The band-edge light absorptance of all semiconductors is ruled by the fine structure constant

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Bulk and low-dimensional semiconductors have found numerous applications in optoelectronics; e.g. photodetectors, LEDs, and solar cells. The dynamics and energetics of light emission have been extensively investigated over the past half century. However, a quantitative comparison of the absorption strength of bulk and low-dimensional semiconductors has remained elusive. *Here, we report generality in the band-edge light absorptance of all direct semiconductors, independent of the type of compound and the dimensions.*

First, we provide atomistic tight-binding calculations that show that the absorptance of semiconductor quantum wells equals mπα (m = 1 or 2 with α as the fine-structure constant), in agreement with reported experimental results. Then, we show experimentally that a monolayer (superlattice) of quantum dots has similar absorptance, suggesting an absorptance quantum of mπα per (confined) exciton diameter. Extending this idea to bulk semiconductors, we experimentally demonstrate that an absorptance quantum equal to mπα per exciton Bohr diameter explains their widely varying absorption coefficients. We thus provided *compelling experimental evidence* that the absorptance quantum πα per exciton diameter rules the band-edge absorption of all direct semiconductors, regardless of their dimension.

In the last part of the lecture, we highlight a k.p model in two dimensions, originally developed for graphene, that rationalize the results observed for 2D semiconductors. We believe that the results should eventually be explained by a more general and thorough theory than what is now available.

The Fine-Structure Constant as a Ruler for the Band-Edge Light Absorption Strength of Bulk and Quantum-Confined Semiconductors." Nano Letters **21,** 9426 (2021).

Universality of optical absorptance quantization in two-dimensional group-IV, III-V, II-VI, and IV-VI semiconductors." Physical Review B **105**(3)