Report from GWSIG

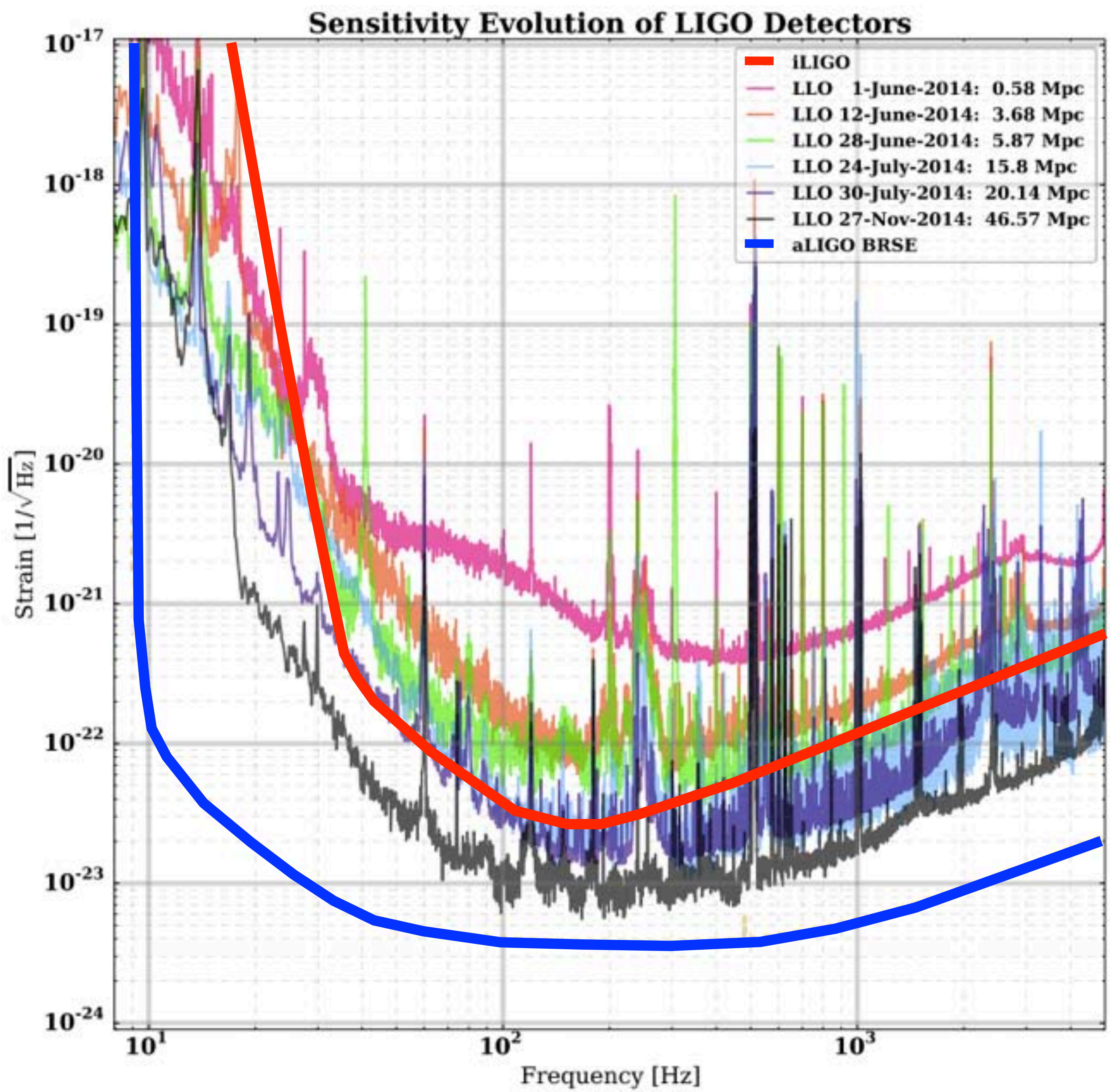
Neil Cornish

John Conklin & Guido Mueller

News Updates

- aLIGO/aVirgo
- Pulsar Timing
- L3 and eLISA
- LISA Pathfinder ST7
- GRACE follow-on

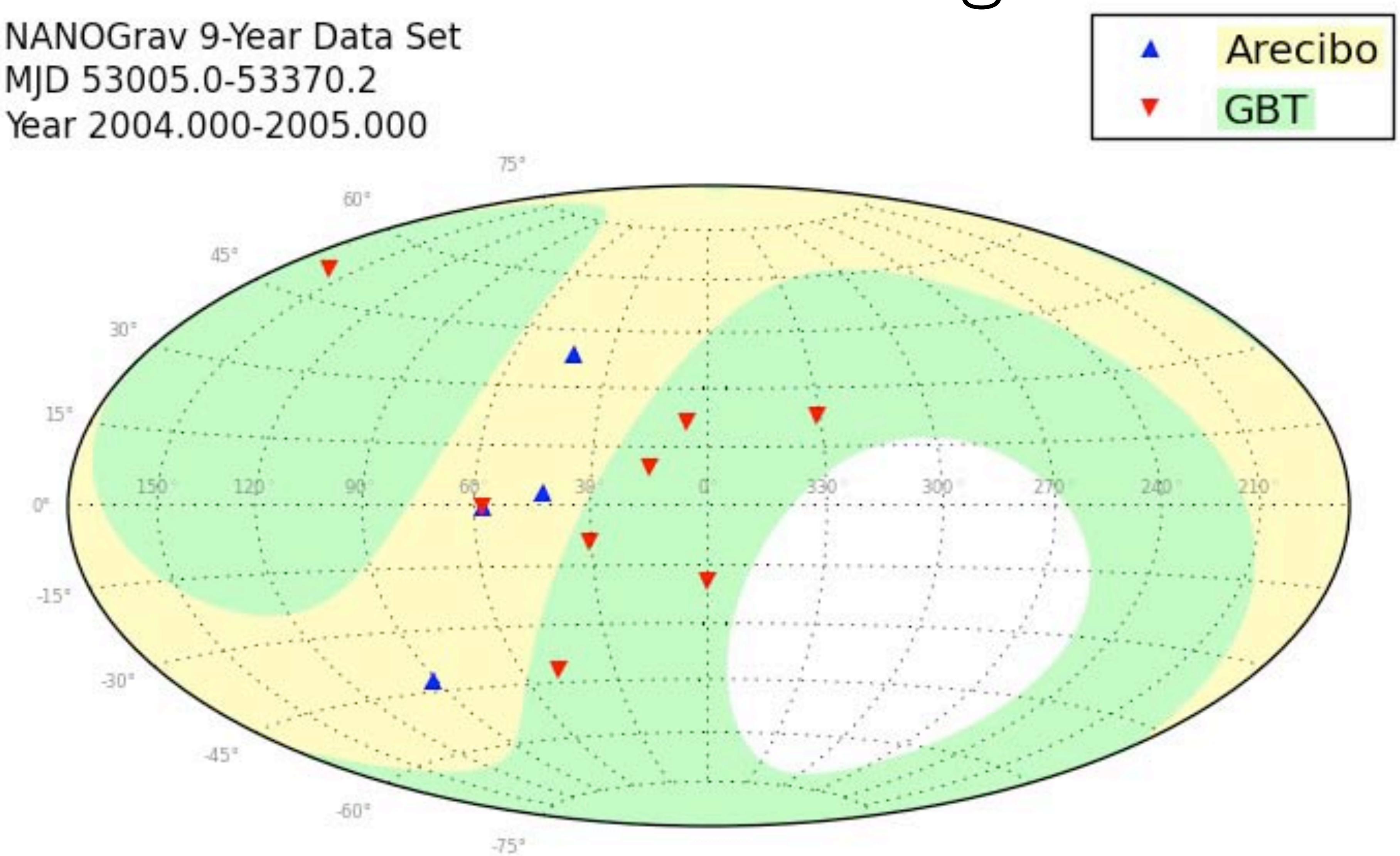
aLIGO status



LLO BNS Average Inspiral Range 57 Mpc, on Dec 18, 2014 (goal is 200 Mpc)

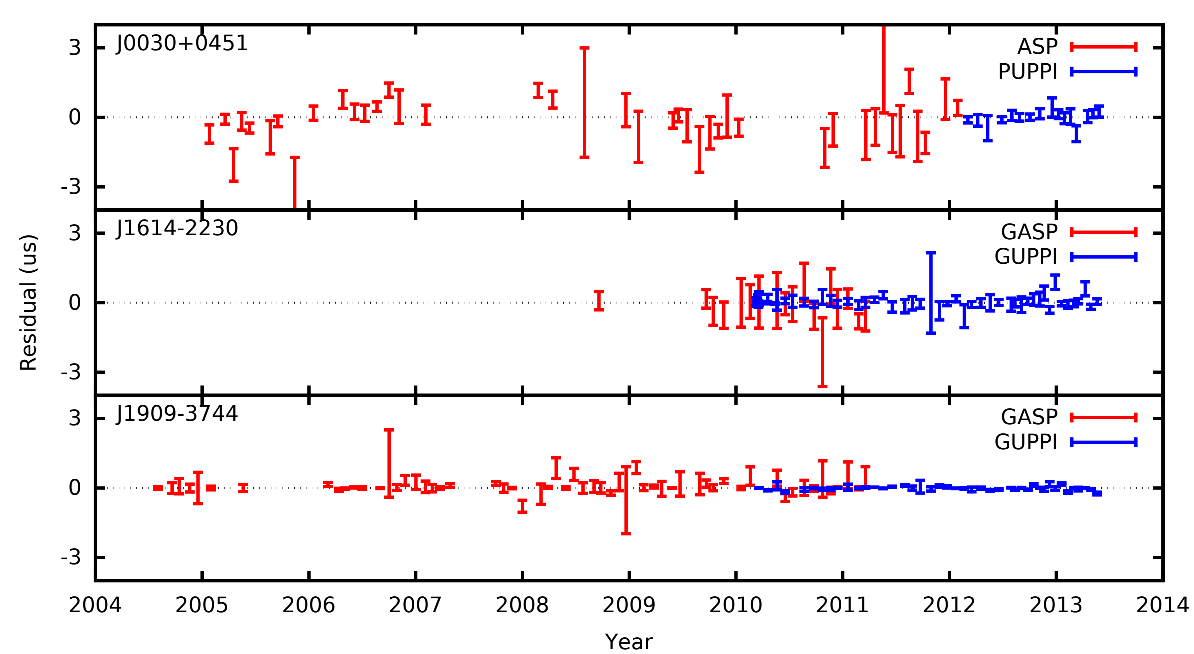
O1 planned for mid-2015

Pulsar Timing



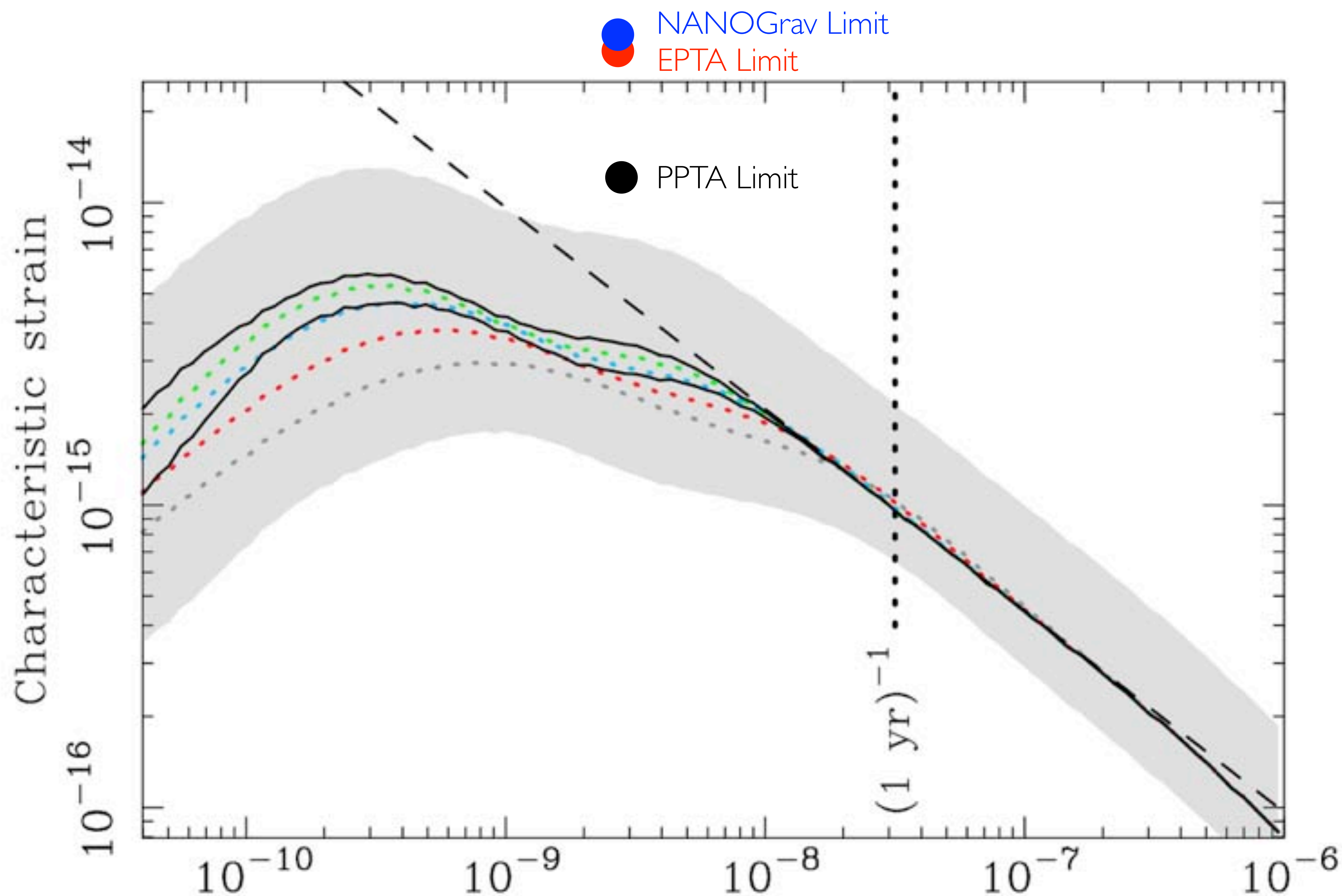
Credit: David Nice

More ms Pulsars



Better Instruments

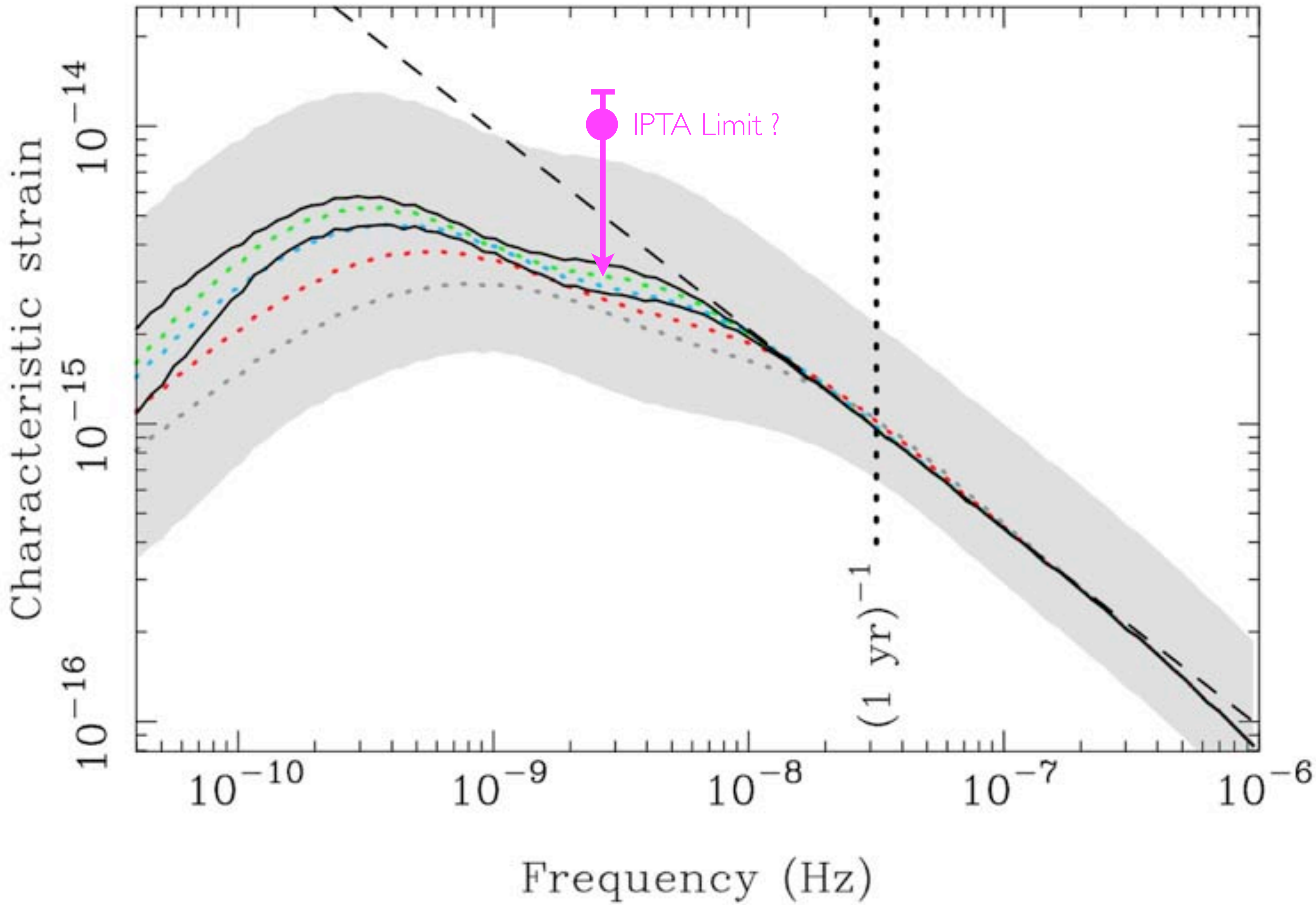
PTA Bounds and Prospects



Adapted from Ravi et al 2014

PTA Bounds and Prospects

Combined bound in the works



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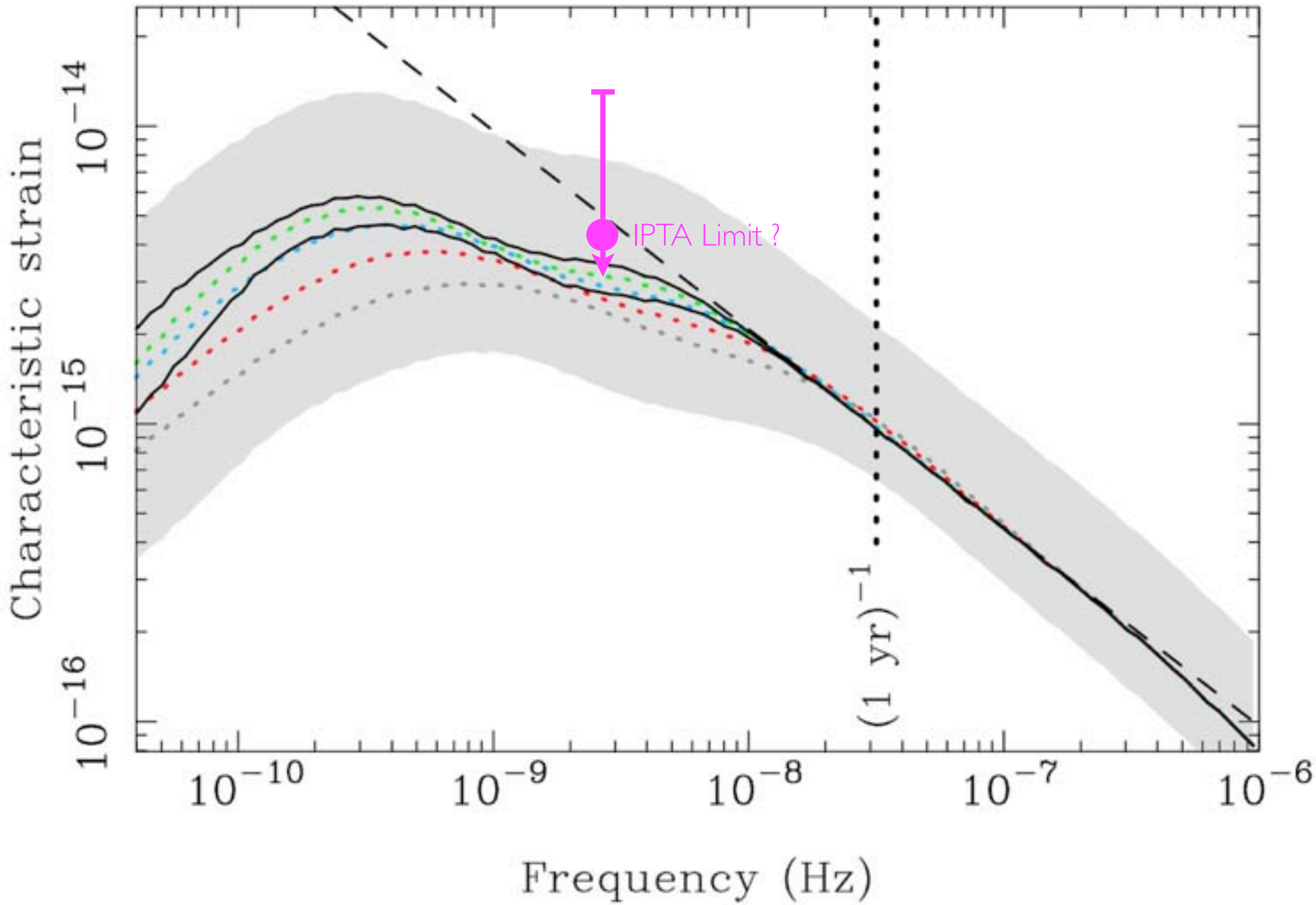

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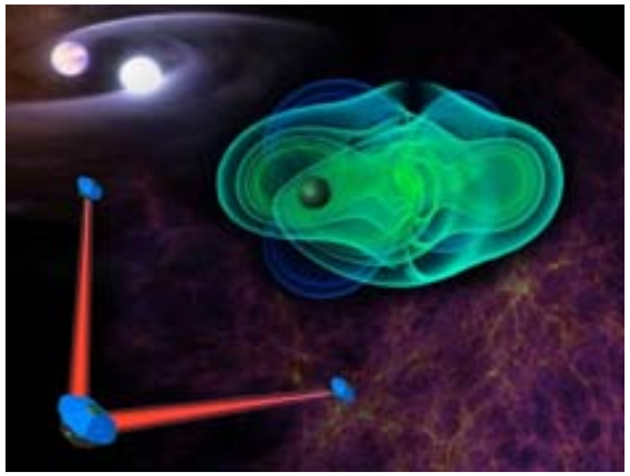
Space GW Status in Europe and U.S.



The "Gravitational Universe" selected as the third large Cosmic Vision (L3) science theme. Mission concept: eLISA (evolved Laser Interferometer Space Antenna).

Launch: 2035+ (~10 years too late)

lisa pathfinder

LISA Pathfinder on schedule

Launch: July 31, 2015 (~10 years too early)

National Aeronautics and Space Administration

NASA

Astrophysics Implementation Plan:
2014 Update

"NASA has expressed an interest in collaborating with ESA for a future L3 gravitational wave observatory"

GRAVITATIONAL OBSERVATORY ADVISORY TEAM

http://www.cosmos.esa.int/web/goat/home

SCIENTISTS

- Pierre Binetruy (APC Paris)
- Philippe Bouyer (LP2N Bordeaux)
- Mike Cruise (U Birmingham)
- Reinhard Genzel (MPE)
- Mark Kasevich (Stanford University)
- Bill Klipstein (JPL)
- Guido Müller (U Florida, Gainesville)
- Michael Perryman (Chair)
- Bernard Schutz (AEI Golm)
- Stefano Vitale (U Trento)

OBSERVERS FROM OTHER AGENCIES

- Masaki Ando (JAXA)
- Robin Stebbins (NASA)

1st Meeting 14-15 October 2014, ESA HQ, Paris
2nd Meeting 8 -9 December 2014, ESA HQ, Paris
3nd Meeting 25-26 March 2015, ESA HQ, Paris
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... to advise on the scientific and technological approaches for a gravitational wave observatory with a planned launch date in 2034.

The committee is due to provide a report to ESA in early 2016.

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L3 tentative timeline for meeting 2034 launch (current eLISA baseline assumed)

esa

• Launch:	2034
• Development schedule (Phase B2 to launch)	8.5 years
• Phase B2 kick-off:	mid-2026
• SPC adoption:	mid-2025
• End Phase B1/SRR:	Early 2025
• Payload EM demonstration:	~ 4 years assumed
• Payload EM kick-off:	2021 (requires S/C and P/L definition studies & I/F definition before)

Note: The timeline and overall approach may require adaptations depending on the final mission concept

European Space Agency

ESA UNCLASSIFIED – For Official Use

(Taken from Frédéric Safa's presentation to the GOAT)

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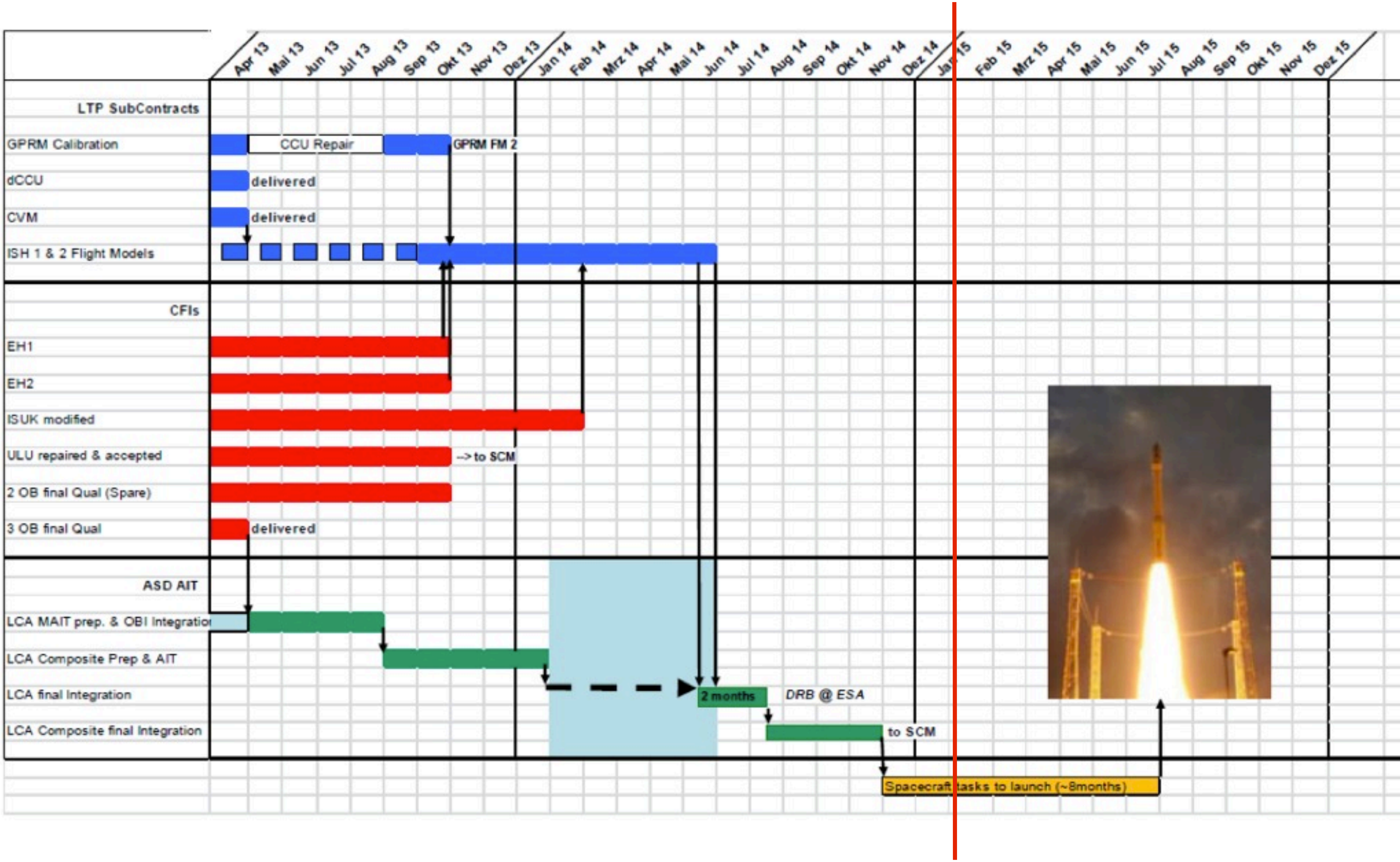
European Space Agency

ESA UNCLASSIFIED – For Official Use

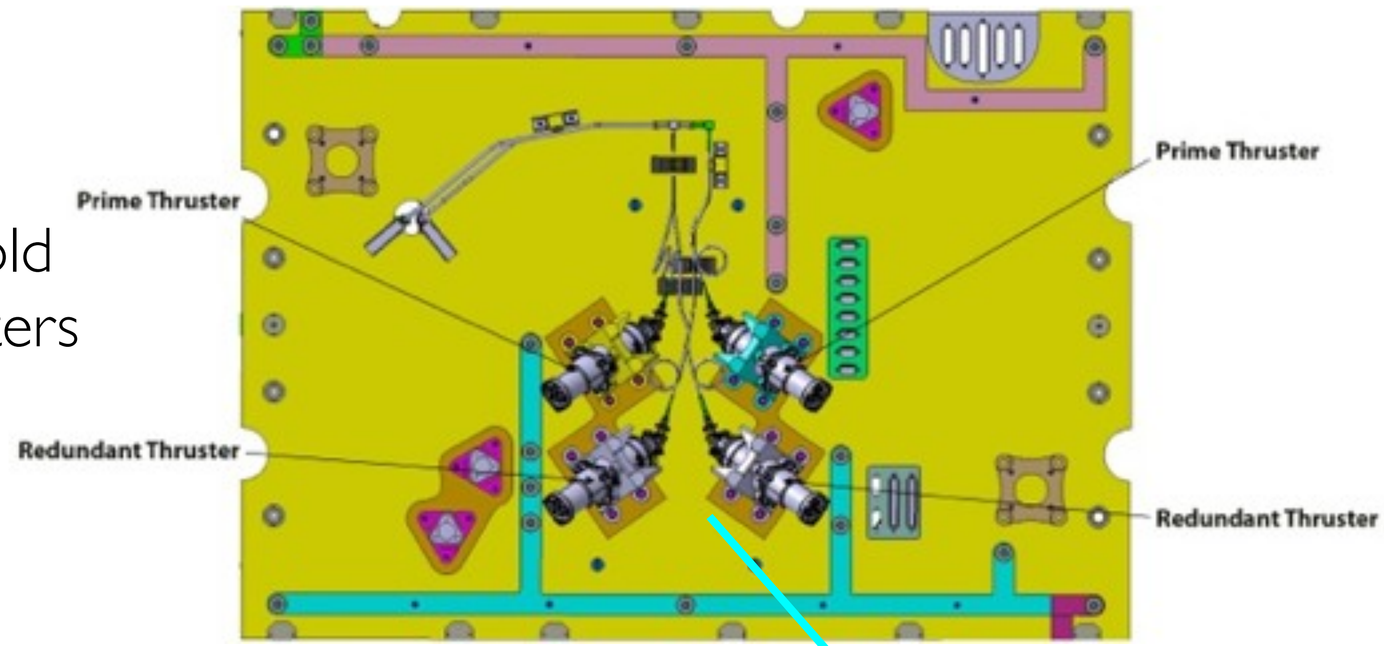
(Taken from Frédéric Safa's presentation to the GOAT) lisa pathfinder

Schedule unchanged for over a year



Final components to be integrated soon

GAIA cold gas thrusters



NASA colloidal thrusters (ST7)

LISA Pathfinder Launch: July 31, 2015

LISA Pathfinder Launch: July 31, 2015

LISA Pathfinder Launch: July 31, 2015

VEGA solid rocket from French Guyana - requires Kourou avoidance maneuver. Potential delay.

Key LISA technologies

Free flying test mass subject to very low parasitic forces:

- Drag free control of spacecraft (non-contacting spacecraft)
- Low noise microthruster to implement drag-free
- Large gaps, heavy masses with caging mechanism
- High stability electrical actuation on cross degrees of freedom
- Non contacting discharging of test-masses
- High thermo-mechanical stability of S/C
- Gravitational field cancellation

Precision interferometric, *local* ranging of test-mass and spacecraft:

- pm resolution ranging, sub-mrad alignments
- High stability monolithic optical assemblies

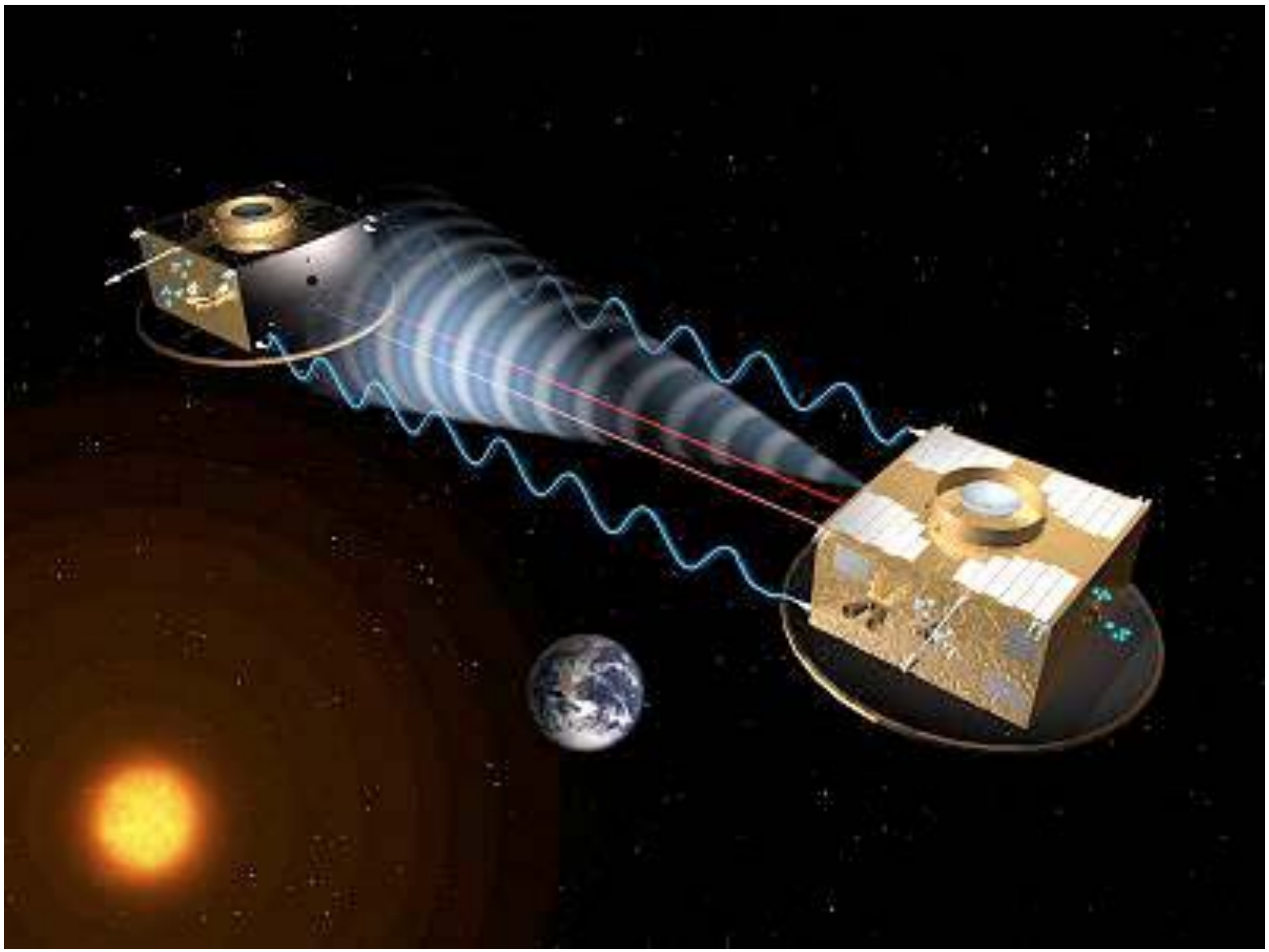
Precision 1 million km spacecraft to spacecraft ranging:

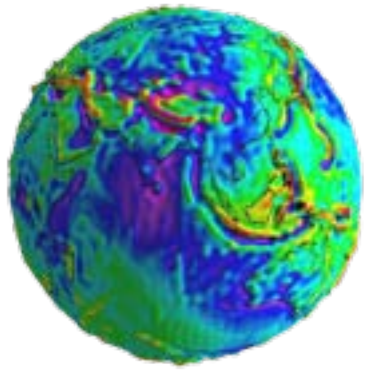
- High stability telescopes
- High accuracy phase-meter
- High accuracy frequency stabilization
- Constellation acquisition
- Precision attitude control of S/C

lisa pathfinder

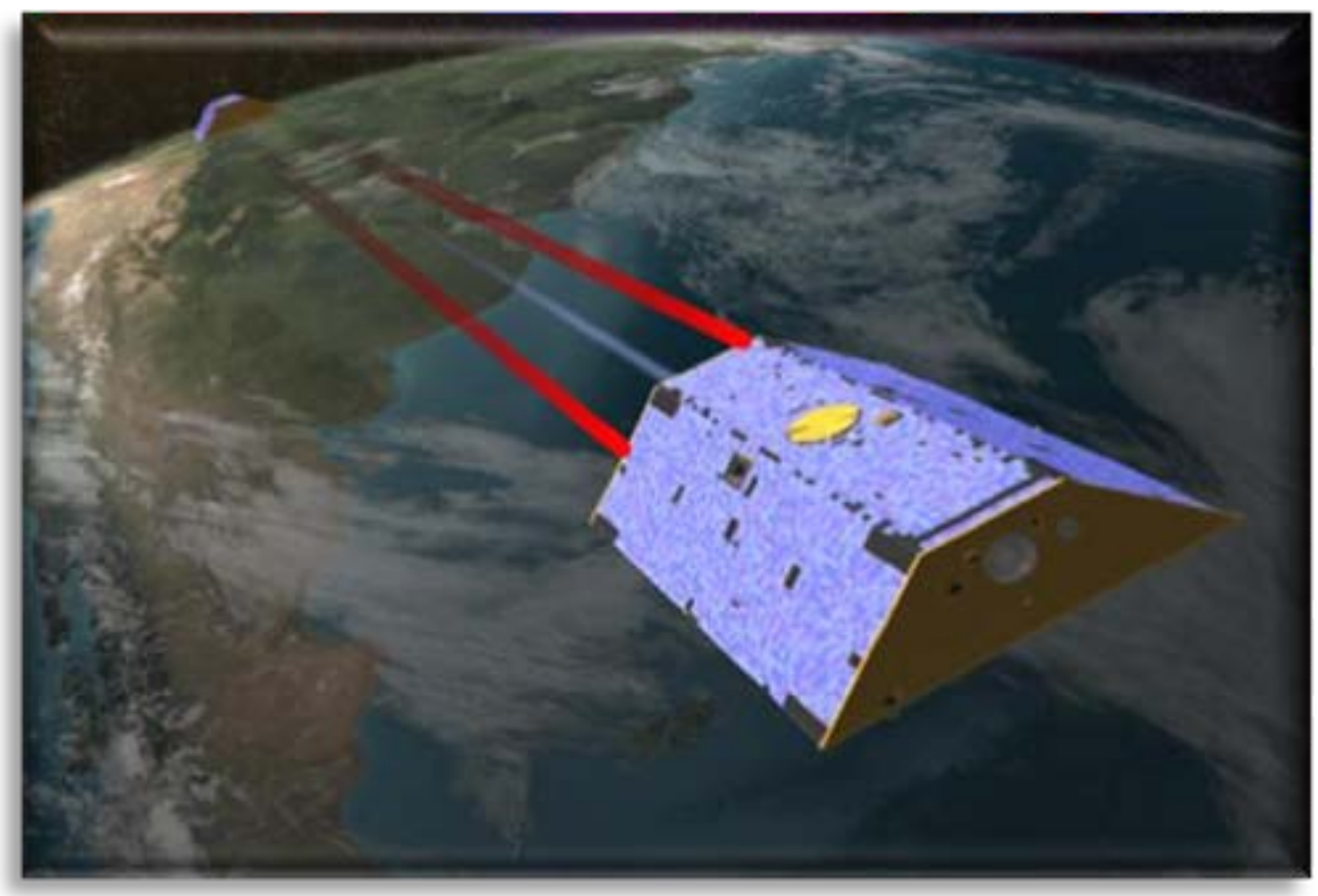
Elements in red tested by pathfinder

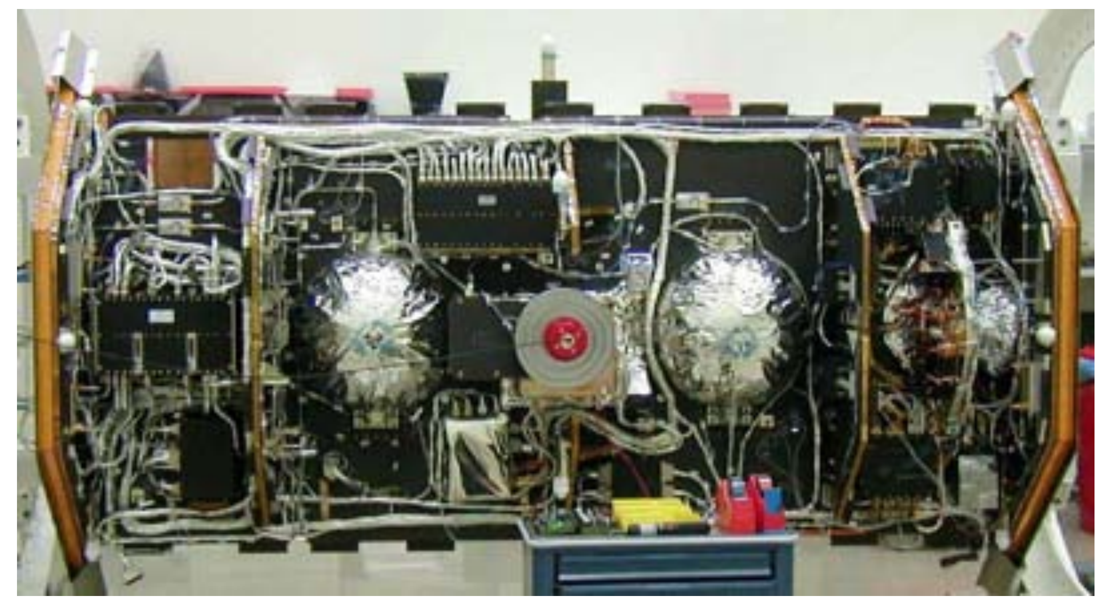
Original LISA/Darwin Pathfinder
SMART-2 2000

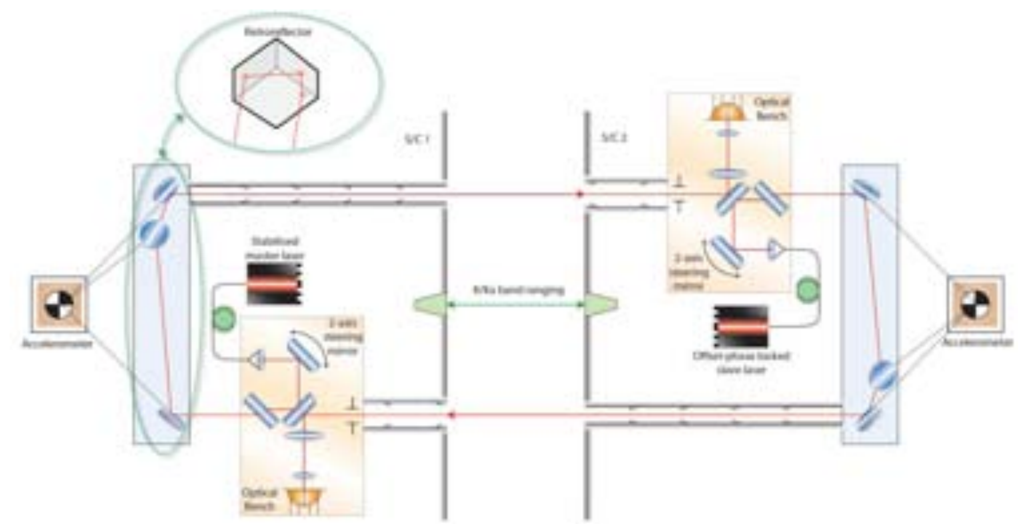




GRACE follow-on
(Launch August 2017)







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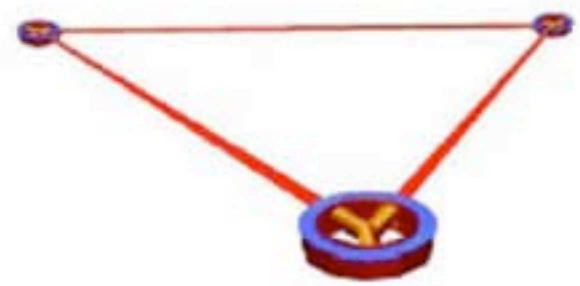
Elements in blue tested by GRACE follow-on

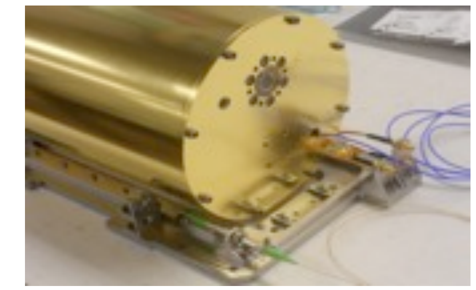
Intersatellite laser interferometers



	LISA	LRI on GFO
Inter-satellite distance	5 million km	170...270 km
Orbit	Heliocentric (1 a.u.)	Low Earth Orbit (400...500 km)
Orbit environment	No atmospheric drag, stable thermal environment	Atmospheric drag, large thermal disturbances
Attitude and Orbit Control System	Drag-free using µN thrusters	Attitude control with magnetotorquers & cold gas thrusters
Measurement band	**100 µHz – 1 Hz**	**200 µHz –100 mHz**
Measurement noise	12 pm/√Hz (× freq. dep.)	80 nm/√Hz (× freq. dep.)
Telescope aperture diameter	38 cm	≈1 cm
Transmit beam waist radius	17 cm	≈2 mm
Transmit power	1 W	≈20 mW
Effective received power (at photodetector)	**≈100 pW**	**≈100 pW**
Maximum relative L.O.S. velocity	±15 m/s	≤ ±3 m/s (depending on orbits)

LISA technology developments in US

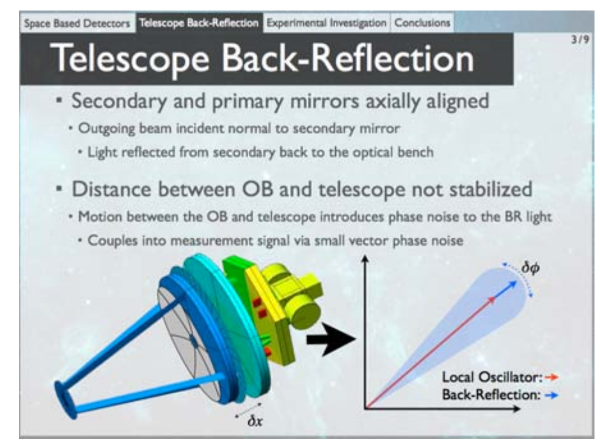
JPL - GRACE Follow on



- High accuracy phase-meter
- High accuracy frequency stabilization
- Constellation acquisition

UF -

- High stability telescope metrology
- Torsion pendulum for DRS studies



Goddard -

- High stability telescope
- High accuracy laser frequency stabilization

Stanford - LISA2020

- UV LED Charge control (flew June 20 2014 on a SAUDISAT)