CesrTA Machine Studies Task Overview

I. Experiment Description

Experimental Topic	Intrabeam Scattering	
Classification[*]	IBS	
Coordinator/ Experimenters	Michael Ehrlichman	Dave Rubin, Jim Shanks, Walter Hartung, Suntao Wang
Primary Goals	Gather data versus current in beams dominates by IBS.	
Description[†]	Definition: "Full decay" refers to charging a single bunch to full current (~10 mA) and taking data down to 0.10 mA, scraping where necessary. Note on xBSM: We plan on taking back-to-back data using pinhole and coded aperture for Data Set 0, but for other Data Sets we prefer to simply use the optic that gives accurate results for the given set of machine conditions. Extensive back-to-back validation of the optics should be a separate machine studies dedicated to instrumentation development. Data Set 0: Validate machine conditions and instrumentation, and establish working points. Electrons and Positrons For each species run full decay in LET conditions. Pay attention to tunes. Expect that tune vs. current may be different for each species. Adjust working point so that range of tunes spanned during decay does not go near resonance lines. The decision whether to the next experiments with e+, e-, or both will depend on whether we observe species dependent effects in this dataset, and the amount of available time. 8 hours (4 hours for each species) Data Set 1: IBS vs. particle density Electrons and/or Positrons 4 Runs: LET, 50 pm, 100 pm, 150 pm Goal is to observe slope of horizontal data change with different particle densities. We have done this experiment in the past and it has been straightforward and successful. However, we have only ever gathered data at, at most, two different vertical beam sizes. This experiment has a very good chance of being successful. Whether we do both species depends on whether we are seeing speciedependent effects.	

[*] Machine Studies Classifications:
- EC – Electron Cloud
- LET – Optics Correction and Low Emittance Tuning
- IBS – Intra-beam scattering studies
- xBSM – x-ray Beam Size Monitor
- INST – Instrumentation (BPM development, RFA development, other)
- MDEV – Machine Development (includes injection configuration, injection tuning, custom orbit setup, instrumentation preparation, etc.)
- MREC – Machine Startup (recovering conditions after down period or access)

[†] Attach additional pages for experimental description if needed

	5 hours (1 hour setup + generously allowing 1 hour for each run) Data Set 2: IBS vs. energy Electrons or Positrons 3 Runs: 1.8 GeV, 2.1 GeV, 2.3 GeV Goal is to observe IBS under different beam energies. IBS is strongly dependent on beam energy. This would be the first time we try to gather data versus beam energy. It is unknown how the tune plane and current-dependent tunes will be impacted by changing energy. It is unknown how the instrumentation will work at different energies. This could very well be a successful experiment, but at the very least what we learn can be applied to the next CesrTA run. If measurements at 1.8 and 2.3 GeV look valid, then we could grow this Data Set by blowing up the vertical beam size using the closed coupling and dispersion bump. 4 hours for 1.8 GeV 4 hours for 2.3 GeV 2 hours for 2.1 GeV Data Set 3: IBS vs. bunch length Electrons or Positrons 3 data sets: Nominal RF, half RF, minimum RF Goal is to observe how IBS changes as particle density is adjusted by changing the bunch length. This experiment can only be done cleanly on a lattice were the dispersion in the RF cavities is zero. I guess it could be done on a lattice that manages V15, but the results might be more difficult to interpret. 4 hours (1 hour setup + 1 hour for each run) Data Set 4: IBS vs. Coupling Electrons or Positrons Make a round-ish beam. After applying LET corrections, generate large amounts of xy coupling to make a round-ish beam. The coupling scheme applied needs to be reproducible in simulation. Take data on beam at various currents. This is interesting for two reasons: 1) The authors of the IBS calculation method we implement claim that their method is valid for arbitrary coupling conditions. 2) Next generation light sources plan to use round beams to mitigate IBS effects, and one way they might make them round is to introduce coupling. Suntao has indicated that with the right slits, we should be able to make simultaneous horizontal and vertical measurements of a round-ish beam. He needs estimated beam sizes to determine the slit dimensions. 4 to 8 hours. Taking the data should not be difficult, but establishing machine conditions and setting up instrumentation could be time consuming.
Special Needs/Requests	1) Lattices which eliminate longitudinal coupling or manage v15 are necessary for these studies. These lattices should be explored in machine studies which precede the IBS machine studies. It should be checked that horizontal beam size does not depend on RF voltage. 2) If we use a lattice with dispersion in the RF cavities, the RF voltage needs to be balanced between the East and the West, and we also need a knob which can tweak the balance. 3) A cot to facilitate 20 to 30 minute naps.

Prerequisites[‡]	**Personnel**	**Description**
Lattice with v15 managed or eliminated	Dave Rubin, Suntao Wang	The IBS studies need to be done on a lattice that ideally has zero dispersion in the RF cavities, or at least minimizes v15 in most of the ring.
Certain IBS experiments will use vBSM, xBSM, and streak camera at 1.8 and 2.3 GeV	Nate Rider, Dan Peterson, Brian Heltsley	
Time Requested[§]	**No. Shifts**	**Principal Tasks**
32 hours at 2.1 GeV	Four 8 hour shifts	1) Validate machine & instrumentation. 2) IBS vs. particle density. 3) IBS vs. bunch length. 4) IBS vs. strong coupling
4 hours at 1.8 GeV	One 4 hour shift	IBS at 1.8 GeV
4 hours at 2.3 GeV	One 4 hour shift	IBS at 2.3 GeV

[‡] Indicate other machine work that is required in preparation for this machine studies experiment.
[§] Indicate the principal shift topics and estimated number of shifts required

II. Machine Studies Assignments

Reserved for Project Management Team Use		
Topic ID		
Priority[**]		
Shift Assignments	**Date**	**Shift**

[**] Priority Scale:

1. Critical – results are necessary for preparation for subsequent down/run periods
2. Very high – results are strongly desired for achieving program milestones or in preparation for subsequent down/run periods
3. High – results are of immediate interest but not require
4. Moderate – results should be pursued at the first convenient opportunity
5. Low – results are not presently a high priority for either project milestones or planning