Experimental Studies of Black Holes: Status & Prospects

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More than a century ago, Albert Einstein presented his general theory of gravitation. One of the predictions of this theory is that not only particles and objects with mass, but also the quanta of light, photons, are tied to the curvature of space-time, and thus to gravity. There must be a critical mass density, above which photons cannot escape. These are black holes. It took fifty years before possible candidate objects were identified by observational astronomy. Another fifty years have passed, until we finally can present detailed and credible experimental evidence that black holes of 10 to 10^10 times the mass of the Sun exist in the Universe. Three very different experimental techniques have enabled these critical experimental breakthroughs. It has become possible to investigate the space-time structure in the vicinity of the event horizons of black holes. I will summarize these interferometric techniques, and discuss the spectacular recent improvements achieved with all three techniques. In conclusion, I will sketch where the path of exploration and inquiry may lead to in the next decades.