Very high energy observations of BNS and BHNS mergers in the Einstein Telescope era

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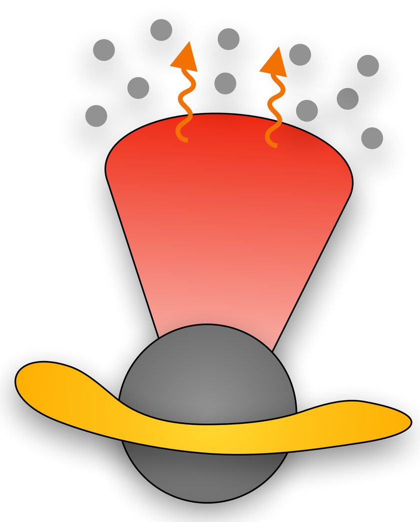
Background

- The current generation of **very high energy (VHE)** detectors have demonstrated the ability to detect the **GRB afterglow**
- The BNS merger GW170817 marked the beginning of **multi-messenger astronomy** with GWs, but no VHE emission was discovered
- The **Cherenkov Telescope Array (CTA)** will be able to detect GRB candidates with unprecedented sensitivity
- The third generation GWs detectors, such as **Einstein Telescope (ET),** will greatly expand the GW horizon, enabling the detection of more sources
- Here we study the number and the properties of **BNS** and **BHNS** mergers in the **ET era**, with a specific focus on the potential detection of VHE afterglows in synergy with **CTA**

GRB model

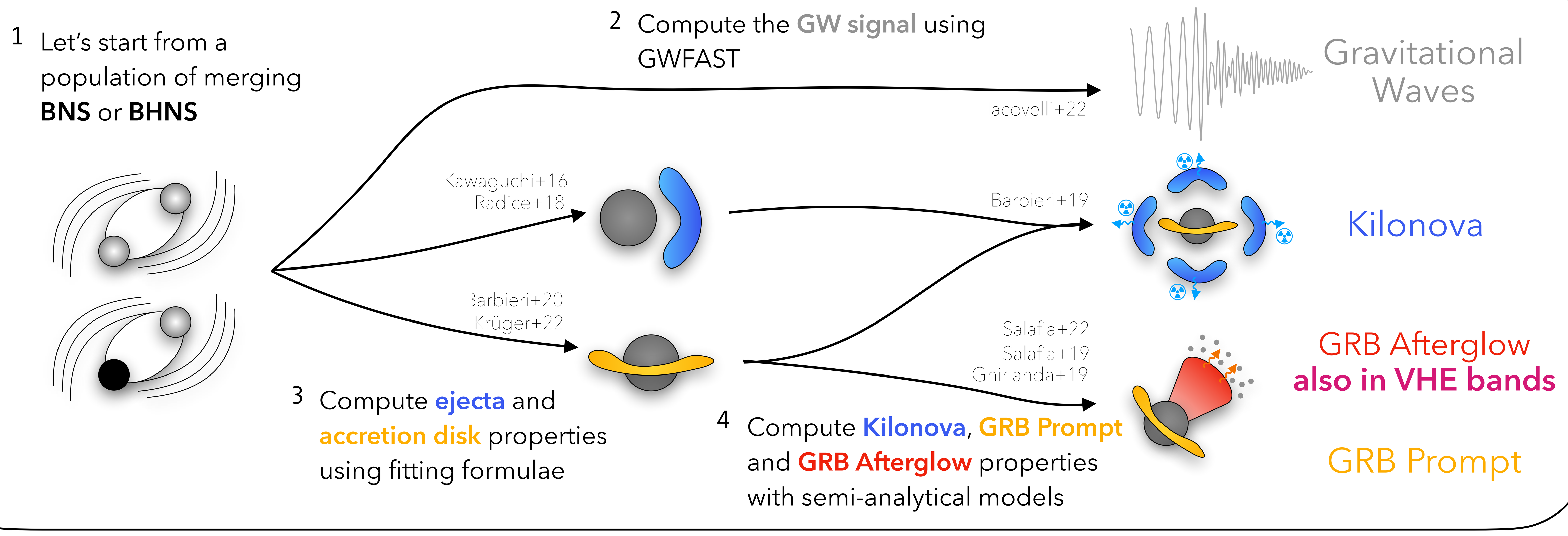


- Blandford-Znajek mechanism
- GRB170717A-like
- θ_{jet} = 3.4 deg

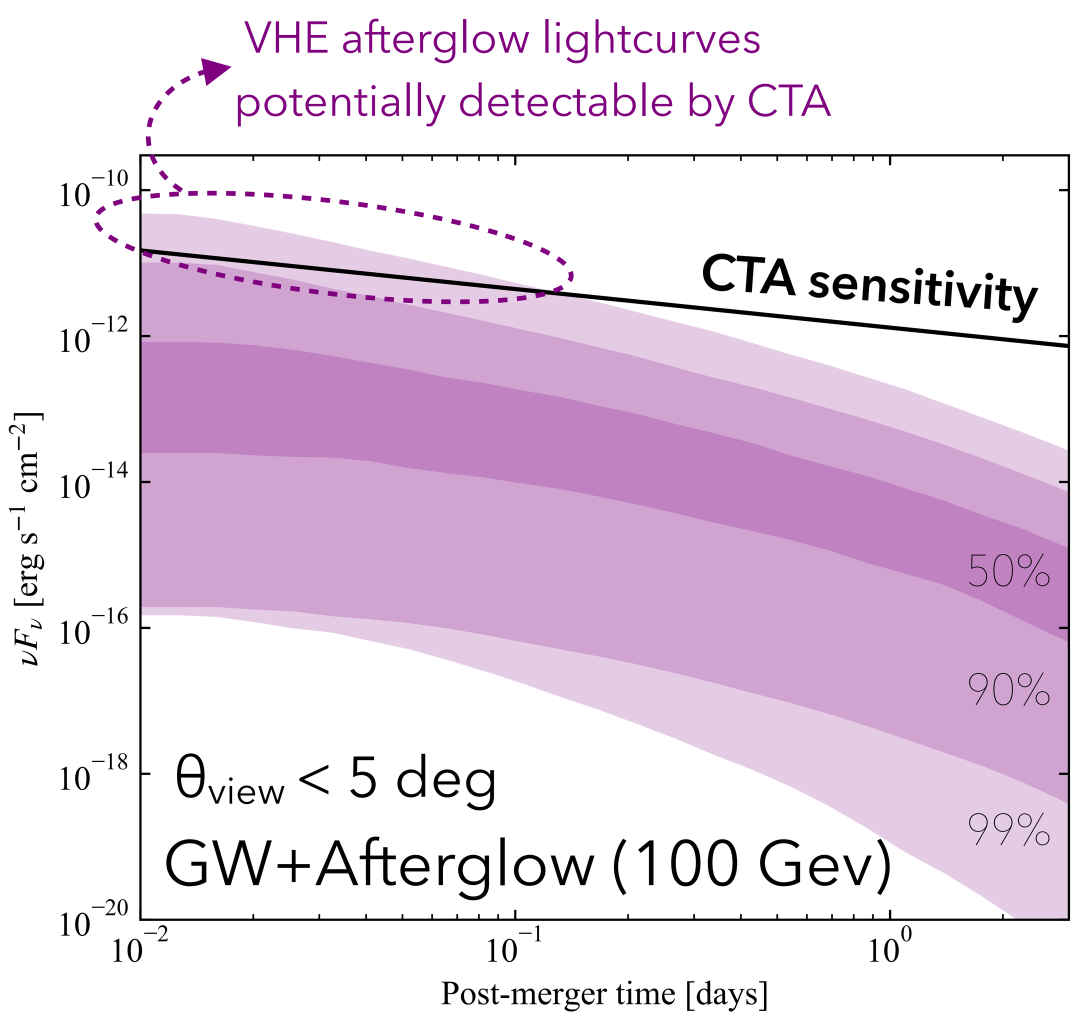
Afterglow

- Microphysical parameters ε_e=0.1, ε_B=10^{-4}, p=2.15
- Low ISM density n=5×10^{-3} cm^{-3}
- For the SSC modeling see App. C in Salafia+22

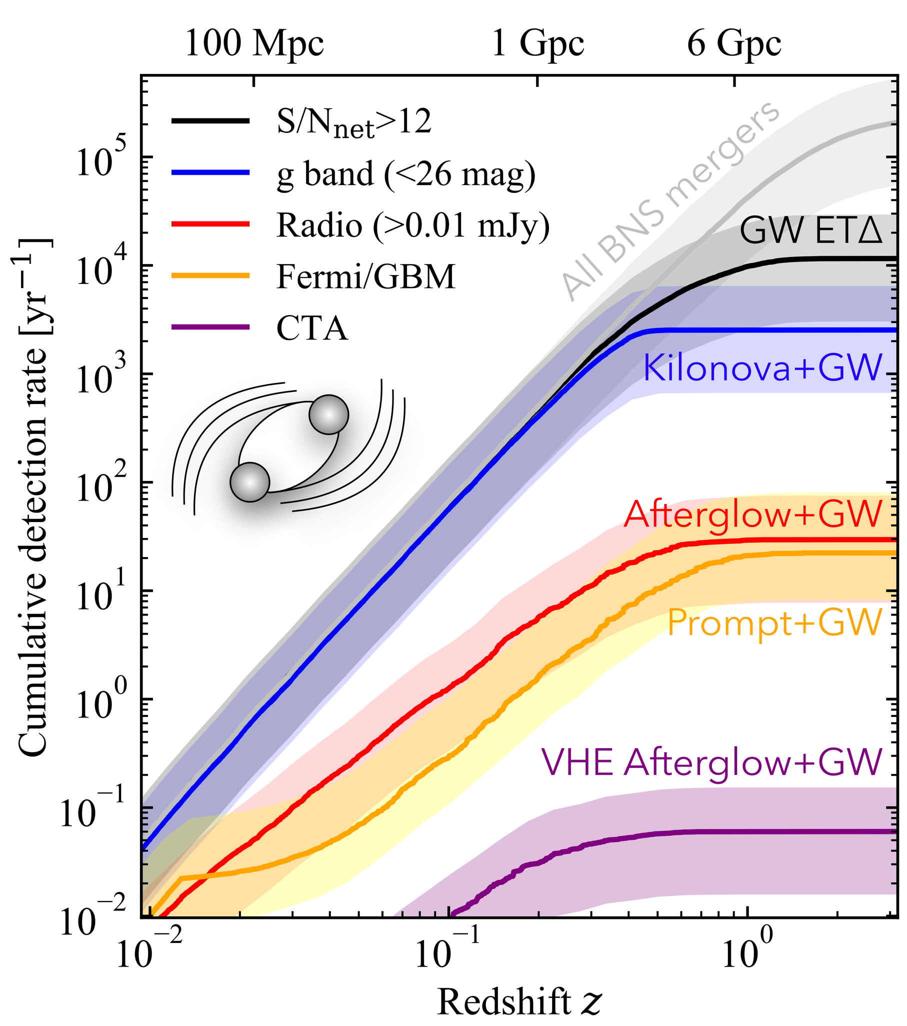
Building a multi-messenger population



Modeling a detection



Detection rates



In this plot we consider the BNS population only

A lot!

~ 10^4 yr^{-1}

Note that the shaded region is the error due to the uncertainty on the local merger rate of BNSs

$0.06^{+0.09}_{-0.04}$ yr^{-1}

Accounting also for CTA duty cycle and EBL absorption

Preliminary results

- Multi-messenger observations will be **routine,** probing BNS and BHNS at **cosmological distances**
- The majority of short **GRB**s will have a **GW counterpart**
- **VHE** afterglow + GW rates are low (~10^{-1} y^{-1}) reflecting the faintness of these components for the **CTA** sensitivity
- We find a similar GW rates for **BHNS**, but lower EM+GW rates because just **2-10%** of the binaries can power EM emissions
- We will perform **variations** on the VHE afterglow models to study the effect on the rates
- Our model can be applied to **specific EM facilities**

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