

Ph.D. Defense

Michael Schumaker

DATE: Tuesday, April 21, 2009

TIME: 9:30 a.m.

PLACE: MacNaughton Room 222

University of Guelph

THESIS TITLE:

COULOMB EXCITATION STRUCTURE STUDIES OF ^{21}Ne , $^{20,21}\text{Na}$

ABSTRACT:

The low-energy structures of the radioactive nuclei $^{20,21}\text{Na}$, and the stable nucleus ^{21}Ne have been examined using Coulomb excitation at the TRIUMF-ISAC radioactive ion beam facility. Beams of $\sim 5 \times 10^6$ ions/s were accelerated to 1.7 MeV/A and Coulomb excited in a 0.5 mg/cm^2 $^{\text{nat}}\text{Ti}$ target. Two TIGRESS HPGe clover detectors perpendicular to the beam axis were used for γ -ray detection, while scattered nuclei were observed by the Si detector BAMBINO. For ^{21}Ne and ^{21}Na , Coulomb excitation from the $3/2^+$ ground states to the first excited $5/2^+$ states were observed, while for ^{20}Na , Coulomb excitation was observed from the 2^+ ground state to the first excited 3^+ and 4^+ states. For all beams, $B(\lambda L)$ values were determined using the $2^+ \rightarrow 0^+$ de-excitation in ^{48}Ti as a reference. The resulting $B(E2)\downarrow$ value for ^{21}Ne is $87.5 \pm 5.8 \text{ e}^2\text{fm}^4$, for ^{21}Na $B(E2)\downarrow = 137 \pm 9 \text{ e}^2\text{fm}^4$, while the resulting $B(\lambda L)\downarrow$ values for ^{20}Na are $55 \pm 6 \text{ e}^2\text{fm}^4$ for the $3^+ \rightarrow 2^+$, $35.7 \pm 5.7 \text{ e}^2\text{fm}^4$ for the $4^+ \rightarrow 2^+$, and $0.154 \pm 0.30 \mu\text{N}^2$ for the $4^+ \rightarrow 3^+$ transitions. This analysis significantly improves the measurement of the ^{21}Na $B(E_2; 5/2^+ \rightarrow 3/2^+)$ value, improves the precision of this same transition in ^{21}Ne , and provides the first experimental determination of $B(\lambda L)$ values for the proton-dripline nucleus ^{20}Na .

EXAMINING COMMITTEE:

Chair : D.E. Sullivan

Advisor: C. Svensson

Internal Examiners: Paul Garrett, Jimmy Law

External Examiner: Kris Starosta