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Resonances in Positron Annihilation on Molecules – Which Bells Ring?[1]

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Positron collisions with molecules can result in the excitation of high-Q vibrational Feshbach resonances – temporary positron-molecule bound states that exhibit greatly enhanced annihilation rates.[3] A simple theory agrees well with data for annihilation spectra as a function of incident positron energy for selected molecules, such as methyl halides, in which infrared-active vibrations dipole-couple the incident positron to the bound state.[4] However additional effects appear to be prominent in most molecules, including the excitation of combination and overtone modes.[5] Until now, limited energy resolution has inhibited the study of these effects. A recently developed, high-energy-resolution, cryogenic trap-based beam is used to investigate two other ways to "ring the molecule's bells": positron coupling to infrared-inactive modes and the excitation of combination modes. The operation of the new beam system will be briefly described,[6] followed by a discussion of high-resolution data for molecules that provide evidence of resonant annihilation due to infrared *inactive* modes. Data exploring the possible excitation of combination modes will also be discussed and related to broad and featureless regions of the annihilation spectra observed in many molecules.[3,5]

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[2]Work done in collaboration with M. R. Natisin and J. R. Danielson.

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