Starting to design the TRIUMF UCN

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To obtain a viable design of the TRIUMF UCN for the purpose of a full blown proposal some engineering effort from the TRIUMF side is necessary. Such effort should clarify the subsequent issues so that informed decisions may be taken and eventually a full, credible proposal be written.

The issues to be resolved include:

- Source design (optimizing neutron fluxes).
- Space needs of the source including an experimental area.
- Absolute position of the source and coupling to beamlines.
- Costing under different scenarios.

It is expected that the same working group stays in place should the construction of the UCN be approved.

1 Source design

The present discussion about a possible UCN source at TRIUMF is based on the Masuda design employing liquid HeII. The latter will be starting point of any design and is not to be changed. However, neutron moderation and optimizing fluxes starting from the spallation target need to be investigated and eventually been optimized. In addition, heat loads induced by γ-ray fluxes need to be taken into account so that a realistic cryogenic system can be devised. There is some expertise world wide in this area and Bob Golup from the North Carolina State University has declared interest. A working group should soon be set up.

However, such work will take its necessary time (greater than 6 months?). In the meantime there is a need to come to some sort of a viable proposal, e.g. for the TRIUMF five year plan, that determines localities and costs. The engineering there has to start from the present Masuda design.

2 Space needs

Source design and space needs are pretty much coupled. However, from the Masuda design, the space needs may be reasonably estimated. One major question to be answered by us is:

Shall we plan to have the space for a 100 μA proton beam source without any later digging necessary?

This is important, as, I presume, the outside dimensions of the source will strongly depend on the shielding that is typically placed outside. Also remote handling might occupy more space for a higher current source.

One of the design goals should be to come up with a source that can be reasonably assembled and disassembled so that repairs and changes can be made. Shielding blocks and other parts need to be stored, when the source is opened. Probably some storage area for cryogenic and vacuum parts should be also included.

The source is a major cryogenic apparatus. This means the refrigeration units and tanks for gases have to be placed. Also connections to the TRIUMF helium system need to be established. Some space for control racks needs to be provided. Areas where the refrigerator and control equipment is in should be accessible when beam on, or maybe a beam on/off lock out is tolerable. There also needs to be some space to bring electric and other services in. (Don't mess with Franco!)

Finally the UCN and possible experiments need a control room.

To accomplish all that we need engineering help from TRIUMF on the following scale:

1. Project engineer: Oversees the design and pulls in resources as required. Participates in meeting, oversees cost analysis.

2. Cryogenic engineer/technician: Should work with the project engineer and participate in most meetings.

3. Shielding and remote handling specialist: works under the guidance of the project engineer. Participates in meetings, when specific questions are up.

4. Design office involvement as needed: At the end, we want to have some nice drawings. We likely need also conceptual design close to machining for some critical components.

5. The TRIUMF safety group should be consulted as major design revisions come along. At the end the UCN needs CNSC approval. Safety features likely required should be part of the design.

The design exercise also needs the costing analysis done as any serious proposal will require these numbers. In my experience, services are a major part of these costs [hint for CFI: a nice TRIUMF contribution]. For CFI and TRIUMF purposes we may also wish for a manpower/hour cost analysis.

The experimental space should be evaluated as well. If one ever wants to put a storage ring and a neutron target in, it should be done in a way that no dismantling of the electron linac or the UCN is necessary. So the area should be expandable in principle (meaning possible digging) and reasonably accessible. It should (up for discussion) provide full space for experiments for the first 10 years (after that, I would expect one can do some clear cutting). Some services should be included in the cost estimates as well a layout and costing of neutron guides done.

When there is a final agreement on the source design depending on the outcome of the design group, likely another design go around for the full source may be necessary. Because of the preliminary work, hopefully done before, that should not be too strenuous.

3 Location

The project engineer assigned together with operations and beamtransport specialist shall also specify and cost the design of the several locations for the UCN that have been discussed:

(i) End of beamline 4A.

(ii) A branch line of beamline 4N close to the ISAC building.

(iii) Beamline 5.

(i) and (ii) would require some fast beam kicker scheme, (iii) beamline 5 a new cyclotron port. All solutions require an additional kicker and beamdump to allow to operate the UCN in macrocycles (e.g. 1 minute on, 3 minutes off). This beamdump should be very well shielded from the experimental area for background reasons.

The choice of location has to be coordinated with the ISAC+ expansion and a likely positioning of the 1 MW electron linac in the present proton hall.