Our proposal is related to the development of the new types of scintillation materials, based on the solid solution of mixed oxides, prepared in the functional forms of single crystalline films and crystals. In frame of our project we plan to use the Liquid Phase Epitaxy (LPE) method to grow the sets of novel scintillating screens based on the single crystalline films of solid solution of Ce^{3+} doped $(Lu_{1-x}R_x)(Al_{1-y}Ga_y)O_3$ perovskites; R= Gd, Tb; x, y=1÷0, *emitting in the UV range* and Tb^{3+} and Eu^{3+} doped $(Lu_{1-x}R_x)(Al_{1-y}Ga_y)O_3$ perovskites and $(Lu_{1-x}R_x)_2O_3$ complex; R= Gd, Tb; x, y=1÷0, *emitting in the visible range*. Finally, we plan also to test the developed film scintillators as the screens for visualization of X-ray images with spatial resolution in *submicron range* using the traditional X-ray sources and synchrotron radiation at ESRF in Grenoble, France.

Recently, mixed crystals have become an important trend in scintillator development pointing at the materials with higher light yield and, as a consequence, better energy resolution. During the last ten years, series of new scintillation materials based on mixed crystals with superior light yield (LY), and very high energy resolution have been introduced. Namely, the developed few years ago, the bulk crystals of the Ce doped $Gd_3(AlGa)_5O_{12}$ (GAGG), $(LuGd)_3(AlGa)_5O_{12}$ (LGAGG) and $(YGd)_3(AlGa)_5O_{12}$ (YGAGG) garnets present now the novel class of efficient and fast scintillators. The LY of these mixed scintillators can reach the *extremely high values 60000-65000 photon/MeV*. The bulk crystals based on the solid solutions of $(LuY)_2SiO_5$:Ce (LYSO:Ce) and $(LuGd)_2SiO_5$:Ce (LGSO:Ce) orthosilicates are also the well-known scintillators for the Positron Emission Tomography (PET) with LY of 35000-45000 photon/MeV. The Ce doped $YAlO_3$ (YAP), $LuAlO_3$ (LuAP) and $(Lu_{1-x}Y_x)AlO_3$ (LuYAP) perovskites are also related to very efficient and fast scintillators for PET application. The LY of scintillators based on the YAP:Ce and LuYAP:Ce crystals can reach also the very *high values 40000-45000 photon/MeV*.

Fast development of microimaging techniques with traditional X-ray sources or synchrotron radiation for applications in biology, medicine and industry also need creation of X-ray image detectors with spatial resolution in the μm range. For this purposes, the scintillating screens based on the thin (up to 20 μm) single crystals and single crystalline films of Ce doped $Y_3Al_5O_{12}$ (YAG) and $Lu_3Al_5O_{12}$ (LuAG) garnets as well as single crystalline films of Eu and Tb doped LuAG and GGG garnets, Ce and Tb doped Lu_2SiO_5 (LSO) orthosilicate and $LuAlO_3$ (LuAP) perovskite were developed using the LPE method in last decade. Meanwhile, the possibility of receiving the highest spatial resolution of X-ray images in *submicron range* strongly demands development of new thin (a few μm) scintillating film screens with extremely high absorption ability of X-rays, which is proportional to ρZ^4, where ρ is the density and Z_{eff} is effective atomic number of scintillators.

The Lu_2O_3 and LuAP hosts have extremely higher density (ρ=8.34 i 8.4 g/cm^3) and effective atomic number (64.9 i 68.8) as compared to the commonly used YAG, LuAG, GGG garnets and LSO and LYSO orthosilicates. For these reasons, LuAP based perovskites and Lu_2O_3 based oxides with extremely high ability for absorption of X-ray quanta ($\rho Z^4*(10^6)$ values for these compounds are equal to 148 and 180, respectively) as well as solid solution on their basis containing Gd and Tb cations are very promising materials for creation of single crystalline film scintillators for visualization of X-ray images with submicron spatial resolution.

In last few years, the two novel concepts of the detectors for microtomography were also proposed. The *first concept* based on the creation of the hybrid multi-film scintillators with the separate pathway for registration of the optical signal from each of film scintillators and final overlapping of images coming from the different parts of hybrid scintillators. Using of the hybrid film scintillators can significantly improved the contrast and resolution of images even in the submicron range. Such novel concepts also requires of the creation of the different sets of the efficient and heavy SCF scintillators which can be deposited onto the same substrate. The *second concept* of creation of a detector for microtomography is connected with engineering of „K-edge of X-ray absorption" multilayer-film scintillators using the mixed oxide compounds containing the Lu, Gd or Tb ions. In such a way the absorption ability of the film scintillator can be significantly improved in the 50-65 eV range due to the significant broadening of the edge of X-ray absorption in such mixed materials. Lu, Gd and Tb based oxides and perovskites are very interesting here because of their absorption K-edges located in an energy range 55-65 eV where imaging applications are suffering for the low efficiency of the detectors in case of small scintillator thickness.

As ***novel research approach*** for creation of scintillation materials, we try to apply in the project combination of: (ii) the "band-gap engineering" and (ii) "engineering of the positions of Ce^{3+} radiative 5d-levels" as well as (iii) the "enhancement of the energy transfer efficiency using the sublattice of rare-earth cations" to the basic scintillation materials - the Ce^{3+} doped $LuAlO_3$ perovskite, using alloying with Gd^{3+} or Tb^{3+} and Ga^{3+} ions into the different cation positions of the perovskite hosts. The combination of the band-gap engineering and change of the energy transfer efficiency will be also applied to the solid solution of $(Lu_{1-x}R_x)_2O_3$ oxides, R= Gd, Tb with Eu^{3+} and Tb^{3+} dopants. Such „engineering" of the energetic structure of the oxide matrixes and rare-earth dopants in them can result in decreasing of the influence of the host defects and flux components on the energy transfer processes and leads to the increasing of the light yield of the single crystalline films scintillators.

The combination of the cation content in the mentioned perovskites and complex oxides opens also the possibility of creation of the wide sets of film scintillators with different absorption ability of X-ray quanta *("screens with absorption on demand")*. This is necessary for the various kinds of applications of such screens for 2D/3D imaging (microtomography, nondestructive testing in industry, biology, medicine, paleontology, etc).

We also plan to compare in our project the luminescent and scintillation properties of best types of developed film scintillators with properties of bulk crystal analogues of these compounds, grown from the melt using MPD method. In such way, we plane also to study of the fundamental optical properties of above mentioned complex oxides and perovskites such as intrinsic luminescence the of hosts of these compounds caused by the radiative annihilation of relaxed low energy excitations (excitons), the emission of the different type of defects as well as the luminescence of the chosen type of rare-earth ions and flux-related dopants in the different cation positions of the oxide lattices.