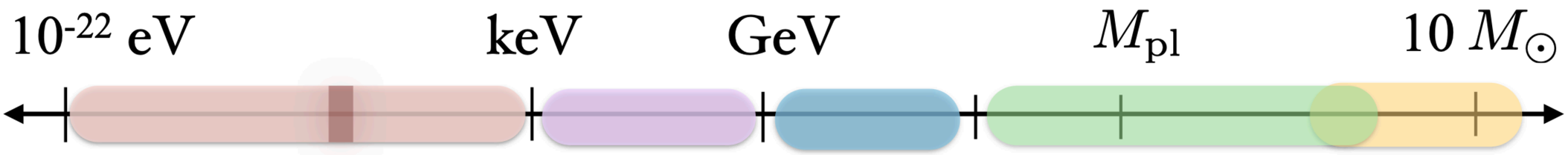
Looking for dark sectors

Fundamental Physics & Gravitational Wave Detectors, Pollica, 10th Sept 2024

Sonali Verma [ULB Brussels]

[1904.07915]



``Ultralight" DM

non-thermal
bosonic fields

``Light" DM

dark sectors
sterile ν
can be thermal

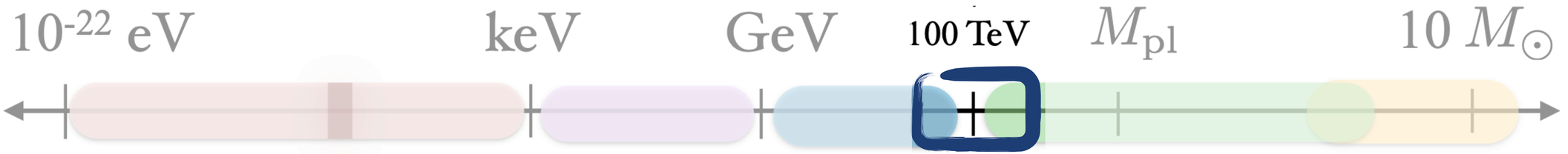
WIMP

Composite DM
(Q-balls, nuggets, etc)

Primordial
black holes

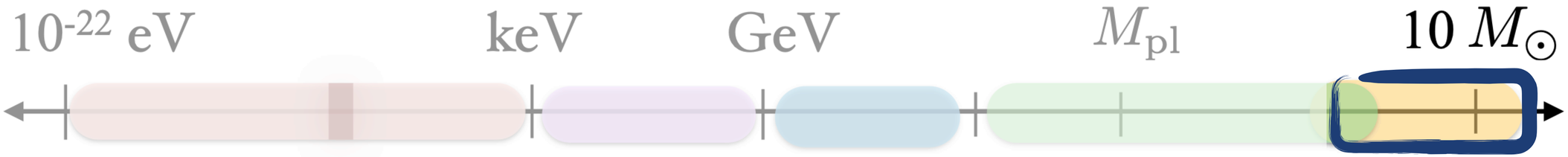
Searching for conformal dark sectors at high-intensity experiments?

[M. Costa, R. K. Mishra, SV]



Could composite dark matter be SU(5) unified?

[S. Bottaro, R. Contino, SV]



Probing PBH clusters with PTA data?

S. Clesse, V. Dandoy, SV [work in progress]

Primordial black holes

10^{-22} eV

QCD axion
classic window
10^{-6} - 10^{-4} eV

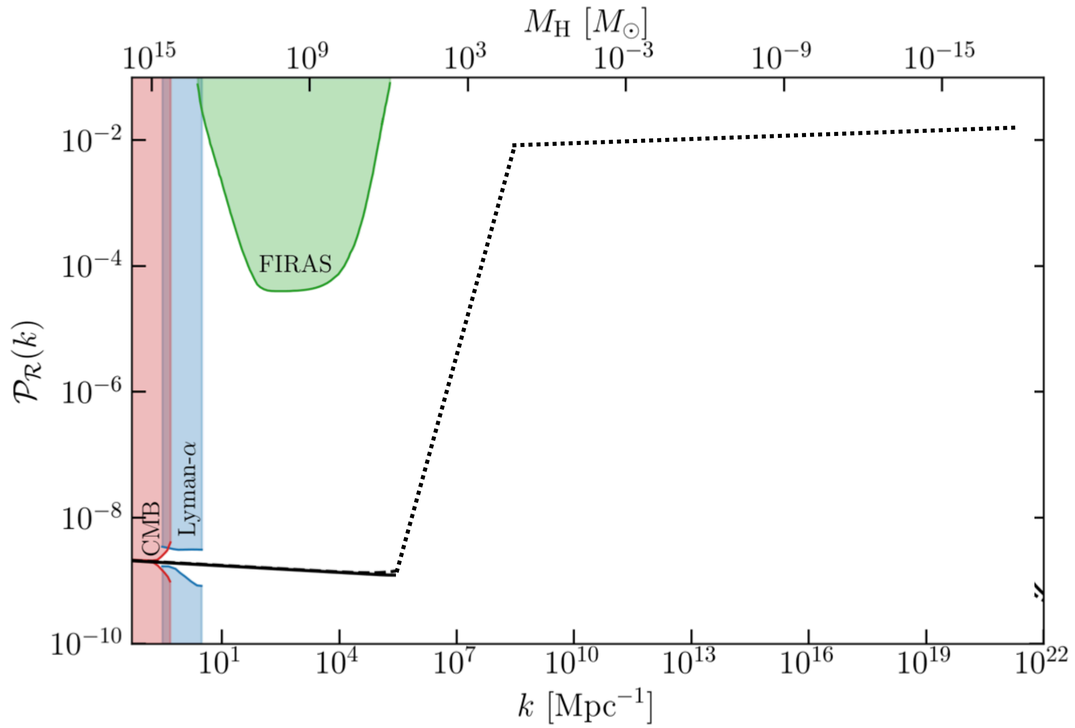
WDM limit
keV

GeV

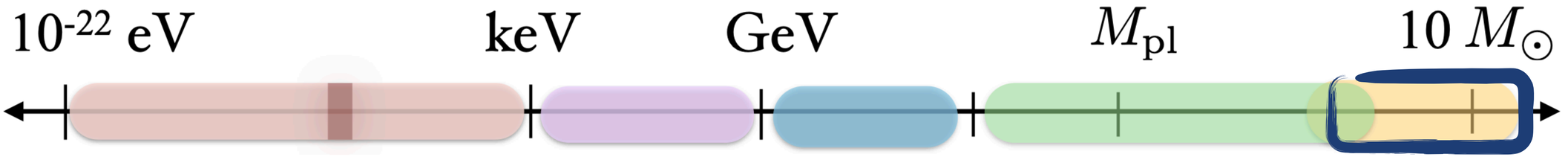
unitarity limit
100 TeV

$M_{\rm pl}$

$10\,M_\odot$



Primordial
black holes



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Primordial black holes

$$P_{poisson} = f_{\rm PBH}^2\, n_{\rm PBH}^{-1}$$

Poissonian fluctuations will enhance matter power spectrum at small scales

See for e.g. [Kashlinsky et. al.]

10^{-22} eV

QCD axion
classic window
10^{-6} - 10^{-4} eV

WDM limit
keV

GeV

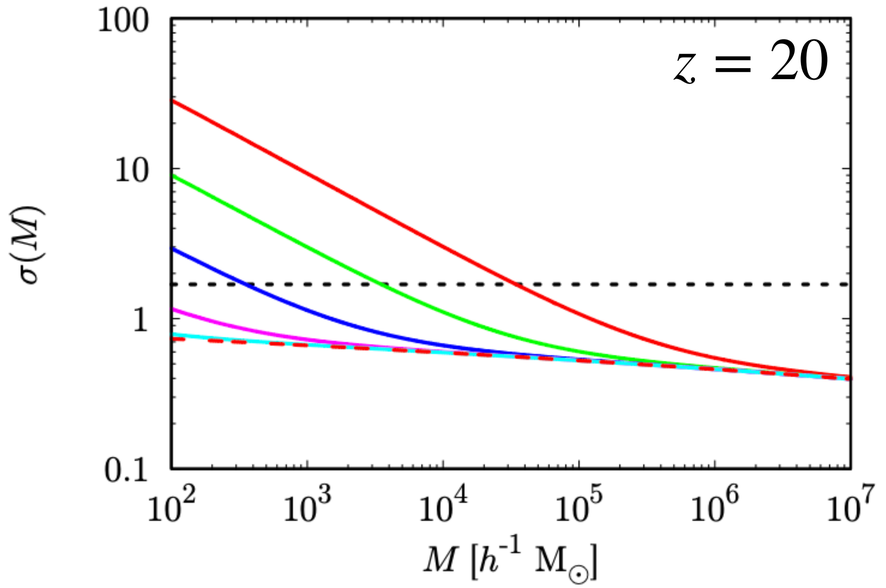
unitarity limit
100 TeV

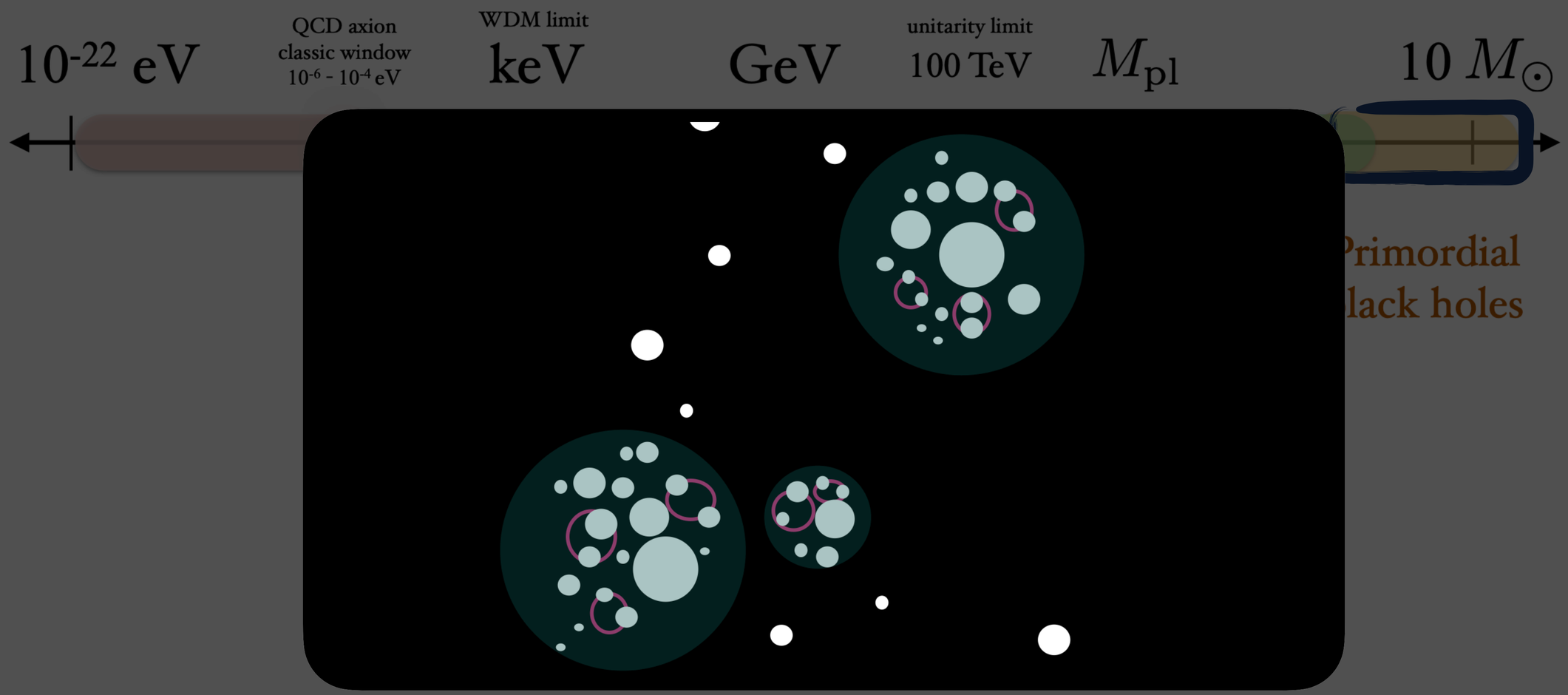
$M_{\rm pl}$

$10\,M_\odot$

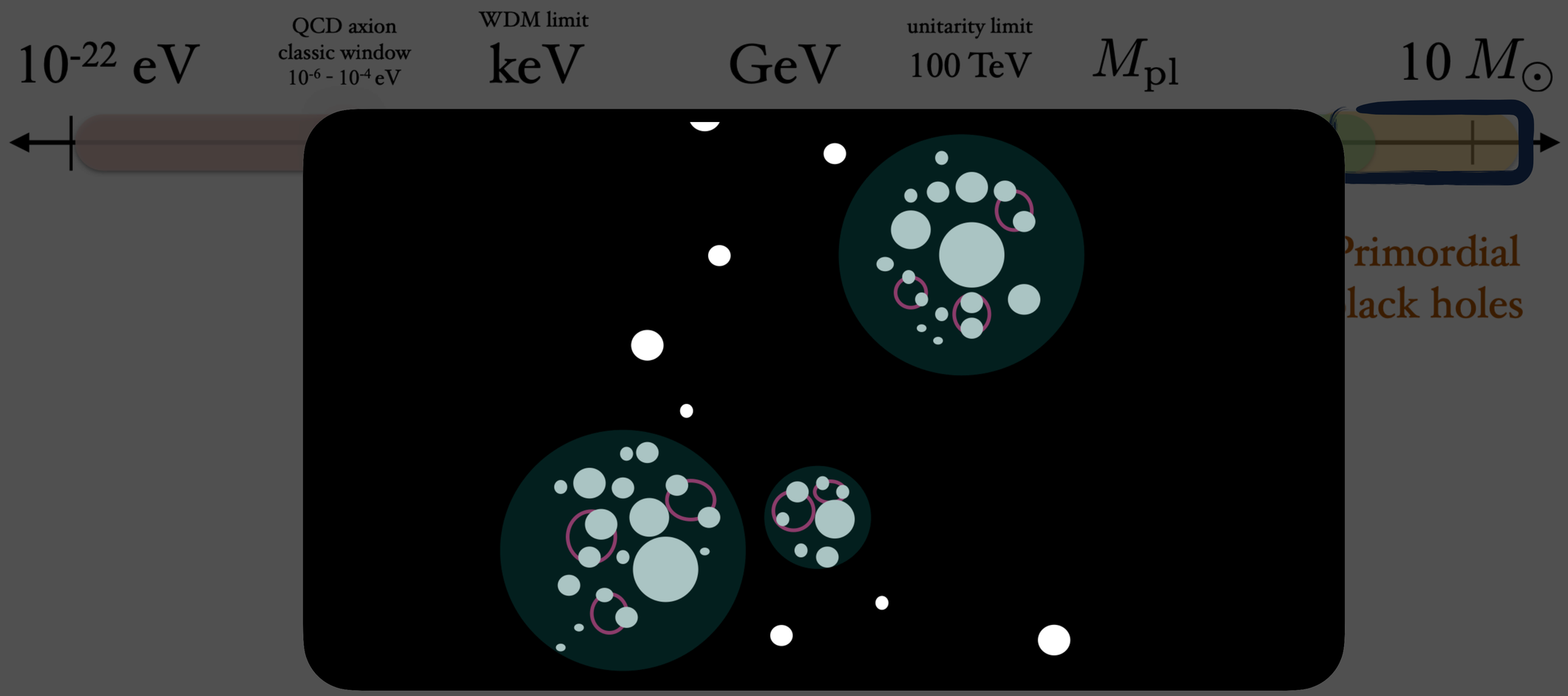
Primordial
black holes

[Gong et. al.]

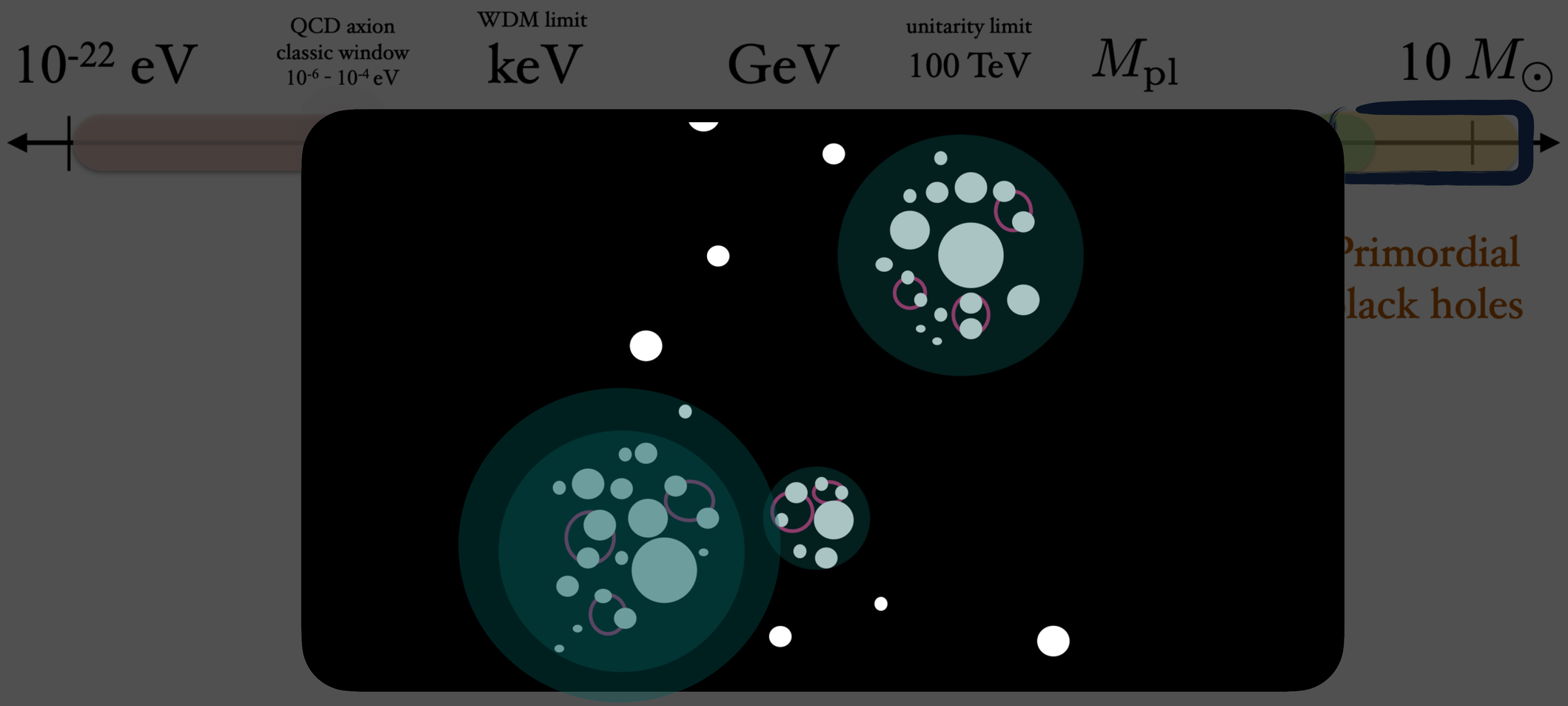




PBH binary formation can take place via capture in PBH clusters

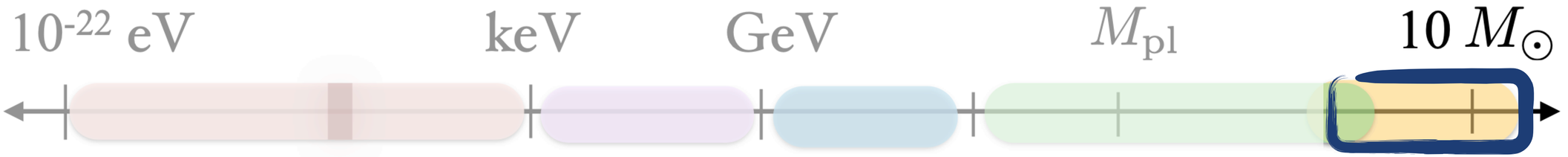


$$\Omega_{GW}(f) = f^{2/3}\,\frac{(\pi G)^{2/3}}{\rho_c}\int dz\,\mathrm{d}\ln m_1 \mathrm{d}\ln m_2 \frac{1}{H(z)(1+z)^{4/3}}\frac{\mathrm{d}\mathscr{V}(z)}{\mathrm{d}\ln m_1 \mathrm{d}\ln m_2}\mathscr{M}_c^{5/3}$$



PBH clusters can also grow in radius due to dynamical heating

[Brandt et. al]



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Primordial black holes

GW spectrum from PBH mergers will be sub-leading wrt SIGWs triggered at PBH formation

PBH merger rates required to fit PTA data ~ $\mathcal{O}(10^4)\ \mathrm{yr}^{-1}\mathrm{Gpc}^{-3}$ wrt LIGO/VIRGO events

[Bellido et. al]