Beam Strategy Meeting

Tuesday, December 16, 2014, 14:00-15:30

Attending:
F. Ames, J. Behr, B. Davids, A. Garnsworthy, D. Jackson, R. Kruecken (chair), P. Kunz, J. Lassen, L. Merminga, A. Mjos, C. Morton, Ch. Ruiz

Excused:
J. Dilling, B. Laxdal, M. Marchetto,

Minutes:

1. **Beam Development Plan**
   The current status of the Beam Development plan was discussed. There is general agreement that the current online form of the plan is not ideally suited to provide all relevant information, e.g. level of difficulty of the required development or progress on recent developments.
   There are in general four types of RIB developments needed:
   - **Production:** Development and test of a production scheme for a new element
   - **Yield:** Measurement of the extracted yield for a certain RIB species
   - **Intensity:** Development of techniques to substantially increase the yield of a certain species
   - **Purity:** Developments to improve the purity of a certain species

   These developments have different levels of difficulty associated with them as well as time-scales.
   The recent successful development of the Ion-Guide Laser Ion Source (IG-LIS) has triggered a number of requests for yield and purity measurements with the IG-LIS on UC, Ta, and SiC targets.
   Other developments are awaiting the availability of TM2, which will reestablish the FEBIAD capability.

   The current demand for high-priority beam developments is summarized in the table below, following the ordering scheme above:

Category	Tgt	Ion Source	RIB Species	Comment
Production				
Yields				
	Nb	FEBIAD	^{70}Br, ^{70}Se	CSB, TM2
	Nb	SIS/RILIS	^{78}Y	
	Nb	SIS/RILIS	^{83}Rb	CSB
	TaC	SIS/RILIS	$^{98\text{-}103}$In	
	U/Th	SIS/RILIS	$^{50\text{-}56}$Ca	Metallic target and/or beam rastering
	ThO	FEBIAD	^{53}Sc, ^{19,20,22}C	TM2
	UC	FEBIAD	^{20,22}O, $^{46\text{-}48}$Ar, $^{23\text{-}29}$F, $^{26\text{-}32}$Ne, $^{96\text{-}99}$Kr	TM2
	UC	SIS/RILIS	$^{30\text{-}33}$Na, $^{49\text{-}54}$K, $^{70\text{-}78}$Ni, $^{78\text{-}80}$Zn, ^{131,132}Cd, $^{130\text{-}137}$Sn, ^{211}Fr	
	ZrC	FEBIAD	^{62,66}Ga, ^{76}Kr	
Intensity				
	SiC	FEBIAD	^{17,18}F, ^{14,15}O	TM2, Challenging
	SiC	FEBIAD/CTL	^{18}Ne	TM2, Challenging
Purity	SiC	IG-LIS	$^{22\text{-}25}$Al	
	Ta	IG-LIS	^{110}Ag, $^{98\text{-}104}$Sn, ^{140,141}Pr, $^{163\text{-}174}$Ho, ^{163}Dy, $^{158\text{-}166}$Tm	
	UC	IG-LIS	$^{126\text{-}130}$Ag, $^{130\text{-}135}$In, $^{211\text{-}213}$Tl, $^{208\text{-}210}$Hg, $^{198\text{-}224}$At, $^{217\text{-}232}$Ac	At 212 established Other Ac, At yields low

ACTION: R.K. will convene a small subgroup of the panel to develop an improved Beam Development Plan and online presentation.

2. **Preliminary results from ThO target test**

Peter Kunz reported on preliminary results from the ThO test run. The target was run with SIS/RILIS.

Overall the observed yields were not much different from those with a UC target. This may in part be due to the fact that the target temperature on the outside was not sufficiently hot.

While no Actinium was observed, large yields for ^{224}Ra were observed. Using TRILIS, the isotope shifts and hyperfine structure off several At isotopes were measured. Substantial yield of BaF were measured.

Further measurements of long-lived species such as ^{224}Ra are being continued into the new year.

3. Update on Beam Raster Magnet

The raster magnet has been installed in the proton beamline leading to ITE. It has already been tested locally. A new beam profile monitor has been installed and initial tests with beam have been carried out. Controls for the magnet will be installed in the upcoming shutdown.

The first online test of the magnet is planned with a low power Ta target with surface source using the standard D- (or egg-) shaped target foils. This target can therefore also be used for non-rotating beam and thus the tests can be scheduled on a production target.
The following tests are planned

- Development of operational parameters for beam rotation
- Tests of the diagnostics
- Implementation and test of interlocks
- Measurement of yields

In a second development step special annular Ta or SiC target foils will be used. Since these targets can only be used with rotating beam this target will have to be a pure development target. Goals for the development are

- Optimization of operating parameters
- Measurement of yields

4. Proposal for Beam Development for Nuclear Astrophysics

Chris Ruiz presented a proposal to initiate developments of non-standard target technologies for Nuclear Astrophysics beams. Based on the fact that standard ISAC targets are not able to produce the high-priority beams for Nuclear Astrophysics (e.g. ^{15}O, ^{30}P, ^{44}Ti, ^{32}Si, ^{60}Fe, …) more risky target technologies need to be developed. This includes LiF targets with 'salted' He gas transport, boiling liquid targets as well as parasitic targets for the harvesting of long-lived isotopes.

Preliminary discussion between target experts and users lead to the VAST (Versatile Alternative Spallation Target) submission to the 2012 PPAC. PPAC at the time valued the idea but due to competing resource requirements, e.g with the ARIEL targets and the ISAC target refurbishment, only medium priority was assigned. As a consequence VAST is not an integral component of resource allocation in the Five-Year Plan 2015-2020.

As a consequence internal and external researchers are planning to submit funding proposal to the UK STFC as well as NSERC to secure resources, including manpower, for such developments. This includes the idea to carry out test irradiations on one of

the other cyclotron beamlines, e.g. BL2C (PIF), BL1B or the 500 MeV irradiation facility on BL1A.

A preliminary study for a parasitic irradiation of Vanadium for the production of ^{44}Ti has been carried out by an SFU student. Based on this, a EEC submission could be put forward.

It was discussed if such discussions should become the task of a specially formed subcommittee or task force of the Beam Development Strategy Committee were experts would develop detailed plans for these development needs. Another alternative is to discuss these potential development avenues during more frequent meetings of the Beam Development Strategy Committee. Monthly scheduled meetings could be a start to identify the scope, resource needs, and priorities for these developments. Some may require a full gate review process.

ACTION: R.K. to schedule monthly meetings of the Beam Development Strategy Meeting. (It was suggested to use one of the regular ISAC beam delivery meetings)

5. Target schedule for 2015

Barry Davids presented a review of schedule 127 as well as a preliminary timeline towards beam schedule 128. It was pointed out that the schedule might need to be accelerated.

The needs for target/ion-source combinations for Schedule 128 was discussed. A number of beam requests could not be accommodated in Schedule 127 and will likely be requesting shifts in Schedule 128. Also, several experiment have to be rescheduled as a result of problems with the ZrC and UC targets in Schedule 127.

Currently TM1 and TM4 are available, while TM2 is being refurbished and will become available towards the end of June 2015. TM3 cannot be scheduled since it has a broken steerer and shows HV instability.

The backlog for high-priority RIB experiments is shown below for different target ion-source combinations. A substantial amount of the SiC/RILIS shifts for 28Mg beam require 56keV for acceleration to TIGRESS and thus requires TM2.

Based on the backlog table below there is demand for

- 3 Ta SIS/RILIS targets
- 2 UC SIS/RILIS targets
- 1 UC IGLIS target
- 1 SiC SIS/RILIS target
- 1 ZrC SIS/RILIS target.

Target	RILIS	SIS	IGLIS	FEBIAD
Nb	4	0	0	0
NiO	0	0	0	10
SiC	48	0	14	66
Ta	24	91	5	0
TiC	0	21	0	0
UC	52	50	41	10
ZrC	14	0	0	12

6. Beam Development Priorities

The following target ion source development has been proposed for 2015 in order of priority:

1. Rotating beam development 2 targets (see above)
2. Graphite target container/insert for UC targets
    a. expected to improve target durability
    b. offline tests to be done in January or February
3. Modified center block for low power target containers
    a. will improve temperature distribution
    b. can be combined with 2nd target for rotating beam
4. IGLIS Lanthanides on high-power Ta target
5. New UCx processing technique
6. High temperature W target for short lived isotopes
7. FEBIAD cold transfer line (requires TM2)
8. Neutron-converter actinide target
    a. Not ready until the fall in the earliest
    b. requires contributions from ISOLDE collaborators
    c. may require graphite container as well

Beam schedule will take beam development priorities and beam request from users into account.

December 22, 2014

Reiner Kruecken