

A note on the trace of commutant operator between a projection and multiplication

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Let Π be an orthogonal projection on the Hilbert space $L^2(E, \mu)$, which is locally trace class i.e., for all compact subset $K \subset E$, the compressed operator $\chi_K \Pi \chi_K$ is trace class. Let $h : E \rightarrow [0, 1]$ be a measurable map. Then

$$0 \leq \operatorname{tr}(h^n \Pi) - \operatorname{tr}((h \Pi)^n) \leq C \cdot 3^n \|[h, \Pi]\|_{HS}^2,$$

where $[h, \Pi] = h \Pi - \Pi h$ and $\|\cdot\|_{HS}$ is the Hilbert-Schmidt norm.