Oh

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Tous les fichiers svg :

Dedication

For those who hate looking at a template with 500 lines of code and an extra 300 lines commented out.

Declaration

Acknowledgements

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Introduction

1.1 Fermi gas preparation (+ Bose gas ?)

1.1.1 TC

Comment on increasing power in TC (thésard marc chesnais)

1.1.2 Zeeman cooling

1.1.3 Blue MOT

1.1.3.1 The physics

1.1.3.2 How to optimize the superposition with the repumper

1.1.3.3 Comment on the hyperfine states (+boson 88)

1.1.3.4 Optical setup (blue + repump)

1.1.4 Repumper

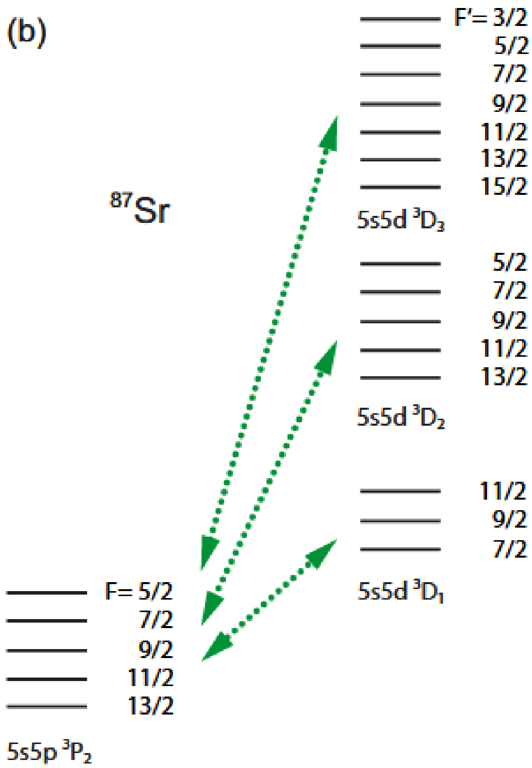


Figure 1.1: Caption

1.1.5 BB MOT

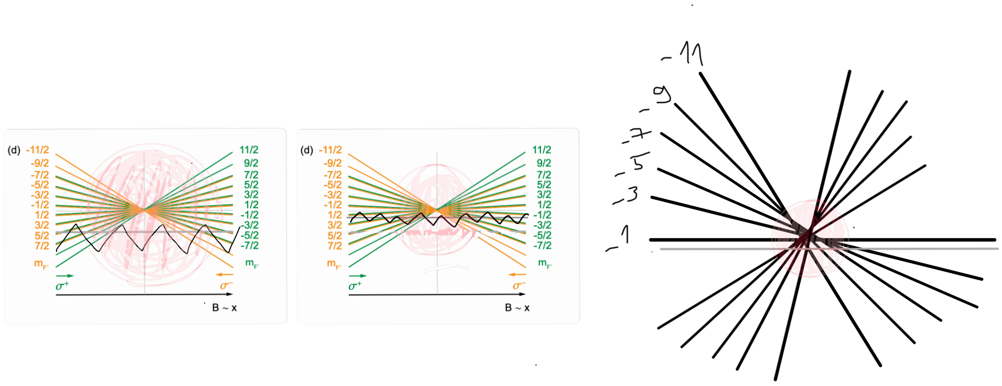


Figure 1.2: Caption

1.1.5.1 First step

1.1.5.2 Second step

1.1.6 Stir

Need a stir because :

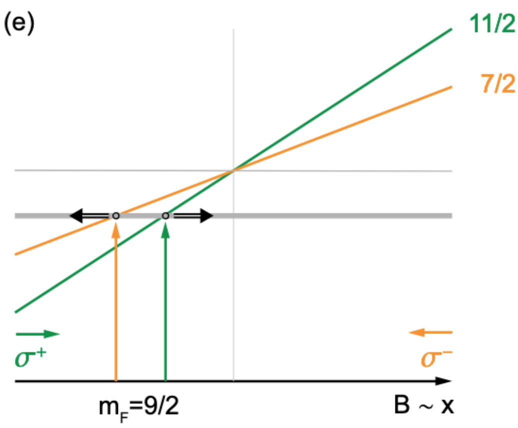


Figure 1.3: Caption

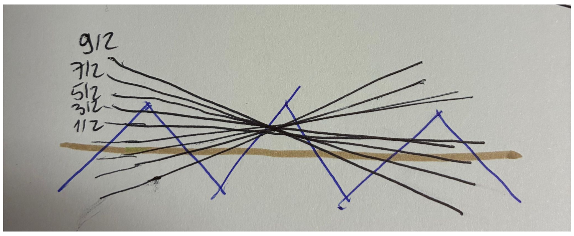


Figure 1.4: Caption

1.1.7 Narrow MOT

cf p.43 S.Stellmer thesis

1.1.7.1 Optimization of the narrow MOT (intensity, frequency, effect on the size of the cloud)

Include images of the cloud for different I and detuning ?

1.1.7.2 Optical setup

1.1.8 ODT and evaporation

1.1.8.1 Charging the crossing

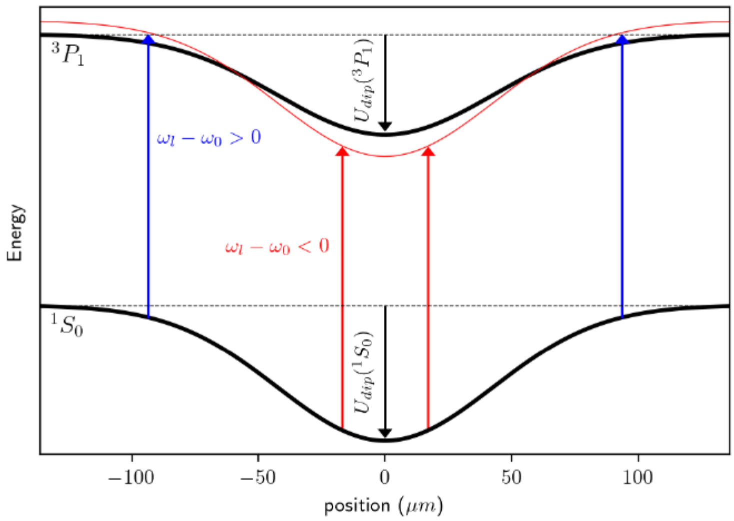


Figure 1.5: Caption

1.1.8.2 Optimization of the evaporation ramps : Dimple + reservoir, just reservoir, parameter to optimize (number of atoms, temperature)

Comment on the LS it does to each state

1.1.8.3 Optical setup

1.1.9 Optical pumping

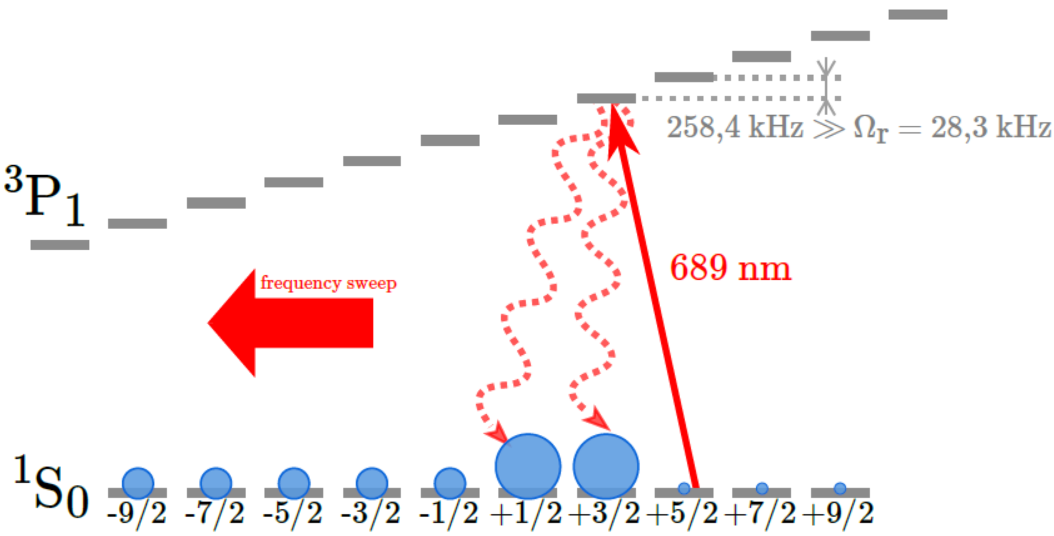


Figure 1.6: Caption

1.2 Spin measurement scheme

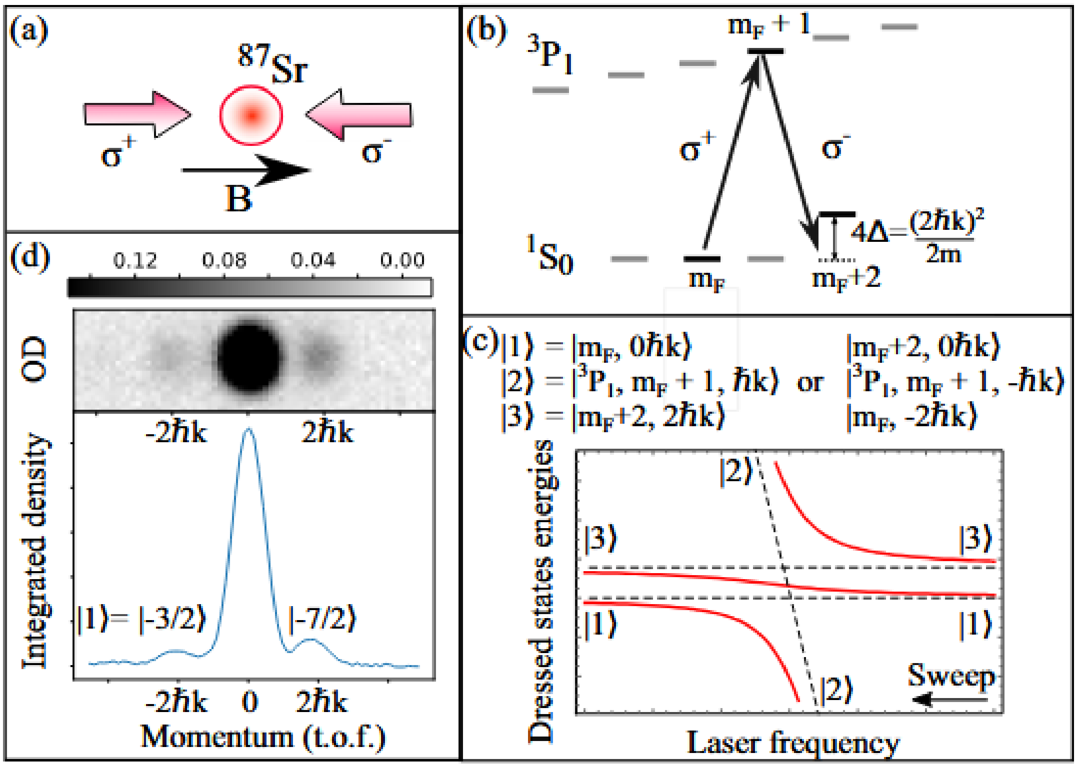


Figure 1.7: Caption

Chapter 2

Ramsey interferometers on qudit

2.1 Preparation of arbitrary dimension Hilbert space

2.1.1 Raman process

2.1.1.1 $\delta m_F = \pm 1$

2.1.1.2 $\delta m_F = \pm 2$

2.1.2 Moglabs chain without cavity

2.1.3 Purification of the laser spectrum with a FP cavity

blablablagtg

2.2 Interferometric sensing with multiple nuclear spin state

2.2.1 Driving long coherence time Rabi oscillations

2.2.1.1 Rabi oscillations

Comment on what the FP could add as a longer coherence time of the qubit

2.2.1.2 Interferometer of su(2) symmetry

2.2.1.3 Discussion on inhomogeneites

2.2.2 Measuring two quantites at a time

2.2.2.1 Physical principle

2.2.2.2 Results

2.2.3 Measuring two non commuting observables

2.2.3.1 Principle

2.3 SU(N) symmetry (ce qu'il faudrait pr la tester e.g densité gaz, alimentation bobines -¿ comment faire mieux que les chiffres actuels)

Chapter 3

Engineering highly entangled system of photoassociated 87Sr atoms

Engineering Dicke states

3.1 Introduction on photoassociation

3.1.1 What is photoassociation

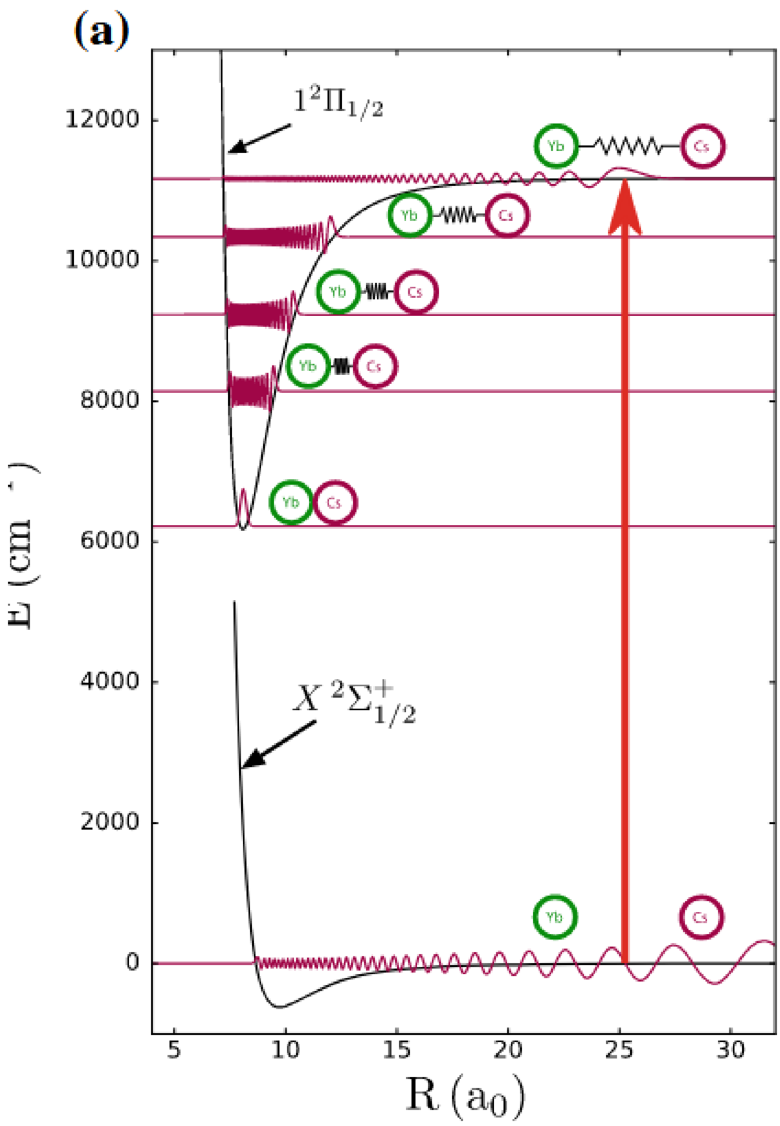


Figure 3.1: Caption

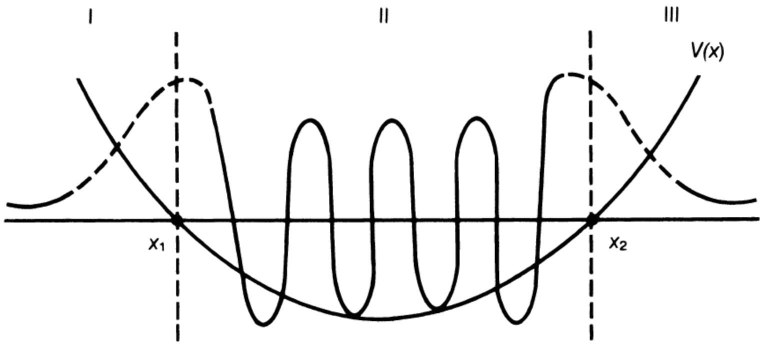
Photoassociating two atoms consists in pairing colliding atoms with light that innhibates mostly two-body losses.
From a non-bound state we couple the atoms at resonance with a molecular vibrationnal state. Two-body photoassociation occurs in agreement with Pauli exclusion. In fermions case, for atoms with even orbital momentum only pairs of

3.1.2 Molecular formalism/vocabulary (condon radius, optical length...)

oui non

3.1.3 Internal energy states

3.1.3.1 WKB approximation



IGURE 2.1. Schematic diagram for behavior of wave function $u_E(x)$ in potential well $V(x)$ ith turning points x_1 and x_2.

Figure 3.2: Caption

3.1.3.2

3.1.4 External energy states

3.2 About photoassociation on other species

3.2.1 Mass scaling (88Sr)

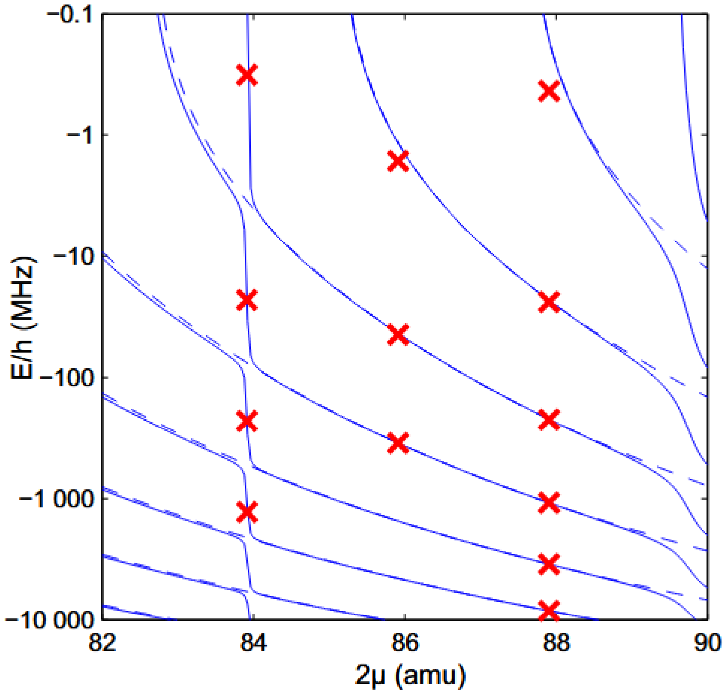


Figure 3.3: Caption

3.2.2 Ytterbium: hfs

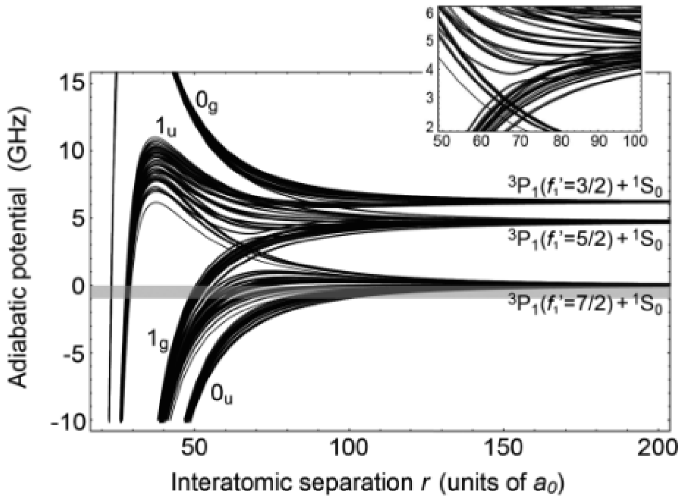


FIG. 2. Adiabatic molecular potentials for a $^{173}Yb_2$ dimer in the $^1S_0 + {}^3P_1$ channel as functions of the interatomic separation r. The molecular potentials for 205 different (T, F, R) configurations are displayed, which are accessible via PA from the initial s-wave colliding atoms in the $^1S_0 + {}^1S_0$ channel. At large r, the potentials converge to three asymptotic branches which correspond to excited atomic states with hyperfine numbers of $f_1' = 3/2,\ 5/2$, and $7/2$. Some of the potentials have a local minimum (inset), possibly hosting purely long-range bound states [14]. The energy offset is adjusted to the $f_1' = 7/2$ asymptote. The shaded region indicates the spectral range of our measurements.

Figure 3.4: Caption

3.3 Experimental setup

3.4 88Sr Results

Lopt, power broadening, thermal broadening...

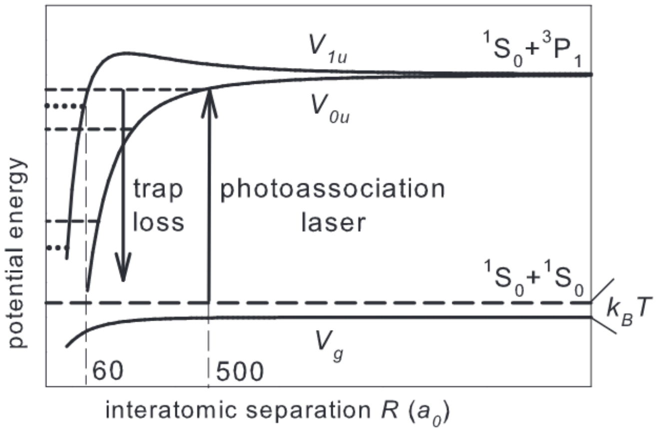


Figure 3.5: Caption

3.4.1 Technical issues of inhabilitation of photoassociation

3.4.1.1 Laser width

3.5 87Sr molecules

Lopt questions sur nb quantique / choix de pompage optique

3.5.1 Physical sources of inhabilitation of photoassociation

3.5.1.1 On F = 9/2 : predissociation

3.5.1.2 Coupling to more energetic state from the IR

3.5.1.3 Node of wavefunction for some vibrational states

3.5.2 Energy landscape of 87Sr-87Sr molecules

Conclusion

Bibliography

Appendix A

Algorithms