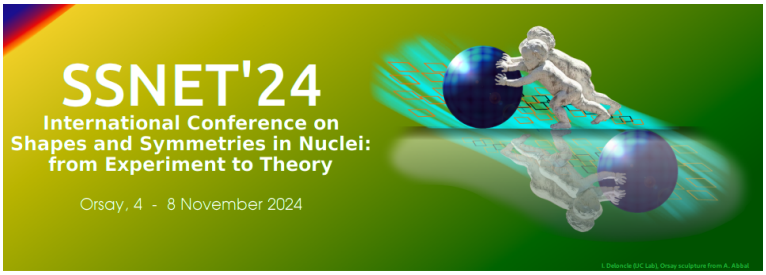


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# Nuclear pairing studies in Dysprosium nucleus

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Pairing in atomic nuclei reveals profound insights into the intrinsic behavior and properties of nuclear systems [1]. Numerous theories have arisen in the exploration of this field, with particular significance attributed to the BCS theory [2]. Extending the boundaries of this theory, the Finite Temperature BCS (FTBCS) theory, with the inclusion of angular momentum [3], has emerged as an important framework for understanding the properties of atomic nuclei [4]. Lately, there has been a notable emphasis on the integration of quasi-particle number fluctuations into the FTBCS theory (FTBCS1) [5].
This study focuses on the Dysprosium (Dy) nucleus, employing the FTBCS1 model to investigate the impact of quasi-particle number fluctuations on pairing gaps, heat capacity, entropy, and level density. Contrary to the expectations from FTBCS theory, the findings reveal that the gap parameter, instead of vanishing at a specific temperature, experiences a gradual reduction, maintaining a finite value. Similar effects are observed in entropy and heat capacity plots, which can be attributed to quasi-particle number fluctuations. Notably, a smooth super-fluid to normal phase transition is observed in FTBCS*emphasized text*1, a phenomenon absent in traditional FTBCS theory.

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