Perspectives of gravitational-wave research at APC

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International network of GW interferometers (frequency band $\sim 10\text{–}10^3$ Hz)

LIGO at Livingston (Lousiana) $\Rightarrow$

$\Leftarrow$ LIGO at Hanford (Washington State)

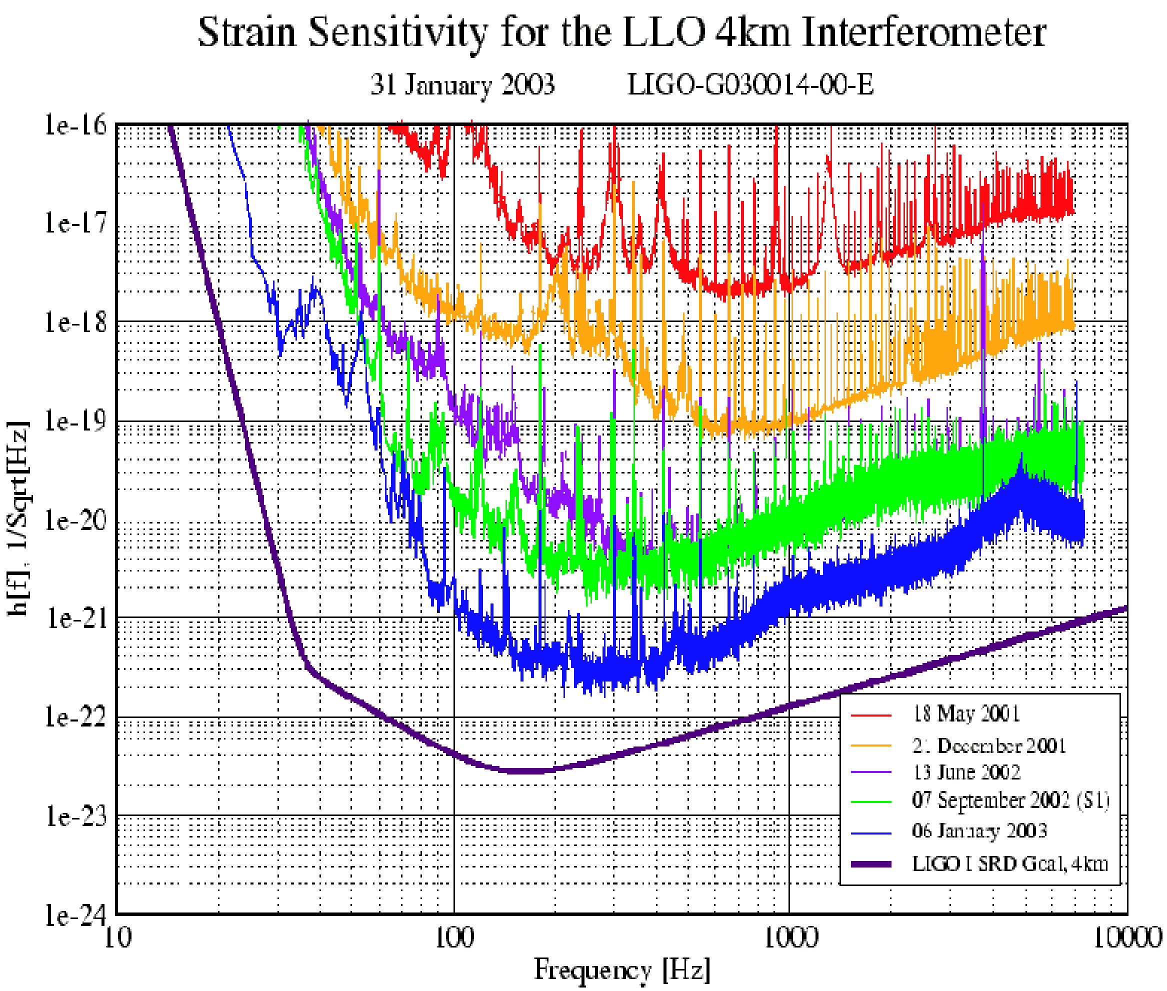
VIRGO (France-Italy) $\Rightarrow$

First locking last night!

GEO 600 (UK-Germany)

TAMA 300 (Japan)

Sensitivity in time of LIGO in Louisiana



Short-term period: 2004-2008

- **All first-generation ground-based interferometers on-line taking data at design sensitivity**
- **Given the very uncertain theoretical predictions for event rates, at design sensitivity GWs** *might not* **be detected**
- **If so, best upper limits on GWs emitted by compact binaries, pulsars and primordial stochastic background**

- **Involvement in LIGO data analysis for inspiraling binaries thanks to ongoing collaborations with Caltech/Cardiff**

- **Interaction/collaboration with VIRGO community**
- **Collaborations with IAP, IHES and LUTH to compare analytical and numerical predictions**

- **Optimization of Advanced LIGO thanks to ongoing collaborations with Caltech/MIT**

- **Start involvement in LISA working groups**

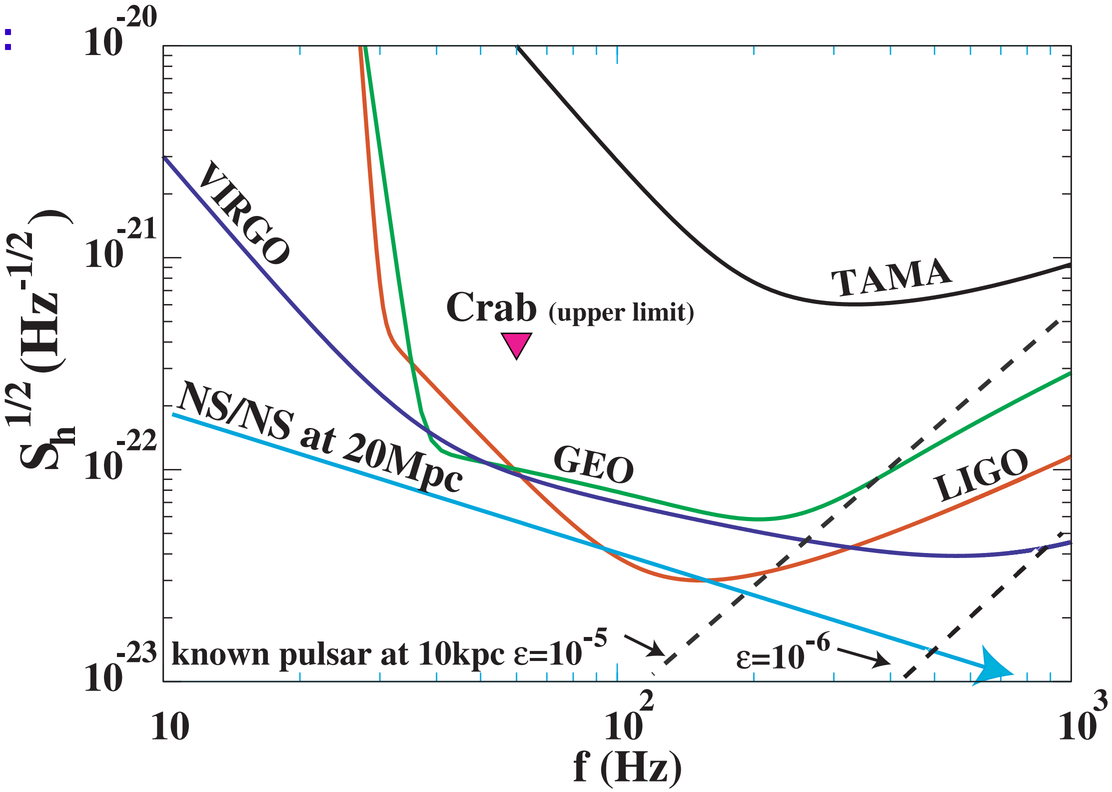
Sources for first generation detectors

- **Detection rate NS/NS at 20 Mpc:**

  up to 1 event per 1 or 2 years

- **Detection rate BH/BH (20 $M_\odot$) at** 100 **Mpc**

  up to 2 events per year

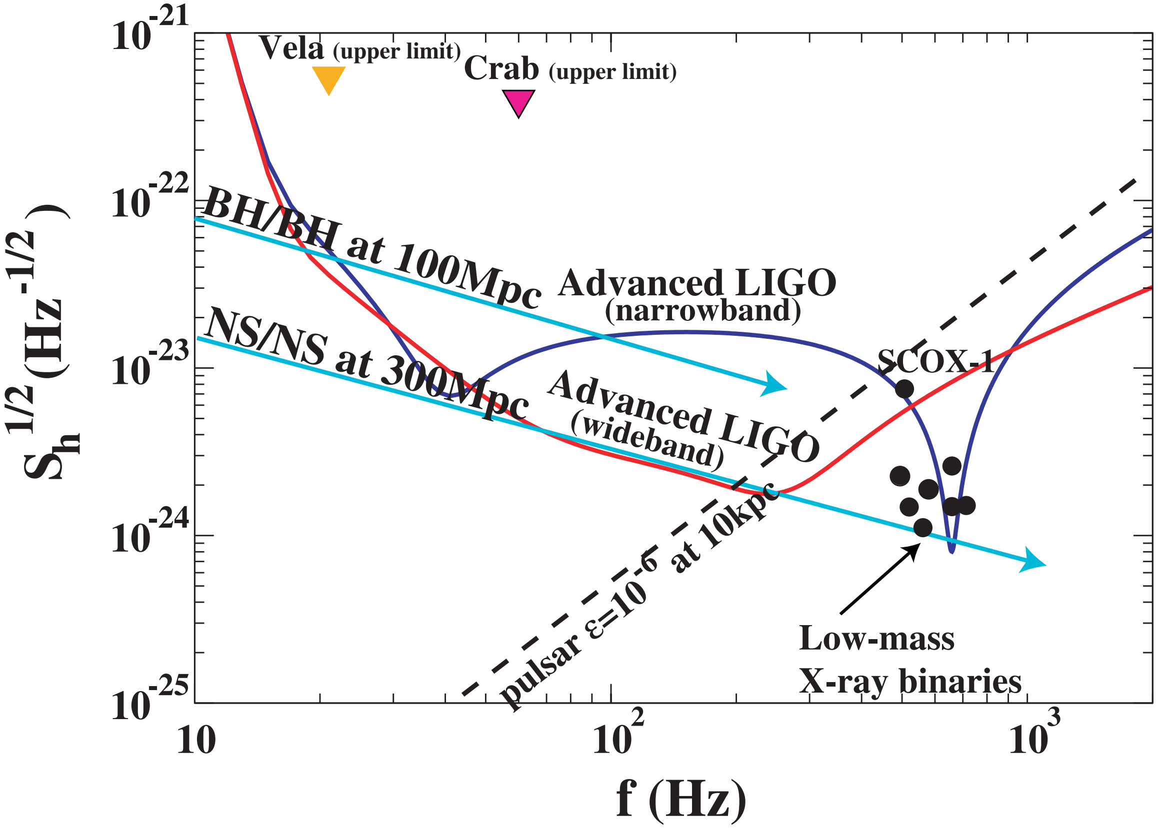


Sources for advanced detectors

- **Rate NS/NS at 300 Mpc:**
  1 - 800 per year

- **Rate BH/BH ($20 M_\odot$)at $z = 0.4$**
  $\lesssim 30 - 4000$ per year

- **Rate BH/NS at 650 Mpc:**
  $\lesssim 1 - 1500$ per year



Middle-term period: 2008-2012

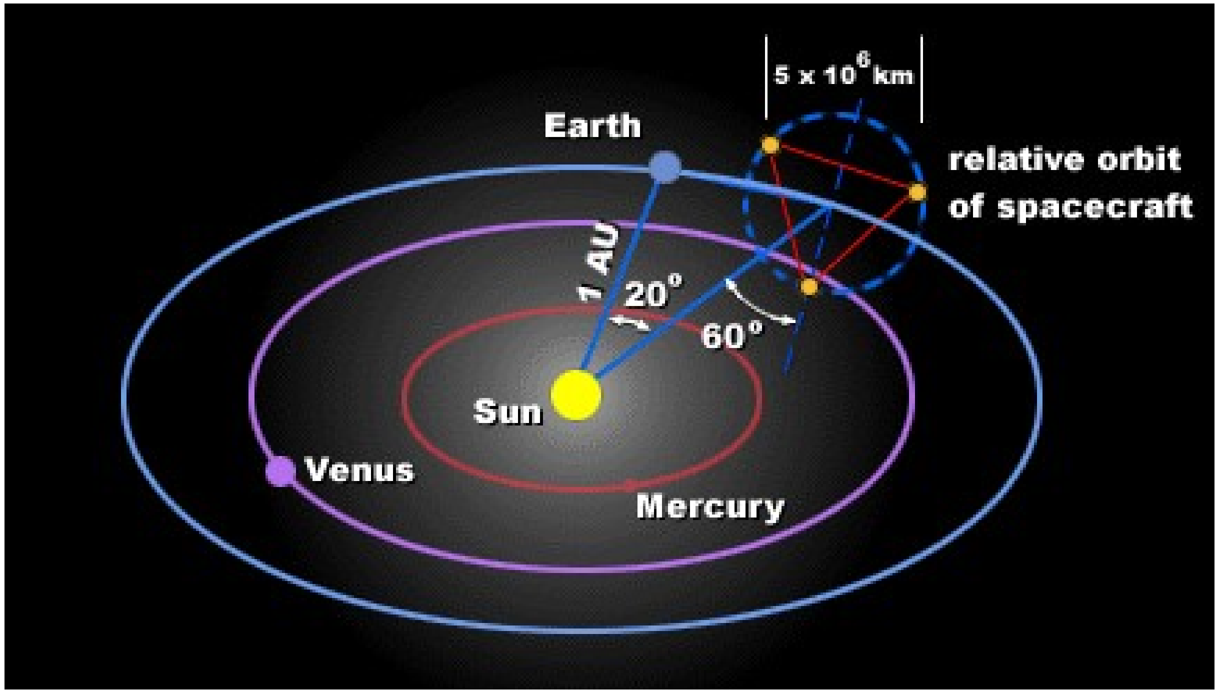
- Upgrade of LIGO (maybe of VIRGO?): design-sensitivity improvement by a factor ~ 10
- New sources (signals) will become observable (detectable) such as low-mass X-ray binaries, collapsars and fast pulsars (tidal disruption of NS by BH)
- Collaborations with IAP and LUTH, e.g., in building templates and extract information on nuclear equation of state of NS
- Development of new data-analysis techniques for those new sources

- Continuing the research and development of design/study for third-generation GW interferometers, such as LIGO-III and EURO, with Caltech/MIT and VIRGO-GEO

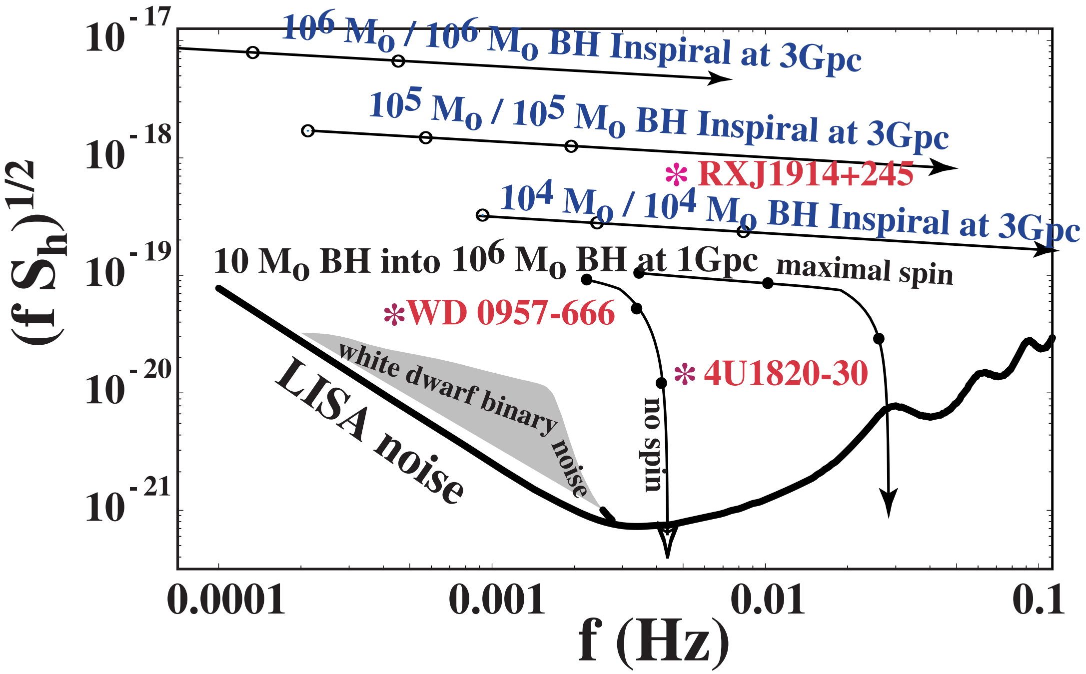
- Launch of LISA in 2012 (?)
- Involvement in preparing LISA data-analysis
- Collaborations with IAP, IHES, LUTH and Observatoire de Nice on various sources
- Coincidence astronomy between gravity-wave signals and electromagnetic signals such as γ-rays, γ-ray bursts, X-rays, and neutrinos

Laser Interferometer Space Antenna (frequency band: $10^{-4} - 0.1$ Hz)

ESA/NASA mission in 2012?



Sources for Laser Interferometer Space Antenna (LISA)



Long-term period: 2012-2016

- If at this time advanced ground-based detectors have reached their design sensitivity, GW will be observed
- Extraction of very rich information from various astrophysical sources

- Hopefully, those years will be marked by the third upgrade of GW interferometers LIGO-III and EURO, capable of observing BH-BH binaries up to redshift 1 or 2
- Coalescence of BH-BH binaries could occur daily and used as standard candles

- If LISA is launched and will reach design sensitivity, GWs from known galactic binaries will be observed
- Depending on event rates, GWs from extreme mass-ratio binaries and massive BHs will be observed as well. Map of BH spacetime
- R&D of follow-on LISA missions aimed at observing GWs from primordial Universe
- Tests of scalar-tensor theories; acceleration of the Universe; fundamental physics

Gravitational-wave research

Theoretical GW research in Paris:

– LUTH: Numerical relativity and GW sources

– IAP & IHES: Theory of relativity and GW sources

–**APC: GW phenomenology [data analysis (new techniques?), astro and primordial sources] and design/theoretical analysis of advanced GW detectors**

Strong relationships between LUTH, IAP, IHES and APC

Involvement of APC in LISA: data analysis and sources