Can we reveal the core-chemical composition of ultra-massive white dwarfs through their magnetic fields?

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Ultra-massive white dwarfs are particularly interesting objects, as they are related to type Ia Supernovae and micronovae explosions, merger events, and Fast Radio Bursts. Traditionally, ultra-massive white dwarfs were thought to harbour oxygen-neon (ONe) cores. However, recent theoretical studies and observations suggest that some ultra-massive white dwarfs could have carbon-oxygen (CO) cores. Although several studies have attempted to elucidate the core composition of ultra-massive white dwarfs, to date, it has not been possible to distinguish them through their observed properties. Here, we present a new method for revealing the core-chemical composition in ultra-massive white dwarfs that is based on the study of magnetic fields generated by convective mixing induced by the crystallization process. ONe white dwarfs crystallize at higher luminosities than their CO counterparts. Hence, the study of magnetic ultra-massive white dwarfs in the particular domain where ONe cores have reached the crystallization conditions but CO cores have not, may provide valuable support to their ONe core-chemical composition, since ONe white dwarfs would display signs of magnetic fields and CO would not. We apply our method to eight white dwarfs with magnetic field measurements and we suggest that these stars likely harbour ONe cores.