

Background:

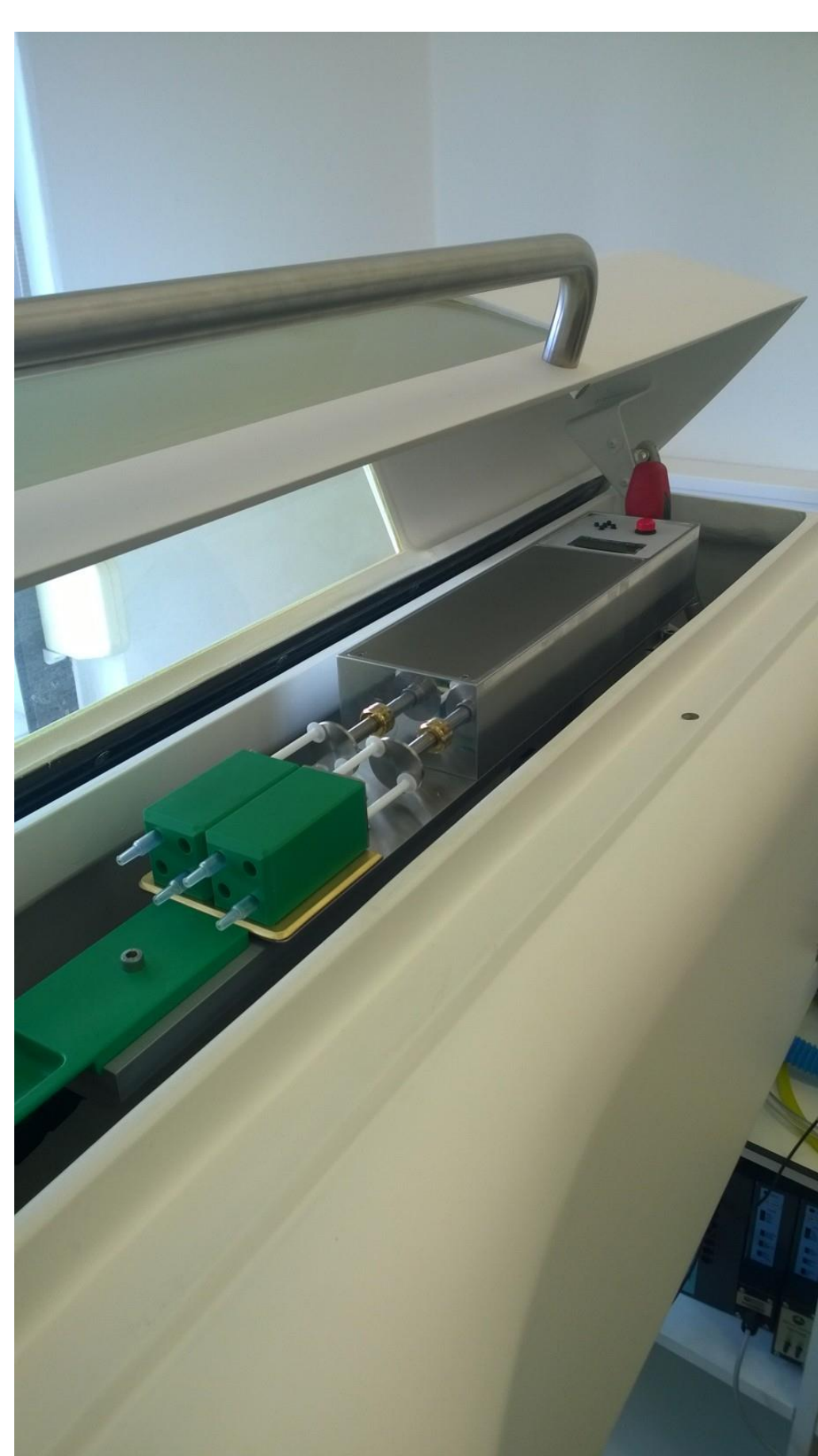
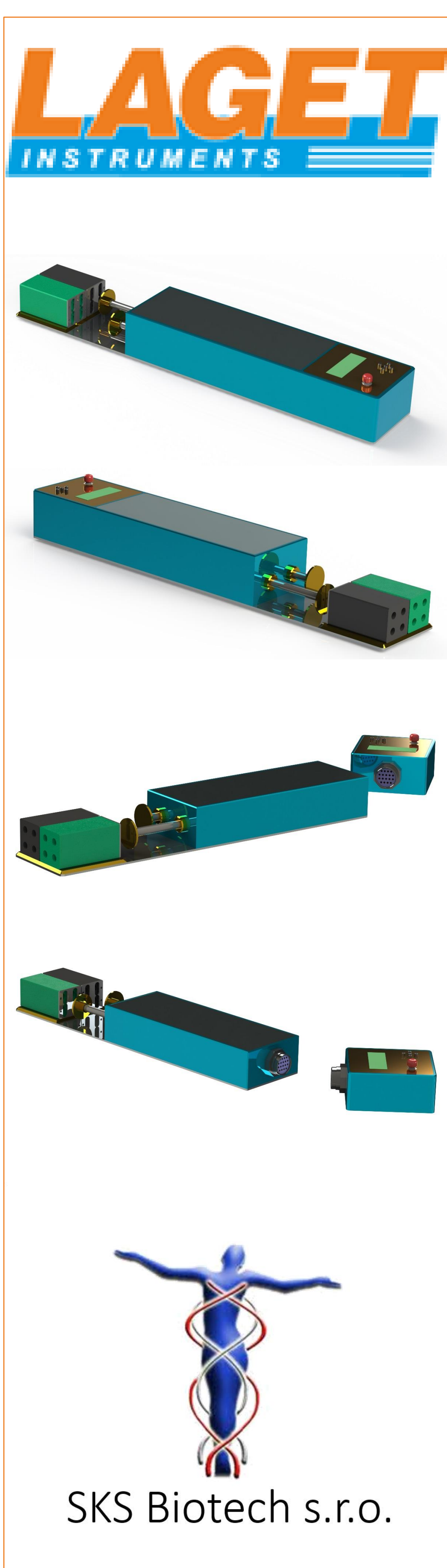
During the last years fully shielded multimodality imaging systems have been developed and are used for various research applications. Furthermore the demand for GLP documented research is increasing, requiring standardized methods and applications. Consequently we developed a computerized, fully automated sequential syringe pump for simultaneous application of up to 4 animals including flush.

Design:

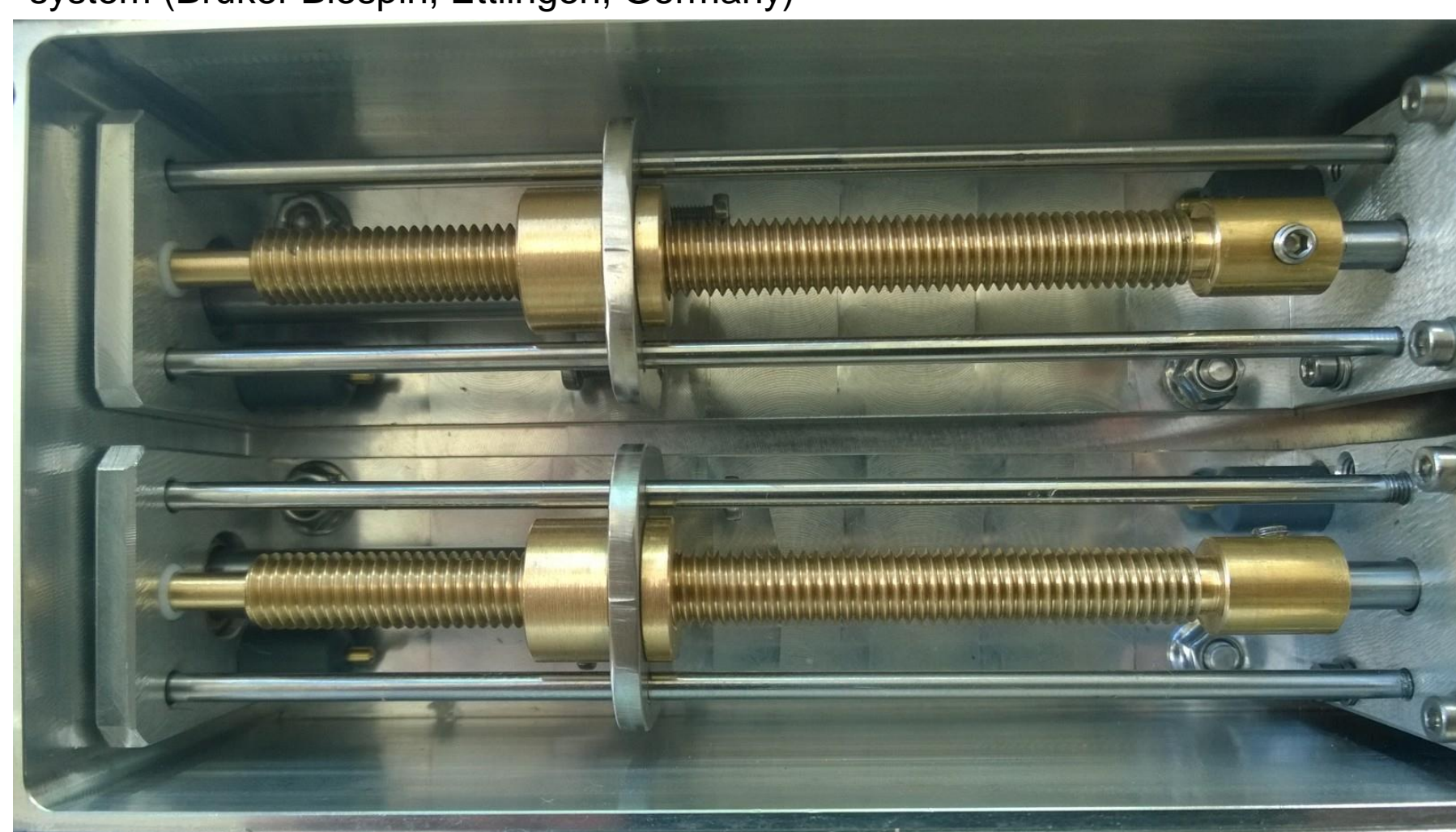
The presented syringe pump consists of two linear step engines and drive shafts in the mechanical part and dedicated electronics allowing for various application speeds including gradients and infusion of up to 30 min per 1 mL. The applicator can be preprogrammed or used with computer uplink. We developed various syringe holders for up to four 1mL syringes. When larger volumes are required the number of syringes is limited to 2 x 5 mL or up to 20 mL in a single syringe. By installing 2 separate, synchronized drives on a single platform automated injection sequences of tracer/contrast agent followed by flushing the catheter are possible without a change of syringes. Pre-catheterized animals are connected to the array of syringes by V-connectors or 3-way-valves. For use in radionuclide imaging we developed shielded syringe holder consisting of up to 95% tungsten or lead. Mechanics and electronics are embedded in an aluminum box, mounted on a stainless steel platform. The system is designed to ride on the bed holder of fully integrated, fully shielded multimodal imaging systems. For open systems special adapters are available.

Applications:

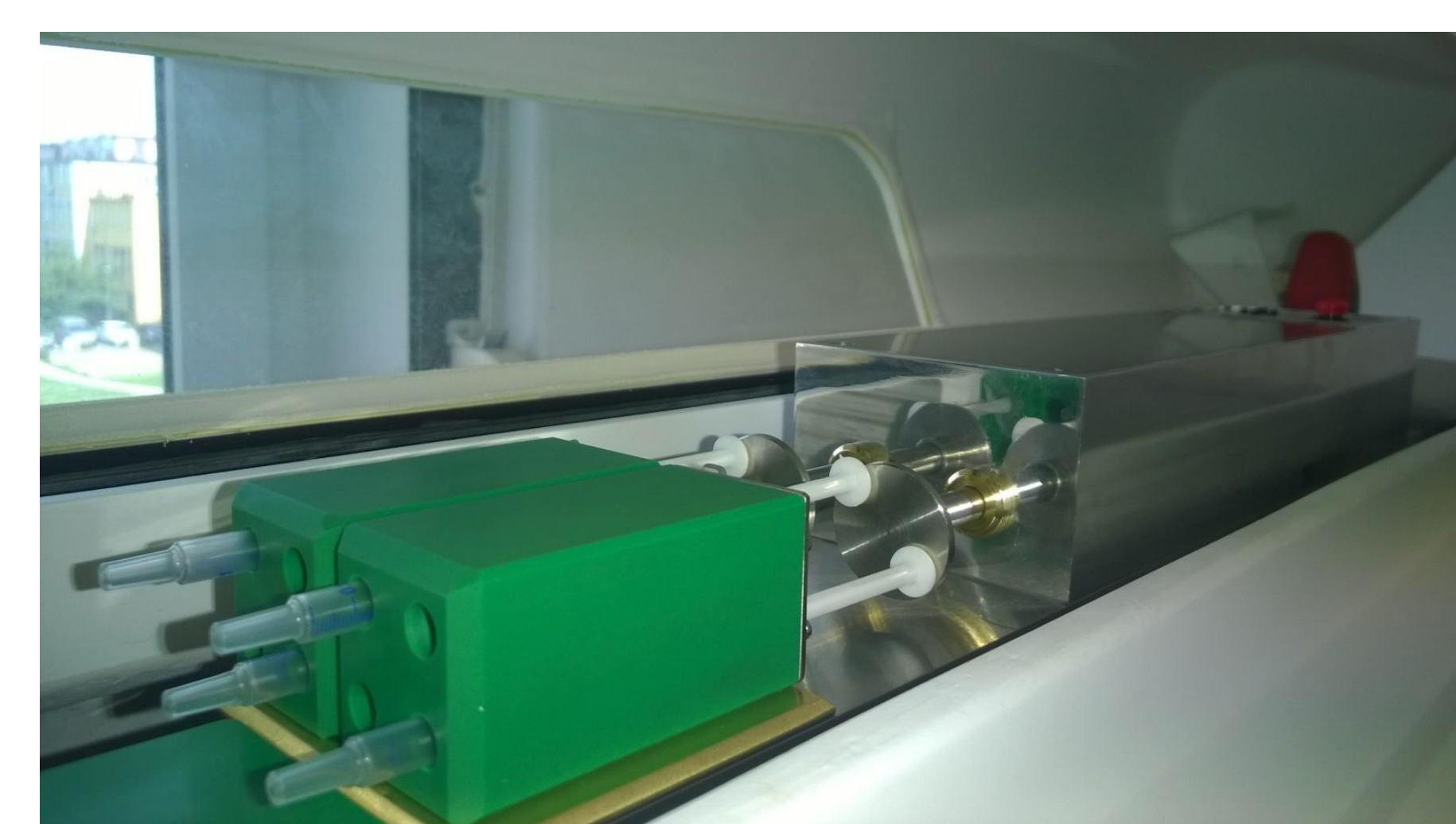
For the application of MRI contrast agents we developed metal free, hydraulic adapters which allow for positioning of the applicator unit outside the shielding of high field MRI systems. Maximum distance between the applicator unit and MRI animal bed is estimated for 15 to 20 meter. MRI adapter are made from peek plastics routinely used in HPLC systems. Our initial tests of the system showed much higher correlations between multiple applications (TACs) and in case of radiopharmaceuticals application drastically reduced dose exposure for the operator. When utilizing radiotracer containing radionuclides with very short half-life (e.g. ¹¹C, ¹³N, ¹⁵O) the use of the applicator in combination with a multiple animal bed (e.g. 4 mice) enables the simultaneous application of up to 4 animals in a single scan and therefore drastically improves financial efficiency.



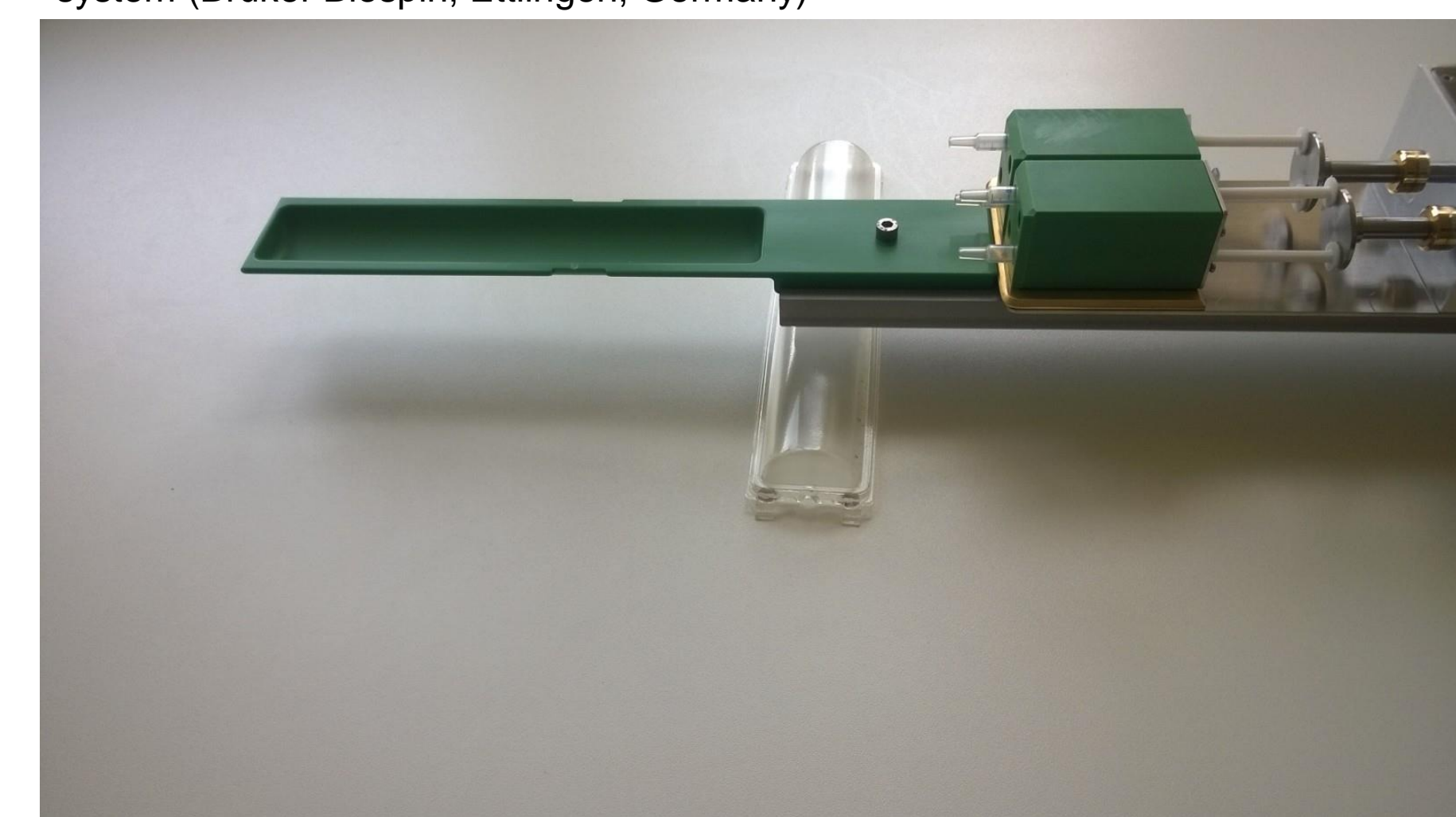
Applicator mounted on mouse bed in an fully shielded Albira PET/SPECT/CT system (Bruker Biospin, Ettlingen, Germany)



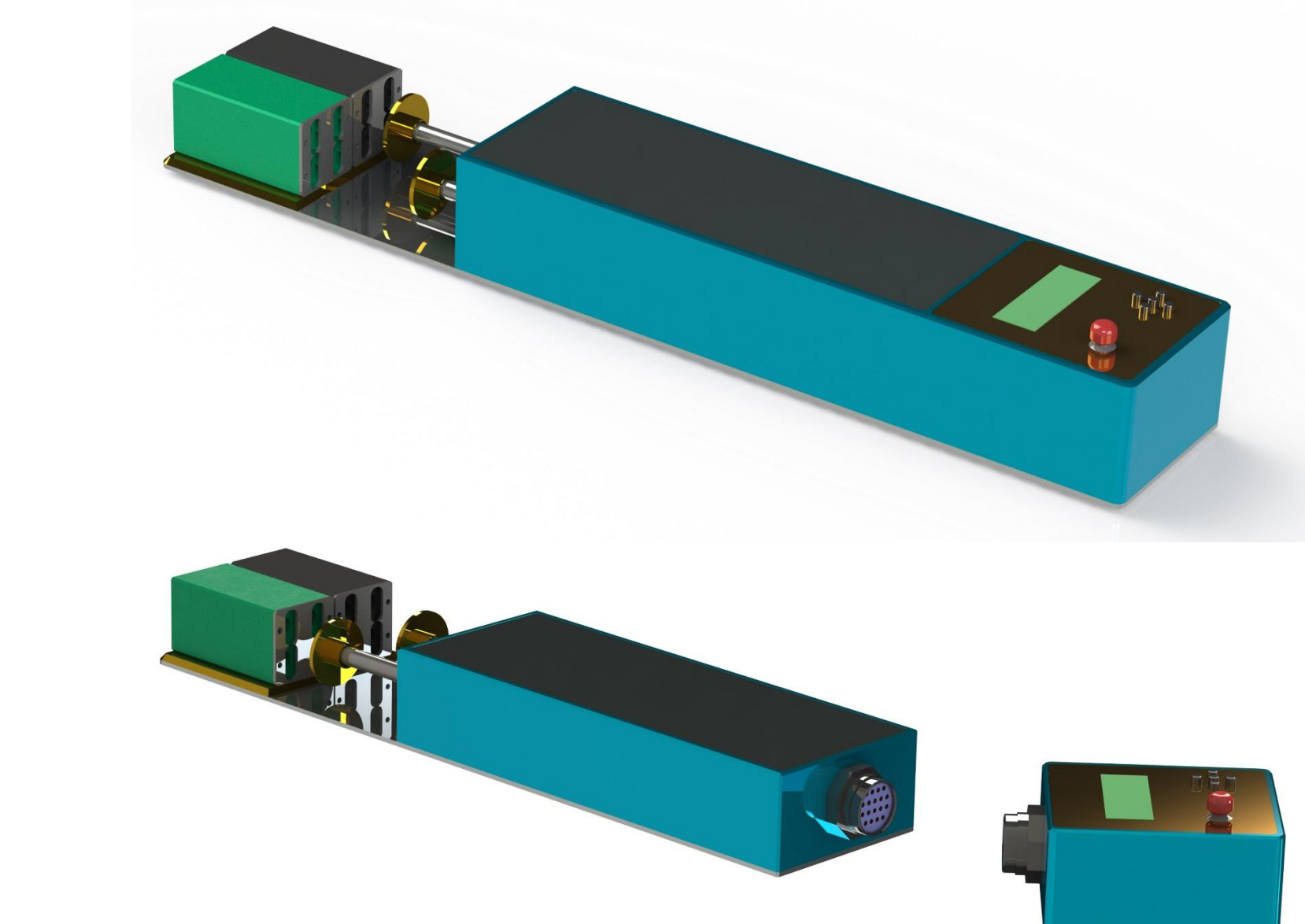
Mechanical drive shafts in the mechanical section of the applicator)



Applicator mounted on mouse bed in an fully shielded Albira PET/SPECT/CT system (Bruker Biospin, Ettlingen, Germany)



Applicator mounted on modified mouse bed for an Albira PET/SPECT/CT system (Bruker Biospin, Ettlingen, Germany)



Available applicator systems:

Top row – single chassis with two 4-syringe-holders (green = not shielded, grey = patented Tungsten-polymer)
Bottom row – micro version with separated electronics and mechanics – smaller, lighter, more flexible

Conclusions:

In conclusion, the presented applicator allows for fully automated, standardized injection of tracer/contrast agent in up to 4 animals per scan for multiple imaging modalities including PET, SPECT, CT, MRI and optics.