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New Measurement Resolves Key Astrophysical Fe XVII Oscillator Strength Problem

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One of the most enduring and intensively studied problems of x-ray astronomy is the disagreement of state-of-the art theory and observations for the intensity ratio of two Fe XVII transitions of crucial value for plasma diagnostics, dubbed $3C$ and $3D$. We unravel this conundrum at the PETRA III synchrotron facility by increasing the resolving power 2.5 times and the signal-to-noise ratio thousandfold compared with our previous work. The Lorentzian wings had hitherto been indistinguishable from the background and were thus not modeled, resulting in a biased line-strength estimation. The present experimental oscillator-strength ratio $R_{\rm exp} = f_{3C}/f_{3D} = 3.51(2)_{\rm stat}(7)_{\rm sys}$ agrees with state-of-the-art calculations of $R_{\rm th} = 3.55(2)$, as well as with some previous theoretical predictions. To further rule out any uncertainties associated with the measured ratio, we also determined the individual natural linewidths and oscillator strengths of $3C$ and $3D$ transitions, which also agree well with the theory. This finally resolves the decades-old mystery of Fe XVII oscillator strengths.

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