Town Meeting on the IFMIF/ELAMAT Scientific Porgram Workshop, Technical university of Rzeszów, April 14-15, 2016

Radionuclides and radiopharmaceuticals for therapy

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Nuclear medicine therapy (radionuclide therapy) uses radioactive preparations for the selective delivery of radiation to target organs or tumors. Such therapeutic use of radioisotopes has been developed in the mid of 20^{th} century following the discovery of methods for production of artificial radionuclides. In that respect ^{131}I iodine has been used for the treatment of differentiated papillary or follicular thyroid carcinoma and ^{32}P phosphorus (as orthophosphate) has been used for treatment of polycythaemia vera. Potential new applications of radionuclide therapy (particularly in the field of oncology) reflect advances in antibody engineering (radioimmunotherapy), the identification of tumor antigen targets or the synthesis of peptide analogues (peptide receptor radionuclide therapy). These compounds are subsequently complexed with β^-, α or Auger emitting radionuclides in order to achieve an appropriate treatment through the delivery of cytotoxic absorbed radiation dose to the desired target and prevent or minimise the toxicity for normal tissues. Radionuclides can be produced with high specific activity or as no carrier added in nuclear reactors (e.g. ^{131}I, ^{153}Sm, ^{166}Ho, ^{177}Lu, ^{47}Sc, ^{117m}Sn), in cyclotrons (^{47}Sc, ^{64}Cu, ^{67}Cu, ^{89}Zr, ^{111}In, ^{211}At) or can be obtained from radionuclide generators (^{99}Mo/^{99m}Tc, ^{88}W/^{188}Re, ^{90}Sr/^{90}Y, ^{225}Ac/^{213}Bi, ^{227}Ac/^{223}Ra, ^{68}Ge/^{68}Ga). Some estimations on the possible radioisotope production using the beams at IFMIF-ELAMAT will be made.