Light bosons, proposed as a solution to various problems in fundamental physics and cosmology, include a broad class of candidates for physics beyond the standard model, such as dilatons and moduli, wave dark matter and axion-like particles. If light bosons exist in nature, they will spontaneously form ”clouds” by extracting rotational energy from rotating massive black holes through superradiance, a classical wave amplification process that has been studied for decades. The superradiant growth of the cloud sets the geometry of the final black hole, and the black hole geometry determines the shape of the cloud. Hence, both the black hole geometry and the cloud encode information about the light boson. For this reason, measurements of the gravitational field of the black hole/cloud system (as encoded in gravitational waves) are over-determined in a unique way. I will present our results showing that a single gravitational-wave measurement can be used to verify the existence of light bosons by model selection, rule out alternative explanations for the signal, and measure the boson mass. Such measurements could be done generically for bosons in the mass range $[10^{-16.5}, 10^{-14}]$ eV using observations of extreme mass-ratio inspirals (EMRIs) by the forthcoming Laser Interferometer Space Antenna (LISA).