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Study of shape coexistence in 60Fe via lifetime measurement of excited 0+ states

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The neutron-rich nuclei below the nickel isotopic chain manifest a sudden onset of collectivity going toward $N = 40$, despite the proximity of the magic $Z = 28$ number. This is interpreted as a result of the change in the underlying shell structure allowing correlation energies to dominate the monopole energy. In other words, structures built on Np-Nh configurations become yrast: we are in the Island of Inversion (IoI). The configurations that are yrast in the IoI can often be found as non-yrast structures in neighboring nuclei and give rise to shape-coexistence. Therefore, further nuclear structure studies devoted to the exploration of shape-coexistence phenomena in nuclei near to the IoI at $N = 40$ will provide valuable data to constrain and test nuclear theory.

To study the presence of coexisting shapes, the measurement of experimental accessible nuclear properties, such as the lifetime of the 0_j^+ excited states, is essential. We propose to measure the lifetime of the first excited 0_j^+ states in ^{60}Fe with the Recoil Distance Doppler Shift technique by populating low-lying yrast and non-yrast states in ^{60}Fe via the multi-nucleon transfer reaction ^{58}Fe(^{18}O,^{16}O)^{60}Fe at energy below the Coulomb barrier. De-excitation γ rays will be detected in coincidence with the back-scattered ions of ^{16}O by using the γ-rays tracking array AGATA and the SPIDER detector for heavy ions.

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