Diagnosing a strong topological insulator by quantum oscillations

Work done with

Frédéric Bègue and Pierre Pujol

Revaz Ramazashvili / LPT Toulouse

ECRYS-2014

...Why pose the question at all?

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11:10-11:35 Mo-IS04-2
IAE-2

ARPES studies of the possible topological Kondo insulator SmB_6
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Abstract book page 156

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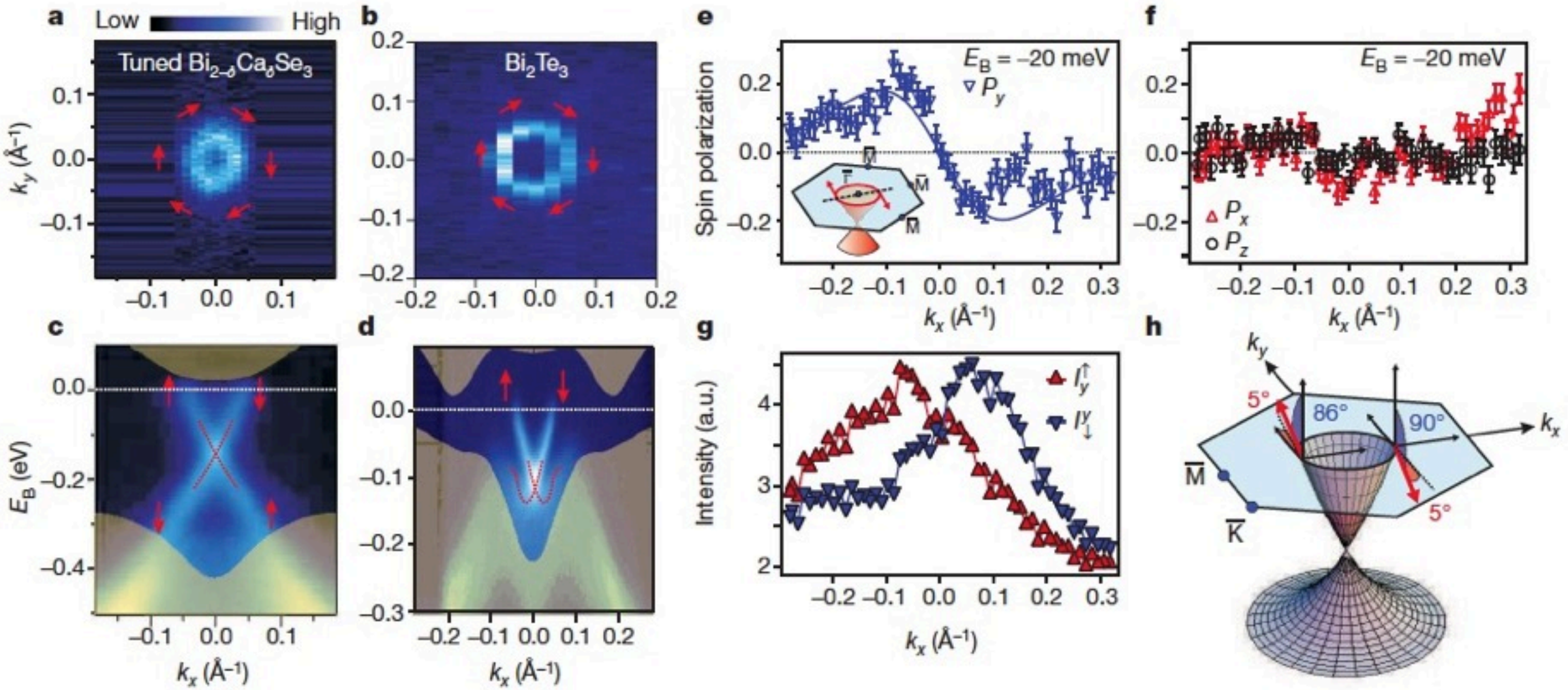
- I. E. Tamm (1932). "On the possible bound states of electrons on a crystal surface".
- W. Shockley (1939). "On the Surface States Associated with a Periodic Potential".

A tunable topological insulator in the spin helical Dirac transport regime

D. Hsieh[1], Y. Xia[1], D. Qian[1,5], L. Wray[1], J. H. Dil[6,7], F. Meier[6,7], J. Osterwalder[7], L. Patthey[6], J. G. Checkelsky[1], N. P. Ong[1], A. V. Fedorov[8], H. Lin[9], A. Bansil[9], D. Grauer[2], Y. S. Hor[2], R. J. Cava[2] & M. Z. Hasan[1,3,4]



Q: Do non-degenerate spin-helical states alone prove that you are dealing with a topological insulator?

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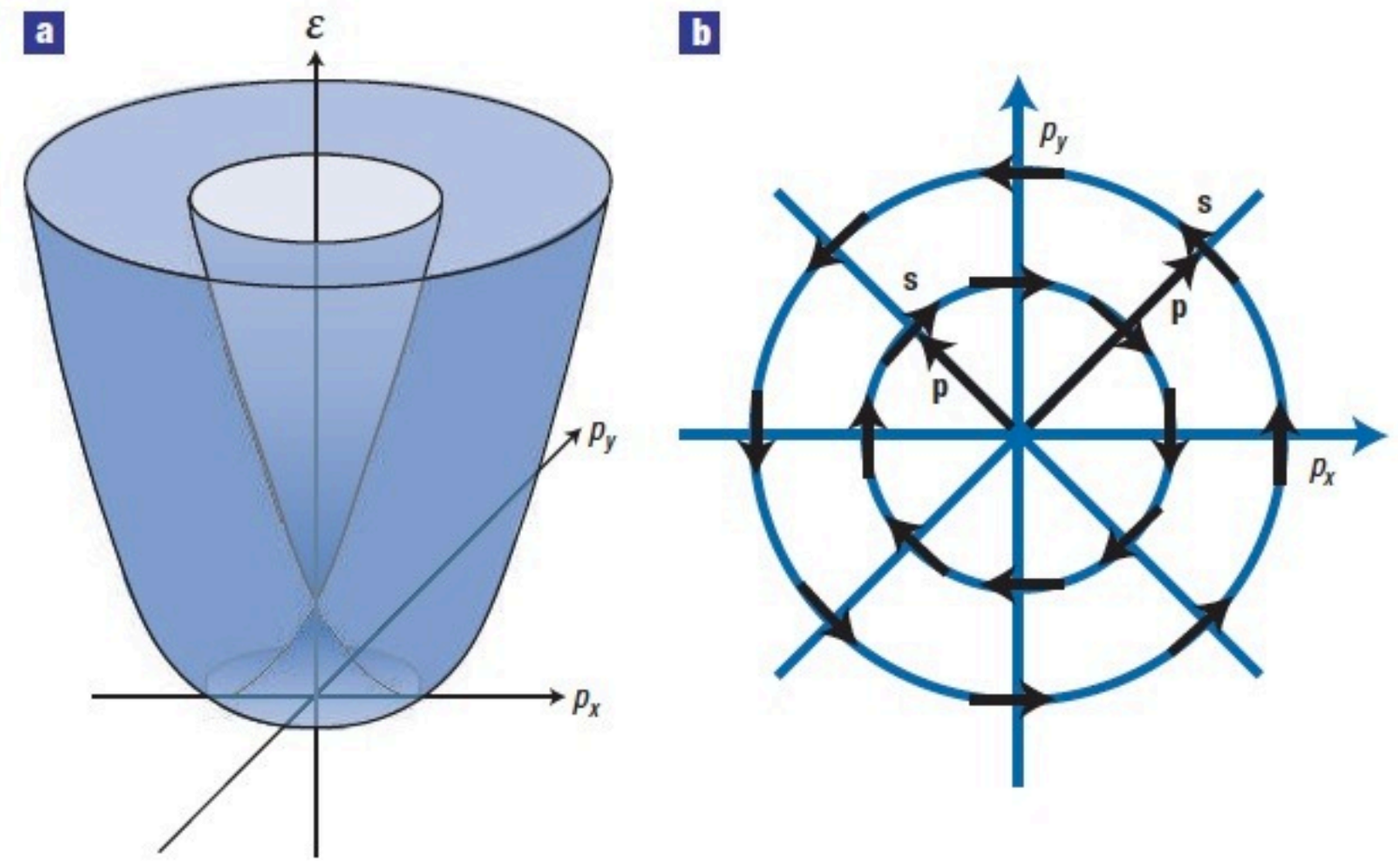
A: Not quite.

Q: Why?

A: Because, e.g., in inversion layers, such states appear due to Rashba spin-orbit coupling, simply because of structural inversion asymmetry.

E. I. Rashba (~1960) :



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$$I = \cos\left[2\pi\frac{F}{H} + \pi + \gamma\right]$$

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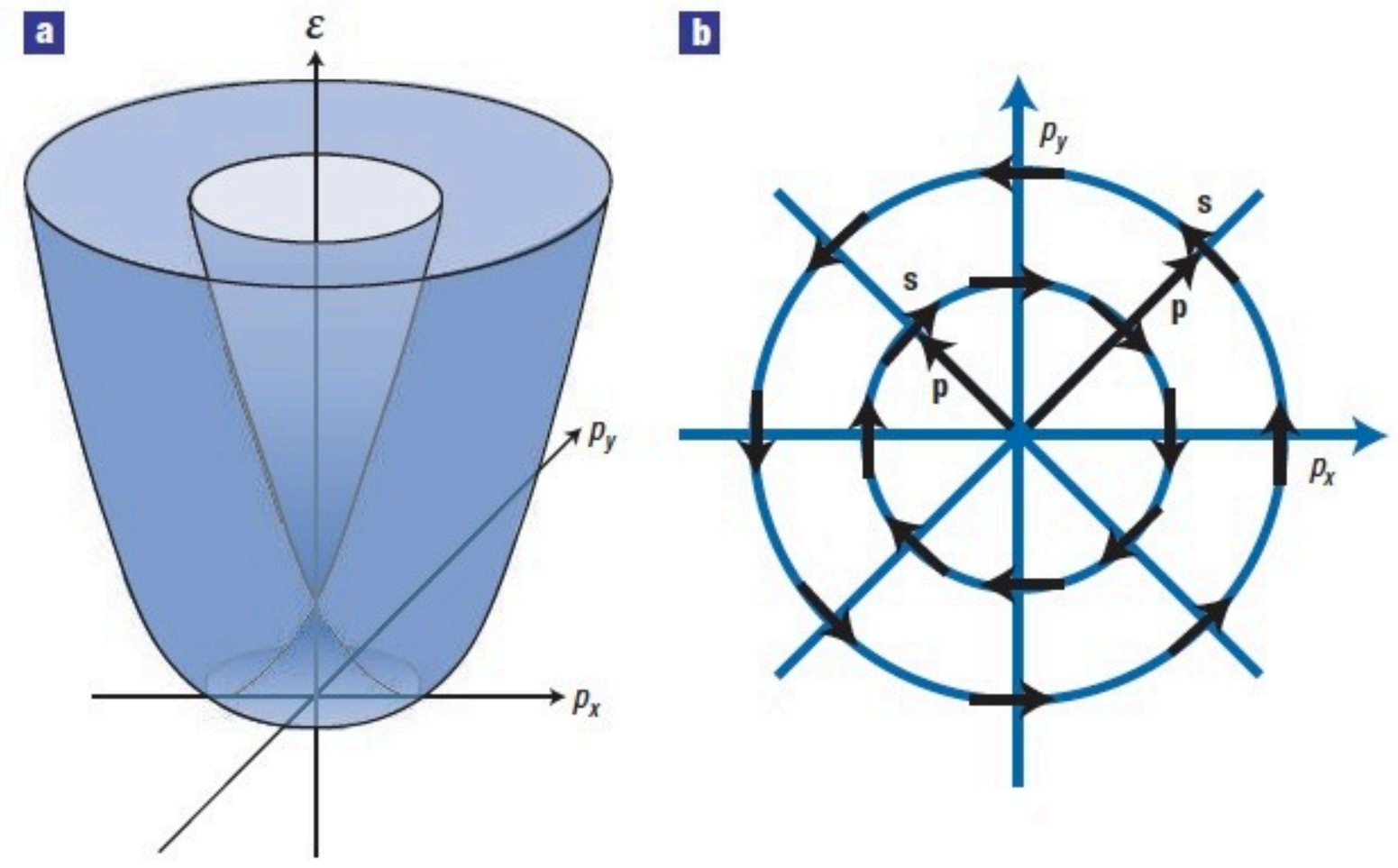

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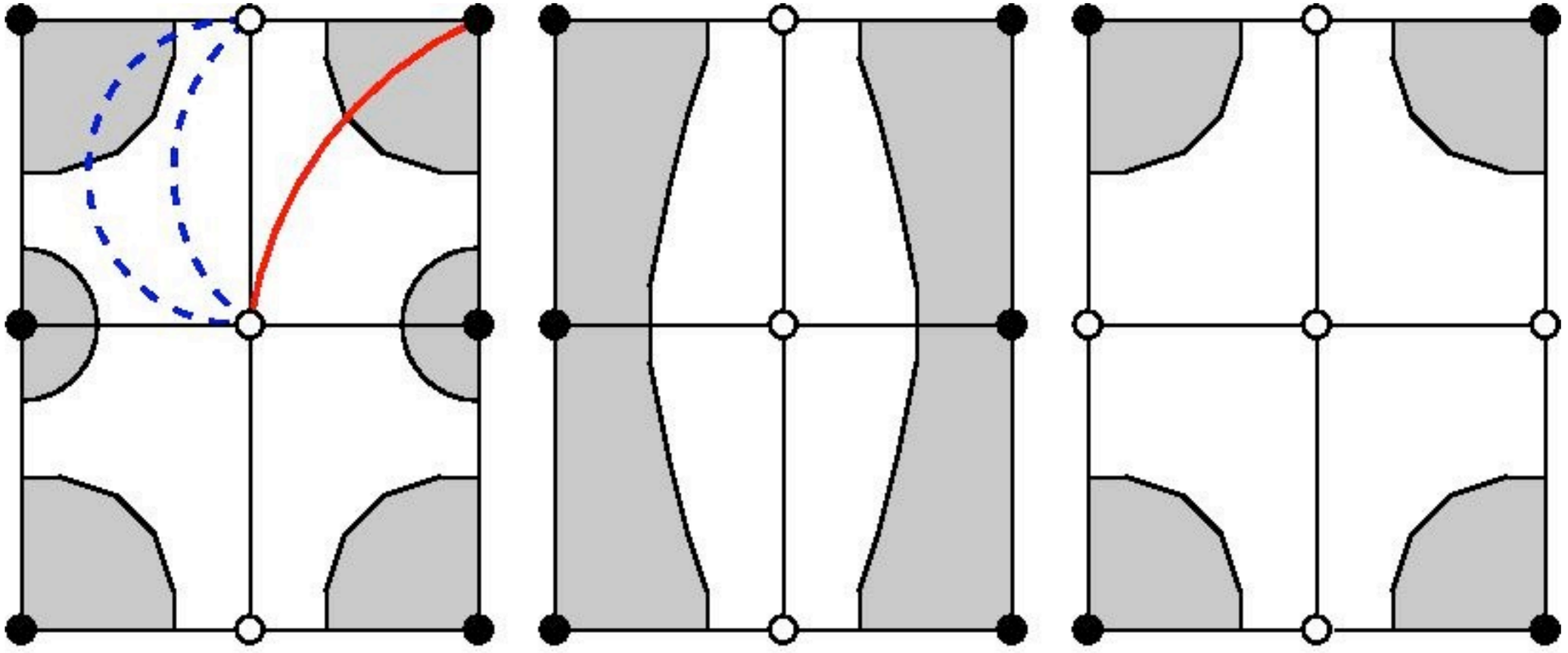

Conclusion:

- An odd number of fundamental frequencies of quantum oscillations mean a strong topological insulator.
- An even number of fundamental frequencies mean a weak or a topologically trivial insulator.

...Thank you!

(arXiv:1401.6228)