

Muon Catalysed Nuclear Fusion

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Abstract

Since the discovery of muon catalysed fusion (M.C.F.) in 1956, theoretical and experimental studies have been conducted by many groups. After construction of meson factories, a huge number of negative muons have been available for experiments and many types of M.C.F. among p, d, and t molecules have been studied. The resonance formation theory explained well a temperature dependence of mesomolecule formation rates and muon cycling rates. The M.C.F. was considered for energy production before the discovery by Sakhalov and recently several ideas have been proposed.

1. Introduction

1.1 Historical review

Muon was discovered by Anderson and Neddermyer [1] in cosmic rays around 1938, who were looking for particles responsible for nuclear forces. Muon was thought to be Yukawa particle at that time, even it had several different aspects from Yukawa meson [2]. After the investigation more than ten years since the discovery, Lattes et al [3] discovered a pion and also its decay into a muon in 1947. The decay scheme is written as $\pi \rightarrow \mu + \nu_\mu$ where ν is a neutral particle called neutrino. The pion reacted strongly with a nucleus as expected from the Yukawa meson. It is now understood that pions are the Yukawa mesons and muons- which are similar to electrons in many ways- are now classified as leptons and are not mesons in the modern use of the term.

When cosmic rays were employed to search for new particles and to study their characteristics, there were many difficulties to study reactions caused by these new particles. After construction of many high energy accelerators, the study of elementary particles became feasible because of the easy control of particle productions, intensities and energies. Especially pions and muons are now produced by intermediate energy accelerators (500MeV-1GeV) called meson factories such as LAMPF (Los Alamos, USA), TRIUMF (Vancouver, Canada) and SIN (Zurich, Switzerland).

The possibility of M.C.F. was discussed first by Frank [4] in 1947. In 1948, Sakharov [5] pointed out that M.C.F. could be used for energy production. In 1956, Alvarez [6] group found M.C.F. tracks in a bubble chamber. Since their discovery, several experimental and theoretical works have been published. Especially Jackson [7] and Zeldovich and Gernstein [8] studied theoretically around 1960. So far many review papers were published and discussed many

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