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Discovery of a New Excited Pair State in Superfluid ^{3}He[1] JOHN P. DAVIS, JOHANNES POLLANEN, HYOUNGSOON CHOI, JAMES A. SAULS, WILLIAM P. HALPERIN, Northwestern University — In superfluid ^{3}He, the order parameter collective modes correspond to excited states of the ^{3}He Cooper pairs and are classified by their total angular momentum, $J = L + S$. Many of these modes with $J \leq 2$ have been experimentally observed through longitudinal sound measurements or NMR. As a result of coupling to the collective mode with J= 2 and $m_J = \pm 1$ there is an enhanced restoring force for transverse sound in superfluid ^{3}He-B. Previously, we have used the interference of transverse sound waves to study this collective mode. Recently we have discovered a new coupling to transverse sound near the pair-breaking threshold with the classic signatures of a collective mode. Application of a magnetic field results in circular acoustic birefringence and a new acoustic Faraday effect, from which we extract the corresponding Verdet constant. Selection rules for the coupling to transverse sound and acoustic birefringence require this mode to have $J \geq 4$, suggesting that this mode is most likely the J= 4 ($m_J = \pm 1$) mode resulting from an attractive f-wave pairing interaction in this p-wave superfluid.

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