Alpha Clusters in ^{32}S, ^{34}S and ^{40}Ca

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The three nuclei ^{32}S, ^{34}S and ^{40}Ca have been examined with the relatively new method of inverse kinematics and a thick gas target. Experiments were carried out using the K-130 cyclotron at Jyväskylä University, accelerating 150 MeV beams of ^{28}Si, ^{30}Si and ^{36}Ar into a scattering chamber filled with helium gas. Detectors at forward angles recorded scattered α-particles and with the help of computer code the events could be traced back to the center-of-mass system and an excitation function constructed. This powerful method gives a continuous energy spectrum for several different angles in one single run, compared to the hundreds of measurements needed to obtain the same data with traditional methods that measure the cross section for many small energy intervals.

The data have been analyzed within a simplified R-matrix formalism along the same lines as in [1]. The nucleus ^{32}S has been thoroughly investigated from an α-cluster point of view also in e.g. [2], [3] and the new data are compared to previous measurements. For ^{34}S and ^{40}Ca the present data is mostly completely new. More than 100 resonances have been identified in each of the investigated nuclei. Most of these resonances have been assigned a spin value, although, quite tentative in some cases. The similarities in the observed structure between the three investigated nuclei are explored. The resonances in all three nuclei are interpreted as indication of a fragmented rotating cluster structure, as illustrated for ^{32}S in Figure 1.

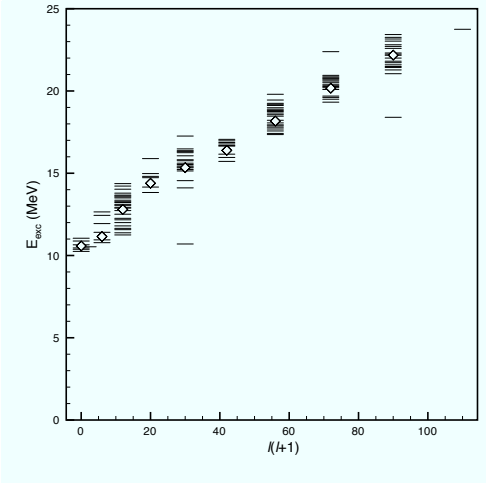

Figure 1: *The linear dependency of energy vs.* $l(l+1)$ *for the resonances in* ^{32}S *indicates a rotational behavior.*

[1] V. Z. Goldberg et al., Physics of Atomic Nuclei **63**, 1518 (2000).
[2] K.-M. Källman et al., Eur. Phys. J. **A16**, 159 (2003).
[3] M. Brenner et al., Acta Phys. Hung. N.S. **11**, 221 (2000).