



## 135La for Auger-based therapy: preparation, imaging and emissions

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**TITLE:**  $^{135}\text{La}$  for Auger-based therapy: preparation, imaging and emissions

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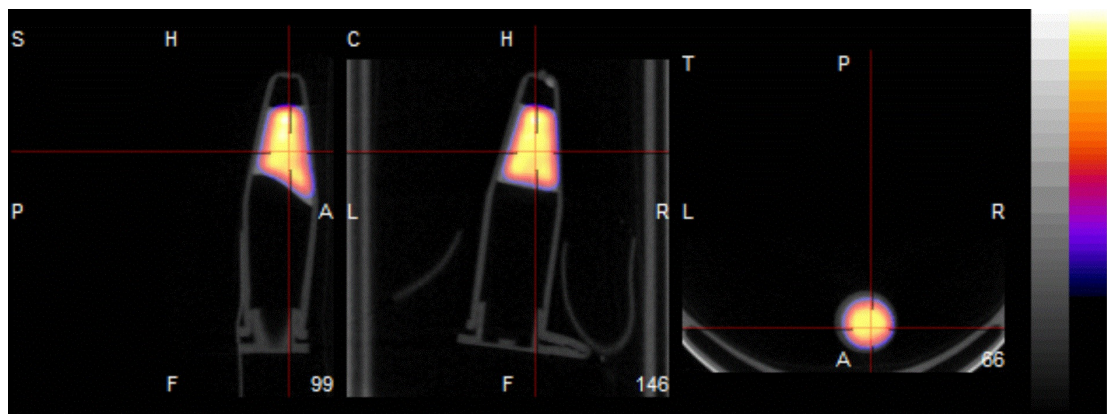
**Objectives:** Our aim was to determine the suitability of  $^{135}\text{La}$  for Auger-based internal radiotherapy. We set out to produce and purify  $^{135}\text{La}$  (EC, 19.5 h) from  $^{\text{nat}}\text{Ba}$ , radiolabel DTPA-mAbs with high specific activity, test X-ray based SPECT/CT imaging capabilities, and calculate detailed X-ray and Auger emission spectra.

**Methods:**  $^{135}\text{La}$  was produced by 16 MeV proton irradiation of  $^{\text{nat}}\text{Ba}$  metal and purified by extraction from  $\text{NH}_4\text{OAc}$  (aq. 30 mM, pH 4.7) onto hydroxamate resin (see  $^{44\text{g}}\text{Sc}$  from  $^{\text{nat}}\text{Ca}$ [1]). A DTPA-functionalized-IgG<sub>1</sub> mAb, h11B6 [2], was labeled in NaOAc, pH 5.5, RT. X-ray emissions were used for SPECT/CT (BioScan) phantom imaging. X-ray and Auger spectra were determined by Monte-Carlo simulation of the atomic relaxation process[3].

**Results:** The saturation production yield of  $^{135}\text{La}$  was 431 MBq/μA on the thick  $^{\text{nat}}\text{Ba}$  target. At 13 h post-bombardment the radionuclidic purity was over 95%. The main impurities were the short-lived  $^{136}\text{La}$  and  $^{134}\text{La}$  (10 min, 6 min), and  $^{133}\text{La}$  which is dosimetrically similar to  $^{135}\text{La}$  but with a potentially useful 7%  $\beta^+$  branch for PET imaging. The chemical separation was 96% efficient for La recovery, reducing the Ba content by a factor of  $\sim 10^4$ . DTPA-IgG<sub>1</sub> labeling reactivity was >70 GBq/μmol at 20 h post EOB. A phantom SPECT/CT image, **figure 1**, illustrates the promise of preclinical imaging. The Auger cascade from the isolated neutral atom was calculated to emit 7.7  $e^-$  per decay, ranging in energy from 1 eV to 36 keV ( $E_{\text{ave}} = 0.8$  keV).

**Conclusions:**  $^{135}\text{La}$  production from  $^{\text{nat}}\text{Ba}$  and its ultimate chemical and radionuclidic purity are appropriate to begin preclinical studies. These studies will be augmented by SPECT/CT. Dosimetry on both the cellular and organ level are now calculable using emissions from the entire Auger cascade.

**References:** [1] Severin GW, et al. (2012) AIP Conf Proc 125:125–128. [2] Tran T, et al Soc Nucl Med Annu Meet Abstr 55:1024. [3] Lee BQ, et al (2012) Comput Math Methods Med 2012:651475.



Phantom SPECT/CT (BioScan) image of 1-1.5 MBq  $^{135}\text{La}$  in an Eppendorf tube.