DRAFT 2 4/9/00

Tasks for Feasibility Study II

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1 Introduction

The following, requested by Mike Zisman, is a list of topics for a possible second feasibility study based on a PJK like, high efficiency, muon source. The draft paper on "ICOOL Simulation of PJK" reports a simulation of 0.15 muons per 24 GeV proton into 9.35 π mm transverse and 71 π mm longitudinal. That paper includes a long list of possible improvements that should be included in the following study. A goal of 0.3 muons per proton seems not unreasonable. It would be understood that such a system might be built in phases, with some more expensive components omitted in the early phases.

There needs to be emphasis on the relative costs of components and parameter choices. For this we need costs as a function of gradients, frequency, acceptance etc., or at least costs for some differing values of these parameters. We may note that such costs can usually be estimated even when it is understood that R&D is needed to establish the behaviour of such systems. This was true of elements in the first study and will inevitably be even more true here. The point is that we do not need to wait for the R&D to perform this study.

I have arranged the items by component, but color coded them for nature:

- Technical studies in black.
- Theoretical work in magenta.
- R & D in red.
- Tasks for individual labs in blue.

2 Driver

- Study AGS upgrade to 1 MW (1 10^{14} 24 GeV p's at 2.5 Hz)
- Continue study of Fermi 1 MW (2.5 10^{13} 16 GeV p's at 15 Hz)
- Study technologies (at BNL and Fermi) to obtain 1 nsec rms proton bunches on target

3 Target

- simulate large emittance p beam focused towards target end to reduce peak temperature rise
- simulate multiple parallel jets
- simulate band saw target
- calculate the perturbative deflections of a liquid jet at an angle to the magnetic fields.
- obtain or write 3D code to calculate motion of jet in fields.
- continue studies of effects of beam on Hg, C and Ni targets.
- Design liquid metal jet and beam dump system for $>$ 10 year life.
- Design Band saw target system.

4 Capture

- simulate longer taper for higher efficiency capture of the higher energy pions (up to 700 MeV)
- simulate realistic fields over target, instead of the fixed 20 T as in current PJK study
- run GEANT/MARS to determine radiation and heating in shields and coils.
- Design 20 T capture magnet using hollow copper insert coil for long life.
- Design shielding inside the copper coil to give $>$ 10 year life.

5 RF Phase Rotation

- re optimize first phase rotation without the 70 MHZ cavities 3 m from target.
- try first phase rotation with lower gradients
- simulate radiation levels at RF locations and consider their consequences.
- Simulate discontinuous focus magnets as function of their fields and spacing.
- Design and Cost low frequency (30 and 45 MHz) rf as a function of rf gradients

- Design and Cost magnet inserts into nose cones.
- Continue study of very low (< 45 MHz) frequency high power RF Sources. In particular, study a single resonator with multiple tetrodes. Continue to suport Holotron development.
- Continue R&D plan to determine working gradients and effects of radiation on these.

6 Induction Phase Rotation

- Design non-distorting Induction Phase Rotation. Such systems yield a rotated distribution with uniform energy spread as a function of time. They must employ at least two distinct wave forms - one nearer, one further, from the target.
- Study particle transmission through focus lattice of discreet coils as a function of their field and spacing
- Study benefits of choosing a field in drifts and induction units that would match the amplitude momentum correllation to the cooling system
- Design and cost induction units with required longer pulse lengths and thus close spacing between pulses. In such a case the gap voltages must be treated as a continuous wave form, rather than as a sequenceof separate pulses. Note that the average gradient must be zero, which suggests that a short high deceleration must be followed by only a moderate longer acceleration.
- Establish R&D plan to determine working gap gradients.

7 Cooling

- Define at least two alternative final acceptances. e.g. 6 and 9.35 π mm tansverse, and 70 and 140 π mm longitdinal
- Continue to study alternative lattices for cooling, including:
  - use higher, or rising, energy in a fofo cooling lattice
  - use of limited numbers of field reversals
  - Super FOFO and other lattices
  - use of shaped absorbers to obtain some emittance exchange
- Continue study of 175/200 MHz high power RF Sources and modulators, where needed (note that tetrodes do not need modulators).

- study cryo properties and availability of AlBemet for hydrogen windows, and for thin wall pipes in grids.
- Consider the practicality of large diameter (30 cm rad), but thick (e.g. 500 microns at 15 Hz) Be foils (noting that, in the BNL case, the repetition rate is 2.5 instead of 15 Hz leading to less heating).
- Continue to study grids of gas cooled tubes to substitute for Be foils.
- Continue engineering studies of lattices.

8 Acceleration

- simulate acceleration in 3D to determine dilution and losses.
- Design and cost accelerator systems for the different above defined initial acceptances.
- Consider the effects of the larger loading in the accelerators (for AGS: $1.5 - 3\ 10^{13}$ muons per pulse)
- Look hard for possible cost savings.

9 Storage Ring

- Determine required beta for straight sections for the different defined acceptances.
- Layout, design, and cost storage ring for 20 GeV aimed from BNL to Soudan, and Fermi to SLAC.
- Continue studies of radiation effects.
- Continue study of injection kicker system.
- Determine if debuncher is needed to reduce momentum spread, and, if so, design it.