More effective than a “super” absorption in spherical nanoparticles

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There was some recent fuzz about “superscattering” effect, which is about to design a structure such a way, that several multiple (electric and/or magnetic) resonances are overlapped. This breaks the theoretical limit we can achieve using a single resonance, that‘s why it is called “super”. Our initial idea was to show the same effect in absorption, and R=63 with R=81nm are such ‘superabsopting‘ designs. However, in 3D case (in contrast to 2D investigated with Ali) it turned out that sometimes it is preferable to use a smaller particle with single resonance to achieve the best efficiency. This way, in 3D case using real materials for a multilayer spherical particle “superabsorbing” design do not always leads to best absorption efficiency. Moreover, same effect exists for scattering from SiAgSi optimized structure. At WL=500 nm “super” scattering mode with two resonances gives the best efficiency, however, at WL=400 nm a single resonance small particle has a better scattering efficiency compared to larger particles with “super” design.

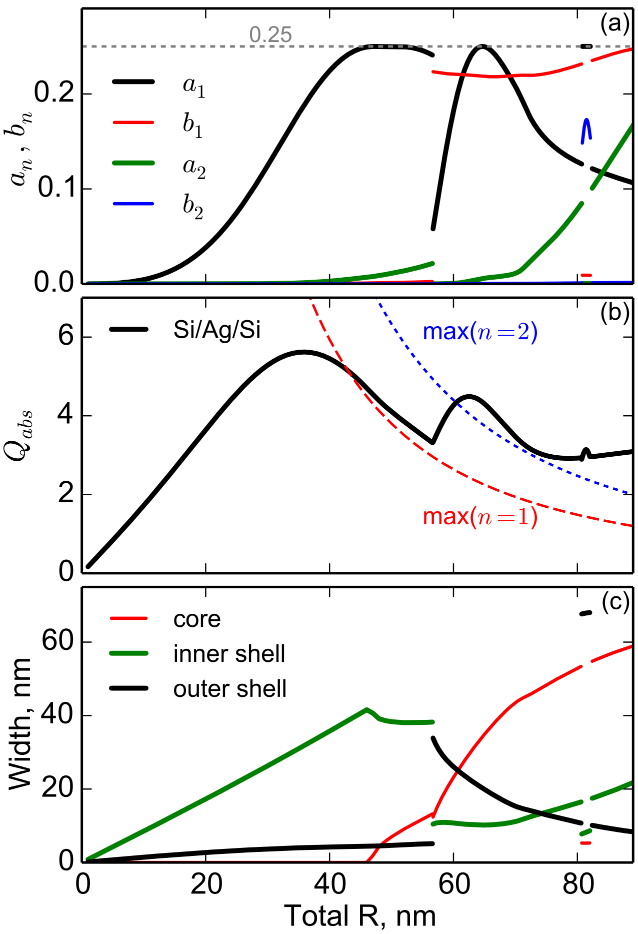

Figure 1. Optimized designs overview at working wavelength $\lambda = 500$ nm. (a) Expansion coefficients (b) Absorption efficiency with best value at total R=36 nm and Ag/Si design (zero sized core) and "super" designs at R=63 nm and R=81 nm. (c) Used layers width

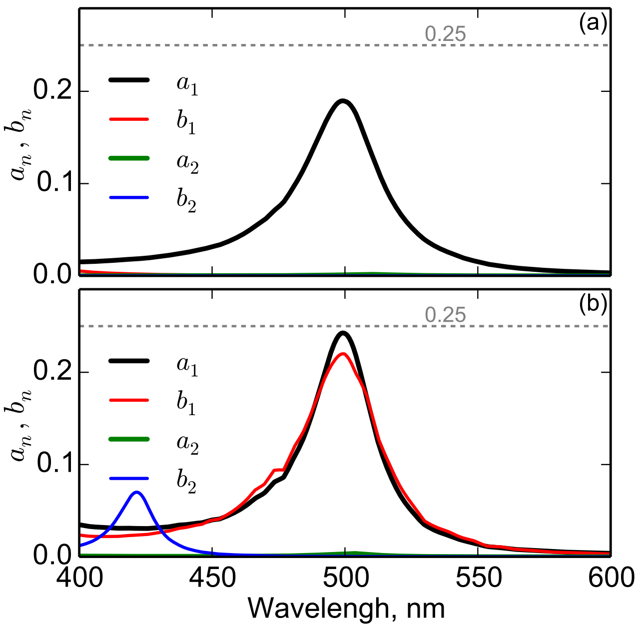

Figure 2. Expansion coefficients spectra of (a) efficient and (b) "super" design.

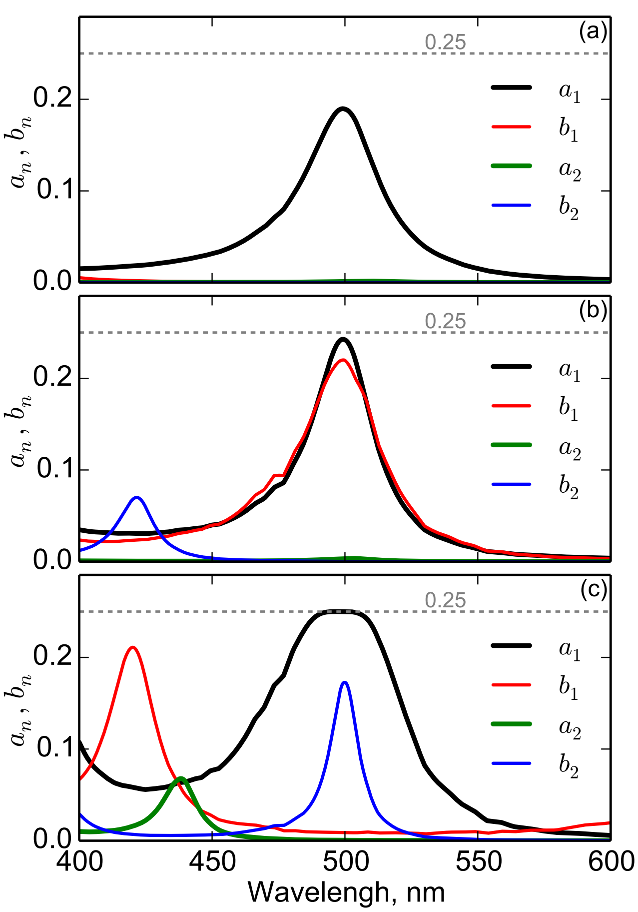

Figure 3. (Or we can use) Expansion coefficients spectra of (a) efficient and (b-c) "super" design.

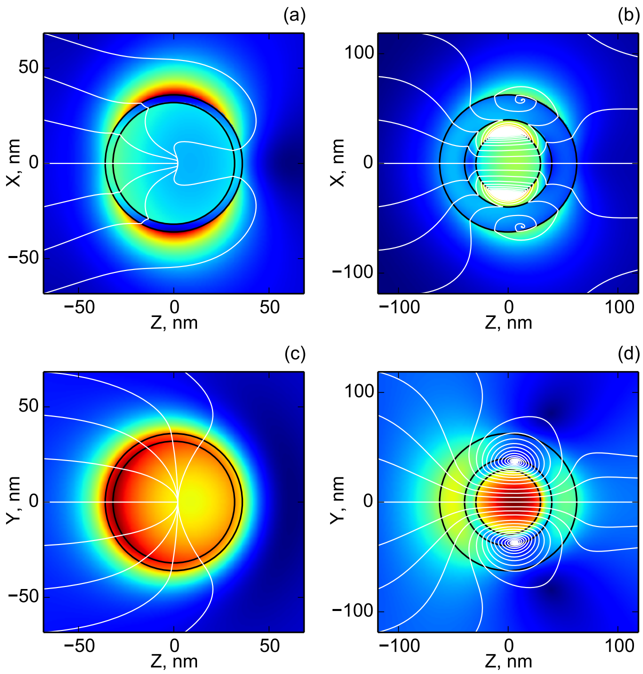

Figure 4. (Main field figure. The following figures are given for reference and should be removed from the manuscript). Electric field for efficient (a,c) and "super" (b,d) designs in E-k (a-b) and H-k (c-d) planes.

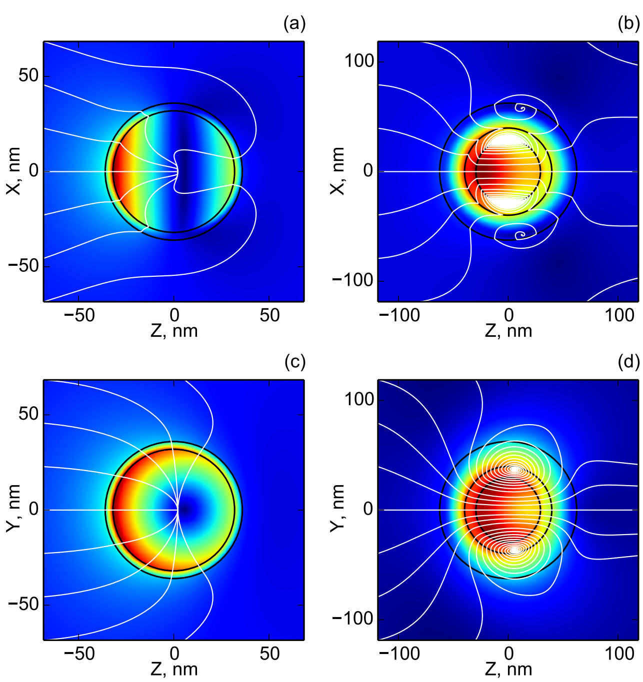

Figure 5. Same as Fig. 4 for magnetic field.

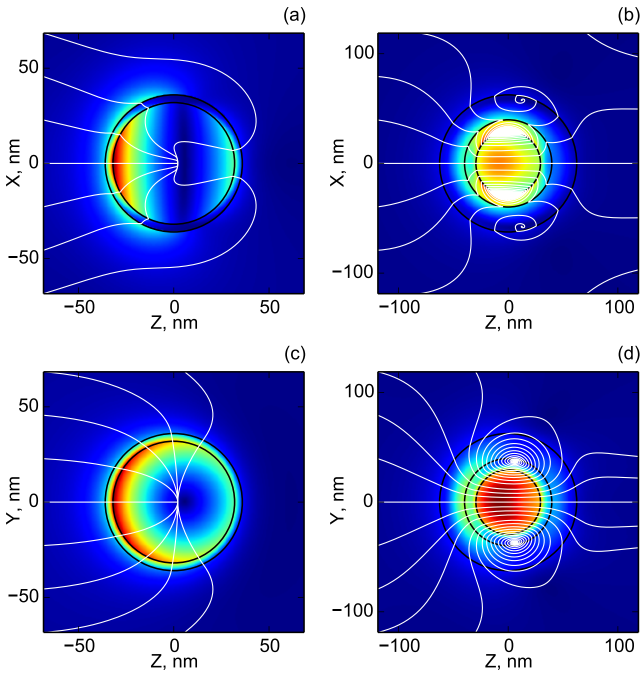

Figure 6. Same as Fig. 4 for Poynting vector.

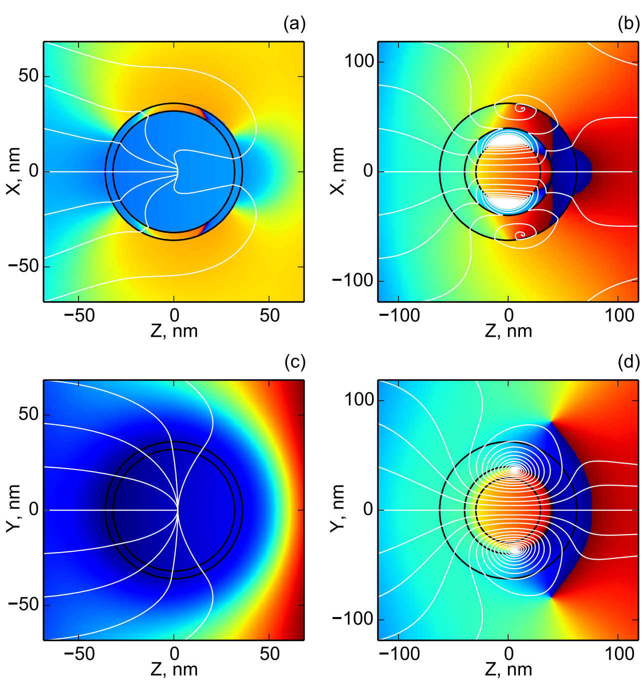

Figure 7. Same as Fig. 4 for phase of the electric field (x component).

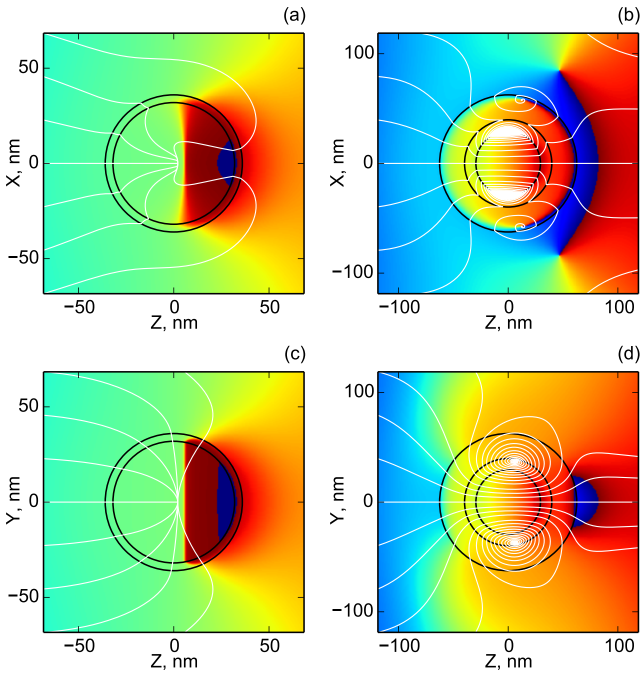

Figure 8. Same as Fig. 4 for phase of the magnetic field (y component).