(b) the same by including the term of resonant $d\mu d$ formation followed by backdecay (full line), see ref. [4]. The HD data point at 50 K (star) is significantly lower than the D_2 results (full circles). It provides first direct experimental evidence that the resonant spin flip term (absent in HD molecules) really exists in D_2 at the predicted intensity. Thus, inelastic scattering $\mu d + d$ will need more theoretical attention to get the theory in accord with the experimental observations.

This experiment will be continued in 1996, primarily with more detailed investigations of the so far poorly known μCF processes with HD molecules.

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PRECISION MEASUREMENT OF NUCLEAR μ-CAPTURE BY ^{3}He

P. Ackerbauer[1], D. V. Balin, V. M. Baturin, G. A. Beer[2], W. H. Breunlich[1], T. Case[3], K. M. Crowe[3], H. Daniel[4], J. Deutsch[5], J. Egger[6], J. Govaerts[5], Yu. S. Grigoriev, F. J. Hartmann[4], P. Kammel[3], B. Lauss[1], E. M. Maev, V. E. Markushin[7], J. Marton[1], M. Mühlbauer[4], C. Petitjean[6], Th. Petitjean[6], G. E. Petrov, R. Prieels[5], W. Prymas[1], W. Schott[4], G. G. Semenchuk, Yu. V. Smirenin, B. van den Brandt[6], A. A. Vorobyov, N. I. Voropaev, P. Wojciechowski[4]

[1] *Austrian Academy of Sciences, Institute for Medium Energy Physics, A-1090 Vienna*
[2] *University of Victoria, Victoria B.C. VW8 2Y2*
[3] University of California and Lawrence Berkeley Laboratory, Berkeley CA 94720
[4] *Technical University of Munich, Physics Department, D-85747 Garching*
[5] *Universite Catholique de Louvain, B-1348 Louvain-La-Neuve*
[6] *Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland*
[7] *Russian Research Center, Kurchatov Institute, Moscow*

In [1] we described a new experiment at PSI with the goal to determine the spin-averaged rate Λ^{stat} of the nuclear muon capture reaction

$$\mu^- + {}^3\mathrm{He} \longrightarrow \nu_\mu + {}^3\mathrm{H} \qquad (1)$$

at high precision. This reaction probes the elementary semi-leptonic weak interaction process $\mu^- + p \rightarrow n + \nu_\mu$ and due to its simplicity (superallowed transition in the A = 3 nuclear system) is directly sensitive to the induced pseudo-scalar coupling constant g_P.

The data from a run of four weeks in 1993 were independently analyzed by two subgroups of our collaboration, and consistency was found within the error bars. Based on $3.75 \cdot 10^8$

muon stops registered in a well defined fiducial volume, we have identified $1.14 \cdot 10^6$ 1.9 MeV tritons from reaction (1) which led after a number of small corrections to the preliminary result [2]

$$\Lambda^{stat}(exp) = [1496 \pm 3(stat) \pm 3(syst)]\ \mathrm{s}^{-1}. \tag{2}$$

This result is by more than an order of magnitude more precise than any previous measurement. At present, we are further investigating and discussing the systematic accuracy of the experiment.

Our experimental result can be analyzed in the framework of the elementary particle model (EPM) following the work of Congleton and Fearing [3]: Λ^{stat} defines a correlation between the formfactors F_A and F_P shown in Fig. Using $F_A(-0.954 m_\mu^2) = 1.052 \pm 0.011$ extrapolated from the tritium beta decay a value of $F_P = 21 \pm 3$ can be extracted. The EPM approach yields Λ^{stat}(EPM)= $[1497 \pm 21]\ \mathrm{s}^{-1}$ in very close agreement with our experiment. Our result coincides thus exactly with the PCAC prediction which was the basis of calculation [3].

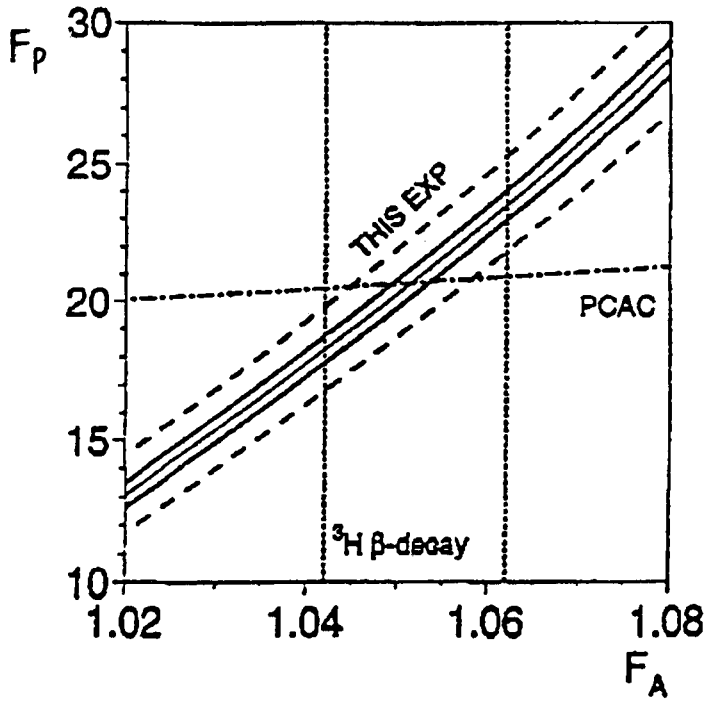

Fig. Plot of pseudo-scalar F_P vs. axial F_A form factors showing the constraints by our experiment (solid lines; dashed lines with errors in F_V and F_M added). Vertical dotted lines show the constraints in F_A extrapolated from tritium beta decay; dash-dotted line is from the PCAC relation

During 1995 Congleton and Truhlik [4] performed a microscopic calculation of reaction (1) by explicitely calculating the contribution from meson exchange currents (MEC) to the vector and axial parts of the weak nuclear current. Their new prediction is Λ^{stat}(MEC)= $[1502 \pm 32]\ \mathrm{s}^{-1}$, again in excellent agreement with our experiment and the EPM approach. So, the understanding of this elementary weak process has indeed reached new levels of precision. This experiment has produced additional results of general interest, namely a

very detailed measurement of the breakup channels [5] and an upper limit for the admixture of heavy neutrinos [6]. Limits on capture from the 2S mesic level as well as the transition rate between the mesic hyperfine levels were also obtained.

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MEASUREMENT OF THE BREAKUP CHANNELS IN NUCLEAR MUON CAPTURE BY ^{3}He AND ^{4}He

E. M. Maev, P. Ackerbauer[1], D. V. Balin, V. N. Baturin, G. A. Beer[2], W. H. Breunlich[1], T. Case[3], K. M. Crowe[3], H. Daniel[4], J. Deutsch[5], T. von Egidy[4], J. Govaerts[5], Yu. S. Grigoriev, F. J. Hartmann[4], P. Kammel[3], B. Lauss[1], J. Marton[1], M. Mühlbauer[4], C. Petitjean[6], Th. Petitjean[6], G. E. Petrov, R. Prieels[5], W. Prymas[1], W. Schott[4], G. G. Semenchuk, Yu. V. Smirenin, A. A. Vorobyov, N. I. Voropaev, P. Wojciechowski[4]

[1] *Institute for Medium Energy Physics, A-1090 Vienna, Austria*
[2] *University of Victoria, Victoria B.C. VW8 2Y2, Canada*
[3] *University of California and Lawrence Berkeley Laboratory, Berkeley CA, 94720, USA*
[4] *Technical University of Munich, Physics Department, D-85747 Garching, Germany*
[5] *Universite Catholique de Louvain, B-1348 Louvain-La-Neuve, Belgium*
[6] *Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland*

The rates of the breakup reactions $\Lambda_B(^3\mathrm{He})$, $\Lambda_B(^4\mathrm{He})$ in nuclear muon capture by ^{3}He and ^{4}He have been measured. The experiments were performed in the muon beam of PSI with a multi-anode high pressure ionization chamber filled with isotopically pure ^{3}He or ^{4}He at 120 bar. The chamber was used as a target and detector for both the incoming muons and for the charged reaction products (tritons, deuterons, protons). When a negative muon is captured by a helium nucleus, the following reactions occur:

$$
\begin{array}{llll}
^3He + \mu \rightarrow & t + \nu_\mu & (1) & \\
& d + n + \nu_\mu & (2) & \\
& p + n + n + \nu_\mu & (3) & \\
^4He + \mu \rightarrow & t + n + \nu_\mu & (4) & \\
& d + n + n + \nu_\mu & (5) & \\
& p + n + n + n + \nu_\mu & (6) &
\end{array}
$$

Reactions (2-6) represent muon captures that result in an unbound triton or ^{4}H nucleus and are referred to as the breakup reactions. Our experiment aims primarily to measure the absolute rate of the $^3\mathrm{He} \longrightarrow {}^3\mathrm{H}$ partial muon capture transition $\Lambda_C(^3\mathrm{He})$, with high preci-