

S1010 - Laser Spectroscopy on Neutron-Deficient Francium S1341 - Laser Spectroscopy on Neutron-Rich Rubidium

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• Quick overview of polarizer setup

Introduction of the physics motivations for the two experiments

• Scheduled back to back 18th - 28th August

• First look at data obtained



Myself

• Originally from town called Bingley in Northern England





 Undergraduate and PhD at University of Manchester work based at ISOLDE, CERN

• Started working at TRIUMF July 2013



Polarizer



Taken from O. Shelbaya presentation 2012

Polarizer



Nuclear Observables



- Coupling of nuclear spin with total electron angular momentum produces hyperfine structure
- Measurement of nuclear **spin**, **magnetic** and **electric** moments



- Isotope shift arises from change in energy of atomic transition between two isotopes
- Caused by change in mass and size of nucleus/shape. Can be used to extract changes in **mean-square charge radii**



Francium Motivation

Magnetic hyperfine interaction arises from magnetic field of electrons interacting with magnetisation of the nucleus.



Figure 1: Probability distributions of relevant atomic and single particle nuclear states in Fr.

- Different atomic states have differing radial overlaps. Change in hyperfine A values
- Francium is heaviest alkali element therefore large overlap of nucleus
- N-def Fr lie around N = 126 n-shell closure; almost single particle nature







				0,
E(level) (MeV)	Jn	Δ(MeV)	T _{1/2}	Decay Modes
0.0	(3+)	0.6073	1.8 s <i>3</i>	α:92.00 % ε:8.00 %
0.0410	(7+)	0.6483	1.6 s +5-3	α:90.00 % ε:10.00 %
0.3160	(10-)	0.9233	0.8 s 2	a : 74.00 % ε : 26.00 %

Ground and isomeric state information for ²⁰⁴₈₇Fr



Q_{EC}(8600) Q_α7170



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206
87

E(level) (MeV)	Jn	Δ(MeV)	T _{1/2}	Decay Modes
0.0	(2+,3+)	-1.2424	≈ 16 s	a ≈ 84.00 % ε ≈ 16.00 %
0.0	(7+)	-1.2424	≈ 16 s	a ≈ 84.00 % ε ≈ 16.00 %
0.5310	(10-)	-0.7114	0.7 s 1	IT : 95.00 % a : 5.00 %

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Rubidium Motivation

- Shape coexistence of different nuclear shapes at similar excitation energies
- Observed in regions with sharp changes in trends of RMS charge radii
- Extend charge radii measurements in Rb and investigate deformation











- Slight difference in isotope shifts from literature
- Two states in ⁹⁸Rb: Low spin (Possibly 0) and higher spin with hyperfine splitting
- Many scans taken on each isotope to infer spin









Isomeric ⁹⁸Rb



- HFS of ^{204,205,206}Fr: 2 isomers in both ²⁰⁴Fr and ²⁰⁶Fr
- HFS of ^{98,98m,99}Rb measured and lifetime measurements of ^{98,98m}Rb
- Analysis on hyperfine coefficients of isotopes, nuclear spins and investigation into shape changes across isotopes and isomers



Thanks for Listening

On behalf of the S1010 and S1341 collaborators:



Large thank you to Francium Trap group for use of their laser system