STUDY OF MUON-INDUCED FISSION WITH
THE PHOTOEMULSION-METHOD

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Abstract:
Photoemulsion plates impregnated with uranium 238 were exposed at SIN to a muon beam. In the later scanning, events are analysed in which muons have induced prompt or delayed fission. Of special interest are processes showing the reemission of muons from a fragment ("muon conversion") or of other charged particles (p,α). Preliminary results on energy and angular distributions of the emitted particles and samples of such events are shown. Some conclusions on the fission mechanism and on the fate of the muons are drawn.

Introduction

Fission of heavy nuclei induced by muons has become a research topic of growing interest. Figure 1 explains the 2 known reaction chains producing muon induced fission and subsequent processes. Reaction sequence (1a) starts with the formation of a muonic atom in the 1s ground state, from which the muon will either decay (which is rare in high Z nuclei, since λt~0.03λc) or will be captured. The nuclear muon capture leads to a nucleus (Z-1)A* with about 20 MeV excitation. With a certain chance it will undergo fission. Other possible deexcitation channels are γ or nucleon emissions. Fission induced by this sequence is named "delayed fission", because there is a characteristic measurable time delay to the muon stop, given by the muon capture time constant λc−1 (~77 nsec in U238 [1,2]). The probability of delayed fission in U238 is about 7% [2]. The
study of delayed fission allows comparisons with other types of fission [3-5], e.g. neutron- or photon induced fission. This can reversely be used to get information on the excitation mechanism in nuclear muon capture.

Figure 1: reaction scheme of muon induced fission and of subsequent processes.