



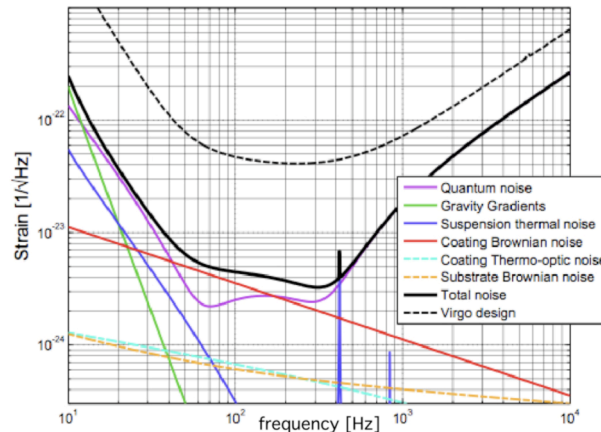
SUMMARY OF THE ADVANCED VIRGO PROJECT

The scientific merit

Interferometric gravitational wave (GW) detectors of the first generation have successfully completed their first long-duration data taking runs. Upgrades exploiting available technology and allowing to enhance the accessible volume of universe by about a factor 10 (Virgo+, Enhanced LIGO), are currently performed. However, it will be the second generation of gravitational wave detectors that will give us the chance to open an exciting new window on the universe. Advanced Virgo will be able to scan a 1000 times larger volume of the Universe than initial Virgo. Even though it will be hosted in the same infrastructures as Virgo, the Advanced Virgo sensitivity will be better by one order of magnitude over most of the detection band. The Advanced VIRGO project will be carried on in parallel to the equivalent Advanced LIGO project already approved by NSF. The world-wide network of GW antennas will permit to localize sources and identify the dynamics of their inner core.

The scientific goal of the project is expressed in terms of the spectral strain sensitivity of the interferometer as it is reported in the figure where the contributions of the detector thermal noise are shown also. This curve is the result of an optimization processes aimed to maximize the sight distance for coalescent events of Binary Neutron Stars (BNS) and Binary Black Holes (BBH), 149 Mpc for BNS and 753 Mpc for BBH.

Although the event rate changes significantly with the models, a realistic assumption for the expected rate is ~ 2 events/year for BNS and ~ 20 events/year for BBH.



Main project milestones

- July 2009 Project start
- July 2011 Shutdown of Virgo+ for Advanced Virgo installation
- Dec. 2013 Finish of assembly and integration
- July 2014 First one-hour long continuously controlled operation (“lock”)

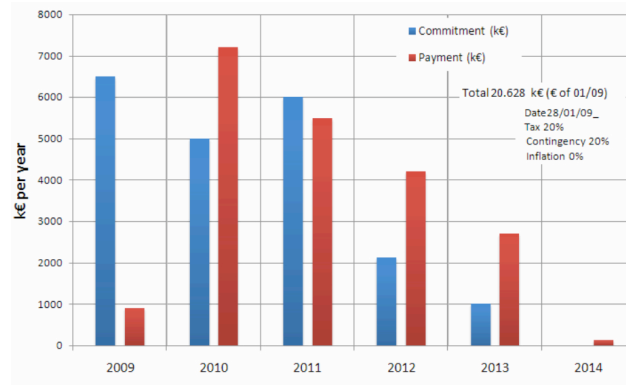
Project Cost

The project cost will be shared at the same financial level by the INFN-Italy and CNRS-France. The negotiation concerning the financial contribution of the laboratory of Nikhef-Nederland is in progress.

All costs of the project sub-systems have been reviewed recently (see VIR-002A-09). They include 20% VAT and the contingency whose mean value is 20% .

The total cost is expected to be about 20.6M€.

The following graph show the commitment and spending profile for the Advanced Virgo construction and installation phase.



Infrastructure impact and manpower

The EGO consortium will support the main infrastructure impact. CNRS laboratories (LAL-Orsay, LAPP-Annecy , OBA-Nice, LMA-Lyon, EPCSI-Paris, APC-Paris) and Nikhef-Nederland are full involved in the collaboration effort.

Manpower support is expected also by groups at university of Birmingham – UK, in Poland (Warsaw Academy of Science and university of Warsaw) and Hungary (Eotvos Institut of Budapest). Negotiation is in progress also with the Max-Planck Institut of Hannover to insure their support for the installation of the new laser system.

Concerning INFN, 8 Sections will support the Advanced Virgo project (Firenze/Urbino, Genova, Napoli, Padova/Trento, Perugia, Pisa, Roma1, Roma2). At present 76 physicists and engineers for a total amount of 55 INFN – full Time Equivalent are members of the collaboration. In the following we show the diagram of the manpower profile estimated taking into account the number of required people associated to each construction and installation task. 220 working days per year were assumed.





Impact of INFN infrastructures

The INFN laboratories will provide support For the hardware and software activities of Advanced VIRGO.

The INFN section of Genova will contribute to

- design and construction of the cryogenics facility needed to support the cryotrap operation
- simulation activity supporting vacuum upgrades

The INFN section of Firenze

- fused silica fiber optimization, construction and characterization for the Advanced Virgo monolithic payload
- software preparation for the Coalescent binary signal analysis
- software simulation of the interferometer control

The INFN section of Napoli

- local sensor and local control system
- environmental monitoring upgrade

The INFN section of Padova

- support in mechanics/electronic development (TBD)
- software development for GW burst signal search and related data management

The INFN section of Perugia

- design of the Advanced Virgo monolithic suspensions and the silicate bonding
- software development for the grid virtual data base for Advanced VIRGO

The INFN section of Pisa

- modifications of the upper part of the suspensions
- mechanical interface between the payload and the upper part of the suspension
- new electronics of the suspension
- software simulation of the interferometer control
- software preparation for GW stochastic signal search and related data management

The INFN section of Roma 1

- design, construction and assembly of the Advanced VIRGO payloads
- mechanical interface between payloads and the upper part of the suspension
- design and simulation of suspension control
- software development for GW continuous signal search and related data management in the dedicated V-Tier 2

The INFN section of Roma 2



- design and construction of the thermal compensation system for Advanced VIRGO
- thermo-mechanical simulation for Advanced VIRGO
- software development for the detector characterization and noise hunting

We summarize in 4 tables the need for the personnel. The number reported here are full time equivalent (FTE) units. We introduce also symbols to specify the category of the temporary personnel to be hired and the INFN personnel on leave at EGO.

Symbols :

- q* temporary contract (Art.15) to be requested
- d* INFN personnel on leave at EGO
- a* Fellows and “assegni di ricerca”
- v* Contracts (Art. 23) to be requested

2009

	Design	Mechanics	Electronics	Software
Genova	0.2	0.2		
Firenze/Urbino	1a	0.3 +1q + 1a	0.1	
Napoli	0.4	0.2	0.4	
Padova/Trento	0.2			
Perugia	0.3	1+ 1v +1a		
Pisa	0.4	1 + 1d	0.4 + 1q +1v + 1d	
Roma1	1+1q	1	1	
Roma2		0.6	0.2	

2010

	Design	Mechanics	Electronics	Software
Genova	0.2+1v	0.5+1q		
Firenze/Urbino	1a	0.3 +1q + 1a	0.1	1v
Napoli	0.4	0.5	0.5+1v	
Padova/Trento	0.3	0.5	0.5	
Perugia	0.3 + 1a	1+ 1v		1v
Pisa	0.3	1.5 + 1d	0.4 + 1q +1v + 1d	
Roma1	1+1q	1	1	1a
Roma2	1a	0.6	0.4	1a

2011

	Design	Mechanics	Electronics	Software
Genova	0.2+1v	0.5+1q		
Firenze/Urbino	1a	0.5 + 1q + 1a	0.1	1v
Napoli	0.2	0.5	0.5+1v	
Padova/Trento	0.3	0.5	0.5	
Perugia	0.3 + 1a	1 + 1v		1v
Pisa	0.3	1.5 + 1d	0.4 + 1q +1v + 1d	
Roma1	1+1q	1	1	1a
Roma2	1a	0.6	0.4	1a

2012

	Design	Mechanics	Electronics	Software
Genova	0.2+1v	0.5+1q		
Firenze/Urbino	1a	0.5 + 1q + 1a	0.1	1v
Napoli	0.2	0.4	0.4+1v	
Padova/Trento	0.3	0.5	0.5	
Perugia	0.3 + 1a	1 + 1v		1v
Pisa	0.3	1.5 + 1d	0.4 + 1q + 1v + 1d	
Roma1	0.7+1q	1.3	1	1a
Roma2	1v	0.6	0.4	1a

2013

	Design	Mechanics	Electronics	Software
Genova	0.1+1v	0.5+1q		
Firenze/Urbino	1a	0.2 + 1q + 1a	0.1	1v
Napoli	0.2	0.4	0.4+1v	
Padova/Trento	0.3	0.5	0.5	
Perugia	0.3 + 1a	1 + 1v		1v
Pisa	0.1	1.5 + 1d	0.4	
Roma1	0.5	2	1	1a
Roma2	1v	0.6	0.4	1a

Finally we summarize in the following table the total number of F.T.E. to be hired with the temporary contracts.

Year	Art 15.	Fellow	Art. 23
2009	3	3	2
2010	4	5	6
2011	4	5	6
2012	4	5	7
2013	2	5	6

CSN2 support

The CSN2 budget until 2012 is fully saturated with the approved programs and therefore there is no room for a direct support to the construction of ADVANCED VIRGO.

However the CSN2 supports the INFN VIRGO scientific teams (travel expenses, data analysis, small R/D ecc.). In 2009 the total budget allocated for the INFN VIRGO scientific teams is 888 Keuro. This support for the scientific teams will continue of course for ADVANCED VIRGO.

Reference documents

The effort of the Virgo Collaboration towards the design of a second generation detector



started in 2005 and in fall 2007 an Advanced Virgo Conceptual Design was proposed [1] and submitted to the funding agencies together with a preliminary project execution plan and cost plan [2].

In 2008 a preliminary design of the project was completed [3] and at the beginning of 2009 we presented the attachment concerning the revised cost and the manpower request for the various sub-systems of the project [4].

[1] The Virgo Collaboration, Advanced Virgo Conceptual Design, Virgo Internal report VIR-042A-07 (2007).

[2] The Virgo Collaboration, Advanced Virgo Preliminary Project Execution Plan, Virgo Internal report VIR-043A-07 (2007).

[3] The Virgo Collaboration, Advanced Virgo Preliminary Design, Virgo Internal report VIR-089A-08 (2008).

[4] The Virgo collaboration, Advanced Virgo: preliminary cost and manpower plan VIR-002A-09 (2009).

The documents are in the folder "Comitato Coordinamento Scientifico" in the csn2 site (<http://www.infn.it/csn2>) username comm2 and password "dream "