# Soft Excitation Modes in Quantum Phase Transitions in Low-dimensional Electron Systems*

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Strongly correlated two-dimensional electrons in quantum Hall states of coupled semiconductor bilayers display a diverse set of broken symmetry many-body states that are accessible under controllable experimental conditions [1]. These intriguing quantum ground states manifest the impacts of fundamental electron interactions. The different states of the electron bilayers are linked by quantum phase transitions. Continuous transformations in these electron liquids are driven by soft collective excitation modes across the tunnelling gap of the bilayers [2]. This talk reviews recent resonant inelastic light scattering experiments that access these soft modes and probe their evolution.

The focus of the presentation is on experiments that explore the excitations of electron bilayers in quantum Hall states with total Landau level filling factors $\nu_T = 2$ and $\nu_T = 1$ [3,4,5]. The experiments succeeded in probing soft spin and charge collective modes at both zero and finite wavevectors, when the states of the bilayers are in close proximity to transitions to broken-symmetry phases with interlayer coherence. The results presented here uncover significant evidence that softening of tunnelling collective excitations plays major roles in the phase transitions that emerge at $\nu_T = 1$ and $\nu_T = 2$. The observed mode softening reveals that excitonic interactions have a leading role in the instabilities in highly correlated states of the electron bilayers. The experiments reviewed in this talk demonstrate new avenues of research on continuous quantum phase transitions in electron liquids of low-dimensional systems.

References:

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