Electronic Supplementary Information

Human cell defence mechanisms against cytotoxicity of $NaYF_4$:(Er,Yb,Gd) nanoparticles

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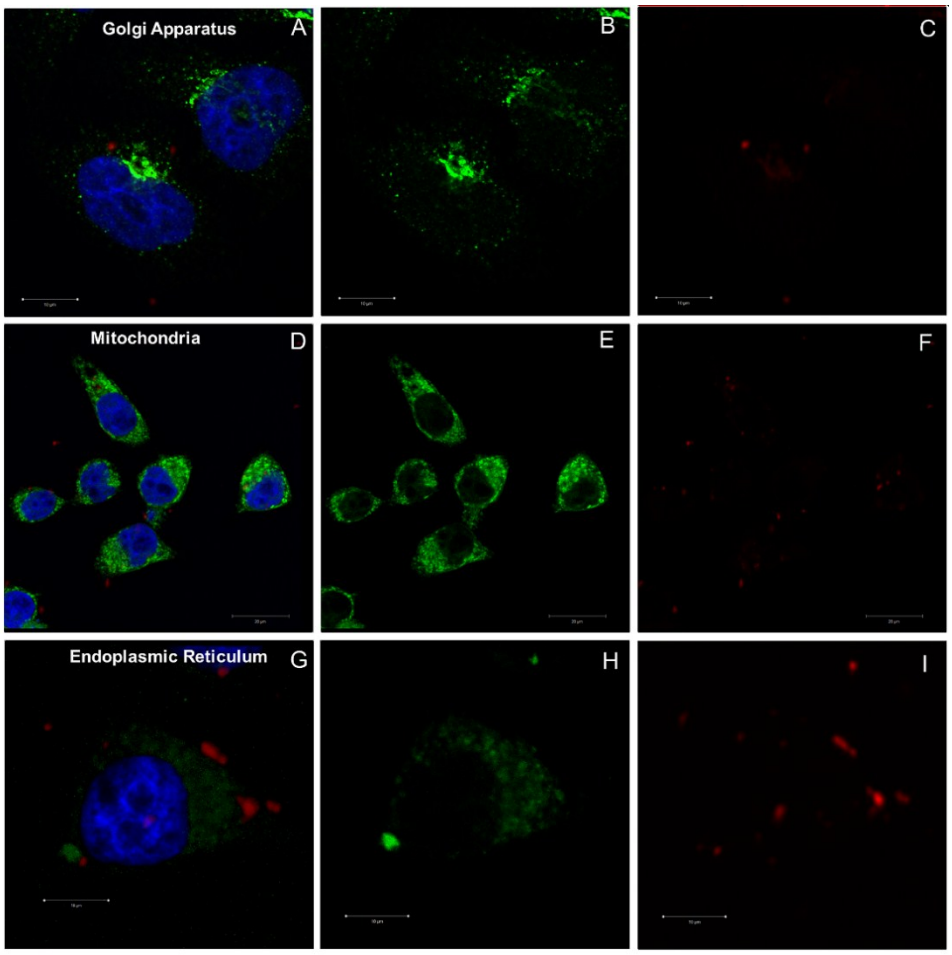

Fig. S1. HeLa cells with the cellular organelles stained by antibody incubated with the $NaYF_4$:2%Er,20%Yb,30%Gd nanoparticles: A, B, C – stained Golgi apparatus; D, E, F - stained mitochondria; G, H, I - stained endoplasmic reticulum A, D, G – superposition of three channels: blue - a channel of the cell nuclei stained with a Hoechst 33342, ex. 690 nm (the laser power: 0.5% -A, D, J and 0.6%-G), em. 430-500 nm; green colour - channel of the stained organelles, ex. 488 nm (the laser power 1.5%-A 0.2%-D, 2.6%-J) em. 495-572 nm); ex. 633 nm (the laser power 0.1% -G), em. 650-740 nm; the red - channel of nanoparticles, ex. 980 nm (laser power 10%-A, 6% -D, J and 4% -G), em. 500-730 nm. B, E, H - channel of organelles stained with antibodies conjugated to a dye. C, F, I - channel of nanoparticles.

The luminescence spectra of Golgi apparatus stained cells with the nanoparticles was collected for: nanoparticles - the NIR (980 nm) laser excitation and AlexaFluor488-conjugated

to antibody bound to the Golgi apparatus - the 488 nm laser excitation. The co-localization of spectra is shown in Fig. S2. The luminescence spectra shows that the place of the nanoparticles did not correlate with the Golgi apparatus. There is no overlapping spectra of nanoparticles luminescence with stained Golgi apparatus luminescence.

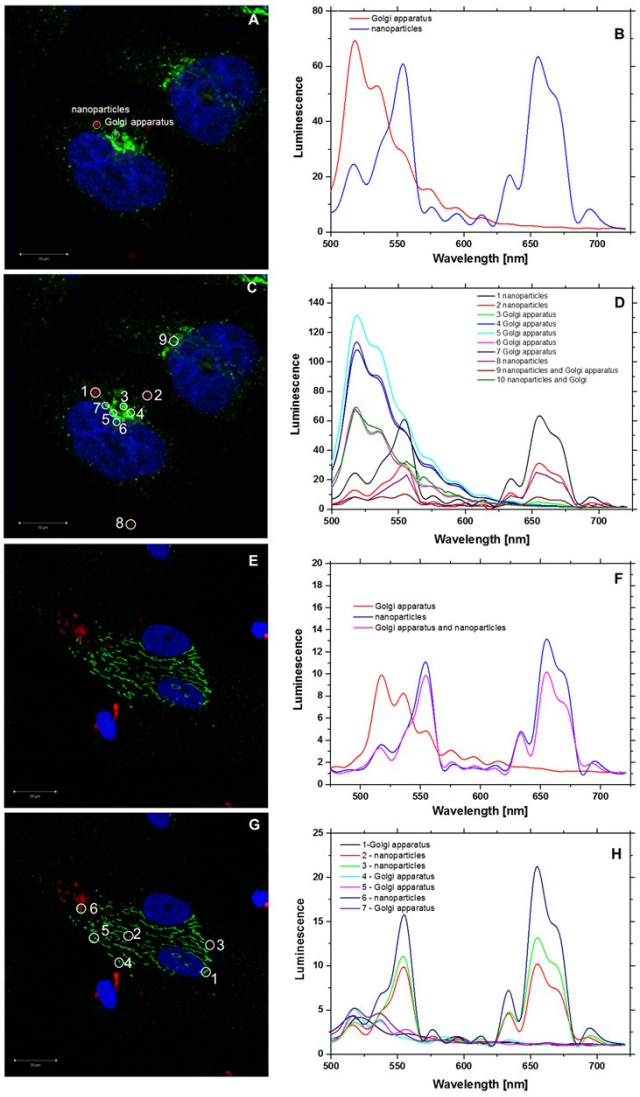

Fig. S2. The confocal luminescence spectra of $NaYF_4$:2%Er^{3+},30%Yb^{3+},30%Gd^{3+}/PVP nanoparticles in HeLa (A-D) and astrocytes (E-H) cells with stained Golgi apparatus. The excitation wavelength of nanoparticles was 980 nm and stained Golgi apparatus was 488 nm. A, E - images of cells with nanoparticles with the measured spectra points shown in B and F, respectively. C, G- images of cells with nanoparticles with the measured spectra points shown in D and H, respectively.

The luminescence spectra of the cells with the stained endoplasmic reticulum and with the nanoparticles was collected for: nanoparticles - the NIR (980 nm) laser excitation and AlexaFluor488-conjugated to antibody bound to the ER - the 488 nm laser excitation. The co-localization of spectra is shown in Fig. S3.

As can be seen in Fig. S3, the nanoparticles located outside of the endoplasmic reticulum.

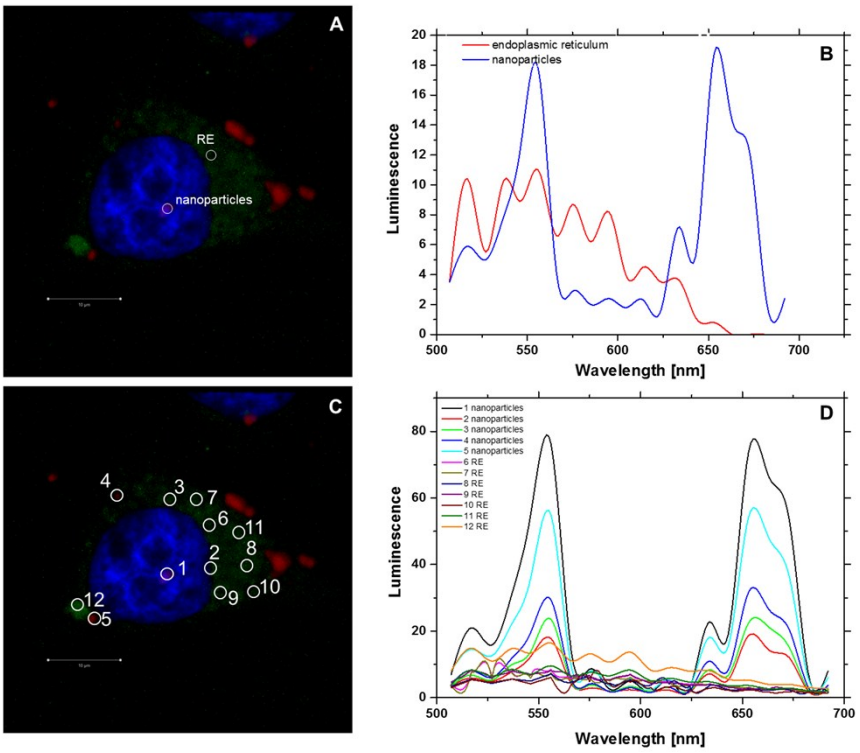

Fig. S3. Confocal luminescence spectra of $NaYF_4$:2%Er^{3+},30%Yb^{3+},30%Gd^{3+}/PVP nanoparticles in HeLa cells with stained endoplasmic reticulum. The wavelength excitation of nanoparticles was 980 nm and endoplasmic reticulum was 488 nm. A, C - images of cells with nanoparticles with the measured spectra points shown in B and D, respectively. A ,C-image of the cells with the nanoparticles marked with the positions at which the measured sample spectrum shown in fig. B and D of Fig. B, D spectra were stained endoplasmic reticulum, nanoparticles and nanoparticles of co-localization of the endoplasmic reticulum.

The colocalization of up-conversion nanoparticles and AlexaFluor488 on the endosomes spectra were observed in HeLa, HEK and astrocytes cells (Fig. S4).

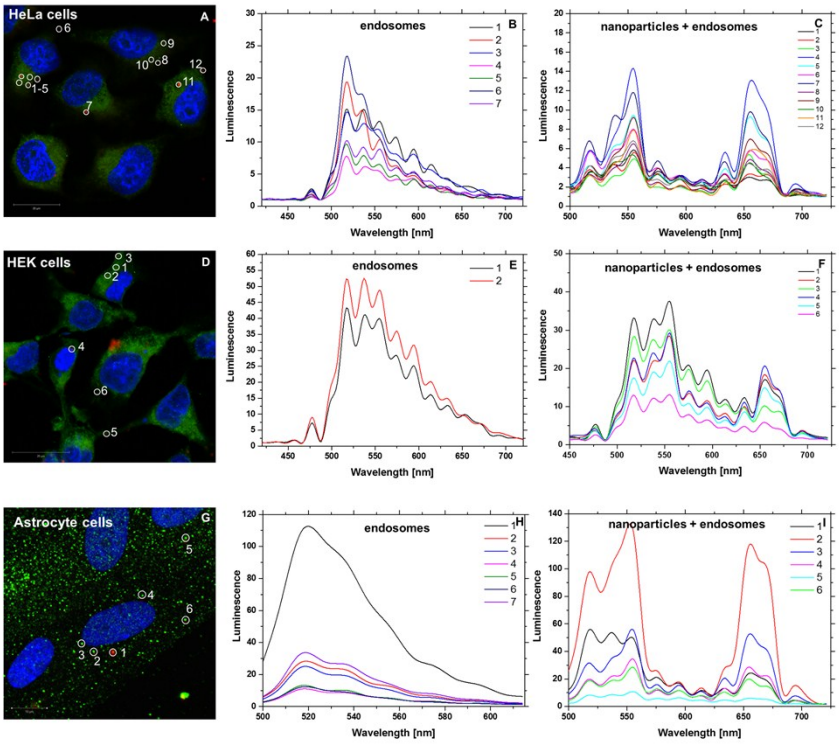

Fig. S4. Confocal luminescence spectra of the $NaYF_4$:2%Er^{3+},30%Yb^{3+},30%Gd^{3+}/PVP nanoparticles in HeLa (A-C), HEK (D-F) and astrocyte (G-I) cells with stained endosomes. The excitation wavelength of nanoparticles was 980 nm, and endosomes was 488 nm. A, D, G-images of cells with nanoparticles with the measured spectra points shown in C, F and I, respectively. B, E, H - spectra registered for stained endosomes. C, F, I-spectra of co-localization of nanoparticles with endosomes (980 nm and 488 nm of excitation).

The up-conversion luminescence of nanoparticles and Alexa Fluor 488 connected to lysosomes were examined. The colocalization of these spectra was observed in HeLa, HEK and astrocytes cells (Fig. S5).

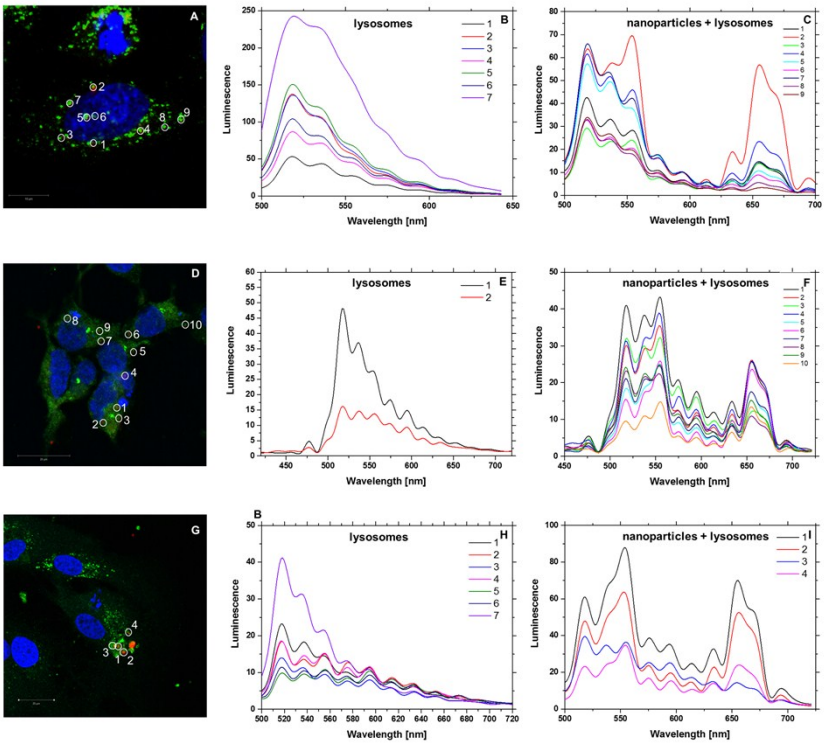

Fig. S5. The confocal luminescence spectra of $NaYF_4$:2%Er^{3+},30%Yb^{3+},30%Gd^{3+}/PVP nanoparticles in HeLa (A-C), HEK (D-F) and astrocyte (G-I) cells with the stained lysosomes. The excitation wavelength of nanoparticles was 980 nm, and stained lysosomes was 488 nm. A, D, G - mages of cells with nanoparticles with the measured spectra points shown in C, F and I, respectively. B, E, H – the stained lysosomes spectra. C, F, I – the nanoparticles and lysosomes spectra with the co-localization (two excitation wavelengths: 980 nm and 488 nm).