Evolution of shell structure in the neutron–rich $^{37}$Rb isotopes

Diego A. Torres
Contents

1) The neutron rich region $A \sim 100$.

2) Experimental setups.

3) Results: The extended level scheme.
   Angular correlations.
   Lifetime measurements.

4) Shell model calculations.

5) Conclusions and ongoing efforts.
The neutron rich region A ≈ 100

\[ g_{9/2}, h_{11/2} \]

Diego A. Torres
IoP conference 2009

Nuclear Physics Group
**Experiment 1**

\[ \frac{96}{40} \text{Zr} + \frac{124}{50} \text{Sn} @ 576 \text{ MeV} \]

Thin target experiment

**PRISMA + CLARA Setup**

- **CLARA – Clover Array**
- \( \gamma \)-ray detector

**Beam**

- **TARGET**
- **QUADRUPOLE MAGNET**
- **DIPOLÉ MAGNET**
- **MCP** (Micro-Channels Plate)
- **MWPPAC**
- **IONIZATION CHAMBERS**

\[ \theta_{grazing} = 38^\circ \]

Diego A. Torres

IoP conference 2009

Nuclear Physics Group
Experiment 2
\[
\begin{array}{c}
\frac{36}{26} S + \frac{176}{70} Yb @ 230 \text{ MeV}
\end{array}
\]
Thick target experiment.

GASP Setup

GASP – HpGe + BGO detectors
\(\gamma\)-ray detection
Results

Prisma+Clara $\gamma$-ray spectrum

Level scheme
Prisma/Clara + GASP

Diego A. Torres
IoP conference 2009
D. A. Torres, et al, to be published.

Nuclear Physics Group

Colloquium UWS December 2008
Spin Assignment

$\gamma\gamma$ angular correlations

Gate $\gamma_0(t_0)$ $\gamma_1(t_1)$

ACO$(t_0, t_1, \theta) = \sum \lambda q_\lambda A_{\lambda\lambda}(t_0, t_1) P_\lambda(\cos \theta)$

Geometrical factors GASP:

Known coefficients.

Legendre Polynomials.


Diego A. Torres

IoP conference 2009

Nuclear Physics Group
Spin Assignment

D. A. Torres et al., to be published.

Nuclear Physics Group
Isomeric States

\[ \tau \sim 15(3) \text{ ns} \]

D. A. Torres, et al., to be published.

Nuclear Physics Group

Diego A. Torres
IoP conference 2009
Shell Model Calculations

In collaboration with Morten Hjorth–Jensen, Oslo University.

There is not an interaction for the region!.

Orbitals used in the calculations:

- $2d_{3/2}$
- $3s_{1/2}$
- $1h_{11/2}$
- $1g_{7/2}$
- $2d_{5/2}$
- $1g_{9/2}$
- $2p_{1/2}$
- $1f_{5/2}$
- $2p_{3/2}$

πν

89
37 Rb

Nuclear Physics Group

Diego A. Torres
IoP conference 2009
Shell Model Calculations
Work in progress

In collaboration with Morten Hjorth–Jensen, Oslo University.


Nuclear Physics Group

Diego A. Torres
IoP conference 2009
Summary and ongoing efforts

\(^{37}\)Rb experimental study.
   Extended level scheme.
   Isomeric states.
   Angular correlations.

\(^{37}\)Rb theoretical analysis.
   Effective interaction.
   Signatures of collective effects.

Upcoming thick target experiment

\(^{98}\)Zr\(^{+}\)\(^{124}\)Sn @ 6 MeV/u

GASP array.

\(\gamma \gamma \) and \(\gamma \gamma \gamma \) information.
Thank you!
Shell Model Calculations
Work in progress

In collaboration with Morten Hjorth–Jensen, Oslo University.

Interaction: N3L0 or CD–Bohn.

Renormalization: $V_k$

$^{78}$Ni core

Single Particles Energies: fit using known states.

For protons we get a good reproduction of excited states in $^{87}_{37}$Rb$_{50}$ with the SPE

- $\text{SPE}(f_{5/2}) = 12.398$
- $\text{SPE}(p_{3/2}) = 13.233$
- $\text{SPE}(p_{1/2}) = 11.831$
- $\text{SPE}(g_{9/2}) = 12.517$
GASP Results

Diego A. Torres
IoP conference 2009

Nuclear Physics Group
The $^{89}$Rb Level Scheme

New!

D. A. Torres, et al., to be published.

Diego A. Torres
IoP conference 2009
Spin and Parity Assignment

\[ \gamma - \gamma \] angular correlations

---

Work in progress!


---

Diego A. Torres

IoP conference 2009

Nuclear Physics Group
Isomeric States

\[ 975+221 \rightarrow \text{DP} \]
\[ 975+221 \rightarrow \text{DD} \]

Gates

Work in progress!

Isomeric States

\[ \tau \sim 15(3) \text{ ns} \]

The $^{89}$Rb Level Scheme

D. A. Torres, et al., to be published.

Diego A. Torres
IoP conference 2009