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Anomalous diffusion of Dirac fermions

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References

[1] D. A. Abanin, P. A. Lee, and L. S. Levitov, Phys. Rev. Lett. **96**, 176803 (2006).

[2] D. A. Abanin and L. S. Levitov, Science **317**, 641 (2007).

[3] S. Adam, E. H. Hwang, V. Galitski, and S. Das Sarma, Proc. Natl. Acad. Sci. USA **104**, 18392 (2007).

[4] S. Adam and S. Das Sarma, Phys. Rev. B **77**, 115436 (2008).

[5] A. R. Akhmerov and C. W. J. Beenakker, Phys. Rev. Lett. **98**, 157003 (2007).

[6] I. L. Aleiner and K. B. Efetov, Phys. Rev. Lett. **97**, 236801 (2006).

[7] S. Alexander and R. Orbach, J. Phys. Lett. (Paris) **43**, L625 (1982).

[8] A. Altland, Phys. Rev. Lett. **97**, 236802 (2006).

[9] P. W. Anderson, Phys. Rev. **109**, 1492 (1958).

[10] T. Ando, T. Nakanishi, and R. Saito, J. Phys. Soc. Japan **67**, 2857 (1998).

[11] Daniel ben-Avraham and Shlomo Havlin, *Diffusion and Reactions in Fractals and Disordered Systems* (Cambridge University Press, 2000).

[12] D. A. Bagrets and Yu. V. Nazarov, Phys. Rev. B **67**, 085316 (2003).

[13] J. H. Bardarson, J. Tworzydło, P. W. Brouwer, and C. W. J. Beenakker, Phys. Rev. Lett. **99**, 106801 (2007).

[14] E. Barkai, V. Fleurov, and J. Klafter, Phys. Rev. E **61** 1164 (2000).

[15] P. Barthelemy , J. Bertolotti, and D. S. Wiersma, Nature **453**, 495 (2008).

[16] F. Bartumeus, M. G. E. Da Luz, G. M. Viswanathan, and J. Catalan, Ecology **86**, 3078 (2005).

[17] C. W. J. Beenakker and H. van Houten, Solid State Phys. **44**, 1 (1991); arXiv:cond-mat/0412664.

[18] C. W. J. Beenakker and M. Büttiker, Phys. Rev. B **46**, 1889 (1992).

[19] C. W. J. Beenakker and C. Schönenberger, Physics Today, May 2003, p. 37.

[20] C. W. J. Beenakker, Rev. Mod. Phys. **80**, 1337 (2008).

[21] D. Ben-Avraham and S. Havlin, J. Phys. A **15**, L691 (1982).

[22] C. M. Bender, K. A. Milton, and D. H. Sharp, Phys. Rev. Lett. **51**, 1815 (1983).

[23] B. A. Bernevig, T. L. Hughes, and S.-C. Zhang, Science **314**, 1757 (2006).

[24] Ya. M. Blanter and M. Büttiker, Phys. Rep. **336**, 1 (2000).

[25] D. Boosé and J. M. Luck, J. Phys. A **40**, 14045 (2007).

[26] D. Brockmann, L. Hufnagel, and T. Geisel, Nature **439**, 462 (2006).

[27] R. Brown, London and Edinburgh philosophical magazine and journal of science **4**, 161 (1828).

[28] S. V. Buldyrev, S. Havlin, A. Ya. Kazakov, M. G. E. da Luz, E. P. Raposo, H. E. Stanley, and G. M. Viswanathan, Phys. Rev. E **64**, 041108 (2001); S. V. Buldyrev et al., Physica A **302**, 148 (2001).

[29] A. Bunde and S. Havlin, editors, *Fractals and Disordered Systems* (Springer, 1996).

[30] M. Büttiker, Science **325**, 278 (2009).

[31] F. E. Camino, V. V. Kuznetsov, E. E. Mendez, M. E. Gershenson, D. Reuter, P. Schafmeister, and A. D. Wieck, Phys. Rev. B **68**, 073313 (2003).

[32] J. T. Chalker and P. D. Coddingon, J. Phys. C **21**, 2665 (1988).

[33] J. M. Chambers, C. L. Mallows, and B. W. Stuck, J. Am. Stat. Ass. **71**, 340 (1976).

[34] V. V. Cheianov and V. I. Fal'ko, Phys. Rev. B **74**, 041403(R) (2006).

[35] V. V. Cheianov, V. I. Fal'ko, B. L. Altshuler, and I. L. Aleiner, Phys. Rev. Lett. **99**, 176801 (2007).

[36] K. W. Cheung, K. W. Yu, and P. M. Hui, Phys. Rev. B **45**, 456 (1992).

[37] R. Danneau, F. Wu, M. F. Craciun, S. Russo, M. Y. Tomi, J. Salmilehto, A. F. Morpurgo, and P. J. Hakonen, Phys. Rev. Lett. **100**, 196802 (2008).

[38] S. Datta and B. Das, Appl. Phys. Lett. **56**, 665 (1990).

[39] S. Datta, *Electronic transport in mesoscopic systems* (Cambridge University Press, 1995).

[40] A. Davis and A. Marshak, in *Fractal Frontiers*, edited by M. M. Novak and T. G. Dewey (World Scientific, 1997).

[41] L. DiCarlo, J. R. Williams, Y. Zhang, D. T. McClure, and C. M. Marcus, Phys. Rev. Lett. **100**, 156801 (2008).

[42] F. Evers and A. D. Mirlin, Rev. Mod. Phys. **80**, 1355 (2008).

[43] B. Fourcade and A.-M. S. Tremblay, Phys. Rev. B **34**, 7802 (1986).

[44] L. Fu and C. L. Kane, Phys. Rev. B **76**, 045302 (2007).

[45] L. Fu, C. L. Kane, and E. J. Mele, Phys. Rev. Lett. **98**, 106803 (2007).

[46] Y. Gefen, A. Aharony, and S. Alexander, Phys. Rev. Lett. **50**, 77 (1983).

[47] A. K. Geim and K. S. Novoselov, Nature Mat. **6**, 183 (2007).

[48] C. W. Groth, J. Tworzydło, and C. W. J. Beenakker, Phys. Rev. Lett. **100**, 176804 (2008).

[49] H.-M. Guo, G. Rosenberg, G. Refael, M. Franz, arXiv:1006.2777.

[50] M. Z. Hasan and C. L. Kane, arXiv:1002.3895.

[51] A. Hansen and M. Nelkin, Phys. Rev. B **33**, 649 (1986).

[52] S. Havlin, A. Bunde, and H. E. Stanley, Phys. Rev. B **34**, 445 (1986).

[53] S. Havlin and D. Ben-Avraham, Adv. Phys. **36**, 695 (1987).

[54] C.-M. Ho and J. T. Chalker, Phys. Rev. B **54**, 8708 (1996).

[55] D. Hsieh, D. Qian, L. Wray, Y. Xia, Y. S. Hor, R. J. Cava, and M. Z. Hasan, Nature **452**, 970 (2008).

[56] E. H. Hwang, S. Adam, and S. DasSarma, Phys. Rev. Lett. **98**, 186806 (2007).

[57] M. B. Isichenko, Rev. Mod. Phys. **64**, 961 (1992).

[58] F. J. Jedema, H. B. Heersche, A. T. Filip, J. J. A. Baselmans, and B. J. van Wees, Nature **416**, 713 (2001).

[59] H. Jiang, L. Wang, Q.-F. Sun, and X. C Xie, Phys. Rev. B **80**, 165316 (2009).

[60] M. Johnson and R. H. Silsbee, Phys. Rev. Lett. **55**, 1790 (1985).

[61] M. J. M. de Jong and C. W. J. Beenakker, Phys. Rev. B **51**, 16867 (1995).

[62] C. L. Kane and E. J. Mele, Phys. Rev. Lett. **95**, 226801 (2005).

[63] M. I. Katsnelson, Eur. Phys. J. B **51**, 157 (2006).

[64] M. I. Katsnelson, K. S. Novoselov and A. K. Geim, Nature Phys. **2**, 620 (2006).

[65] K. Kazymyrenko and X. Waintal, Phys. Rev. B **77**, 115119 (2008).

[66] K. Kechedzhi, O. Kashuba, and V. I. Fal'ko, Phys. Rev. B **77**, 193403 (2008).

[67] M. Yu. Kharitonov and K. B. Efetov, Phys. Rev. B **78**, 033404 (2008).

[68] Y. A. Kinkhabwala, V. A. Sverdlov, A. N. Korotkov, and K. K. Likharev, J. Phys. Condens. Matter **18**, 1999 (2006).

[69] K. v. Klitzing, G. Dorda, M. Pepper, Phys. Rev. Lett. **45**, 494 (1980).

[70] M. König, S. Wiedmann, C. Brüne, A. Roth, H. Buhmann, L. W. Molenkamp, X.-L. Qi, and S.-C. Zhang, Science **318**, 766 (2007).

[71] J. Kogut and L. Susskind, Phys. Rev. B **11**, 395 (1975).

[72] H. Kohno and H. Yoshida, Solid State Comm. **132**, 59 (2004).

[73] M. König, S. Wiedmann, C. Brüne, A. Roth, H. Buhmann, L. Molenkamp, X.-L. Qi, and S.-C. Zhang, Science **318**, 766 (2007).

[74] M. König, H. Buhmann, L. Molenkamp, T. Hughes, C.-X. Liu, X.-L. Qi, and S.-C. Zhang, J. Phys. Soc. Japan **77**, 031007 (2008).

[75] B. Kramer, T. Ohtsuki, and S. Kettemann, Phys. Rep. **417**, 211 (2005).

[76] R. Kutner and Ph. Maass, J. Phys. A **31**, 2603 (1998).

[77] V. V. Kuznetsov, E. E. Mendez, X. Zuo, G. L. Snider, and E. T. Croke, Phys. Rev. Lett. **85**, 397 (2000).

[78] H. Larralde, F. Leyvraz, G. Martinez-Mekler, R. Rechtman, and S. Ruffo, Phys. Rev. E **58**, 4254 (1998).

[79] P. Levitz, Europhys. Lett. **39**, 6593 (1997).

[80] C. H. Lewenkopf, E. R. Mucciolo, and A. H. Castro Neto, Phys. Rev. B **77**, 081410(R) (2008).

[81] J. Li, R.-L. Chu, J. K. Jain, and S.-Q. Shen, Phys. Rev. Lett. **102**, 136806 (2009); commentary by S. Mitra in Physics, April 6, 2009.

[82] C.-X. Liu, T. Hughes, X.-L. Qi, K. Wang, and S.-C. Zhang, Phys. Rev. Lett. **100**, 236601 (2008).

[83] C.-X. Liu, X.-L. Qi, X. Dai, Z. Fang, and S.-C. Zhang, Phys. Rev. Lett. **101**, 146802 (2008).

[84] R. C. Liu, P. Eastman, and Y. Yamamoto, Solid State Comm. **102**, 785 (1997).

[85] X. Lou, C. Adelmann, S. A. Crooker, E. S. Garlid, J. Zhang, K. S. Madhukar Reddy, S. D. Flexner, C. J. Palmstrom, and P. A. Crowell, Nature Phys. **3**, 197 (2007).

[86] A. W. W. Ludwig, M. P. A. Fisher, R. Shankar, and G. Grinstein, Phys. Rev. B **50**, 7526 (1994).

[87] B. B. Mandelbrot, *The Fractal Geometry of Nature* (Freeman, New York, 1983).

[88] R. N. Mantegna, Phys. Rev. E **49**, 4677 (1994).

[89] J. Martin, N. Akerman, G. Ulbricht, T. Lohmann, J. H. Smet, K. von Klitzing, and A. Yacoby, Nature Phys. **4**, 144 (2008).

[90] E. McCann, K. Kechedzhi, V. I. Fal'ko, H. Suzuura, T. Ando, and B. L. Altshuler, Phys. Rev. Lett. **97**, 146805 (2006).

[91] J. W. McClure, Phys. Rev. **104**, 666 (1956).

[92] R. Metzler and J. Klafter, Phys. Rep. **339**, 1 (2000).

[93] J. C. Meyer, A. K. Geim, M. I. Katsnelson, K. S. Novoselov, T. J. Booth, and S. Roth, Nature **446**, 60 (2007).

[94] J. E. Moore and L. Balents, Phys. Rev. B **75**, 121306(R) (2007).

[95] J. Moore, Nature Phys. **5**, 378 (2009).

[96] K. E. Nagaev, Phys. Lett. A **169**, 103 (1992).

[97] Yu. V. Nazarov, Phys. Rev. Lett. **73**, 134 (1994).

[98] H. B. Nielsen and M. Ninomiya, Nucl. Phys. B **185**, 20 (1981).

[99] K. Nomura, M. Koshino, and S. Ryu, Phys. Rev. Lett. **99**, 146806 (2007).

[100] K. Nomura, S. Ryu, M. Koshino, C. Mudry, and A. Furusaki, Phys. Rev. Lett. **100**, 246806 (2008).

[101] H. Obuse, A. Furusaki, S. Ryu, and C. Mudry, Phys. Rev. B **76**, 075301 (2007).

[102] M. Onoda and N. Nagaosa, Phys. Rev. Lett. **90**, 206601 (2003).

[103] M. Onoda, Y. Avishai, and N. Nagaosa, Phys. Rev. Lett. **98**, 076802 (2007).

[104] P. M. Ostrovsky, I.V. Gornyi, and A. D. Mirlin, Phys. Rev. Lett. **98**, 256801 (2007).

[105] B. Özyilmaz, P. Jarillo-Herrero, D. Efetov, D. A. Abanin, L. S. Levitov, and P. Kim, Phys. Rev. Lett. **99**, 166804 (2007).

[106] J. C. J. Paasschens, M. J. M. de Jong, and C. W. J. Beenakker, arXiv:0807.1623.

[107] K. Pearson, *A mathematical theory of random migration* (Dulau and co., London, 1906).

[108] X.-L. Qi, S.-C. Zhang, arXiv:1008.2026.

[109] R. Rammal and G. Toulouse, J. Phys. Lett. (Paris) **44**, L13 (1983).

[110] R. Rammal, J. Phys. Lett. (Paris) **45**, L1007 (1984).

[111] S. Redner, arXiv:0710.1105.

[112] P.-E. Roche, B. Derrida, and B. Douçot, Eur. Phys. J. B **43**, 1434 (2005).

[113] A. Roth, C. Bruene, H. Buhmann, L. W. Molenkamp, J. Maciejko, X.-L. Qi, and S.-C. Zhang, Science **325**, 294 (2009).

[114] R. Roy, Phys. Rev. B **79**, 195321 (2009).

[115] S. Russ, J. W. Kantelhardt, A. Bunde, and S. Havlin, Phys. Rev. B **64**, 134209 (2001).

[116] A. Rycerz, J. Tworzydło, and C. W. J. Beenakker, Europhys. Lett. **79**, 57003 (2007).

[117] S. Ryu, C. Mudry, H. Obuse, and A. Furusaki, Phys. Rev. Lett. **99**, 116601 (2007).

[118] P. San-Jose, E. Prada, and D. S. Golubev, Phys. Rev. B **76**, 195445 (2007).

[119] G. M. Schütz, in *Phase Transitions and Critical Phenomena*, edited by C. Domb and J. L. Lebowitz (Academic, 2001).

[120] M. Schulz, Phys. Lett. A **298**, 105 (2002); M. Schulz and P. Reineker, Chem. Phys. **284**, 331 (2002).

[121] A. Schuessler, P. M. Ostrovsky, I. V. Gornyi, and A. D. Mirlin, Phys. Rev. B **79**, 075405 (2009).

[122] A. Schuessler, P. M. Ostrovsky, I. V. Gornyi, and A. D. Mirlin, Phys. Rev. B **82**, 085419 (2010)

[123] M. J. Schmidt, E. G. Novik, M. Kindermann, and B. Trauzettel, Phys. Rev. B **79**, 241306(R) (2009).

[124] R. A. Sepkhanov, A. Ossipov, and C. W. J. Beenakker, Europhys. Lett. **85**, 14005 (2009).

[125] H. Scher and E. Montroll, Phys. Rev. B **12**, 2455, (1975).

[126] P. Sheng, *Introduction to Wave Scattering, Localization, and Mesoscopic Phenomena* (Springer, Berlin, 2006).

[127] R. Shindou and S. Murakami, Phys. Rev. B, **79**, 045321 (2009).

[128] B. I. Shklovskii and A. L. Efros, *Electronic Properties of Doped Semiconductors* (Springer, 1984).

[129] M. Shlesinger, G. Zaslavsky, and U. Frisch, editors, *Lévy Flights and Related Topics in Physics* (Springer, Berlin, 1995).

[130] W. Sierpiński, C. R. Acad. Sci. Paris **160**, 302 (1915).

[131] Y. Asada, K. Slevin, and T. Ohtsuki, Phys. Rev. B **70**, 035115 (2004).

[132] K. Slevin and T. Ohtsuki, Phys. Rev. B **80**, 041304(R) (2009).

[133] I. Snyman, J. Tworzydło, and C. W. J. Beenakker, Phys. Rev. B **78**, 045118 (2008).

[134] R. Stacey, Phys. Rev. D **26**, 468 (1982).

[135] D. Stauffer and A. Aharony, *Introduction to Percolation Theory* (Taylor and Francis, 1994).

[136] E. V. Sukhorukov and D. Loss, Phys. Rev. Lett. **80**, 4959 (1998).

[137] H. Suzuura and T. Ando, Phys. Rev. Lett. **89**, 266603 (2002).

[138] H. Tamura and T. Ando, Phys. Rev. B **44**, 1792 (1991).

[139] N. Tombros, C. Jozsa, M. Popinciuc, H. T. Jonkman, and B. J. Van Wees, Nature **448**, 571 (2007).

[140] S. A. Trugman, Phys. Rev. B 27, 7539 (1983).

[141] J. Tworzydło, B. Trauzettel, M. Titov, A. Rycerz, and C. W. J. Beenakker, Phys. Rev. Lett. **96**, 246802 (2006).

[142] J. Tworzydło, I. Snyman, A. R. Akhmerov, and C. W. J. Beenakker, Phys. Rev. B **76**, 035411 (2007).

[143] P. R. Wallace, Phys. Rev. **71**, 622 (1947).

[144] I. Webman, Phys. Rev. Lett. **47**, 1496 (1981).

[145] E. R. Weeks, J. S. Urbach, and H. L. Swinney, Physica D **97**, 291 (1996).

[146] J. R. Williams, L. DiCarlo, and C. M. Marcus, Science **317**, 638 (2007).

[147] K. Wilson, in *New Phenomena in Subnuclear Physics*, edited by A. Zichichi (Plenum, New York, 1977).

[148] Y.-Y. Zhang, J. Hu, B. A. Bernevig, X. R. Wang, X. C Xie, and W. M Liu, Phys. Rev. Lett **102**, 106401 (2009).

[149] S.-C. Zhang, Physics **1**, 6 (2008).

[150] H. Zhang, C.-X. Liu, X.-L. Qi, X. Dai, Z. Fang, and S.-C. Zhang, Nature Phys. **5**, 438 (2009).

[151] I. Žutić, J. Fabian, and S. Das Sarma, Rev. Mod. Phys. **76**, 323 (2004).