Title (e.g., “Jan Zaanen – *in memoriam*”
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In September 2022 Joerg Schmalian (then my co-Editor in Chief for Advances in Physics) made an interesting proposal: he has seen on ArXiv a manuscript by Jan Zaanen, containing what Joerg described as a series of “thought provoking lectures on holography”. He proposed that we asked Jan to re-format it into a paper, with the idea of publishing it in AiP after peer review. PGR (then the other co-Editor in Chief) was enthusiastic about the idea, and Jan promptly accepted our proposal. The project progressed rather slowly, due in part to Jan’s poor health, but at the end of 2023 we had a final draft of the manuscript. In the course of the review process, Jan became more and more passionate about the paper, though he was keenly aware that his state prevented him from polishing it as perfectly as he would have wanted. Shortly afterwards, we received the tragic news of his death. We were left with a complete manuscript that, no doubt, represents Jan’s final contribution on a topic he embraced later in life, but he deeply cared about. Jan’s tragic death has prevented us from having what we expect would have been a lively, invigorating, and instructive correspondence in the process of finalising the manuscript. Therefore, we present it here with a minimal degree of proofreading and editing for grammatical correctness, but without modifying the prose style. The result is a narrative in Jan’s unique (if occasionally quirky) style, where his personal scientific vision shines through—a piece the Editorial team greatly enjoyed reading. We are grateful to Jan’s widow Christa and to Prof. Tjerk Oosterkamp for locating the original manuscript, which greatly facilitated the production process. A few biographical notes about the author follow here below.

Jan Zaanen was born on 17th April 1957 in Leiden . As an undergraduate, he studied chemistry in Groningen and continued there as a graduate student under the supervision of George Sawatzky, receiving his PhD in 1986. In his PhD thesis, Jan introduced what was to become the celebrated “Zaanen–Sawatzky–Allen” model [1] – a theory for describing band gaps and electronic structures of transition-metal compounds. The theory was particularly suitable for cations with a single unpaired electron (or hole) and became an instant hit when high-Tc superconductivity was discovered the following year [2]. Jan continued at the Max Planck Institute at Stuttgart, first as post-doc, then as staff scientist. There, in 1989, he produce another of his classic papers [3]. Jan predicted that, in certain conditions, charges and spins in cuprates would organise in “charged magnetic domain lines”, which later became widely known as “stripes”. During his time in Stuttgart, Jan also co-invented (with Vladimir I Anisimov and Ole K. Andersen) LDA+U [4]. LDA+U combines the Local Density Approximation and the Hubbard potential U, which adds a far more realistic local potential felt by electrons and is now a well-known tool in quantum chemistry. Jan’s work on high-Tc continued at AT&T Bell Laboratories in the USA. In 1993 Zaanen returned to the Netherlands, where he worked at Leiden University as a Royal Netherlands Academy of Arts and Sciences (KNAW) fellow. He has been a professor at Leiden since 2000. In 2006 Jan received the Spinoza Prize for his scientific accomplishments. In recent years, Jan became interested in the connections between quantum many body physics and “holographic mathematics” – a formalism originally proposed in the context of string theory in the 1990s. Jan delved in to this topic, of

which he admitted he initially knew very little, and became an expert [5], introducing concepts such as “Planckian dissipation” and “Quantum supreme matter”. Jan Zaanen died on January 18th, 2024, at the age of 66.

[1] J. Zaanen, G. A. Sawatzky, and J. W. Allen, “Band gaps and electronic structure of transition-metal compounds” Phys. Rev. Lett. **55**, 418 (1985).
[2] In their undoped state, cuprate superconductors do indeed have one hole per Cu^{2+} cation.
[3] J. Zaanen and O. Gunnarsson, “Charged magnetic domain lines and the magnetism of high-Tc oxides”, Phys. Rev. B **40**, 7391 (1989).
[4] V. I. Anisimov, J. Zaanen, and O. K. Andersen, Phys. Rev. B **44**, 943 (1991).
[5] J. Zaanen, Y. Liu, Y.-W. Sun, and K. Schalm, *Holographic Duality in Condensed Matter Physics* (Cambridge University Press, Cambridge, 2015).