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[91] Open questions in the formation of binary stellar systems containing black holes.

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The recent detection of gravitational waves from coalescing binary black holes by LIGO allowed for the first time the direct observation of stellar-mass black holes. These gravitational wave detections, complemented by a 45-year-long history of indirect observations of black holes in X-ray binaries, can give us now a more complete picture of the formation and evolution of binary stellar systems containing black holes. Yet, to date, a number of physical processes involved in the formation and evolution of these systems remain poorly understood. In this talk I will review our current understanding of the evolutionary channels leading to the formation of coalescing binary black holes. Furthermore, I will discuss the main uncertainties involved in these formation scenarios: the phase of dynamically unstable mass-transfer also known as common envelope, the occurrence of natal kicks during the core-collapse phase leading to black-hole formation, and the angular momentum content of the formed black holes. Finally, I will present an outlook of how we can improve, in the near future, our understanding in all these fronts.

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