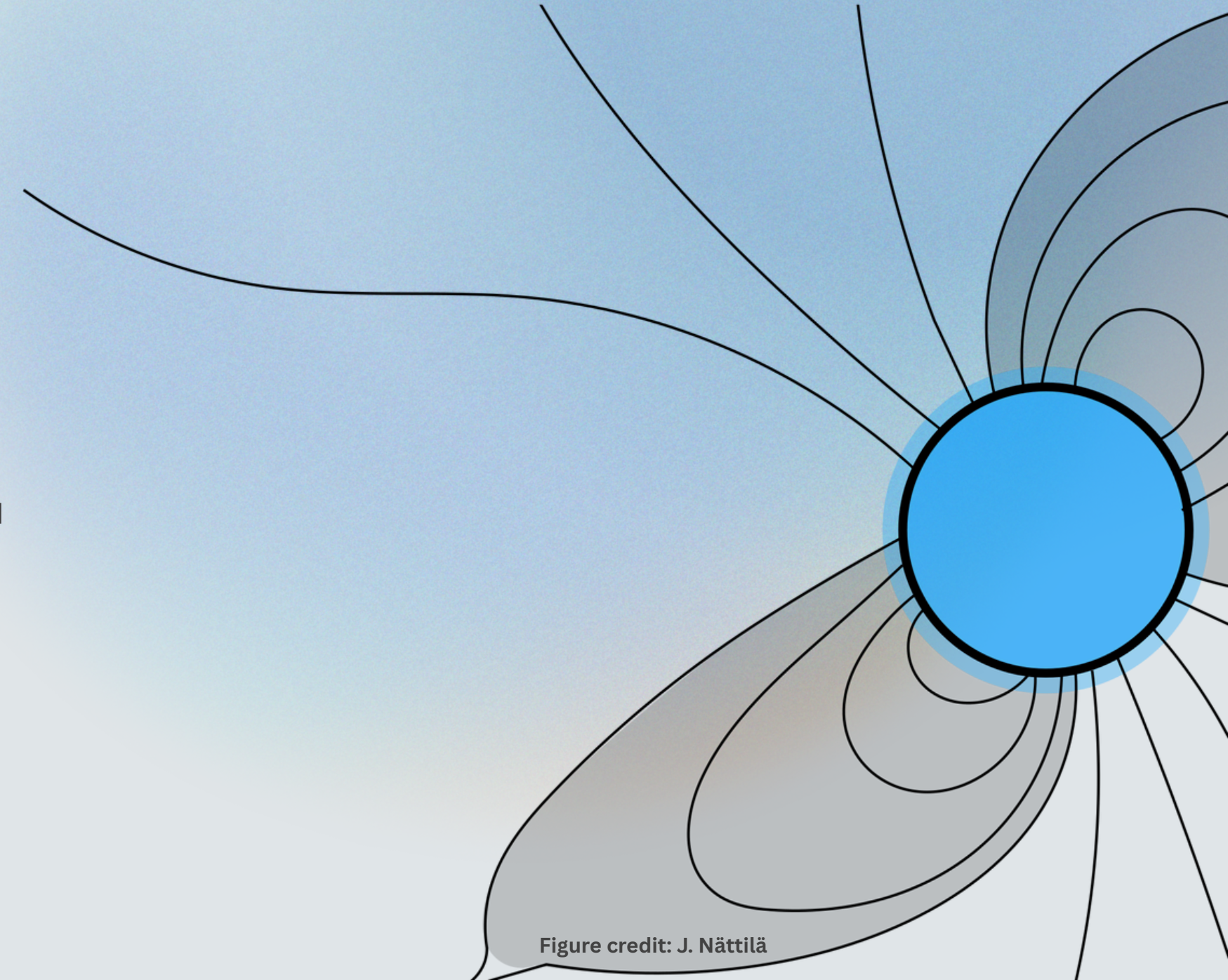
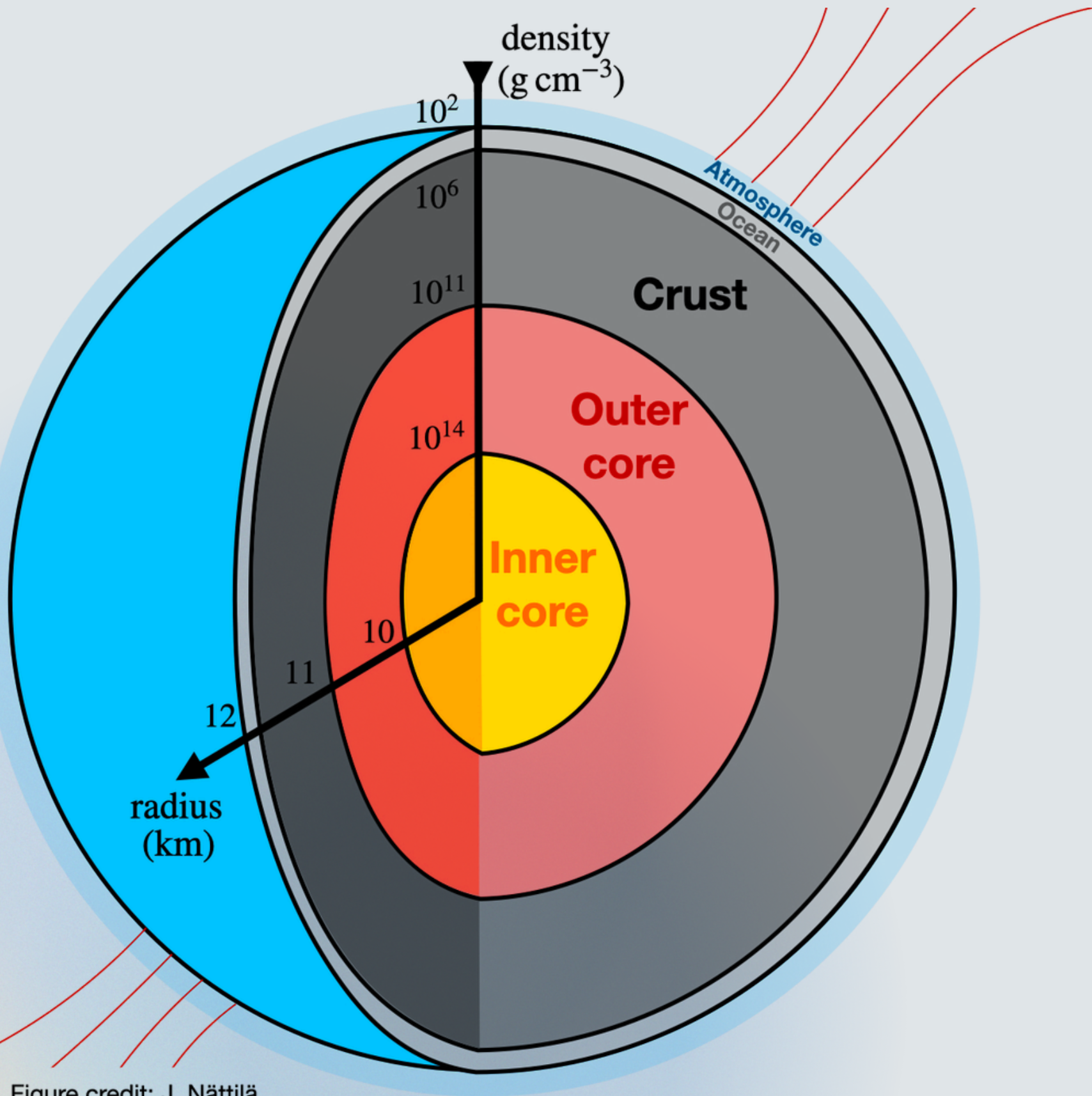


Strong constraints for twin-star solutions



Extreme environments of Neutron Stars (NS)



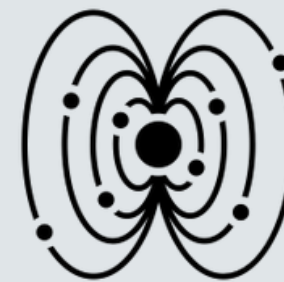
Compact

$M \sim 1.1 - 2 M_{\odot}$, $R \sim 11 - 14 \text{ km}$



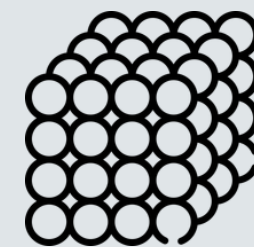
Rapidly spinning

$P \sim 0.001 - 10 \text{ s}$



Strong magnetic fields

$B \sim 10^8 - 10^{15} \text{ G}$



Very high densities

$\rho \sim 10^{13} \text{ g cm}^{-3}$

Describing NS matter and structure

with an Equation of State (EoS).

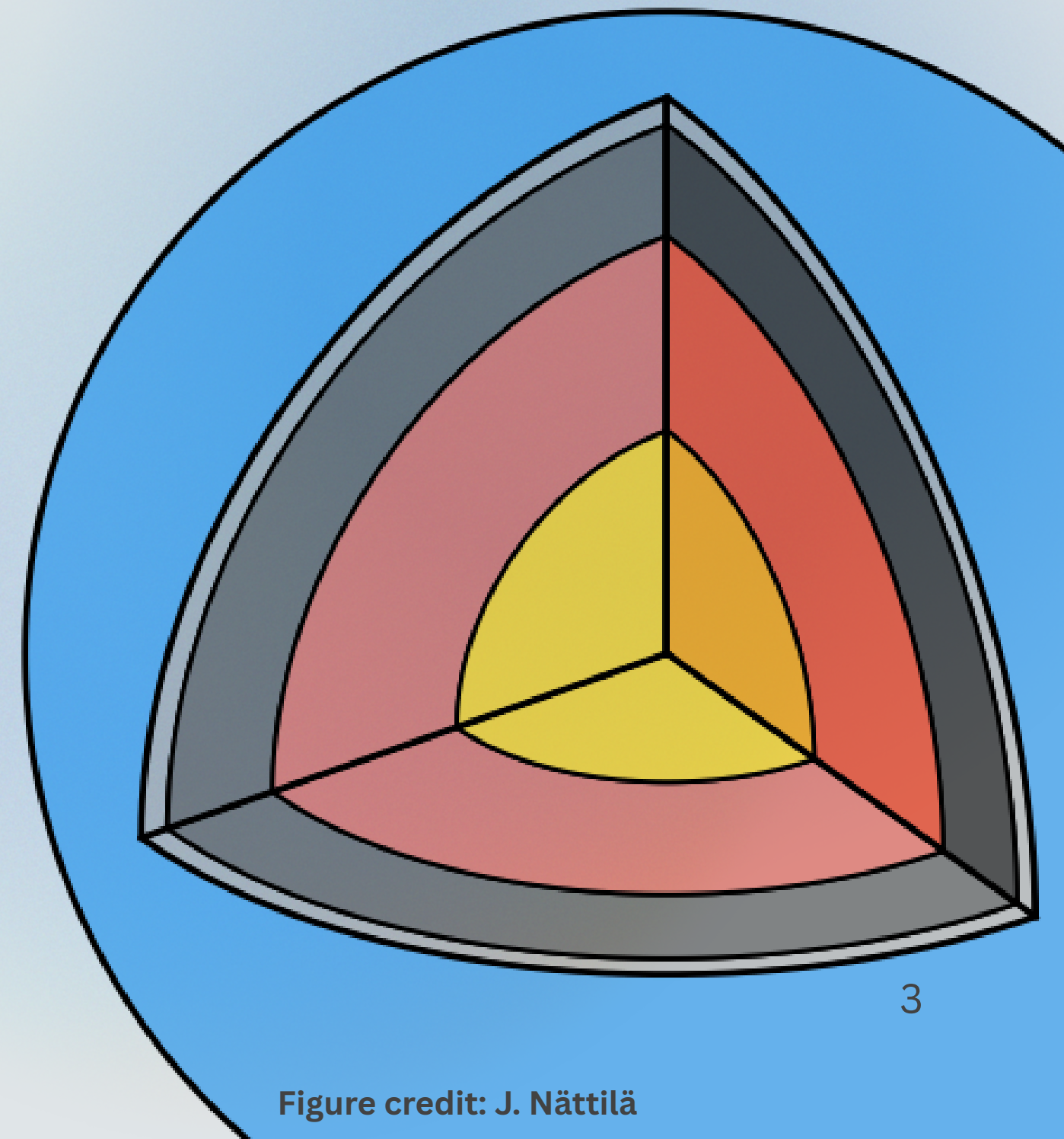
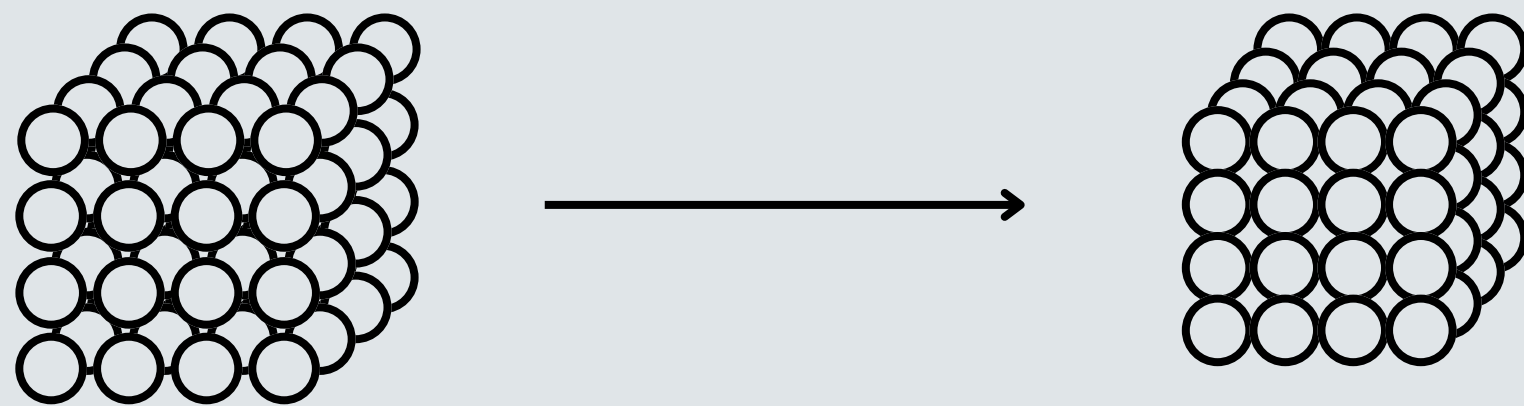
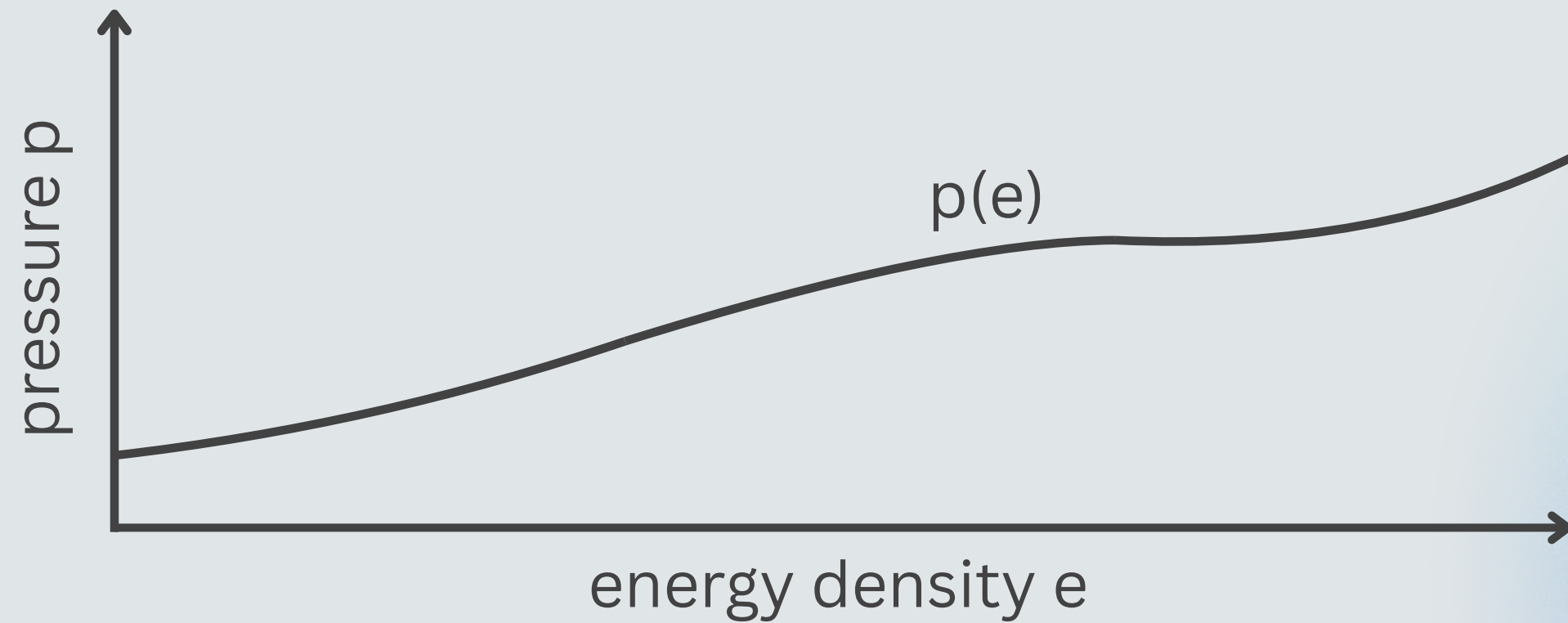


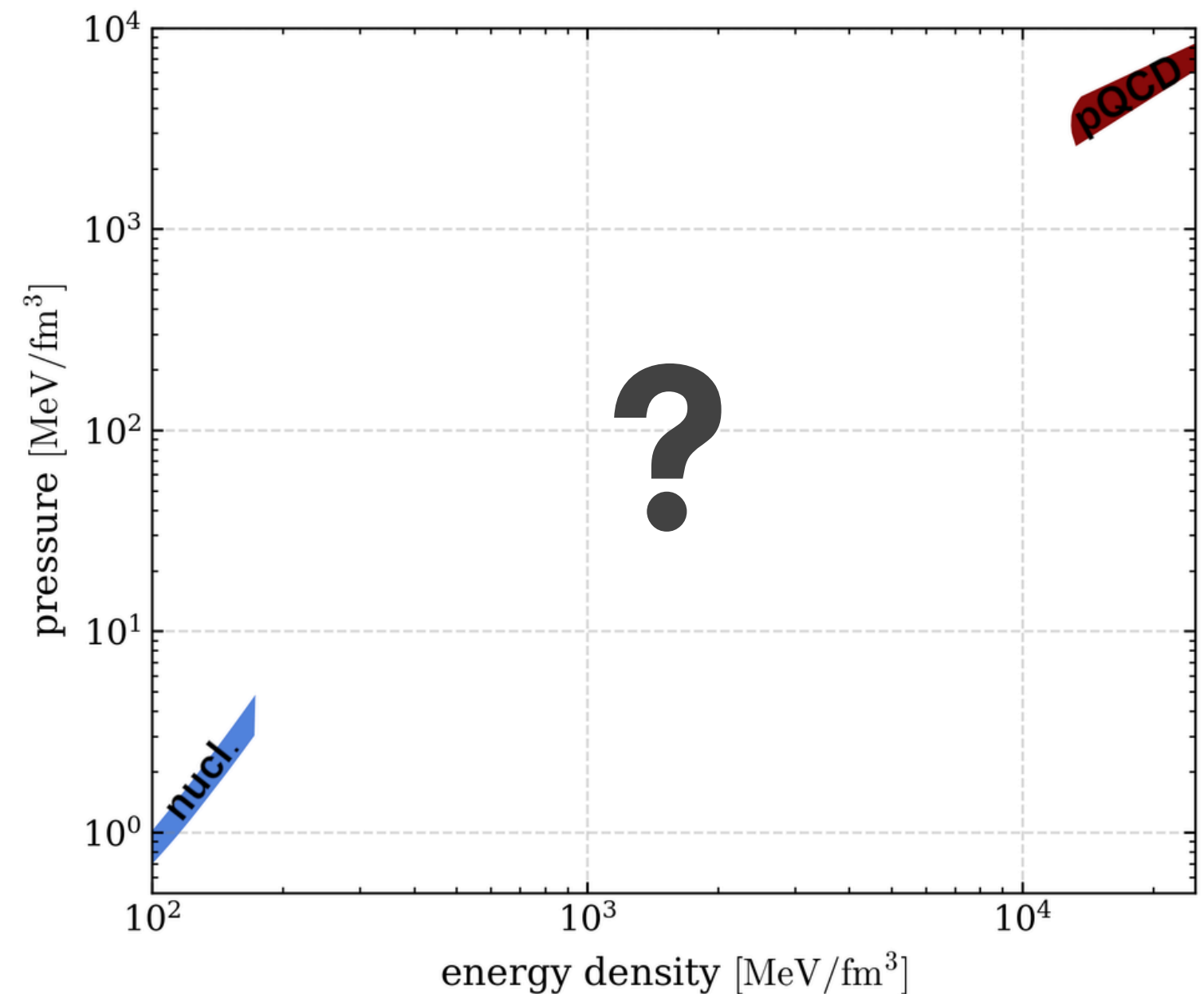
Figure credit: J. Nättilä

How matter behaves at NS densities?

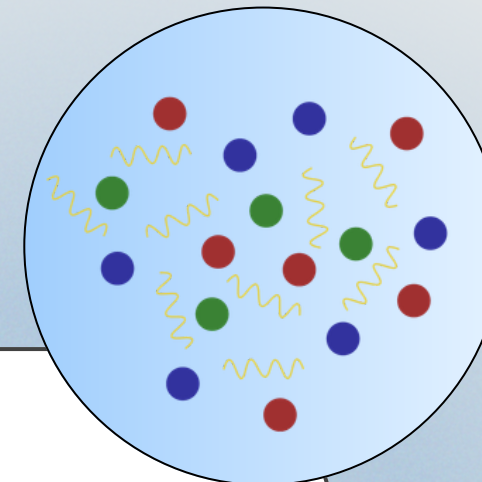
Equation of state (EoS) describes NS matter and structure

Theoretical constraints at low- and high-density limits

Exact form not known between!



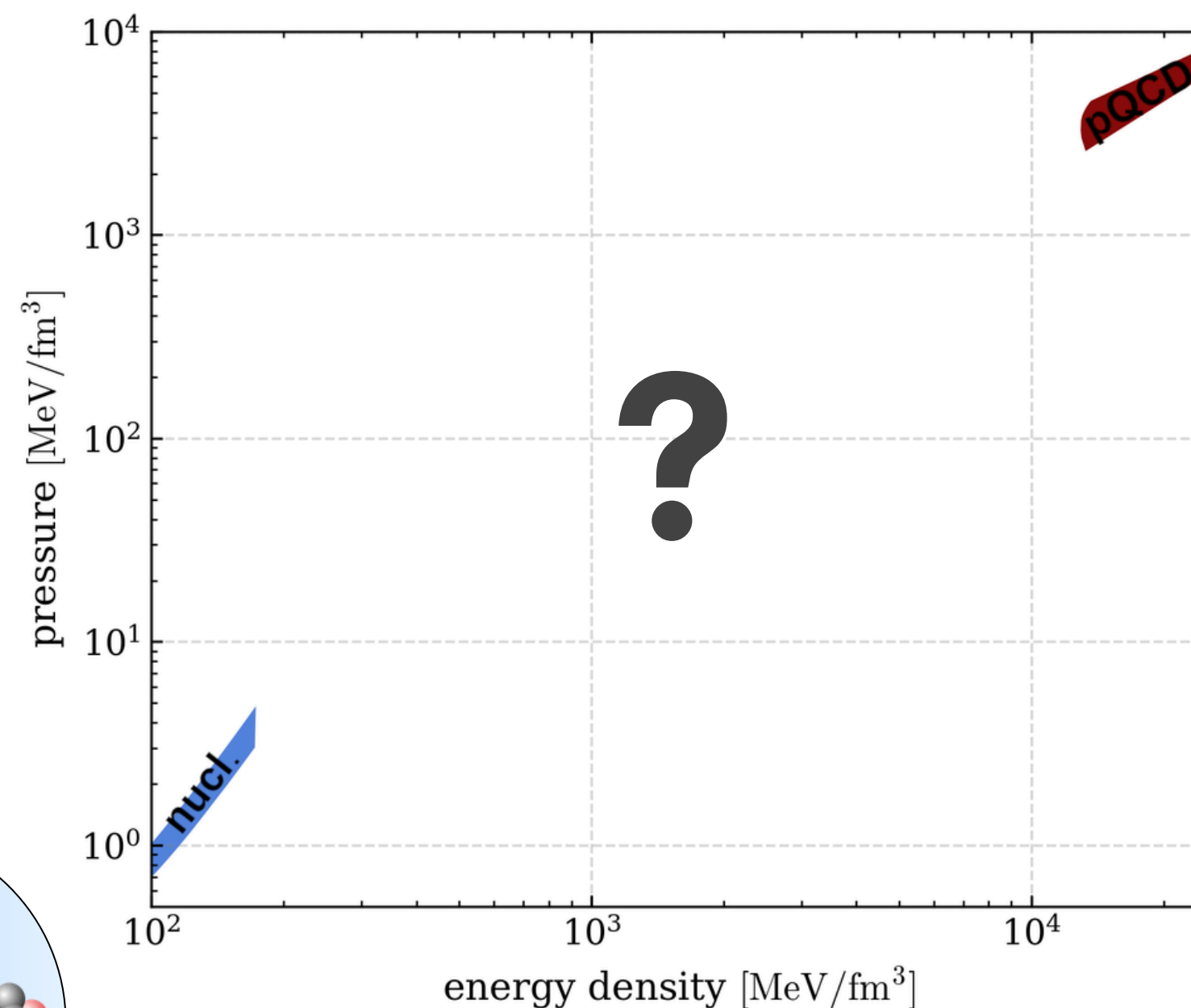
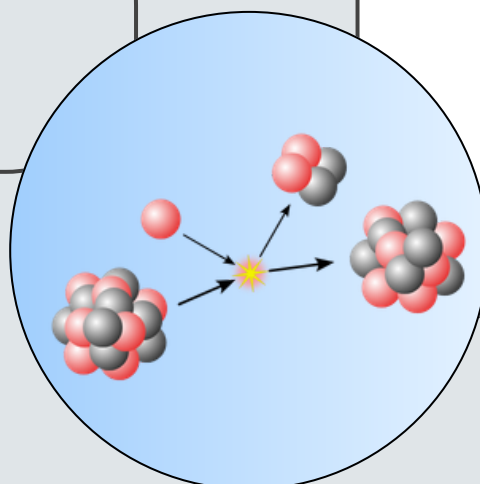
How matter behaves at NS densities?



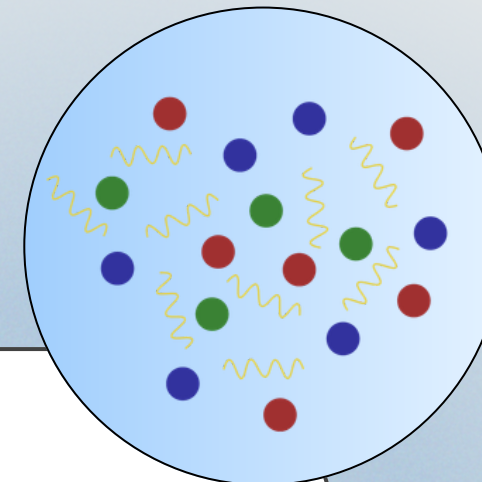
Equation of state (EoS) describes NS matter and structure

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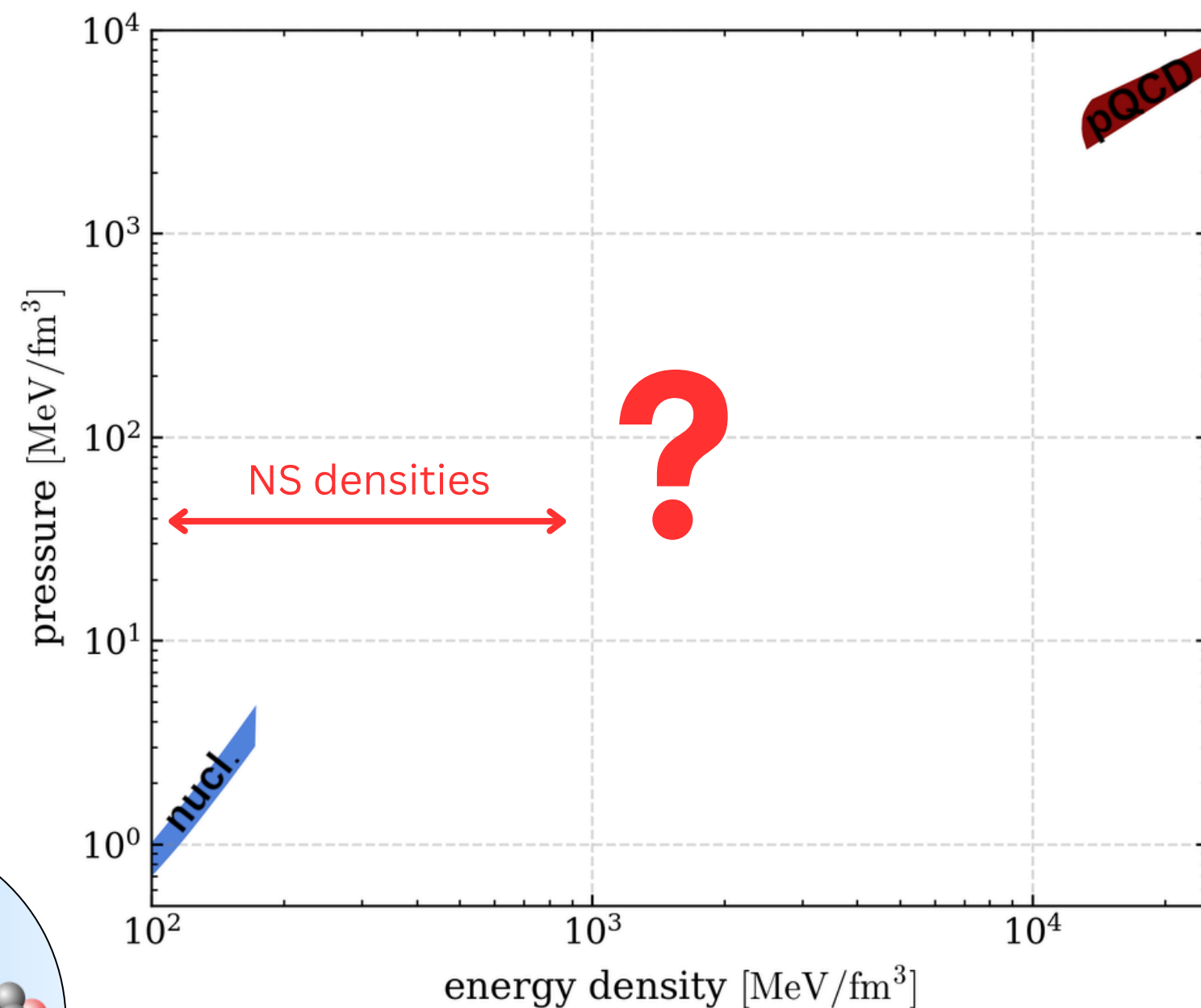
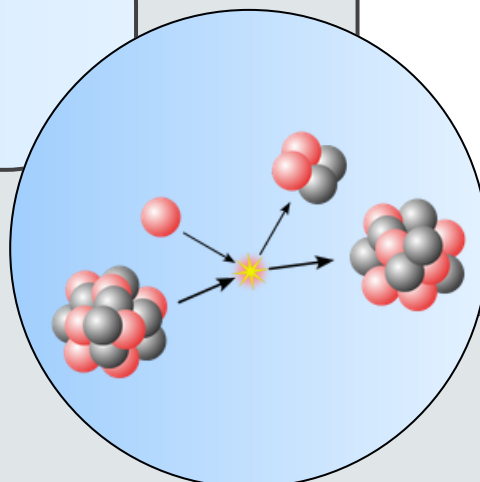
How matter behaves at NS densities?



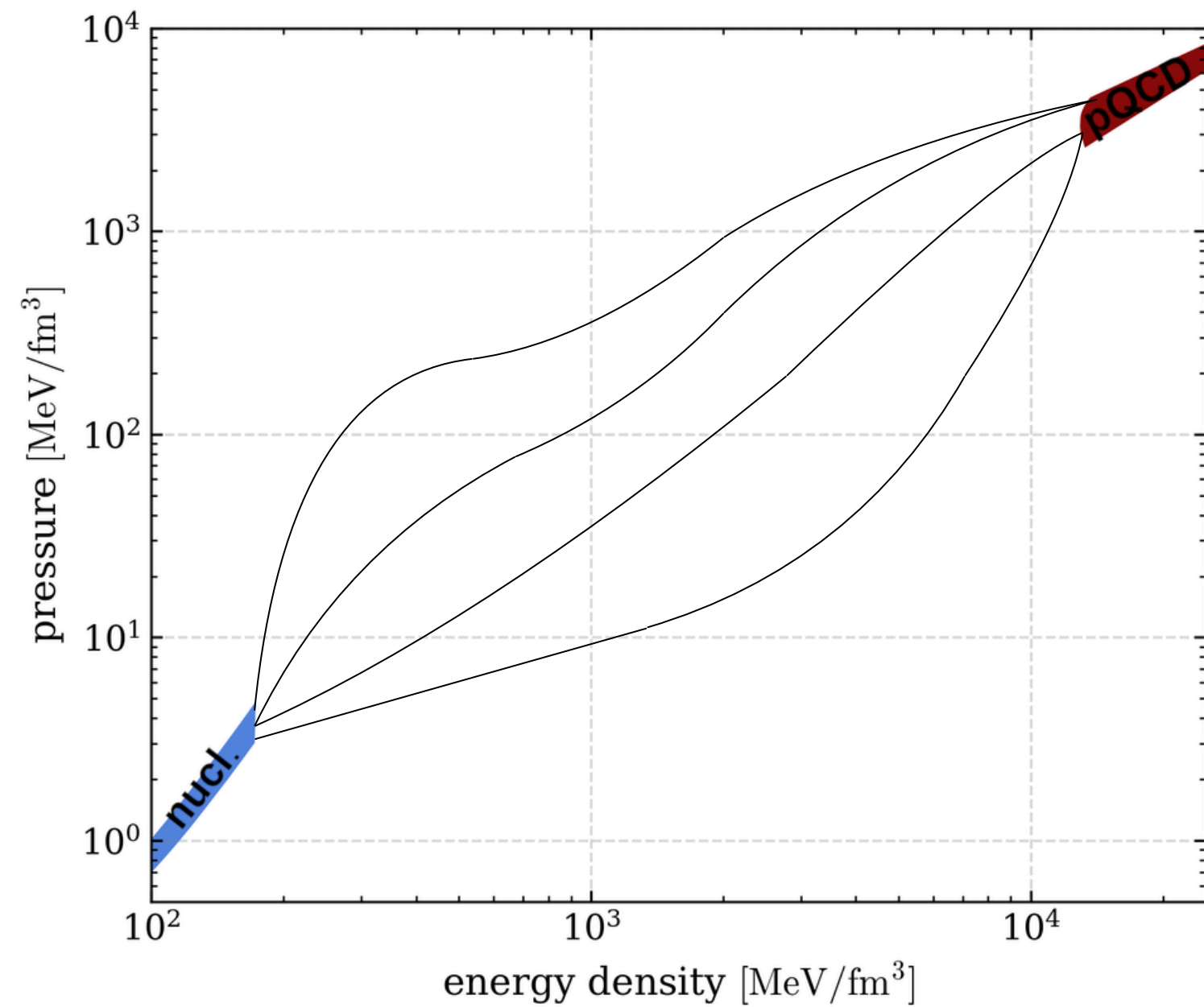
Equation of state (EoS) describes NS matter and structure

Theoretical constraints at low- and high-density limits

Exact form not known between!



How to connect low- and high-density limits?



Generate thermodynamically consistent curves

Infinite possibilities: which curve is the right one that describes NS matter?

Compare to astrophysical observations

Narrows down the possible behavior of the EoS.

Connecting to observable properties

Obtain NS mass and radius by solving the structure equations.

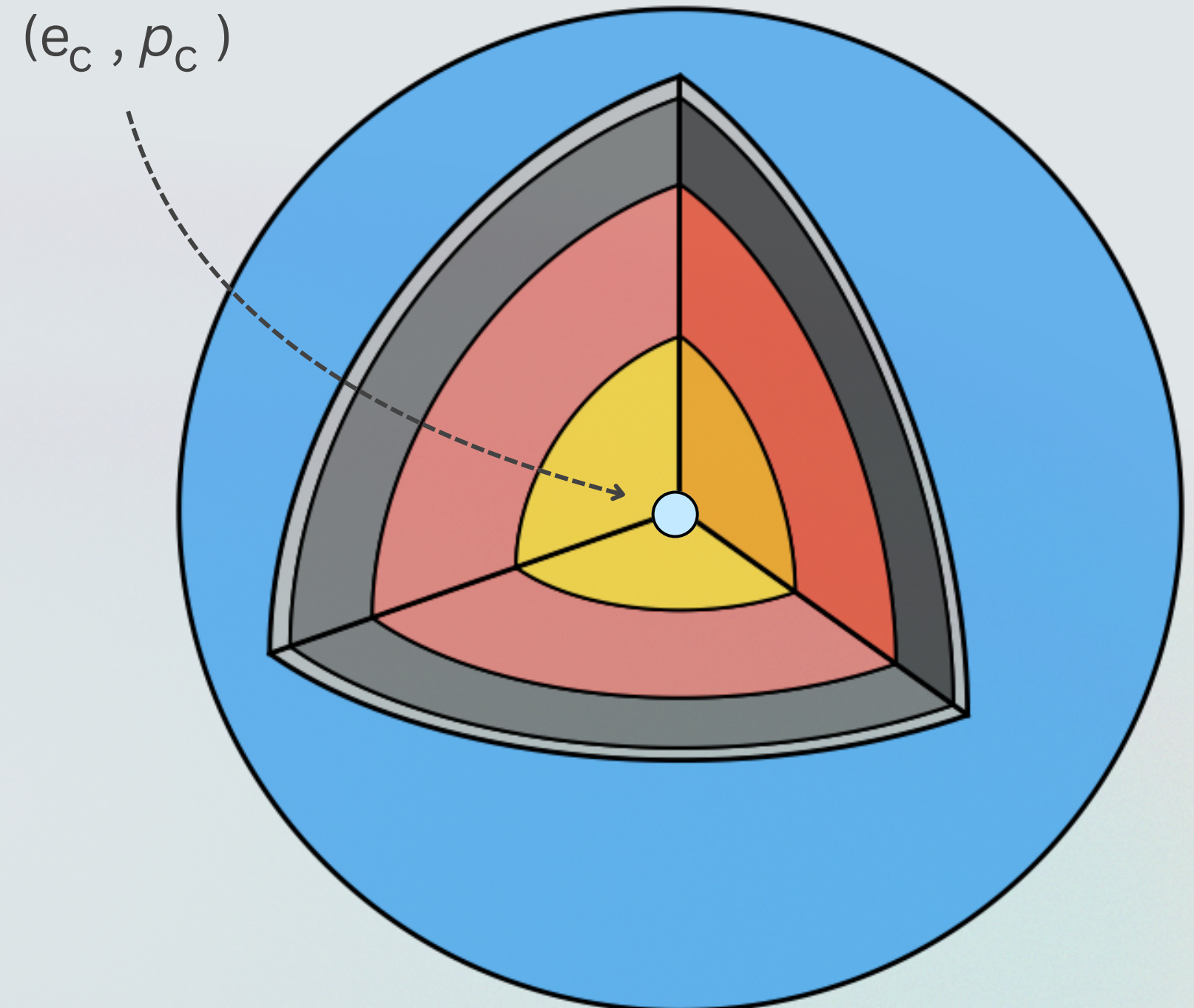
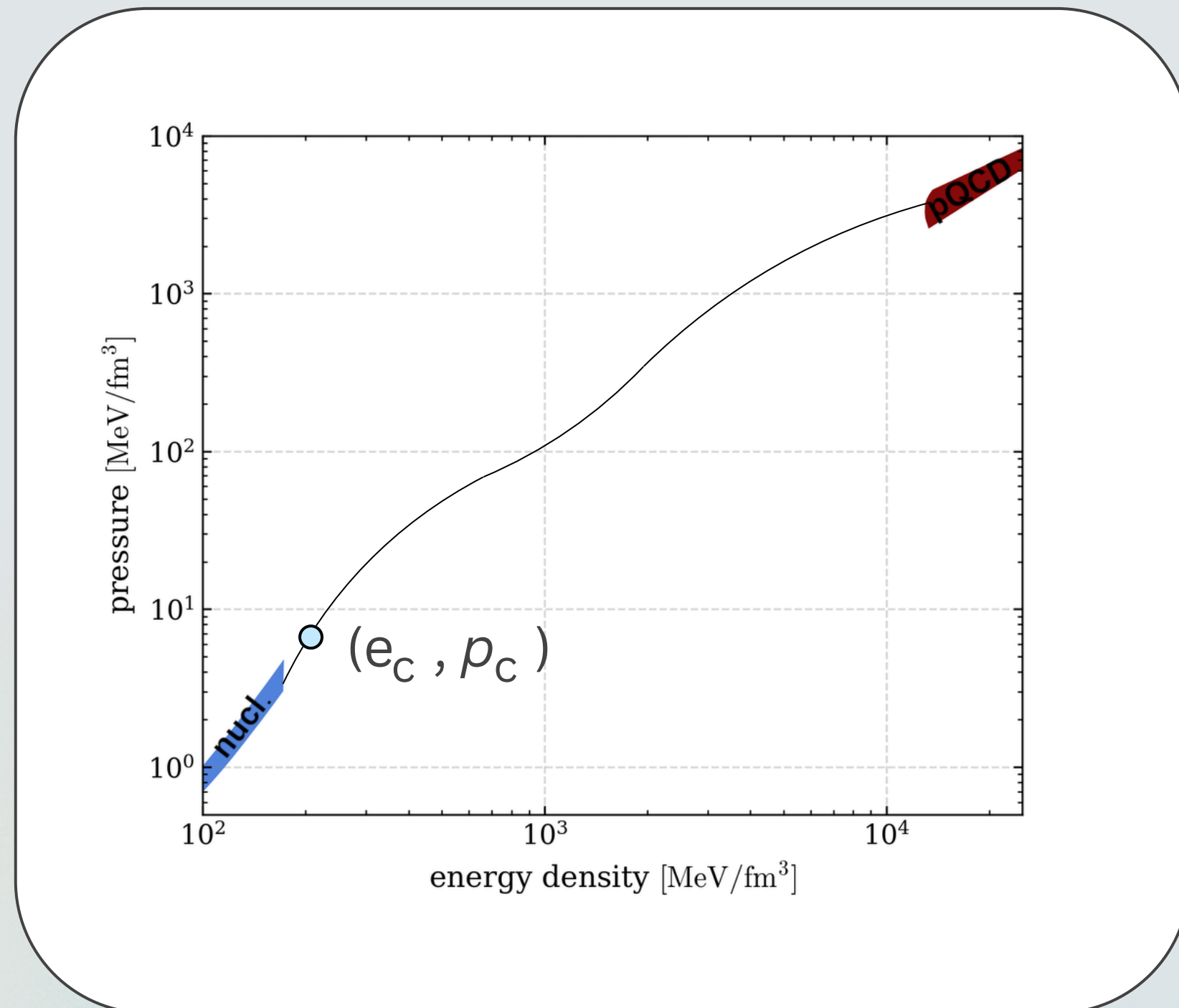


Figure credit: J. Nättilä

Connecting to observable properties

Obtain NS mass and radius by solving the structure equations.

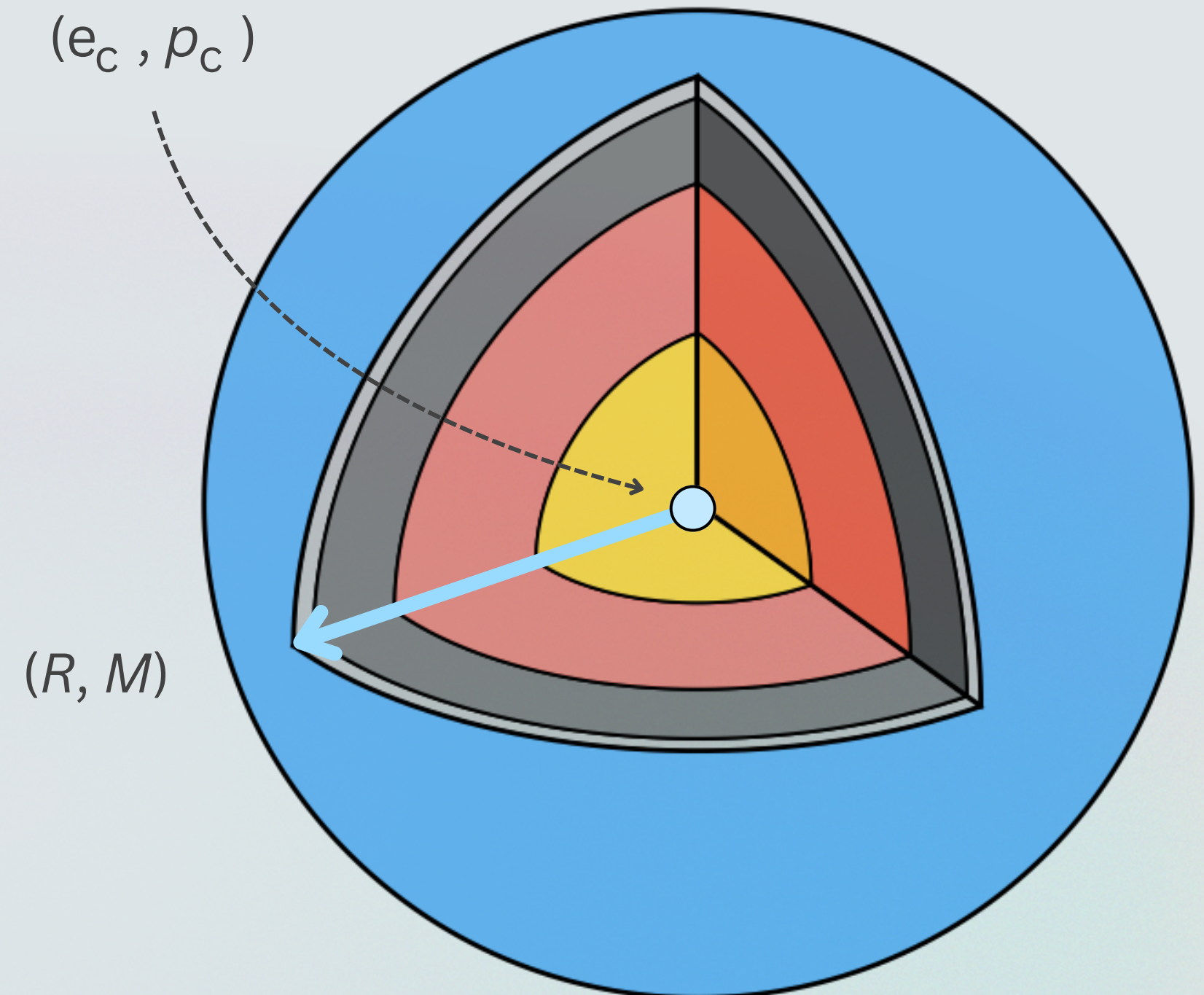
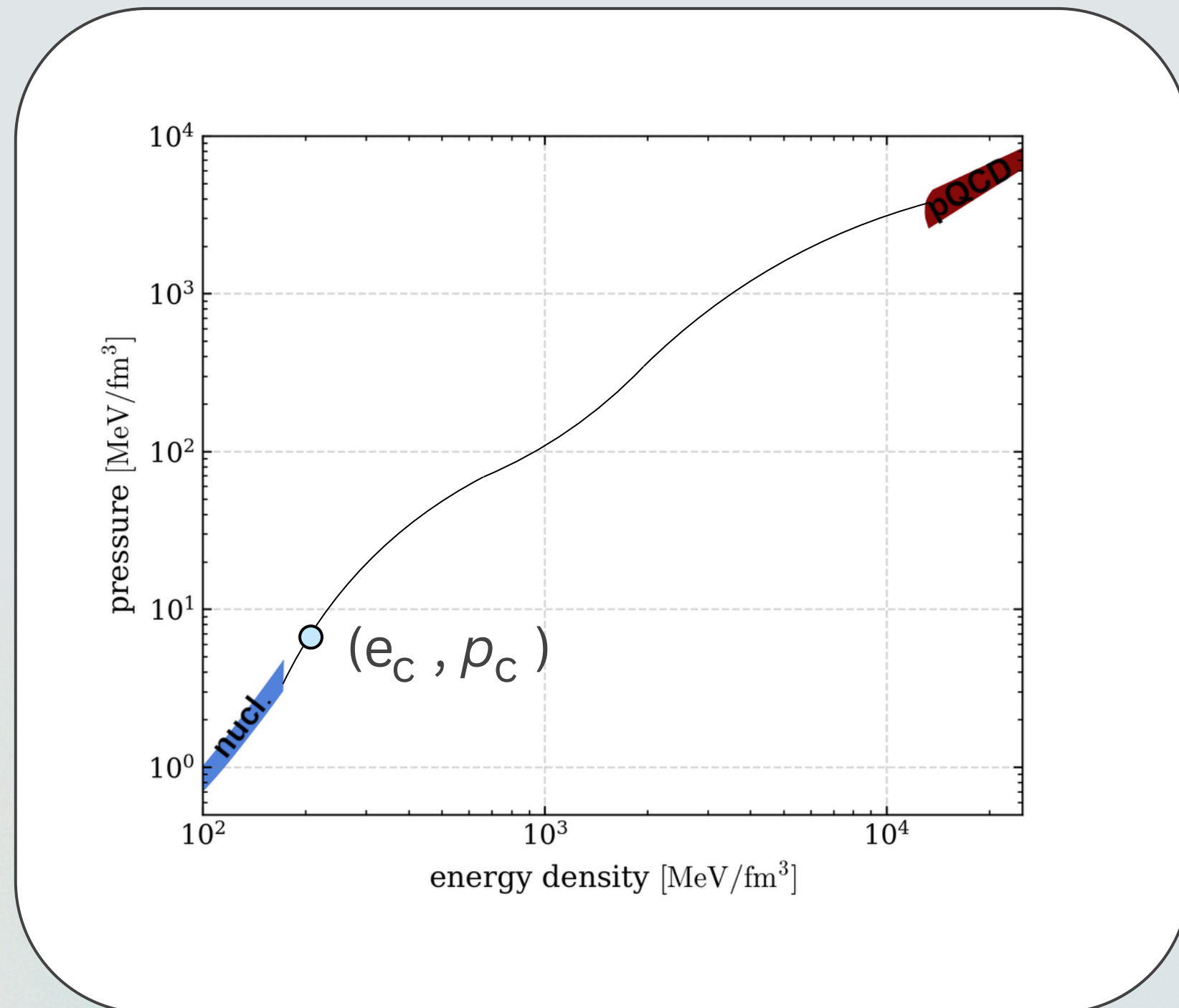
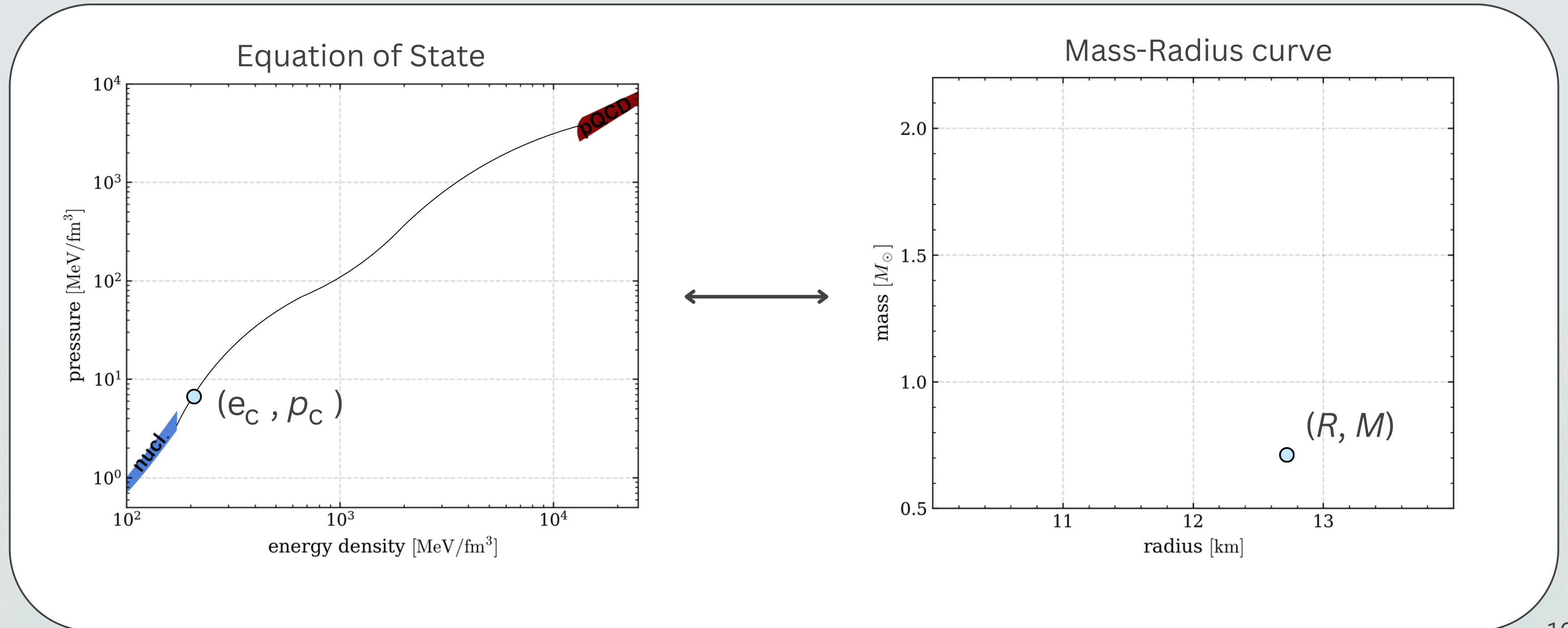


Figure credit: J. Nättilä

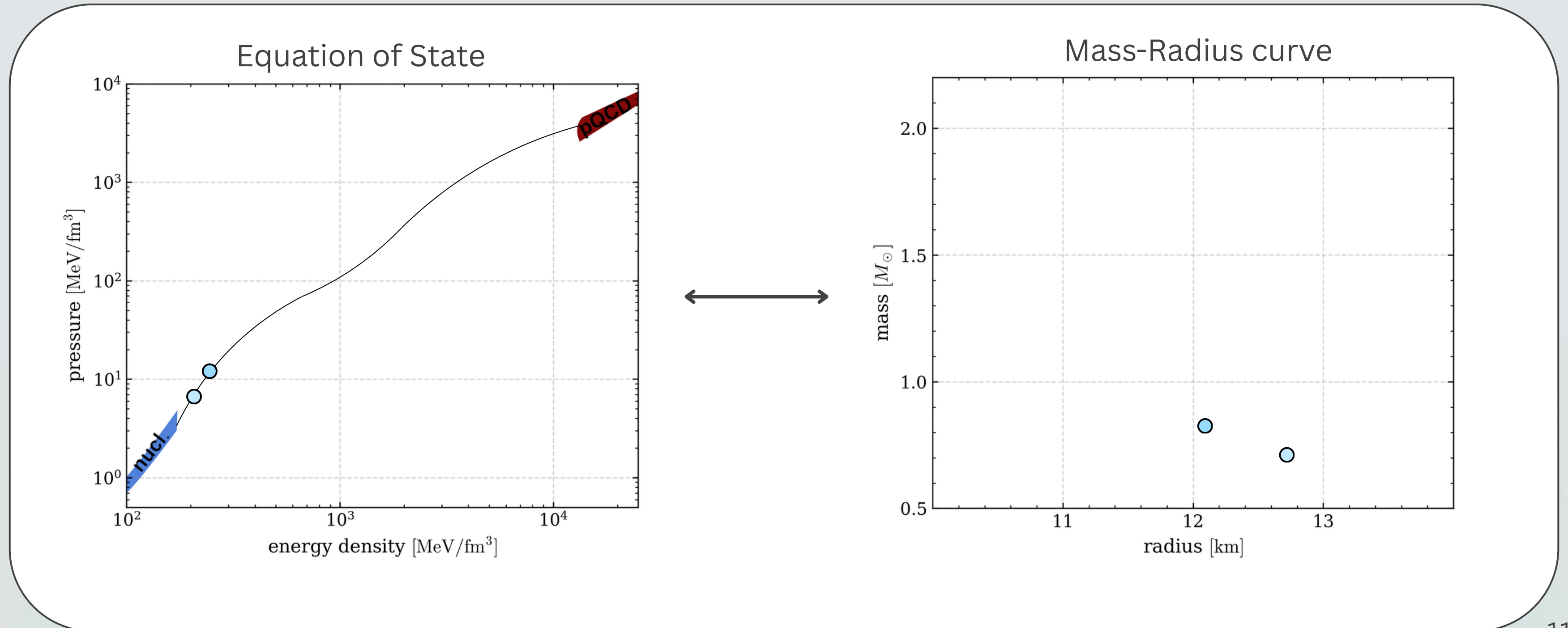
Connecting to observable properties

With schematic illustration.



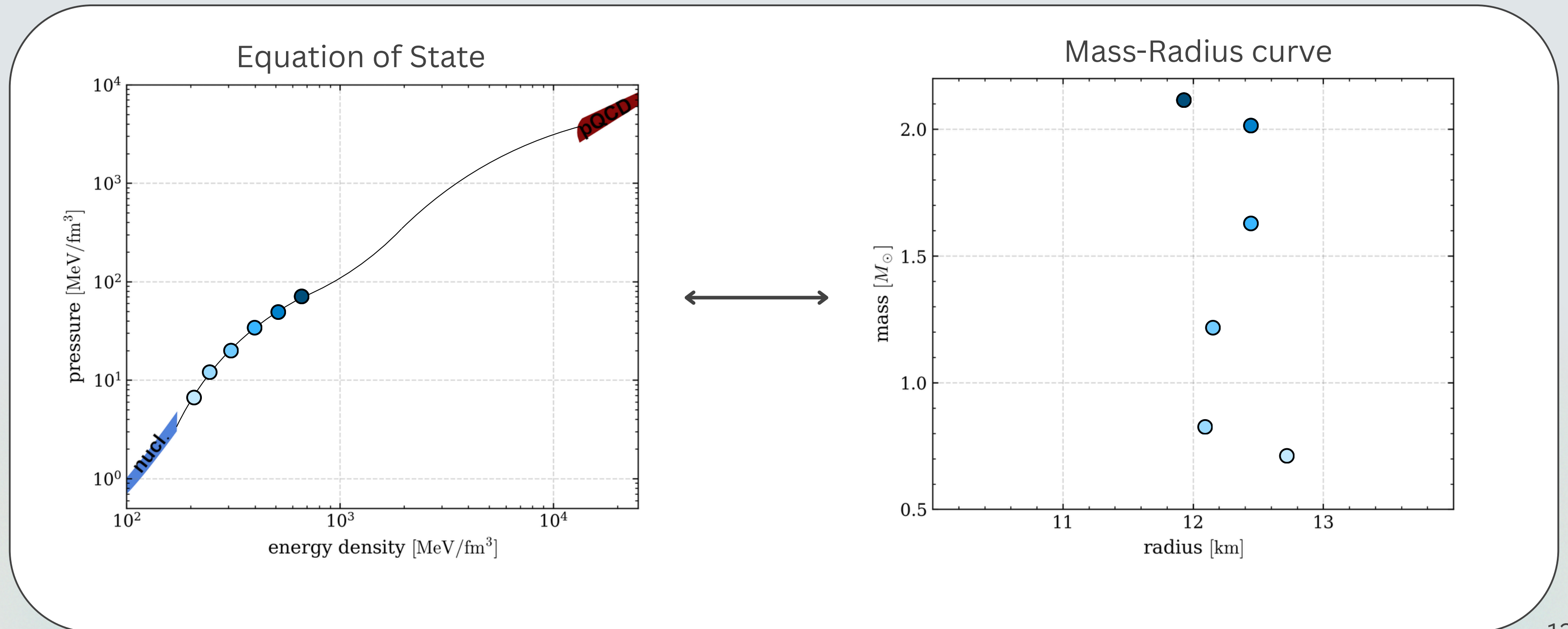
Connecting to observable properties

With schematic illustration.



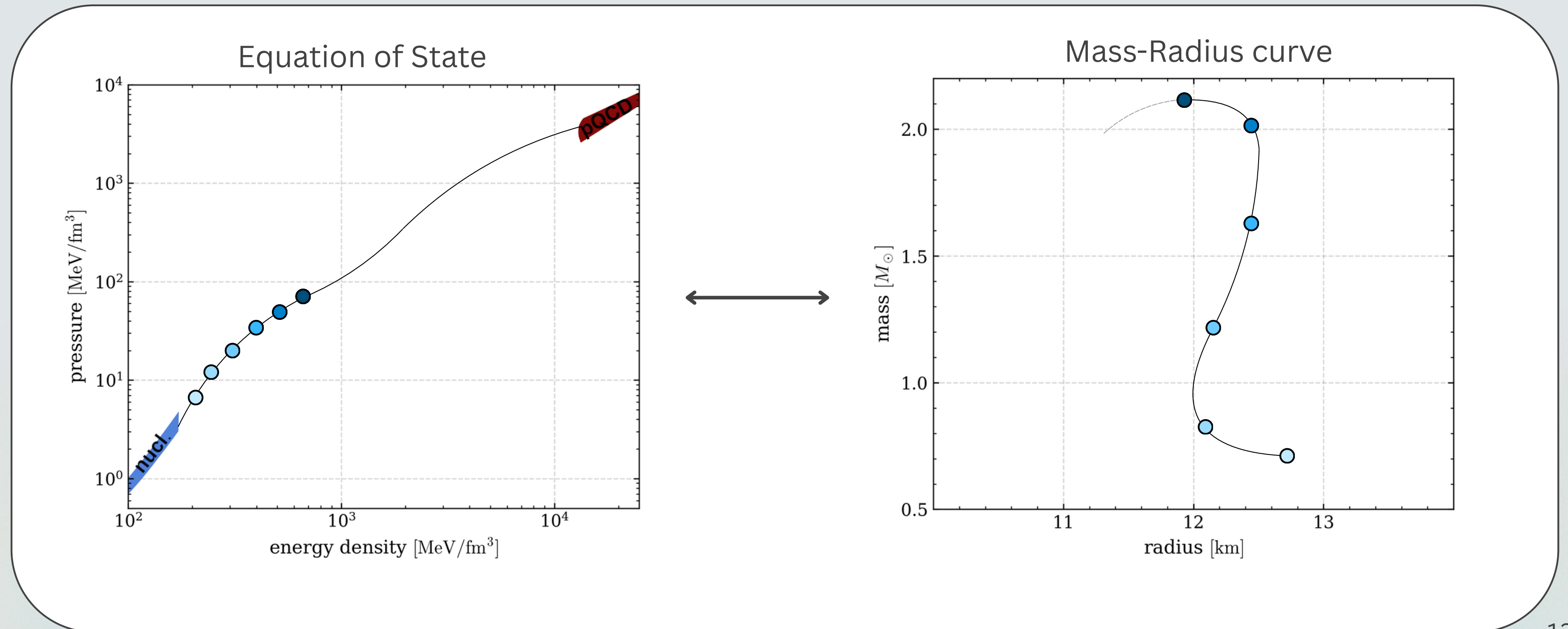
Connecting to observable properties

With schematic illustration.



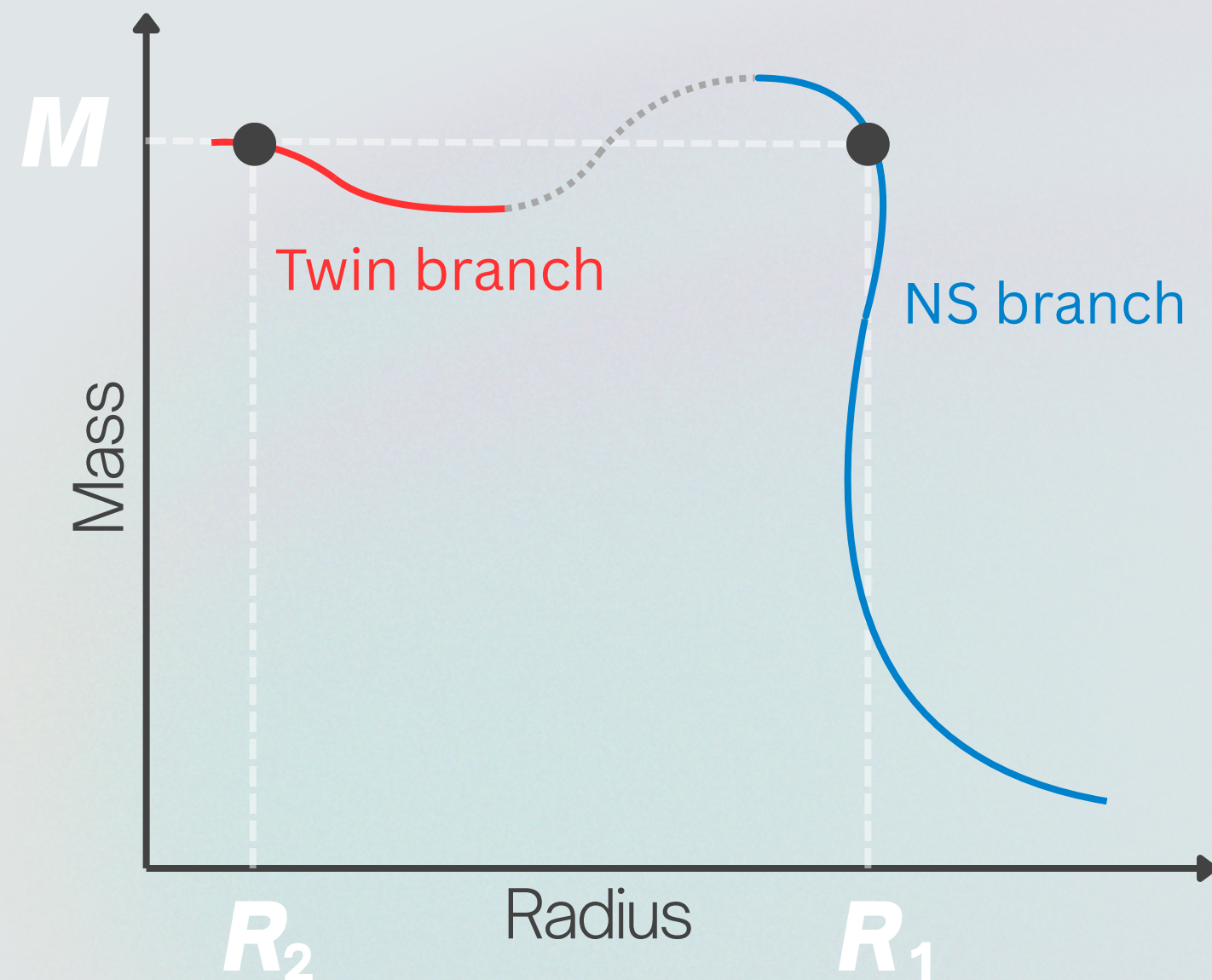
Connecting to observable properties

With schematic illustration.



Twin stars are hypothetical compact objects

and exhibited by some EoS. That allows for stars of same mass but differing radius.



M, R_2

M, R_1

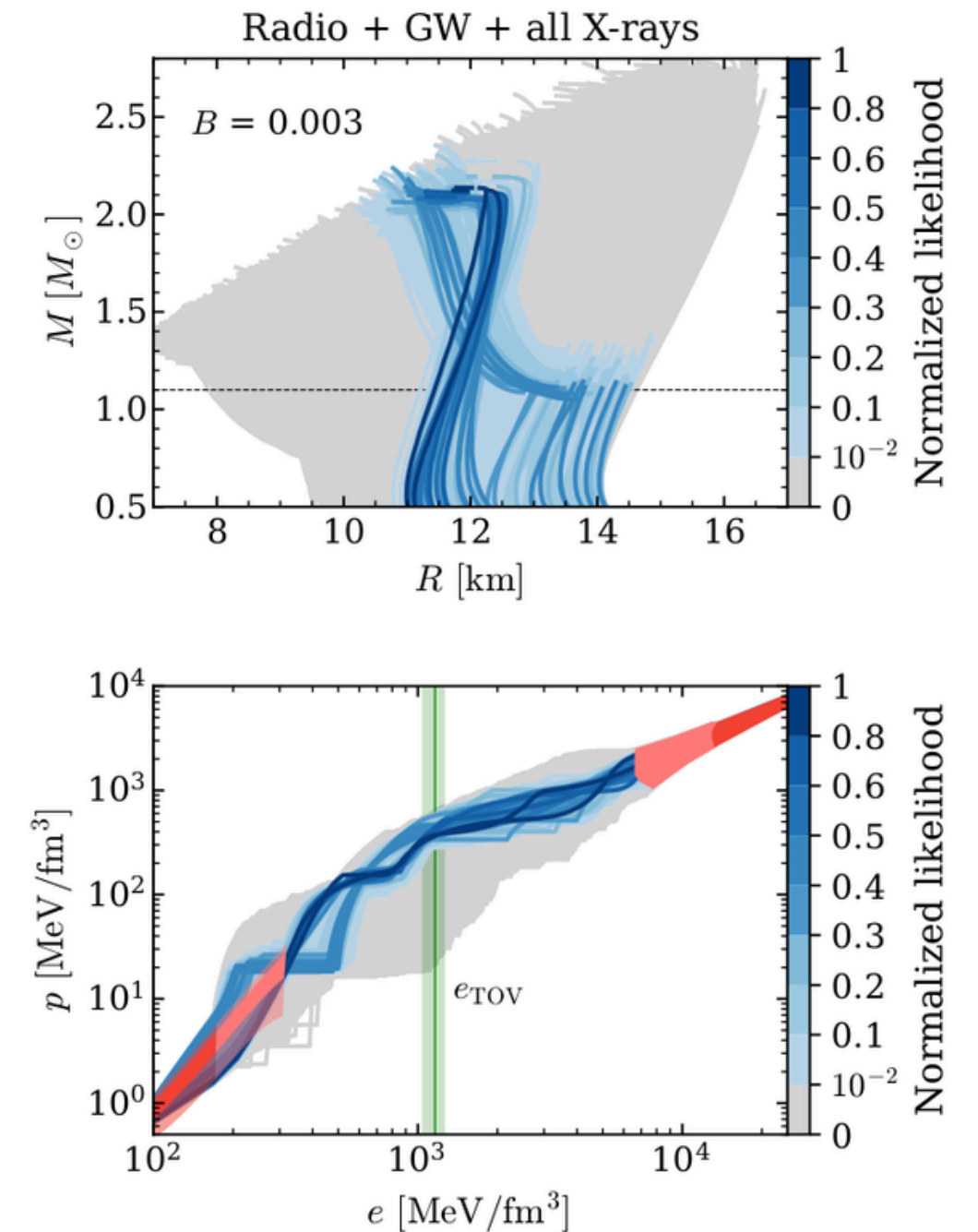
Twin stars are disfavored by astrophysical observations

Bayes factor B compares marginalized likelihoods of twin stars to NS.

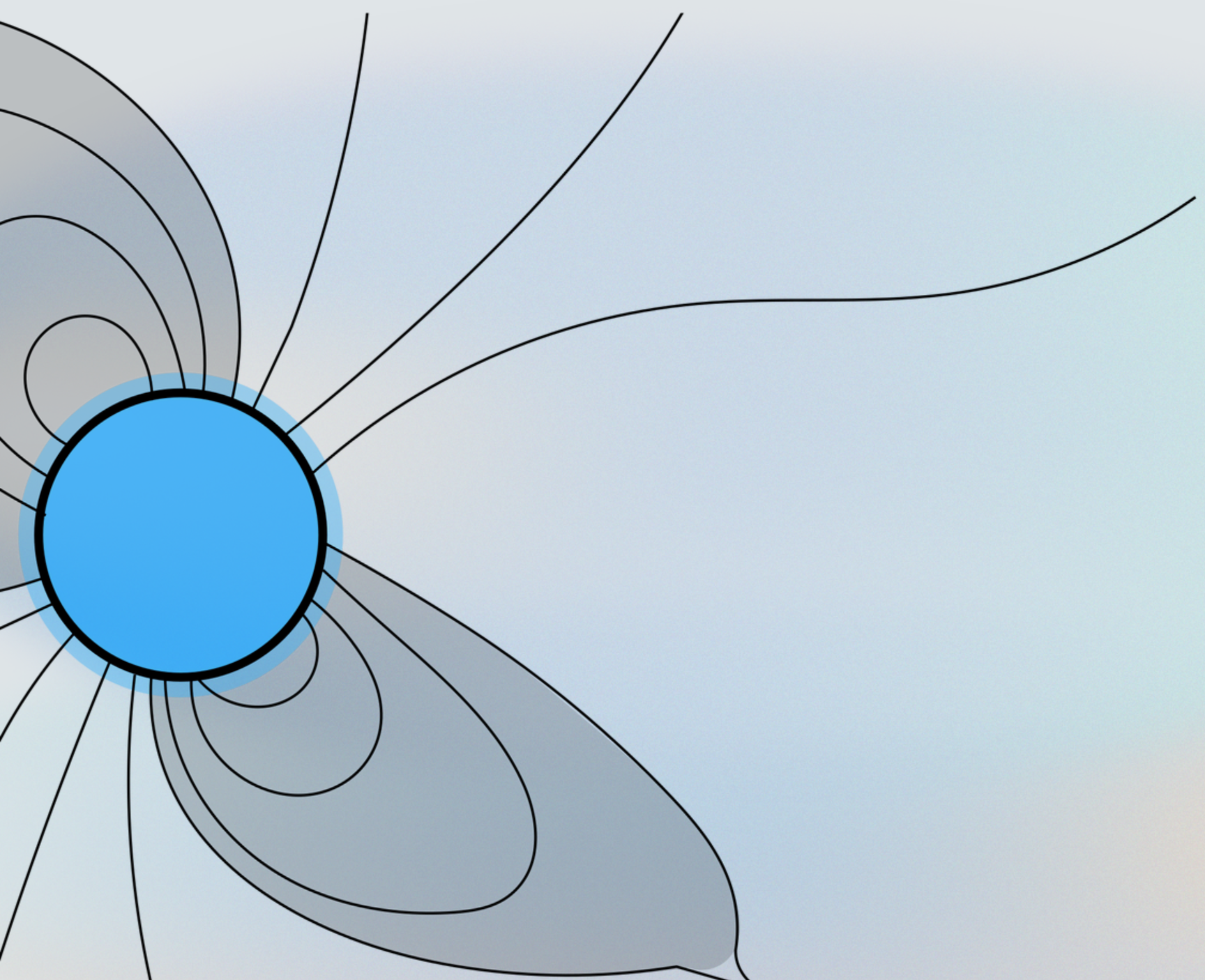
! Key observations

Two classes of twin stars survive

$B \ll 1$ indicates that twin stars are disfavored



Final conclusions



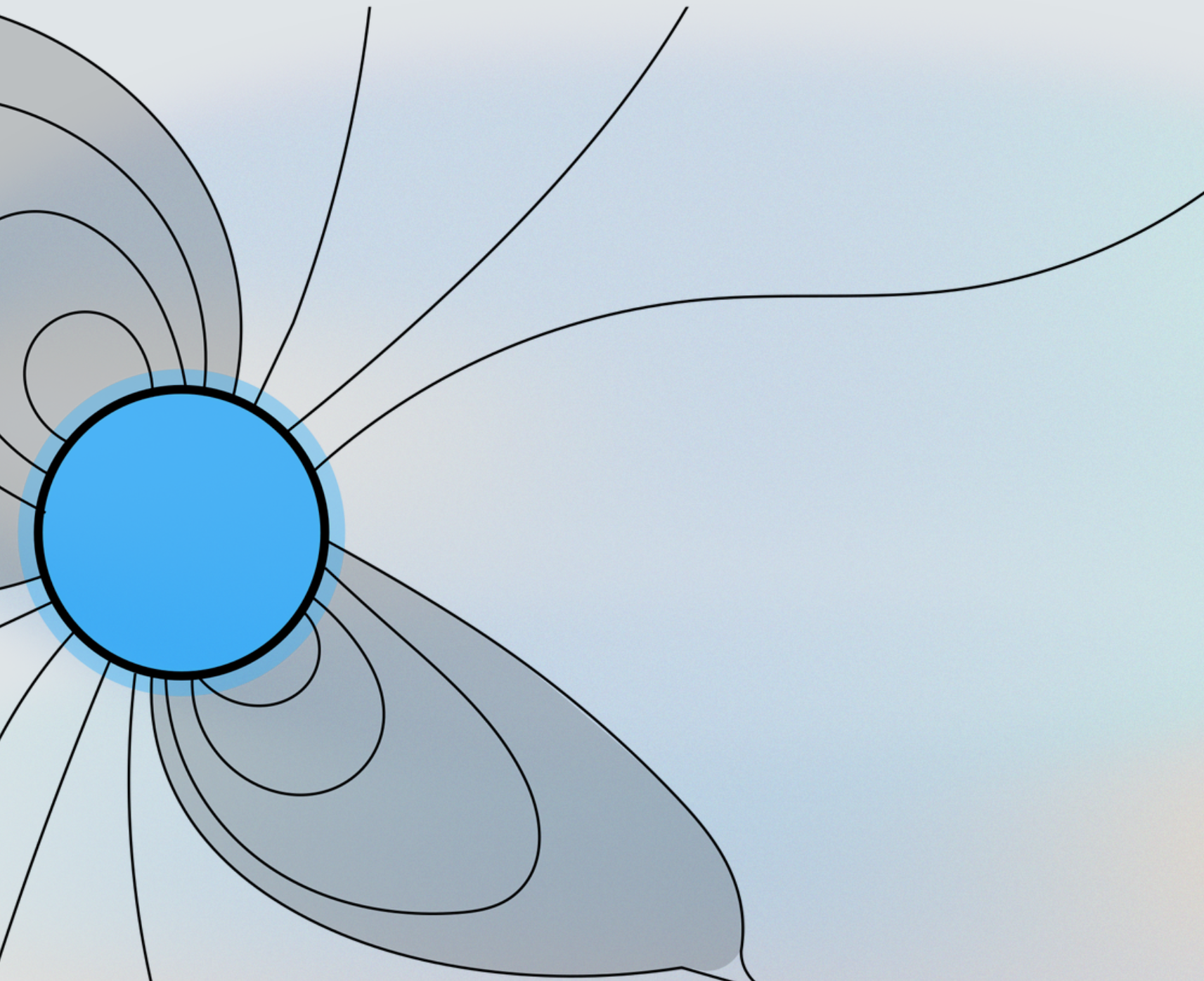
NS are extreme environments from many perspectives

NS structure or the EoS is not known exactly

Some EoS produce twin stars

Twin stars cannot be strictly ruled out

Thank you!



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