# *Technical and Cost Group Overview*

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# Outline

- Mission
- Iteration with parameters group
- Cost estimate
- Decisions needed soon
- Technical areas
- Scope of work
- R&D needs
- Summary

# Mission

- Iterate component designs with Parameters Group to ensure realistic specifications for all devices
- Prepare layouts and drawings, using CAD where practical (CAD cartoon $\Rightarrow$ "realism")
- Specify all required technical components in sufficient detail for a top-down cost estimate
  - talk from Kem Robinson on guidance for doing this
  - we will identify someone at LBNL to collect the information and "package" it
- Develop, with engineering help as needed, a top-down cost estimate for each area of responsibility
  - look for opportunities to adopt common designs
  - look for cost-saving approaches and designs
- Define R&D activities needed to validate concepts

# Iteration with Parameters Group

- This is most crucial task initially
  - — simulations must be based upon buildable components to demonstrate feasibility
    - o buildable means that parameters (gradients, magnetic fields, window dimensions and materials,…) are achievable
      - – and physical sizes are compatible (use Exclusion Principle as limiting case)
        - ♦ need room for assembly/disassembly
        - ♦ need room for inputs (power feeds, monitoring devices, control lines, vacuum and/or cryogenic lines)
- We must reach convergence on all simulation parameters by end of November
  - — that gives us only about two months!

# Iteration with Parameters Group

- Important to air problems/issues immediately
  - — we need to provide guidance to simulators on how to change parameters
    - not useful simply to say “that doesn’t work”
- We need to bring out possible cost saving options for exploration
  - — strive to identify parameters that drive costs to see which are “negotiable”
- Please keep Study Leaders in the loop on these discussions
  - — any requests for parameter changes should be communicated to us
- For now, I would err toward feasibility over cost (within reason)

# Cost Estimate

- First task is to know what is being costed
  - CAD drawings of components are highly desirable
    - both for credibility and cost reasons
- Use WBS structure for collecting costs
  - down to level 4
  - editors to prepare draft version for MZ/tbd approval
  - take all Lab labor costs as fully burdened
  - contingency should be called out separately (at level 3)
    - use a percentage based on how conventional component is
      - 15-20% means you already have built one; 25% means you've heard of it before; 30-50% means you're winging it
  - okay (not preferred) to put in percentage cost for items not covered but known to be needed, e.g., magnet supports, building utilities

# Decisions Needed Soon

- Based on Design A parameters there are several issues that arise
  - maximum radius for Be window cavities
  - maximum allowable cavity gradient
  - $LH_2$ absorber window material and thickness
  - pressure of $LH_2$ in absorbers
- Other issues needing resolution
  - style of target solenoid coil (Bitter or hollow conductor)
  - parameters of Hg jet target
  - need for polarization (and all that goes with it)
  - shielding requirements for near detector
- By end of meeting, we should have discussed these issues and have a plan and timeline for resolving them
  - we need to augment this list as this meeting proceeds

# Technical Areas

- We are presently covering the following areas:

  Target (incl. including solenoid, beam dump, shielding)
  Phase Rotation (incl. induction linac, solenoids, minicooling)
  Matching and Bunching (incl. solenoids, NCRF)
  Cooling (incl. absorbers, NCRF, solenoids)
  Acceleration (incl. linacs, RLAs, SCRF)
  Storage Ring (incl. magnets)

  Diagnostics (for each area)

  — and providing costs for them

- Areas not covered yet

  Initial Phase Rotation (incl. low frequency RF) [awaits simulation]
  RF Power Source (all frequencies)
  Acceleration Magnets

- Questions for this meeting

  — are there topics missing that are needed?

  — do we have adequate resources to do the job?

# Scope of Work

- **Target**
  - **define required apparatus, including**

    **Target**
    **Target and matching solenoids**
    **Beam dump**
    **Shielding and hot storage**
    **Remote handling equipment and features**

  - **specify geometry and layout of Hg target, proton beam, and beam dump [drawings]; indicate R&D needs**
  - **update target solenoid design for hollow copper conductor [drawing]**
  - **update matching channel solenoid design as needed [layout and component drawings]**
  - **define required vacuum systems [include in layout]**
  - **define required diagnostics**
  - **update target facility design from Study-I for Hg target, considering target changing and storage, ES&H aspects; indicate R&D needs**

# Scope of Work

- **Initial phase rotation and decay channel**
  - **define magnet layout [drawing] and cross section [drawing] for Drift; leave space for services and consider quench protection**
  - **define vacuum system approach [include in layout]**
  - **evaluate radiation levels from target area and pion decays; assess shielding needs**
  - **specify RF cavity design(s) [drawing], power source [footprint/layout], and R&D issues for initial phase rotation system (NOTE: not needed for Design A)**
  - **evaluate beam polarization (NOTE: not needed for Design A)**

# Scope of Work

- **Final phase rotation and minicooling**
  - **update induction linac 1 and 2 and pulsed power system designs for Study-II parameters [layout and cross section drawings; waveform calculations]**
  - **update internal superconducting (SC) solenoid design for Study-II parameters**
  - **specify solenoids for field reversal section [layout and component drawings]**
  - **define vacuum system approach [include in layout]**
  - **define mini-cooling absorber and layout [drawing]**
  - **evaluate beam polarization (NOTE: not needed for Design A)**

# Scope of Work

- **Matching and bunching**
  - **define magnets and layout for matching section [drawing(s)]; specify R&D issues**
  - **define vacuum system approach [include in layout]**
  - **specify RF cavity (201 and 402 MHz) and window designs [drawings], power source [footprint/layout], and R&D issues for buncher system**
  - **evaluate beam polarization (NOTE: not needed for Design A)**

# Scope of Work

- **Cooling**
  - **specify NCRF cavity concepts for baseline design (Be window, 4-cell and 2-cell) [drawings]; indicate R&D issues**
  - **specify RF power source for baseline design [layout, "plumbing"]; indicate R&D issues**
  - **specify designs of $LH_2$ absorbers, especially windows [drawings]; indicate R&D issues**
  - **produce layout of channel [drawing], including RF, cryogenic, and $LH_2$ feeds, vacuum system, mechanical supports, and diagnostics**
  - **evaluate beam polarization (NOTE: not needed for Design A)**

# Scope of Work

- **Acceleration**
  - **specify first pre-accelerator linac, incl. NCRF cavities and power source, solenoids, vacuum system, mechanical supports, cryogenics, and diagnostics [layout and cross section drawings]**
  - **specify second pre-accelerator linac, including SCRF cavities, quadrupoles, vacuum system, mechanical supports, cryogenics, and diagnostics [layout and cross section drawings]**
  - **define first and second RLA components, including SCRF cavities and power source, optics, magnet designs, especially splitter and recombiner magnets, mechanical supports, cryogenics and diagnostics [layout and cross section drawings]**
  - **examine cost tradeoffs *vs*. transverse acceptance and energy spread**
  - **assess radiation effects on cryogenic components**
  - **evaluate beam polarization (NOTE: not needed for Design A)**
  - **specify R&D issues for all items**

# Scope of Work

- **Storage ring**
  - **define lattice optics and layout [drawings]; include some space for utility straights**
  - **evaluate lattice design that could "stretch" from 20–50 GeV**
  - **specify required magnets (dipoles, quadrupoles, sextupoles, correctors), vacuum system, mechanical supports and diagnostics**
  - **assess radiation effects on components**
  - **evaluate beam polarization (NOTE: not needed for Design A)**
  - **specify required R&D activities**

# R&D Needs

- Need to provide list of activities and rough budget for them
  - compare with Study-I items to identify modified or additional tasks
  - indicate task duration and required starting date
- As for Study I, there will be an R&D section that summarizes the needs
  - to be written by MZ based on collected inputs
  - refer to this section in your write-up rather than duplicate the information

# Summary

- This is an important opportunity to provide guidance to the simulations group
  - — and to get guidance from the simulations group
- We need to identify technical problems, parameter uncertainties, and missing topics
  - — Study report should reflect a coherent whole (within our resources)
- Facility description and cost represented by this Study will help determine what we present at Snowmass
  - — a high-performance facility with a staged implementation approach
    - o could be sited at either FNAL or BNL (maybe even SLAC?)
    - o preliminary idea of facility cost
  - — a detailed R&D plan that will lead to a CDR for the project
    - o including budget and schedule
- Snowmass will be a key event for Neutrino Factory proponents