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## ACCEPTED MANUSCRIPT

### MULTIPLIERS FOR VON NEUMANN-SCHATTEN BESSEL SEQUENCES IN SEPARABLE BANACH SPACES

#### HOSSEIN JAVANSHIRI AND MEHDI CHOUBIN

ABSTRACT. In this paper we introduce the concept of von Neumann-Schatten Bessel multipliers in separable Banach spaces and obtain some of their properties. We study their behavior when the symbol belongs to  $\ell^p$ . Also, we investigate the continuous dependency of Hilbert–Schmidt Bessel multipliers on their parameters. Special attention is devoted to the study of invertible Hilbert-Schmidt frame multipliers which is an extensive class of ordinary frame multipliers and includes g-frame multipliers and fusion frame multipliers as elementary examples. Among other things, the invertibility of Hilbert-Schmidt Riesz multipliers is completely characterized. In particular, we show that all the existing frames in Hilbert spaces is uniquely determined by the set of its dual frames.

#### 1. INTRODUCTION

Due to the fundamental works done by Feichtinger and his coauthors [29, 30], Fourier and Gabor multipliers were formally introduced and popularized from then on. Fourier and Gabor multipliers play an important role in theory and applications; For more information about the history of this class of operators, some of their properties and their applications in scientific disciplines and in modern life the reader can consult Section 1 of the papers [15, 52] and the references (for examples) [16, 22]. Balazs [8] extended the notion of Gabor multipliers to arbitrary Hilbert space frames. In details, he considered the operators of the form

$$\mathbf{M}_{\mathfrak{m},\Phi,\Psi}(f) = \sum_{i=1}^{\infty} \mathfrak{m}_i \langle f, \psi_i \rangle \varphi_i \qquad (f \in \mathbb{H}), \qquad (1.1)$$

where  $\Phi = \{\varphi_i\}_{i=1}^{\infty}$  and  $\Psi = \{\psi_i\}_{i=1}^{\infty}$  are ordinary Bessel sequences in the Hilbert space  $\mathbb{H}$ , and  $\mathfrak{m} = \{\mathfrak{m}_i\}_{i=1}^{\infty}$  is a bounded complex scalar sequence in  $\mathbb{C}$ . It is worthwhile to mention that this class of operators is not only of interest for applications in modern life (see for example [2, 14, 40, 41]), but also it is of utmost importance in different branches of linear algebra, matrix analysis and functional analysis. For example, they are used for the diagonalization of matrices [33, Definition 3.1], the diagonalization of operators [9, 23, 49], matrix representation of operators using frames [10], Galerkin–like representation of operators [13] and for

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