The recent availability of a cryostream cooler at beamline L has allowed synchrotron radiation based micro-XRF analysis of frozen biological samples close to their native state. In a previous contribution, we compared the elemental distributions within a hydrated (frozen) and a fixed (dehydrated) *Daphnia magna*, which is a freshwater crustacean used in toxicological research as a model organism for evaluating effects of metals on the ecosystem. Although hydrated samples show less dislocation of elements and/or sample contamination as compared to fixed samples, they are mainly composed of a water matrix, which is more susceptible to absorption effects of low energy X-rays. Therefore, we investigate the degree of absorption in 2D/CT micro-XRF elemental maps of *Daphnia magna* using a dual silicon drift detector (SDD) setup.

Fig. 1 shows a photograph of the experimental setup used for performing 2D/CT micro-XRF on *Daphnia magna* under cryogenic conditions. The SR-XRF spectra were measured under 90° detection angle relative to the incident beam using 2 Vortex-EX SDD detectors, coupled with a XIA digital signal processor. Silver detector collimators of sufficient solid angle were used in order to detect the fluorescent radiation emerging from the full beam path within the sample. Both detectors were gain optimized and their sample distance was adjusted providing an identical XRF spectrum for NIST SRM1577B (Bovine liver). Since icing can occur on objects outside the path of the laminar flow, a single bounce capillary with a large working distance was used providing a 15 μm FWHM pencil beam.
Fig. 2 (left part) shows the results when performing 2D micro-XRF on *Daphnia magna* under cryogenic conditions using a dual detector configuration. The left column shows the elemental maps built from the spectra collected by the SDD located on the left with respect to the incident beam (looking at the front part of the sample), while the middle column shows the elemental maps built from the spectra collected from the SDD on the right (looking at the back part of the sample). The elemental maps are composed of 158 x 130 pixels corresponding to a step size of 20 µm and a real measuring time of 0.6 seconds. A clear advantage of the dual detector setup is that the partial self-absorption influencing the lower Z elemental maps (e.g. P, S, Ca) can be investigated. For example, Ca-Kα fluorescent photons originating from the edge of the sample are unable to travel through the entire organism towards the detector on the far side; however they do escape from the sample towards the other detector. Surprisingly, also Fe- Kα is partially absorbed, e.g. in the region of the eggs for the left detector and in the region of the gut for the right detector. For elements such as Cu, Zn, Rb and Sr no obvious self-absorption could be observed. However, also these elements benefit from a dual detector setup since the collected fluorescent signal is effectively doubled, which in turn allows the reduction of scanning time by a factor of two per sample. The elemental distributions originating from the left and right SDD detectors can be summed to provide elemental maps for metals with low fluorescent energies, which are to a large extent corrected from self-absorption effects occurring in the sample.

Fig. 2 (right part) shows a single virtual cross-section of *Daphnia magna* reconstructed from the elemental sinograms. Using a symmetric dual-detector arrangement, a rotation angle of 0-180° is sufficient, decreasing either the measuring time, improving the reconstructed resolution due to the finer angular step-size that can be chosen for a given total analysis time. When the sinograms originating from the individual detectors are reconstructed, approximately only half of the Ca containing exoskeleton can be reconstructed. However, the summed sinograms provide a full reconstruction for the Ca distribution within the sample. Also here, some absorption effects can be observed for the virtual cross section of Cu and Zn which are largely corrected when using the data originating from both detectors.

![Figure 2: separate and summed elemental distributions from a cryogenically frozen *Daphnia magna* as collected by both silicon drift detectors (left). Reconstructed cross section of the separate and summed elemental sinograms collected from both detectors (right). RGB image shows the presence of Cu, Zn and Rb.](image)

**References**