Resonance Tuning and Detuning Phenomena in Muon Catalyzed Fusion (μCF)

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Negative muon (μ^-), which has 207 times heavier mass than that of electron, can catalyze nuclear fusion reactions among hydrogen isotopes (p, d, t) by forming a small muon molecular ion e.g. $(dd\mu)^+$, $(dt\mu)^+$. In some cases, in particular for the d-t μCF, the catalyzed fusion reaction can be repeated upto more than 100 times within muon life time (2.2 μs), providing us an expectation of the use for atomic energy related applications. It is well-known that the formation of muon molecular ion like (ddμ) and (dtμ) proceeds quite rapidly to the shallowest molecular state by a resonant reaction between $(d\mu)+D_2$ and $(t\mu)+D_2$, respectively. After a series of related experiments conducted rather recently, the following surprising phenomena was discovered; at low-temperature, e.g. in solid-phase, resonance tuning occurs for $(t\mu)+D_2$, while resonance detuning occurs for $(d\mu)+D_2$.

Details of experimental results, possible explanations and implications towards future developments will be presented.