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2D and 3D Schrodinger operators with point interactions

Schrödinger operators with point interactions have been intensively studied in the three last decades (see [1, 2, 3, 4, 5, 9]). In the present talk we are dealing with two- and three-dimensional Schrödinger operators with point interactions.

Starting from fundamental paper [5], operator associated with differential expression

$$l := -\Delta + \sum_{j=1}^{m} \lambda_j \delta(\cdot - x_j), \quad \lambda_j \in \mathbb{R},\, m \in \mathbb{N}. \tag{1}$$

in $L^2(\mathbb{R}^3)$ is being treated in the framework of extension theory.

Namely, minimal Schrödinger operator $H_{\min} = -\Delta$ with the domain

$$\operatorname{dom}(H_{\min}) := \left\{ f \in W_2^2(\mathbb{R}^v, \mathbb{C}^n) : f(x_j) = 0, \quad j \in \{1, .., m\} \right\}, \quad v = 2, 3 \tag{2}$$

is considered. Note that $H_{\min}$ is closed symmetric operator with equal deficiency indices $n_\pm(H_{\min}) = nm$, and operator associated with (1) is treated as a certain self-adjoint extension of $H_{\min}$.

In the recent years, the concept of boundary triplets and corresponding Weyl functions (see [7, 8]) was invoked for investigation of symmetric operators. In [4, 6, 9], boundary triplet approach was applied to the investigation of several-dimensional Schrödinger operators with point interactions. In [6, 9], two- and three-dimensional Schrödinger operators with one point interaction were studied. Arlinskii and Tsekanovskii, in [4], obtained parametrization of all nonnegative self-adjoint extension of "three-dimensional" $H_{\min}$ with arbitrary finite m.

In the present talk, some results from [6] are generalized to the case of m point interactions. Namely, we obtain boundary triplet Π for $H^*_{\min}$, we also find corresponding Weyl function and γ-field for Π. Moreover, we obtain a description of symmetric, self-adjoint and nonnegative self-adjoint extensions of the initial minimal symmetric operator $H_{\min}$, and characterize their spectra.

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