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Spontaneous circular polarization of photoluminescence from WS_2 single layers[1] THOMAS SCRACE, YUTSUNG TSAI, BIPLOB BARMAN, PEIYAO ZHANG, ATHOS PETROU, SUNY Buffalo, GEORGE KIOSEOGLOU, University of Crete, MAREK KORKUSINSKI, National Research Council Canada, ISIL OZFIDAN, PAWEL HAWRYLAK, National Research Council Canada and University of Ottawa — We have carried out a magnetoluminescence study of WS_2 single layer crystals excited with linearly polarized light. The photoluminescence (PL) contains two features. The first is associated with the neutral exciton (X^0); the second feature is due to the recombination of negatively charged excitons (X^-) in the presence of a two-dimensional electron gas (2DEG). The $X^- - 2DEG$ feature has a non-zero circular polarization up to 19% at zero magnetic field even though the PL excitation light is linearly polarized. The circular polarization is effected by an external magnetic field applied perpendicular to the crystal plane at $2\%/Tesla$. The zero field circular polarization of the $X^- - 2DEG$ photoluminescence feature is interpreted as due to the existence of a spontaneously valley polarized 2DEG. This is a new state possible in WS_2 due to valley and spin locking and a strong electron-electron interaction.

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