Recommendations from the February 2014 XMAC

#	Committee Recommendation	Response
R1	Prepare a revised PIP-I plan in case PIP-II is approved.	Two adjustments to the PIP-I plan have been made in anticipation of PIP-II: 1)the acquisition of 201 MHz klystrons will not proceed beyond the testing and validation of the development model; 2)the development and acquisition of a complete set of new rf cavities has been delayed until PIP-II requirements are finalized. (SH)
R2	Get confirmation that the physics needs for continuous beam are essential in the long term future.	The 2014 P5 report summary of future opportunities for particle physics includes: "Upgrades to the accelerator complex at Fermilab (PIP-II and additional improvements) will offer further opportunities to detect the influence of new particles in rare processes." The leading experimental opportunity identified by P5 is an upgrade of the Mu2e experiment (see below), which requires continuous beam. Experimental backgrounds in Mu2e and other rare-process experiments scale as the inverse square of the macro duty-factor, consequently there is strong motivation for maximizing the duty factor of the continuous beam. P5 background discussion: "Looking farther into the future, progress in precision physics and rare processes will be shaped partly by what particle physicists learn in the coming decade. Upgrades to the accelerator complex at Fermilab (PIP-II and additional improvements) will offer opportunities to further this program. For example, combined with modest upgrades to Mu2e, improvements in the Fermilab accelerator complex potentially could provide increased sensitivity (by a factor of ten) to muon-to-electron conversion and allow one to search for this very rare process in different nuclei. This will provide crucial clues on the nature of the new physics revealed in the event of an

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		observation in the next-generation.” experiments.”
R3	Plan for injecting (into Booster) slightly below 800 MeV to be able to compensate for a faulty cavity.	The rf system will include two in-situ spares, thus minor variations in the injection energy do not require additional hardware or software work. However, accommodation of such variation precludes utilization of permanent magnets in the transfer line.
R4	Plans for consolidation in RR and MI should be based on an exhaustive and quantitative analysis of the risks.	We have started looking into what it would take to reliably run MI/RR the next 10+ years. We have identified the elements with the largest risk (RR Vacuum, MI quad spares, MI power supply transformers) and are developing plans to address them.
R5	Demonstrate with realistic simulations that slip stacking in RR at high intensity can be achieved with the acceptable loss budget. Identify the resulting requirements for equipment and for the beam from the Booster.	We are running simulations with Synergia including realistic apertures and transverse space charge. We will start longitudinal slip stacking simulations including beam loading and space charge. Eventually we plan to simulate the whole slip stacking process in the Recycler(0.8 sec) including both transverse and longitudinal space charge and impedances. The most important parameter governing the slip-stacking efficiency is the longitudinal emittance from the Booster, set at 0.08 eV-sec (97%)
R6	Test production and preservation of low emittance bunches in the Booster and their capture in the MI at the highest possible intensity. Proceed with extensive simulations and benchmark results with experimental observations.	The present operations have achieved the necessary emittances at the currently requested intensities. The Booster has been modeled and ample simulations done to provide guidance to operations and beam optics control. Further effort is underway to understand the PIP II intensities and beam parameters.
R7	The design of a proper 800 MeV injection layout fitting in the available space is critical for gaining confidence in achieving PIP-II goals.	We have a preliminary injection insert design which fits into the present straight section length. We are looking closely at the design of the new ORBUMP magnets and injection absorber to determine if the requirements of these devices will be consistent with the currently available beam line space. In the event that the current design is not suitable, we have an alternate design which utilizes lower current

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		ORBUMP magnets and requires two reduced length gradient magnets. The design of these magnets is being looked into. http://beamdocs.fnal.gov/AD-public/DocDB/ShowDocument?docid=4683
R8	Make sure that beam instrumentation is adequate for supporting the investigations required above.	Beam instrumentation requirements are developed through the coordinated discussions with the various machine groups (Booster, MI ,and Recycler) on the measurements required to confirm the accelerator design performance. The instrumentation requirements are then documented through the completion of FRSs. These steps are currently in process.
R9	The operational consequences of the combined use of TLM and shielding deserve in-depth analysis. The requirements for the MPS have to be refined.	A lot of work has already been completed to consider the role of TLMs in conjunction with shielding. Some of the key references are: Beams doc 4491, 4437, 4478, 4482, 4532, 4533, 4539, and 4549. Two additional references (4559 and 4575) include MARS calculations for the TLM systems. We consider these two documents preliminary, but representative of the type of future calculations to be made. The TLM systems would interrupt operations in exactly the same manner as the existing, approved ion chambers (chipmunks and scarecrows). The approved, existing ion chambers have been employed for decades in this role. **Note: Preliminary approval was granted by the ESH&Q Section in May 2014 for the use of the TLM as an accredited safety system. Accelerator Division is working for a final approval during CY15.** (TL) MPS requirements and architecture are being developed and will be initially tested at PXIE.
R10	Prepare back-up plans in case the external contributions do not reach the expected	We have a preliminary list of international in-kind deliverables and their associated values. These deliverables will be finalized in negotiation

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	level.	between the DOE and the relevant international agencies once PIP-II has been designated as a DOE project. The primary backups if these contributions do not meet expectations are 1)descope PIP-II (most likely lowering the linac energy); or 2)provide additional funding from DOE.
R11	The highest priorities in the development of Linac beam instrumentation should result from the needs of PIP-II at injection in the Booster.	We are interpreting this recommendation to mean that instrumentation development should be based on the requirements of operating an 800 MeV pulsed linac, injecting into the Booster. This is the intention; however to the extent possible instrumentation will be developed that can also operate in CW mode.
R12	If resources are short, the construction of an SSR2 prototype (cavities) could be delayed as well as the construction of the 6 cavities high beta cryomodule.	The FY15 budget has been established with the following srf priorities: 1)HWR and SSR1 procurement and assembly; 2)HB650 development; 3)SSR2 design; 4)LB650 design. Within the current budget item 1 is fully funded at the level required for cryomodule completion in FY17,
R13	If resources are short, the development of the MEBT choppers could be delayed until the start of construction of PIP-II.	The development of 50 Ω kicker is nearly complete. We will finish its construction and testing soon. Its installation in PXIE will be determined by the test results. The construction of the second kicker and purchasing the amplifiers can be postponed. We need to make an administrative decision on the 200 Ω kicker development. Its status will be presented at the next XMAC meeting.