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AHARONOV–CASHER THEOREM FOR A PLANE DOMAIN WITH HOLES WITH THE APS BOUNDARY CONDITION

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Abstract: Consider the Dirac operator on a plane with a compactly supported smooth magnetic field perpendicular to the plane with total flux Φ. The Aharonov-Casher theorem tells us that the dimension of the kernel, i.e., the number of zero modes, of this operator is the largest integer strictly less than $|\Phi|/2\pi$. The talk is focused on a similar result on the number of zero modes in an alternative setting. In particular we are interested in the Dirac operator on the complex plane outside a finite number of balls with a magnetic field supported inside each ball, i.e., an Aharonov-Bohm setting. We consider the domain of the operator with the famous Atiyah-Patodi-Singer boundary condition on the boundaries of the balls. The number of zero modes depends only on the flux Φ_k through each ball $\mod 2\pi$. If we assume that $\Phi_k/2\pi \in [-1/2, 1/2)$ the number of zero modes is again the largest integer strictly less than $|\Phi|/2\pi$, where $\Phi = \sum_k \Phi_k$. I will discuss the case of one ball where the theorem says that there cannot be any zero modes.