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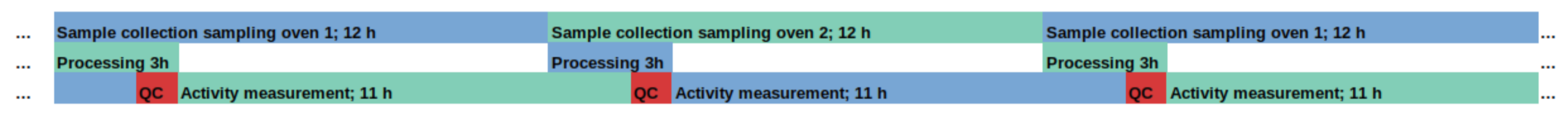
SAUNA Cube is a new concept in radioxenon detection, based on the deployment an *array* of smaller and less complex systems compared to the ones presently used in the IMS. The goal is to develop an array consisting of 4-5 Cube units. The total cost of the array should be comparable to the total cost of a single SAUNA II-system. The concept has been developed in the laboratory (see poster ) , and a first industrial prototype manufactured and tested. The results show that one Cube-unit will have almost the same detection sensitivity as a SAUNA-II system, to a fraction of the cost. A proof-of-concept array will be installed and tested in Sweden during 2019-2021.


## Main features

The Cube works according to the same main collection and processing principles as the newly developed SAUNA III – system ( see poster ) , however all hard- and software has been completely re-designed in order to meet the new requirements.

The Cube is designed to be robust, simple to transport, operate and maintain. It can be transported in one piece. The total weight is 350 kg. The installation is very simple: connect power (a 10 A fuse is sufficient); connect a bottle of nitrogen; press the power button. After an initial self-check and 6 h-regeneration cycle the system starts routine operation.

## Measurement cycle



Continuous sampling is performed in 12 h-cycles, followed by a 3h processing stage. See poster  for details. The activity concentrations are available live, once the activity measurement is started. Gas background is not measured in standard operation.

## Detector

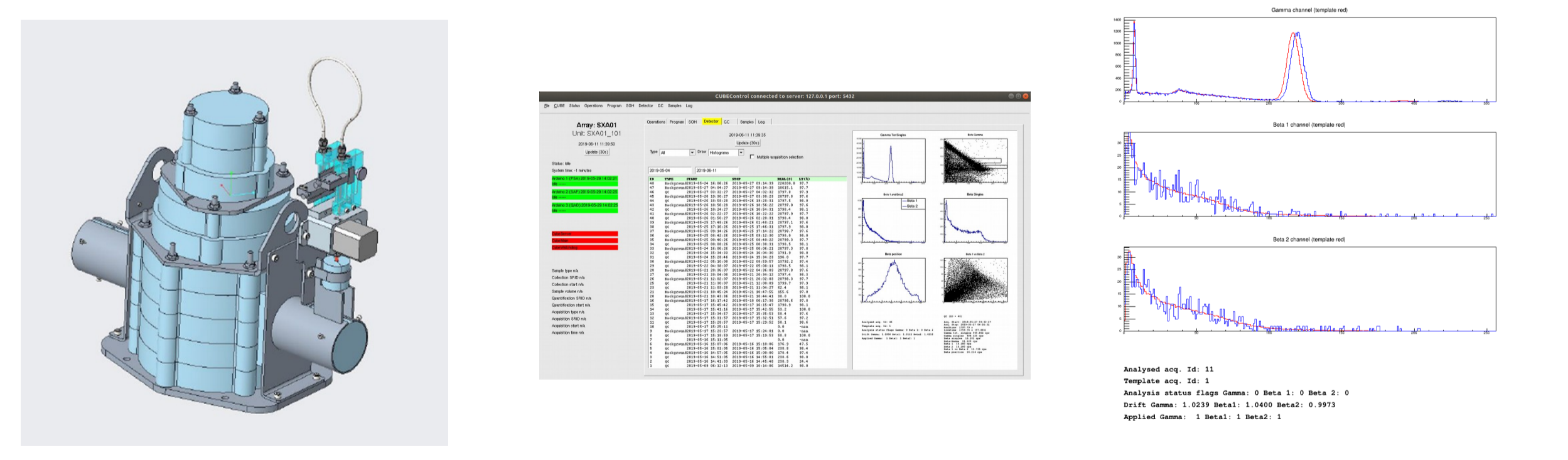


Fig. 1: Left: A CAD drawing of the detector lead-shield and QC-mechanism. Center: A screen-shot of the GUI showing the detector tab. Right: An example of drift-correction spectra (from top to bottom: NaI, beta-1, beta-2). Red lines are template, and blue lines the 30-minute QC spectrum.

The CUBE uses a single beta-gamma detector of the same type as used in the SAUNA III and Field-systems, a 18 ml plastic scintillator cylinder inside a 4" NaI crystal. The 4-cm thick lead-shield is equipped with a <sup>137</sup>Cs check source used for QC and drift control.

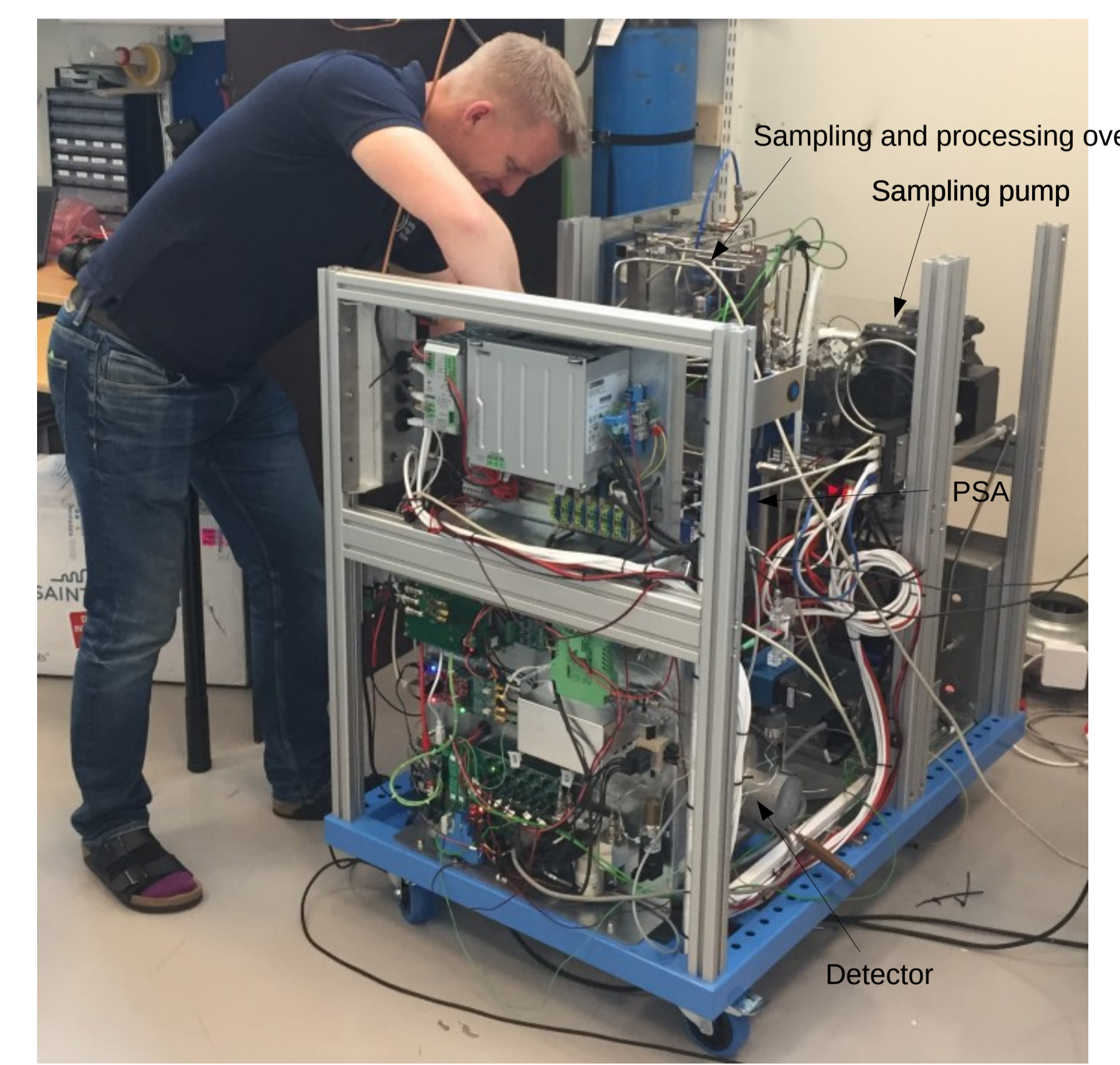


Fig. 2: The first industrial version of the SAUNA CUBE, without cover.

## Test results

Isotope	MDC (mBq/m <sup>3</sup> )
<sup>133</sup> Xe	0.3
<sup>131m</sup> Xe	0.1
<sup>133m</sup> Xe	0.1
<sup>135</sup> Xe	1.0

Table 1: Estimated minimum detectable concentrations using the achieved stable Xenon volume of 1.3 ml and measured detector background.

The industrial prototype has collected and quantified its first samples, and the results are similar to the capability of the laboratory prototype, i.e., ~ 1.3 ml of stable xenon/12h. Estimated MDC:s are shown in table 1.

## Control and data acquisition

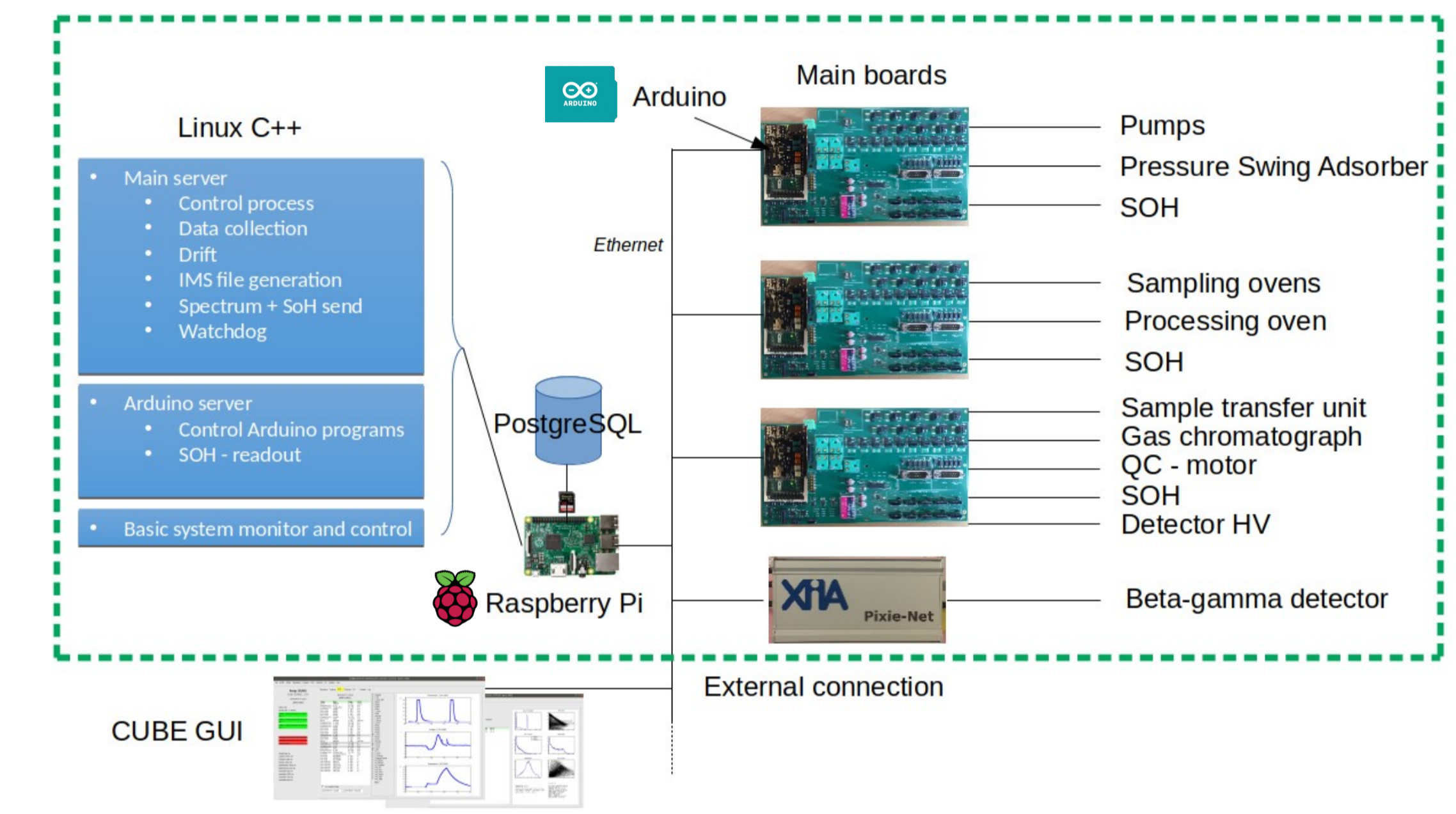


Fig. 3: The CUBE control and data acquisition system. All data is collected in a postgresQL database which can be accessed through an external Ethernet connection.

Except for the detector data acquisition, the system control and data acquisition are in-house developed using a Raspberry Pi as the main computer, and three Arduino cards in combination with IO-cards, also in-house developed. All software is written in C++.

## Future plans

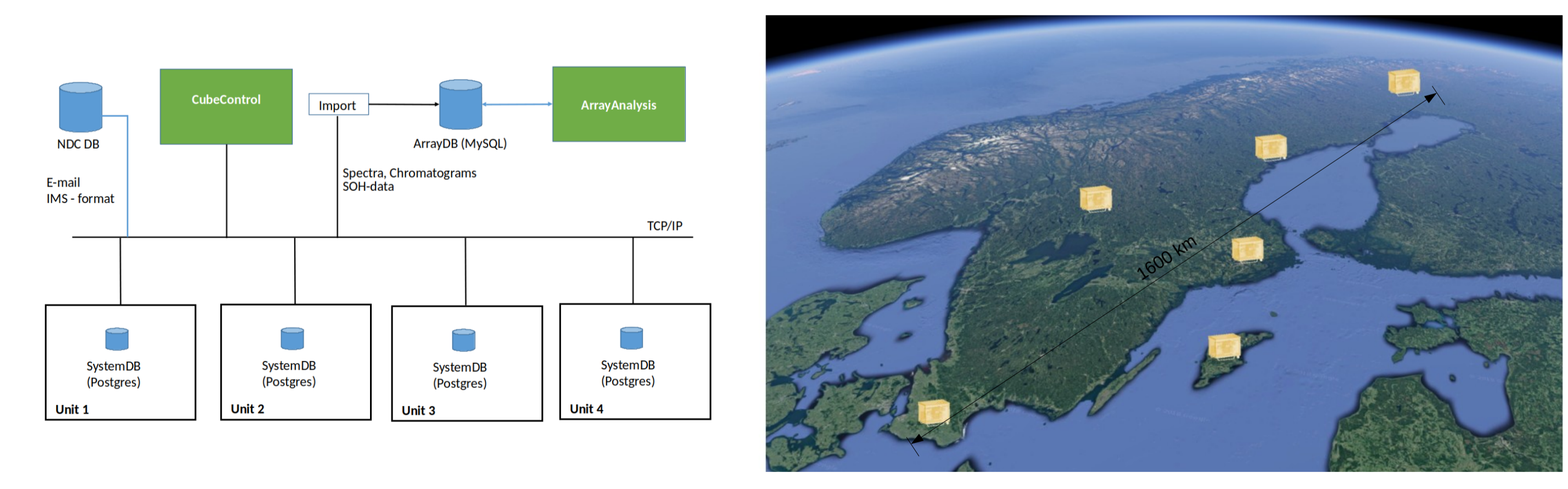


Fig. 3: Left: The planned array data acquisition and analysis system. Right: The CUBE array to be installed in Sweden during 2019-2020.

During 2019-2021, the worlds first radioxenon array will be installed and tested in Sweden. A hardware and software structure for data analysis will also be developed. The array will be evaluated with respect to verification performance.