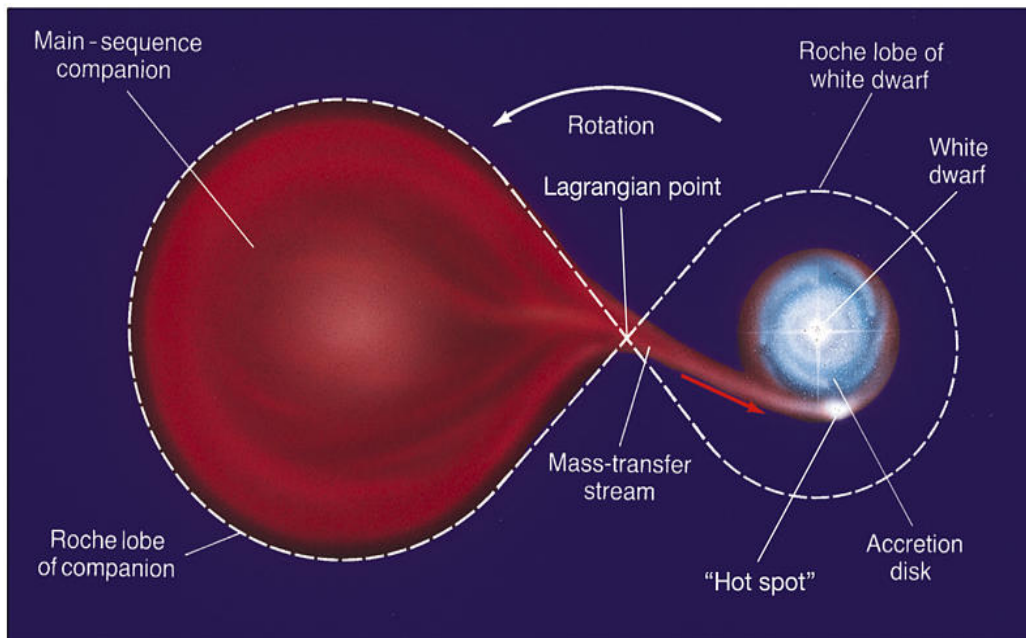


Miskovicova, Ivica

### Black Holes and Binary Evolution

The evolution of a star depends on its mass, but in any case, there is no escape from a final collapse. Mainly depending on its mass, a white dwarf, a neutron star or a black hole can be created (in general they are called compact objects in astrophysics). Black holes are created from the most massive stars, where masses of stellar remnants exceed 3 solar masses. Black holes are probably the most exciting objects in the Universe. They are infinitely dense singularities with infinitesimal volumes enclosed by the so-called event horizon. We cannot observe them directly, since the gravity inside the event horizon is that strong, that neither matter nor even light can escape its gravitational pull. This is why they are called "black holes".



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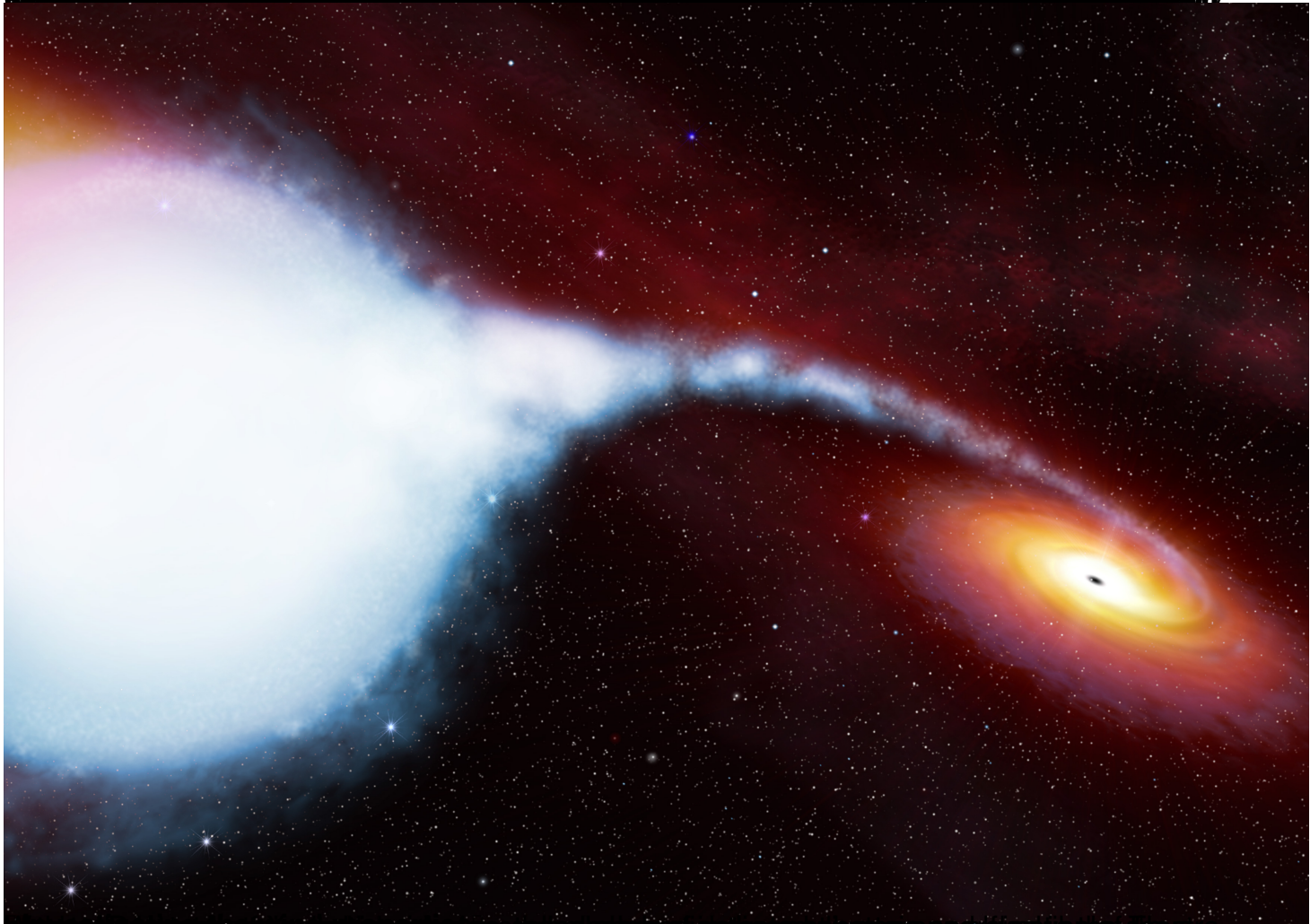
However, isolated objects in general are quite rare in the Universe. All the objects tend to join together into pairs or groups of few members orbiting around their common center of mass. The pairs of objects are usually called binary systems, or binaries.

The evolution of such a binary is different to that of a single star. If a star expands in close

binary, it can easily fill its so-called Roche lobe. Roche lobes are the surfaces separating the volume being bound gravitationally to one of the stars. When this happens, material from this star starts to flow to its companion via the inner Lagrange point of the binary system, where the gravitational forces from both objects are equal. The star which loses mass becomes the compact object after its collapse. When the companion star fills its Roche lobe, the interaction goes on again. In this case the compact object can grow by attracting matter from its surrounding. This process is called accretion. Since black holes produce their high luminosities exactly through accretion, we can detect them, observe them (indirectly), and especially, analyze properties of black hole binaries.

### **Accretion in X-ray Binaries**

Companion stars may be of different types and masses. According to these two characteristics, two different scenarios for accretion in X-ray binaries are known:



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