Status report of the gravitational wave detector **AURIGA**

J.P. Zendri*

For the Auriga Collaboration

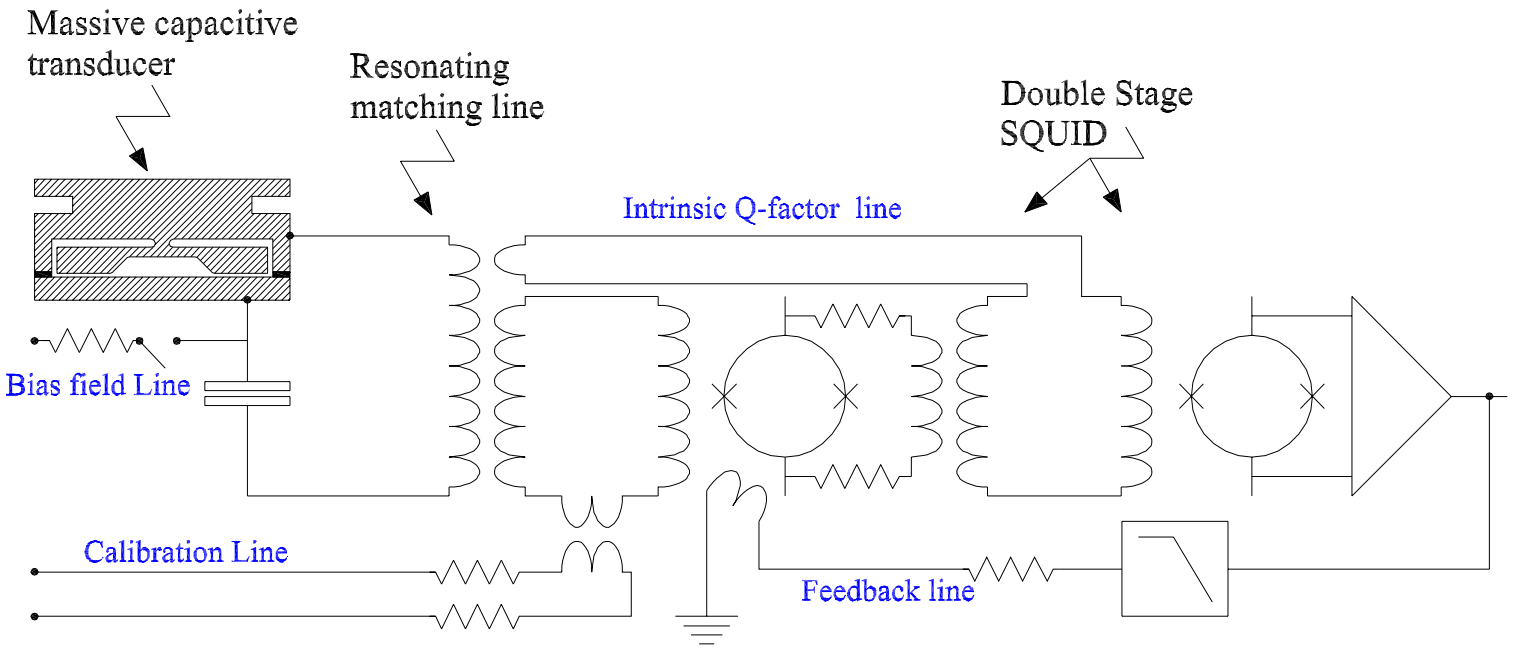
I.N.F.N. Padova Section, Via Marzolo 8, 35010 Padova, Italy,
Zendri@lnl.infn.it

Next Auriga run

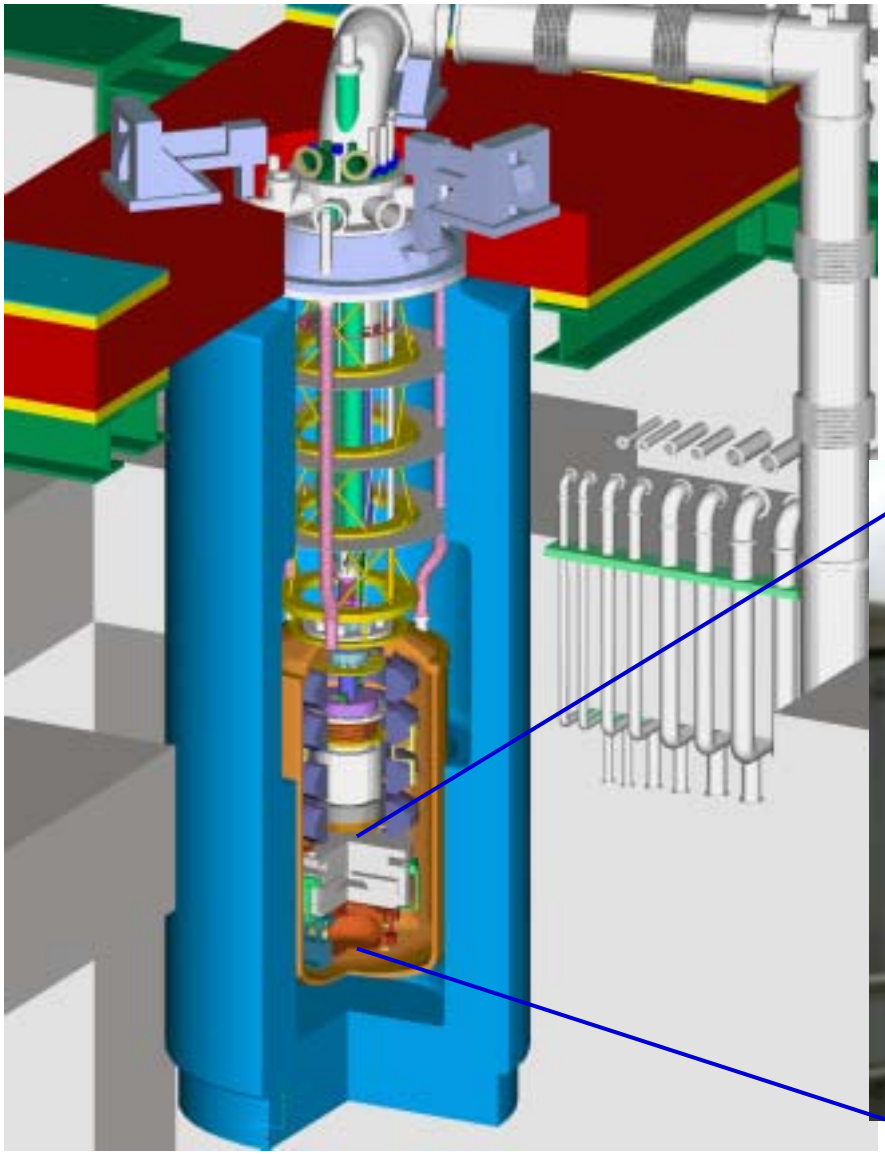
1. More sensitive readout
2. New cryogenic suspensions
3. Simplified cryogenics
4. New DAQ system and data analysis

1.The new readout

Scheme

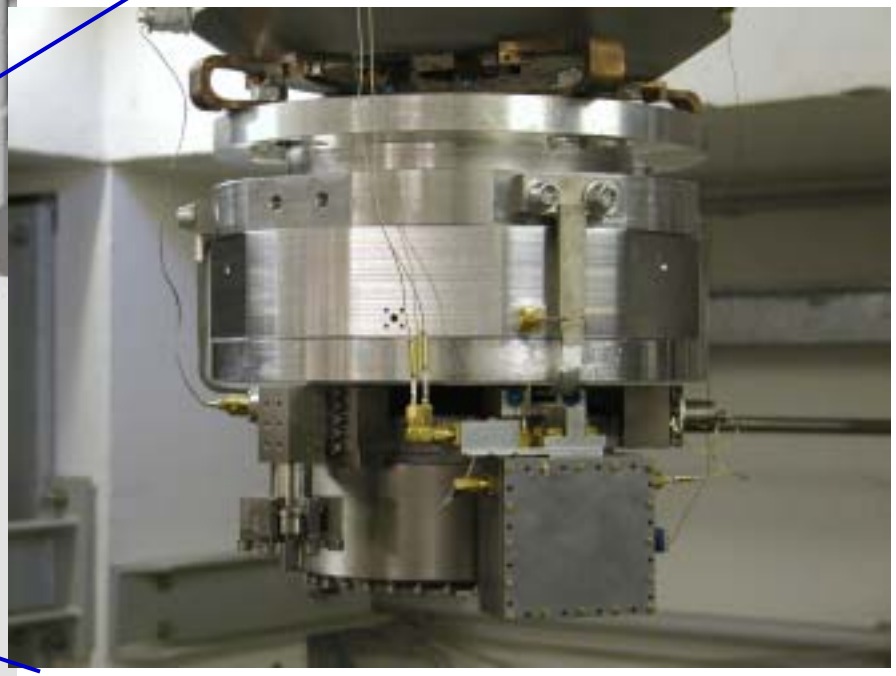


1. The new readout



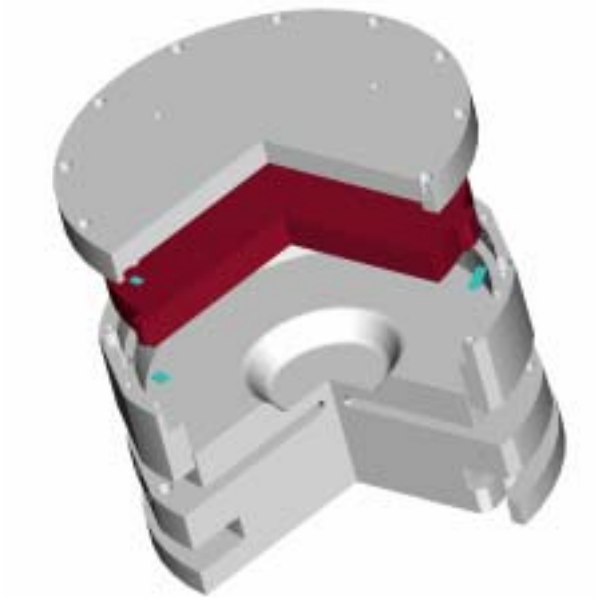
Transducer Test Facility

- Cryogenic suspensions 180 db @ 1KHz
- Dilution refrigerator
- Fast thermal cycle (few days)



1.The new readout:results

Separated $(\nu_{el} \neq \nu_{mec})$ modes: Transducer thermal noise



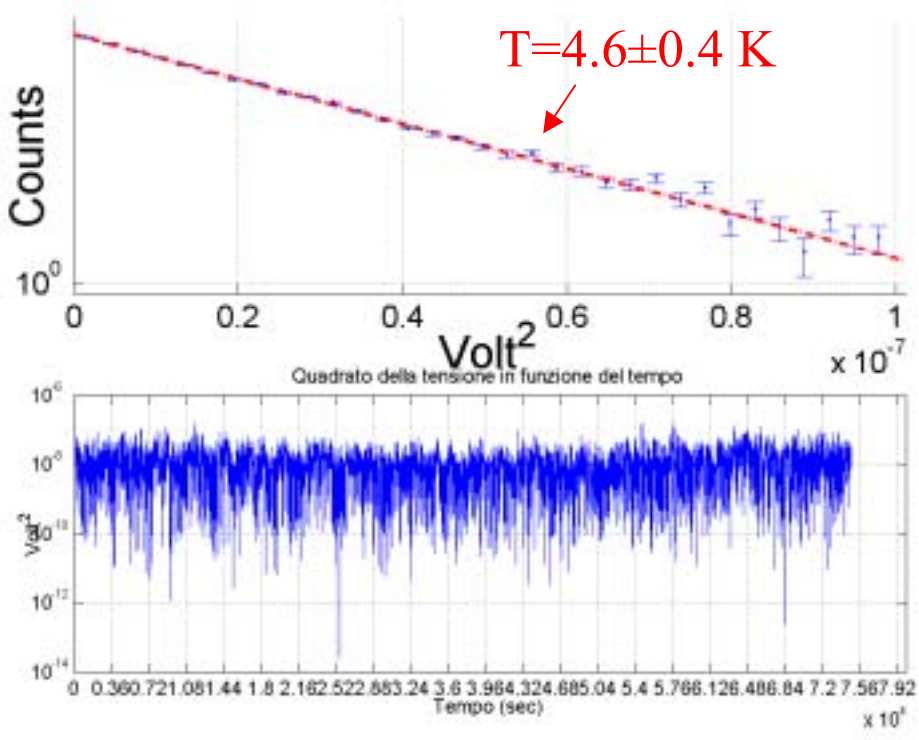
$\nu_{mec} = 938.18 \quad Hz$

$Q_{mec} = 1.1 \times 10^6 \quad m_{Tr} = 3.8\ Kg$

$\nu_{el} = 1168.6 \quad Hz$

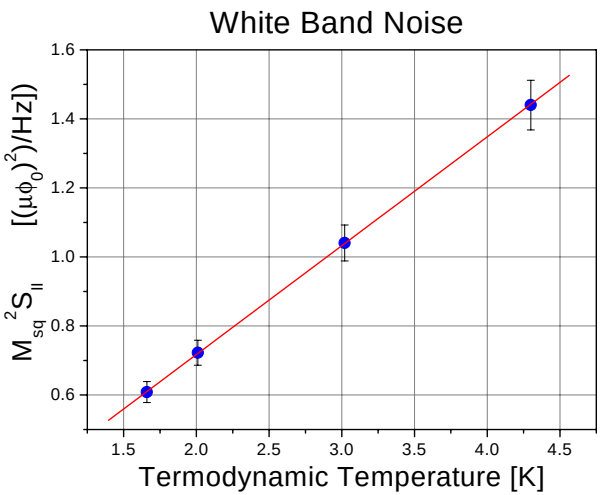
$Q_{el} = 0.4 \times 10^6$

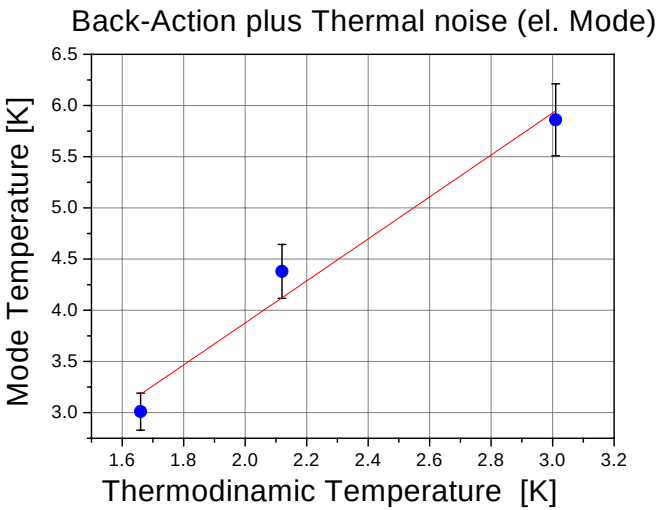
Measures at 4.2 K



1.The new readout

Separated $(\nu_{el} \neq \nu_{mec})$ modes:
amplifier W.B. noise and LC thermal noise



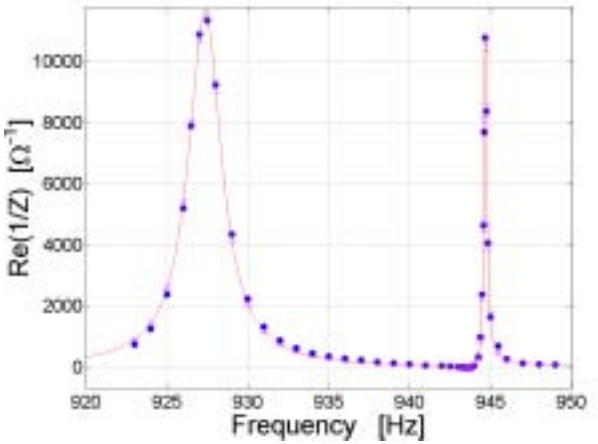


Measured Energy Sensitivity at 1.5 K $20\ \mu K$ $(\Delta E/\hbar\omega_{el}=350)$

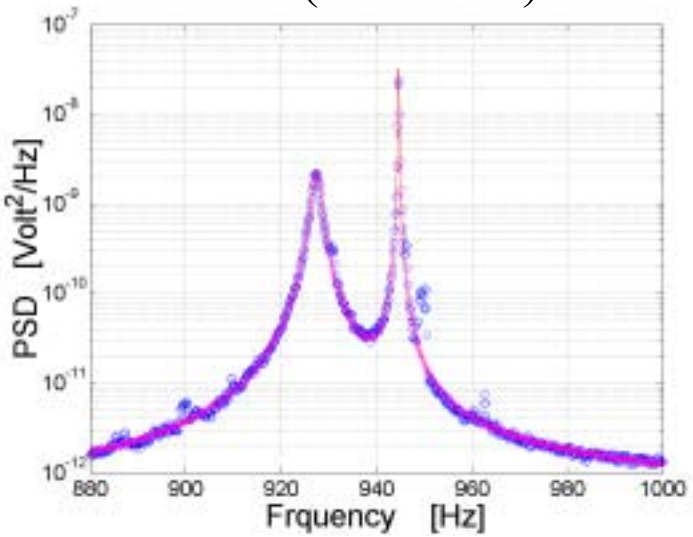
1.The new readout

Tuned modes: noise measurements

$\Re e\left\{\frac{1}{Z(\omega)}\right\}$ (measured)



PSD (measured)

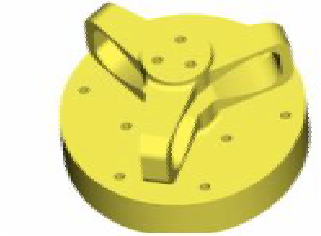


Fitting function: $2\,k_B T\,\Re e\left\{\frac{1}{Z(\omega)}\right\}$

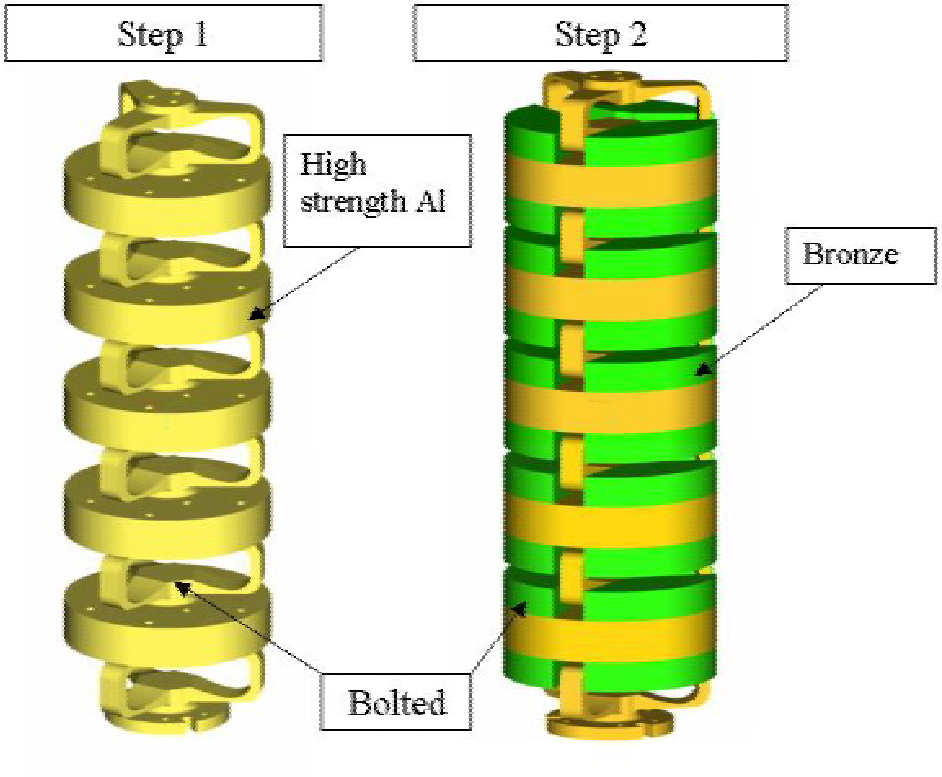
$T = 4.2 \pm 0.2\ K$

2.The new cryogenic suspensions

Single monolithic part

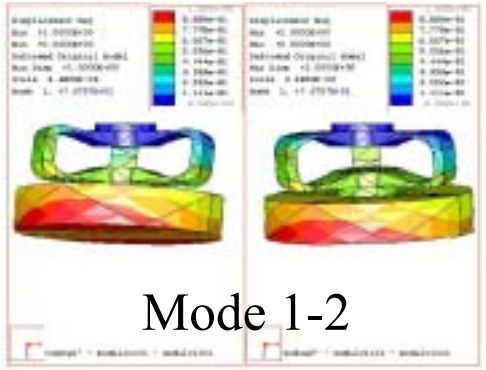


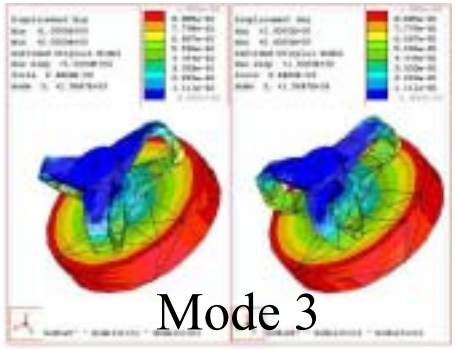
Prototipe

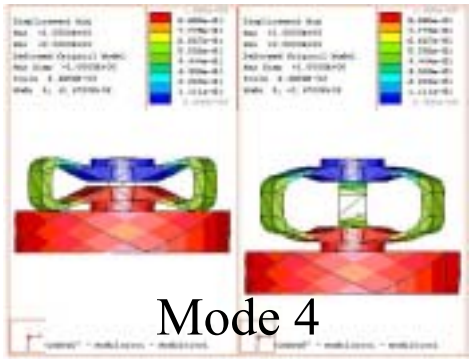


Diameter :250 mm	High 780 mm
Total weight 140 kg	Predicted attenuation at 1kHz (0.7 ton loaded): 240dB

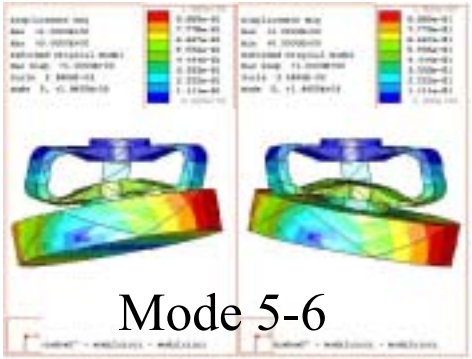
2.The new cryogenic suspensions

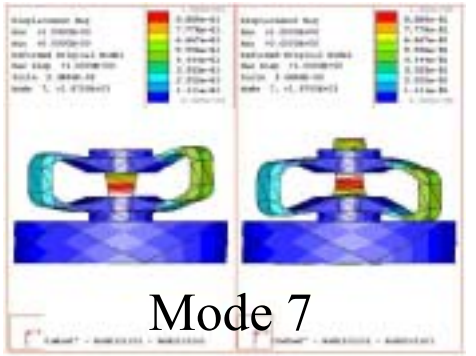






Mode Number	FEM predict [Hz]	FEM accuracy [%]	Measured [Hz]	FEM pred. brass [Hz]	FEM accuracy [%]	Measured [Hz]
1	74.8	4.3	69.4	38.4	4.5	38.8
2	74.9	4.9	69.4	38.6	5.2	40.0
3	149.4	4.0	140.0	74.6	4.1	74.2
4	168.3	1.9	160.6	86.1	2.7	82.5
5.	185.7	3.2	190.0	86.5	1.8	86.9
6.	186.0	3.2	190.1	86.6	3.2	87.7
7.	1796.0	2.1	1820.	1852.0	2.5	1815.0



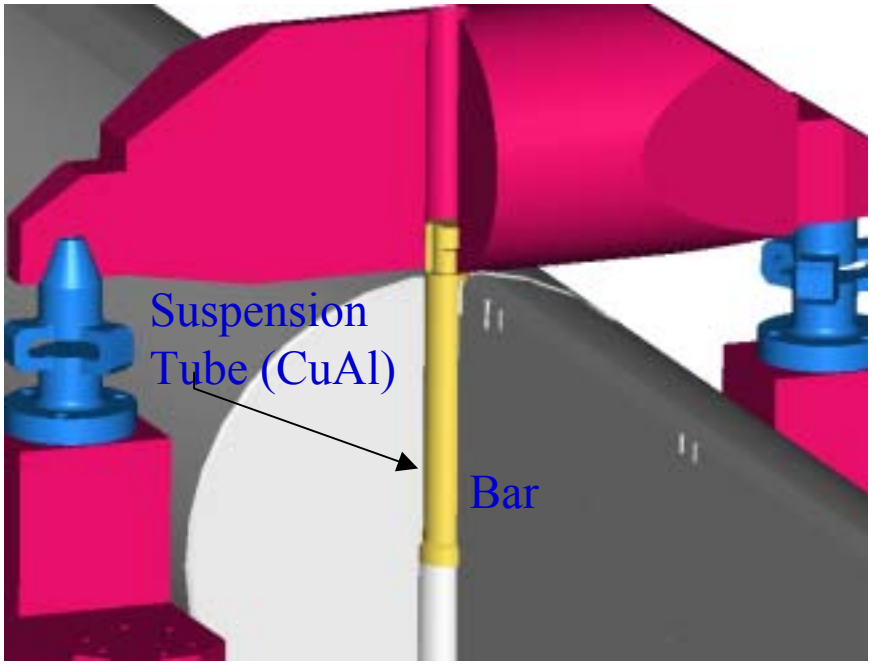


2. The new cryogenic suspension

Last suspension stage

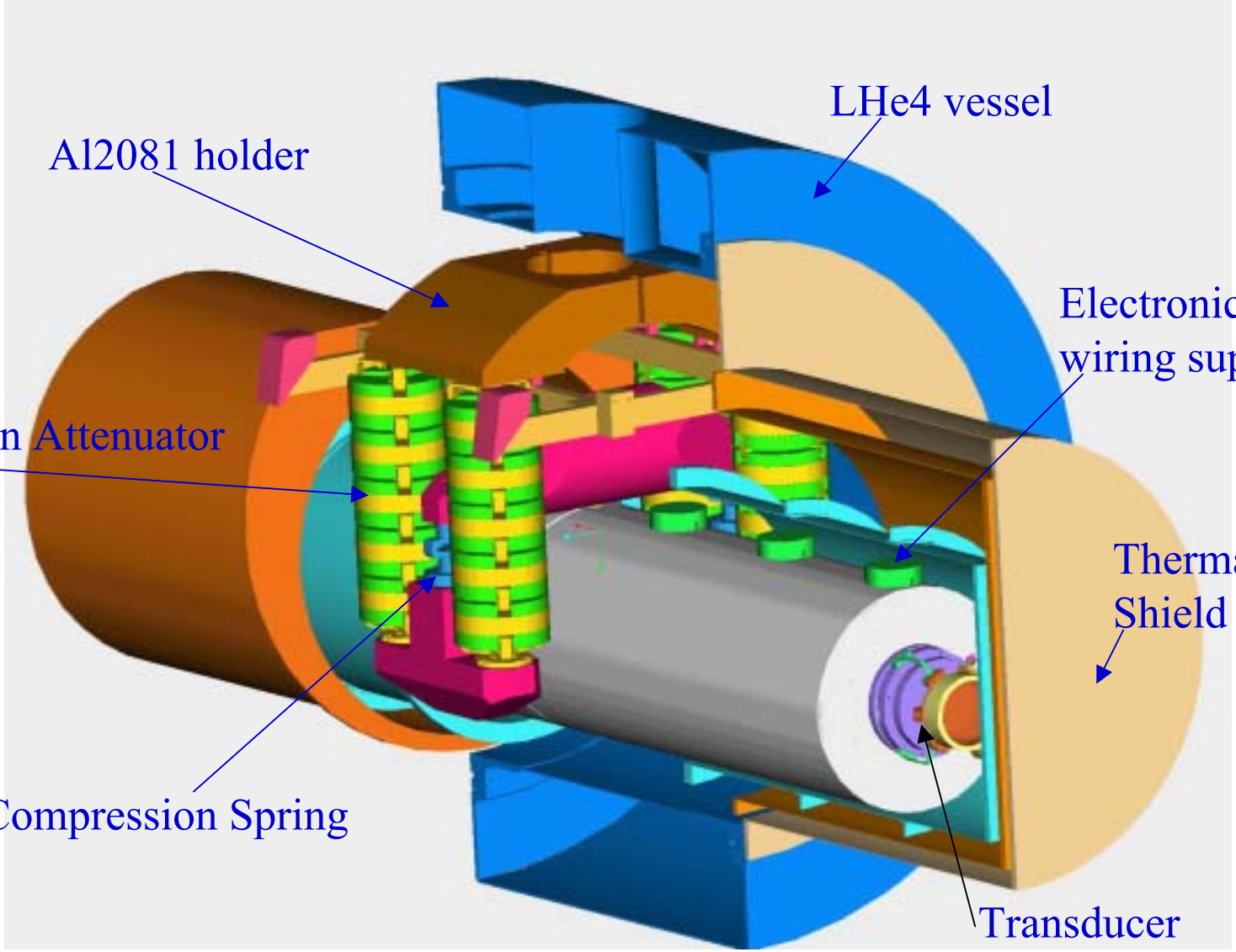
Old Set-up

New configuration



- Geometric attenuation gain 10 db
- First violin 1300 Hz
- First longitudinal 200 Hz

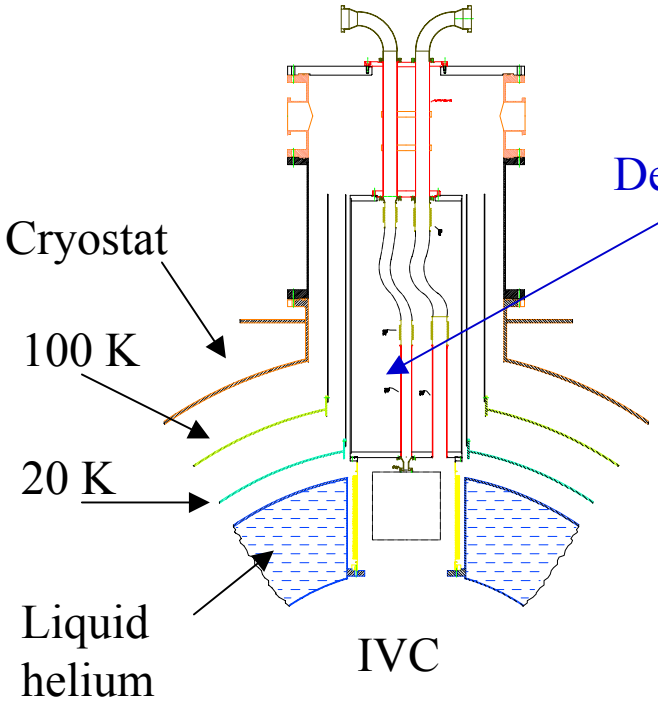
2. The new cryogenic suspension



2. The new cryogenic suspensions

Present Status

3. The new cryogenics



A new 100 liters LHe4 dewar is installed

For the next Auriga run the detector temperature will be 1.5 K

- Stable cryogenic temperature
- Time to solve 1K-pot problem

In the next run this dewar will hold the cold part of the dilution refrigerator

4. New DAQ & data analysis

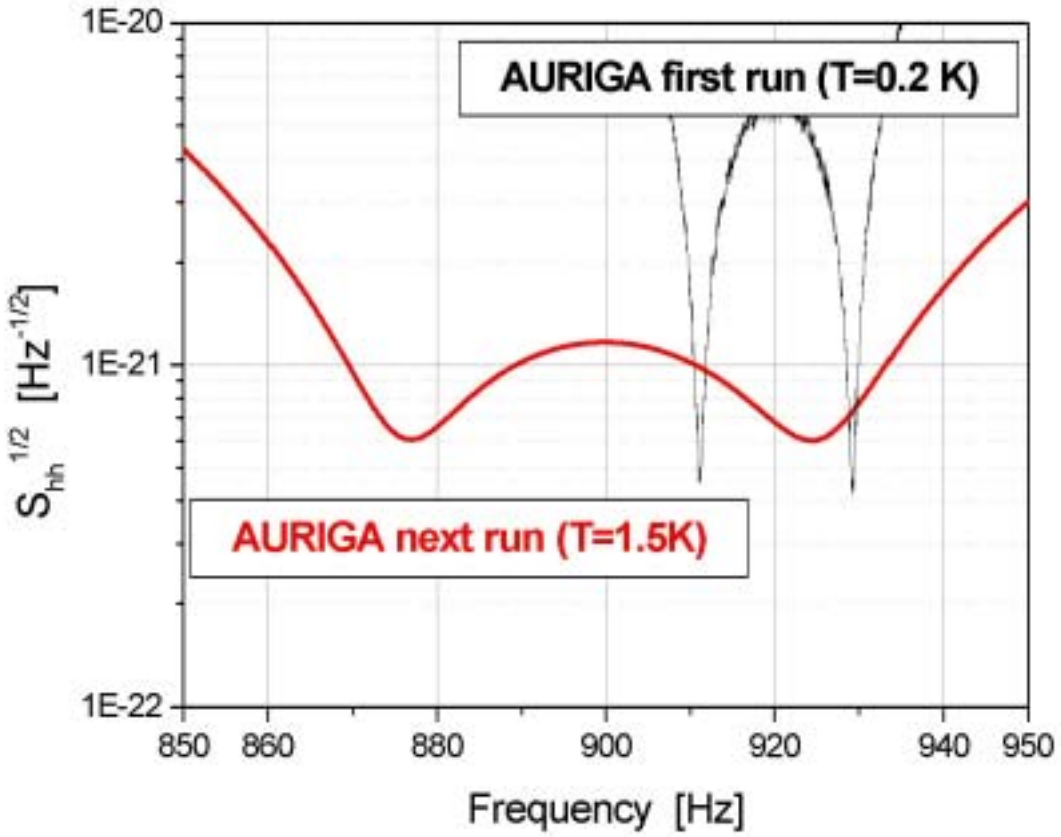
DAQ (CHEP03 at www-conf.slac.standford.edu)

- Same Front-end
- Linux, C++
- Frame format

Data analysis

- Optimized for the incremented bandwidth
- Frame format
- Burst
- More general templates (less then few seconds)

Predicted noise curve for the next AURIGA run



For impulsive signal:

$$H_{min}(\omega) = 6\times10^{-23} \quad Hz^{-1}$$

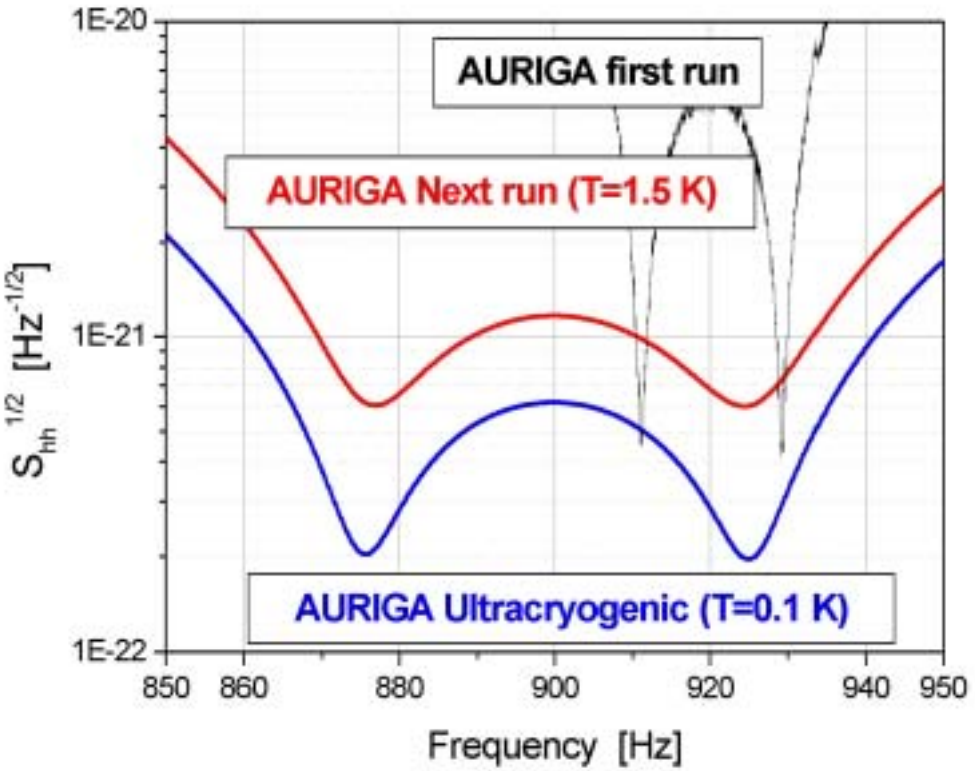
$$\varepsilon = 1500\,\hbar$$

For a ms pulse:

$$h_{min} = 1.2\times10^{-19}$$

Near future improvements

Auriga Ultracryogenic



Preliminary results

•At 0.2 K the SQUID noise is 35 ħ (P.Falferi this conf.)

Still Open Questions:

•Is the LC resonator thermal at 0.1 K?

•Are we able to reduce the disturbances of the 1K pot vibrations?

Conclusions

1. The resonant detector of gravitational wave AURIGA is about to start its second run
2. Compared to the previous run the sensitivity and the bandwidth should be increased of at least one order of magnitude
3. The up-graded detector has been designed to maximize the observation duty cycle and to reduce as much as possible the non gaussian noise which strongly affected the G.W. detectors sensitivity