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Combining parabosons and parafermions in a new graded superalgebra

When a system of m parafermions and n parabosons are combined, there are two choices for the relative commutation relations. One choice (referred to as "of relative parafermion type") gives rise to the classical orthosymplectic Lie superalgebra $\mathfrak{osp}(2m+1|2n)$. For the other choice (of "relative paraboson type"), the underlying algebraic structure is no longer an ordinary Lie superalgebra, but a $\mathbb{Z}_2 \times \mathbb{Z}_2$-graded Lie superalgebra, denoted here by $\mathfrak{pso}(2m+1|2n)$. Analysing the subalgebra structure of $\mathfrak{pso}(2m+1|2n)$ allows the investigation of the parastatistics Fock spaces for this new set of $m+n$ para-operators, as they correspond to lowest weight representations of $\mathfrak{pso}(2m+1|2n)$. Our main result is the construction of these Fock spaces, with a complete labeling of the basis vectors and an explicit action of the para-operators on these basis vectors. This is the first example of whole class of representations for a $\mathbb{Z}_2 \times \mathbb{Z}_2$-graded Lie superalgebra.