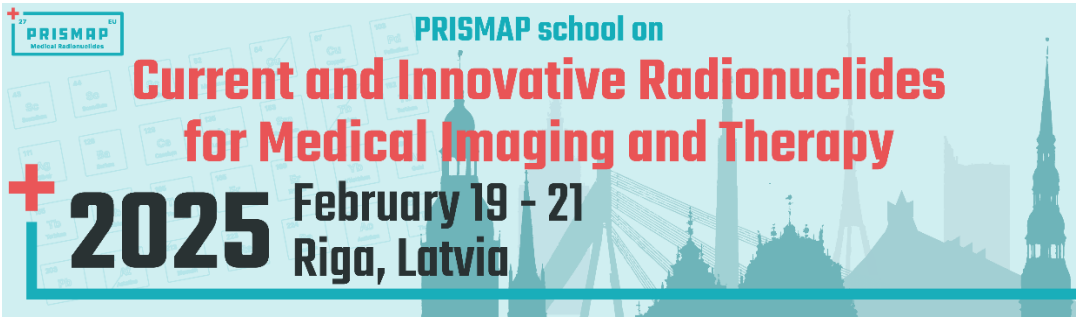

New resins and methods for the purification and QC of radionuclides for use in imaging and therapy

Inés Llopart-Babot (*TrisKem International*),
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Abstract: New approaches to radionuclide purification and quality control have been developed over the last years, focusing on advancements in resins and methodologies tailored to nuclear medicine applications. Highlighted topics include work on zirconium-89 separation as chloride for direct radiolabeling [1], and the separation of Ag-111 from irradiated Pd targets for its use in therapeutic applications [2].

Due to the increased interest in Tb isotopes, especially Tb-161, methods for the separation of Tb isotopes from elevated amounts of Gd [3] and Dy (≥ 1g) have been optimized. The development and testing of novel CU iSheets [4] and DGA iSheets, including the ongoing evaluation of new TK213 iSheets, represent significant progress in quality control solutions. Additionally, innovative impregnated membranes have been investigated allowing for direct alpha spectroscopic analysis of these discs after filtration of test solutions and retention of analytes on their surface, simplifying their detection and quantification.

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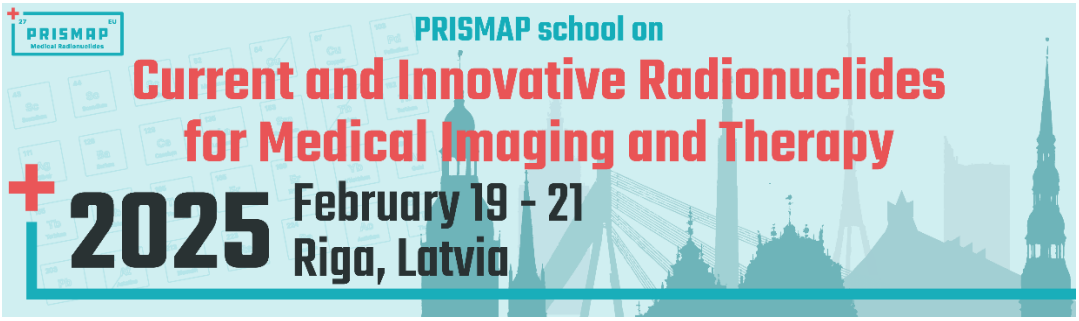

THE EFFECT OF IONIZING RADIATION ON THE EFFICIENCY OF N,N,N',N'-TETRA(2-ETHYLHEXYL) DIGLYCOLAMIDE RESIN PERFOMANCE FOR SCANDIUM SEPARATION

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Laura Dace Pakalniete (*University of Latvia, Faculty of Science and Technology*)
Edgars Mamis (*CERN and University of Latvia, Faculty of Science and Technology*)
Liga Avotina (*University of Latvia, Faculty of Science and Technology*)
Magdalena Rzepna (*Centre for Radiation Research and Technology, Institute of Nuclear Chemistry and Technology*)
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Abstract: To effectively diagnose and treat malignant tumors, it is possible to use a combination of radioactive isotopes that form a theranostic (therapeutic and diagnostic) pair. These radioactive isotopes have a short half-life, requiring their artificial production using nuclear reactors or particle accelerators.

The radioactive isotopes of scandium, 43Sc, 44Sc, and 47Sc, are ideally suited for theranostic purposes. However, for their application in nuclear medicine, purification from various impurities is necessary, which is achieved through physical and chemical methods. One of the most suitable chemical separation methods is ion-exchange chromatography.

Diglycolamide ion-exchange resins are effective for the selective separation of scandium. However, the impact of ionizing radiation on the stability and operational lifespan of these resins remains unclear. This study evaluates the effect of irradiation with accelerated electrons on N,N,N',N'-tetra(2-ethylhexyl)diglycolamide (TEHDGA) ion-exchange resins, determining their selectivity for scandium, separation efficiency, and assessing limits of their potential applications.

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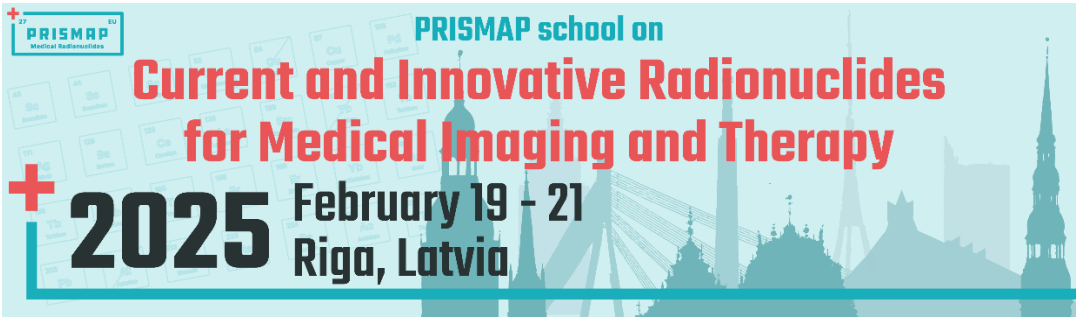

Method development for radiopharmaceutical scandium separation from contaminants using 45Sc aqueous and non-aqueous solution electrolysis

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Abstract: Scandium radioisotopes have a wide range of potential applications in diagnostic and therapeutic medicine. For medical purposes, radioisotopes can be produced in nuclear reactors or by irradiating a target material with accelerated protons or helium ions. However, during production of radioactive Sc isotopes other impurities are also produced that are undesirable for medical purposes.

This study is aimed at developing a method for electrolysis of aqueous and non-aqueous (ethanol and acetonitrile) solutions for the separation of scandium from unwanted impurities.

It was found that electrolysis in a non-aqueous medium show better results than electrolysis in an aqueous medium, since the efficiency of metal ion separation is higher, which means that lower voltage and temperature are required for the separation. Additionally, the electrochemical separation time is very important for the separation of radioactive scandium, as radionuclides have relatively short half-lives. Water electrolysis occurs in an aqueous electrochemical separation process, which uses a lot of energy and therefore takes more time for ion separation, but this process does not occur in a non-aqueous medium, making it more suitable for separation of radioactive scandium.

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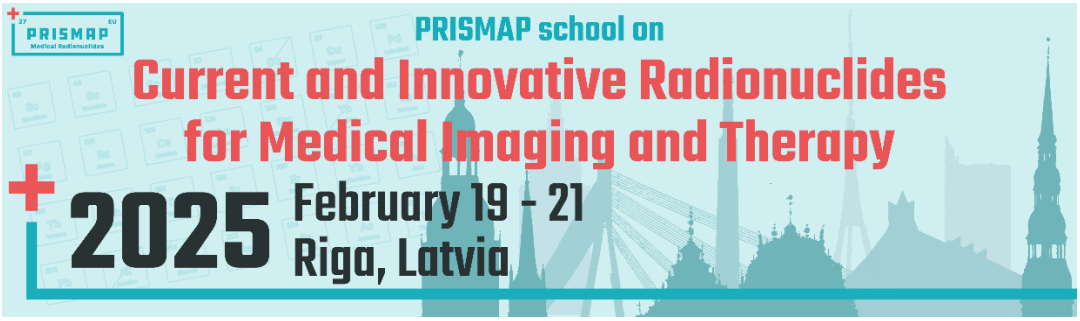

Development of [^{64}Cu] and [^{99m}Tc] Labeled FAP inhibitors for Targeted Tumor Imaging

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Abstract: Fibroblast activation protein (FAP) is a transmembrane serine protease overexpressed in the tumor microenvironment, playing a crucial role in cancer progression. Targeting FAP offers promising opportunities for novel anti-cancer therapeutics and molecular imaging agents. This study presents the synthesis, radiolabeling, and preclinical imaging of dimeric dithiocarbamate-based FAP inhibitor derivatives, labeled with [^{64}Cu] and [^{99m}Tc], in tumor-bearing mouse models. The radiolabeling of DTC-FAP-IN-2 with [^{64}Cu] and [^{99m}Tc] was achieved with high radiochemical yield (>95%) and purity (>95%). Both complexes demonstrated moderate lipophilicity ($logD_{7.4}$ = 1.6–1.7) and excellent stability in human serum for up to 12 hours. In vivo imaging studies in SCID mice xenografted with MDA-MB-231 cells confirmed effective tumor delineation, with rapid clearance through the hepatobiliary system and minimal soft tissue uptake. These findings highlight the potential of [^{64}Cu] and [^{99m}Tc]-labeled dithiocarbamate FAP inhibitors for cancer imaging and warrant further investigation.

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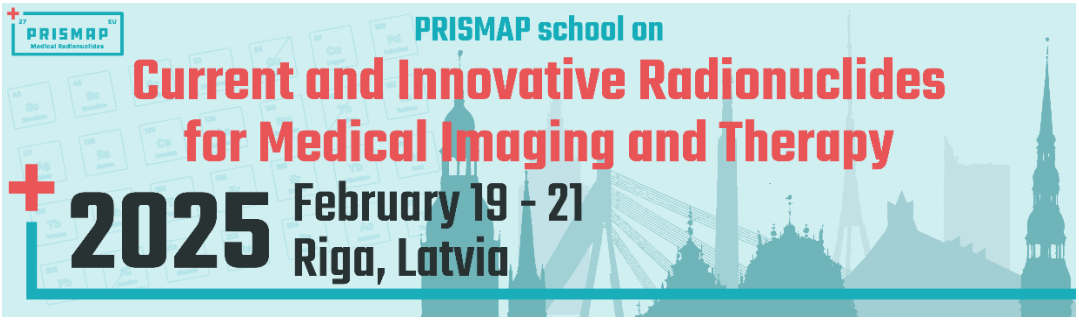

Antimony-119 for Targeted Radiopharmaceutical Therapy: Unlocking the Potential of Auger Electron Emitters

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Abstract: Antimony-119 ($t_{1/2}$ = 38.19 h) is a radionuclide of therapeutic interest, decaying through the emission of Auger (< 0.5 µm) and conversion (< 10 µm) electrons. Due to the low path-length in tissue, Sb-119 can be applied to target cancer on a cellular basis, provided a sufficiently selective delivery mechanism can be attained. To date, no suitable delivery mechanisms have been developed, due to several factors, including a lack of robust purification method for isolating Sb-119 in a suitable oxidation state, species, and matrix for further application in chelation, in vitro, and in vivo studies. Moreover, the suggested production route by proton bombardment of tin-119 in a conventional low energy cyclotron requires expensive enriched material, which must be recycled and reused for Sb-119 based radiopharmaceuticals to be viable. Therefore, efforts in establishing a robust production of Sb-119 were sought by designing new solid-phase extraction chromatography resins. These resins showed improved concentration of Sb-119 in a suitable matrix compatible with further applications in radiopharmaceutical synthesis. The purification system was also able to quantitatively recover the Sn target material in a concentrated form, and an electroplating method capable of recycling the recovered Sn is in the process of being developed. Initial testing shows the method's compatibility with the developed purification system, establishing a new, improved approach for Sb-119 production.

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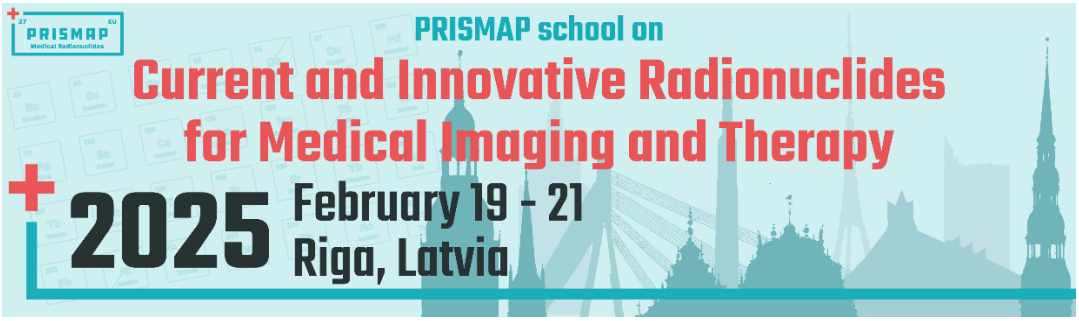

Mitotropic 161Tb-Radioconjugates for Prostate Cancer Therapy

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Abstract: 177Lu-PSMA-617, targeted at the Prostate-Specific Membrane Antigen (PSMA), was approved for targeted radionuclide therapy (TRT) of metastatic-castration resistant prostate cancer. 161Tb, a beta-minus emitter that also emits Auger electrons (AE), can be a promising alternative to 177Lu, since combined beta/AE therapy could enhance therapeutic effects. AEs present high linear energy transfer over a nanometric range, holding promise for TRT when emitted near highly radiosensitive organelles (e.g.,mitochondria).

We designed dual-targeted 161Tb-complexes carrying a PSMA derivative for selective uptake by prostate cancer cells and a triphenylphosphonium group for accumulation in the mitochondria, including one radiocomplex bearing a triglycine linker to enhance accumulation in the mitochondria upon enzymatic cleavage. Herein we report their radiosynthesis and preclinical evaluation in cellular and animal tumor models. Studies in PSMA(+) PC3 PIP and PSMA(-) PC3 FLU cells showed high and PSMA-specific uptake and internalization in PSMA(+) cells. Radiobiological effects evaluated with clonogenic survival and yH2AX assays indicate that the dual-targeted radiocomplexes are more radiotoxic than the single-targeted 161Tb-PSMA-617, and present slightly higher mitochondrial uptake that could contribute to this effect. uSPECT/CT imaging studies in tumor-bearing mice revealed that the dual-targeted complexes exhibit PSMA-specific tumor uptake, with effective clearance from non-target tissues.

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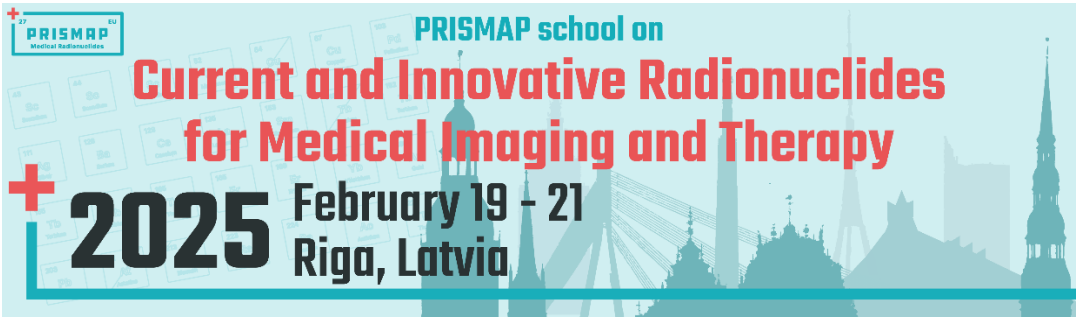

Innovation in precision radiopharmaceuticals to treat cancer

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Prof Tijani GHARBI (*AKEN MEDICAL*)
Dr Mikhael BECHELANY (*Institut Européen des Membranes (IEMM, ENSCM UM CNRS UMR5635)*)
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Abstract: Radiopharmaceuticals that combine biological carriers with radionuclides can selectively target tumors, offering a promising approach to cancer therapy. When these radionuclides emit alpha particles, this method is called alpha-targeted radionuclide therapy. Alpha emitters have drawn attention for their effectiveness due to their high linear energy transfer and short tissue penetration, which allow for precise tumor irradiation while sparing healthy tissues. However, challenges exist, such as low drug-to-antibody ratios, and conventional chelators may not bind effectively to certain alpha emitters, risking leakage and off-target toxicity. Alpha radiopharmaceuticals also have specific complications, including the recoil energy that disrupts radionuclide retention, which limit their effectiveness. To overcome these limitations, we propose a core/shell nanoparticle platform for radionuclide encapsulation, which enhances stability and retention while improving tumor targeting. Additionally, aKen Medical is using this technology to encapsulate positron-emitting (beta+) radionuclides for PET imaging along with alpha emitters, enabling real-time tracking of radiopharmaceutical distribution. This integration of diagnostic and therapeutic capabilities, known as theranostics, enables real-time monitoring of drug biodistribution, enhancing patient safety and treatment outcomes, and marks a significant advancement in nano-radiopharmaceuticals for more effective cancer treatment.

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