Even denominator and higher Landau level fractional quantum Hall states in ZnO

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The ZnO two-dimensional electron system has recently emerged as an alternative platform for investigating 2D correlation physics. Advances in growth techniques now allow the realisation of samples with electron mobilities exceeding $\mu = 700{,}000$ cm^2/Vs [1], enabling the observation of an extensive series of fractional quantum Hall states (FQHS) in the lowest Landau level [2].

In this work, we present low temperature magnetotransport data focusing on the higher Landau level physics of the system. Figure 1 displays the magnetotransport, where a rich variety of FQHS are revealed for $\nu > 2$ at base $T \approx 20$mK. Most notable is the clear quantisation of the even denominator $\nu = 7/2$ FQHS; the first observation of an even denominator state outside of the GaAs electron system. While this state is stable, the $\nu = 5/2$ FQHS is curiously absent. Rather, the $\nu = 5/2$ region presents as asymmetric, with the observation of FQHS $\nu = 8/3$, 13/5 and 18/7 on the low field side contrasted by a complete absence of FQHS on the high field side. Instead, a single reentrant integer quantum Hall state (RIQHS) is revealed at *higher* temperature. Such results suggest that ZnO allows the exploration of new and unique facets of 2D electron correlation physics.

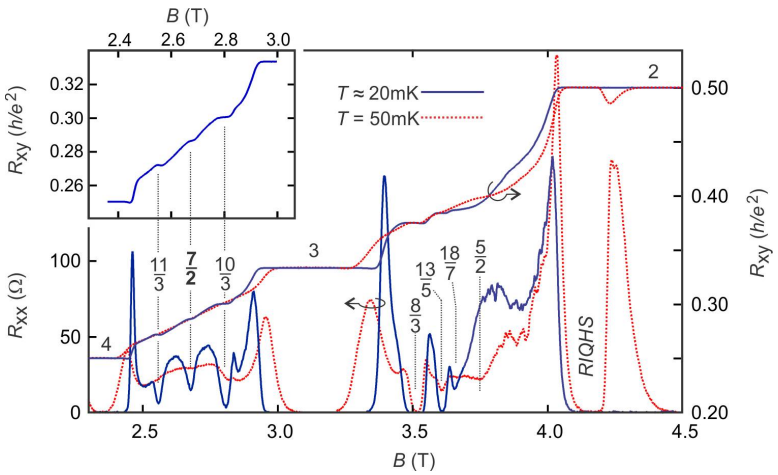

Figure 1: Magnetotransport at $T \approx 20$mK (blue, solid) and 50mK (red, dotted) for $4 > \nu > 2$ with notable quantised states, and the location of $\nu = 5/2$ indicated. The inset displays a close-up of the quantised Hall resistance for $4 > \nu > 3$.

[1] J. Falson *et al.*, *Appl. Phys. Express* **4**, 091101 (2011).
[2] D. Maryenko *et al.*, *Phys. Rev. Lett* **108**, 186803 (2012).