

Oh

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A thesis presented for the degree of
Bachelor of Science (Honours) (Physics)



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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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Chapter 1

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

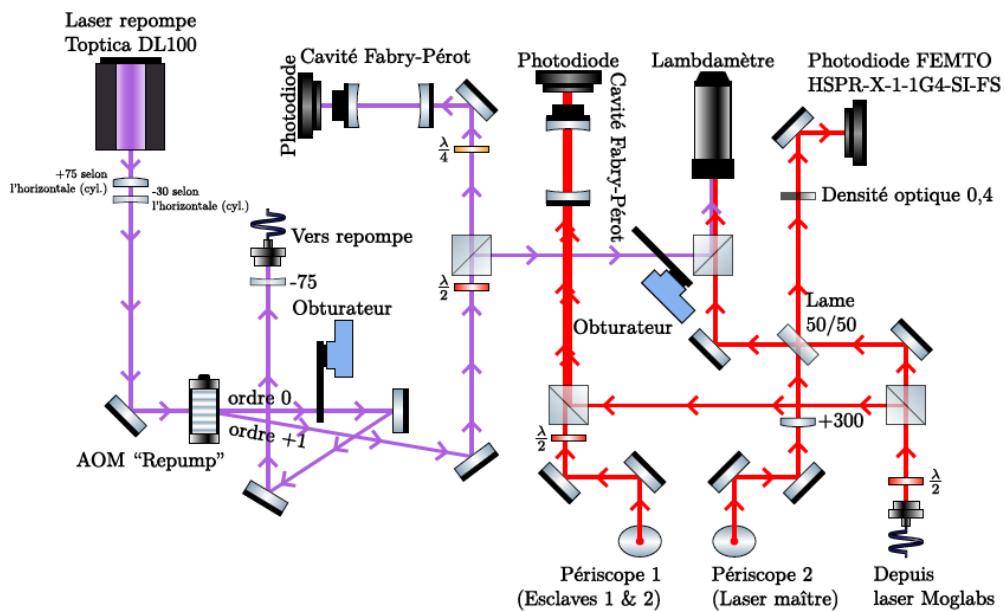


Figure 1.1: Caption

1.1.3.3 Comment on the hyperfine states (+boson 88)

1.1.3.4 Optical setup (blue + repump)

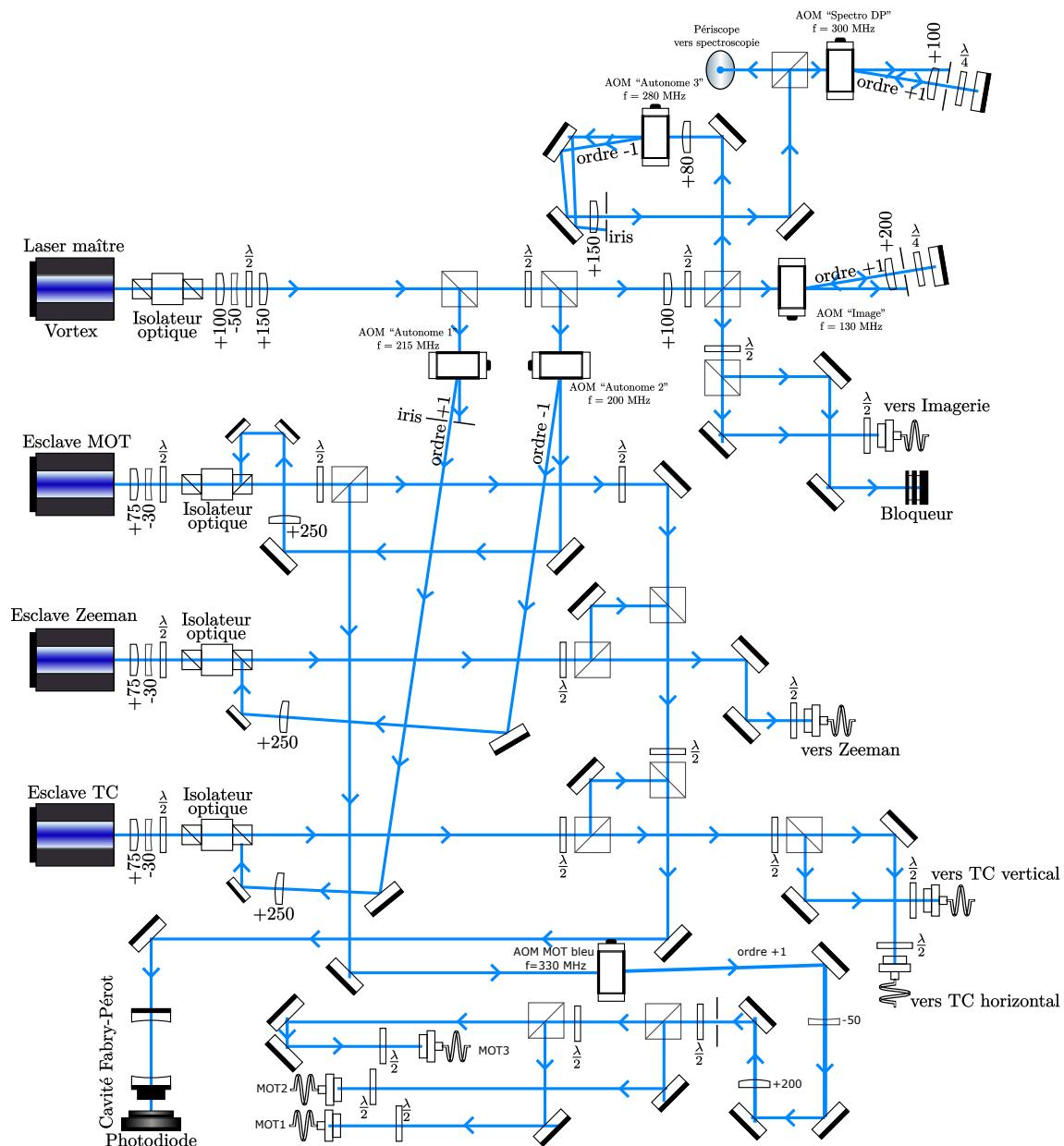


Figure 1.2: Caption

1.1.4 Repumper



Figure 1.3: Caption

1.1.5 BB MOT

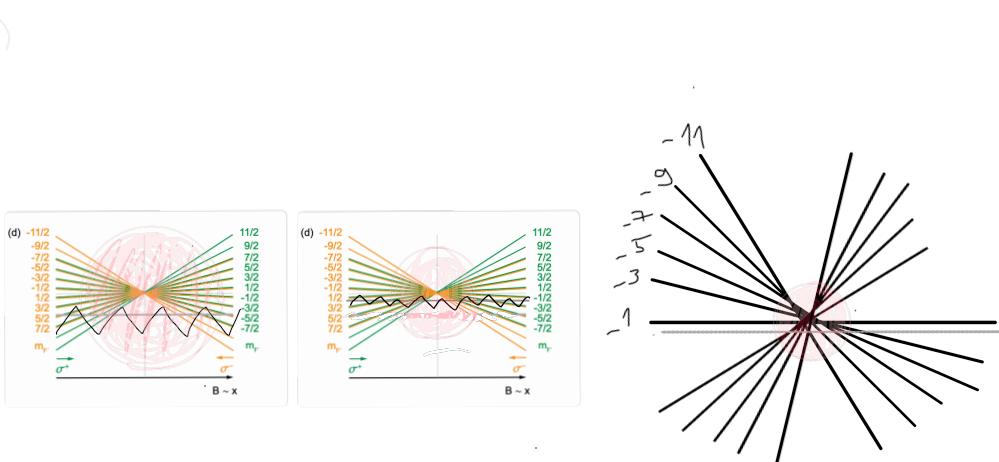


Figure 1.4: Caption

1.1.5.1 First step

1.1.5.2 Second step

1.1.6 Stir

Need a stir because :



Figure 1.5: Caption

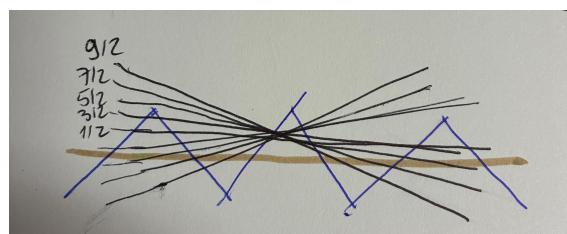


Figure 1.6: Caption

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

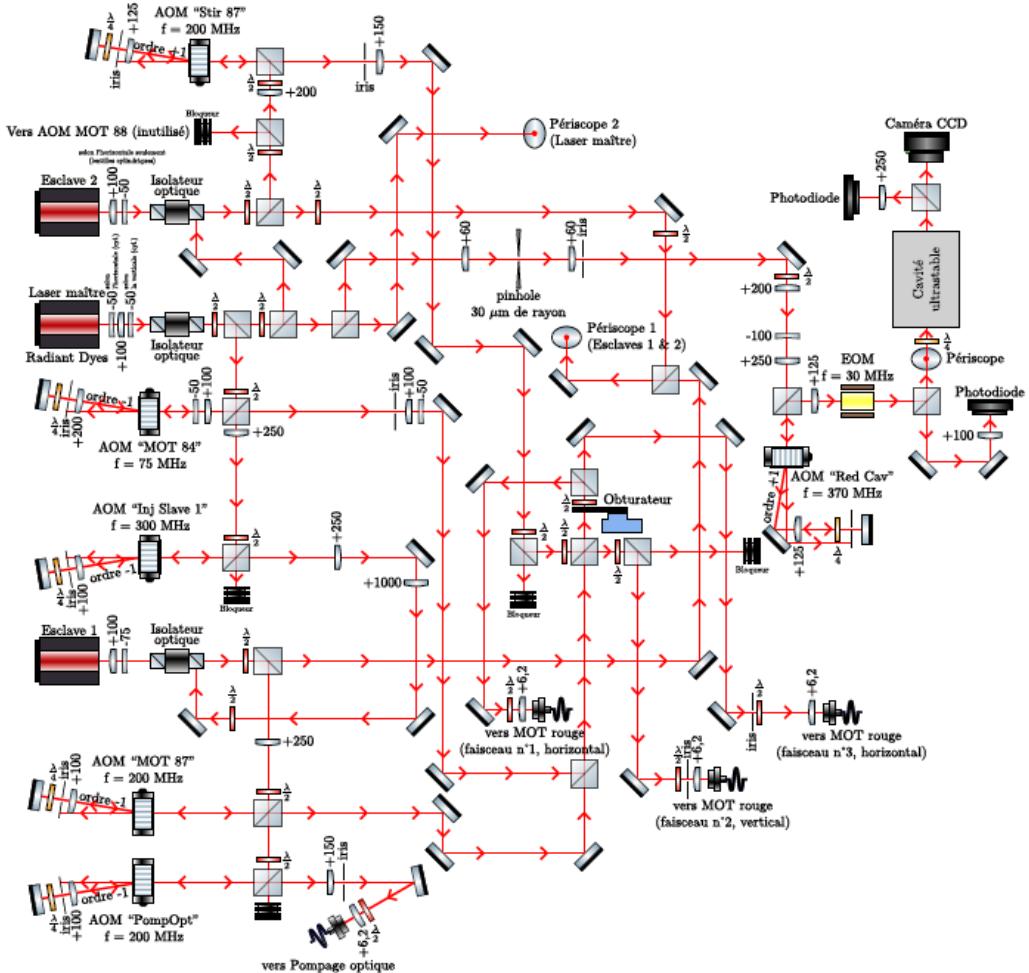


FIGURE 14 – Préparation des différents lasers rouges

Figure 1.7: Caption

1.1.8 ODT and evaporation

1.1.8.1 Charging the crossing

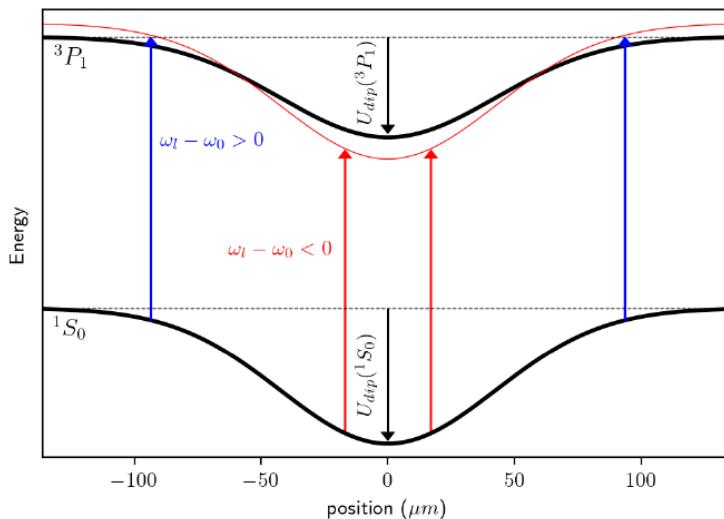


Figure 1.8: Caption

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 1.9: Caption

1.2 Spin measurement scheme



Figure 1.10: Caption

Chapter 2

Ramsey interferometers on qudit

2.1 Preparation of arbitrary dimension Hilbert space

2.1.1 Raman process

2.1.1.1 $\delta m_F = \pm 1$

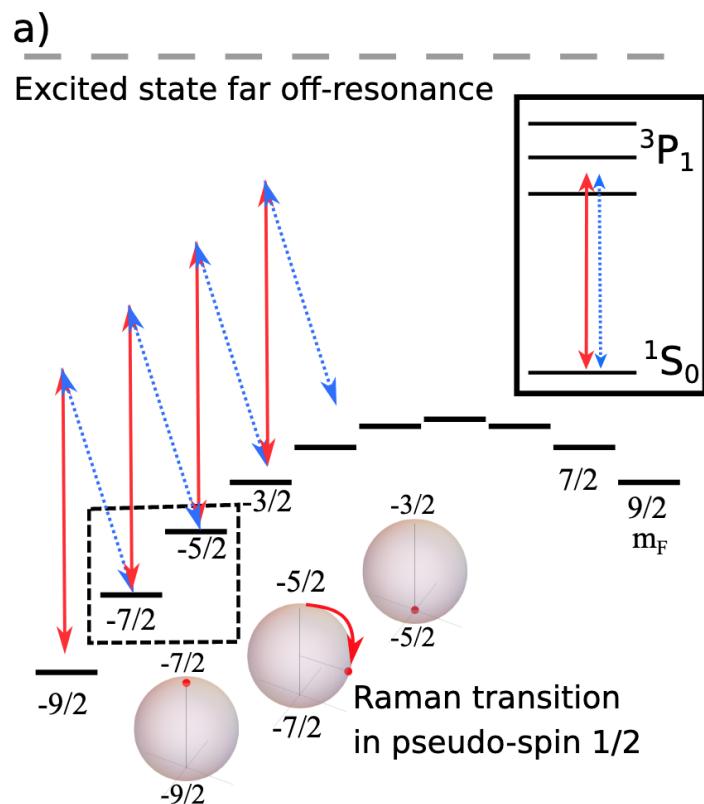


Figure 2.1: Caption

2.1.1.2 $\delta m_F = \pm 2$

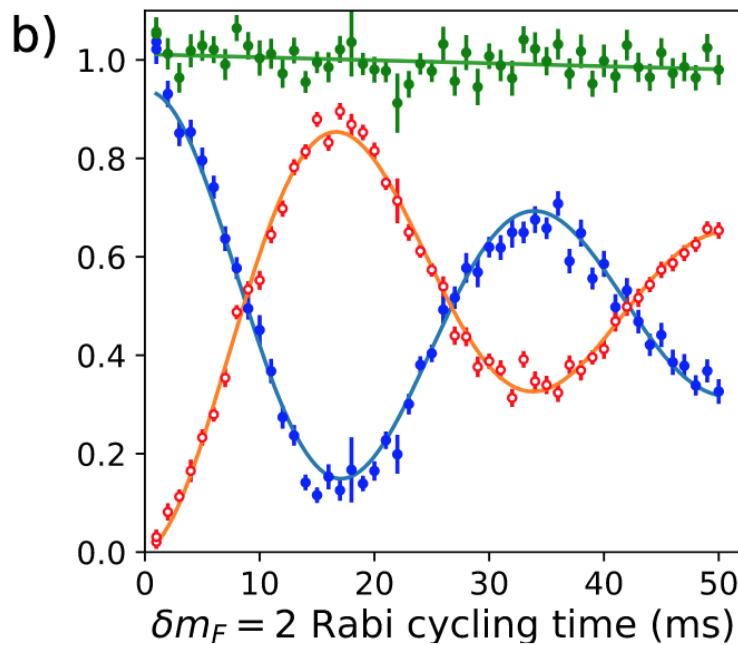


Figure 2.2: Caption

2.1.2 Moglabs chain without cavity

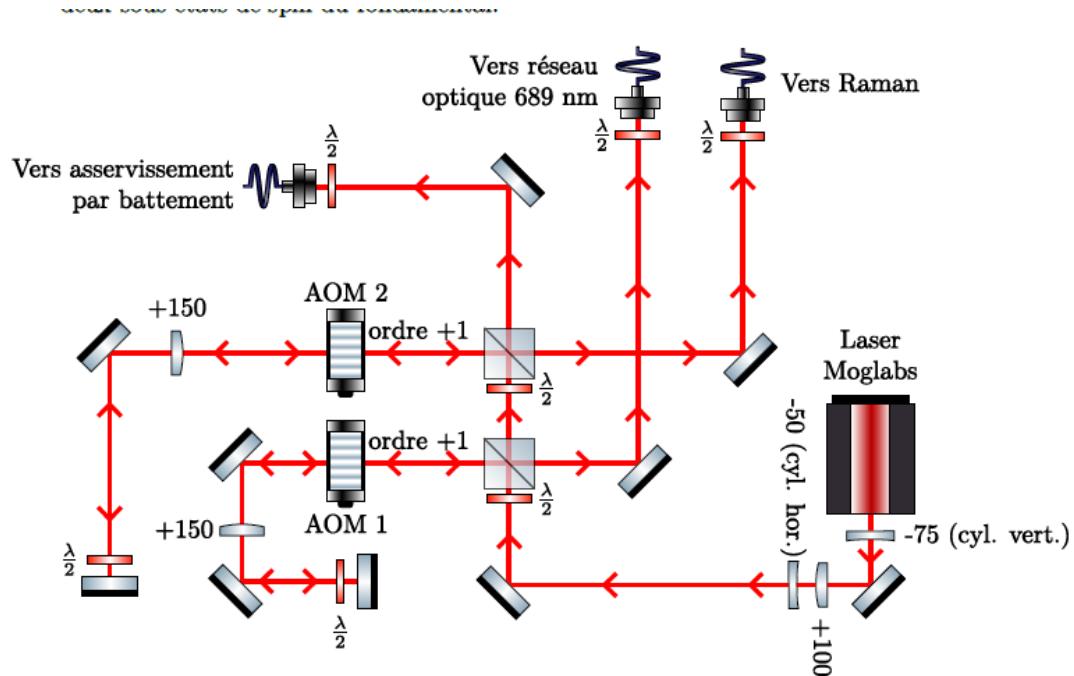


FIGURE 41 – Préparation du laser Moglabs à 689 nm.

Figure 2.3: Caption

2.1.3 Purification of the laser spectrum with a FP cavity

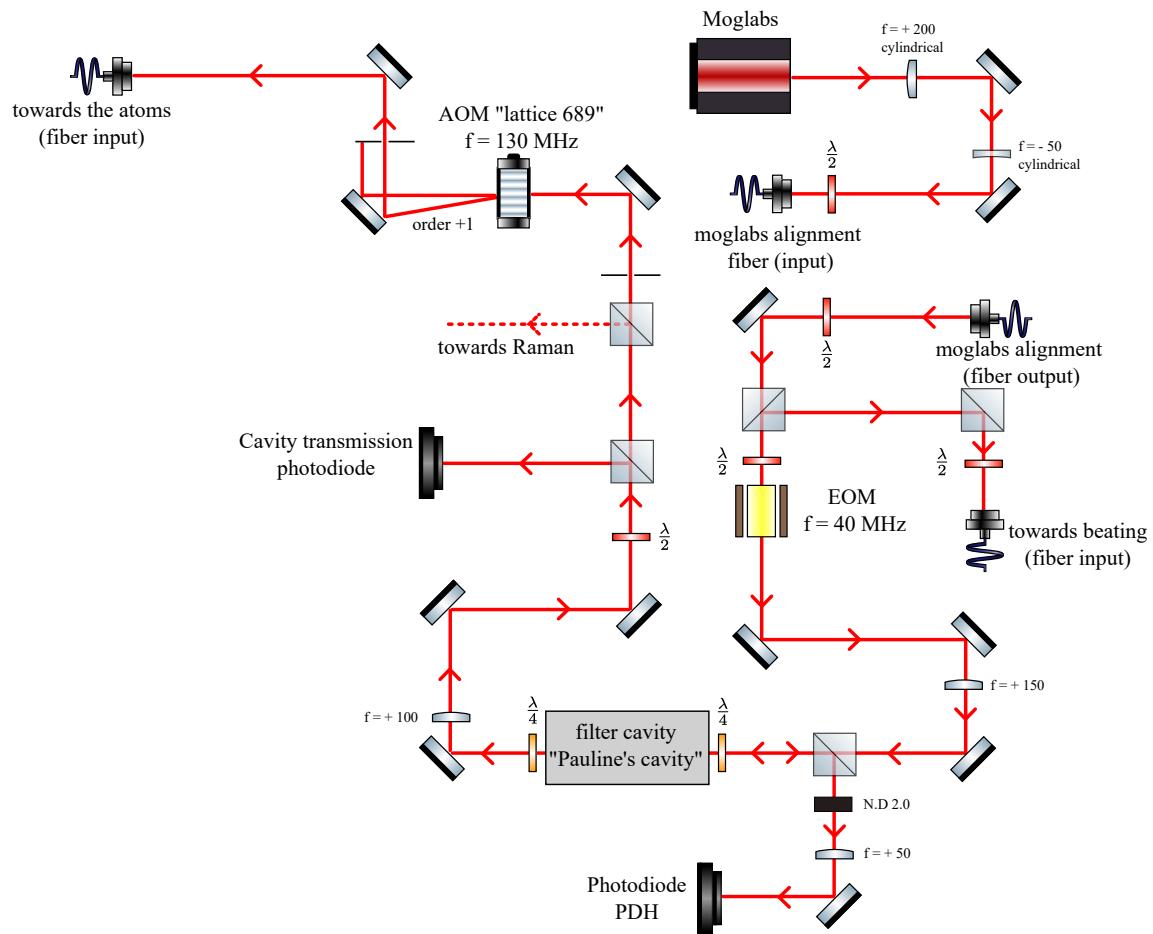


Figure 2.4: Caption

2.2 Interferometric sensing with multiple nuclear spin state

2.2.1 Driving long coherence time Rabi oscillations

2.2.1.1 Rabi oscillations

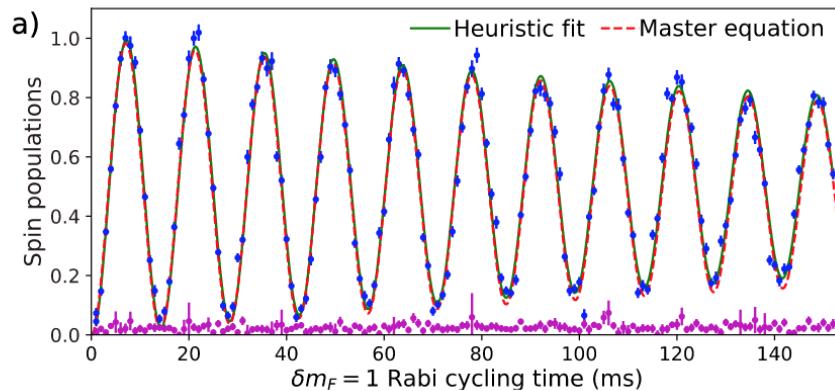


Figure 2.5: Caption

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

2.2.1.2 Interferometer of su(2) symmetry

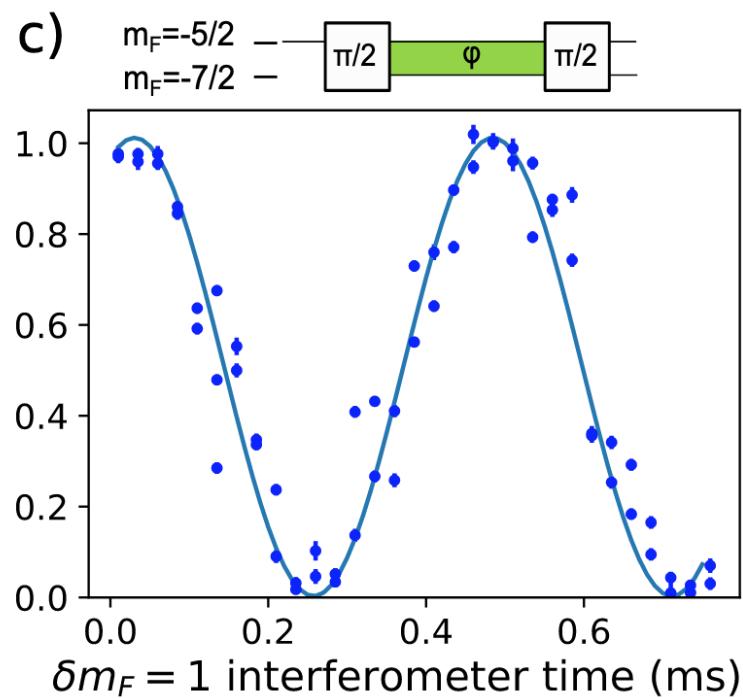


Figure 2.6: Caption

2.2.1.3 Discussion on inhomogeneities

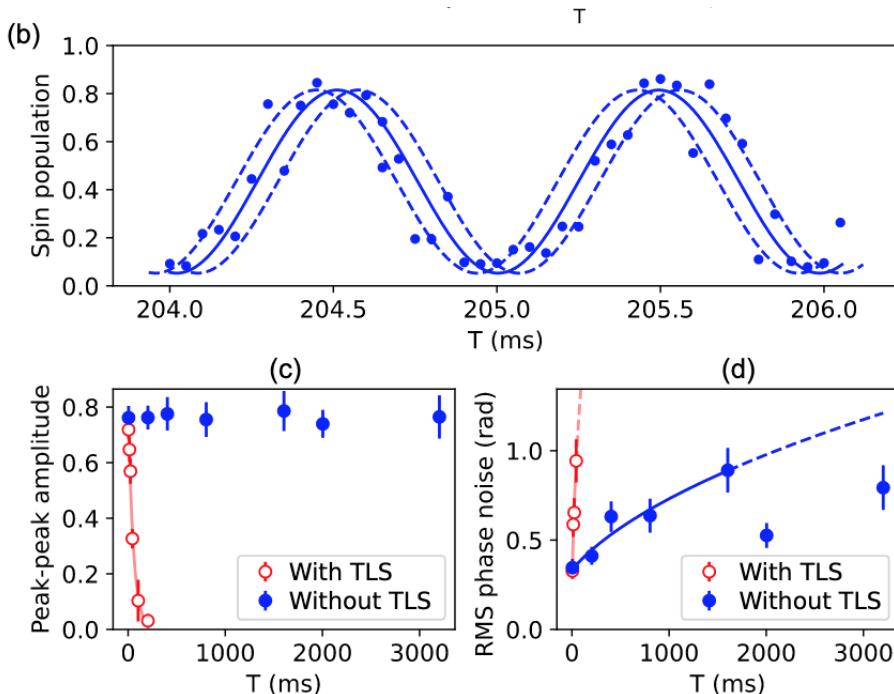


Figure 2.7: Caption

2.2.2 Measuring two quantities at a time

2.2.2.1 Physical principle

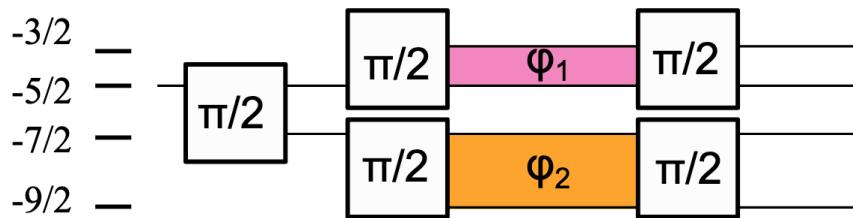


Figure 2.8: Caption

2.2.2.2 Results

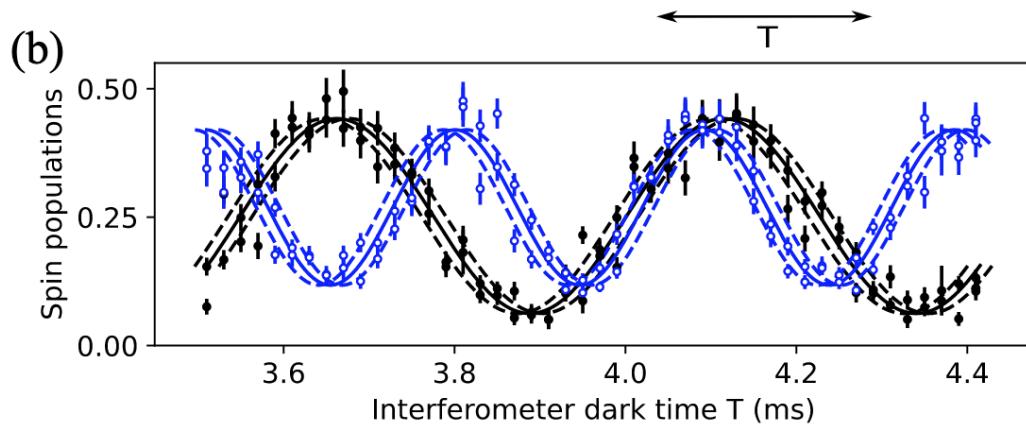


Figure 2.9: Caption

2.2.3 Measuring two non commuting observables

2.2.3.1 Principle

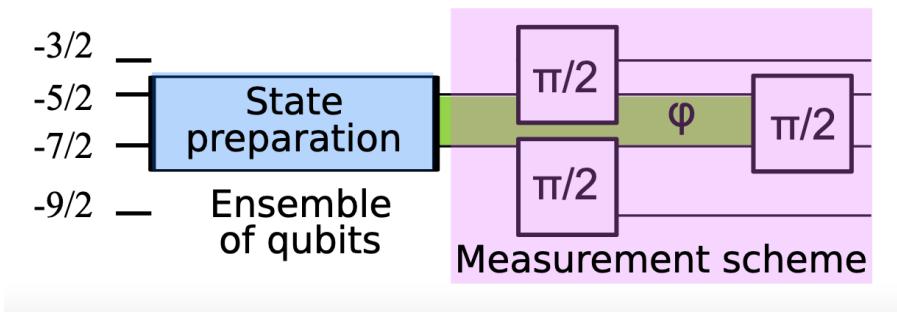


Figure 2.10: Caption

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

Chapter 3

Engineering highly entangled system of photoassociated ^{87}Sr atoms

Engineering Dicke states

3.1 Introduction on photoassociation

3.1.1 What is photoassociation

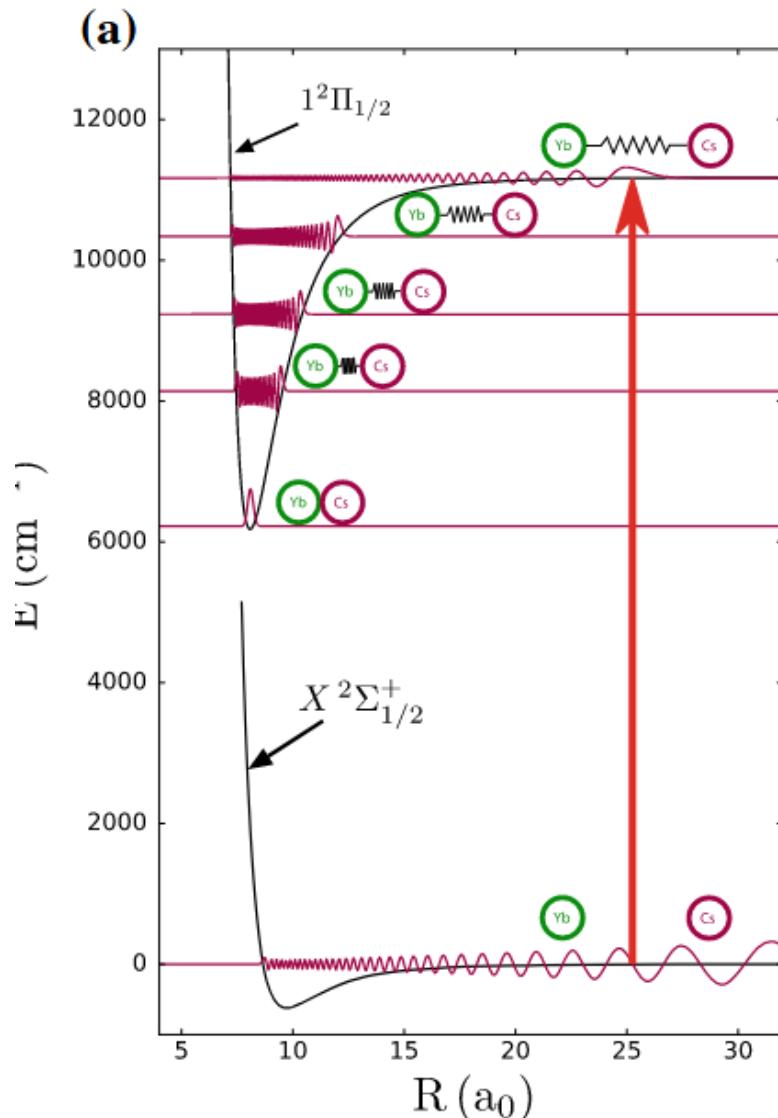


Figure 3.1: Caption

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

3.1.3 Internal energy states

3.1.3.1 WKB approximation

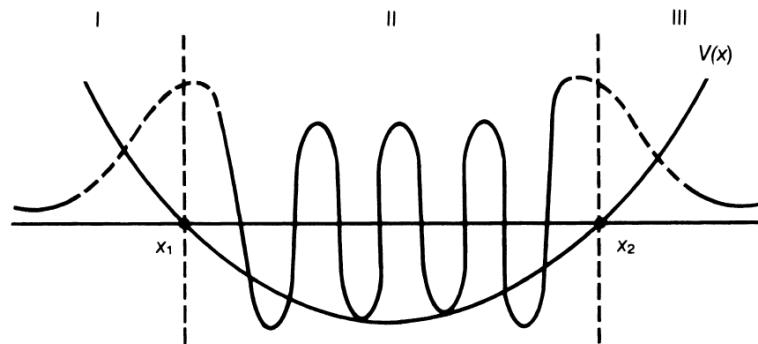


FIGURE 2.1. Schematic diagram for behavior of wave function $u_E(x)$ in potential well $V(x)$ with turning points x_1 and x_2 .

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)

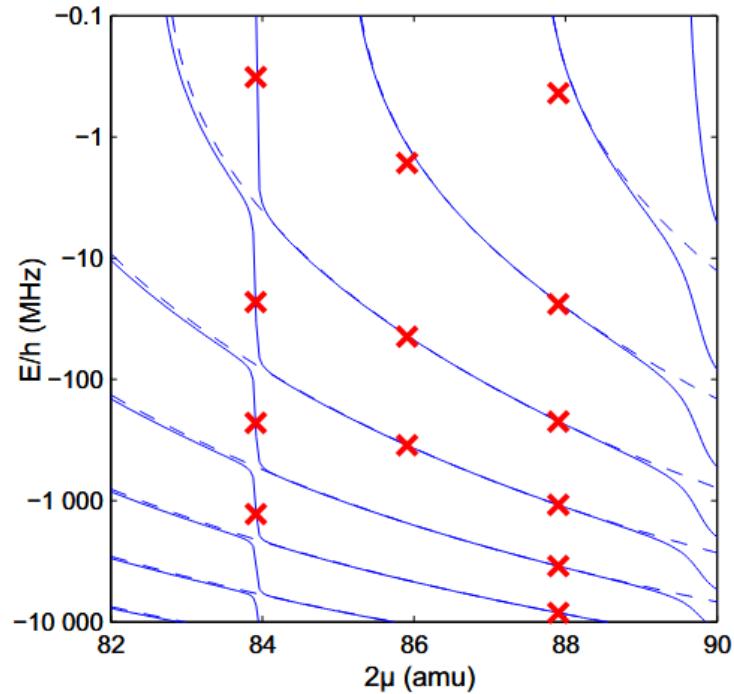


Figure 3.3: Caption

3.2.2 Ytterbium: hfs

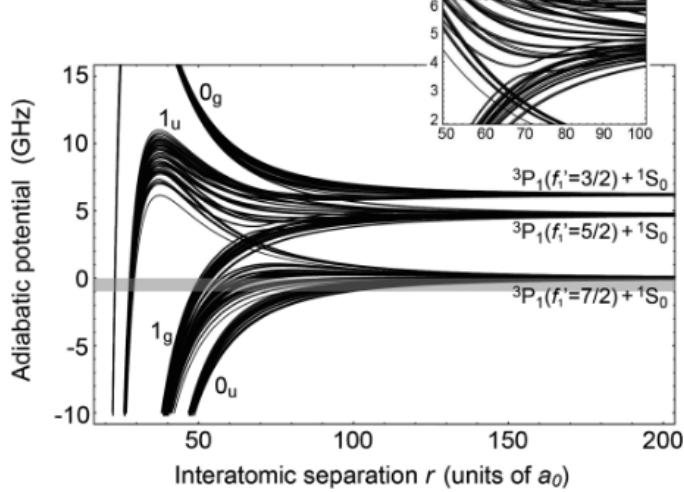


FIG. 2. Adiabatic molecular potentials for a $^{173}\text{Yb}_2$ dimer in the $^1\text{S}_0 + ^3\text{P}_1$ channel as functions of the interatomic separation r . The molecular potentials for 205 different (T, F, R) configurations are displayed, which are accessible via PA from the initial s -wave colliding atoms in the $^1\text{S}_0 + ^1\text{S}_0$ 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...

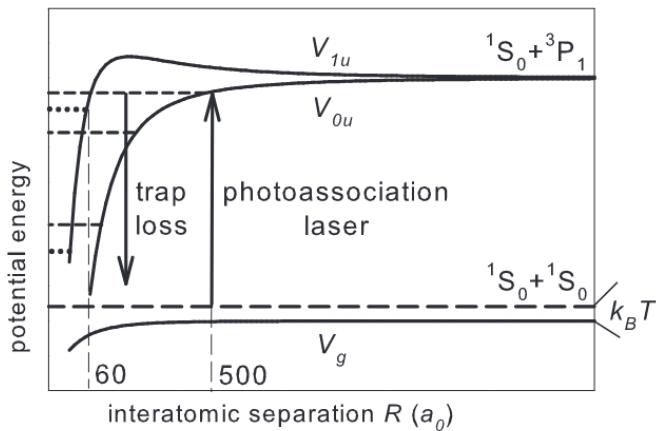


Figure 3.5: Caption

3.4.1 Technical issues of inhabilitation of photoassociation

3.4.1.1 Laser width

3.5 ^{87}Sr 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 $^{87}\text{Sr}-^{87}\text{Sr}$ molecules

Conclusion

Bibliography

Appendix A

Algorithms