Summary

of the

Annual NewCompStar Conference 2015

15-19 June 2015 | Hotel Mercure Buda, Budapest

G.G. Barnaföldi,
Wigner RCP of the Hungarian Academy of Sciences
Hotel Mercure Buda, Budapest, Hungary, 19th June 2015

Topics were covered...

… since NewCompStar has wide variety

- Equation of State of Hot and Dense Matter
- Neutronstar evolution and Neutronstar cooling
- Nucleosynthesis and Supernova Physics
- Pulsars and Observation
- Magnetars and Gamma Ray Bursts
- Gravitational Waves
- Cosmology and Alternative theories

The Cast

… who played the main role...

Mehmet Ali Alpar (Sabanci University)

Nils Anderson (University of Southampton)

Almudena Arcones (Darmstadt TU)

Maria Grazia Bernardini (INAF - Osservatorio Astronomico di Brera)

Fiorella Burgio (INFN Catania)

Valeria Ferrari (Universita di Roma La Sapienza)

Francesca Gulminelli (LPC Caen France)

Oleg Kargaltsev (The George Washington University)

Kostas Kokkotas (Eberhard-Karls University of Tubingen)

Andrew Melatos (University of Melbourne)

Sandro Merghetti (INAF, IASF-Milano)

Rosalba Perna (Stony Brook University)

Jose Pons (Universitat d'Alacant)

Michele Punturo (INFN Perugia)

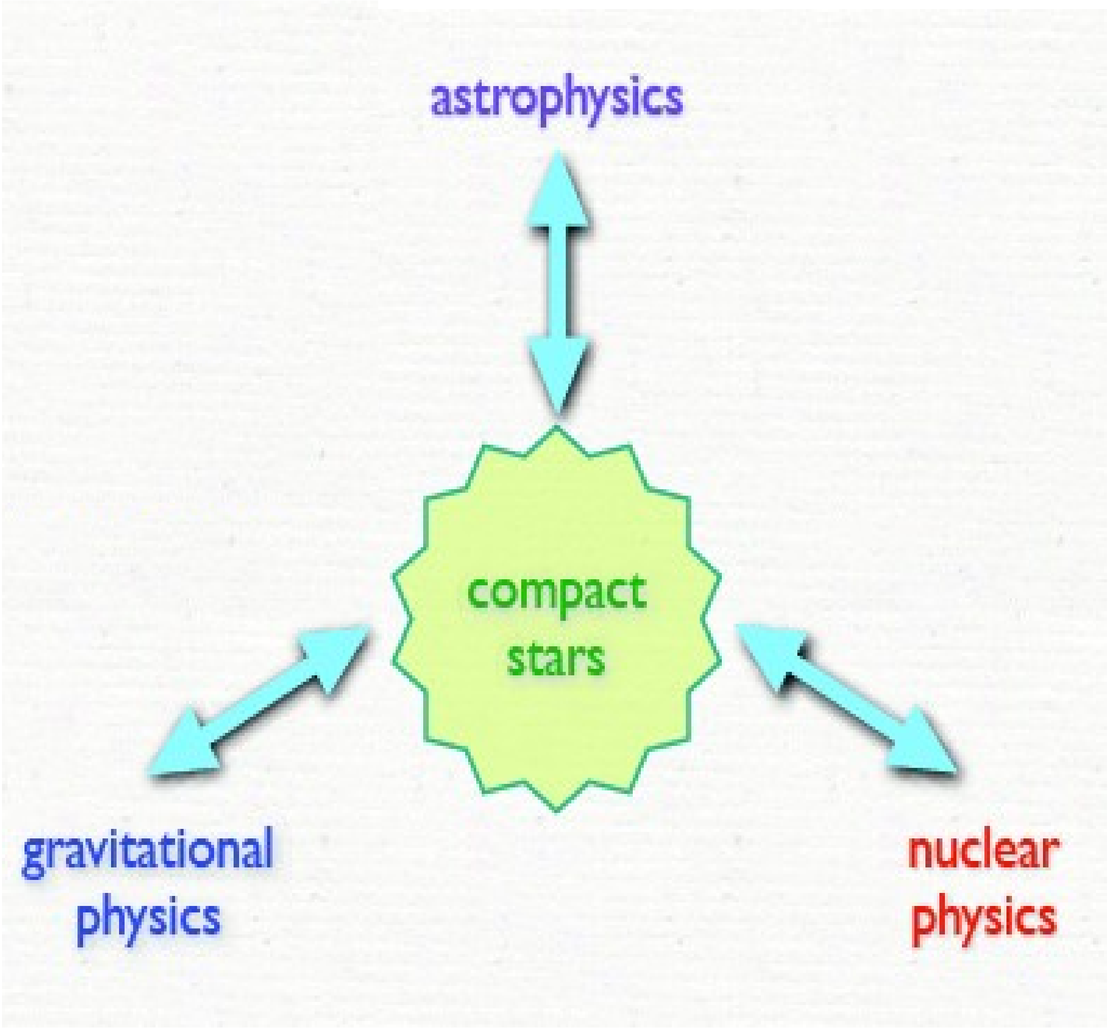
Chihiro Sasaki (FIAS - University of Frankfurt)

Andreas Schmitt (TU Wien)Equation of State of Hot and Dense Matter

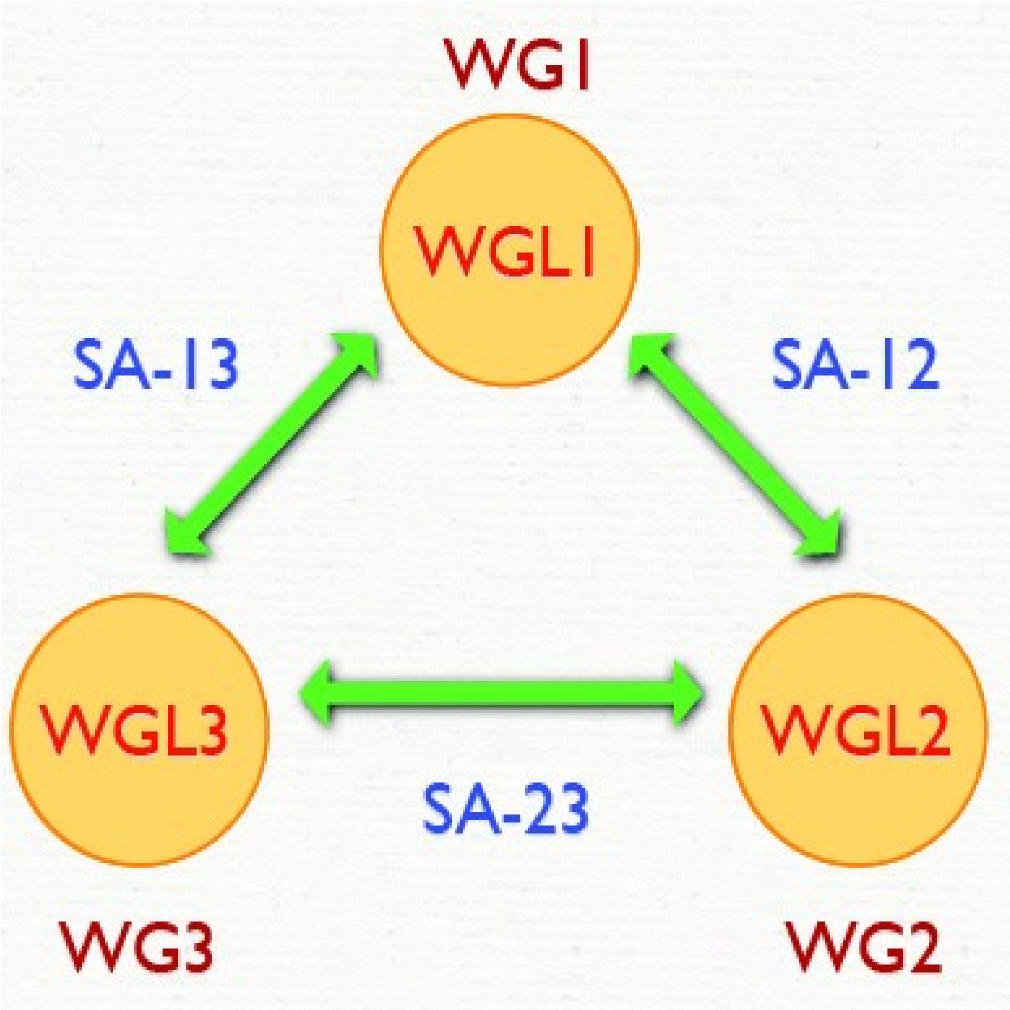
and many OTHERS including young STUDENTS and POSTDOCS

The Cast

The NewCompStar Approach



The NewCompStar Approach



The NewCompStar Approach

- WG1:
  - Observation and modeling of compact stars
- WG2:
  - Physics of the strong interaction theory and experiment
- WG3:
  - Gravitational physics theory and observation

The NewCompStar Approach

- WG1: Observation and modeling of compact stars
  - GRB & Magentars & Glitches:
    - R. Perna: Overview of a magnetized NS
    - J. Ponds: Magnetic, thermal and rotational evolution of a NS
    - M.G. Bernardini: Observation and signature of magnetars and
    - O. Kargaltsev: Pulsars from optical to gamma rays
    - D. Alvarez-Castillo: Supporting QGP CEP existence by compact star observation (hNJL)
    - S. Mereghetti: Overview
    - A. Melatos: lack of binary magnetars (accretion reduces B or selection effect)
    - V. Graber: Megnetic field evolution in SC NS
    - M.A. Alpar: NS structure, gitches
    - L. Ducci: glicthes (superfluid) and anti-gliches (accreting pulsar) long range and long recovery
    - B. Haskell: Vortex avalances can propagate in NS, vortex-fluid coupling is required
  - Observations & Pulsars:
    - B. Rangelov: SNR G284.3 18 XRB 1FGLJ1018.6 model consistency (25 M)
    - O. Akbal: abnormal glitch signature PSRJ1119-6127 (quake model test)
    - A. Bilous: B0943+10 LOFAR's mode switching pulsar
    - E. Gügercinoglu: Implication for plusar glitches and NS structures
    - F. Coti Zelati: The X-ray outburst of the Galactic Centre
    - A. Borghese: Phase dependent feature in X-ray spectrum of RX J0720.4-3125
    - G. Ashton: comparing pulsar timing models

The NewCompStar Approach

- WG2: Physics of the strong interaction theory and experiment
  - EoS and related theory/experiment:
    - F. Burgio: EoS overview (need for more measurements)
    - C. Providencia Crust & Core
    - N. Chamel: NS crust with energy density functional
    - I. Vidana: Hyperonic three body forces
    - A. Vourinen: pQCD based calculations for NS properties
    - K. Petrík: Advanced Mean Field model for dense matter EoS
    - D. Klabucar: Analitic structure of nonpert. Quark propagators
    - E. Kolomeittsev Solving hyperon puzzle with RFM method
    - A. Fantina: Unified EoS by energy-density functional
    - D. Gondek-Rosinska: equilibrium ans properties of rotating NS
    - Rana Nandi: Low-density nucl. Matter by quantum molecular dynamics
  - Thermal, viscosity coefficients and thermal conductivity
    - L. Tolos: collisions of superfluid phonon
    - Ch. Sasaki: QCD thermodynamics
    - P. Kovács: vector meson extednded Polyakov

The NewCompStar Approach

- WG2: Physics of the strong interaction theory and experiment
  - Supernovae & proto-NS & EoS :
    - M. Bejger: Rotation and stability of NS with strong phase transition
    - D Bandypadhyay: Core collapes SN simulation
    - J Leszek: Deep crustal heating in accreating NS
    - H. Pais: Pasta phases in Core collapse SN matter
    - M, Hempel: EoS and equilibrium constrains from HIC
    - H-T. Ngo: Beta-stable matter in proto-neutron stars
    - P. Shternin: Modified Urca prosess in BHF framework
    - J. Horvath Close binary massive system with NS.
  - Cooling
    - A. Sedarakian: Unpairing effect in magnetars: cooling
    - A. Perego: Neutrinos and neutrino driven winds in binary star mergers

The NewCompStar Approach

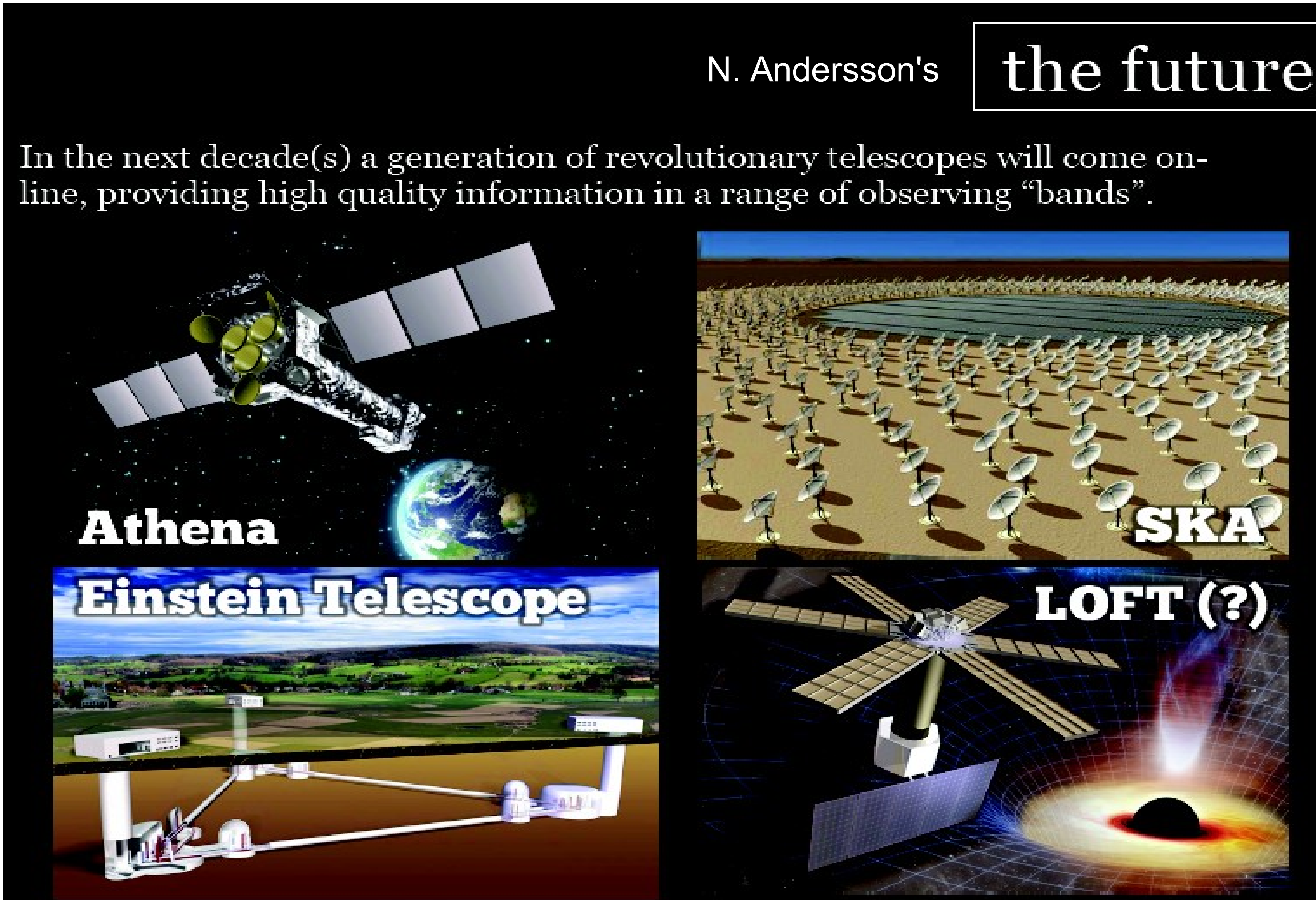
- WG3: Gravitational physics theory and observation
  - GW constrainst for EoS
    - V. Ferrari: Istiffness of the EoS NS-NS binaries
    - K. Kokkotas: NS: oscilaltions instabilities and GWM.
    - M. Punturo: From Virgo to ET
  - Gravitation Waves
    - D. Barta: Highly-eccentric GW sources,
    - G. Debreczeni:GRB coalescence time forecasting
    - M. Kubaca: GW signals from ensemble of Sns
    - M. Szkudlarek: Differential rotating Strange stars in GR
    - I. Jones: GW form r-mode excitations in accreting NS
    - L. Gualtieri: Tidal Love numbers of rotating NS
    - G. Camelio: Early evolution of a newly formed proton NS
    - T. Kuroda: DW singals vs. EoS/progenitor models
    - A. Grazioano Pili: Modelling higly magnetized NS in GR

"YOUR **FUTURE** IS CREATED BY WHAT

YOU DO { **TODAY** }

~~NOT~~ { ~~TOMORROW~~"

Future Experimental Facilities



Future Experimental Facilities

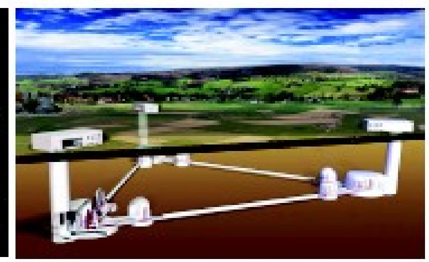
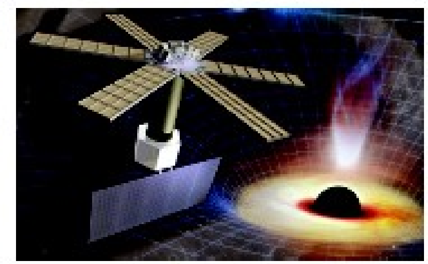
N. Andersson's **final remarks**

Neutron stars are Nature's own extreme physics laboratories.

Observations allow us to probe regimes that can never be reached on Earth, complementing information gleaned from colliders like the LHC, RHIC etc.

A new generation of telescopes will ("soon") provide a wealth of relevant data.



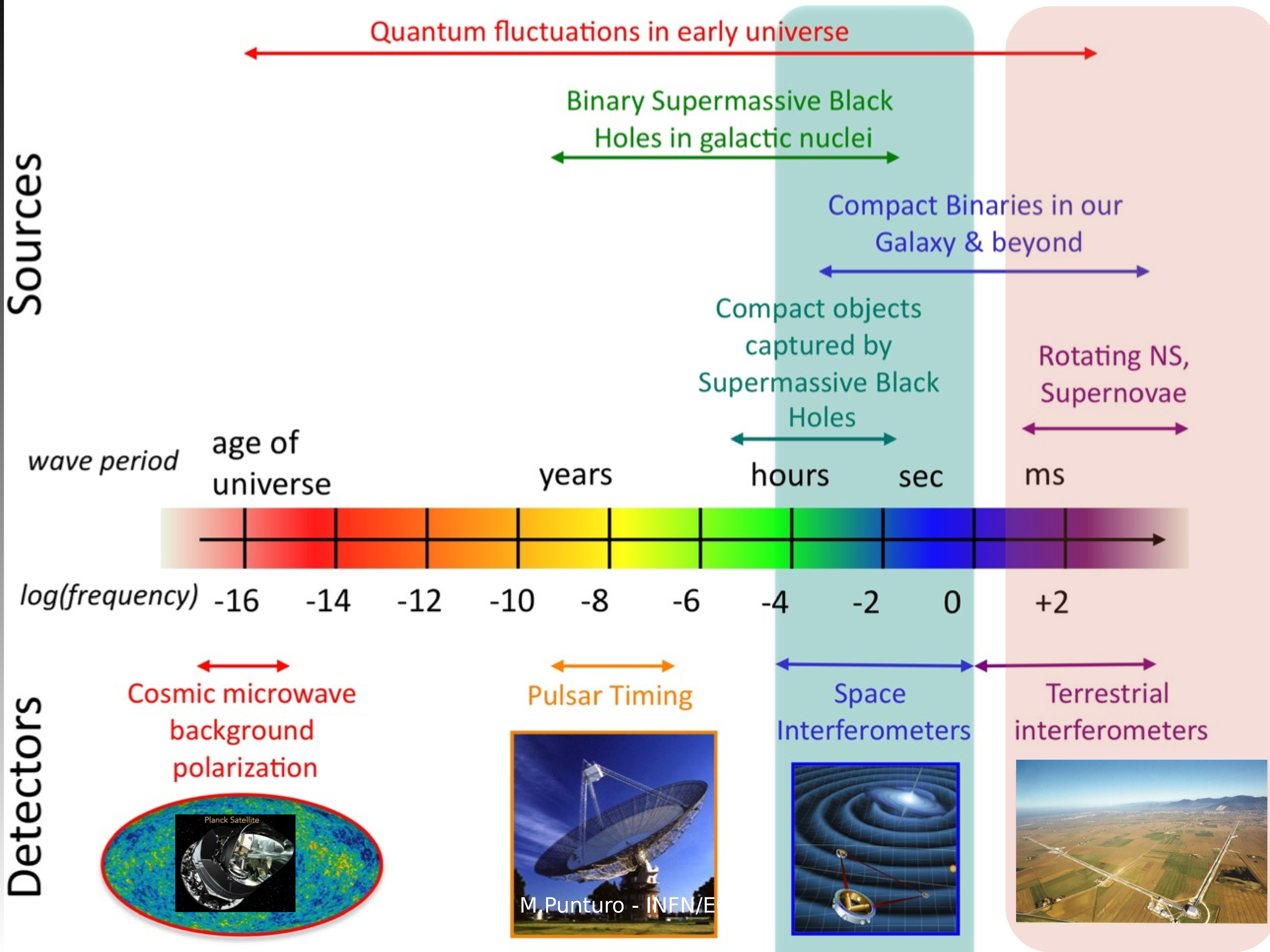
However... these are hands-off laboratories.

If we want to move beyond "zoology", and make maximal use of data to constrain fundamental physics, we need to combine information from different "channels".

We need urgent progress on the theory side;

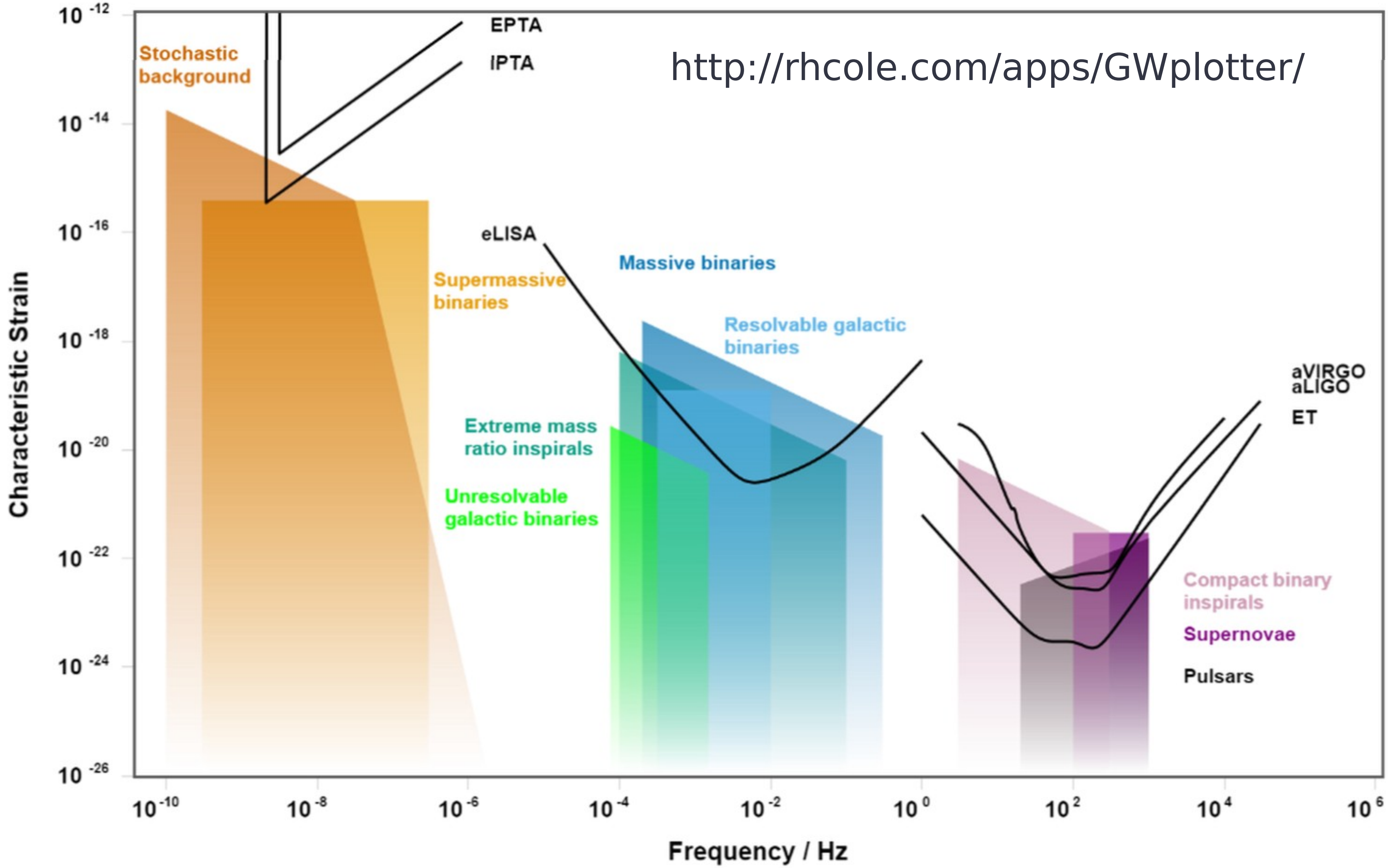
- next generation models should incorporate "all" the expected physics (identify key issues and parameterise ignorance if required),
- need to figure out how to model (nonlinear) systems that evolve on a secular timescale...

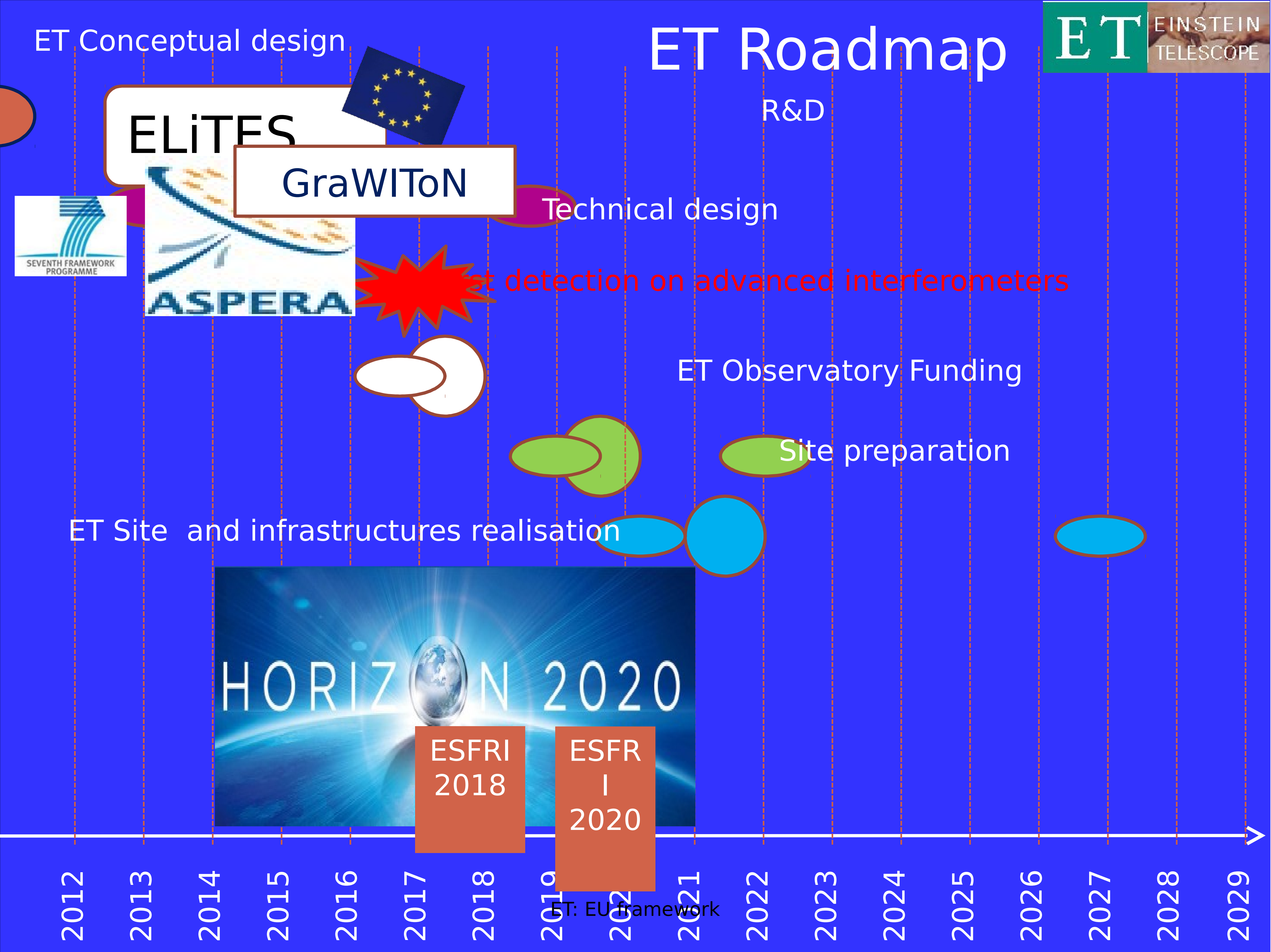
The Gravitational Wave Spectrum



Improving the sensitivity

http://rhcole.com/apps/GWplotter/




ET Roadmap
EINSTEIN TELESCOPE
ET Conceptual design
ELiTES
GraWIToN
R&D
Technical design
ASPERA
SEVENTH FRAMEWORK PROGRAMME
detection on advanced interferometers
ET Observatory Funding
Site preparation
ET Site and infrastructures realisation
HORIZON 2020
ESFRI 2018
ESFR I 2020
ET: EU framework
2012
2013
2014
2015
2016
2017
2018
2021
2022
2023
2024
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2026
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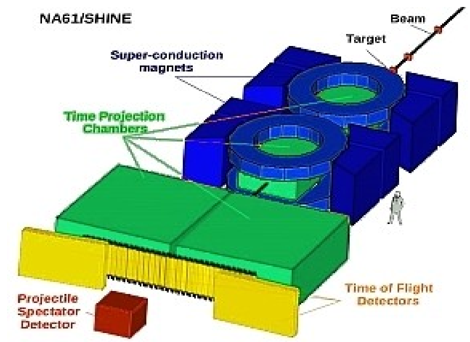
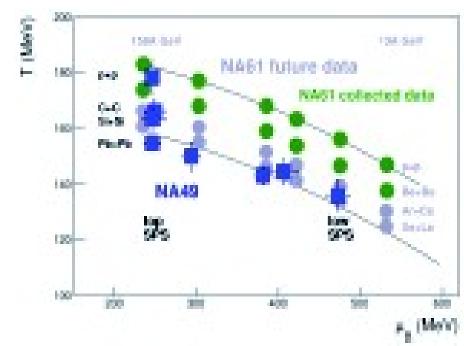
2029

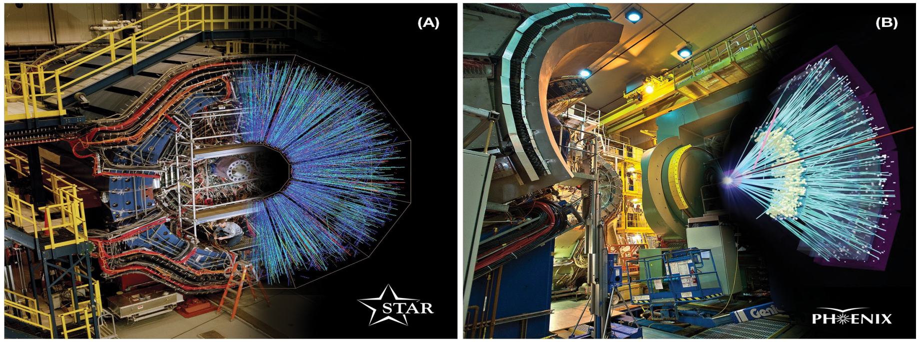
Existing and Working Detectors

- NA49, NA61/SHINE
  < 20 GeV SPS energies
  Targets: p,S,O,W,

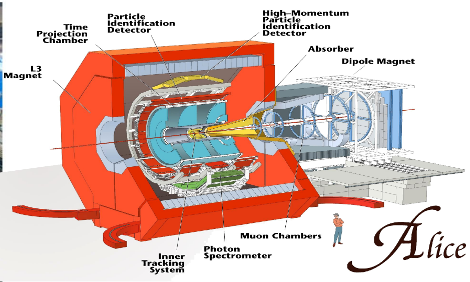




- STAR/PHENIX
  10-500GeV RHIC energies
  Targets: p,d,O,Cu, Au,

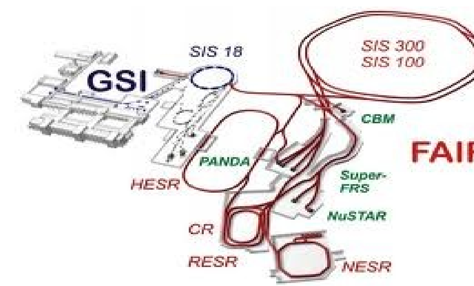


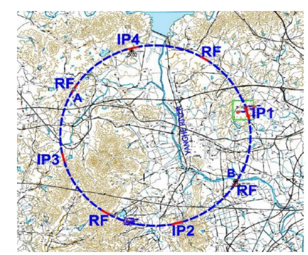
- ALICE/CMS/ATLAS
  0.2-14 TeV LHC energies
  Targets: p,Pb

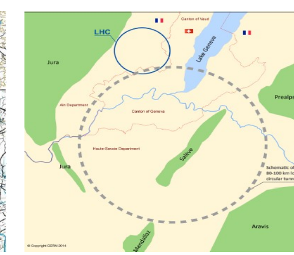


Future Experimental Facilities

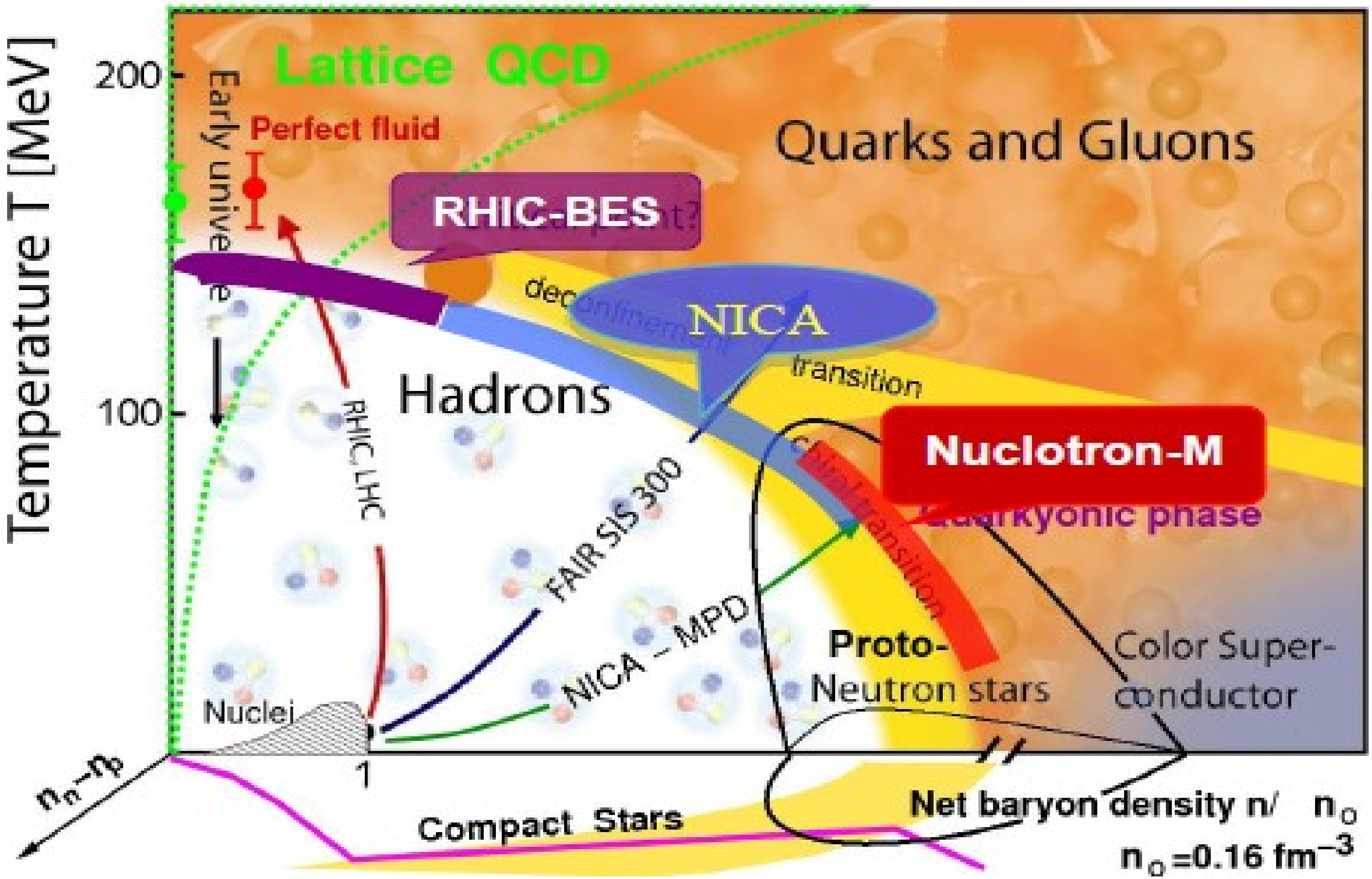
- 2017: NICA (DUNBA)
  - In accordance with GSI, parallel & pre-studies
- 2016: FAIR (GSI)
  - PANDA and CBM probably in this order
- 2020: HLLHC (CERN)
  - ATLAS, CMS, ALICE after upgrade
- 2025-2040 ILC, FCC (CERN, China)
  - US: Neutrino Physics
  - Japan: ILC, FCC:
  - FCC CERN and/or China
- Future computing technologies:
  - Rise of the parallel computing
  - Multi-core machines
  - GP/GPU technologies







Future Experimental Facilities



New Theoretical Directions

- On the GR side
  - Post-TOV formalism (K. Glampedakis)
  - Kaluza- Klein-like models (Sz. Karsai)
  - Dark matter searches (P. Fiziev)

- On the Field theory & EoS side
  - Holography methods vs. QCD matter (A. Schmitt)
  - FRG methods for scalable EoS (P. Pósfay)

What can be a take away message?
What was this meeting about?

If I need to make one take away message:

Magnetic fields play a MAJOR role in the life of a neutron star

Why do we care about magnetic fields ?

Keep in mind: The star's magnetic field may play an important role, even if it is too weak to affect the nature of the r-mode itself.

Magnetic fields play fundamental role in post-merger dynamics (jets from BH/NS+torus, NS collapse to BH, ...)

- use (improved) results for phenomenology:
  - fit 3 parameters to nuclear saturation and compute equation of state
  - nuclear matter in a magnetic field

    pointlike: F. Preis, A. Rebhan, A. Schmitt, JPG 39, 054006 (2012)