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The **ORIGIN** *of the* **THIRD** **FAMILY**

IN HONOUR OF A. ZICHICHI ON THE XXX ANNIVERSARY OF THE
PROPOSAL TO SEARCH FOR THE THIRD LEPTON AT ADONE

**C.S. Wu, T.D. Lee, N. Cabibbo,
V.F. Weisskopf, S.C.C. Ting, C. Villi,
M. Conversi, A. Petermann,
B.H. Wiik and G. Wolf**

Edited by

O. Barnabei, L. Maiani, R.A. Ricci and F. Roversi Monaco

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The most favourable mechanism for the production of a heavy lepton HL is

$$(1) \quad e^+e^- \rightarrow HL + \overline{HL},$$

which, in the one-photon approximation, is described by the Feynman diagram

By analogy with muon decay, we may expect the predominant decay channel to be

$$(2) \quad HL^\pm \begin{cases} \rightarrow e^\pm \nu_e \nu_H, \\ \rightarrow \mu^\pm \nu_\mu \nu_H \end{cases}$$

where ν_H indicates the neutrino proper to the heavy lepton HL. If this is the case, and the two modes are, as expected, equally probable, then there is $\sim 50\%$ probability that the final state from reaction (1) consists of a noncollinear $e^\pm \mu^\mp$ pair.

From: "Limits on the Electromagnetic Production of Heavy Leptons", Lettere al Nuovo Cimento, **4**, 1156 (1970).

The introduction from the paper published by the BCF group, where the first limit on the HL search at ADONE was reported.

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*This book is dedicated to three Founding Fathers of European Physics and CERN:
Patrick Maynard Stuart BLACKETT, Enrico FERMI and Isidor Isaac RABI.*

Chien Shiung Wu

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FOREWORD

The interest raised by this volume and its success have prompted the publication of this second edition. It enables interested readers to have at their disposal a source of basic material on the Origin of the Third Family of fundamental particles.

On 20 March 1967 a group of physicists from the University of Bologna and the Italian Institute for Nuclear Physics (INFN), led by A. Zichichi, published a proposal to search for a heavy lepton using the new INFN (e^+e^-) collider to be built at Frascati. The proposal, whose key pages are reproduced herein on the 30th anniversary of their publication, was the consequence of many years of work started at CERN where, in addition to the original idea of searching for a heavy lepton carrying its own leptonic number, new technologies were invented in order to allow the detection of a signal whose identification against the high background of hadronic processes was extremely difficult.

More than ten years of work by A. Zichichi, together with his students and his collaborators, have paved the way for the discovery of the Third Family of fundamental particles. The INFN, the University of Bologna, its Academy of Sciences and the Italian Physical Society (SIF) are proud to edit a volume where a group of eminent physicists, with their authority, unequivocally establishes the origin of the Third Family, a milestone of the Standard Model.

This volume is a joint publication, promoted by the Bologna Academy of Sciences and the Alma Mater Studiorum (University of Bologna), together with the Italian Institute for Nuclear Physics (INFN) and the Italian Physical Society (SIF). We thank the Director of the Physics Department of the University of Bologna, Professor Attilio Forino, the Director of INFN-Bologna, Professor Paolo Giusti, Professor Maurizio Basile and Professor Luisa Cifarelli, for their collaboration in the preparation of the volume.

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Bologna, Padua, Rome, 20 March 1998