Black holes as microlenses in the Milky Way

Grzegorz Wiktorowicz

University of Warsaw

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Motivation

Why black holes are of interest in the context of microlensing?

- black holes are totally **dark**
- black holes are **massive**
- there are **several candidates** (Wyrzykowski et al. 2016), but a degeneracy hinders the lens' mass.

Problem

What are the properties of the black hole population in the Milky Way and other stellar populations?

Methodology

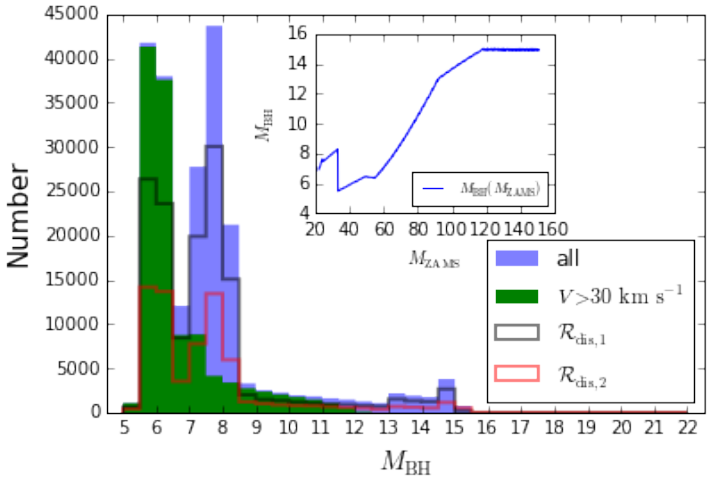
Population synthesis

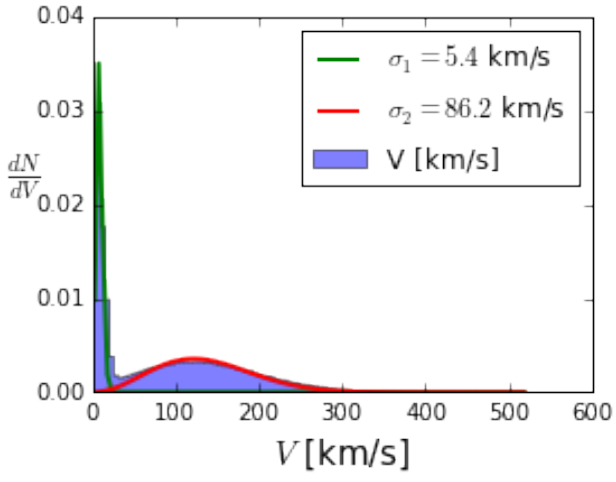
Stellar/binary evolution of a large number of systems in order to reproduce the statistical properties of galaxies.

- $N \approx 2 \times 10^6$ massive binaries ($M_{\mathrm{ZAMS}} > 10\,M_\odot$)
  $\rightarrow$ corresponds to $4.8 \times 10^8\,M_\odot$, i.e. $\sim 1\%$ of M_{MilkyWay}
- physical models of important evolutionary phases, e.g.
  - stellar winds, supernova explosions, compact object formation
  - common envelop, mass transfer, tidal interactions

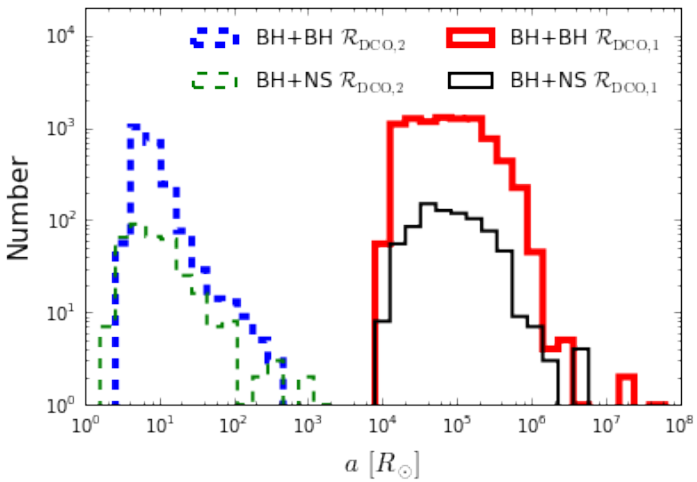
Formation routes

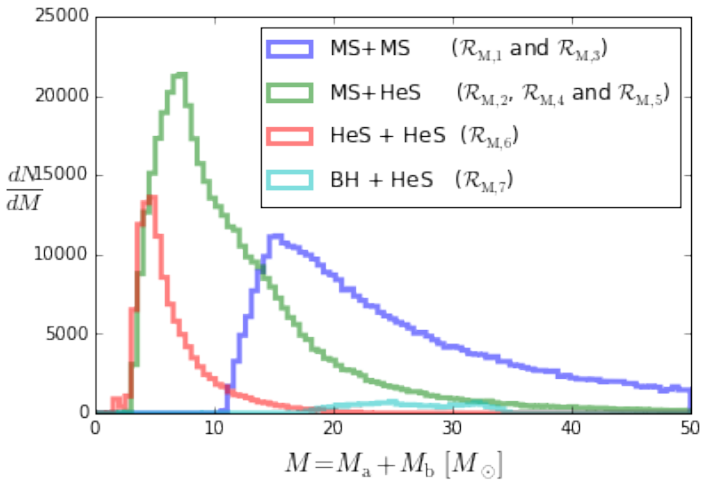
1. binary disruption during supernova explosion





2. BH in a binary system





3. BH from mergers

Estimates for the Milky Way

Asumptions for simple model

- Mass: $6 \times 10^{10}\, M_\odot$ (Licquia & Newman 2015)
- constant star formation rate
- Age: $10\,\mathrm{Gyr}$

Results

- $\mathbf{5.3 \times 10^7}$ BH from disrupted binaries
  (about half with high velocities $\sim 100\,\mathrm{km\,s^{-1}}$)
- $\mathbf{2,500}$ double compact objects with short periods
  (fit into a typical θ_E)

Summary

1. Black holes are **promising microlenses**.
2. current understanding of stellar evolution and computational power allow to **constrain black hole population's characteristics**.
3. forthcoming **database** will make it possible to perform in-depth studies of black holes in the context of microlensing what will **improve our understanding** of this fascinating objects.