TABLE IV: Limits on the effective neutrino mass $\langle m_\nu \rangle$ (in eV) corresponding to different theoretical model calculations of nuclear matrix elements obtained for $T_{1/2}(0\nu\beta\beta) > 1.1 \cdot 10^{24}$ y in case of ^{100}Mo and $T_{1/2}(0\nu\beta\beta) > 3.6 \cdot 10^{23}$ y in case of ^{82}Se.

Nuclear matrix elements		^{100}Mo	^{82}Se
Shell model	[23]	-	< 2.43
QRPA	[24],[25]	$< 0.58 - 0.75$	$< 1.12 - 1.38$
QRPA	[26]	$< 0.45 - 0.93$	$< 0.89 - 1.61$
IBM-2	[27]	$< 0.49 - 0.55$	$< 1.03 - 1.19$
PHFB	[28]	< 0.70	

C. Search for double beta decay with Majoron emission

The $0\nu\chi^0\beta\beta$ decay requires the existence of a Majoron. It is a massless Goldstone boson that arises due to a global breakdown of (B-L) symmetry, where B and L are, respectively, the baryon and the lepton number. The Majoron, if it exists, could play a significant role in the history of the early Universe and in the evolution of stars. A 2β-decay model that involves the emission of two Majorons was proposed within supersymmetric theories and several other models of the Majoron were proposed in the 1990s (see review [29] and references therein). The possible two electrons energy spectra for different $0\nu\chi^0\beta\beta$ decay modes of ^{100}Mo are shown in Fig. 4. Here n is the spectral index, which defines the shape of the spectrum. For example, for an ordinary Majoron $n = 1$, for 2ν decay $n = 5$, in the case of a bulk Majoron $n = 2$ and for the process with two Majoron emission $n = 3$ or 7.

No evidence for $0\nu\chi^0\beta\beta$ decay was found for all seven isotopes. The limits for ^{100}Mo, ^{82}Se, ^{150}Nd and ^{96}Zr are presented in Table 5. In particular, strong limits on "ordinary" Majoron (spectral index 1) decay of ^{100}Mo ($T_{1/2} > 2.7 \cdot 10^{22}$ y) and ^{82}Se ($T_{1/2} > 1.5 \cdot 10^{22}$ y) have been obtained. Corresponding bounds on the Majoron-neutrino coupling constant are $< g_{ee} >< (0.35 - 0.85) \cdot 10^{-4}$ and $< (0.6 - 1.9) \cdot 10^{-4}$, respectively (using nuclear matrix elements from [23–28]).