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We introduce Floquet-transform techniques to study Bergman spaces, Bergman kernels and Toeplitz operators T_a on unbounded periodic planar domains Π , which are defined as the union of infinitely many copies of the translated, bounded periodic cell ϖ . The Floquet-transform yields a connection between the Bergman projection $P_\Pi : L^2(\Pi) \rightarrow A^2(\Pi)$ and a family of Bergman-type projections P_η in the space $L^2(\varpi)$, where $\eta \in [-\pi, \pi]$ is the so-called Floquet variable. We get an explicit formula for the corresponding kernels.

In addition, we study Toeplitz operators $T_a : A^2(\Pi) \rightarrow A^2(\Pi)$ with periodic symbols. Floquet-transform establishes a connection of T with family of Toeplitz-type operators $T_{a,\eta}$, $\eta \in [-\pi, \pi]$, in the cell ϖ . In particular, we prove the “spectral band formula”, which describes the essential spectrum of T_a in terms of the spectra of the operators $T_{a,\eta}$.

We apply the described methods to construct new types of examples of Toeplitz operators with discontinuous essential spectra. By using conformal mappings, the examples can be presented as Toeplitz operators on the standard Bergman-Hilbert space of the open unit disc.

References

- [1] Taskinen, J., On the Bergman projection and kernel in periodic planar domains, *Proceedings of IWOTA 2022 Lancaster*, Springer (2023).
 - [2] Taskinen, J., On Bergman-Toeplitz operators in periodic planar domains, *Transactions London Math. Soc.*, **12** (2025).
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