

Merged-beam study of associative ionization in collisions of C⁻ with C⁺, N⁺ and O⁺

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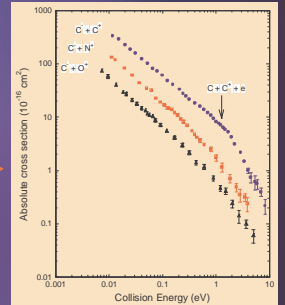
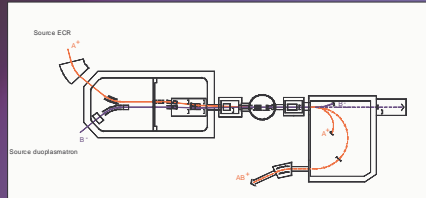
The associative ionization is an efficient process at low collision energy



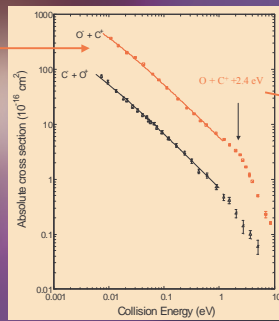
Experimental method: merged beams

$$\sigma = q_1 q_2 v_1 v_2 \frac{1}{v_r F} \int_0^T I_1(t) I_2(t) dt$$

$$\text{avec } F(z) = \frac{\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} j_1(x, y, z) j_2(x, y, z) dx dy dz}{\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} j_1(x, y) dx dy \int_{-\infty}^{\infty} j_2(x, y) dx dy}$$



Difficulties to measure cross section at low energy



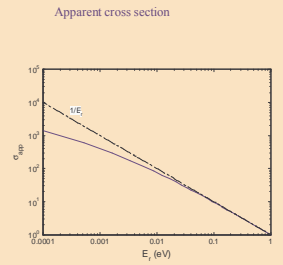
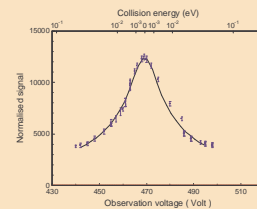
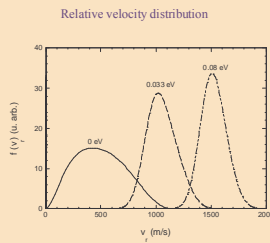
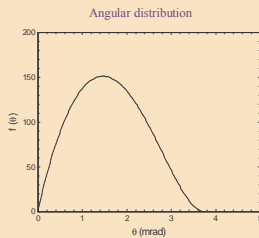
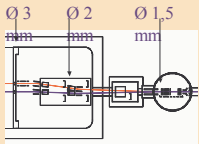
- CO (X¹Σ⁺) + 20.89 eV
- C (P) + O (P) + 9.80 eV
- CO⁺ (X²Σ⁺) + e + 6.88 eV
- C⁺ (P) + O (P) + e - 1.46 eV
- C⁺ (S) + O⁺ (S) - 2.56 eV
- C (P) + O⁺ (S) + e - 3.82 eV
- C⁺ (P) + O⁺ (S) + 2e - 15.08 eV
- CO²⁺ (X¹Π) + 2e - 20.38 eV

Contribution of the rotationally excited molecular ions !!!!

Numerical simulation of apparent cross sections at low collision energy

Reaction rate $\alpha = \int_0^\infty \sigma(v) f(v) v dv$

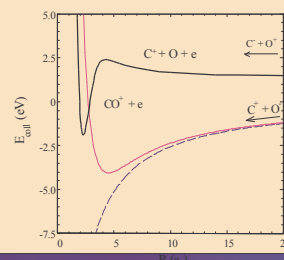
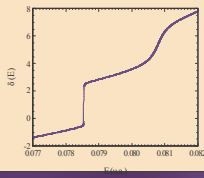
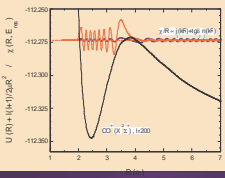
$$f(v) = \iiint g(v_1) g(v_2) f(\theta) \delta(v - \sqrt{v_1^2 + v_2^2 - 2v_1 v_2 \cos \theta}) dv_1 dv_2 d\theta$$



Predissociation lifetime of rotationally excited molecular ions

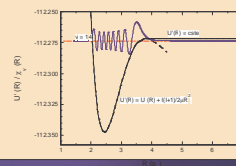
Quantum method

$$\text{Wave fonction : } \frac{d^2}{dR^2} \chi(R) + \left(2\mu \frac{E-U}{\hbar^2} - \frac{l(l+1)}{R^2} \right) \chi(R) = 0$$



Phase shift:

$$\delta = \delta_0 + \arctg \frac{\Gamma}{2(E_r - E)}$$

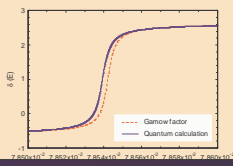


Semi classical method

Semi-classical expression for the lifetime:

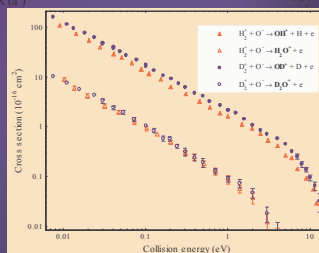
$$\tau^{-1} = \frac{\Gamma}{\hbar} = \frac{\sigma}{2\pi} \exp\left(-2 \int_{R_1}^{R_2} k(R) dR\right)$$

avec $\hbar k = \sqrt{2\mu(U - E_r)}$



Other results

Chemical ionization in polyatomic systems :
towards reactive collisions !



Competition between abstraction and insertion mechanisms in the formation of water cation

