Advanced Virgo
Work Breakdown Structure

VIR-031A-09

The Virgo collaboration

20/05/2009

Introduction

This document gives the Advanced Virgo Work Breakdown Structure up to level 2 of the arborescence. The labs which are responsible of tasks at level 3 are listed in brackets behind the level 2 tasks. Only final task assignments to labs, decided by the VSC, are shown.

The complete 3-level WBS is given in another document.

Subsystem overview

This section lists the Advanced Virgo organizational breakdown in subsystems, with the 2nd level tasks associated to each subsystem.

MAN

The MAN subsystem is concerned with project management and contingency administration.

Labs involved: EGO

MAN.1 Project management [EGO]
MAN.2 Contingency 2011
MAN.3 Contingency 2012
MAN.4 Contingency 2013
MAN.5 Contingency 2014

COM

The COM subsystem is concerned with the first part of commissioning of the detector, from the end of subsystem assembly, integration and pre-commissioning up to the project end milestone (first uninterrupted operation of 1 hour).

Labs involved: all

COM.1 AdV commissioning (1st part)

MIR

The MIR subsystem concerns the procurement and preparation of the AdV test masses and spares. The main tasks of MIR are: the realization of the substrates (including spares) and the coatings with the best available optical and mechanical features.

Labs involved: LMA, LAPP, Nice

MIR.1 MIR sub-system management [LMA]
MIR.2 Substrates Fabrication [LMA]
MIR.3 Substrate Polishing [LMA,LAPP,Nice]
MIR.4 Coating [LMA]
MIR.5 Metrology upgrades [LMA]

PAY

The PAY subsystem concerns the realization of the SA payload (marionette -test mass-RM). The main tasks of PAY are: the design and realization of the new steering stage and of the new reference mass compliant with the AdV test mass geometry, the realization of the monolithic payload, the sensing/actuation for local controls.

Labs involved: Roma1, Firenze, Perugia, EGO, Nikhef, Napoli, Padova

PAY.1 PAY SS Management [Roma1]
PAY.2 Recoil Mass for NE and WE Monolithic Payloads [Roma1]
PAY.3 Recoil Mass for NI and WI Monolithic Payloads [Roma1]

PAY.4 Marionetta for Monolithic Payloads [Roma1]
PAY.5 Marionetta Recoil Mass for Monolithic Payloads [Roma1]
PAY.6 Silica Fibers for Monolithic Payloads [Firenze]
PAY.7 Silica Clamps for Monolithic Payloads [Perugia]
PAY.8 Assembly Structure for Monolithic Payloads [Roma1,EGO]
PAY.9 BS Payload [Roma1]
PAY.10 Injection Bench Payload [NIKHEF]
PAY.11 Detection Bench Payload [NIKHEF]
PAY.12 IMC Payload [NIKHEF]
PAY.13 Payloads Control [Roma1,Perugia,Napoli,Padova]

TCS

The TCS subsystem concerns the design and installation of the new thermal compensation system compliant with the AdV power and sensitivity. The system must correct thermal effects in the input and end test masses. TCS dedicated sensors, to monitor the radius of curvature of all test masses and the wavefront distortion of the input test masses, are part of this subsystem as well.

Labs involved: Roma Tor Vergata, EGO, Roma1

TCS.1 SS Management [RomaTV]
TCS.2 TCS studies (simulations + experiments) [RomaTV]
TCS.3 CO2 laser projector [RomaTV,EGO]
TCS.4 Ring Heater [RomaTV,EGO,Roma1]
TCS.5 Viewports [EGO]
TCS.6 Wavefront sensing [RomaTV]
TCS.7 High reflectivity face sensing [RomaTV]
TCS.8 Sensing beams in-vacuum layout [RomaTV]
TCS.9 Cabling and auxiliary software [EGO]
TCS.10 CP requirements definition [RomaTV]
TCS.11 CP mounting [Roma1]
TCS.12 SS precommissioning [RomaTV]

SAT

The SAT subsystem concerns all the modifications to the existing superattenuators (SA) and the construction of the signal recycling one. The main task of SAT are: the construction of the superattenuator for the signal recycling mirror, the upgrade of the short SA (injection, detection, mode cleaner), the change of the inverted pendulum legs, the implementation of the tilt control and all the modifications to the inertial damping, the upgrade of the filter 0 on the long towers, the upgrades of the SA sensors, actuators and electronics.

Labs involved: Pisa, EGO

SAT.1 Subsystem management [Pisa,EGO]
SAT.2 SAT Upgrades Validation in SAFE [Pisa]
SAT.3 SAT Upgrades + Spares Costr.: PR, BS, NI, NE WI, WE [Pisa]
SAT.4 Suspension Control Upgrade [Pisa,EGO]
SAT.5 SR construction [Pisa,EGO]
SAT.6 Short SAs Upgrade (MC,IB,DB) construction [Pisa,EGO]
SAT.7 Short SAs upgrade installation [Pisa,EGO]
SAT.8 SR installation [Pisa,EGO]
SAT.9 SAT Long SAs Upgrade installation [Pisa,EGO]
SAT.10 Subsystem commissioning [Pisa,EGO]

VAC

The VAC subsystem concerns all the modifications to the vacuum pipes and tower vacuum chambers. The main tasks of VAC will be: the upgrades of the vacuum system needed to meet the AdV sensitivity target, the replacement of the vacuum links in the central area (compliant with the larger beam and the modified optical scheme)), the realization of the vacuum chamber for the new

signal recycling tower and the modifications of the chambers for the injection and detection towers, the installation of the clean air flux in each tower, the works for the displacement of the towers in the central area

Labs involved: EGO, Nikhef, Roma Tor Vergata, LAL, Genova

VAC.1 SS management + engineering support [EGO]
VAC.2 Cryotraps [Nikhef,EGO]
VAC.3 LN2 plant [Genova,EGO]
VAC.4 Vacuum accessories [EGO]
VAC.5 Thermal effects on TMs [RomaTV]
VAC.6 Towers displacement [EGO]
VAC.7 Enlarged Links [EGO]
VAC.8 UHV clean air flux
VAC.9 Towers upgrade [EGO]
VAC.10 Control System [LAL,EGO]
VAC.11 General electronics HW+SW coordination [EGO]

IME

The IME subsystem (Infrastructure Modifications for Environmental noise reduction) concerns all the hard works aimed to reduce the level of anthropogenic noise into the experimental buildings. The main tasks of IME will be: the replacement of the machines with more silent ones and, if needed, their displacement out of the experimental halls. The subsystem will also be involved in minor tasks such as the support in the realization of the eventual infrastructural works needed for the installation of the deliverables of the other subsystems.

Labs involved: EGO

IME.1 Subsystem management [EGO]
IME.2 Finalization of scientific results
IME.3 HVAC machines relocation [EGO]
IME.4 IMMS improvement [EGO]
IME.5 HVAC air distribution [EGO]
IME.6 Electronics/vacuum pumps relocation [EGO]
IME.7 INJ and DET lab insulation improvement [EGO]
IME.8 Support works to the other SS [EGO]

OSD

The OSD (Optical Simulation and Design) subsystem concerns the finalization of the optical design and the coordination of the optical simulation efforts.

OSD.1 Design of arm cavity geometry
OSD.2 Update optical design
OSD.3 effects of mirror, BS substrate geometry
OSD.4 test compatibility of etalon effect and thermal compensation
OSD.5 Investigate scattered light in CITF
OSD.6 Define NDRC layout
OSD.7 Modeling with 3D software
OSD.8 Modeling Advanced Virgo with DarkF
OSD.9 Modeling Advanced Virgo with Finesse
OSD.10 Modeling Advanced Virgo with OptoCad
OSD.11 Coordination of simulation work (towards commissioning)

ISC

The ISC subsystem (Interferometer Sensing and Control) concerns the preparation of the complete control strategy (lock acquisition, robust steady state control, alignment). The main tasks of ISC are: the preparation of the lock acquisition, including radiation pressure effects; the definition of the

steady state control, including a noise budget of the predictable control noise; the definition of the alignment scheme; the mitigation of the parametric instabilities.

Labs involved: EGO, Nice, Pisa, LAL

ISC.1 ISC management [Nice]
ISC.2 Alignment conceptual design [Pisa]
ISC.3 Alignment design specifications [Pisa]
ISC.4 Alignment simulations - pre-commissioning [Pisa]
ISC.5 Modulation frequencies [Nice]
ISC.6 Steady state locking: conceptual design [Nice]
ISC.7 Steady state locking: design specifications [Nice]
ISC.8 Steady state locking: simulations - pre-commissioning [Nice]
ISC.9 Lock acquisition conceptual design [LAL]
ISC.10 Lock acquisition: construction [LAL]
ISC.11 Lock acquisition: simulations - pre-commissioning [LAL]
ISC.12 Parametric instability mitigation
ISC.13 sensing and control: integration [EGO]

DET

The DET subsystem concerns all the modifications of the detection system necessary for the AdV configuration. The main tasks are: the general layout of the optical benches, a new output mode cleaner, new photodetectors (including their demodulation electronics), new and improved optical benches, new telescopes for beam reduction, tools for beam diagnostic and the software for the photodiode readout and the slow control of the whole system.

Labs involved: LAPP, EGO, APC, Nikhef, Napoli

DET.1 General design of the detection system (specs) [LAPP]
DET.2 Optical benches layout (CAD drawing) [LAPP]
DET.3 Suspended detection bench (SDB) mechanics (developed for SIB as well) [LAPP]
DET.4 SDB local controls (common to SIB?) [LAPP]
DET.5 Photodiodes air tanks (assuming no new study needed) [LAPP]
DET.6 SDB cabling (may include multiplexing electronics) [LAPP,EGO]
DET.7 SDB installation and tests (pre-commissioning)
DET.8 External bench [LAPP]
DET.9 External benches and their support + damping (5-6 benches) [NIKHEF]
DET.10 Telescopes for end benches (including for auxiliary lasers) [APC]
DET.11 Phase shifter (if needed) [APC]
DET.12 Telescopes for pickoff beams [APC]
DET.13 Telescope for dark fringe [APC]
DET.14 Telescope on SDB for BS AR or SRM3 transmission (highly dependent on SR cavity design) [APC]
DET.15 Beam dumps, mechanical and electronic components for benches (optics mounts, fast shutter, motors,..) [EGO,LAPP]
DET.16 Output mode cleaner [LAPP]
DET.17 Photodiodes + demodulation boards (longitudinal control) including vacuum compatibility if needed
DET.18 Quadrant photodiodes + demodulation boards (alignment) including vacuum compatibility if needed [NIKHEF]
DET.19 Local oscillator distribution electronics
DET.20 Galvanometers (new items needed for pickoff beams) - no new design assumed [EGO]
DET.21 Beam imaging system integration (development done in DAQ or during Virgo+) [LAPP]
DET.22 Scanning Fabry-Perot
DET.23 Phase camera (2 to be developed) [Napoli]
DET.24 Photodiodes readout software [LAPP]
DET.25 Detection system slow control [LAPP]
DET.26 Auxiliary lasers integration (if needed, TBD by ISC) [LAPP]
DET.27 New optical windows for towers (if needed) [LAPP]

PSL

The PSL subsystem concerns the installation of the new power stabilized laser, able to provide a power of about 200 W.

Labs involved: Nice, EGO

PSL.1 SS management [Nice]
PSL.2 HP amplifier [Nice,EGO]
PSL.3 Beam Characterization [Nice]
PSL.4 Design & realization of control servos [Nice]
PSL.5 pre-mode-cleaner [Nice,EGO]
PSL.6 Monitoring [EGO]
PSL.7 Long term tests [Nice]
PSL.8 Laser Bench setup [Nice,EGO]
PSL.9 Installation on site [Nice,EGO]
PSL.10 Commissioning of SS [EGO,Nice]

INJ

The INJ subsystem concerns all the modifications of the injection system to make it compliant with AdV. The main tasks of INJ are: the design of the optical layout downstream the laser bench, the input optics (EOM and RF modulation, Faraday isolator, polarizers, mechanics), the injection bench (mechanics, mode matching telescope, adaptive mode matching system), input mode cleaner (optics and mechanics).

Labs involved: EGO, Napoli, Nikhef, LMA, LAPP, APC

INJ.1 Management [EGO]
INJ.2 Preliminary design study, requirements definition and baseline design delivery [EGO]
INJ.3 Electro optical modulation system (EOM) [EGO]
INJ.4 Input Power Control (IPC) system [EGO]
INJ.5 Beam Pointing Control [EGO,Napoli]
INJ.6 Input Beam Jitter Monitoring [EGO]
INJ.7 Input Beam Spatial and Spectral Characterization system [EGO]
INJ.8 Input Mode Cleaner cavity [EGO,NIKHEF,LMA]
INJ.9 Faraday Isolators [EGO]
INJ.10 Reference cavity (RFC) [EGO]
INJ.11 IMC Mode Matching Telescope [EGO]
INJ.12 ITF Mode Matching Telescope [APC]
INJ.13 Assembling of the various subsystems together [EGO]
INJ.14 Optical setup of ITF reflection [EGO]
INJ.15 Telescopes for pick-off beam taken from transmission of PRM3 on injection bench [APC]
INJ.16 Suspended injection bench (SIB) body [LAPP]
INJ.17 SIB local controls (common to SDB) (standardization of LC system for AdV)
INJ.18 Support to ITF commissioning [EGO]

DAQ

The DAQ subsystem concerns the electronics and software related to the control of the ITF. The main tasks of DAQ are the modifications to the electronics, the upgrade of control loops (hardware, software and algorithms), automation, timing, data conversion, environment monitoring and control. Subsystem specific front end electronics is usually part of the subsystem. DAQ system shall give specifications for any piece of electronics hardware and software involved in the operation of AdV.

Labs involved: Napoli, Pisa, EGO, LAPP

DAQ.1 SS management [Napoli]
DAQ.2 Data Acquisition and Global Control [LAPP]
DAQ.3 General Purpose DAC Board [Pisa,LAPP]
DAQ.4 Environmental Monitoring [Napoli]

DAQ.5 Local Position Read-Out and Beam Imaging [LAPP]
DAQ.6 Electronic Infrastructure [EGO]
DAQ.7 Software Framework [EGO]