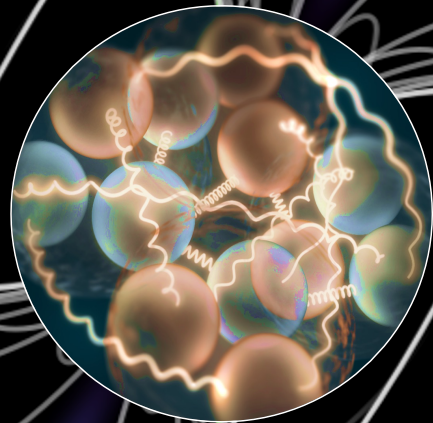


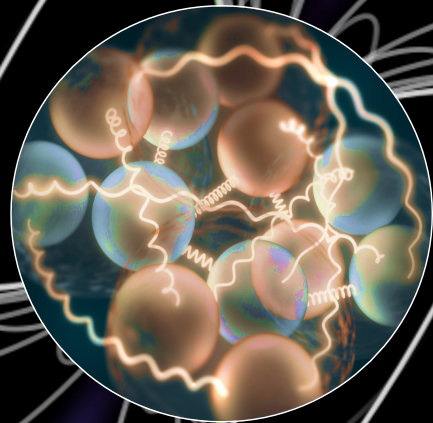
NICER: PAST, PRESENT AND FUTURE



PROF. ANNA WATTS
(UNIVERSITY OF AMSTERDAM)



PULSE PROFILE MODELLING: PAST, PRESENT AND FUTURE



PROF. ANNA WATTS
(UNIVERSITY OF AMSTERDAM)



FROM NUCLEAR PHYSICS TO TELESCOPE

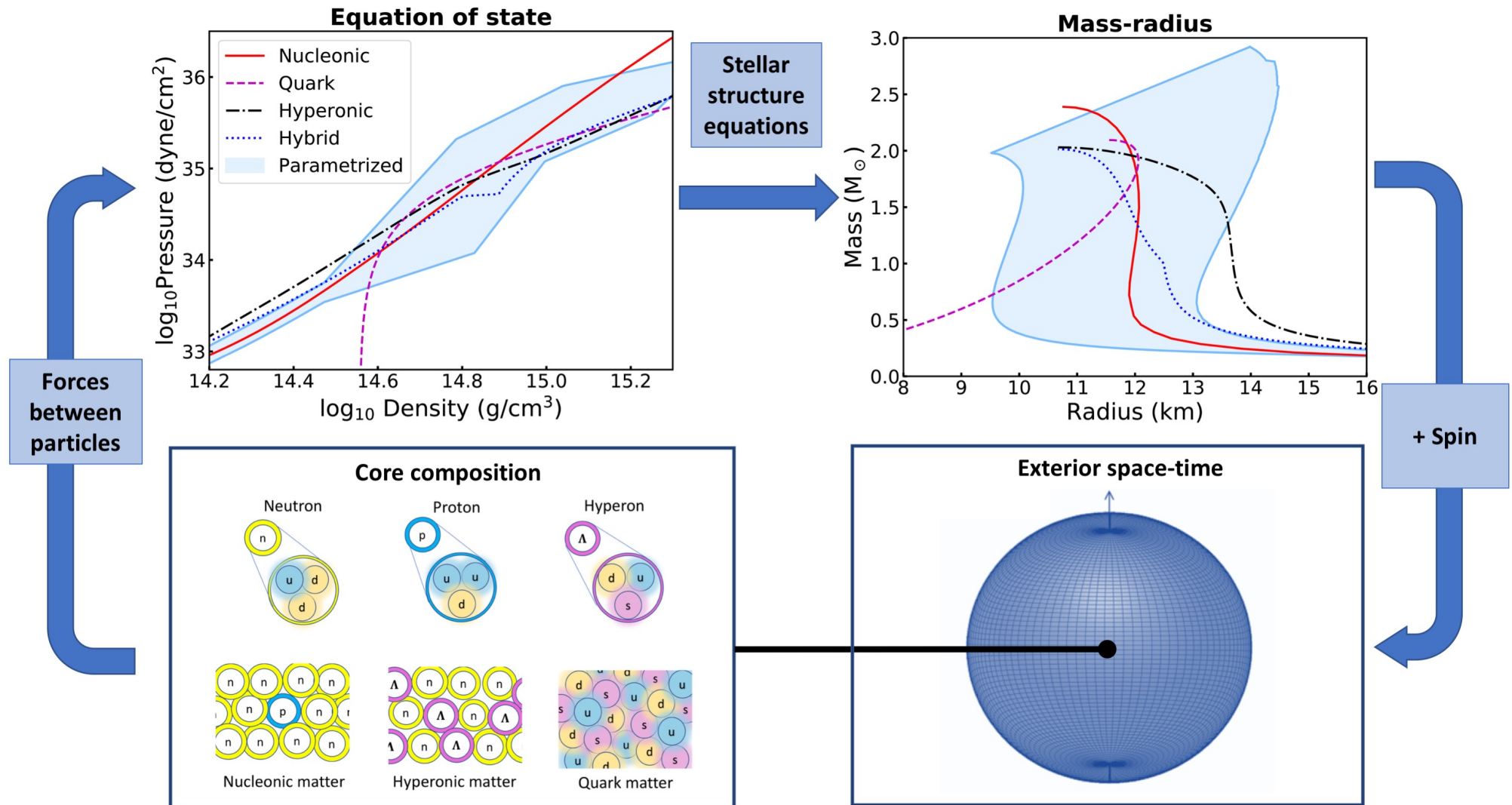
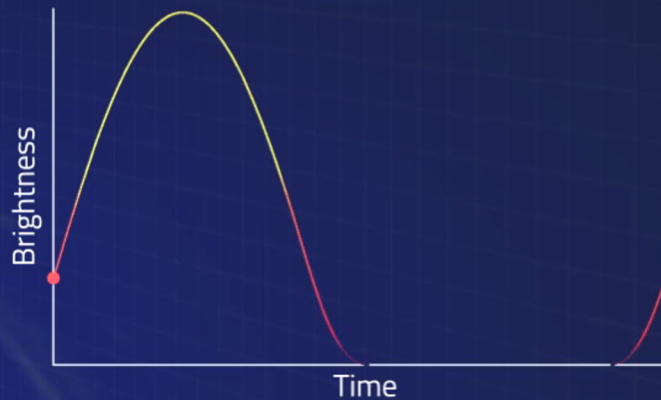
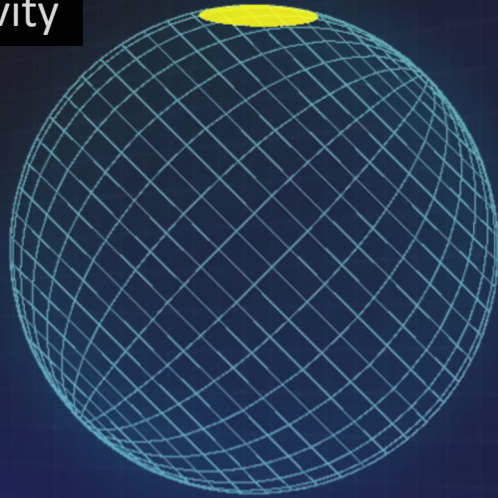


Figure: Adapted from Ray et al. 2019

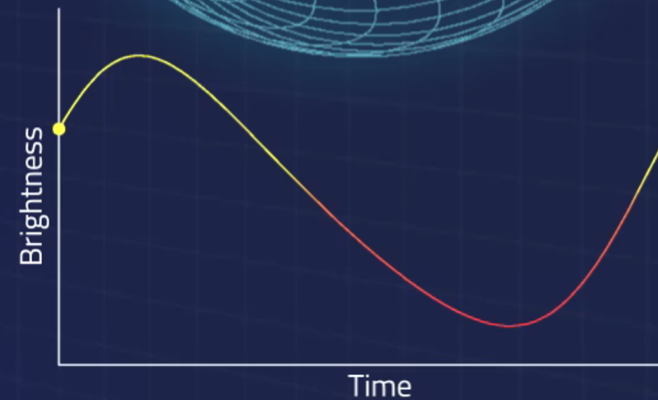
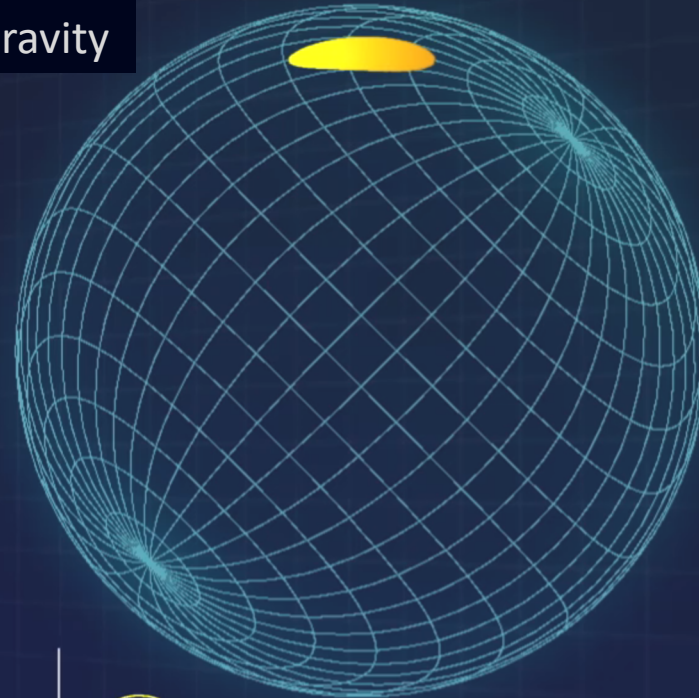
PULSE PROFILE MODELING (PPM): PAST

Credit: Morsink/Moir/Arzoumanian/NASA-GSFC

Weak Gravity

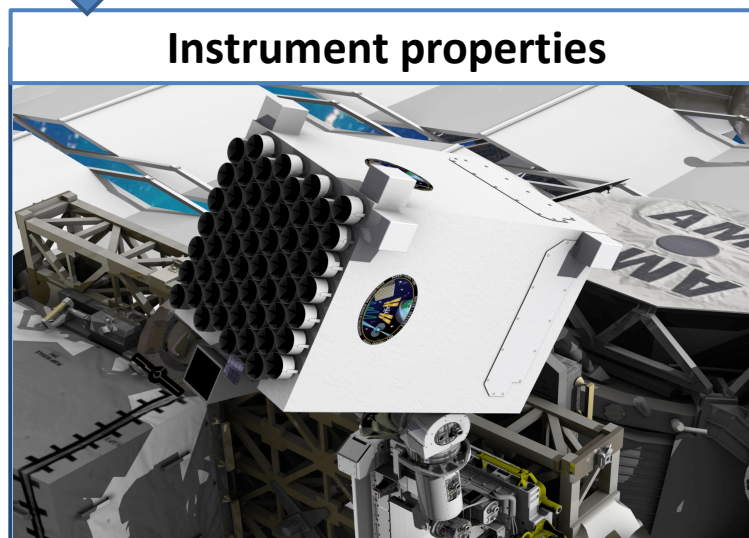
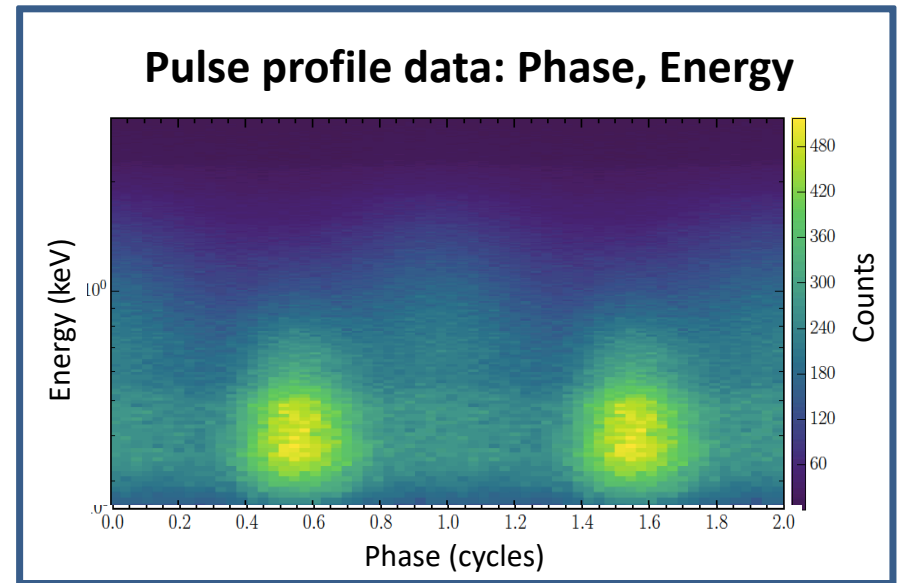
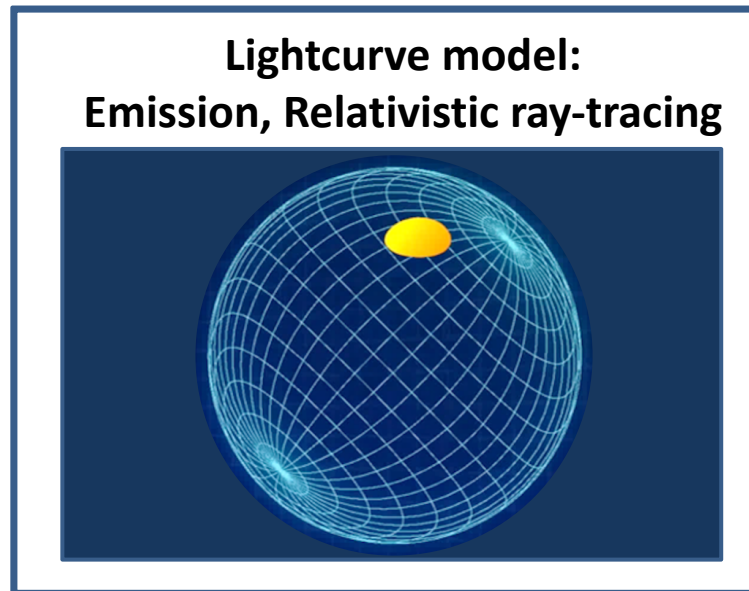


Strong Gravity



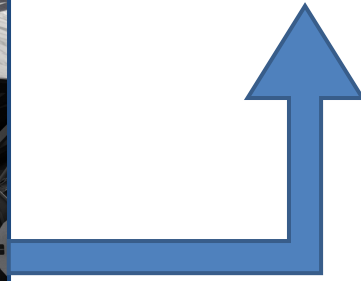
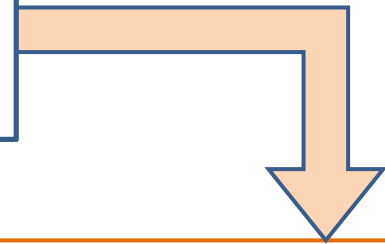
Pechenick et al. 1983, Poutanen & Gierlinski 2003, Viironen & Poutanen 2004, Poutanen & Beloborodov 2006, Morsink et al. 2007, Bogdanov et al. 2007, Baubock et al. 2012, 2013, Lo et al. 2013, AlGendy & Morsink 2014, Psaltis et al. 2014, Miller & Lamb 2015

PPM: PRESENT (NICER)



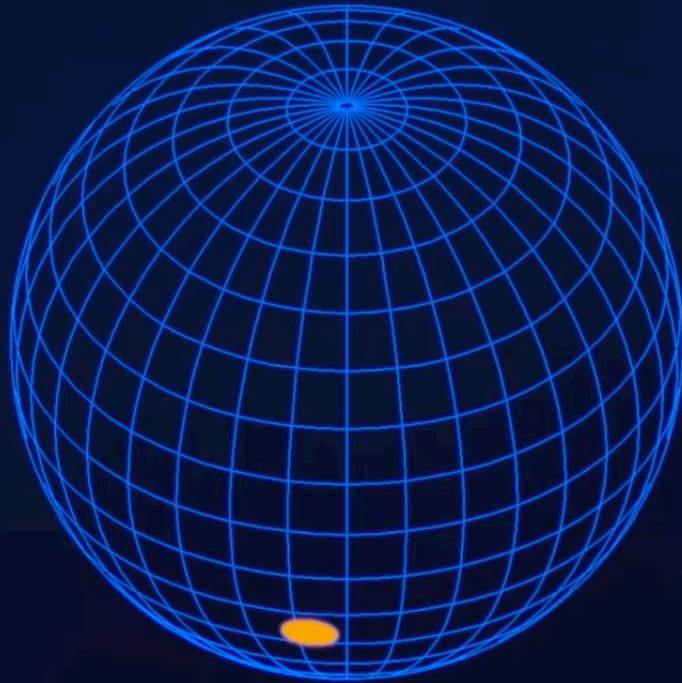
**Inference code:
Likelihood calculation,
statistical sampling**

**Mass-radius
Geometric parameters**

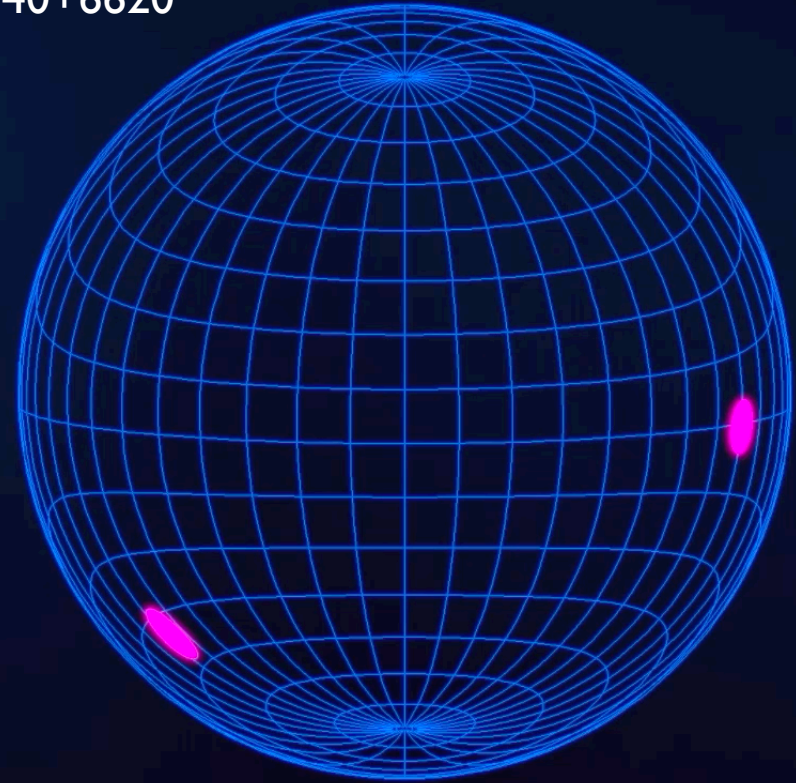


NICER SURFACE MAPS

PSR J0030+0451

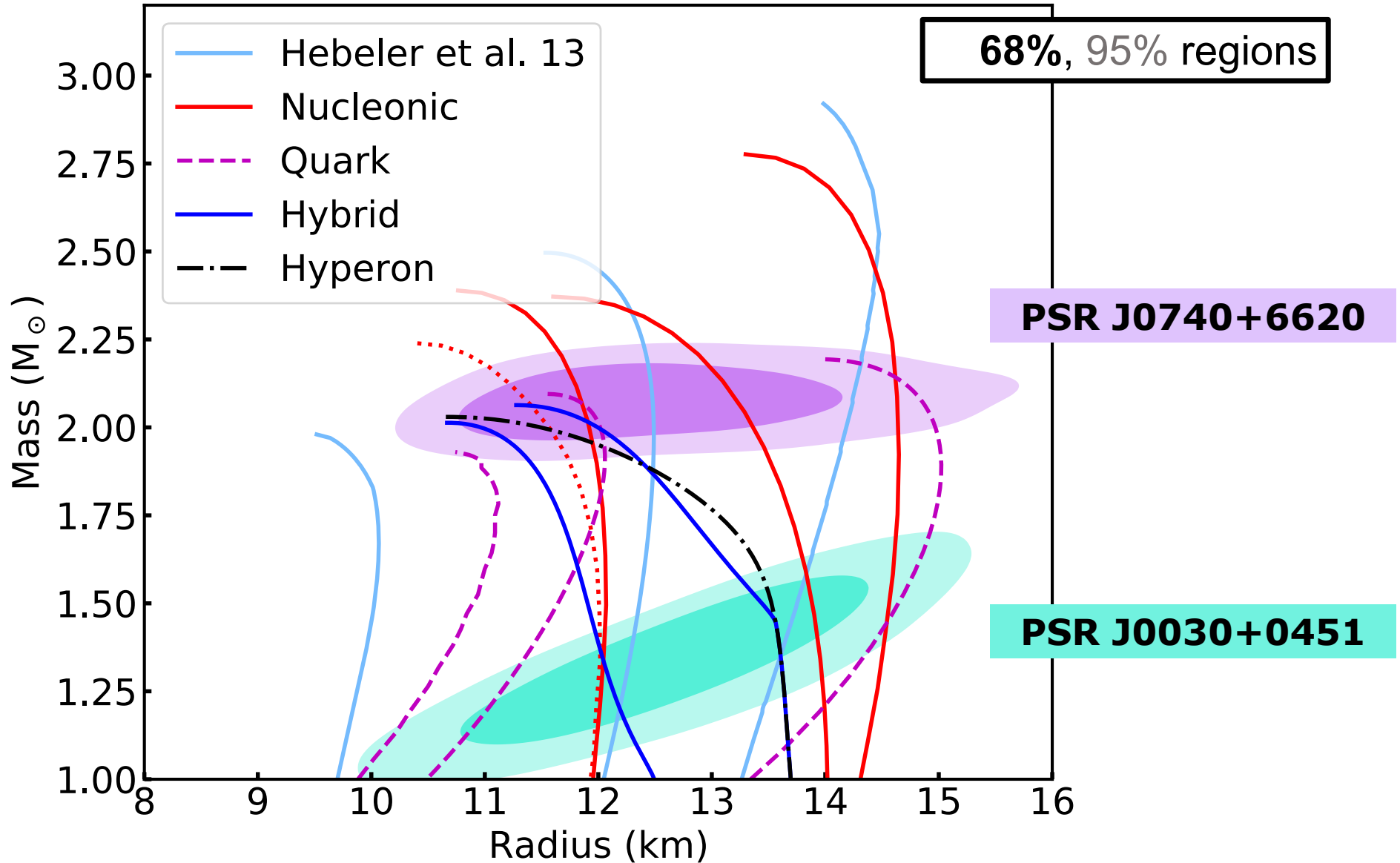


PSR J0740+6620



Movie: Sharon Morsink, NASA, based on surface patterns from Riley et al. 2019, 2021.
Comparable patterns found by Miller et al. 2019, 2021

NICER MASSES AND RADII

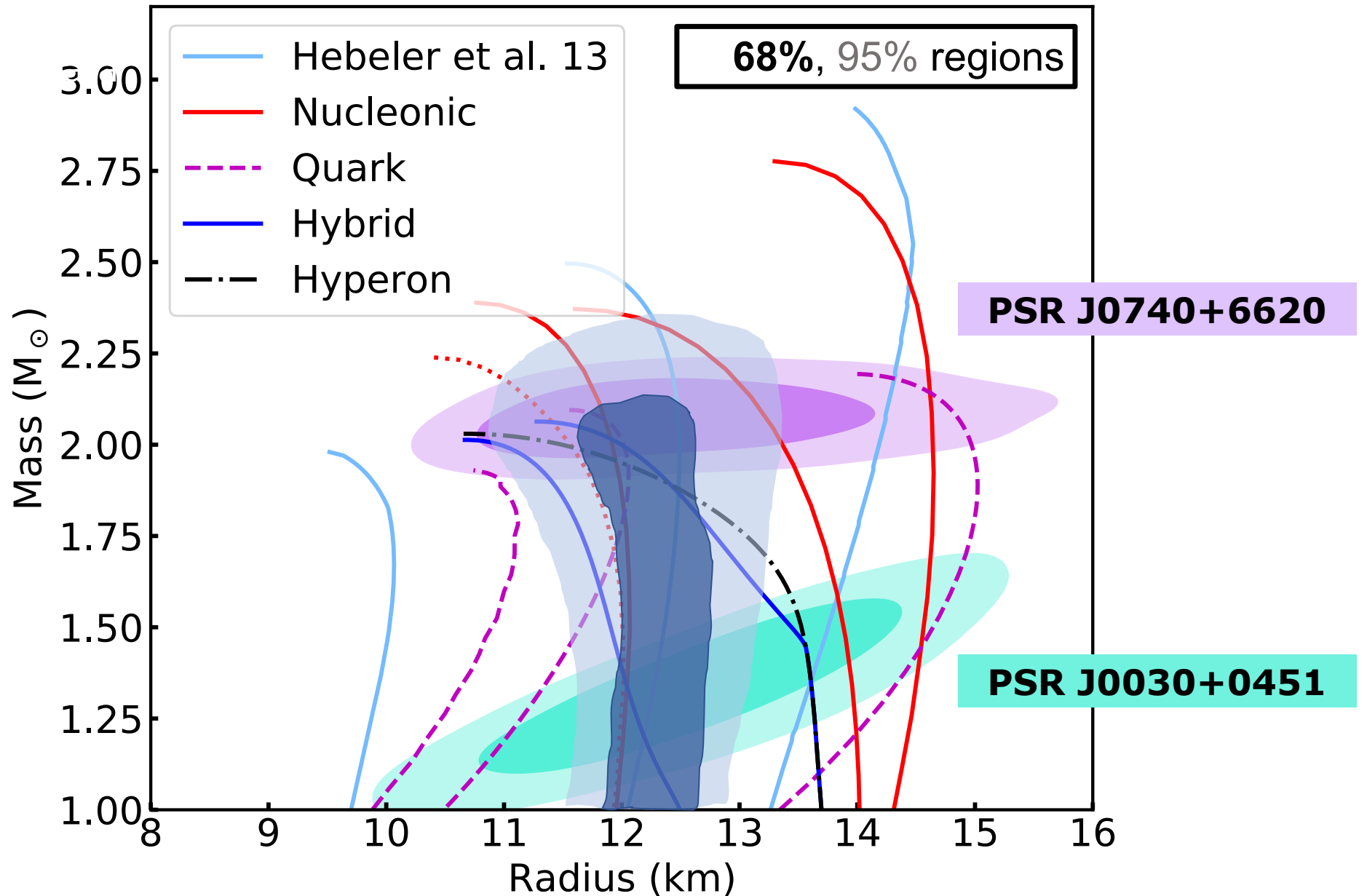


NICER team setup/support papers: Bogdanov et al. 2019a, 2019b, 2021

NICER team J0030 papers: Riley et al. 2019, Raaijmakers et al. 2019, Bilous et al. 2019, Miller et al. 2019.

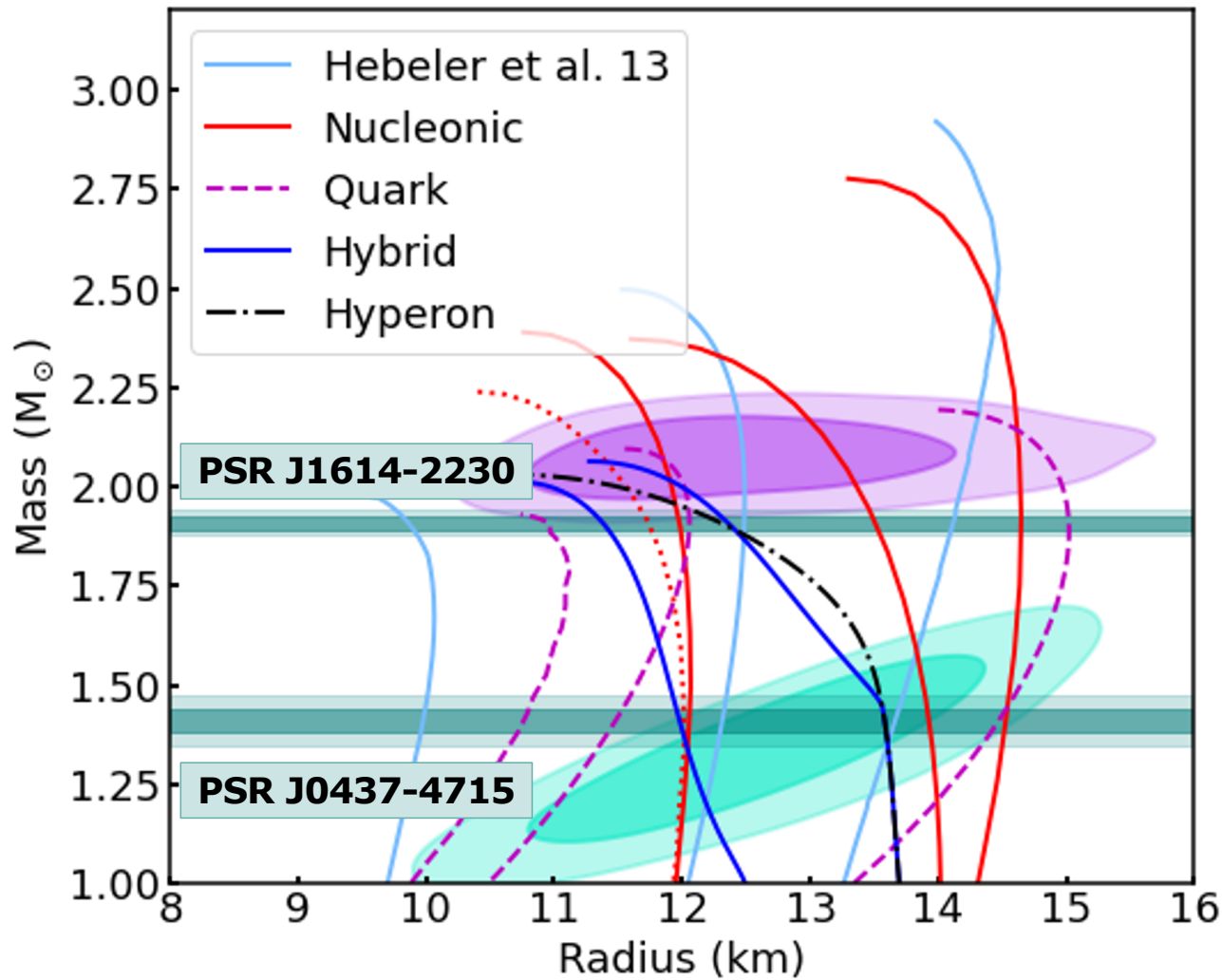
NICER team J0740 papers: Wolff et al. 2021, Riley et al. 2021, Raaijmakers et al. 2021, Miller et al. 2021.

DENSE MATTER IMPLICATIONS



M-R relation (for one specific EOS parameterization) from Raaijmakers et al. 2021

NEXT STEPS FOR NICER

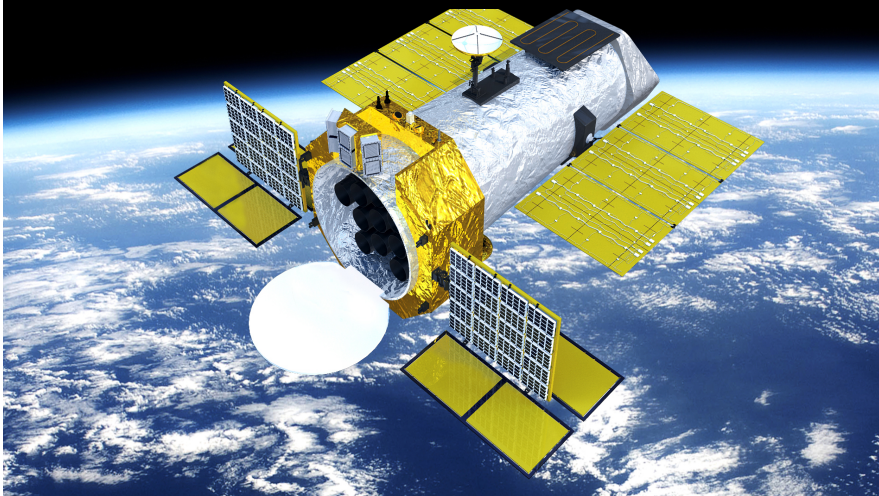


- NICER mission extended to 2025.
- Improved instrument response.
- Better NICER background models
- Updates to already-published results.
- 5 new sources coming!
- Interaction with pulsar astrophysics.

PPM: LONGER-TERM FUTURE

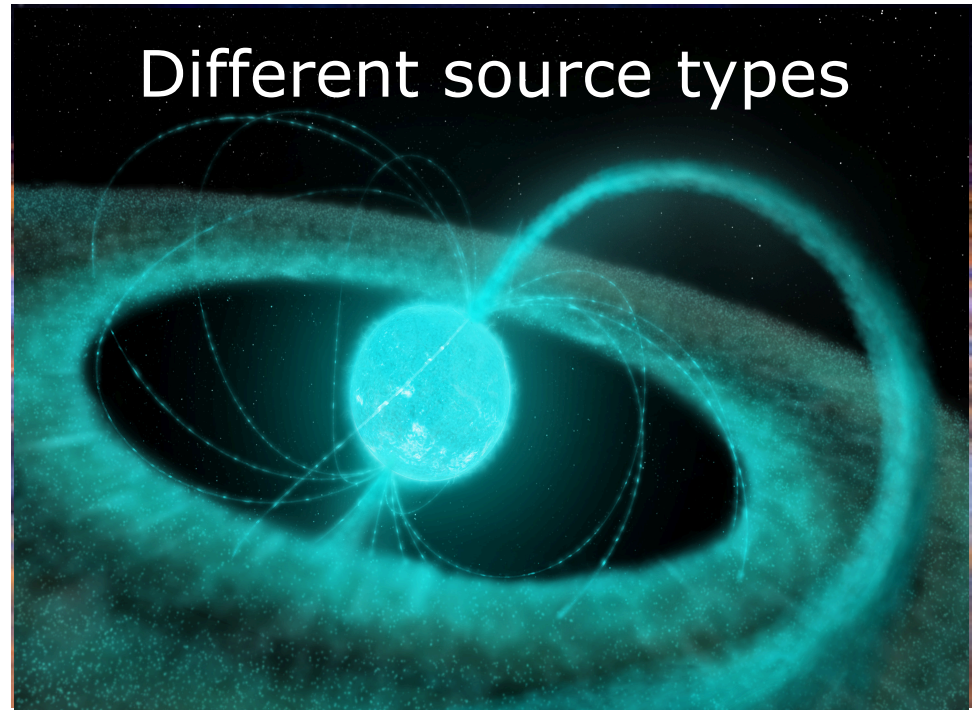
The relativistic effects pulse profile modeling exploits are larger for the more rapidly-rotating **accreting** neutron stars.

Next generation
telescopes



eXTP (Zhang et al. 2019)
STROBE-X (Ray et al. 2019)

Different source types



New astrophysical modeling and
analysis challenges!