J. Carwardine
28 July 09

TTF/FLASH 9mA weekly meeting on 27 July 09

Participants

Jacek Sekutowicz, Gustavo Cancelo, Nicoleta Baboi, Nick Walker, Shilun Pei, Shin Michizono, Ned Arnold, Toshi Masumoto, Wojciech Cichalewski, Stefan Simrock, Brian Chase, Marius Grecki, Valeri Ayvazyan, Maciej Kudla, John Carwardine, Siggi Schreiber, Marc Wenskat

Agenda

- Status report on downconverters for 9mA studies
- Beam studies outline plan - Nick
- Summary of studies proposals – John

Meeting notes

1. RF absorber (cryoload) studies

There was a brief discussion on the planned RF absorber cryoload studies planned by Jacek. These will mostly involve parasitic monitoring during the main 9mA studies. Jacek also explained that he would like to do measurements with different bunch lengths. This would require dedicated beam time and using bunch compression (currently no compression is foreseen for the 9mA studies in order to minimize the energy spread). This should be discussed off-line with the FLASH operations people. In any case, the dedicated beam time experiments would have to be late in the 2-week studies period. Jacek will submit a studies proposal write-up in the next couple of days. It was noted that evenm for the nominal uncompressed state a measurement of the bunch length is still important; this will be followed up by Siggi.

Nicoletta asked whether we wanted a written studies plan for diagnostics commissioning. The answer is Yes. Diagnostics commissioning is already implicitly part of the machine start-up and commissioning plan, it would be helpful to know what is needed in terms of beam conditions, studies plans, time, etc.

2. Downconverters

Maciej reported that cryoelectra downconverters were now available and working. These will be used for the ATCA demonstration.

Gustavo reported that Brian anticipated shipping three Fermilab downconverters to DESY in the next couple of days. These will be the boards used in ACC456 for the 9mA studies, with cryoelectra

downconverters being the primary solution for the ATCA tests and a backup solution for the 9mA tests on ACC456. The Fermilab downconverters will use an IF of 9MHz and the SimconDSPs will digitize at 81MHz.

Note that ACC23 is not being modified, so will still have the same downconverters and IF of 250KHz.

3. Beam studies outline plan

1. The machine will be run 24/7, with the two daytime shifts being used for experiments and for dedicated 9mA studies. The night shift will be used to attempt stable operation at the best parameters achieved during the daytime shifts. Only parasitic monitoring would be allowed during the night shifts.

Three general categories of activity are envisaged:

- Machine setup and commissioning
- Achieving long-pulse 9mA beam pulses with high gradient
- Dedicated experiments within the 9mA context.

The bunch charge will remain fixed at 3nC and the average current will be adjusted through the bunch repetition rate. Nick showed a table of possible bunch repetition rates using dividers from the main 3MHz trigger clock. There are two intermediate frequencies between 1MHz and 3MHz (corresponding to 3mA and 9mA respectively).

Getting finer resolution on the average current between 3mA and 9mA requires a bunch pattern generator. However, this creates complications for the MPS system. As a result, the bunch pattern generator option will not be pursued for the September studies.

There was a lot of discussion about approaches to increasing the beam power. 'Knobs' are the bunch repetition rate and the number of bunches per pulse. Together these allow adjustment of the average current and the length of the beam pulse. There are two basic approaches to ramping the power:

1. For a given average current, start with a short pulse and increase to the full 800us pulse length. Then increase the current by increasing the rep rate and drop down to a short pulse (30 bunches) before increasing the pulse length to 800us again. This requires incremental tuning of the LLRF beam loading compensation as the pulse length is extended.
2. Start with a low average (low rep rate) and extend to the full 800us pulse length. Gradually increase the average current by increasing the rep rate but always with a full-length pulse.

Both Valeri and Siggi recommended the first approach. This is also the method used in September 08. It was noted that this manual approach would be time-consuming when applied to all three RF stations. Valeri was asked to write a description of the steps involved in tuning the beam loading compensation by hand.

Valeri plans to make manual beam loading compensation adjustments rather than using adaptive feed-forward (as was done a year ago). The SimconDSP system is expected to be able to run at higher feedback gain compared with the old DSP system. This will also help to stabilize the RF against beam loading changes.

Nick asked whether there would be a reason to want to change beam energy before we reach the full beam loading? [Changing energy requires an optics re-scaling and retuning the machine]. In general not, except perhaps if we have reached some limit on what can be achieved with the beam loading.

What measurements do we want to take in order to effectively document the results of the 9mA studies so they can be presented/published?

What scripts and data analysis do we want to do on a regular basis, such as overnight?

For the routine data analysis, it was proposed to catalogue and present at a future meeting the existing analysis scripts, with a view to understanding both what we currently have available, and also to identify what important analysis is missing (or needs improvement).

Siggi reported that Florian Loehl will be coming to DESY for the 9mA studies and Lars Froehlich will be able to participate remotely.

4. Beam studies proposals – John

As noted by Nick, we encourage people to submit proposals for studies that can take advantage of the beam conditions the main program will provide, recognizing that the main program will have priority. Overnight, studies will be limited to taking parasitic measurements. Please submit study proposals through the TTF/FLASH beam request system by August 10th.

5. Studies proposals already 'in the system'

1. ATCA LLRF system demonstration (W. Koprek, MSK)
   - This will require ~4 shifts split between RF-only and studies with beam. It is an important demonstration for XFEL.
2. Cavity jitter studies and RF power overhead studies (S. Pei, C. Adolphsen)
   - Study the effects of cavity detuning and gradient on the field probe pulse-to-pulse jitter with and without piezo Lorentz force detuning compensation
3. RF power overhead studies with heavy beam loading and with piezos (S. Pei, C. Adolphsen)
4. ILC RTML (Ring to Main Linac) studies (N. Solyak)
   - Run ACC456 RF at the zero crossing rather than on crest.
   - Measure energy and energy-spread jitter.

5. RF absorber (cryoload) studies with high power beams (J. Sekutowicz)
    - *(This was mentioned earlier in the notes)*

It should be noted that Item 3 specifically addresses one of the secondary goals of the 9mA program, namely to understand the minimum RF power overhead needed to provide stable operation under ILC-like beam conditions.

Machine time for commissioning, setup, and the main 9mA studies program are already implicitly included in the studies planning. Nevertheless, we anticipate proposals (studies plans) being documented and entered into the beam requests page. Examples:

- Characterize new dump line diagnostics
- Optics setup and model validation in the bypass and dump line
- LLRF high beam loading studies
- LLRF gradient studies
- Energy stability studies with long bunch trains and heavy beam loading

It is anticipated that time will be specifically allocated to collect datasets for publication and presentations of 9mA studies results

6. Follow-on discussion of RTML studies proposal at ACC456

(Siggi Schreiber, Nick Walker, John Carwardine)

The proposed RTML study is targeted at measuring jitter in energy and energy spread with the cavities phased so that the beam arrives at the RF field zero crossing. FLASH is interested in doing similar studies. As envisaged, the RTML study cannot practically be achieved in September, in part because some of the needed beam diagnostics measurements are not currently available in the bypass line. There are, however, some useful setup studies that could be performed by way of preparation for possible future studies.

28 July 28, 2009
J. Carwardine