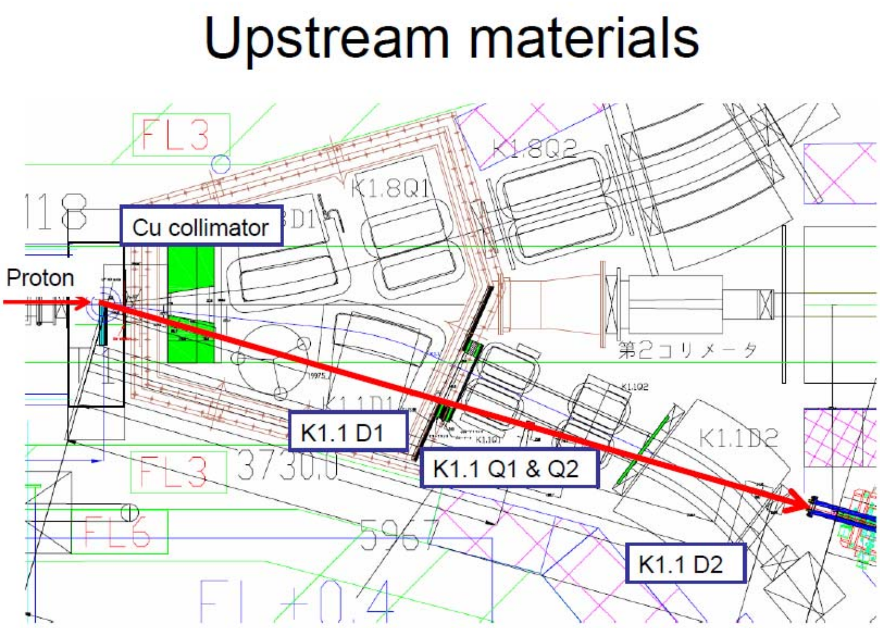
FIFC report　14-Oct-208

(Based on the FIFC meeting held on 3-Oct-08)

KL beam line simulation study

The FIFC heard the presentation from the E14 group on the beam line simulation study especially on the feasibility of the co-existence of the KL and K1.1 beam lines in view of neutron background change.　Although the previous results of beam simulation done by the E14 group reported in the former PAC meetings, showed somewhat reluctance to the co-existence with K1.1 beam line because of the increase of halo neutron background, the latest result based on an elaborate simulation reported this time showed that some components of the K1.1 beam line seems to help to reduce the halo neutron rate while K_L yield or core neutron rate stay unchanged, This implies that the KL and K1.1 beam lines can co-exist with no serious degradation in the KL line performace. The revision of the results mainly comes from the more realistic source distribution of halo neutrons implemented for a wider area downstream of the target. Then it was found that the beam hole penetrating the iron yoke of the first K1.1 magnet (K1.1-D1) can work as an effective collimator and helps to improve the beam quality at the KL line while keeping the KL intensity. FIFC agreed the E14 experiment to go with the current coexistence scheme of KL and K1.1.



The E14 group presented also the beam line construction plan. The main construction will be performed in the first half of JFY 2009. The fabrications of the beam line components which require longer production period have already been started. A beam plug and a sweep out magnet are fabricated on schedule and will be delivered in the next spring. However FIFC recognized that the fabrication of main beam-line collimators is a bit delayed. The design is being finalized; the final decision about the shape of the collimator hole (circular or rectangular) has not yet been made. Then the deadline of the fabrication is approaching. The FIFC recommend strongly that the group should fix the final design of the collimators, contact a manufacture and start the fabrication as soon as possible.

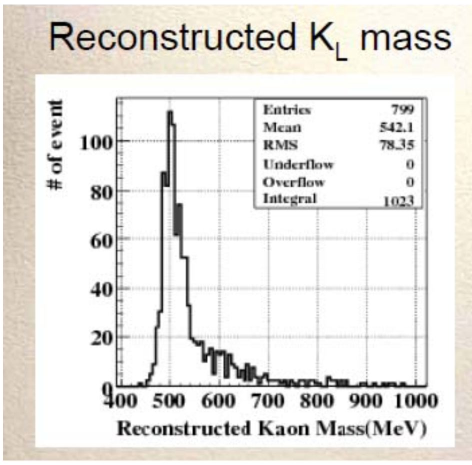
In order to complete the construction of KL beam line in the first half of JFY 2009 on time, the experimental group and facility construction team should have close contact and start preparation of beam line elements needed in the early days of the construction. For this purpose, FIFC recommends the experimental team to ask for some support by the mechanical engineering group to the Institute of Particle and Nuclear Studies, if necessary.

E14 beam survey status and plan

The status of the preparation for the KL beam line survey was reported by the E14 group. Primary goal of the survey is to confirm the K_L yield assumed in the proposal. It is known that different MC code (various versions of FLUKA, Geant3, Geant4. etc.) gives quite different results (as much as factor of 3). Another important measurement is the flux of core neutron to confirm the n/K_L ratio. Intensity of hallo neutron is also a crucial issue for the experiment but it should be very low (comparable with the background from K_L decay or core neutron interaction) with a properly designed collimators. The survey is scheduled in Fall 2009.

The profile of beam (charged/neutral/photon) will be measured by a simple combination of scintillation counters used in E391a. Rate capability of the counters is critical and low intensity beam run may be needed. The simulated beam profiles for horizontal and vertical direction looks quite different indicating that the characteristics of the collimations in two directions are not same and there might be some possibility to improve K_L yield further.

K_L flux will be measured by reconstructing the decay $K_L \rightarrow \pi^+\pi^-\pi^0$ with two mini-arrays of 25 CsI crystals and two banks of scintillator hodoscope tracker. The plot below shows the invartiant mass distribution of reconstructed K_L. The tail in higher mass, which



may be due to the poor π^0 measurement at the boundary of CsI array, should be understood definitely. The acceptance of the K_L reconstruction is evaluated by the simulation to be around 0.5 x 10^{-4} for the momentum range to be used in E14. Since the measurement has the least redundancy, any unexpected background (higher single count etc) will easily degrade the reconstruction efficiency with increased uncertainty. This could make the K_L yield measurement very tough.

Core neutron flux will be measured by the sampling calorimeter (Cerberus) used in E391a. Because of very high count rate (several 10 MHz for no γ absorber geometry), lower intensity beam operation may be needed.

Hallo neutron measurement will be made with a CsI crystal enclosed in other CsI or PWO crystals. Since major background will come from KL decays and interactions of core neutron, vacuum beam pipe is essential for the survey.

It is noted that the measurement at the beam commissioning stage may suffer from an unstable beam condition including beam position and premature beam spill control. For low power operation, low sensitivity of primary beam monitor should also be considered.

In view of radiation safety, a timely application of the facilities including radiation shield, beam dump or beam shutter/plug is essential. FIFC recognized that the overall preparation is in good progress but a realistic revision of the design/schedule of the relevant apparatus should be made very soon.

SKS Magnet

The SKS magnet is being modified to use new compact refrigerator (GM-JT cryo-cooler) which can keep the liquid state of helium at the magnet without a big refrigerator. Three units of the GM-JT cryo-cooler replace the existing refrigerator system, which were proven to be enough to keep the liquid helium in the performance test.

The magnet has then been moved to J-PARC site. For the transportation, a part of the magnet yoke was disassembled and the coil unit was once disassembled as shown in the photo above. During the stand alone test of the coil at Toshiba, it was found that the coil has an earth fault newly developed. The coil was investigated in detail and the fault was identified at the most inner side of the coil assembly where the repair is almost impossible. The coil assembly was finally fixed by disconnecting one coil block out of six. The protection resistor was changed from 3 to 2 ohm to avoid an excessive high voltage to ground on occasion of possible quench. Because of the disconnection, the central magnetic field is reduced from 2.7T to 2.48T with the maximum rating current of 400A.

The modification of the magnet affects the application in the experiment in two points. One is the change in the distribution of the magnetic field. It means the field map obtained formerly by the real measurement cannot be applied any more to the physics reconstruction. A possible solution is the use of the "calculated map" obtained by the detailed simulation of the magnetic field in the new configuration. The simulation study confirms that the calculated map well reproduces the original map in the previous configuration once the overall normalization is given, although some discrepancies at the edge of the pole are still observed. The discrepancies are expected to be improved by the adjustment of the pole shape and the coil position in the simulation. The calculated map is also tested in the real data analysis using the PS-E556 data. The results show a satisfactory agreement with that obtained with the measured map.

The other impact is the reduction of the maximum strength of the magnetic field to 2.48T. The experimental setup has to be modified to be compatible with the reduced field. Preliminary examinations of the use of modified magnet in the real experiments (Sks0, SksPlus and SksMinus) are made to conclude that the modification of the magnet does not affect the physics performance. The spectrometer acceptance is found to be kept by adjusting the placement of the experimental apparatus, however, a slight degradation in the momentum resolution is inevitable.

FIFC discussed the situation of the modified SKS magnet and basically agreed on its proposed use at J-PARC. Some worries were raised about the use of the calculated map in the physics analysis. FIFC suggests further investigation of the reliability of the calculated to improve the performance. The other concern is the cause of the coil earth fault. Although the mechanism is yet unknown, it was reported that the fault developed after transporting the magnet to Toshiba and the transportation and disassembling of the magnet are considered as the cause. Reducing the number of quenching and/or thermal cycling of the magnet could be effective to avoid the further development of the coil faults. It is recognized that the new cooling system enables to keep the liquid helium at a low temperature for a long time without the assistance of operation shifters and it is useful to reduce the number of warming of the coil. FIFC suggests further investigation of the cause of the coil faults with the possible improvement in its detection.