Determination of black holes by boundary measurements

For a wave equation with time-independent Lorentzian metric consider an initial-boundary value problem in $\mathbb{R}\times\Omega$, where $x_0 \in \mathbb{R}$ is the time variable and Ω is a bounded domain in $\mathbb{R}^n$. Let $\Gamma \subset \partial\Omega$ be a subdomain of $\partial\Omega$. We say that the boundary measurements are given on $\mathbb{R} \times \Gamma$ if we know the Dirichlet and Neumann data on $\mathbb{R} \times \Gamma$. The inverse boundary value problem consists of recovery of the metric from the boundary data. In the author's previous works a localized variant of the boundary control method was developed that allows the recovery of the metric locally in a neighborhood of any point of Ω where the spatial part of the wave operator is elliptic. This allows the recovery of the metric in the exterior of the ergoregion.

Our goal is to recover the black hole. In some cases the ergoregion coincides with the black hole. In the case of two space dimensions we recover the black hole inside the ergoregion assuming that the ergosphere, i.e. the boundary of the ergoregion, is not characteristic at any point of the ergosphere.