Tangent fermions: massless fermions on a lattice

Donís Vela, A.

Curriculum Vitæ

I was born in Valladolid, Spain, in 1996. I attended primary and secondary education in Colegio San José and I obtained my high school diploma in 2014, after which I received the *Premio Extraordinario de Bachillerato* awarded by the Autonomous Community of Castilla y León.

Having developed a liking for exact sciences, from 2014 to 2018 I pursued a Bachelor's degree in Physics at the University of Valladolid. There, I had my first experience with research in the summer of 2017, when I interned in the G-FOR research group under the supervision of Dr. J. C. García Escartín. Later that year, I was awarded a grant by the Spanish Ministry of Education to engage in an internship in the department of Theoretical and Atomic Physics and Optics in the same university under the supervision of Prof. dr. J. A. Alonso Martín and Prof. dr. M. J. López Santodomingo. During these years, I also worked part time as a private tutor for high school students.

In 2018, I moved to the Netherlands to pursue a Master's degree in Theoretical Physics in Leiden University. At the Lorentz Institute, I joined the Theoretical Nanophysics group lead by Prof. dr. C. W. J. Beenakker as a Master's student. Being admitted to the Casimir Master Track, I also had the opportunity to work on a short research project in the lab of Dr. S. Goswami in the Technical University of Delft. In 2019, I was employed by Leiden University as a teaching assistant in two different Bachelor's courses. I obtained my Master's degree diploma *summa cum laude* in 2020 and was awarded the Hendrik Casimir prize.

In the same year, I started my Ph.D. studies on the topic of topological

states of matter under the supervision of Prof dr. C. W. J. Beenakker and Prof. dr. J Tworzydło. My research first focused in transport properties in mesoscopic topological superconductors, and later shifted towards the development of methods for simulating massless fermions on a lattice. I also worked on the simulation of the dynamics of non-Abelian anyons in a superconducting device while supervising a Master's student. During these years I have attended several schools and conferences, presenting my work in Spain, France, Italy, the Netherlands, Germany and the USA. I have also been a teaching assistant in four different Master's courses and received the Teaching Assistant Prize in the fall of 2022.

List of publications

- A. Donís Vela & J. C. Garcia-Escartin. A quantum primality test with order finding. *Quantum Information and Computation*, **18**, 1143-1151 (2018).

- A. Donís Vela, M. J. López, & J. A. Alonso. Bimetallic Al-Sn clusters: mixing at the nanoscale. *Physical Chemistry Chemical Physics*, **21**, 22919-22929 (2019).

- G. Lemut, A. Donís Vela, M. J. Pacholski, J. Tworzydło & C. W. J. Beenakker. Magnetic breakdown spectrum of a Kramers–Weyl semimetal. *New Journal of Physics*, **22**, 093022 (2020).

- A. Donís Vela, G. Lemut, M. J. Pacholski & C. W. J. Beenakker. Chirality inversion of Majorana edge modes in a Fu–Kane heterostructure. *New Journal of Physics*, **32**, 103006 (2021).

  [Chapter 5 is based on this publication.]

- A. Donís Vela, M. J. Pacholski, G. Lemut, J. Tworzydło & C. W. J. Beenakker. Massless Dirac fermions on a space-time lattice with a topologically protected Dirac cone. *Annalen der Physik*, **534**, 2200206 (2022).

  [Chapter 2 is based on this publication.]

- A. Donís Vela, G. Lemut, M. J. Pacholski, J. Tworzydło & C. W. J. Beenakker. Reflectionless Klein tunneling of Dirac fermions: Comparison of split-operator and staggered-lattice discretization of the Dirac equation. *Journal of Physics: Condensed Matter*, **34**, 364003 (2022).
  [Chapter 3 is based on this publication.]

- A. Donís Vela, G. Lemut, J. Tworzydło & C. W. J. Beenakker. Method to preserve the chiral-symmetry protection of the zeroth Landau level on a two-dimensional lattice. *Annals of Physics*, **456**, 169208 (2023).
  [Chapter 4 is based on this publication.]

- C. W. J. Beenakker, A. Donís Vela, G. Lemut, M. J. Pacholski & J.Tworzydło. Tangent Fermions: Dirac or Majorana fermions on a lattice without fermion doubling. *Annalen der Physik*, **535**, 2300081 (2023).
  [Part of chapter 1 is based on this publication.]

- I. M. Flór, A. Donís Vela, C. W. J. Beenakker & G. Lemut. Dynamical simulation of the injection of vortices into a Majorana edge mode. *Physical Review B*, **108**, 235309 (2023).
  [Chapter 6 is based on this publication.]