Towards description of light antiprotonic atoms (in relation with PUMA experiment)

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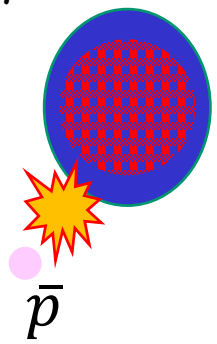
Goals

- It is believed that some exotic nuclei, which are rich in neutrons (number of neutrons exceeds largely number of protons) has more extended neutron distribution– neutron skins
- It is also believed that a imminent annihilation happens once slow antinucleon « touches » nucleon

PUMA project



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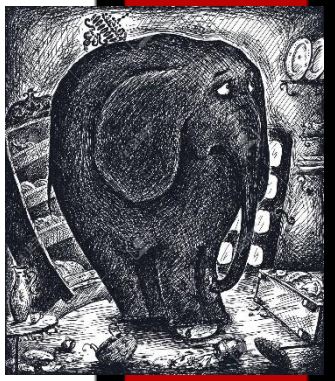


PUMA project

- Slow antiproton is captured onto highly excited orbitals (n~30)
- It cascades through Auger & X-ray emission to low orbits
- From low orbit it is captured

Signal

- Atomic cascade → Atomic energy levels
- Annihilation products →« Annihilates on proton/neutron »

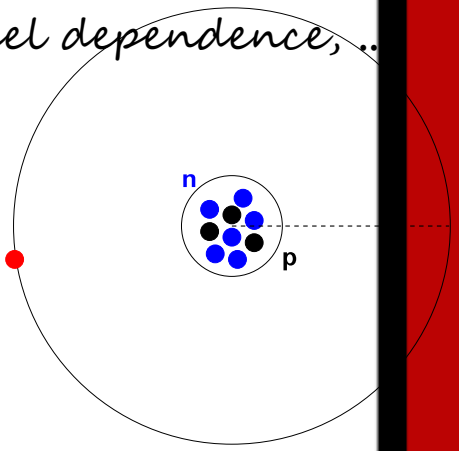
Goals

The goal of **PUMA** (CERN/FAIR) project is to measure nuclear neuron skins from the $\bar{p}$A annihilation data. Sucess of the project strongly relies on theory support, since it is still not clear:

- if the exp. data lead to unambiguous conclusion?
- can we interpret them?
- if yes, how and how well?

Accuracy of the solutions, quality of the input, model dependence, ..

Our aim is to provide the «best» solutions for the accessible systems and use this knowledge to build «antiproton-nucleus» potentials for the systems of the experimental realm



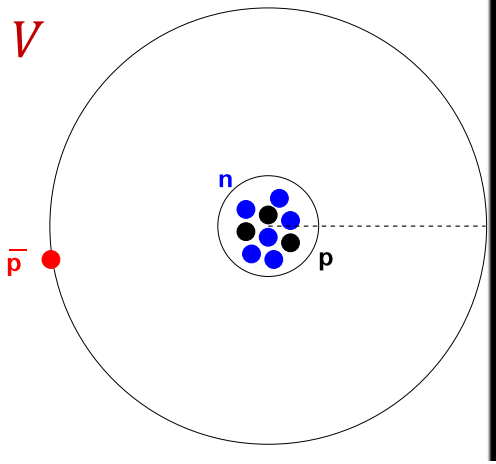
PUMA: T. Aumann, W. Bartmann, A. Bouvard, O. Boine-Frankenheim, A. Broche, F. Butin, D. Calvet, **J. Carbonell**, P. Chiggiato, H. De Gersem, R. De Oliveira, T. Dobers, F. Ehm, J. Ferreira Somoza, J. Fischer, M. Fraser, E. Friedrich, M. Gomez-Ramos, J.-L. Grenard, **G. Hupin**, K. Johnston, Y. Kubota, P. Indelicato, **R. Lazauskas**, S. Malbrunot-Ettenauer, N. Marsic, W. Müller, S. Naimi, N. Nakatsuka, R. Necca, D. Neidherr, G. Neyens, **A. Obertelli**, Y. Ono, S. Pasinelli, N. Paul, E. C. Pollacco, D. Rossi, H. Scheit, R. Seki, A. Schmidt, L. Schweikhard, S. Sels, E. Siesling, T. Uesaka, M. Wada, F. Wienholtz, S. Wycech, S. Zacarias

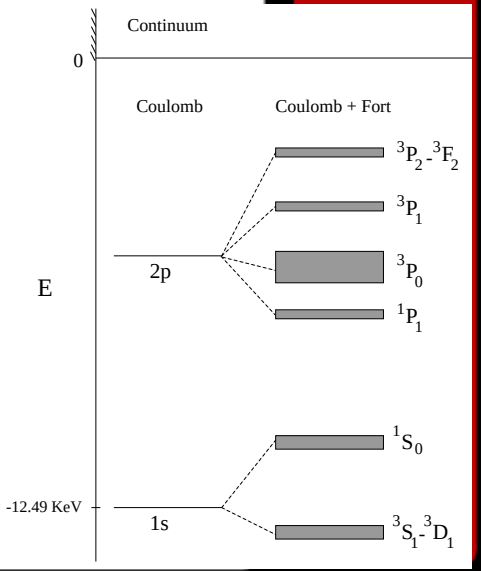
Introduction

Very interesting problem of interdisciplinary physics

- Our aim, provide the « best possible » solution for the NR Schrödinger eq.

$$\hat{H}|\Psi\rangle = E|\Psi\rangle; \quad \hat{H} = \widehat{H_0} + V$$





Introduction

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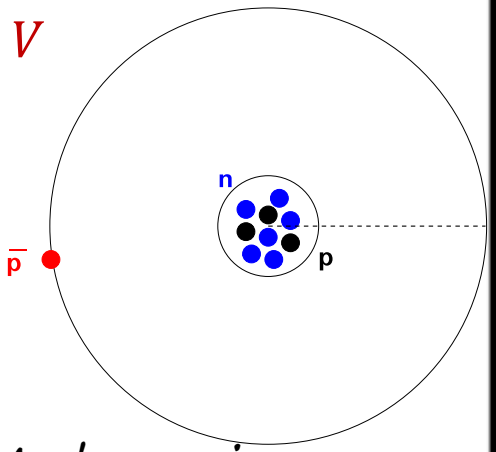

The problem is extremely ambitious:

- ~~Relativity~~ and annihilation dynamics
- Complexity of the $\bar{p}N$ interaction and $\bar{p}A$ dynamics
- Presence and coupling between the very different physical scales: atomic (Coulomb), nuclear ($\bar{p}A$), subatomic (annihilation) !!
- Non-perturbative problem!