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How peculiar was the recent extended minimum - A hint towards double minima

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In this paper, we address the controversy regarding the recent extended solar minimum as seen in helioseismic low- and intermediate-degree mode frequencies: studies from different instruments identify different epochs of seismic minima. Here we use mode frequencies from a network of six identical instruments, Global Oscillation Network Group, continuously collecting data for more than 15 years, to investigate the epoch of minimum in solar oscillation frequencies prior to the beginning of solar cycle 24. We include both low- and intermediate-degree modes in the ℓ range of 0 -- 120 and frequency range of 2.0 -- 3.5 mHz. In this analysis, we demonstrate that there were indeed two minima in oscillation frequencies, depending upon the degree of modes, or more precisely the lower turning point radius of the propagating wave. We also analyze frequencies as a function of latitude to identify the beginning of solar cycle 24. We observe two minima at high latitudes and a single minimum at mid/low latitudes. This scenario is in contrast to cycle 23 where the epoch of seismic minimum did not change with latitude or depth. Our results also hint towards a possible role of the relic magnetic field in modifying the oscillation frequencies of modes sampling deeper layers.

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