Zhao *et al.* Reply: The effectiveness of a theory lies in its ability to accurately predict an experimental outcome. In Ao's Comment [1], two specific predictions were made, but both are incompatible with our experiment. Specifically,

(1) According to Refs. [1–3], the Hall sign reversal should vanish below a lower critical field. However, as seen in Fig. 2(a) in our Letter [4], which we replot here as Fig. 1, specifically for low magnetic fields, the Hall resistance is negative (i.e., reverses in sign) at all nonzero magnetic fields, without any hint to the existence of the lower critical field. Neither was a lower critical field reported in previous experiments.

(2) Likewise, our data do not support the prediction in Eq. (11) of Ref. [3] that the Hall conductivity σ_{xy} follows an Arrhenius law [1]. As seen in the inset of Fig. 1, σ_{xy} does not evolve monotonically with temperature, much less follow an Arrhenius law. In the Supplemental Material of Ref. [4], we show that the Hall sign reverses above the Berezinskii-Kosterlitz-Thouless transition around 60 K, where the Arrhenius behavior of longitudinal resistance R_{xx} places the Hall sign reversal within the thermally activated flux flow regime above the vortex lattice melting temperature [5]. This confirms that the Hall sign reverses in the vortex-liquid regime where the vortex lattice and, therefore, vortex vacancies simply do not exist. This agrees with all other experiments where the sign reversed Hall effect has been mostly seen in the vortex-liquid regime, before vanishing as the vortex liquid freezes into a solid.

A detailed look at the references in Ao's Comment [1] contests his claim that his model is supported by other experiments. Of the 14 papers Ao referenced, Refs. [4,6–18], in Ref. [1], none quantitatively compared the predictions of his theory to experimental results. The only paper (Ref. [17]) which made quantitative comparisons used an unrelated numerical simulation instead of Ao's predictions, and the only paper (Ref. [14]) to indicate Ao's theory explains their data made this claim in a single sentence without discussion. Even his Ref. [6], which "tested qualitatively" his theory with experiment, is Ao's Comment, which appeared without a single equation or fit to experiment. At the same time, Refs. [8,11] indicated that Ao's theory is inapplicable to their experiment. In another 9 papers (Refs. [4,9,10,12,13,15–18]), Ao's work was simply acknowledged in passing as one of several references, and appeared without any discussion. Therefore, contrary to his claim, his model has not been validated by previous experiments.

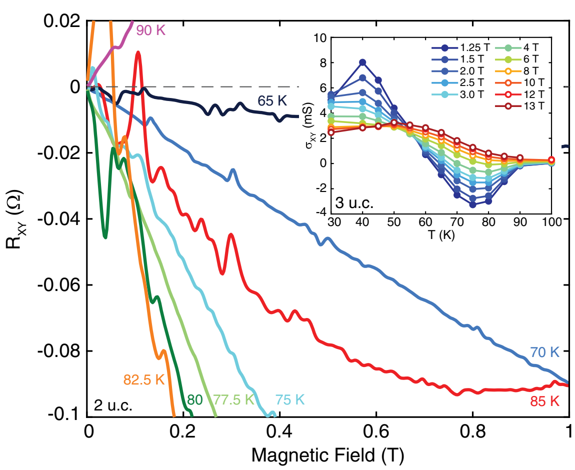

FIG. 1. Hall sign reversal for a 2.0 unit cell thick Bi-2212 crystal at low magnetic fields. We observe no evidence of a lower critical field. Inset: Temperature dependence of the Hall conductivity at various constant magnetic fields for a 3 u.c. device.

The inability of Ao's theory to describe the experiment does not come as a surprise. In his theory he claims [3] that "… the Hall anomaly can be understood based on the vortex vacancy motion in a pinned vortex lattice." However, the temperature interval where the sign reversal is observed falls mostly into the vortex-liquid regime where the vortex lattice, let alone vortex vacancies, does not exist. In other words, Ao's theory does not explain our data.

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S. Y. Frank Zhao,[1] Nicola Poccia,[1] Margaret G. Panetta,[1] Cyndia Yu,[1] Jedediah W. Johnson,[1] Hyobin Yoo,[1] Ruidan Zhong,[2] G. D. Gu,[2] Kenji Watanabe,[3] Takashi Taniguchi,[3] Svetlana V. Postolova,[4,5] Valerii M. Vinokur[6,7] and Philip Kim[1,*]

[1]Department of Physics, Harvard University
Cambridge, Massachusetts 02138, USA
[2]Department of Condensed Matter Physics and Materials Science, Brookhaven National Laboratory
Upton, New York 11973, USA
[3]National Institute for Materials Science
Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan
[4]Institute for Physics of Microstructures RAS
Nizhny Novgorod 603950, Russia
[5]Rzhanov Institute of Semiconductor Physics SB RAS
Novosibirsk 630090, Russia
[6]Materials Science Division, Argonne National Laboratory
Argonne, Illinois 60439, USA
[7]Consortium for Advanced Science and Engineering,
Office of Research and National Laboratories,
University of Chicago
Chicago, Illinois 60637, USA

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*pkim@physics.harvard.edu

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