

Gravitational Wave Signatures of (Ultra)Light **Wave** Dark Matter

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Fundamental Physics and GW detectors

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האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM



Why are we interested in GWs?

In general..

- **GWs are messengers from the early universe**
understand cosmology before BBN (inflation?)
BSM theory/very high energy
- **GWs are emitted in strong gravitational fields**
understand GR/modified gravity
study black holes

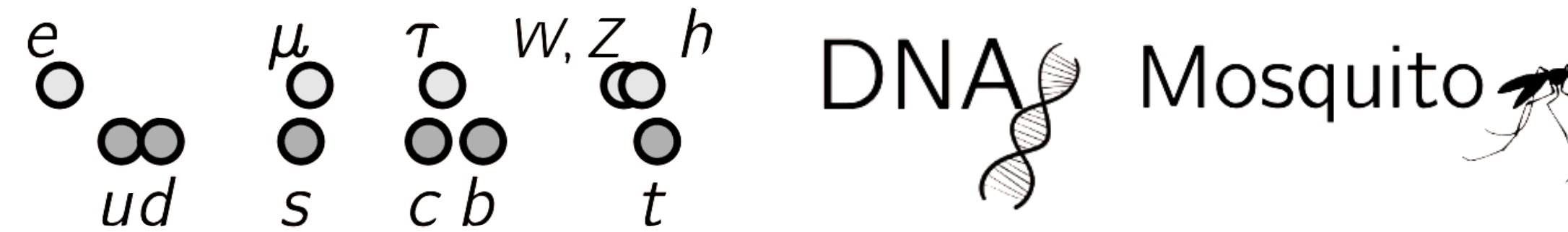
For me... as a DM theorist

- **GWs are emitted across a wide range of scales**
understand nature of DM
and maybe its wave properties?
- **GWs are universal/minimal**
direct coupling DM-SM not required

length associated to **mass** : particle "size"

$$v \sim 10^{-3}$$

$$\lambda \sim \frac{1}{mv}$$



10^{-30} eV

10^{-22} eV

10^{-14} eV

10^{-3} eV

10^3 eV

10^{12} eV

10^{29} eV

10^{27} m

10^{19} m

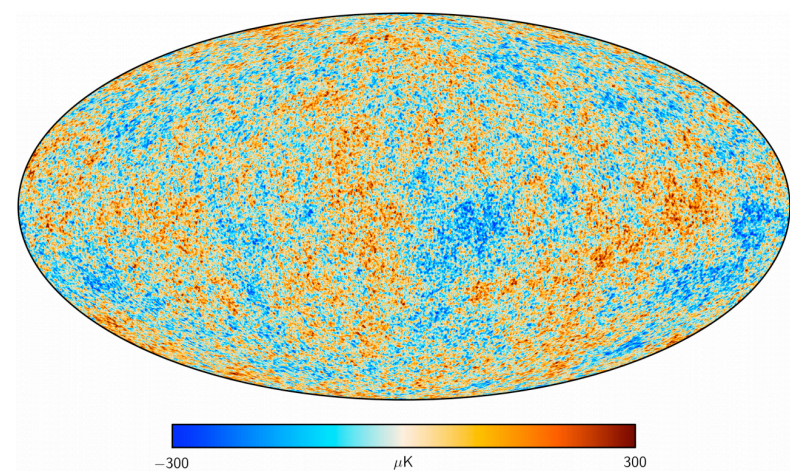
10^{11} m

1 m

10^{-10} m

10^{-15} m

10^{-33} m



Observable universe



Dwarf galaxy



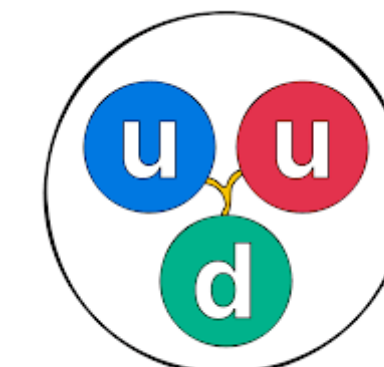
Earth-Sun



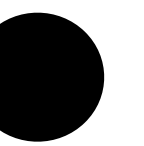
Human



Atom



Proton

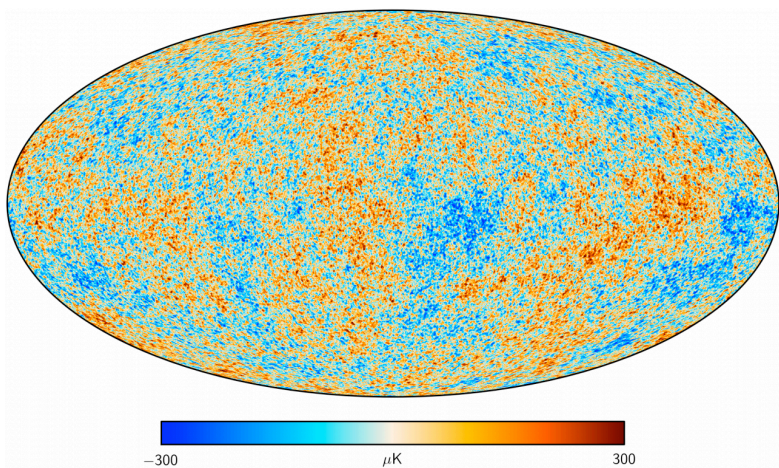
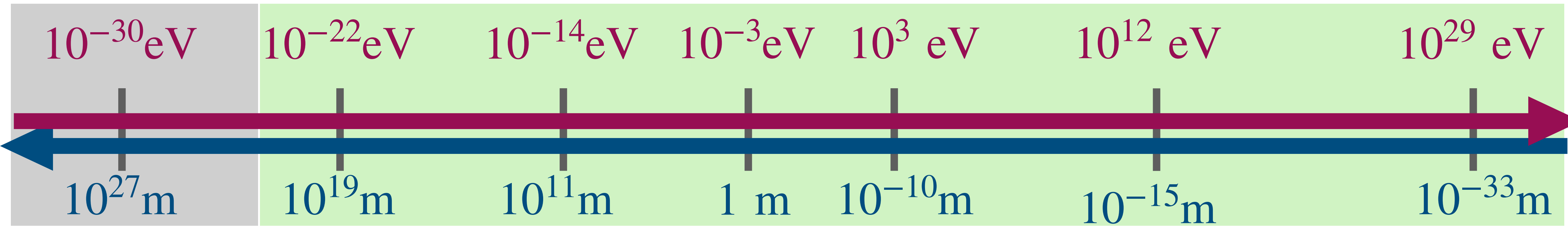
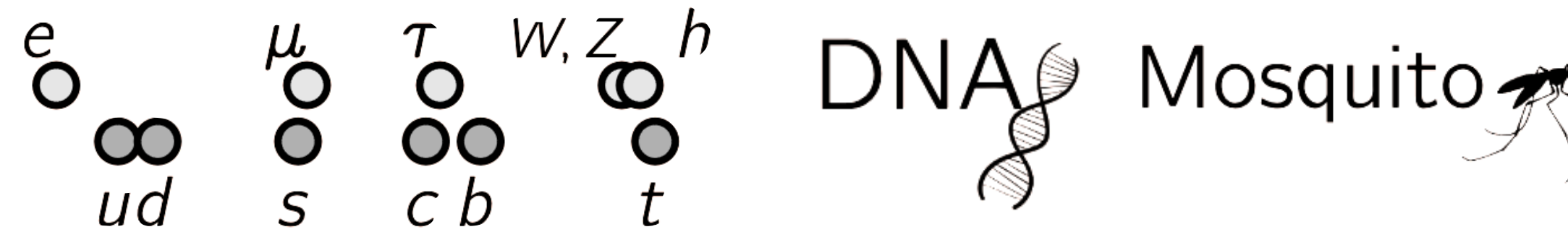


Planck scale

length associated to **mass** : particle "size"

$$v \sim 10^{-3}$$

$$\lambda \sim \frac{1}{mv}$$



Observable universe



Dwarf galaxy



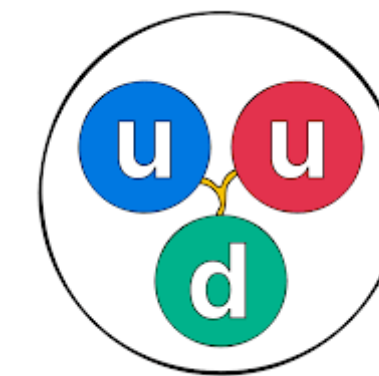
Earth-Sun



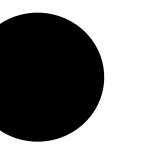
Human



Atom



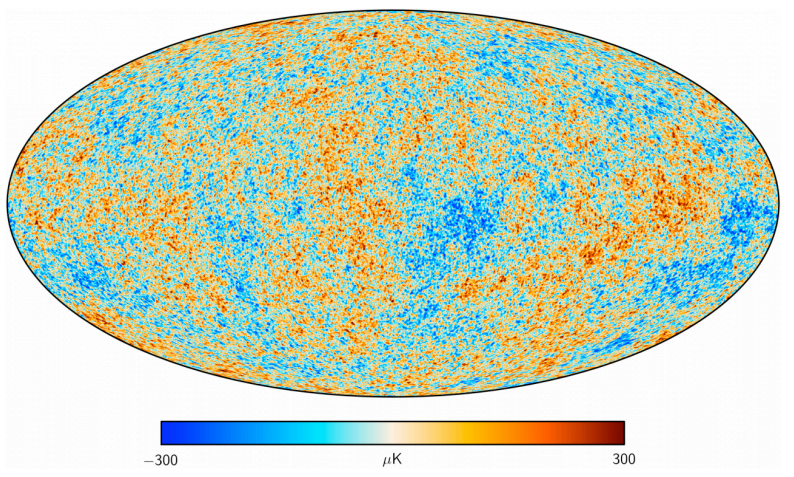
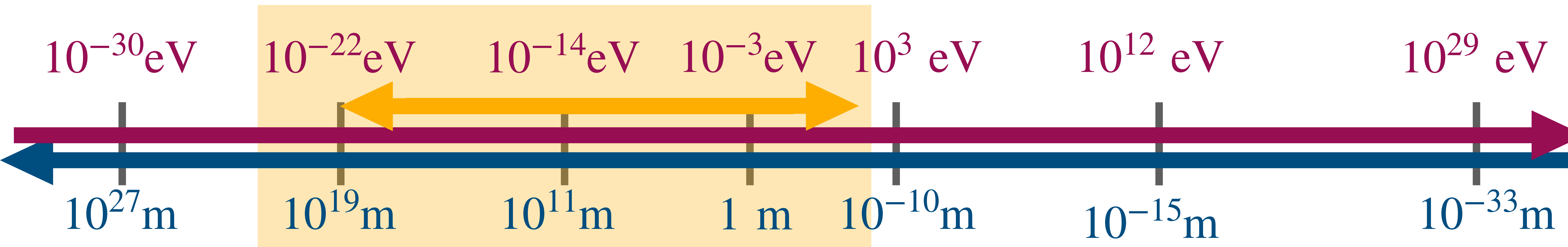
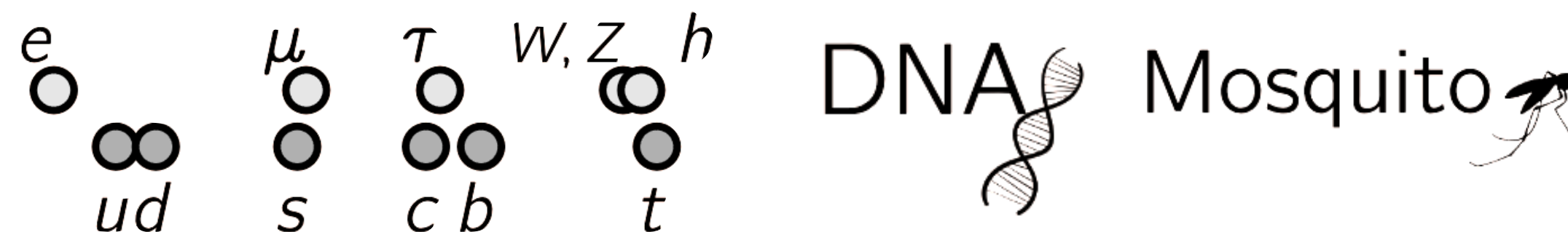
Proton



Planck scale

Wave dark matter

= (ultra)light dark matter with macroscopic wavelength



Observable universe



Dwarf galaxy



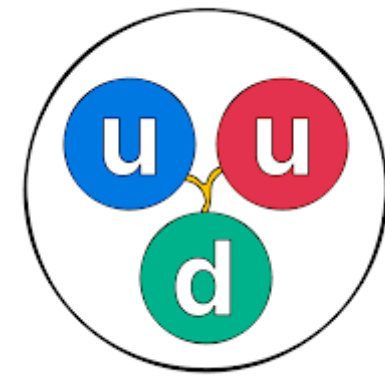
Earth-Sun



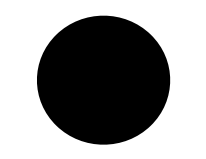
Human



Atom



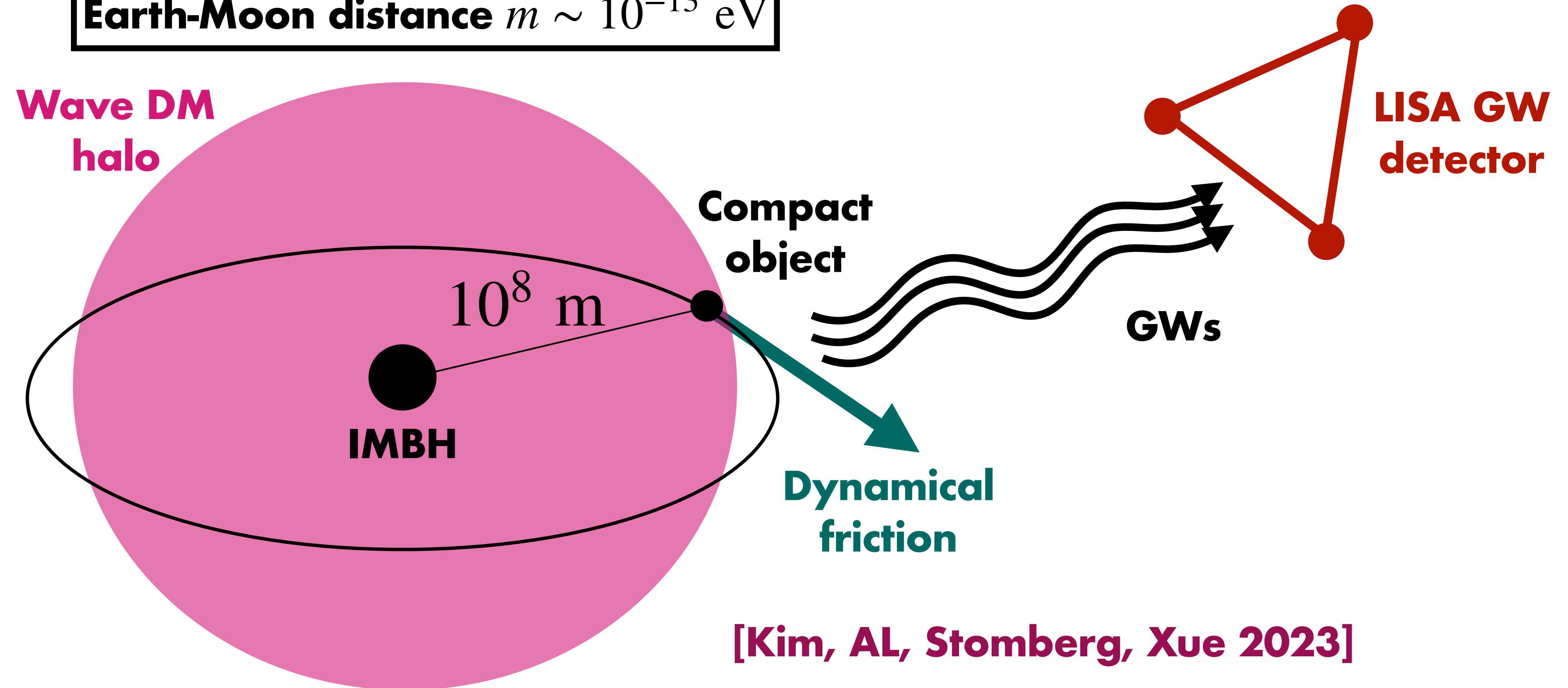
Proton



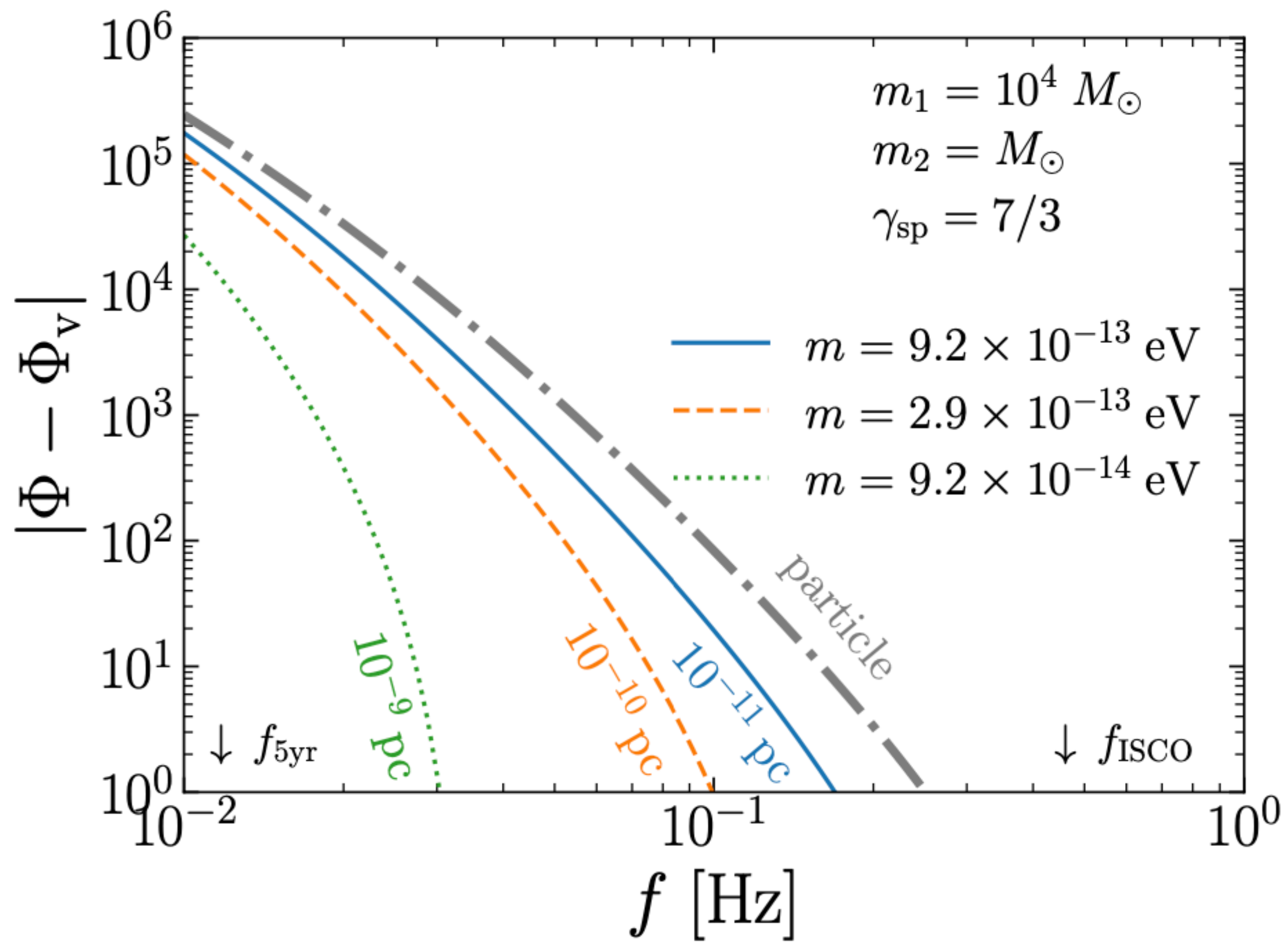
Planck scale

Vast range of scales accessible from GWs

Earth-Moon distance $m \sim 10^{-13}$ eV



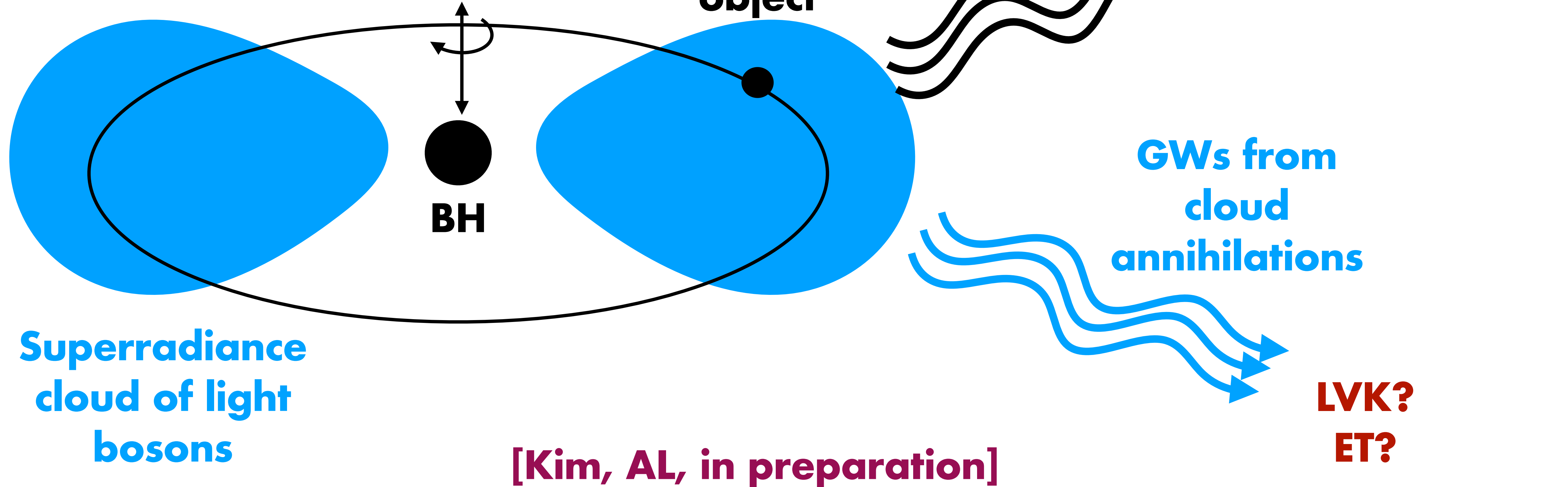
[Kim, AL, Stomberg, Xue 2023]

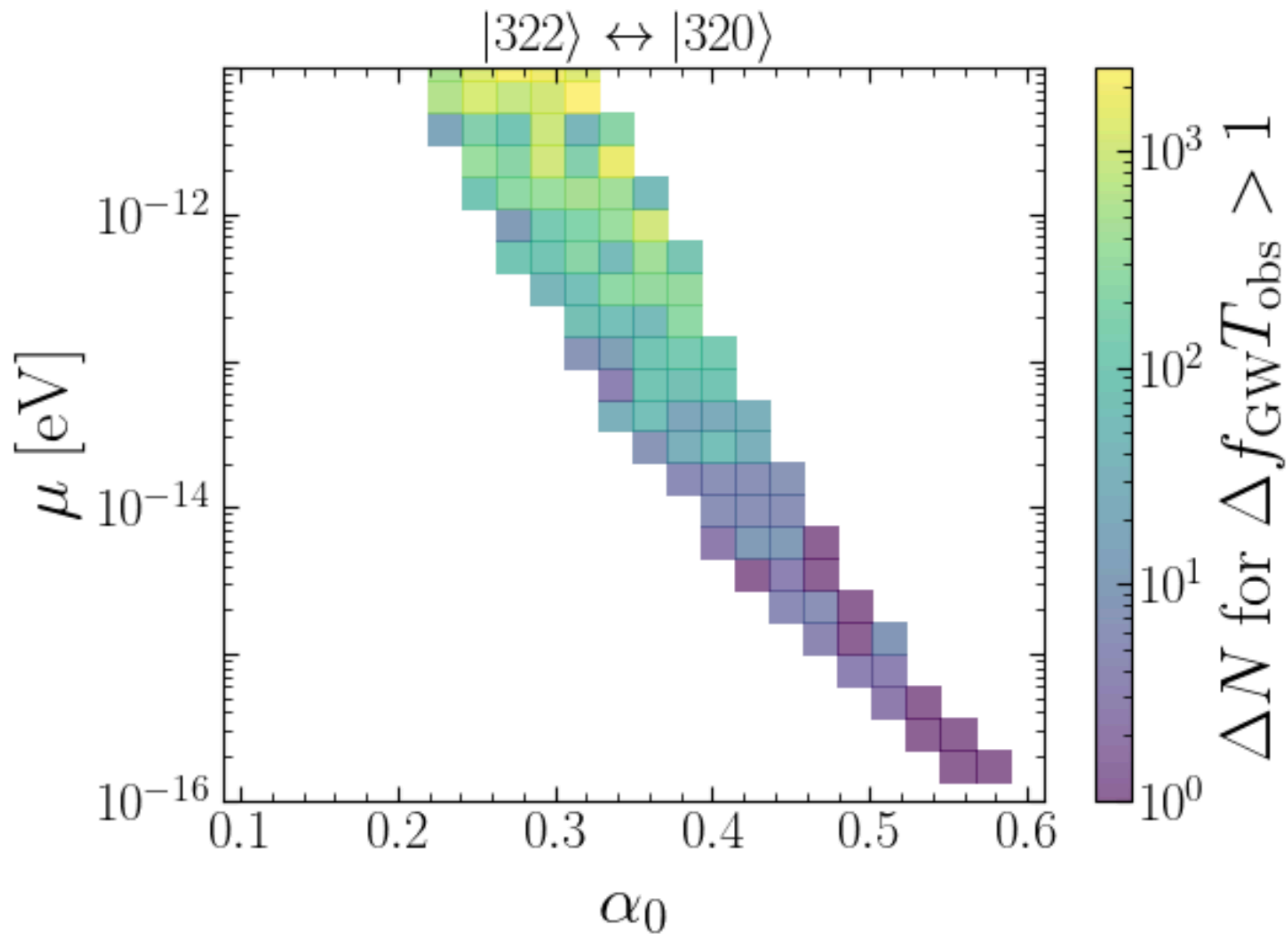


Vast range of scales accessible from GWs

Vast range $m \sim (10^{-16} - 10^{-10})$ eV

$$M_c \lesssim 0.1M$$





Thank you!

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