

## TABLE OF CONTENTS

Introduction and overview	1
<b>Chapter 1</b>	
<i>Atom (ion)-atom collisions in the molecular regime</i>	9
Coupled equations in the semiclassical region	11
How to demonstrate the LCP?	16
Local complex potential approximation	21
*Classical description of the nuclear motion	21
*Spectrum of ejected electrons	23
*Semiclassical picture:	24
He( $2^3S$ )H system	26
He( $2^3S$ ) – Ar system	26
He( $2^1S$ ) + Ar system	28
He <sup>+</sup> He system	31
Bibliography to chapter 1:	34
<b>Chapter 2</b>	
<i>Continuum states – Scattering by a potential</i>	35
Notation	35
Threshold laws for short-range potentials	37
Threshold law for interactions	39
Threshold laws for the amplitude:	41
Effective range approximation	47
a) s wave, without any long-range potential	49
b) p wave, without long-range potential	51
c) d wave, without long-range potential	52
d) p wave, with a long-range polarization potential	53
e) Scattering by a double square well potential	54
f) e <sup>-</sup> H <sub>2</sub> scattering in the $^2\Sigma_g$ symmetry (s wave)	56
Bibliography to chapter 2	58

### Chapter 3

<i>Collisional detachment in <math>H^-</math> - Rare gas collisions</i>	60
Generalities about the $H^-$ ion:	60
General discussion of the $H^- - He$ collisional problem	63
ZRP picture of the $(HHe)^-$ system	65
Exact solution of the time dependent ZRP equation	68
Time dependence of the electron wave packet during the collision	69
$H^- Ne$ collisions	78
Velocity dependence of the detachment process	79
A quick view at other methods for the same process	
* Local complex potential	83
* Wang and Delos 1984	85
Bibliography to chapter 3	88

### Chapter 4

<i>Associative detachment</i>	91
* Langevin cross section	92
* Effective range approximation for the associative detachment problem	94
* Asymptotic behaviour:	95
* A simplified problem in the ZRP approximation	96
* Examples and discussion: (quasi s wave problems)	100
Bibliography to chapter 4	106

### Chapter 5

<i>Electron-molecule collisions</i>	107
* General characteristics	107
Sudden approximation: $\tau_{\text{coll}} \ll \tau_{\text{vib}}$	109
Resonance formalism:	113
Bibliography to chapter 5	123

### Chapter 6

<i>Dissociative attachment &amp; vibrational excitation in <math>e^- - HCl</math> collisions</i>	126
* Study of dissociative attachment	126
Threshold behaviour of the DA cross sections	130

*Vibrational excitation in $e^- - \text{HCl}$ collisions	133
*Picture of the process:	135
Bibliography to chapter 6	140

## Chapter 7

$e^- - \text{H}_2$ collisions	143
* $e^- - \text{H}_2$ phaseshifts in the $^2\Sigma_u$ symmetry	144
*Associative detachment in $\text{H}^- - \text{H}$ collisions:	151
*Dissociative attachment in $e^- - \text{H}_2, \text{D}_2$ collisions	152
*Characteristics of the process: Resonant or sudden?	154
Bibliography to chapter 7	162

Concluding summary	165
--------------------	-----