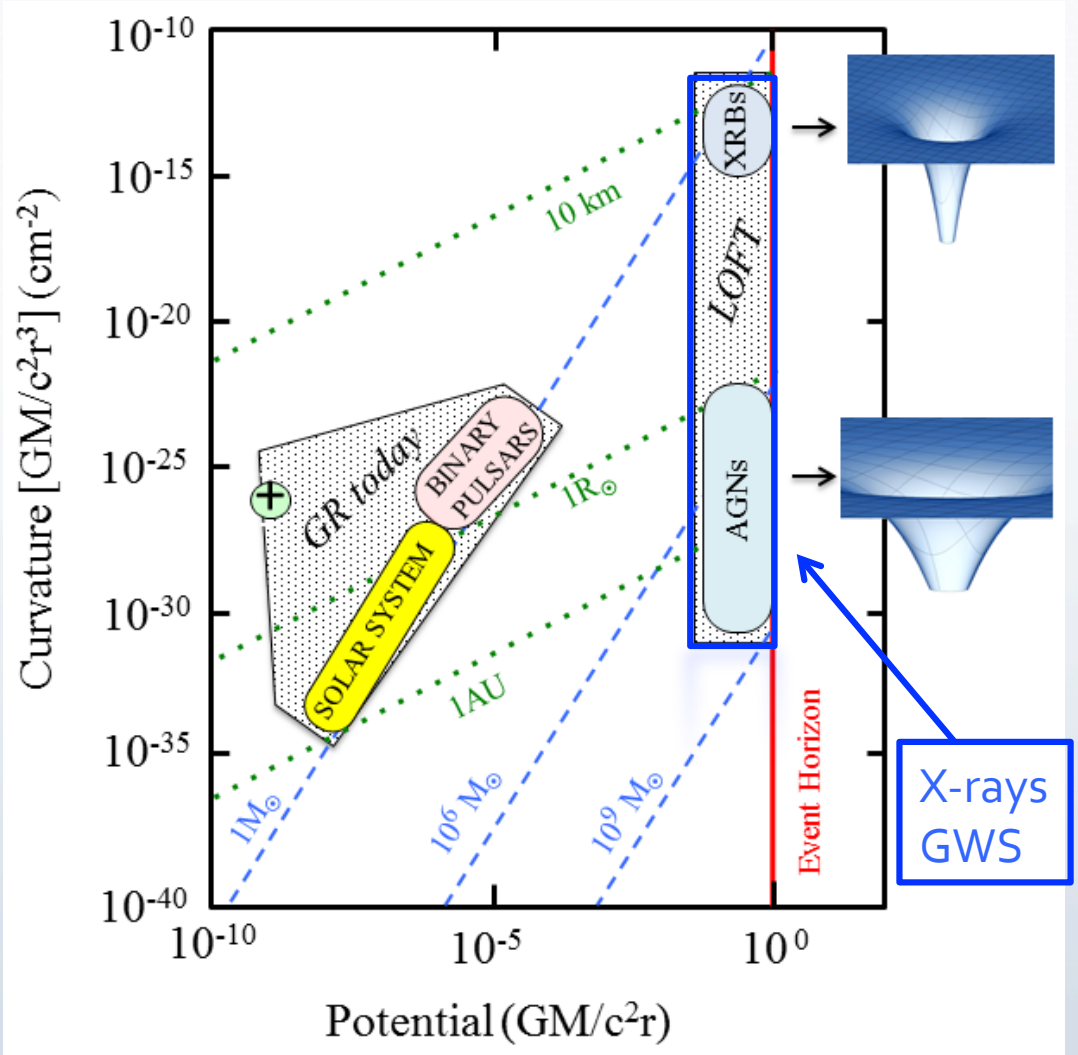
Probing strong field gravity at at a few R_g with X-ray and GW Diagnostics

* Strong fields and both:
  - weak curvatures (Massive BHs)
  - strong curvature (XRBs, BHs & NSs)

- - Gravitational waves probe *dynamic* spacetimes
  - X-rays probe *stationary* spacetimes

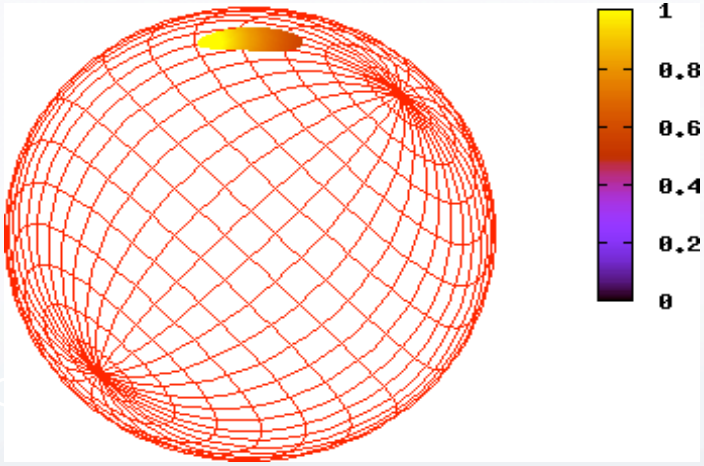
- Testing/constraining alternative gravity theories that differ from GR only in the strong field regime (e.g. Einstein-Dilaton-Gauss-Bonnet, Kerr BH with static air)

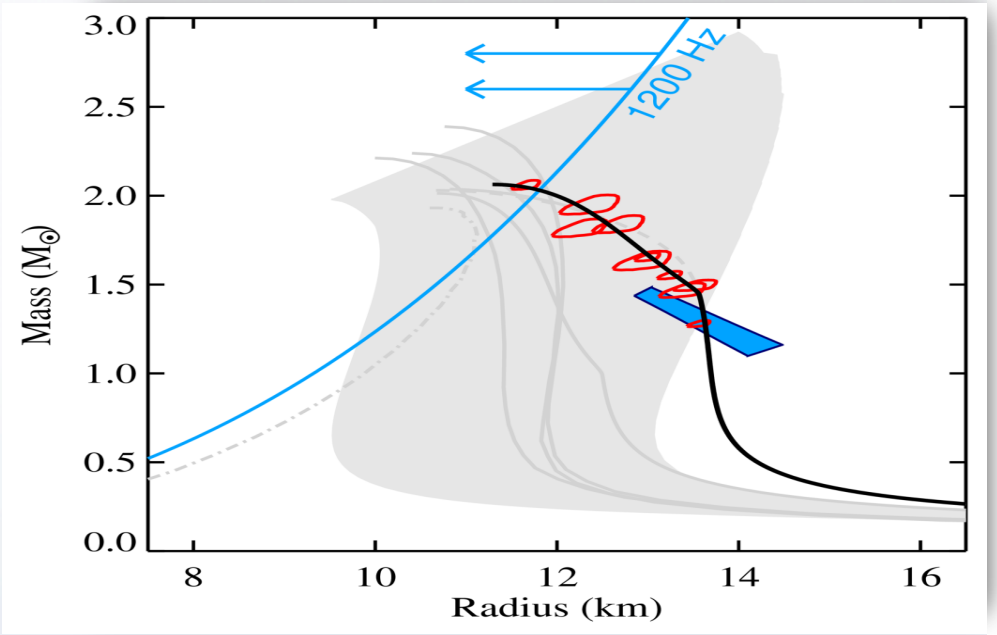


Great degree of complementarity and clear synergies between X-rays and GWs

- same physics (e.g. BH spin, relativistic precession)
- different physics (e.g. tests of different alternative theories)

Determining the Equation of State of Ultradense Matter





X-rays: EoS from measurement of NS M and R; 3 methods

1. Hotspots on neutron stars generate pulsations
2. Fastest spin period
3. Seismic oscillations during Magnetar Flares

now about M and R know with 15 % errors

LOFT (~10 NSs; methods 1,2,3 ; ~ 3-4 % errors on M and R)

NICER, Athena (few NSs; 1 method; 3-4% error on R, 10% error on M),

RADIO: EoS from measurements of M and I (moment of inertia) in some binary pulsars

SKA (~10% errors ?)

GWs: aVirgo/aLIGO: EoS from signal during merger phase in coalescing binary neutron stars

(errors probably ~10% with 20 NS events)

Astrophysical Modeling and Observations of GW Sources

Many areas related to GWs are active within INAF (MA4 especially); among these are:

- formation of coalescing binary systems
- GRBs
- supernovae
- magnetars
- fast spinning NSs

Integration of these activities is necessary

Electromagnetic follow-up at INAF

- organisation at INAF (MA4 plus other Mas) begun > 2 yrs ago
- it is one of the largest collaborations worldwide and it's "up and running"

Identification of 1st counterpart will probably require:

a. high S/N GW event different from BH-BH merging
b. smaller error region

What can INAF do ?

- Invest in these research areas: personnel and funds
- Forster collaboration between groups
- Interface with aLIGO/aVirgo and INFN at a high level