COSY Beam-Time Request

For Lab. use	
Exp. No.: 147.2	Session No. 32

Title of Experiment

Study of the K^- and Φ nuclear potentials in p+A reactions at ANKE

Collaborators: see proposal

Institute: see proposal

(Continue on separate sheet if necessary)

Spokesperspersons for collaboration: Name: M. Hartmann and Y. Kiselev

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Is support from the LSF program of the EC requested?
Yes No

Date: 04 October 2006

Total number of particles and type of beam (p,d,polarization)	Momentum range (MeV/c)	Beam intensity	
		minimum needed	maximum useful
$3\text{-}6\cdot10^{10}$ protons	3650	$\geq 3\cdot10^{10}$ protons	
Type of target	Safety aspects (if any)	Earliest date of Installation	Total beam time (weeks)
^{12}C, ^{108}Ag, ^{196}Au strip target		At the beginning of 2007	5

What equipment, floorspace etc. is expected from Forschungszentrum Jülich/IKP?

Summary of experiment

The aim of the approved experiment is to study the K^--nucleus and Φ-nucleus potentials via K^- and Φ production in p+A reactions. We plan to obtain data on non-resonant K^+K^- and resonant $\Phi \rightarrow K^+K^-$ production on ^{12}C, ^{108}Ag and ^{197}Au targets at maximum COSY energy of 2.83 GeV. The analysis of the resonant data will allow us to estimate the momentum dependence of the imaginary part of the Φ potential at normal nuclear density — and hence the Φ width in matter — through the analysis of the A-dependence of the production cross sections. The K^- spectra will be measured in a wide momentum range from 200 to 1100 GeV/c. The low momentum spectra are most sensitive to the antikaon-nucleus potential. The real part of the K^- nuclear potential will be derived from an analysis of the low momentum parts of the K^- spectra based on the effect due to the interplay between Coulomb and nuclear potentials. The ANKE spectrometer is ideally suited for the proposed measurements.

We ask to allocate the approved 5 weeks of beam time in the early spring 2007. Only in the cold season the required high energy for the proposed experiment is possible due to limitation of the COSY cooling system.

Attach scientific justification and a description of the experiment providing the following information:

For proposals:
Total beam time (or number of particles) needed; specification of all necessary resources

For beam requests:
Remaining beam time (allocations minus time already taken)

Scientific justification:
- What are you trying to learn?
- What is the relation to theory?
- Why is this experiment unique?

Details of experiment:
- Description of apparatus.
- What is the status of the apparatus?
- What targets will be used and who will supply them?
- What parameters are to be measured and how are they measured?
- Estimates of solid angle, counting rate, background, etc., and assumptions used to make these estimates.
- Details which determine the time requested.
- How will the analysis be performed and where?

General information:
- Status of data taken in previous studies.
- What makes COSY suitable for the experiment?
- Other considerations relevant to the review of the proposal by the PAC.

EC-Support:
- The European Commission supports access of new users from member and associated states to COSY. Travel and subsistence costs can be granted in the frame of the program Access to Large Scale Facilities (LSF).

COSY-BEAM–REQUEST (147.2)

Study of the K^- and ϕ nuclear potentials in p+A reactions at ANKE

M. Hartmann[a] and Y. Kiselev[b] **(Spokespersons)** on the behalf of the COSY–ANKE experiment No. 147.

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Recent experimental results, published during the last year, make the proposed COSY measurements even more important and interesting. The LEPS experiment at SPring–8 (Japan) [1] has found an anomalously weak A^α-dependence with a slope parameter $\alpha = 0.72 \pm 0.07$ for the production of relatively slow ϕ's in photonuclear reactions. This observation was interpreted by the authors as evidence for a strong ϕ absorption in nuclear matter. However, theoretical analyses based on different approaches fail to reproduce the LEPS data. The A–dependence is determined by the imaginary (absorptive) part of the ϕ nuclear potential which is directly related to the ϕ -meson width in matter. On the other hand, experiments on the production of high momentum ϕ's in proton-induced reactions at KEK (Japan) [2] and HERA–B (Germany) [3] both found a rather strong A^α–dependence with α close to 1. The ANKE spectrometer is able to detect ϕ's with momenta down to 0.6 GeV/c, *i.e.* in the not yet explored range of very low momenta where we expect the strongest effect of anomalous ϕ absorption.

In addition, we intend to evaluate the magnitude of the real part of the antikaon nuclear potential from an analysis of low momentum non-resonant K^- production on light and heavy nuclei. Theoretical predictions for the potential are spread over a wide range from -40 MeV to -200 MeV, however its strength is not really constrained up to now by the available data.

In the following we argue why the approved 5 weeks of beam time for proposal 147 should be scheduled in *one single block* without interruption. We kindly ask the PAC to allocate this beam time in early spring 2007 (plus few days for machine development). Only in the cold season the required high energy for the proposed experiment is possible due to limitations of the COSY cooling system.

Several arguments are in favor of a continuous measurement. The most relevant is that we have to aim at errors smaller than 20% (see approved proposal). This is particularly the case for the cross–section ratios for the C and Au targets. If the experiment were split in parts, the errors would inevitably increase. This is due to the fact that we have to use the "delayed veto" technique for K^+ identification, where the K^+ efficiency strongly depends on the gates in time–difference spectra and changes from beam time to beam time. For each experimental run new efficiency calibrations have to be carried out, thus increasing the systematic and statistical errors and making additional machine–development time necessary.

In addition, our experience shows that vibrations of the target (which effect the dead time) and the background conditions change with every modification of the beam–target interaction parameters, *i.e.* from beam time to beam time. This is especially important for the lower part of the K^- momentum spectrum. Even in case of similar background conditions, reached by optimizing of the beam-target interaction, the latter procedure requires a few days of additional machine development. There is even the danger of breaking the delicate strip targets during the (dis–) mounting procedure.

If we are able to perform measurement in one block, we have a much higher flexibility in optimizing the time needed to measure each of the targets (C and Au) based on the results of the on–line analysis.

References

[1] T. Ishikawa *et al.*, Phys. Lett. B **608** (2005) 215.

[2] T. Tabaru *et al.*, Phys. Rev. C **74** (2006) 025201.

[3] I. Abt *et al.*, hep-ex/0606049.