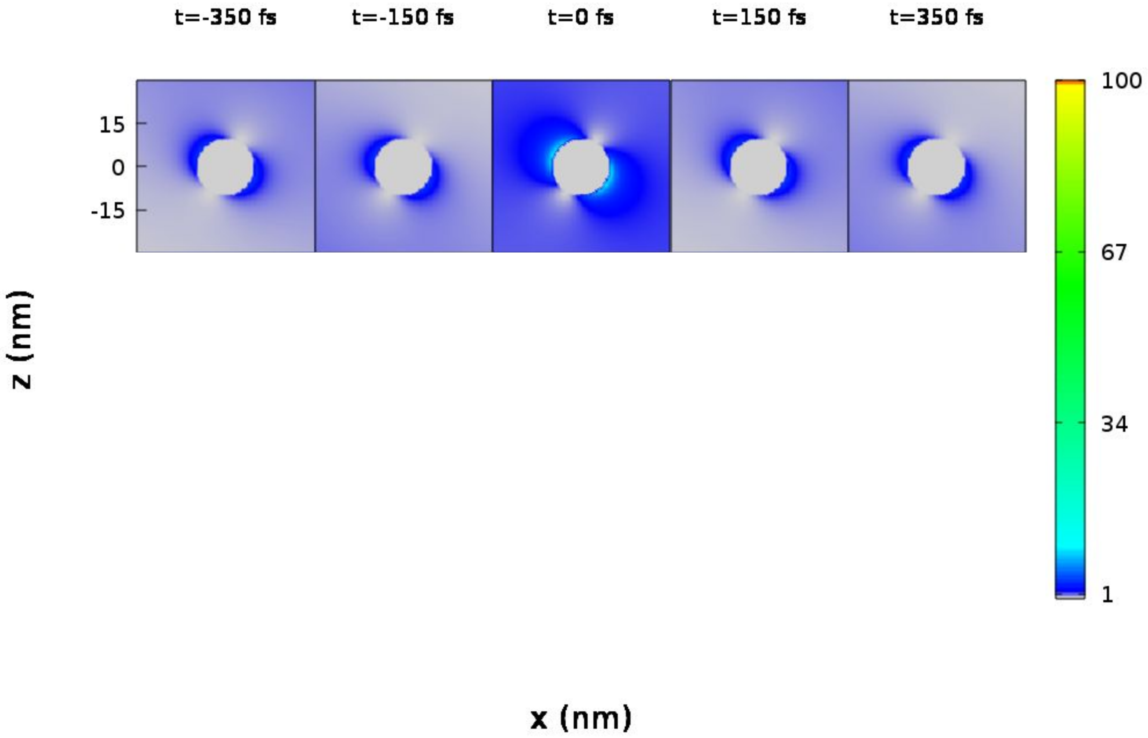

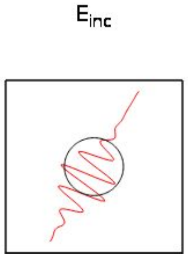

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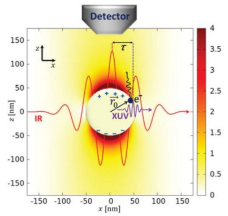

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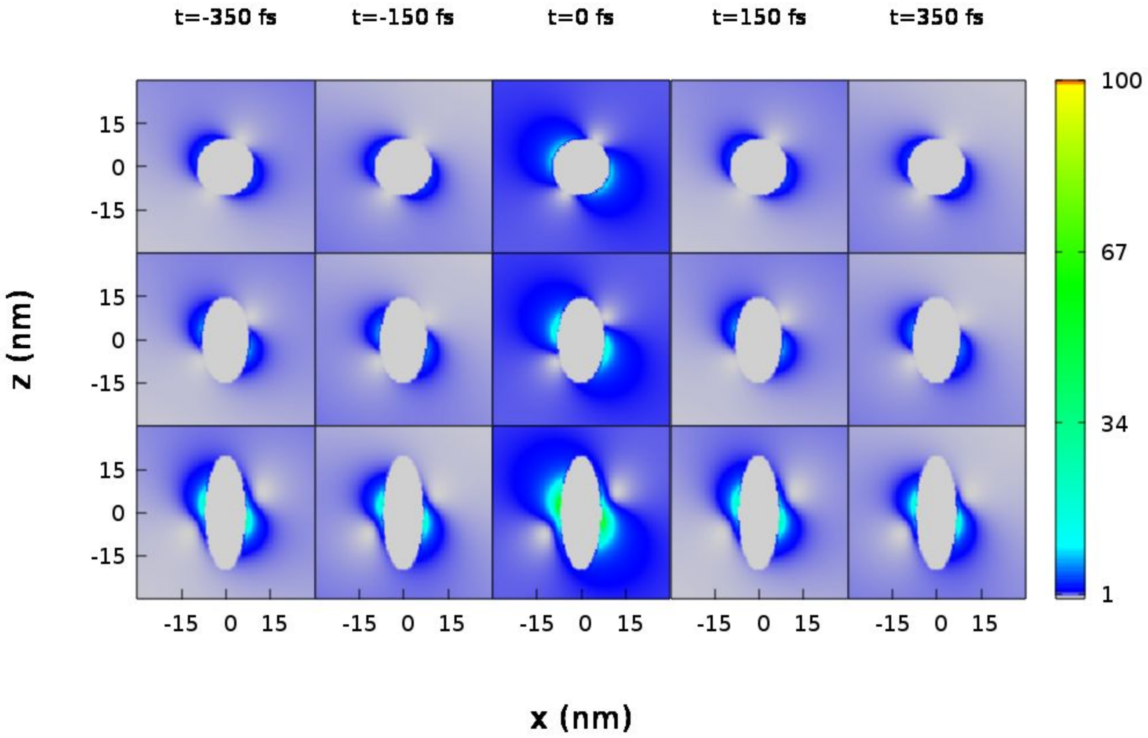

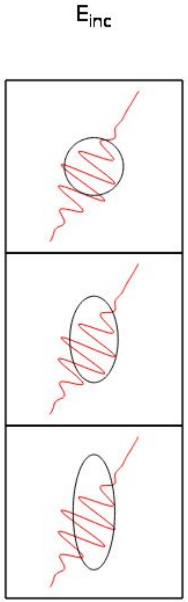

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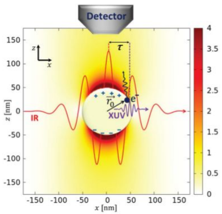
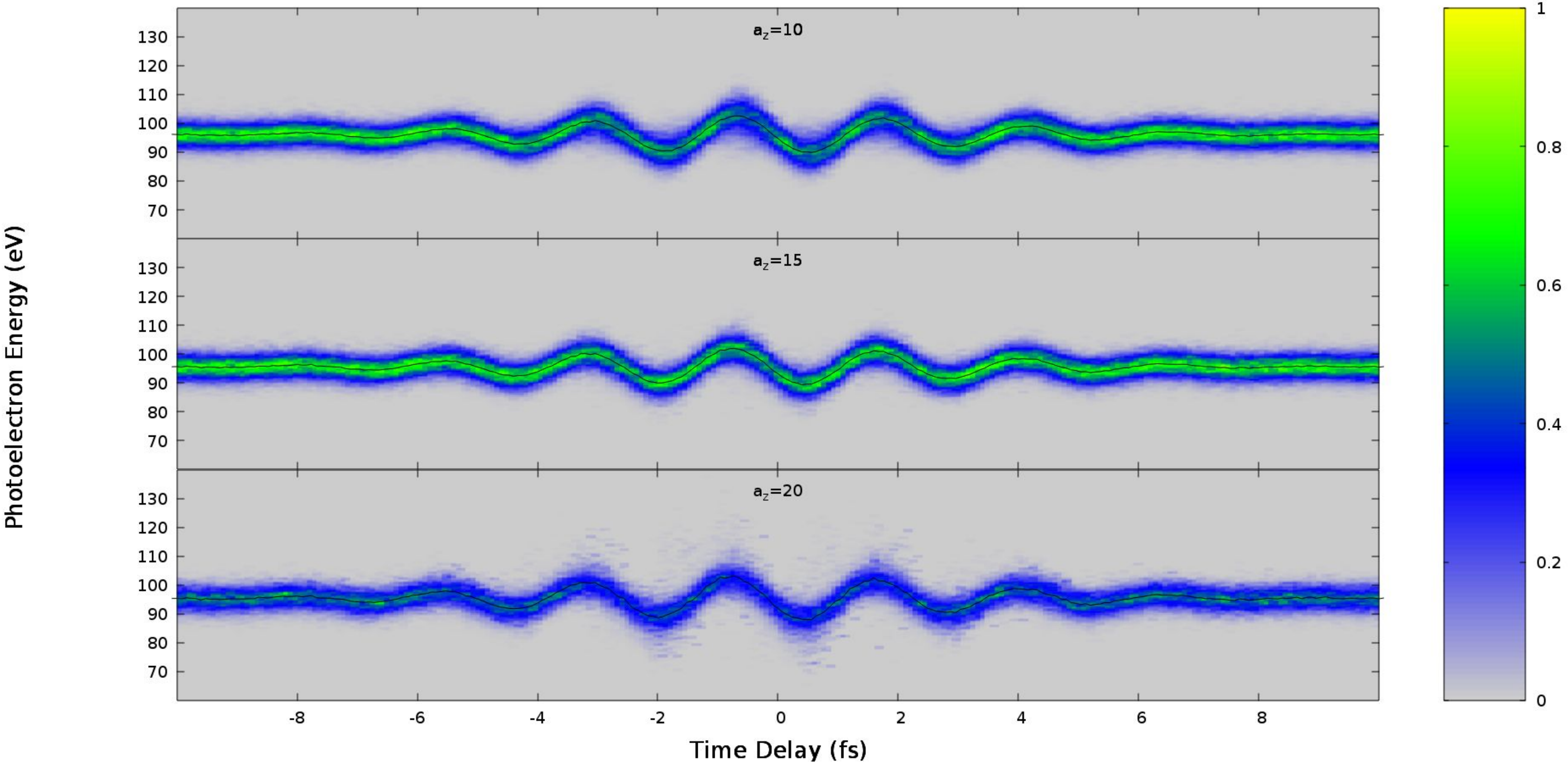
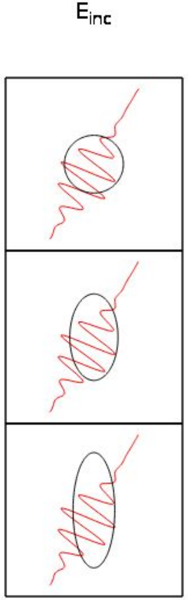
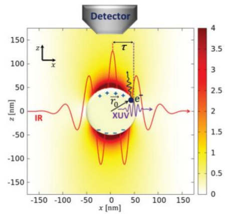


Streaked Spectra with E_{inc} at π/3 rad.







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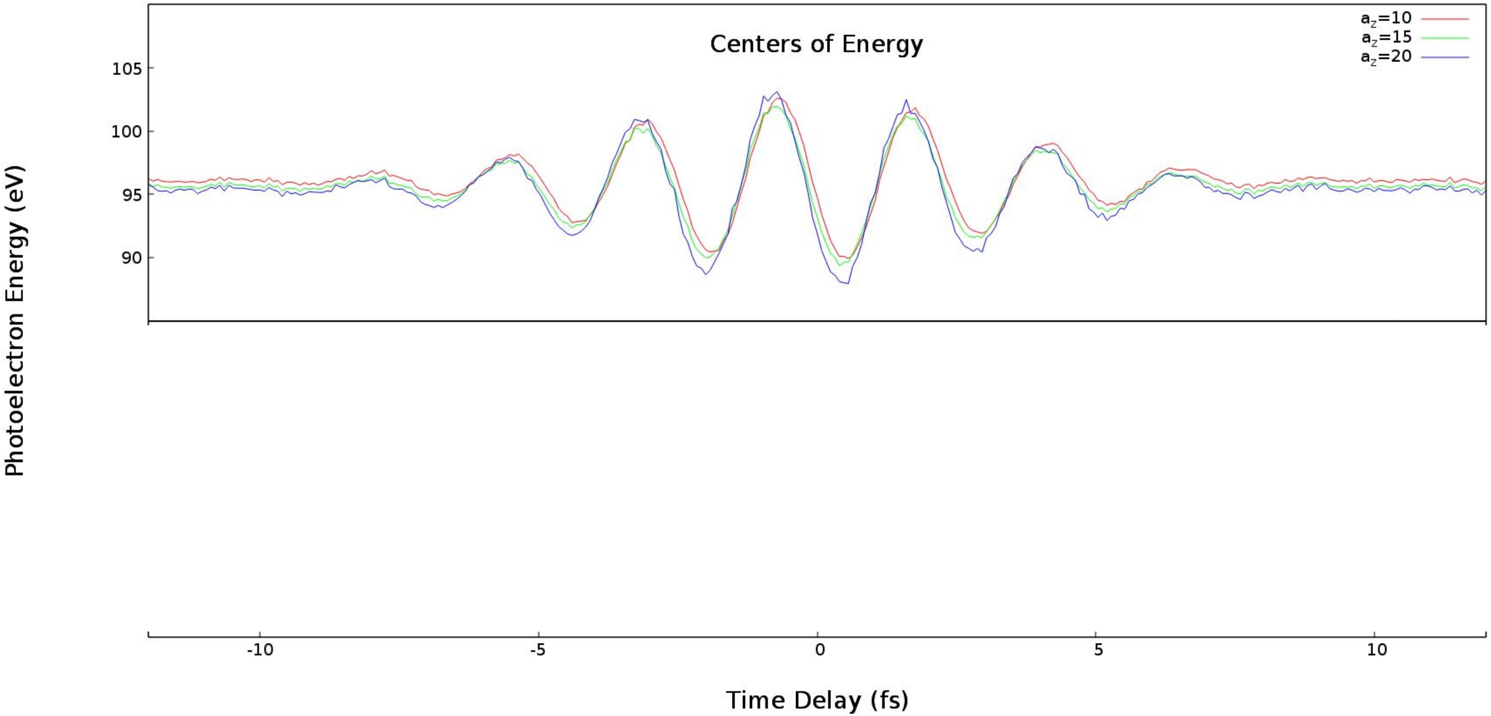

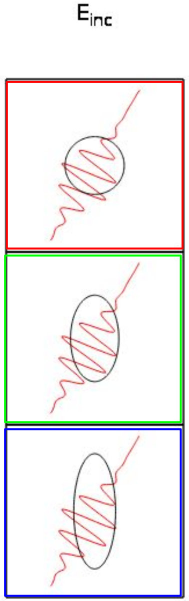

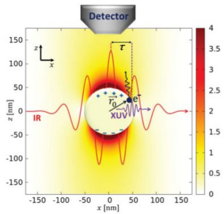

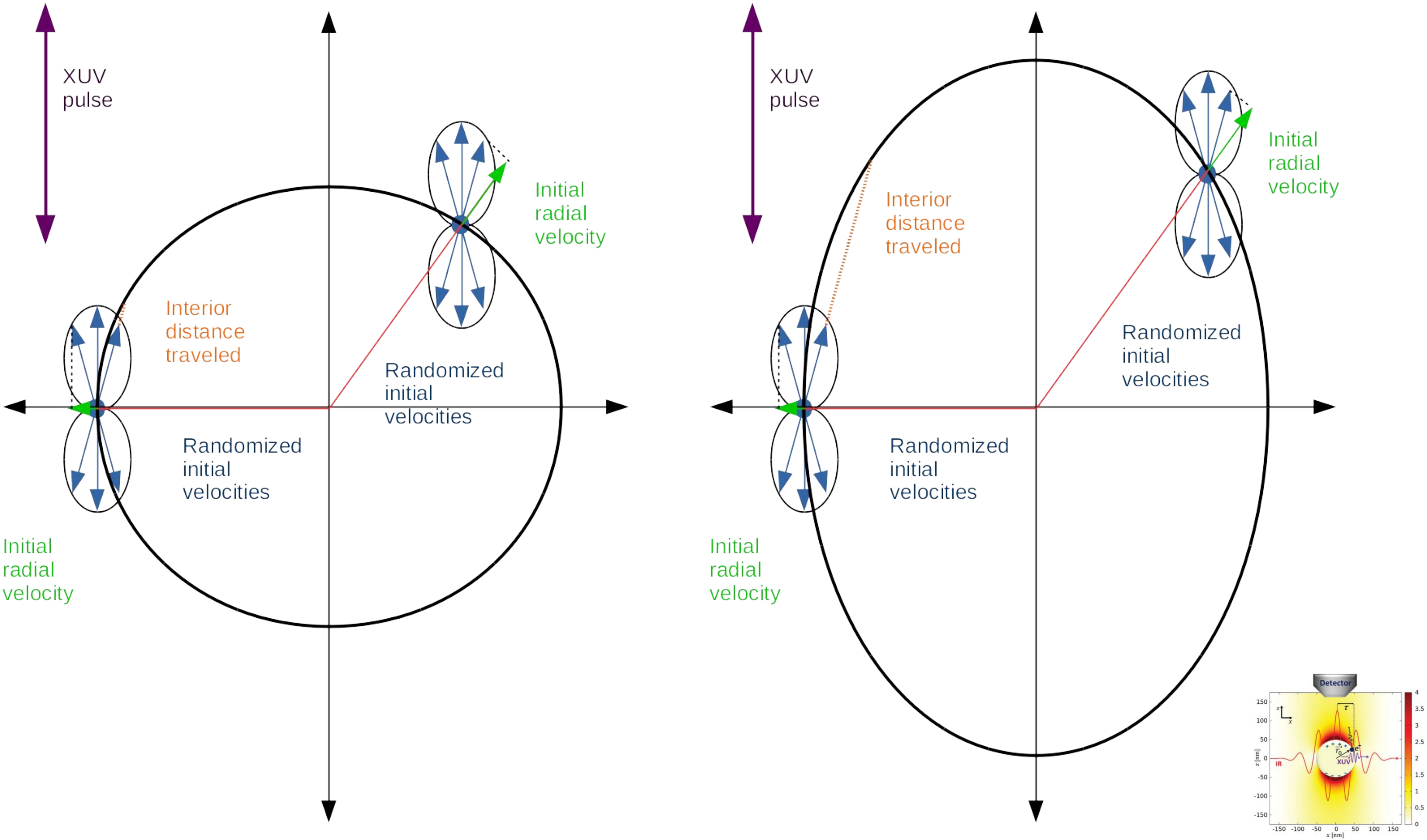
XUV
pulse
Interior
distance
traveled
Initial
radial
velocity
Randomized
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velocities
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IR
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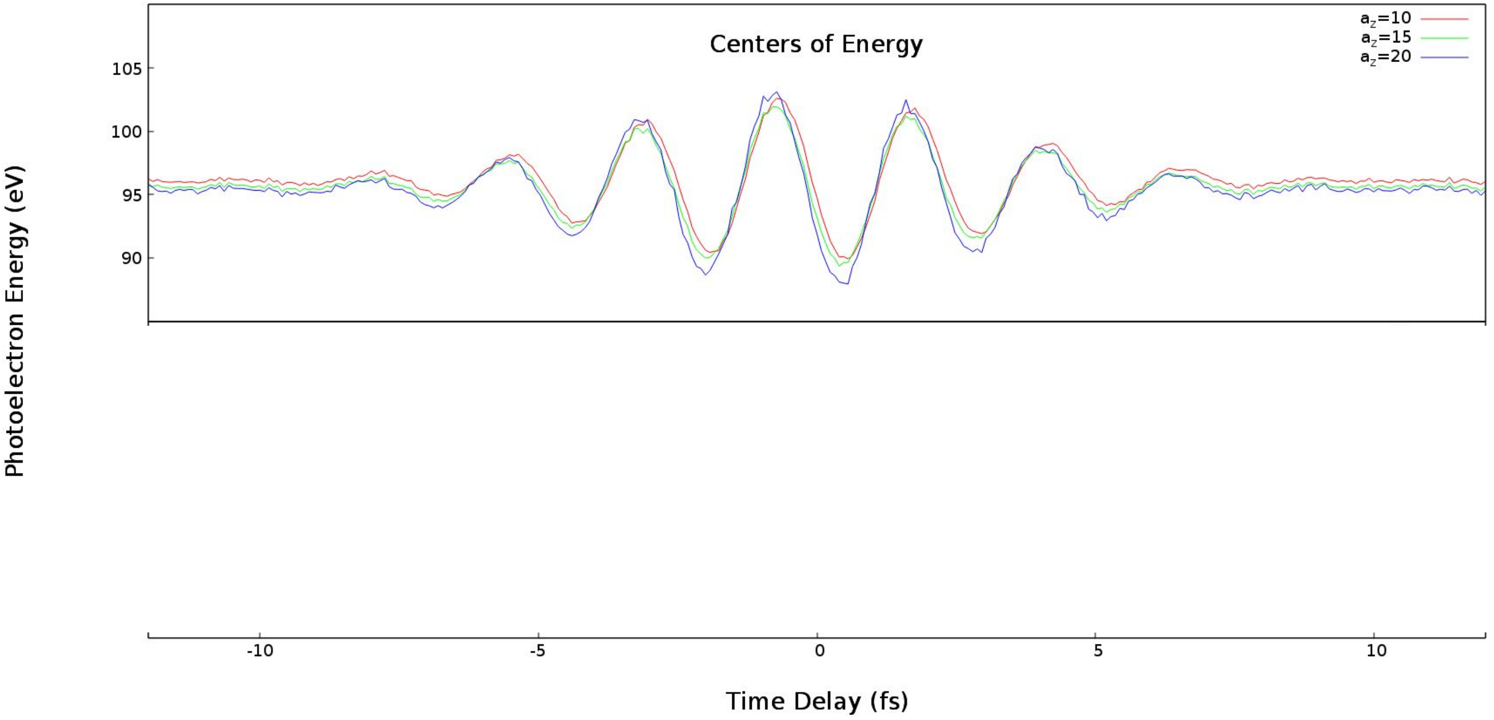
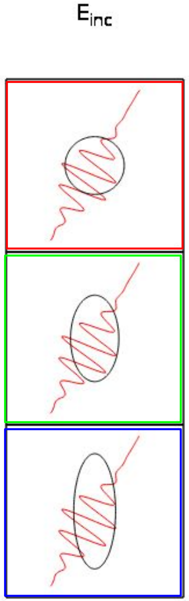
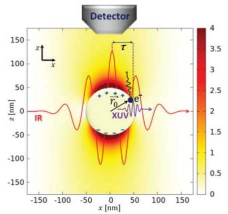
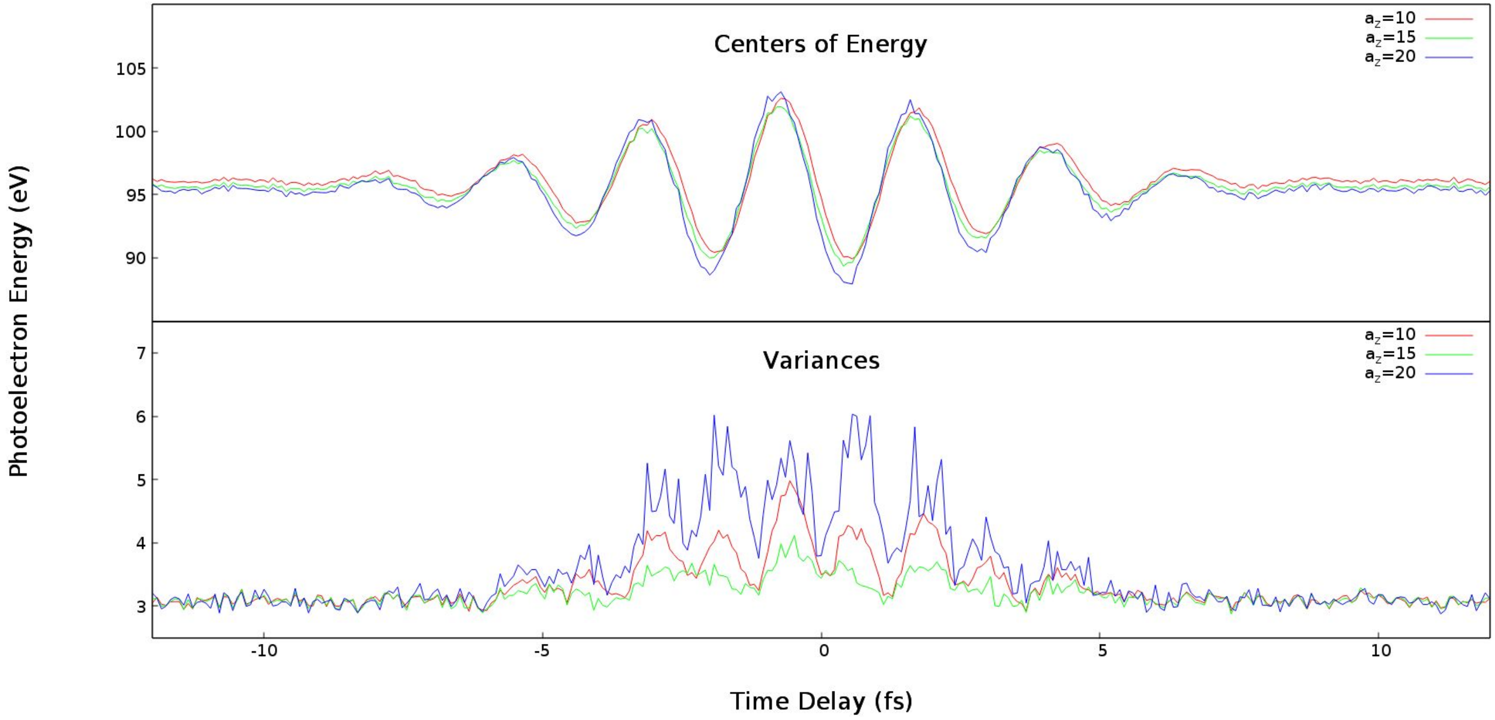
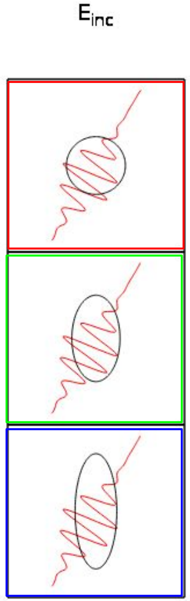


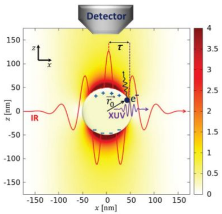




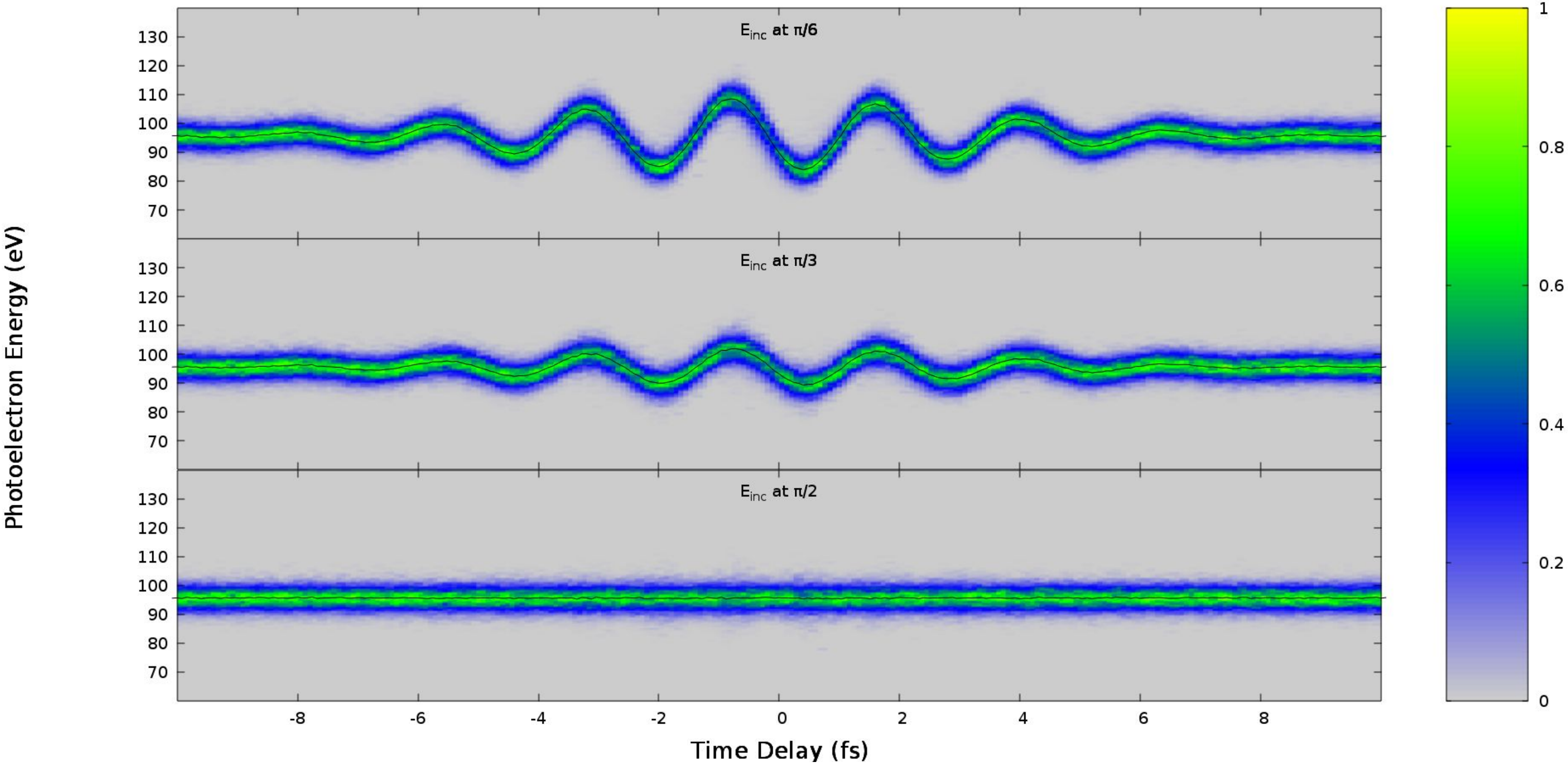
Streaked Spectra with E_{inc} at π/3 rad.

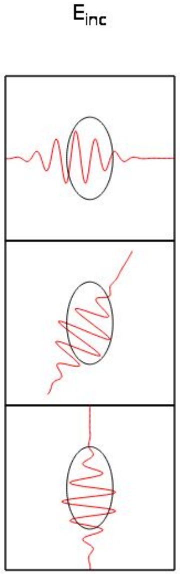


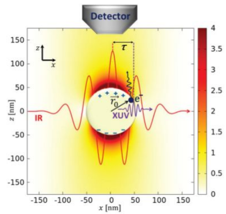




Streaked Spectra with a_z = 15 nm







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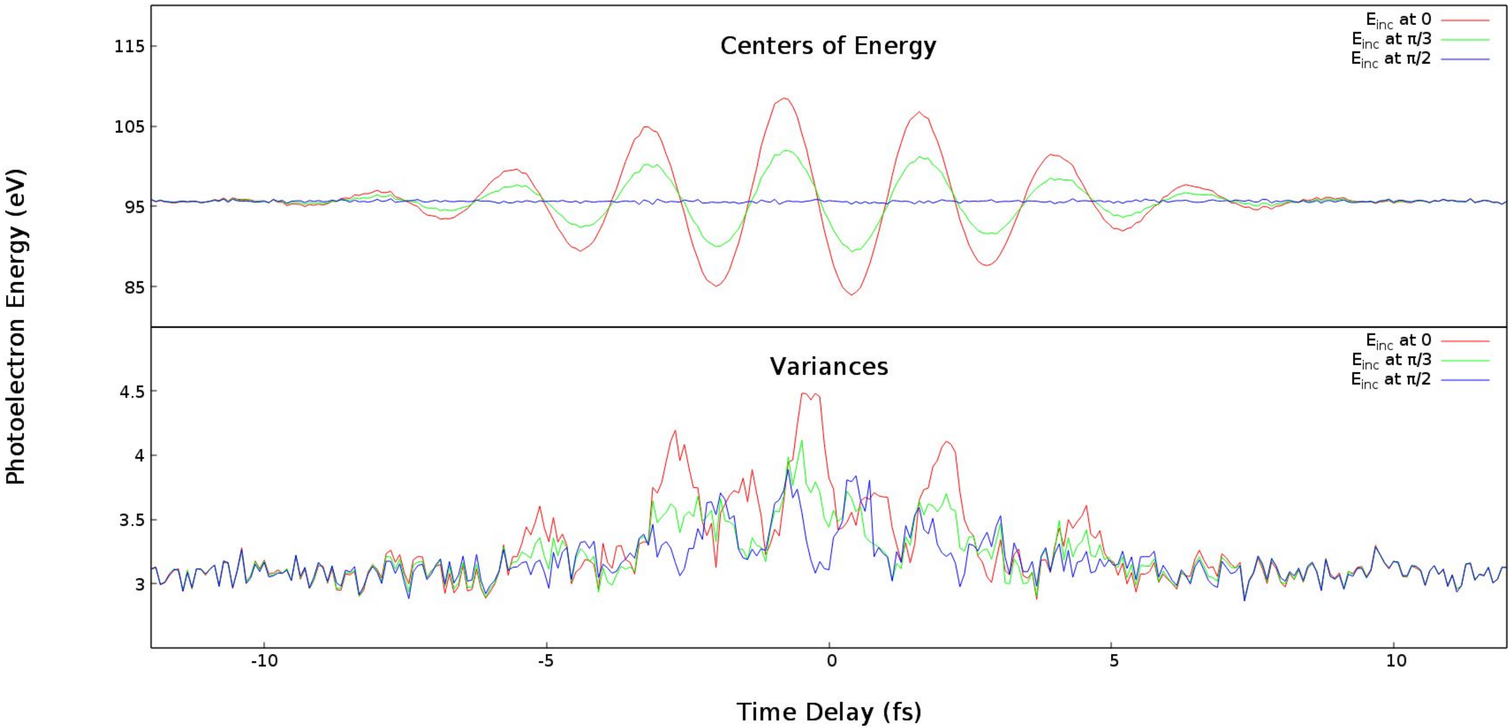

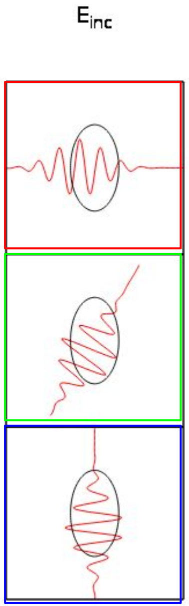

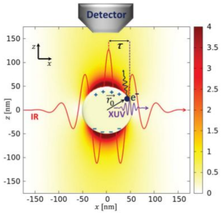

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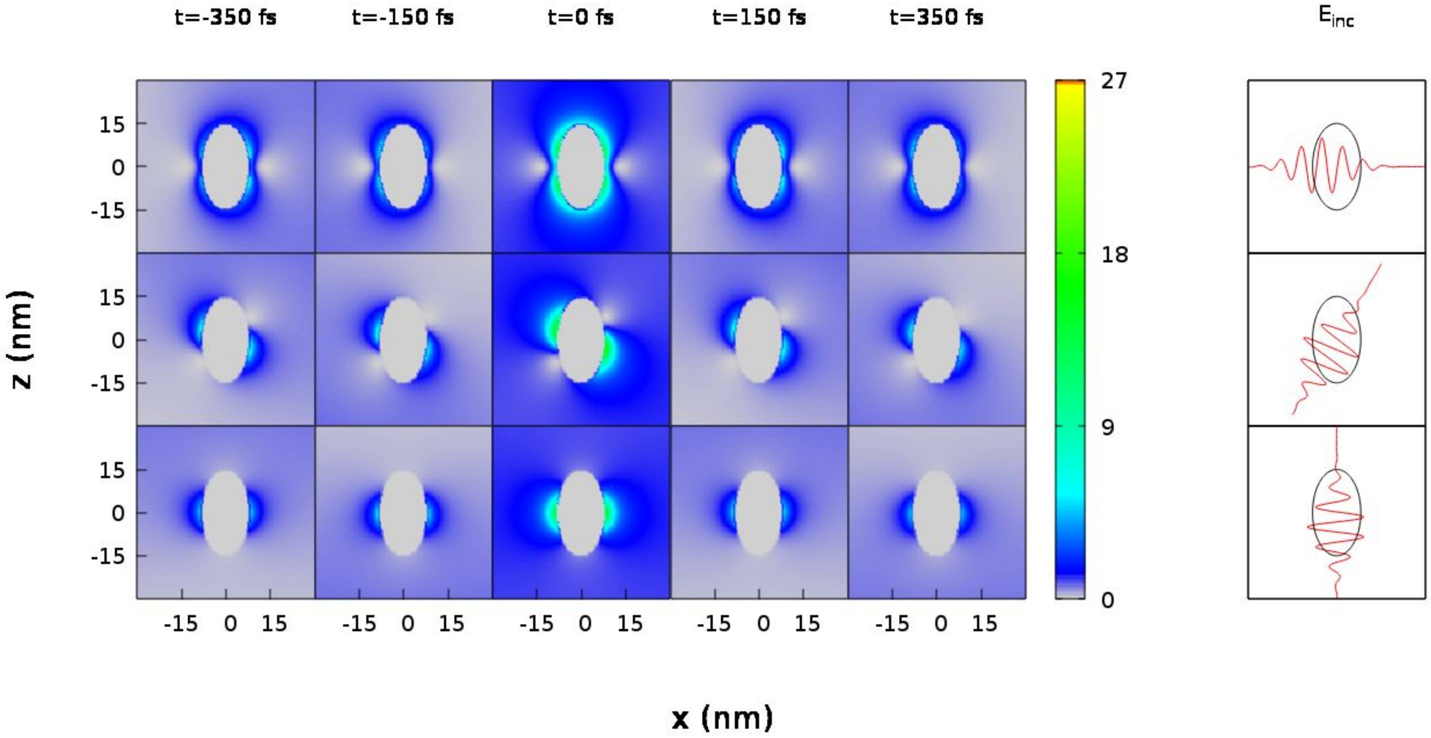

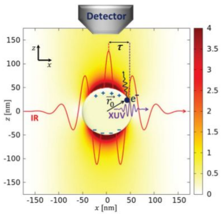

Conclusions

- Streaked spectra of nanoparticles are shape dependent
- Streaked spectra depend on the incident angle of the IR pulse
- In future:
    - Investigate variance
    - Vary incident angle of XUV pulse
    - Rotate both pulses