ACOUSTIC gw DETECTORS IN THE 2011 TIMEFRAME:
a vision

- why
- where are we
- towards “advanced” acoustic detectors
- a “third kind” of gw detector:
  WIDEBAND “***DUAL***” RESONANT MASS SYSTEMS
- R&Ds

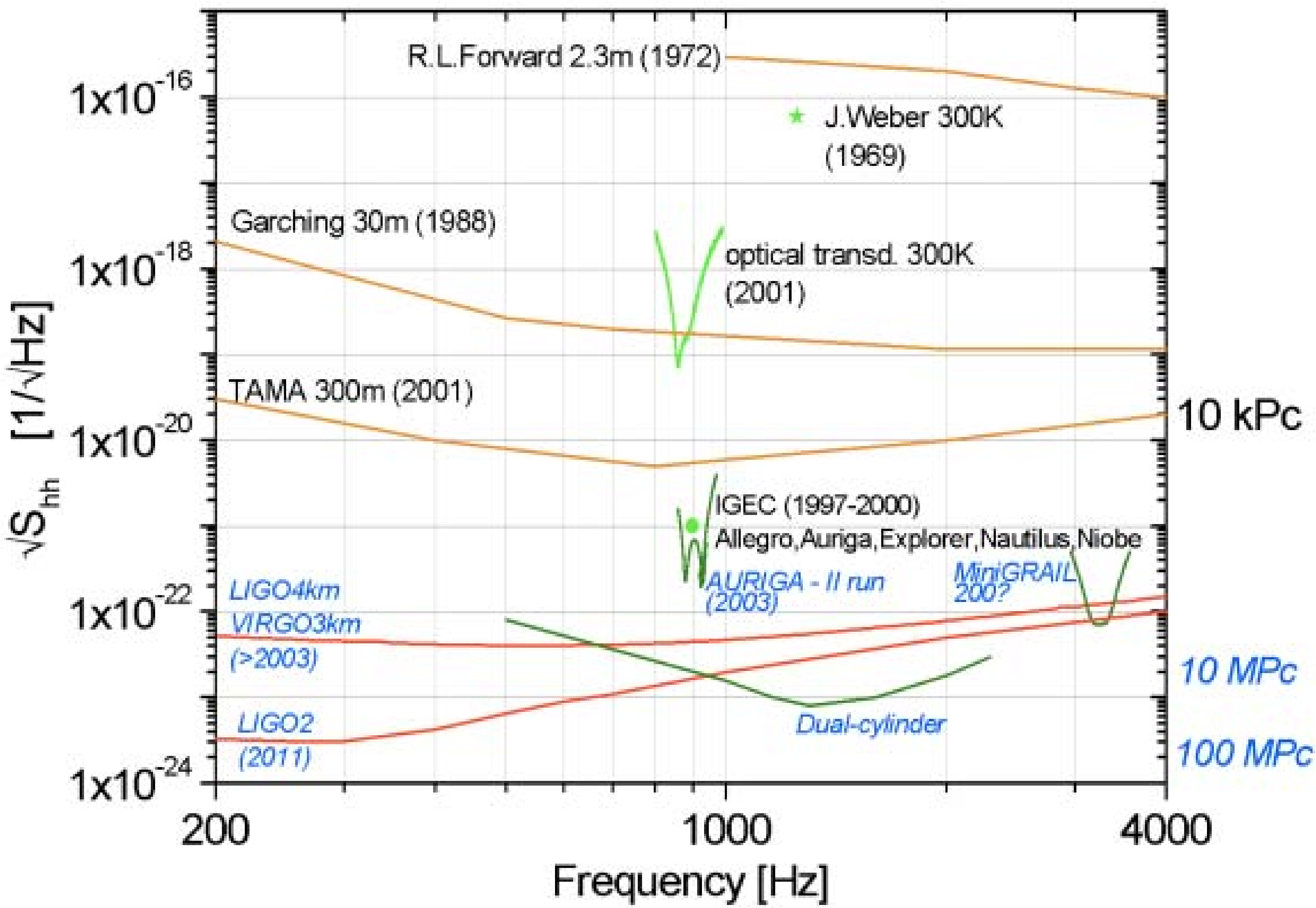
GW searches with “advanced” acoustic detectors

- potentially most sensitive @ kHz for long duration chirps, merging of **ns** and **bh**, ringdowns of **bh** and quasi-normal modes of **ns**, **Sn core** collapses, rotational instabilities of **ns**, shock waves in the fluid at the surface of rapidly rotating **ns**, **ns** “bar” instabilities and fragmentations

- correlations with interferometers for poor signature high frequency signals as bursts

- complement interferometrers in searches of inspiraling **bh-bh**, **bh-ns** and **ns-ns** binaries (“stellar” bh of M_{bh} ~ 3 – 10 solar masses)

- **stochastic background** @ kHz frequencies


R.L.Forward 2.3m (1972)
J.Weber 300K (1969)
Garching 30m (1988)
optical transd. 300K (2001)
TAMA 300m (2001)
10 kPc
IGEC (1997-2000)
Allegro,Auriga,Explorer,Nautilus,Niobe
AURIGA - II run (2003)
MiniGRAIL 200?
LIGO4km
VIRGO3km
(>2003)
10 MPc
Dual-cylinder
LIGO2
(2011)
100 MPc
1x10-16
1x10-18
1x10-20
1x10-22
1x10-24
√Shh [1/√Hz]
200
1000
4000
Frequency [Hz]

a “third kind” of gw detector

thermal and back action noise and signal

interferometers — “single” resonators
bars and spheres

“ ***far*** ” from — “ ***at*** ”
system resonant modes
wideband — *narrowband*

“dual” resonators

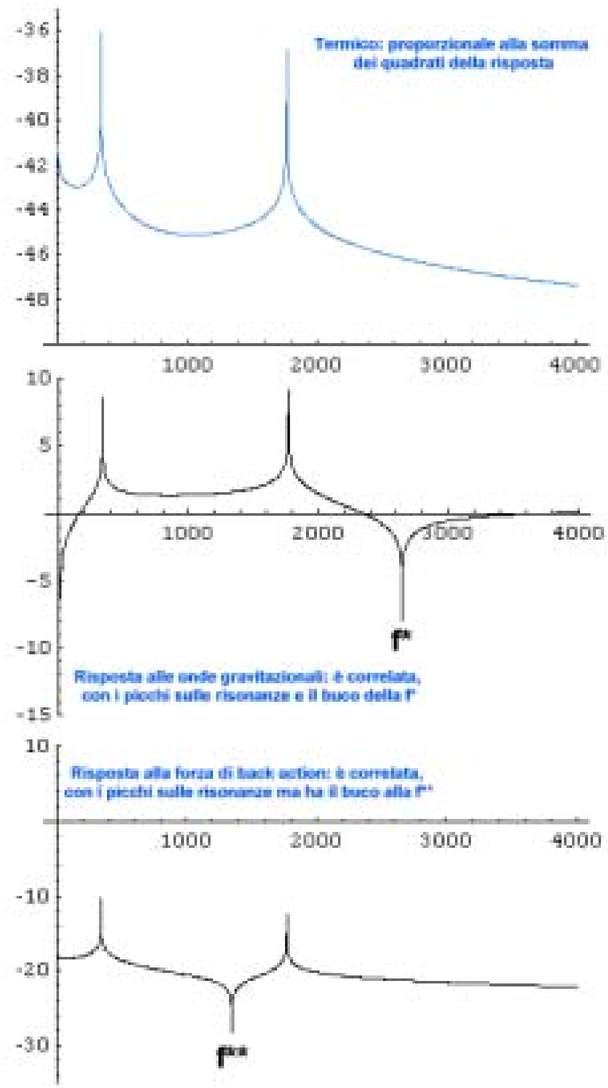
“ ***in between***”
gw sensitive system resonant modes
wideband

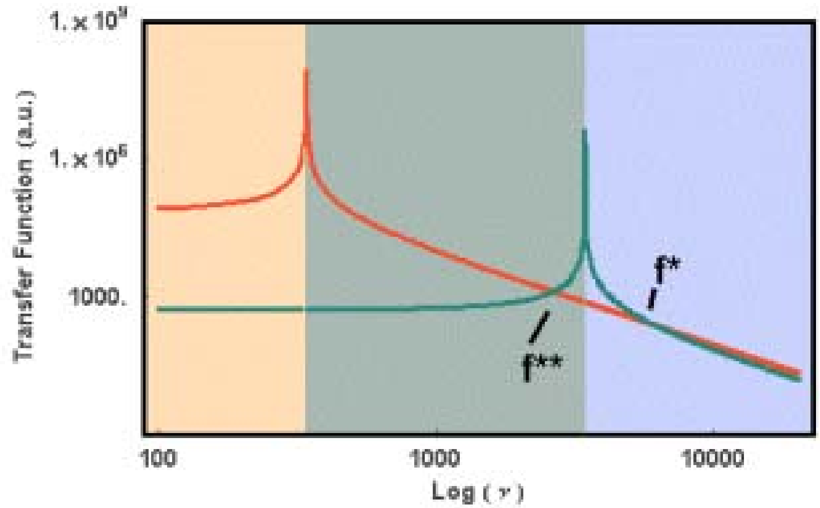
- “*additive*” effect on signal
- “*subtraction*” effect on back action

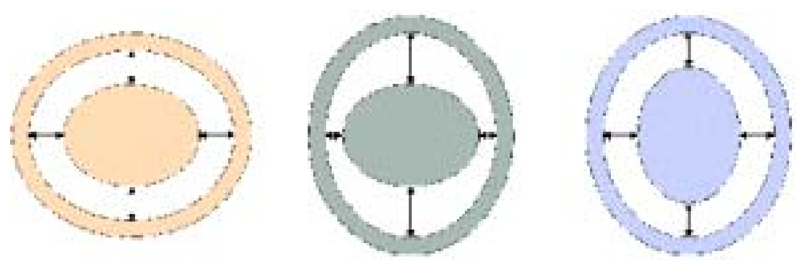
Massimo Cerdonio, Livia Conti et al PRL **87** (2001)
Michele Bonaldi (in preparation)

(of course use ***non***-resonant displacement transducers)

how a “dual” resonators works as a gw detector

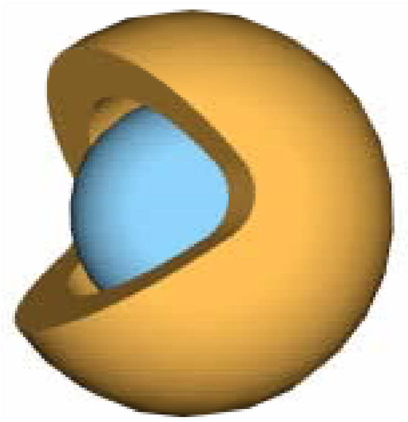






the "DUAL SPHERE "

Two nested spheres:



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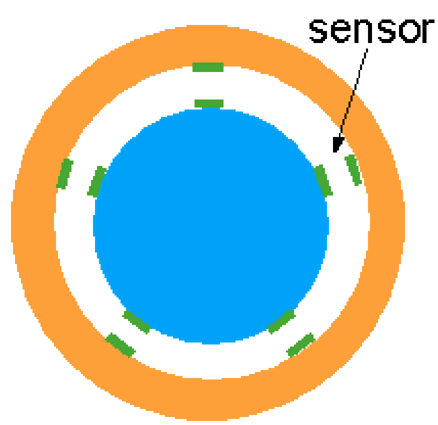
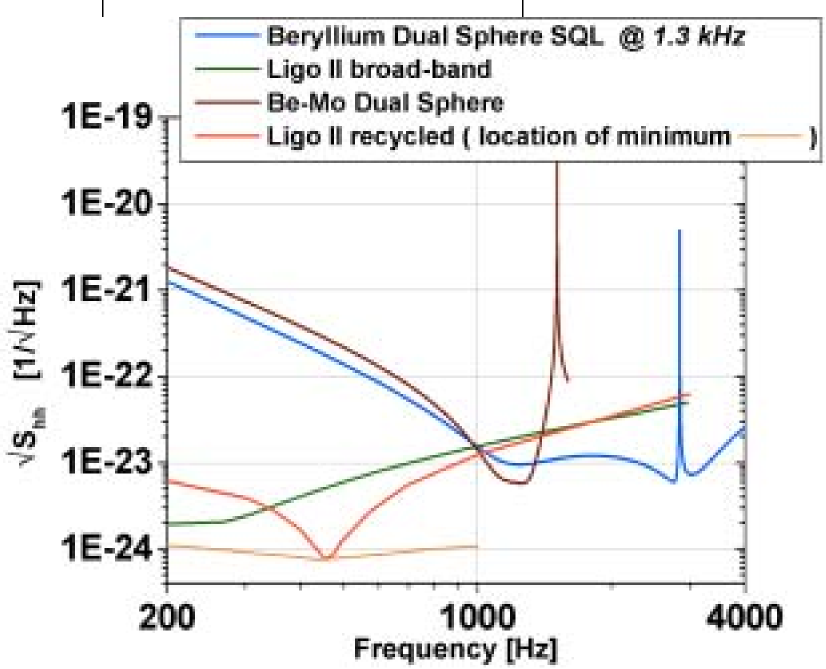


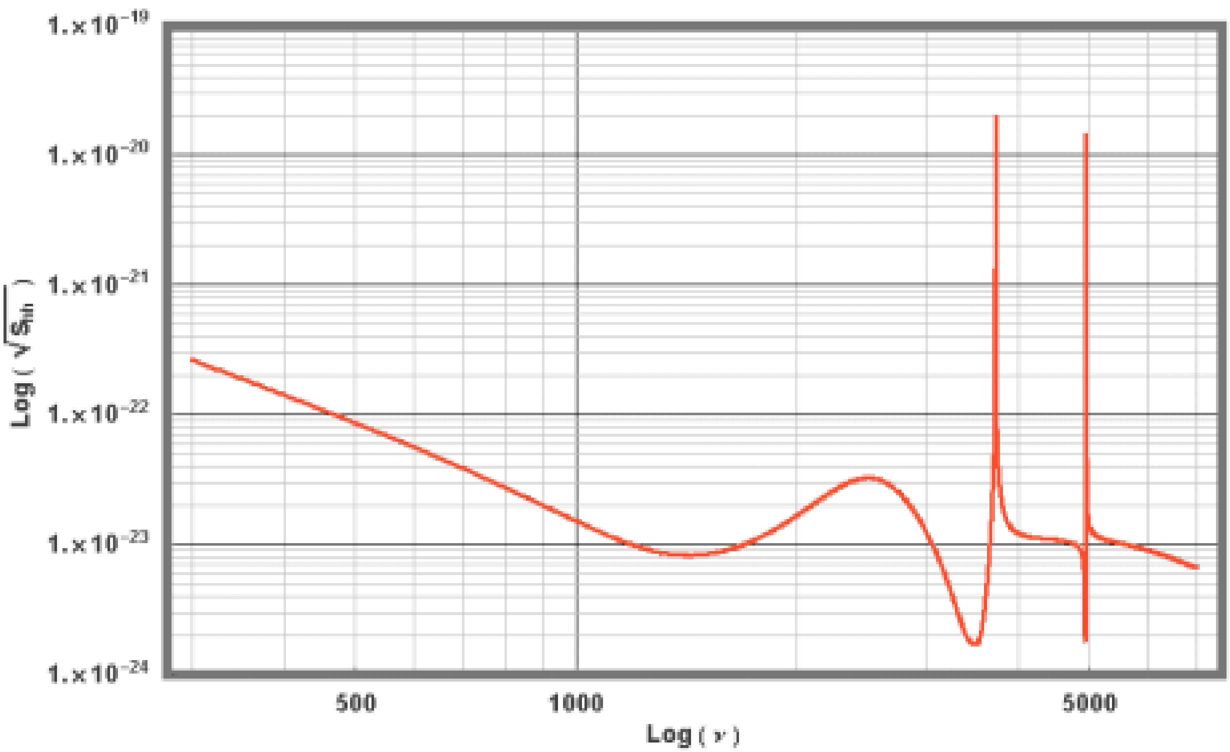
	Beryllium ext	Beryllium int	Beryllium- Molybdenum ext	Beryllium- Molybdenum int
diameter	*4.0 m*	*2.4 m*	*4.0 m*	*2.4 m*
mass	*52 ton*	*14 ton*	*52 ton*	*79 ton*
f (1st quadr.)	*1100 Hz*	*2900 Hz*	*1100 Hz*	*1300 Hz*
f (2nd quadr.)	*2800 Hz*	*4700 Hz*	*2800 Hz*	*2500 Hz*



a dual torus

Si C 2.5 m
external: 1.25 - 0.95 m 20 t 800 Hz
internal: 1.25 – 0.30 m 16 t 1900 Hz

no non-gw active modes “in between”
+ a “narrowband” sensitive region @ 3500 Hz
need further understanding of configurations…



CURRENT ACTIVITIES

INFN Legnaro Natl.Lab., INFN Sections and Dept. Physics of Padua+Trento, Florence, Ferrara, Dept.Physics Barcelona, Kastler-Brossel Lab. ENS-CNRS

- studies of "dual" configurations
  dual sphere and dual torus of
  Mo, Be, Be-Mo, SiC, C/SiC,…
- screening of candidate materials (as above)
  - mechanical quality factor $Q>10^6$ at low T
  - low temperature thermal properties
  - fabrication
  - high cross section (ρv_s^5)
- evaluate operation underground
- FEM studies of suspensions
- FEM studies of dissipation and thermal noise in the sensitive resonant mass
- thermal noise and "quantum limits" in the read-out
  - optical transducers
  - capacitive + SQUID transducers
- apply for funding for an aggressive R&d on the above
  - to Italian Ministry of Research (done)
  - to European Community (announced through APPEC)
  - to INFN (done)
  - to EGO (in preparation)