Response to "Comment on 'Transverse rectification in superconducting thin films with arrays of asymmetric defects'" [Appl. Phys. Lett. 92, 176101 (2008)]

E. M. Gonzalez,[1] N. O. Nunez,[1] J. V. Anguita,[2] and J. L. Vicent[1,a)]
[1]*Departamento Física Materiales, Facultad Ciencias Físicas, Universidad Complutense, 28040 Madrid, Spain*
[2]*Instituto Microelectrónica, CSIC, Tres Cantos 28760 Madrid, Spain*

(Received 8 April 2008; accepted 16 April 2008; published online 2 May 2008)

[DOI: 10.1063/1.2920161]

Silhanek *et al.*,[1] in their comment on our recent letter,[2] raised concerns regarding the effect of the well-known inhomogeneous current distribution at the corners of cross-shaped bridges. While these concerns are understandable, they were considered by us earlier and have been ruled out for the following simple reasons:

(i) Cross-shaped bridges were used in our earlier measurements of vortex lattice ratchet effect[3] and here precisely to avoid these types of effects. In this geometry, the only asymmetry in the experiment is due to the asymmetric potential wells (produced by the magnetic triangles).

(ii) Others, including some of the authors of the comment, have published experimental data on guided vortex motion and in-plane anisotropy of the vortex mobility using the very same bridge geometry in films with submicrometric holes.[4] These authors even incorporate, in patterned films, an unusual position of the voltage probes within the cross, which may induce inhomogeneous current distribution in the center of the bridge. However, they believe that their results are not affected by this.

(iii) Simulations of the transversal effect by Olson–Reichhardt and Reichhardt[5] have been done using parameters relevant to Nb films that match our experimental parameters (Ref. 5, p. 126, bottom of second column). These authors claim that, "The magnitude of the rectification is comparable to that seen in f_{AC}^{Y} (i.e., the longitudinal case) and it should thus be experimentally observable" (Ref. 5, p. 130, second column).

(iv) Even if all other above mentioned issues are discarded and they are not taken into account, it is hard to understand how, in a nonperfect cross-shaped bridge, a leakage of the longitudinal ratchet can produce the transversal signal observed by us for the following reasons: The longitudinal ratchet consists of an output voltage which changes from positive for small fields to negative for large ones.[3] This means that there is a reversal in the longitudinal signal. Contrary to this, the transverse ratchet always has the same sign (negative) for the same range of applied magnetic fields, without any reversal at all. Moreover, increasing the applied magnetic field, there is a longitudinal ratchet (of comparable size), but the transverse one vanishes. These facts could be easily explained in the framework of numerical simulations using the appropriate overdamped Langevin equation.[6]

In summary, all indications point that the concerns raised by Silhanek *et al.*[1] do not affect the results presented in our earlier paper.

a)Electronic mail: jlvicent@fis.vcm.cs.

[1]A. V. Silhanek, J. Van de Vondel, V. V. Moshchalkov, A. Leo, V. Metlushko, B. Ilic, V. R. Misko, and F. M. Peeters, Appl. Phys. Lett. **92**, 176101 (2008), preceding comment.
[2]E. M. Gonzalez, N. O. Nunez, J. V. Anguita, and J. L. Vicent, Appl. Phys. Lett. **91**, 062505 (2007).
[3]J. E. Villegas, S. Savel'ev, F. Nori, E. M. Gonzalez, J. V. Anguita, R. Garcia, and J. L. Vicent, Science **302**, 1188 (2003).
[4]A. V. Silhanek, L. Van Look, S. Raedts, R. Jonckheere, and V. V. Moshchalkov, Phys. Rev. B **68**, 214504 (2003).
[5]C. Olson-Reichhardt and C. Reichhardt, Physica C **432**, 125 (2005).
[6]L. Dinis, E. M. Gonzalez, J. V. Anguita, J. M. R. Parrondo, and J. L. Vicent, New J. Phys. **9**, 366 (2007); L. Dinis, E. M. Gonzalez, J. V. Anguita, J. M. R. Parrondo, and J. L. Vicent, Phys. Rev. B **76**, 212507 (2007).

