About AdV+ organization

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- Reminder: systems
- Existing subsystems
- New subsystems
- The QND system (FDS)
- System managers
- Summary

Reminder: systems

- Interferometer (ITF)
  - Larger laser power
  - Larger beams
- Suspensions & Mirrors (SUM)
  - Signal recycling payload installation
  - Larger mirrors with better coatings
- Electronics, Software & Controls (ESC)
  - Signal recycling control
- Environment (ENV)
  - Newtonian noise cancellation
  - Infrastructure noise reduction
- Quantum noise demolition (QND)
  - Frequency dependent squeezing

Subsystems

- Cases where subsystem and person in charge already exist
  - OSD: J. Degallaix
  - INJ: A. Chiummo
  - SLC: A. Chiummo
  - DET: R. Gouaty
  - SBE: A. Bertolini
  - MIR: L. Pinard
  - TCS: V. Fafone
  - SAT: R. Passaquieti
  - ISC: M. Mantovani
  - DAQ: A. Masserot
  - INF: L. Paoli
  - VAC: A. Pasqualetti

Subsystems

- Subsystem already existed but person in charge is changing
  - PSL: N. Christensen
  - PAY: E. Majorana

- Approval of VSC requested

Subsystems

- Subsystems existed as an item in another subsystem
- Upgraded to subsystem in the logistic document
  - CAL: L. Rolland
  - EM: R. De Rosa
  - SRC: N. Leroy
- Approval of VSC requested

Subsystems

- Definition of sub-systems main task(s)
  - Work in progress. To be finalized and checked with SS managers

AdV+ Subsystems

21/02/2019

– DRAFT –

Remove phase II, except preparation

1 ITF - Interferometer

1.1 OSD

Finding the optimum optical configuration for phase II, given constraints (infrastructure, suspensions,...)
Propose configurations with large beams on End Mirrors or on End and Input mirrors for allowing decision between both solutions

1.2 PSL

Inject 40 W in ITF
R&D for 200W laser in phase II

1.3 INJ

Replacement of IMC end mirror and payload
Study of needed adaptations of EIB optics to higher power (if needed)
Study of adaptation of input optics to larger beam

1.4 DET

Study of adaptation of output optics to larger beam

1.5 SBE

Study of adaptation of bench suspensions to changed weight of new optics (Phase II)

1.6 SLC

Development of instrumented baffles
Study of baffles system for large mirrors (phase II)

2 SUM

2.1 MIR

Adapt facilities for production of large mirrors (coating, cleaning, handling, metrology)

2.2 PAY

Change SR lens with real mirror
Study of Parametric Instabilities mitigation
Study of payloads for large mirrors (phase II)

2.3 TCS

Realize and install the SR mirror ring heater (TBC if exists already)
Study of thermal compensation system for large mirrors (phase II)

2.4 SAT

Study of suspension changes for large mirror payloads (phase II)

2.5 VCRD

Development of coatings with lower thermal noise (for phase II)

3 ESC - Electronics, Software & Controls

3.1 SRC – Signal Recycling Control hardware

Design of aux. laser system for arm cavity control during lock acquisition
Integration of aux. lasers in injection and detection system (end bench modifications)

3.2 ISC

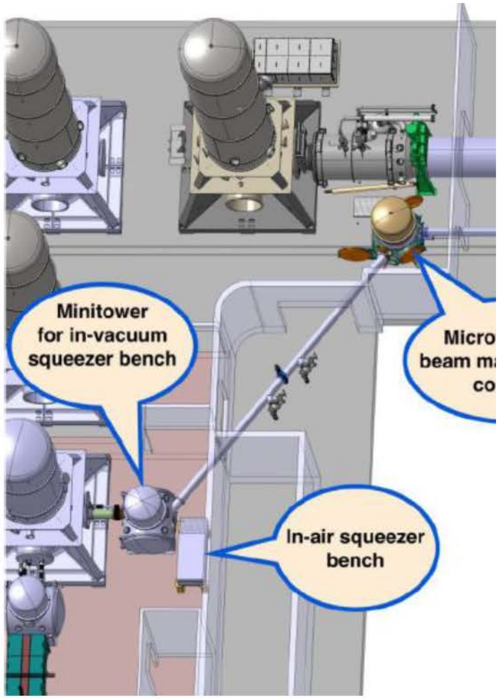
Simulations: Develop lock acquisition, steady lock and autoalignment schemes for SRC
Prepare ITF control with increased laser power (simulations with thermal effects)

3.3 DAQ

Provide DAQ infrastructure (signal acquisition/control hard-software) for new systems (Signal Recycling, Squeezing, Newtonian Noise)

The QND system (FDS)

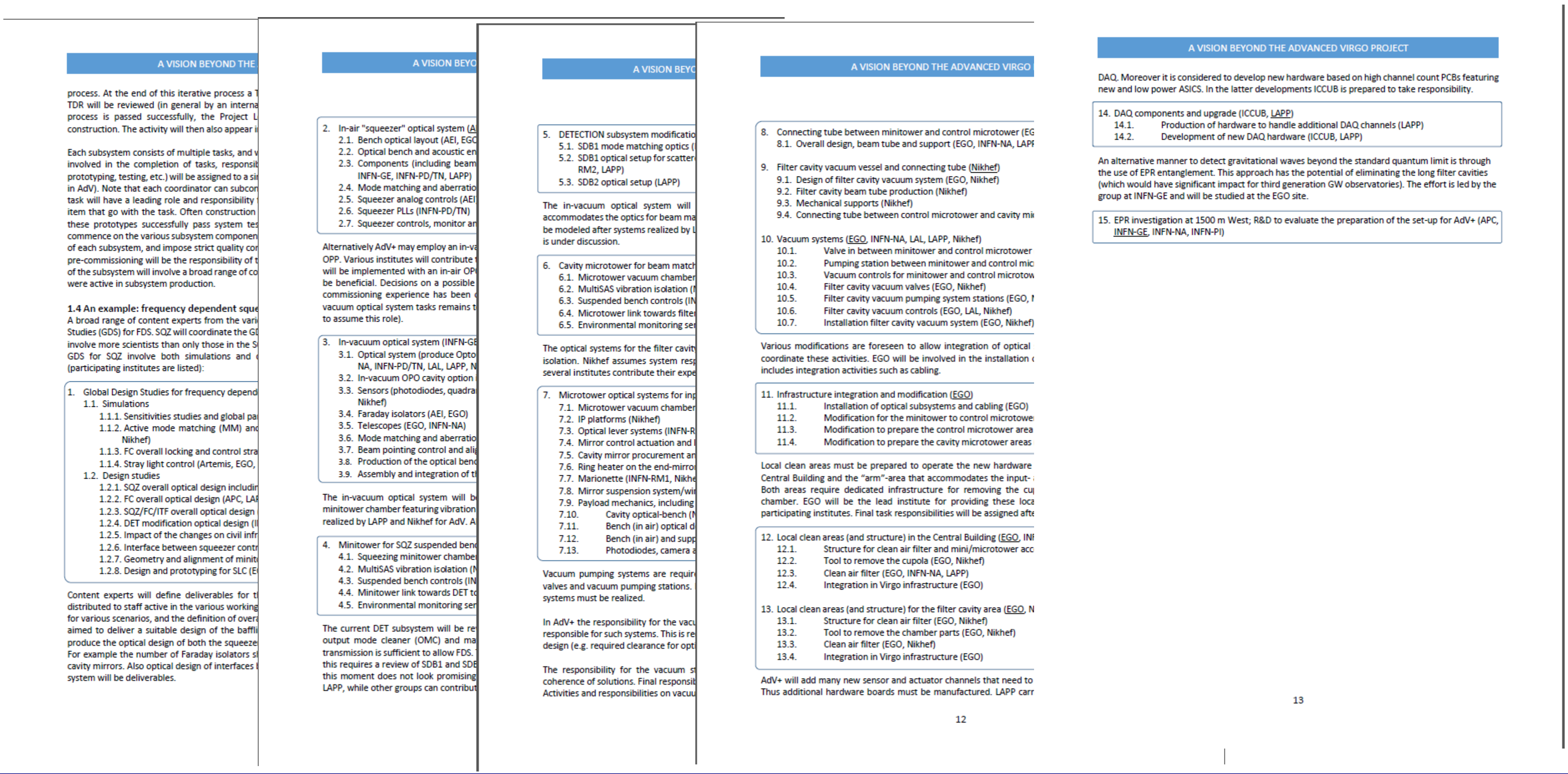
- For AdV+ SQZ has the size of a system
  - Amount of hardware, amount of budget, amount of time needed



Phase	Item	Completed	BNS range [Mpc]	Cost [M€]	In kind [M€]
AdV-O3		2019	60 - 80		
AdV	Tuned signal recycling + 125 W	2021	120	0.4	
AdV+	Frequency dependent squeezing (FDS)	2021	150	1.3	1.4
	Newtonian noise cancellation (NNC)	2021	160	0.4	1.7
	Large mirror development (LM)	2021			
	- Large mirror tooling, cleanroom upgrade (MIR)			0.6	
	- Large test masses (PAY)			0.8	
	- Superattenuator upgrades (SAT)			0.2	0.2
	- Thermal compensation (TCS)			0.3	
	Coating material development (VCRD)	2021		0.3	
	ITF upgrade: vacuum and SLC			0.4	0.3
	Contingency (20 %)			0.9	
	Human resources			2.3	
	In-kind contribution				3.5
	AdV+ Phase I request to EGO Council			**7.9**	

The QND systems (FDS)

- From the logistic document
  - 15 sections, 85 items, 15 laboratories



A VISION BEYOND THE

process. At the end of this iterative process a T
TDR will be reviewed (in general by an interna
process is passed successfully, the Project L
construction. The activity will then also appear i

Each subsystem consists of multiple tasks, and v
involved in the completion of tasks, responsil
prototyping, testing, etc.) will be assigned to a si
in AdV). Note that each coordinator can subcon
task will have a leading role and responsibility
item that go with the task. Often construction
these prototypes successfully pass system tes
commence on the various subsystem componen
of each subsystem, and impose strict quality cor
pre-commissioning will be the responsibility of t
of the subsystem will involve a broad range of co
were active in subsystem production.

1.4 An example: frequency dependent sque
A broad range of content experts from the vari
Studies (GDS) for FDS. SQZ will coordinate the GI
involve more scientists than only those in the S
GDS for SQZ involve both simulations and
(participating institutes are listed):

1. Global Design Studies for frequency depend
   1.1. Simulations
      1.1.1. Sensitivities studies and global pa
      1.1.2. Active mode matching (MM) and
      Nikhef)
      1.1.3. FC overall locking and control stra
      1.1.4. Stray light control (Artemis, EGO,
   1.2. Design studies
      1.2.1. SQZ overall optical design includir
      1.2.2. FC overall optical design (APC, LAI
      1.2.3. SQZ/FC/ITF overall optical design
      1.2.4. DET modification optical design (I
      1.2.5. Impact of the changes on civil infr
      1.2.6. Interface between squeezer contr
      1.2.7. Geometry and alignment of minit
      1.2.8. Design and prototyping for SLC (E

Content experts will define deliverables for t
distributed to staff active in the various working
for various scenarios, and the definition of overa
aimed to deliver a suitable design of the baffli
produce the optical design of both the squeeze
For example the number of Faraday isolators sl
cavity mirrors. Also optical design of interfaces l
system will be deliverables.

A VISION BEYO

2. In-air "squeezer" optical system (A
   2.1. Bench optical layout (AEI, EGO
   2.2. Optical bench and acoustic en
   2.3. Components (including beam
   INFN-GE, INFN-PD/TN, LAPP)
   2.4. Mode matching and aberratio
   2.5. Squeezer analog controls (AEI
   2.6. Squeezer PLLs (INFN-PD/TN)
   2.7. Squeezer controls, monitor an

Alternatively AdV+ may employ an in-va
OPP. Various institutes will contribute
will be implemented with an in-air OPO
be beneficial. Decisions on a possible
commissioning experience has been
vacuum optical system tasks remains t
to assume this role).

3. In-vacuum optical system (INFN-GE
   3.1. Optical system (produce Opto
   NA, INFN-PD/TN, LAL, LAPP, N
   3.2. In-vacuum OPO cavity option
   3.3. Sensors (photodiodes, quadra
   Nikhef)
   3.4. Faraday isolators (AEI, EGO)
   3.5. Telescopes (EGO, INFN-NA)
   3.6. Mode matching and aberratio
   3.7. Beam pointing control and ali
   3.8. Production of the optical benc
   3.9. Assembly and integration of t

The in-vacuum optical system will b
minitower chamber featuring vibration
realized by LAPP and Nikhef for AdV. A

4. Minitower for SQZ suspended ben
   4.1. Squeezing minitower chambe
   4.2. MultiSAS vibration isolation (N
   4.3. Suspended bench controls (IN
   4.4. Minitower link towards DET to
   4.5. Environmental monitoring ser

The current DET subsystem will be re
output mode cleaner (OMC) and ma
transmission is sufficient to allow FDS.
this requires a review of SDB1 and SDE
this moment does not look promising
LAPP, while other groups can contribut

A VISION BEYO

5. DETECTION subsystem modificatio
   5.1. SDB1 mode matching optics (
   5.2. SDB1 optical setup for scatter
   RM2, LAPP)
   5.3. SDB2 optical setup (LAPP)

The in-vacuum optical system will
accommodates the optics for beam ma
be modeled after systems realized by L
is under discussion.

6. Cavity microtower for beam match
   6.1. Microtower vacuum chamber
   6.2. MultiSAS vibration isolation (I
   6.3. Suspended bench controls (IN
   6.4. Microtower link towards filte
   6.5. Environmental monitoring ser

The optical systems for the filter cavit
isolation. Nikhef assumes system resp
several institutes contribute their expe

7. Microtower optical systems for inp
   7.1. Microtower vacuum chamber
   7.2. IP platforms (Nikhef)
   7.3. Optical lever systems (INFN-R
   7.4. Mirror control actuation and I
   7.5. Cavity mirror procurement an
   7.6. Ring heater on the end-mirro
   7.7. Marionette (INFN-RM1, Nikhe
   7.8. Mirror suspension system/wi
   7.9. Payload mechanics, including
   7.10. Cavity optical-bench (N
   7.11. Bench (in air) optical d
   7.12. Bench (in air) and supp
   7.13. Photodiodes, camera a

Vacuum pumping systems are requir
valves and vacuum pumping stations.
systems must be realized.

In AdV+ the responsibility for the vacu
responsible for such systems. This is re
design (e.g. required clearance for opt

The responsibility for the vacuum s
coherence of solutions. Final responsil
Activities and responsibilities on vacuu

A VISION BEYOND THE ADVANCED VIRGO

8. Connecting tube between minitower and control microtower (EG
   8.1. Overall design, beam tube and support (EGO, INFN-NA, LAPI

9. Filter cavity vacuum vessel and connecting tube (Nikhef)
   9.1. Design of filter cavity vacuum system (EGO, Nikhef)
   9.2. Filter cavity beam tube production (Nikhef)
   9.3. Mechanical supports (Nikhef)
   9.4. Connecting tube between control microtower and cavity mi

10. Vacuum systems (EGO, INFN-NA, LAL, LAPP, Nikhef)
   10.1. Valve in between minitower and control microtower
   10.2. Pumping station between minitower and control mic
   10.3. Vacuum controls for minitower and control microtow
   10.4. Filter cavity vacuum valves (EGO, Nikhef)
   10.5. Filter cavity vacuum pumping system stations (EGO, I
   10.6. Filter cavity vacuum controls (EGO, LAL, Nikhef)
   10.7. Installation filter cavity vacuum system (EGO, Nikhef)

Various modifications are foreseen to allow integration of optical
coordinate these activities. EGO will be involved in the installation o
includes integration activities such as cabling.

11. Infrastructure integration and modification (EGO)
   11.1. Installation of optical subsystems and cabling (EGO)
   11.2. Modification for the minitower to control microtowe
   11.3. Modification to prepare the control microtower area
   11.4. Modification to prepare the cavity microtower areas

Local clean areas must be prepared to operate the new hardware
Central Building and the "arm"-area that accommodates the input-
Both areas require dedicated infrastructure for removing the cu
chamber. EGO will be the lead institute for providing these loca
participating institutes. Final task responsibilities will be assigned afte

12. Local clean areas (and structure) in the Central Building (EGO, INF
   12.1. Structure for clean air filter and mini/microtower acc
   12.2. Tool to remove the cupola (EGO, Nikhef)
   12.3. Clean air filter (EGO, INFN-NA, LAPP)
   12.4. Integration in Virgo infrastructure (EGO)

13. Local clean areas (and structure) for the filter cavity area (EGO, N
   13.1. Structure for clean air filter (EGO, Nikhef)
   13.2. Tool to remove the chamber parts (EGO, Nikhef)
   13.3. Clean air filter (EGO, Nikhef)
   13.4. Integration in Virgo infrastructure (EGO)

AdV+ will add many new sensor and actuator channels that need to
Thus additional hardware boards must be manufactured. LAPP carr

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DAQ. Moreover it is considered to develop new hardware based on high channel count PCBs featuring new and low power ASICS. In the latter developments ICCUB is prepared to take responsibility.

14. DAQ components and upgrade (ICCUB, LAPP)
   14.1. Production of hardware to handle additional DAQ channels (LAPP)
   14.2. Development of new DAQ hardware (ICCUB, LAPP)

An alternative manner to detect gravitational waves beyond the standard quantum limit is through the use of EPR entanglement. This approach has the potential of eliminating the long filter cavities (which would have significant impact for third generation GW observatories). The effort is led by the INFN-GE and will be studied at the EGO site.

15. EPR investigation at 1500 m West; R&D to evaluate the preparation of the set-up for AdV+ (APC, INFN-GE, INFN-NA, INFN-PI)

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The QND systems (FDS)

- Proposal for four subsystems
  - SGLO
    - » Global design and control
    - » Commissioning plan
  - SSRC
    - » Task: production of squeezed vacuum beam
    - » Equipment: vacuum squeezed source (including in-vacuum option)
  - SINJ
    - » Task: injection of the squeezed vacuum beam into the filter cavity and into the ITF
    - » Equipment: in vacuum injection benches
  - SFLT
    - » Task: filtering of the squeezed vacuum beam
    - » Equipment: 300m filter cavity

The QND systems (FDS)

- Proposal for four subsystems
  - Assignment of items to subsystems to be discussed

Squeezing from AdV+ Logistics document (VIR-0652A-18)

		GLB	SSRC	SINJ	SFLT	*Expressions of interest from Logistics document*
1	**Global Design Studies for frequency dependent squeezing (coordinated by SQZ)**					
1.1	Simulations	X				
1.1.1	Sensitivities studies and global parameters	X				*APC, LAPP, LKB, Nikhef*
1.1.2	Active mode matching (MM) and aberration studies	X				*INFN-PD/TN, INFN-RM2, LAPP, Nikhef*
1.1.3	FC overall locking and control strategy	X				*AEI, INFN-PD/TN, LAL, LAPP, Nikhef*
1.1.4	Stray light control	X				*Artemis, EGO, IFAE, INFN-NA, INFN-PD/TN, INFN-RM2*
1.2	Design studies	X				
1.2.1	SQZ overall optical design including the vacuum version	X				*AEI, INFN-NA, LAL, LAPP*
1.2.2	FC overall optical design	X				*APC, LAPP, LAL, Nikhef*
1.2.3	SQZ/FC/ITF overall optical design	X				*INFN-GE, INFN-NA, LAPP*
1.2.4	DET modification optical design	X				*INFN-NA, LAPP*
1.2.5	Impact of the changes on civil infrastructure and vacuum	X				*EGO, LAPP, Nikhef*
1.2.6	Interface between squeezer control and overall control	X				*EGO, LAPP*
1.2.7	Geometry and alignment of minitowers, microtowers and beam tubes	X				*EGO, LAPP*
1.2.8	Design and prototyping for SLC	X				*EGO, IFAE*
2	**In-air "squeezer" optical system**					*AEI*
2.1	Bench optical layout		X			*AEI, EGO, INFN-GE, INFN-NA, INFN-PD/TN, LAPP, Nikhef*
2.2	Optical bench and acoustic enclosure		X			*AEI, EGO*
2.3	Components		X			*AEI, EGO, INFN-GE, INFN-PD/TN, LAPP*
2.4	Mode matching and aberrations sensing and control		X			*INFN-PD/TN, INFN-RM2*
2.5	Squeezer analog controls		X			*AEI*
2.6	Squeezer PLLs		X			*INFN-PD/TN*
2.7	Squeezer controls, monitor and trigger		X			*LAPP*
3	**In-vacuum optical system**					*INFN-GE, INFN-NA, INFN-PD/TN, LAPP*
3.1	Optical system (produce OptoCad layout) and optical components			X		*AEI, EGO, INFN-GE, INFN-NA, INFN-PD/TN, LAL, LAPP, Nikhef*
3.2	In-vacuum OPO cavity option including controls		X			*AEI, INFN-NA, LKB*
3.3	Sensors (photodiodes, quadrant-photodiodes), actuators and controls			X		*Artemis, ICCUB, LAPP, Nikhef*
3.4	Faraday isolators			X		*AEI, EGO*
3.5	Telescopes			X		*EGO, INFN-NA*
3.6	Mode matching and aberrations sensing & control			X		*INFN-NA, INFN-PD/TN, INFN-RM2, LAL*
3.7	Beam pointing control and alignment control (This is connected to bench control)			X		*INFN-GE*
3.8	Production of the optical benches			X		*INFN-NA, LAPP*
3.9	Assembly and integration of the optical benches			X		*INFN-GE, INFN-NA, INFN-PD/TN, LAPP*
4	**Minitower for SQZ suspended bench**					*INFN-NA, LAPP*
4.1	Squeezing minitower chamber			X		*INFN-NA,LAPP*
4.2	MultiSAS vibration isolation			X		*Nikhef*
4.3	Suspended bench controls			X		*INFN-NA, LAPP*

System managers

- Proposal for system managers
  - ITF: M. Was
  - SUM: H. Vocca
  - ESC: B. Swinkels
  - ENV: discussion ongoing
  - QND: subsystems structure to be finalized first

Summary: work in progress

EGO consortium

Virgo Steering Committee

Project Supervisor Board
Convener: G. Gemme
EGO director
Virgo Spokesperson
Project Leader
Technical Manager
Quality responsible
Commissioning coordinator
Operations coordinator
3 Country representatives

AdV+ Management Team
Project Leader: R. Flaminio
Technical Manager: H. Heitmann
ITF: M. Was, SUM: H. Vocca, ESC: B. Swinkels, ENV: TBD, FDS: TBD

- **OSD** – J. Degallaix
- **PSL** – N. Christensen
- **INJ** – A. Chiummo
- **SLC** – A. Chiummo
- **DET** – R. Gouaty
- **SBE** – A. Bertolini

- **MIR** – L. Pinard
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- **SAT** – R. Passaquieti
- **VCRD** – G. Cagnoli

- **ISC** – M. Mantovani
- **SRC** – N. Leroy
- **DAQ** – A. Masserot
- **CAL** – L. Rolland

- **NNC** – TBD
- **INF** – L. Paoli
- **VAC** – A. Pasqualetti
- **EM** – R. De Rosa

- **SGLO** – TBD
- **SSRC** – TBD
- **SINJ** – TBD
- **SFLT** – TBD

Blue: already existed
Green: new