CAMEA

Technical Solutions

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1 Introduction

CAMEA is a new instrument concept so it is possible that the construction could or maintenance of the instrument would be hampered by technical details. In order to prevent this a technical predesign have been performed. This is not a final technical solution with bolts and nuts but a 3d drawing where the important elements were put into place to confirm that it could be constructed in reality and that it would be possible to get access to the key areas for maintenance. Further the design has been used as a basis for the cost estimate. Since the primary instrument will not be unique the design has concentrated on the secondary instrument.

2 Sample area

The sample will be placed on a commercial sample table, compatible with the extreme sample environments planned for CAMEA. It is hoped that certain sample environments can be bought especially for CAMEA and can contain a radial collimator plus shielding hiding everything above and below the scattering plane from the analysers. There will further be space for an external radial collimator and filter outside the sample environments. These can be rotated away when not needed.

2.1 Sample Changing

With the unprecedented high flux on the sample of CAMEA certain samples will become too active for human handling after the experiment. Waiting for them to cool down will delay experiments considerably so a solution where samples can get changed without close human contact will be needed. The best solution will be a robotic sample changer but as a fall back we will here describe a simple

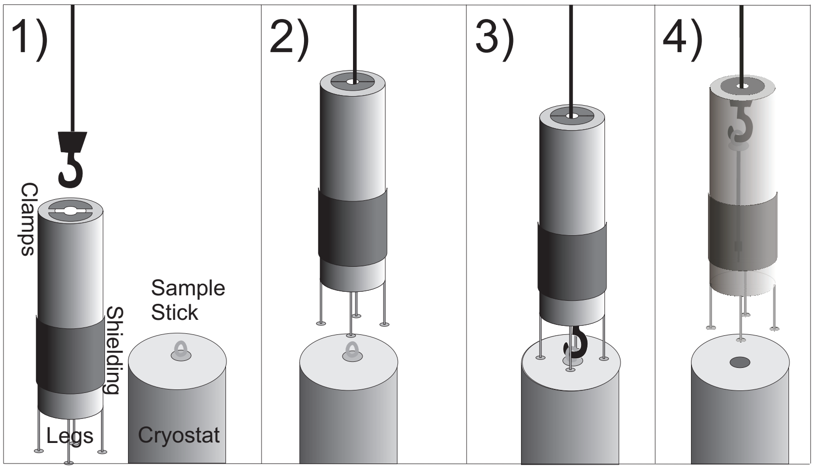

Figure 1: Illustration of simple sample changer. 1) The crane is lowered down through the sample changer tube and the clamps are closed. 2) The crane lifts the tube on top of the cryostat. 3) The crane is connected to the sample stick and it is disconnected from the cryostat. 4) The crane lifts samplestick with active sample and the tube with shielding away from the cryostat to a storage area.

mechanical solution that will work with any cryostat.

The fall back solution is a tube that is lifted onto the cryostat with a crane, then the sample stick is raised into it and lifted away with the sample on it to a safe storage facility where it can cool down. (See figure 1)

3 The Analyser-detector tank

The entire analyser-detector module will be encapsuled in an Al vacuum tank (se figure 2). To sustain the outside pressure 5 cm Al is generally needed giving a tank mass of 6 tons in total. Since the tank will remain stationary once installed the weight will not be problematic. A thin window for the incoming beam will be incorporated and will not compromise the structure. It will be possible to remove the lid of the tank to allow access to the analysers and hatches in the side will allow access below the detectors. The tank will be covered on the outside in a thick layer of plastic and Boron plastic and on the inside with a thin layer of Cd.

Inside the tank the analyser-detector module will be standing on the floor in a way designed to make it independent of any pressure deformations of the tank. This module will have a rail allowing the entire module to shift up to 9 degrees in order to cover dark angles.

The module itself consists of 15 segments each covering 9 degrees and with a 6 degrees active area covered by 10 analyser-detector setups behind each other.

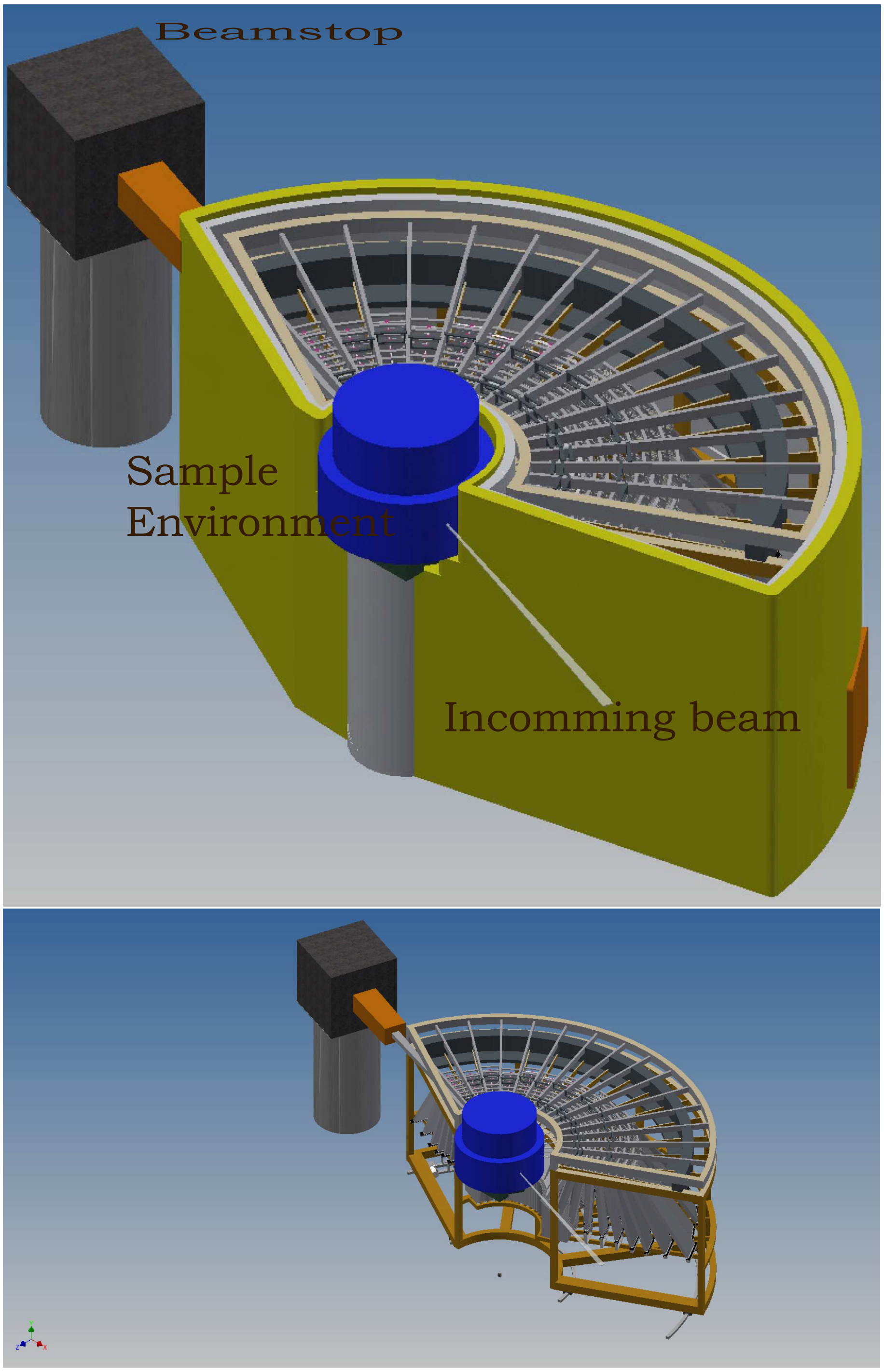

Figure 2: The detector tank with without its lid (top) and the analyser-detector modules inside it (bottom).

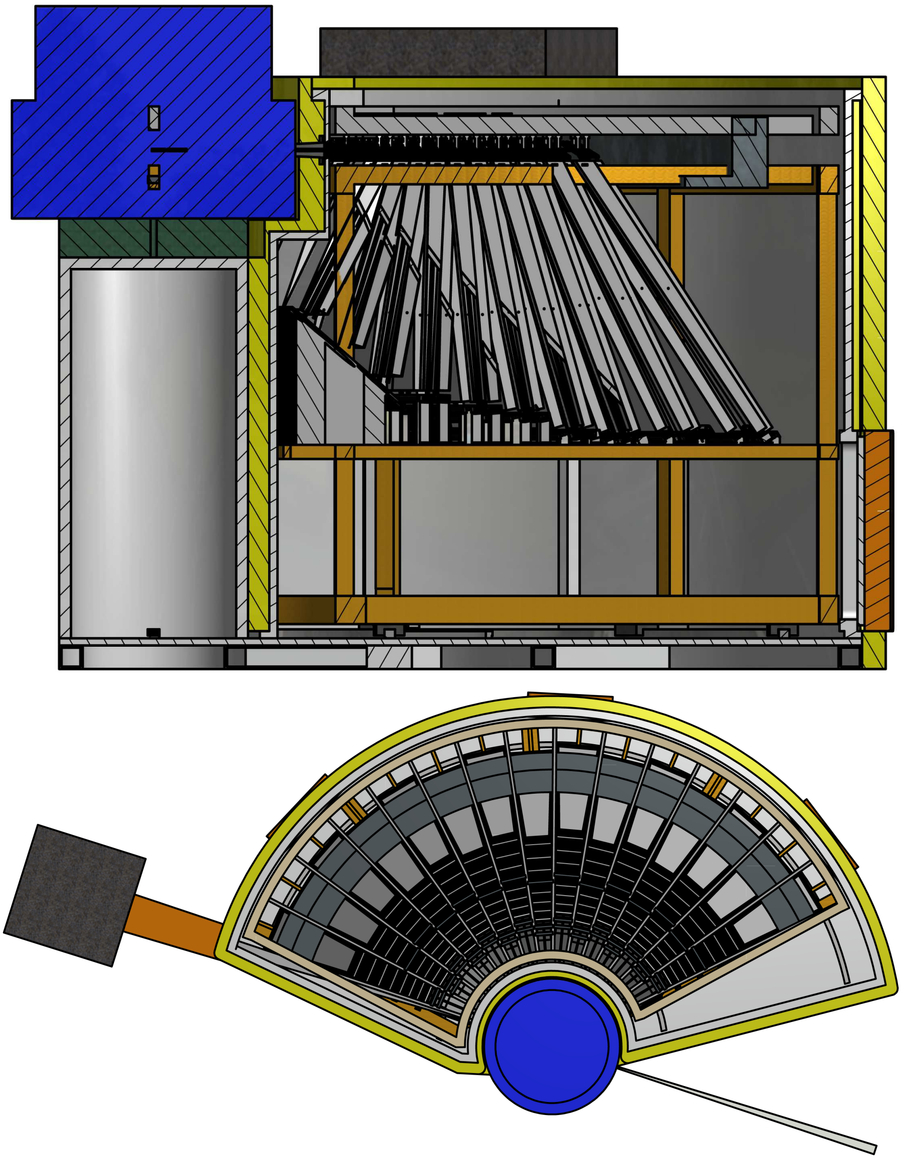

Figure 3: The tank seen from the side (top), and from the top (bottom panel).

4 Analysers

The analysers will be lowered down from above into predefined slots and locked into position. They will consist of an Al frame holding Silicon wafers with the PG crystals screwed in place. The design is such that the Al parts do no not block line of sight from sample to analysers further back and all non-active elements can thus be hidden behind Cadmium sheets. It will be possible to remove or replace each analyser individually when the lid of the analyser tank is removed. Every second segment will have all analysers (and detectors) placed 4 cm further back than the standard segment. This zigzag pattern will be key in reducing the dark angles to at most 3 degrees per segment. The first segment will be constructed slightly differently with shorter analysers that is only mounted from one side in order to get as close to the direct beam as possible. In this way it is possible to get down to 3 degrees scattering angle which allows inelastic SANS measurements.

4.1 Aligning

The Al mounting will be machined to hold the Si wafers and thereby the analyser crystals in precalculated fixed angles so aligning is unnecessary. To tjeck the alignment and as a backup if something is not aligned well enough the prototype testing showed that optical alignment and small all spacers will be a fast and permanent fix. Since the energy resolution comes from distance collimation (i.e. that the small sample height and analyser and detector width combined with the long distances limits the possible scattering angles) and not the mosaicity of the graphite the instrument is very robust to small analyser misalignments.

5 Beam vanes

Just below the analysers Al vanes with an inside Cd lining will lead down to the detectors and make sure that each detector group can only "see" one analyser. It will be possible to install radial collimators in these guides to decrease the solid angle seen by the detectors further.

6 Detectors

As the reflected signal from the analysers will become wider than the 9 degrees of each segment the detectors will overlap with the neighbour segment but thanks to the zigzag pattern and beam vanes no interference will be possible. The last 7 detector groups will each consist of 3 parallel detector tubes placed in a Al housing with Cd cladding. For the first 3 detectors the signals are so close that this will not leave space for the inactive ends of the detectors so instead the analysers will reflect down towards one big detector area. This are constructed from radially aligned detector tubes covering the entire cone. Figure 4 shows how the reflected signal will look on this detector setup. Below the detectors there will be an empty space so that it is possible to lower the 7 backmost detectors

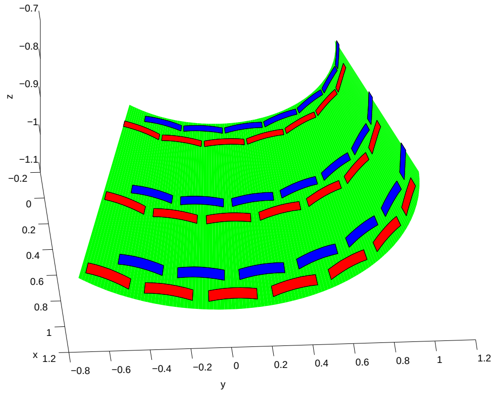

Figure 4: The first detectors. The green area is the total area covered by detectors while the red are is the region illuminated by the 3 first analysers of the even analyser segments while the blue is illuminated by the odd analyser segments. It is possible to fill the unused parts of the detector tubes with a non-conducting ceramic material to reduce He_3 consumption.

from one segment down on a wagon and move it out of the tank through one of the hatches for maintenance.
It will be possible to remove the front most detectors individually from the space below the detectors if maintenance is needed.

7 Magnetic materials

The tank and holders can be produced in nonmagnetic materials. Only the rails moving the analyser detector module needs some amount of steel. However this is more than two meters from the sample position and should cause no problems.