Summary of WG1

K. Kubo, D. Schulte,
P. Tenenbaum

Goals at Snowmass

- Agreement on beam parameters with GG1
- Bunch compressor design
- Main linac configuration
- Agreement on model assumptions
- Agreement on necessary data standards
- Agreement on plan for coming 16 months
  - Definition of tolerances and specifications
  - Beam dynamics simulations / benchmarking

Bunch Compressor

- A few designs for bunch compressors have been developed
  - Will be collected on the web for evaluation
- Conclusion sofar
  - One stage can go from 6mm to 0.3mm
  - Two-stage compressor can go from 6/9mm to 0.15mm, has lower enery spread
  - Two-stage preferred can accept longer bunches, provide shorter bunches, has looser tolerances
  - Question to WG3b is 9mm needed?

Bunch Compressor 2

- Two-stage compressor range from 0.35 to 1.4km
  - Need to understand relative benefits
  - Tolerance studies are in different state for different designs
  - Need to bring them to the same level
  - Sofar: amplitude stability 0.1%, phase tolerance 0.03-0.1degree, cavity position tolerances seem OK, cavity tilt is tight
  - Question to WG1+all: Do we need 0.15mm?

Main Linac Lattice

- Lattice concept is very simple
- Different configurations have been simulated
  - Optimum depends on assumptions of imperfections and beam-based alignment
- But choice of design should be relatively transparent for other working groups, affects mainly length
  - Different module lengths should be OK

Tunnel Layout

- Do we need to have a straight tunnel or can we follow the curvature of the earth (or have a few kinks)?
- Closely linked to civil engineering / cryogenics, may be site dependent
- Preliminary simulations indicate that curved tunnel is acceptable for the main linac
  - Will be continued

Beam Delivery System

- Details of the lattice are more important than in main linac
- Some lattices exist (WG4)
- Wait for narrowed choice
- But already did some simulations for some lattices

Beamline from Damping Ring to Main Linac

- Could be useful to have beam extracted from damping ring in opposite direction of main linac
- Turn around would allow to use feed forward to compensate beam jitter
- The necessary beam line should be studied
- In certain cases a low energy, low emittance transport line may be necessary

Integrated Simulations

- Necessary to predict luminosity and to define system specifications and tolerances
  - Realistic bunch shapes are necessary for realistic performance prediction□□
  - Need to understand the timescales for beam-based alignment, tuning and feedback as well as their interaction
  - Need to understand the dynamic imperfections and how they impact machine performance
  - Still in an early stage

Tracking Codes

- Typical problem:
  - Tracking in bunch compressor and beam delivery system (non-linear systems)
  - Tracking in main linac (linear but wakes)
  - Beam-beam interaction
- Some code packages exist / are under development which allow fully integrated studies
  - Benchmarking essential, some potential problems already found

Models for Imperfection

- A simple scattering model exists for prealignment
- A model (LICAS) for the survey line is interfaced to one code
- Ground motion models exist
- Vibration model not satisfactory
- RF stability looks easier than for X-FEL
- A central documentation would be useful

Pre-Alignment

- Link from pre-alignment (LICAS) to beam dynamics simulation established
  - First results indicate a closer look is necessary
- Is there another system to be considered?
- A number of details needs to be established / verified
  - Alignment of elements in cryomodule
  - We are using TDR numbers but would like them to be cross checked

Other Imperfections

- RF stability seems sufficient but detailed model should be made available
- Quadrupole problem: we do not reliably know the position jitter
  - Should be determined with higher priority
- Long range wakefields need to be understood (rotating modes), since they might be harmful
  - Split tune lattice would help

Ground Motion

- A number of measurements are ongoing
- Need to agree on some set of models for different sites (as for TRC)
- Need to specify acceptable levels
  - Requires all the feedback, alignment and tuning studies

Beam-Based Alignment

- Has been discussed for main linac
- Several people are w□orking on it
- Different methods are being investigated
- Needs also to be addressed for beam delivery system, bunch compressor and some other beam lines
- Benchmarking will be essential

Status for Main Linac

- Not yet satisfactory
  - Several methods used reach performance in the right regime
  - But in some cases the target is met in some not
  - A number of details needs checking, in some cases more effects need to be added
  - Ideas for improved procedures exist
  - Cannot yet specify BPM resolution, different conclusions, but range (1-10um)
  - Study of robustness started but much more remains to be done

Tuning Studies

- Tuning of the emittance or luminosity is a valuable tool
- Studies showed very promising improvements compared to beam-based alignment alone
  - Could make the difference to meeting the target
- Need to develop coherent concept of bumps
- Need realistic modelling (started)
- Integrated simulation studies with benchmarking

Feedback Studies

- Pulse-to-pulse and intra-pulse feedback can be used
- A number of studies are being performed
- Predictions look mainly promising but a number of problems still needs to be solved
  - E.g. energy jitter in BDS feedbacks
  - Interplay of feedbacks and tuning / alignment
  - Full optimisation of the feedback layout
- Benchmarking of codes is essential

Outlook for Next Week

- Provide input for discussion on parameters
- Agree on data standards and repositories
- Agree on models or at least on how to derive them
- Make a plan to continue with beam dynamics studies to provide system specifications
- Sit together and solve some of the detailed problems in front of a computer