2nd RF-Gun Workshop Committee Feedback

Yosuke Honda (KEK)
Katsunobu Oide (KEK)
Matthew Poelker (JLab)
Tsumoru Shintake (Chair, OIST)

not present Sasha Gilevich (SLAC)

RF-Gun Cavity&Cathode Development

- Comittee congratulate successful operation of thermionic gun and A-1 RF gun.
- With new cathode plug design functioned well, and smooth high power conditioning was observed.

Comment on Cathode R&D

- Ir_5Ce cathode "should have" higher potential,

while obeserved QE = $4.4x10^{-5}$ was close to bare copper.

- It may help to reconsider the laser cleaning as the "cathode activation".
- Before starting R&D on Cs_2Te cathode, team shold put some effort to investigate "laser activation" on Ir_5Ce cathode.

- Congratulations on much progress since last review, only 8 months ago
  - Much improved master oscillators, commercial and in-house manufactured
  - Greatly reduced ASE using tailored preamps
  - Semiconductor optical amplifier excellent pulse-picker and preamp for 10 MHz pulse train
- Impressive level of creativity and enthusiasm for work

- Virtual photocathode is only truly useful if located near the gun
- Work toward constructing a vacuum or nitrogen-filled optical transport line and employ an imaging system that reduces sensitivity to pointing instability
- Investigate changing the size of the laser beam at photocathode serve as a useful adjustment to reduce beam loss in first accelerator section.
- Continue to install more diagnostics at each laser subsystem to isolate the origin of instabilities
- Build diagnostics that help differentiate between three instabilities: amplitude, timing and pointing, e.g., a timing instability at stage X can cause amplitude instability at stage Y

- Because the pathlength of some subsystems is so long, extra sensitive to mechanical vibrations. Correlate instabilities to mechanical vibration: install piezo geophone in laser room to identify vibration frequencies. Eliminate or isolate vibrations.
- Ask management to approve the purchase Menlo oscillator at 1064 nm. It's only money.
- Are there better ways to drive pockels cell in regenerative amplifier, with less "ringing"?
- You will learn a great deal if you are allowed to commission rf gun during Phase 1

- Laser development effort appears more focused and coordinated now, compared to last review, this is good
- You continue to reduce the number of technical challenges but some concern that the list is still too large. Can you "down select" and reduce the number of projects you are pursuing? For example, can you decide now, Nd:YAG versus Yb:YAG? With just months to go, can you work on both to prepare for Phase1 operation?

Stability of the electron beam

- The stability of the electron beam is worse than the laser power fluctuation:
  - Identify the reason by observing pointing stability, etc., and taking the correlation with the beam data.
  - If it is caused by the pointing stability, please look at the amplification effect due to the transverse impedance of the RF cavity. In that case, future upgrade of the RF gun cavity should take this into account.

Beam Transport to Linac

- Currently a beam loss by about 30% has been observed at the accelerating structure next to the RF gun.
  - Understand the reason of the beam loss:
    - It can be a simple optical mismatch: build up an optics model after the RF gun. A standard optics calculation as in the thermionic beam line will be useful at least after the gun.
    - Improve the optics matching after the gun. Choose the polarity of the quadrupole doublets properly.
    - It can be caused by the fluctuation of the beam: look at pulse-to-pulse correlation of the BPMs and laser power, timing, etc.

The further development of RF gun cavity

- The idea of CDS Rf gun cavity seems excellent.
- The size of the beam hole can be bigger. Optimize it by considering the transverse impedance and the rf focusing, etc. Even an APS-like structure with a larger hole may benefit in this sense. Note that a smaller beam size at the output is not always better, considering the matching to the next section to the linac.

Stability of the laser

- The progress after the last review on the stability of the laser is remarkable: now there is no uncontrolled drop of the laser power for days.
- However, the stability of the intensity, is not satisfactory yet as a usable beam in the linac. It is reported that the beam intensity fluctuates 0.7+/-0.3 nC. Please identify the source of the fluctuation: Looking at the time structure with higher sampling rate may reveal the source.
- The fluctuation of the piezo feedback for phase stabilization indicates some sources in 10 - 30 Hz frequency range (although an aliasing cannot be excluded).

Comment on laser

- Environment issues, such as covering and temperature stabilization, should be considered. It will be needed anyway later. No reason to wait these items after completion of all the system.
- Oscillator timing stability. Not only the feedback voltage to piezo, a direct timing stability data should be taken. A fast piezo, which means small one, may be essential to have a good stability. It is known the stability of LD driver power affects phase noise of fiber oscillator, there is a way to apply feedback control to the LD to cure phase noise. Putting an EO phase modulator in the oscillator may be a solution to have a high bandwidth feedback.

- Origin of shot by shot fluctuation should be surveyed. Measurement in each stage and correlation analysis should be done.
- Need to show experimental data of position stability, profile stability, ...
- Laser transport line will be very important for beam operation. It should not be compromised. Try to reduce number of mirrors, girder stability should be important.
- Virtual cathode should be placed at the most downstream after transport. Spatial shaping should be considered also at the place.
- Arrangement of delay line for producing 2-bunch was not shown in detail.

Thank you
for excellent tour and
presentations.