Multiwavelength Pulsar Astronomy

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Green Bank Observatory (GBO)

Transformative Science for the Next Decade with the
Green Bank Observatory
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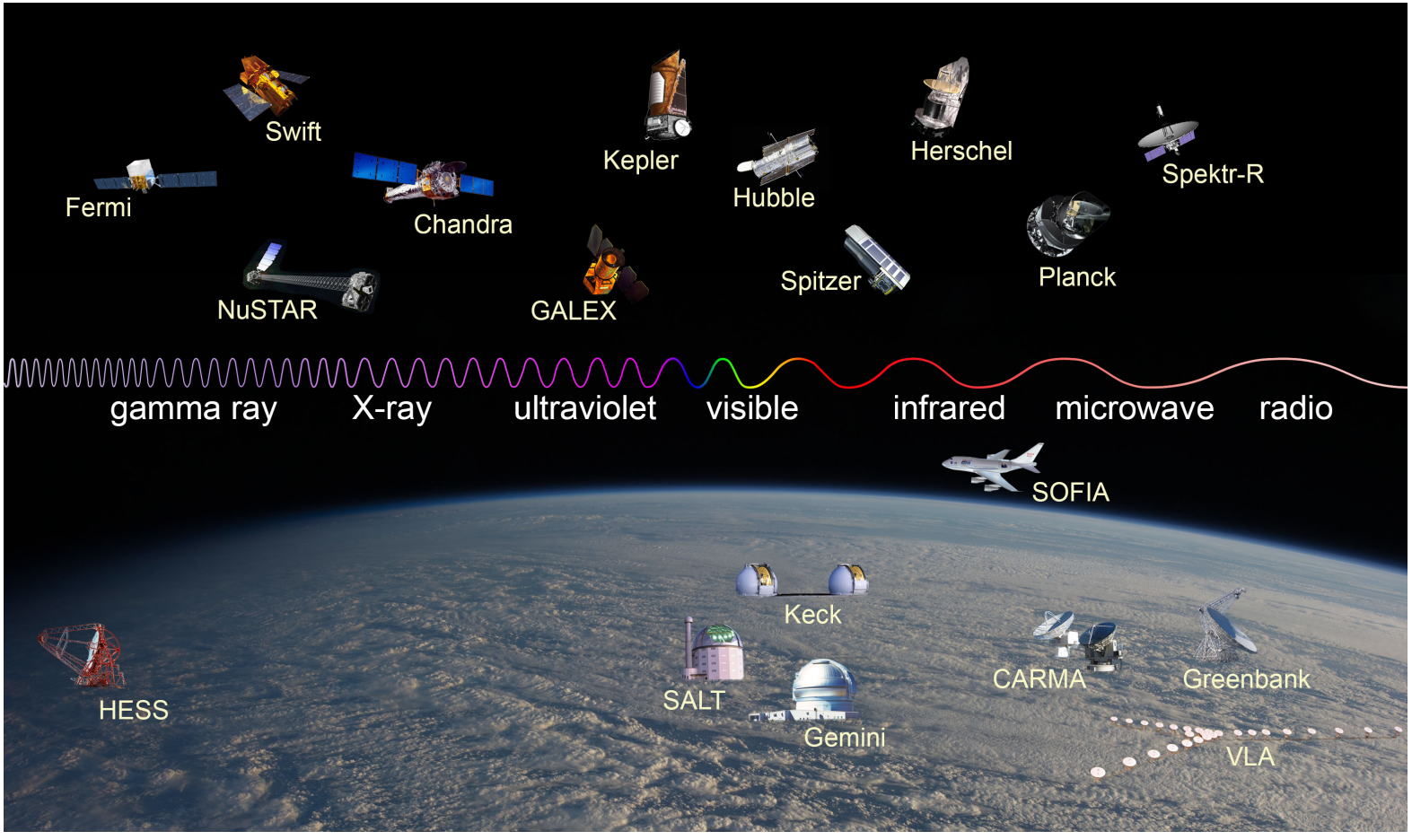
GREEN BANK OBSERVATORY

Multiwavelength Astronomy



[Credit: NASA, ESA, Lavochkin Association, HESS, SALT, Keck, Gemini, CARMA, NRAO/AUI, GBO]

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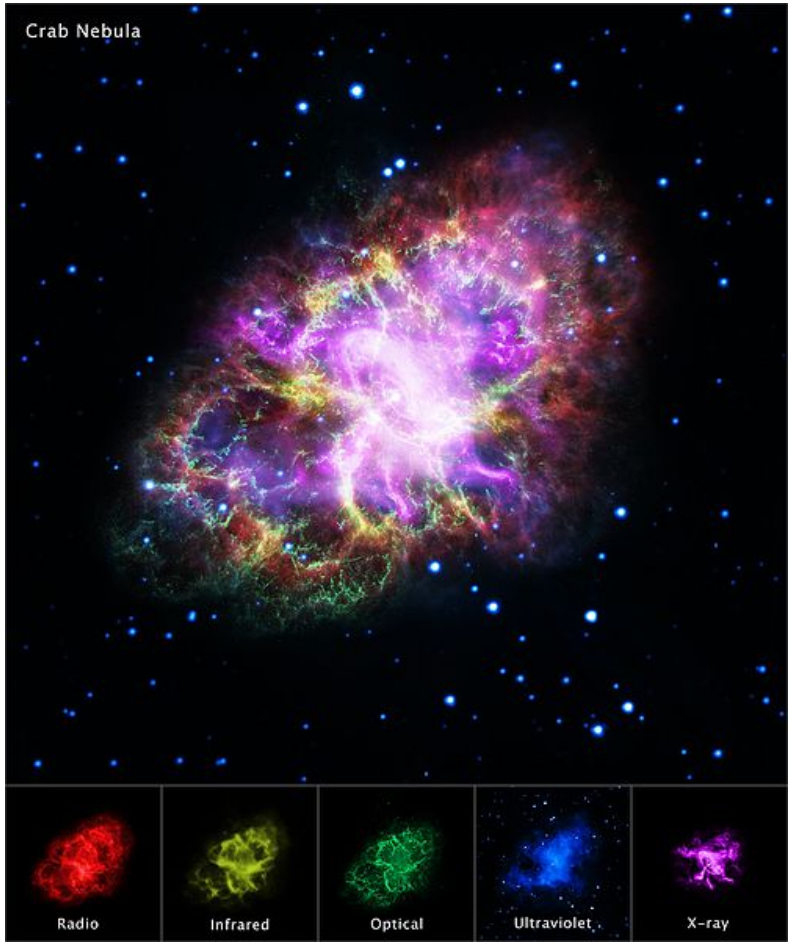
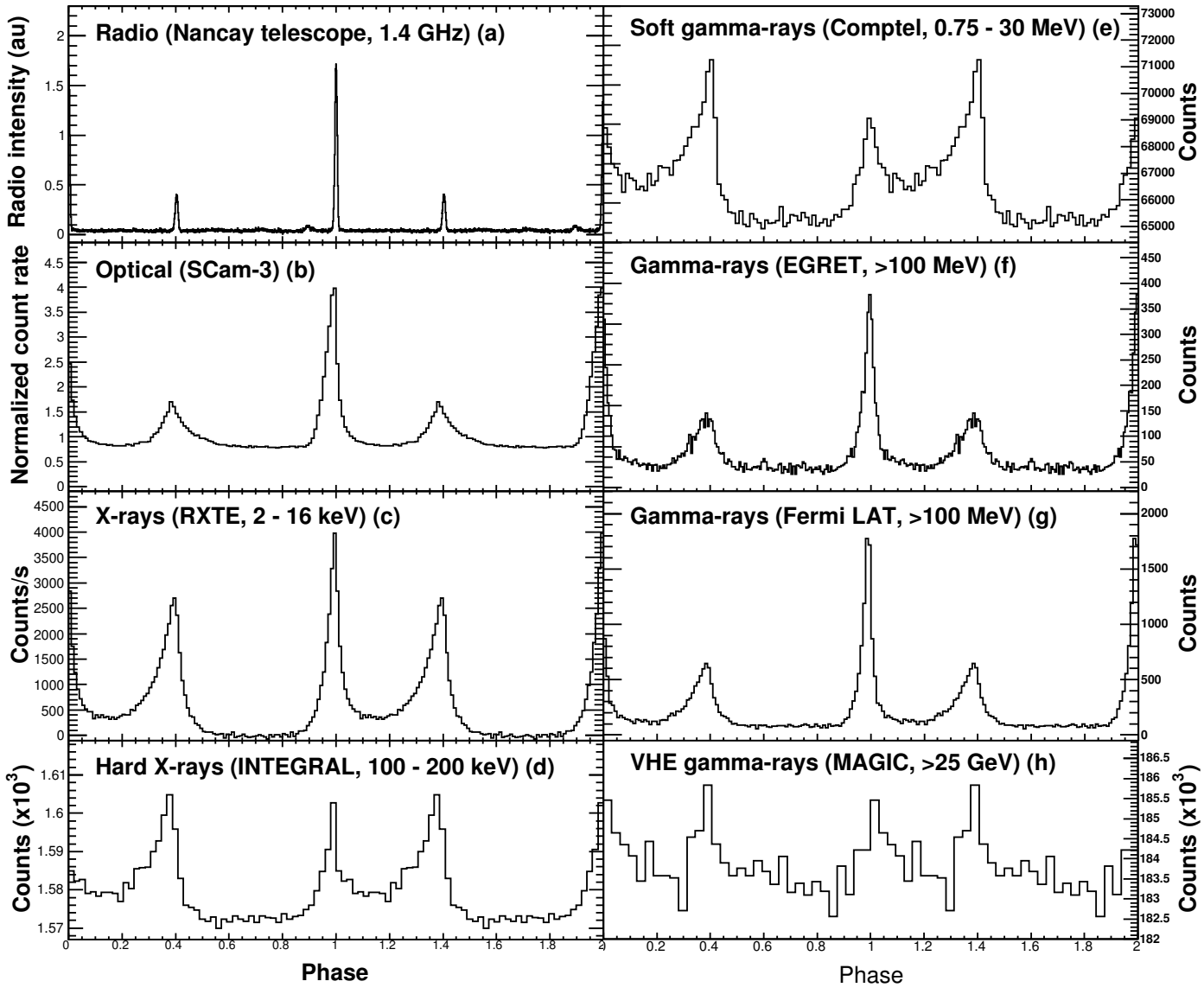


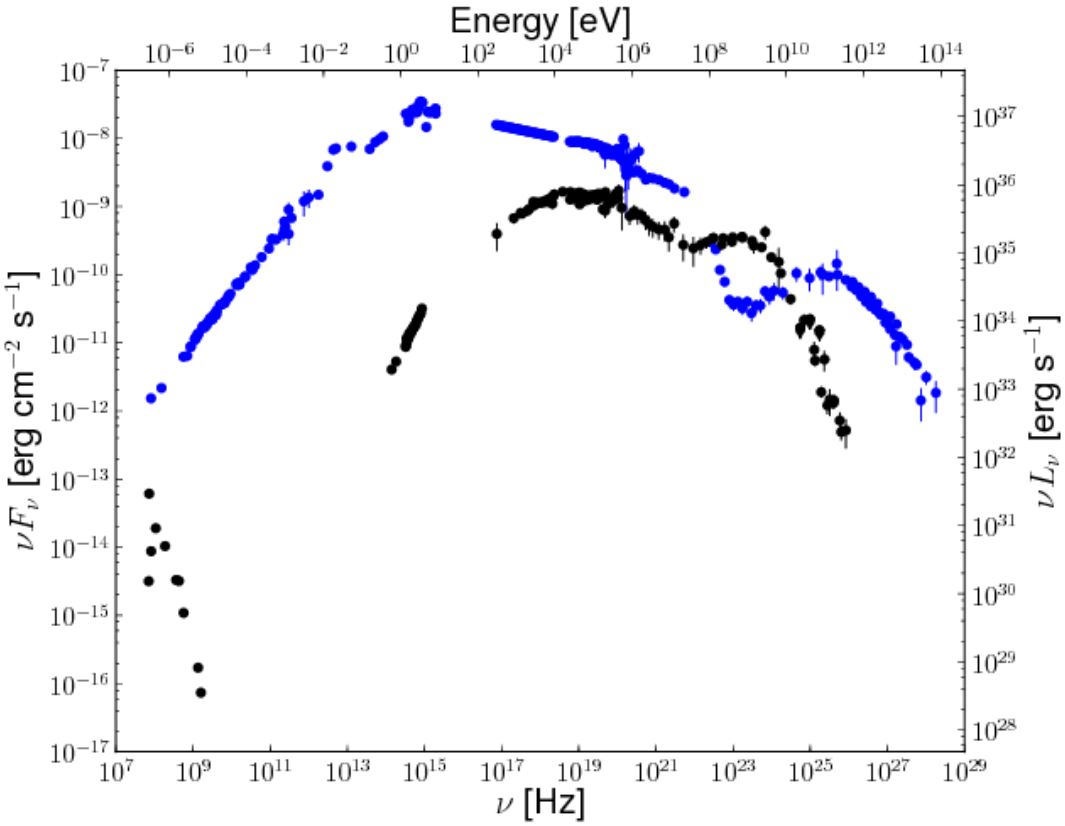
[Credit: NASA, ESA, G. Dubner (IAFE, CONICET-University of Buenos Aires) et al.; A. Loll et al.; T. Temim et al.; F. Seward et al.; VLA/NRAO/AUI/NSF; Chandra/CXC; Spitzer/JPL-Caltech; XMM-Newton/ESA; and Hubble/STScI]

Multiwavelength Pulsar Astronomy



[Credit: Abdo et al. 2010]

Multiwavelength Pulsar Astronomy



Crab Nebula (blue) and Crab pulsar (black) Spectrum

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"Pulsar Problem"

- observed radio emission: spontaneous, coherent, wideband, polarized
- proposed emission mechanisms:

  -particle bunching
  -relativistic plasma emission
  -maser emission mechanisms
- coherent emission: produced by incoherent emission processes through particle bunching? (Michel 1991)

  $\rightarrow$ connection to incoherent emission at higher energies?
  $\rightarrow$ transition between coherent and incoherent emission?

ALMA (**A**tacama **L**arge **M**illimeter **A**rray)

- range of operations: 31 - 1000 GHz
- operations start: $>$ June 2011
- full operations: March 2013
- (imaging) detection of Vela pulsar: arXiv:1708.02828
- (timing) detection of Vela pulsar: 2017-09-08

[Credit: ESO]

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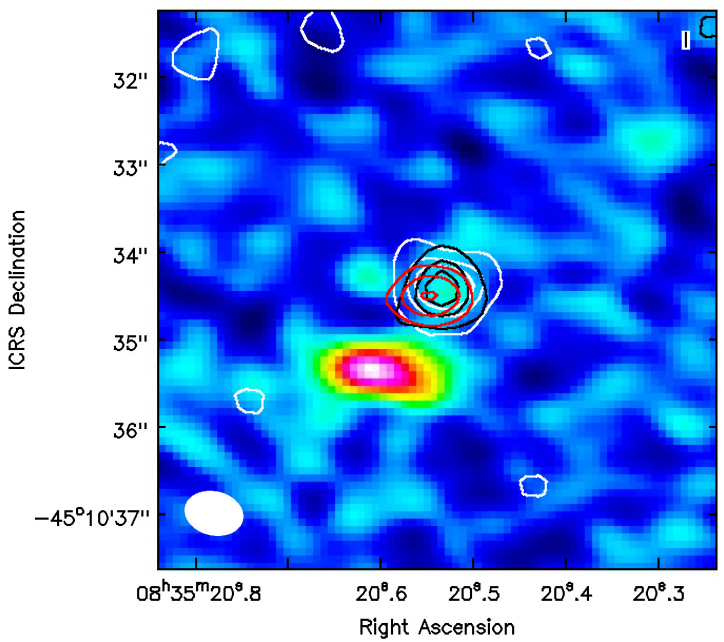

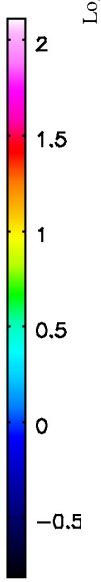

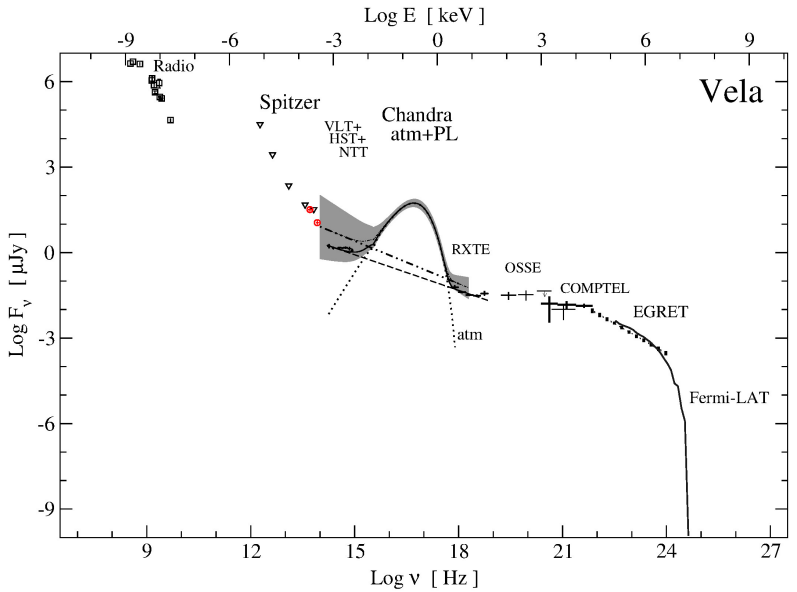

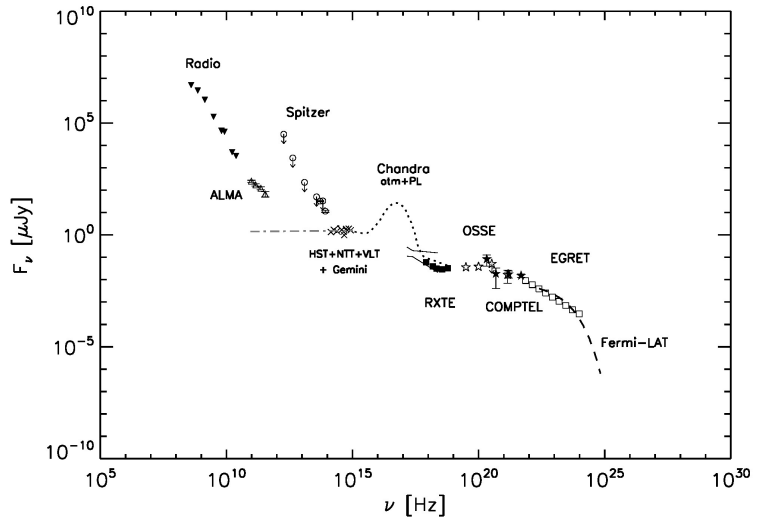

[Danilenko et al. 2011, Mignani et al. 2017]

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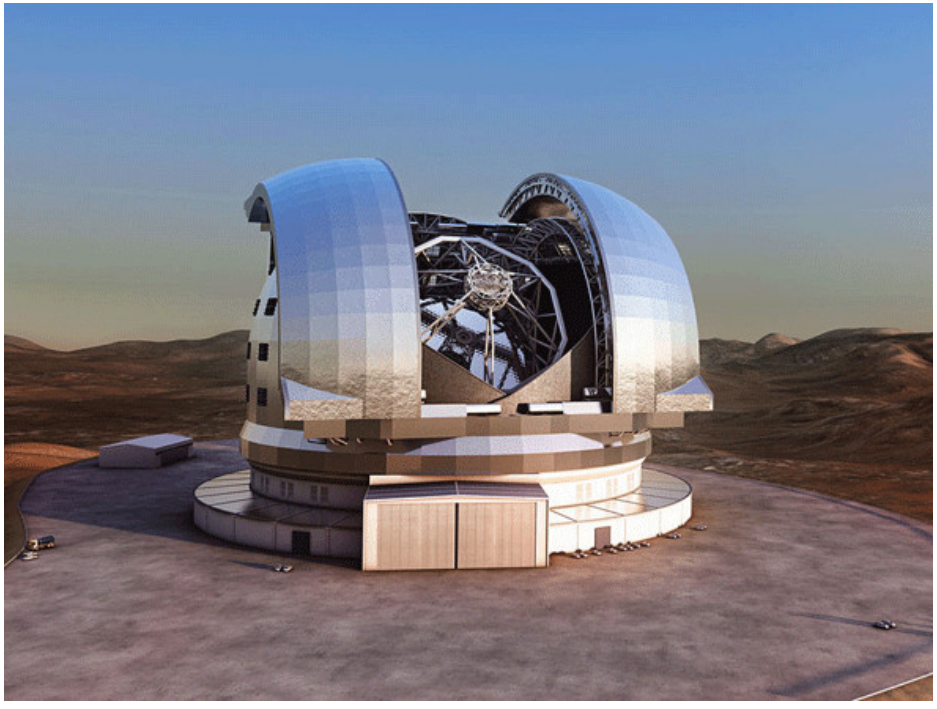
E-ELT (European Extremely Large Telescope)

- range of operations: optical - infrared
- construction start: June 2014
- first light: 2024
- location: Cerro Armazones/Chile
- host: $\leq$ 8 instruments (Iqueye, OPTIMA)



[Credit: ESO]

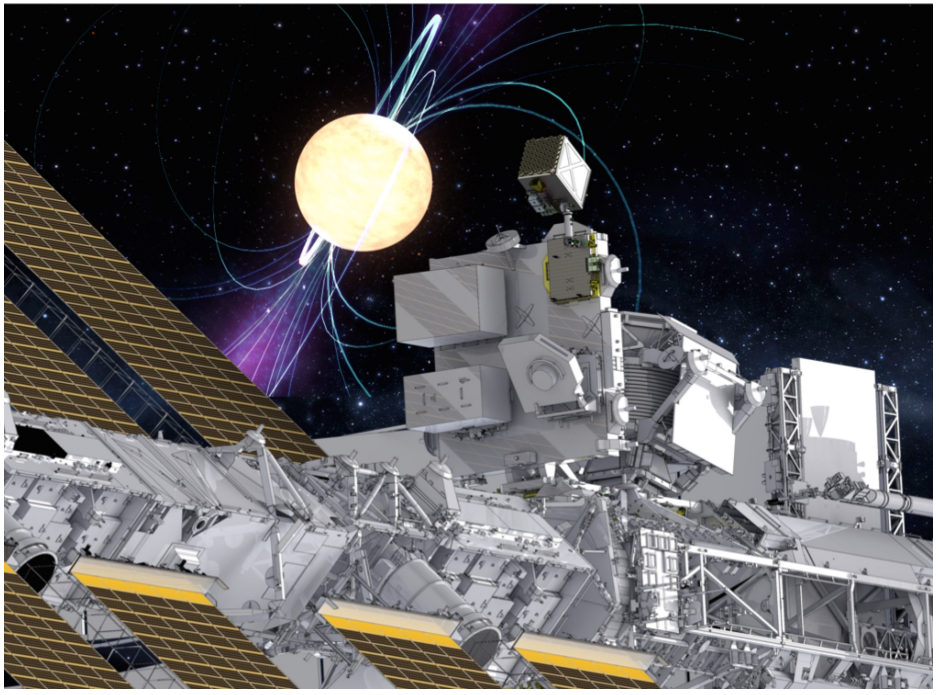
List of Optical Pulsars

Name	Magnitude [B]
Crab pulsar	17
Vela pulsar	24
PSR B0540-69	23
PSR B0656+14	26
Geminga pulsar	25.5
PSR B1509-58	25.7

[Shearer & Golden 2002]

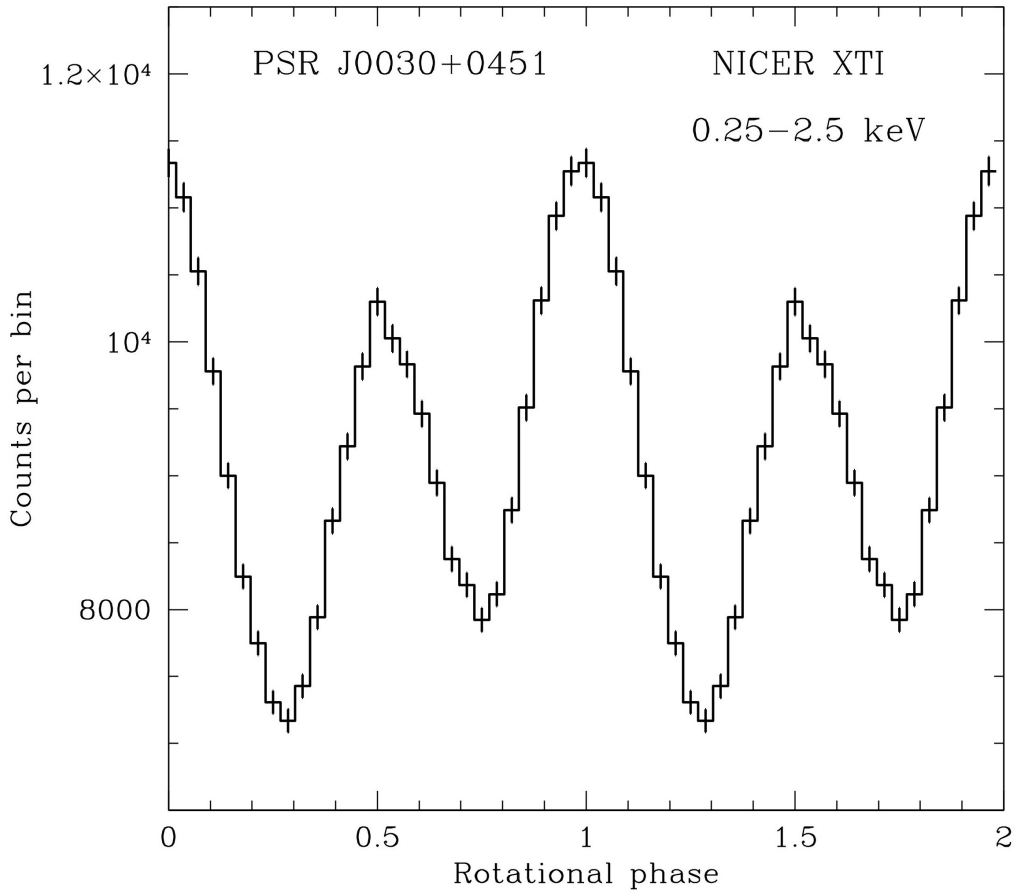
NICER (**N**eutron star **I**nterior **C**omposition **Explore**r)

- range of operations:
  0.2 - 12 keV
- launch: June 3, 2017
- science operations start:
  July 17, 2017
- mission life time:
  18 months ++



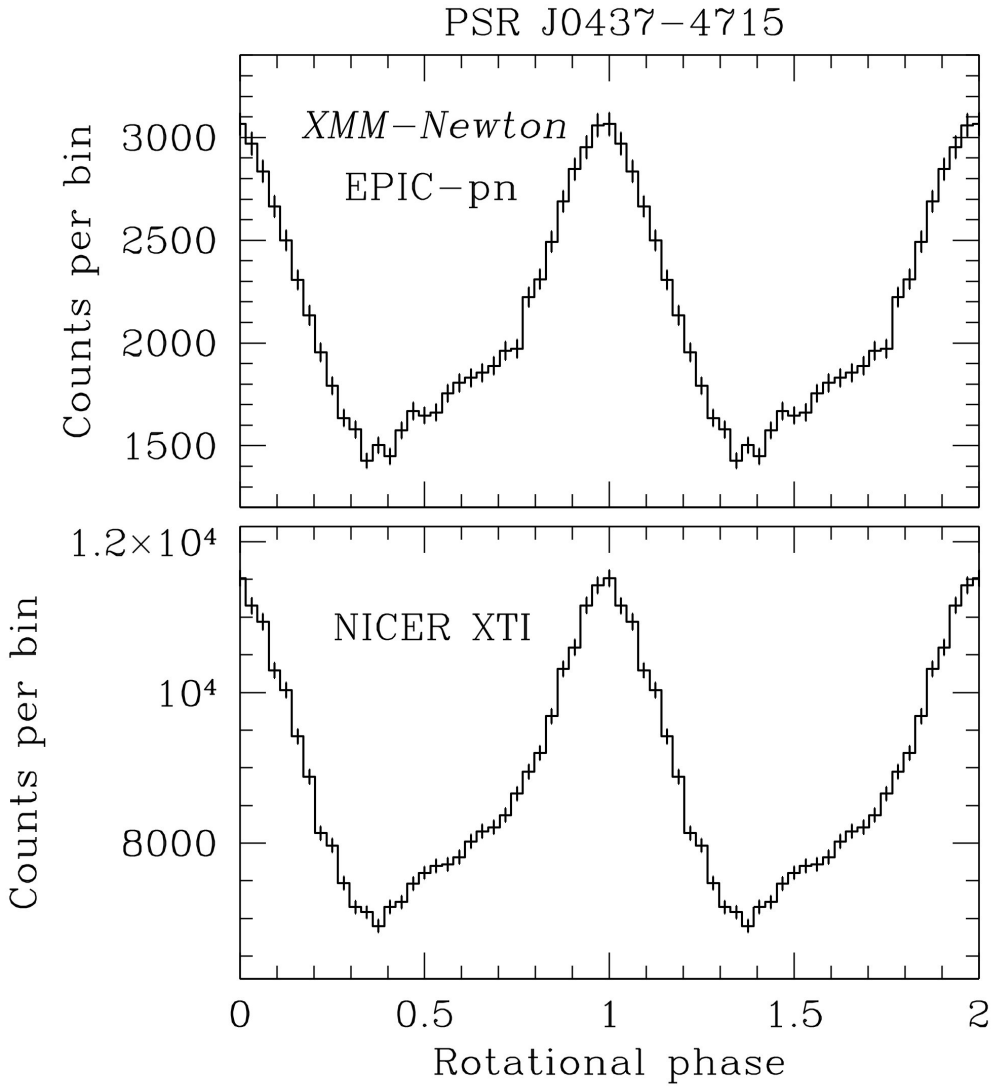
[Credit: NASA]

NICER (**N**eutron star **I**nterior **C**omposition **Explore**r)



[Credit: Z. Arzoumanian]

NICER (Neutron star Interior Composition ExploreR)



[Credit: Z. Arzoumanian]

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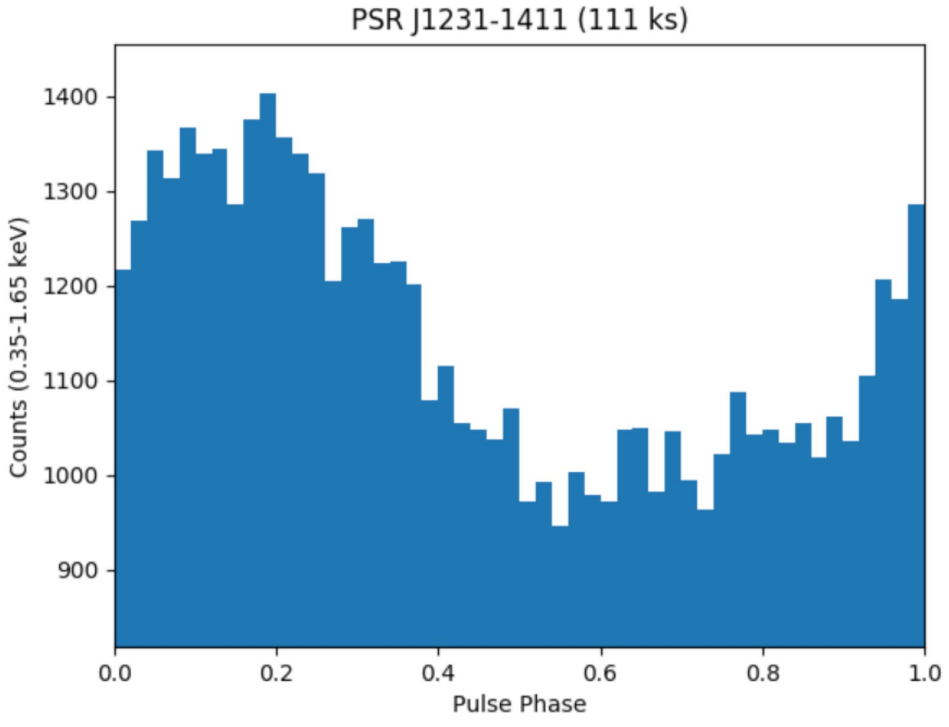

[Credit: Z. Arzoumanian]

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CTA (**C**herenkov **T**elescope **A**rray)

- range of operations:
  20 GeV - 300 TeV
  (3 classes of telescopes)
- operations start: ???
- CTA-North:
  Roque de los
  Muchachos/La Palma
- CTA-South: Chile

[Credit: cta-observatory.org]

Conclusions

- the future brings interesting experiments (ground-based & satellites)
- large(r) coverage of em spectrum
- simultaneous multiwavelength observations: key strategy for further modelling constraints
- GBT: dominant role in pulsar science
  → large, unblocked aperture
  → large variety of receivers & backends
  → ...
- constraints: weather, scheduling, technical characteristics