# SPECIAL CHEMICAL PHYSICS AND PIZZA SEMINAR SERIES**

# "Low Energy Limit for Tunneling via an Eckart Barrier"


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**Abstract**

For two-body s-wave collisions subject to tunneling though an Eckart potential barrier, cross sections and rate coefficients in the low-energy regime can be evaluated in analytic form. These provide criteria for approach to the Wigner limit and a generic plot applicable to ultracold collisions (< 1 mK). The Eckart barrier shape is found to fit fairly well accurate potential curves available for $F(^2P) + F(^2P)$ and $He(^1S) + He^*(^1S)$ collisions. Also discussed are tunneling-dominated ultracold chemical reactions, exemplified by $F + H_2$. The very slow approach of the reactants allows averaging over rovibrational motions, so the effective adiabatic ("dressed") potential surface differs substantially from the Born-Oppenheimer ("bare") surface obtained from electronic structure calculations. The dressed barrier is more than twofold lower and also thinner. For it the Eckart model gives a ultracold rate coefficient for forming HF in its v' = 2 vibrational state ($4 \times 10^{-13}$ $cm^3$/sec) that is about 200-fold higher than for the bare barrier and of the same magnitude found from a full-scale 3-D quantum scattering calculation.


**Wednesday, December 8, 2010**
**11:30 a.m. IQSE 578**
**Mitchell Physics Building**

**Texas A&M University**
**Department of Physics**

(Pizza, salad, and soda to be served at 12:30 p.m. outside IQSE 578)

** Grad students and postdocs are invited to participate in the "Entanglement Club" for further discussions on various aspects of entanglement, pertaining to quantum optics as well as quantum computing, to be held on Thursday, December 9, 10 AM – 12 noon, in IQSE 578.