Non-topological 2DEG at the surface of YbB$_6$ and Divalent Hexaborides\textsuperscript{1} J.D. DENLINGER, Lawrence Berkeley Nat’l Lab, C.H. MIN, F. REINERT, U. Wuerzburg, BOYOU N KANG, GIST, D.J. KIM, Z. FISK, UC Irvine, K. GOTLIEB, A. LANZARA, UC Berkeley, C.-J. KANG, B.I. MIN, POSTECH, J.W. ALLEN, U. of Michigan — A recent theoretical prediction of YbB$_6$ being an f-d band-inverted mixed-valent topological insulator very similar to SmB$_6$ \cite{Weng14} and subsequent angle-resolved photoemission topological interpretations of V-shaped electron pockets \cite{Xia14} are at odds with the previous experimental classification of the material as a divalent small p-d band gap semiconductor. Our angle-resolved photoemission of the (001) surface of YbB$_6$ confirms the nearly pure divalency of Yb and demonstrates that in-gap surface electron pockets, with slightly non-parabolic dispersion indicative of a small p-d gap, originate from quantum well states confined to the inversion layer of n-type surface regions with cation termination. Spatial- and time-dependent variations of the surface Fermi-level pinning are shown to be universal polar-surface-driven features of the semiconducting divalent hexaborides including CaB$_6$, SrB$_6$ and EuB$_6$. Also DFT+U+SO+mBJ theoretical band calculations are able to reproduce the experimental energy ordering of a p-d gap existing at $E_F$ above the Yb 4f states with no f-d or p-d band inversions.

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