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## Electromagnetic and thermodynamic properties in the quasi-continuum of mid-mass nuclei through inverse and direct kinematics.

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The electromagnetic properties of nuclei excited to the quasi-continuum region are best studied and explained using statistical decay observables, such as the nuclear level density (NLD) and  $\gamma$ -ray strength function ( $\gamma$ SF). These quantities can be extracted from experimental particle- $\gamma$  coincidence matrix using the Oslo method and Shape method, respectively. In this study, experiments were carried out at iThemba LABS using the AFRODITE array with  $^{84}\text{Kr}$  beam on a deuterated polyethylene target, and proton beam on  $^{64}\text{Ni}$  target to undergo (d, p) reactions, producing  $^{85}\text{Kr}$  and  $^{63}\text{Ni}$ . The nuclear level density and strength function will be extracted from the coincidence events which were detected in the AFRODITE array. The NLD and  $\gamma$ SF will be investigated to i) determine the existence of low-lying energy enhancement in  $^{85}\text{Kr}$ , confirm the reported of low-lying energy enhancement in  $^{63}\text{Ni}$  ii) perform a rigorous test of the Brink-Axel hypothesis in  $^{85}\text{Kr}$  and  $^{63}\text{Ni}$ , and iii) the first experimental determination of thermodynamic properties of  $^{85}\text{Kr}$  and  $^{63}\text{Ni}$ .

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PhD

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