Task 9.3

LINAC AND FINAL FOCUS STABILISATION

CERN, 27-Mar-2009

Task 3 in DoW:

Task3. Linac & FF Stabilisation

- Design, build and test for stabilisation a CLIC quadrupole module in an accelerator environment
- Design, build and test for stabilisation a Final Focus test stand

Task 3. Linac & FF stabilisation

In the future linear colliders such as ILC and CLIC, beam sizes will be of the nanometre scale. In a real accelerator environment, many sources of noise such as ground motion, pumping devices, acoustic vibrations, cooling systems and others are present, sources which generate vibrations several orders of magnitude larger than the beam size. Stabilization of accelerator components such as the final focus (FF) is critical if the desired nanometre beam sizes are to be reached. It is particularly challenging for the CLIC project, where a stability of 1 nm above one Hertz is required even in the linac section, 0.1 nm above a few Hertz in the FF section. In a laboratory environment, these values could already be demonstrated. It is planned in this project to study the effectiveness of stabilisation equipment (such as seismic sensors, actuators, interferometers etc…) in a real accelerator environment. The equipment will be implemented at a CLIC quadrupole module inside the CTF3 facility, in the first stage with a quadrupole mock-up. In addition it is planned to use a CLIC standard module for comparing the vibration measurements with a laser interferometer (which can also serve as an alignment device) and the seismic sensors. The compatibility of these stabilisation devices with the alignment system that will be used in CLIC will be checked. A dedicated FF test stand will be built with a support and magnet prototype where the stabilisation will be developed. Furthermore, the stabilisation procedures will be simulated to ensure a better understanding of the beam-based feedback, stabilisation and the alignment. This will be tested on different accelerator facilities such as ATF2, CTF3 in preparation of ILC and CLIC.

Task 3 in DoW (continued)

- **Sub-task 1: CLIC quadrupole module.** CERN together with LAPP aims at demonstrating 1 nm quadrupole stability for the CLIC main linac quadrupole. Investigation of stabilisation feedback performance in different locations, e.g. an accelerator test tunnel will be performed. The aim is to demonstrate better than 1 nm stability of the main linac quadrupoles in an accelerator environment above frequencies of approximately 1 Hz. Inertial sensors will be tested and evaluated for accelerator environment (magnetic field, radiation, electrical and acoustic noise from accelerator components). The module needs a main beam linac support: study vibration isolation for the main beam quadrupole (principle, mock-up, feedback to be adapted to new boundary conditions) and build a test bench. The interferometric measurement system, developed in UOXF-DL, will be installed at the Final Focus Test stand and will be used to cross check results and extend the frequency range. CERN will also study the design and construction of main linac prototype magnet. The stabilisation of the main linac quadrupoles is one of the fundamental issues of CLIC. This activity aims to design and build a quadrupole mock-up that can serve as a model for the main linac quadrupole. New magnet manufacturing and assembly methods will be studied and implemented. The model will be used to investigate the performance of the stabilisation equipment that is also developed in this task.

  CERN aims at testing the compatibility (space, interferences, and complementarities) between the repositioning system (movers + associated sensors) and the stabilization system foreseen for the main beam quadrupole of CTF3/CLIC, in the real environment of the two beam test stand.

- **Sub-task 2: Final Focus Test stand.** LAPP together with CERN aims at exploring the potential to achieve 0.1 nm stability scale for the final doublet quadrupoles above a few Hz by working on the design, simulation, construction and installation of the support (final doublet mock-up, eigenmode analysis) and on the feedback design depending strongly on the final doublet support chosen. LAPP will adapt feedback software to new configuration and boundary conditions and continue work to reduce costs.

  Oxford aims at studying the design, construction and deployment of an interferometric system to measure the motion between the proposed test magnet/girder and floor. This task includes the installation of interferometric system with the goal to push for maximum resolution and the possibility to correlate results with measurements done by inertial sensors. UOXF-DL will contribute to the Development of optimized low-emittance beam transport and feedback for ILC and CLIC by completing an ILC prototype ATF2 intra-train and pulse-pulse Feedback and Final Focus system. In addition, they will study the simulation of the global luminosity performance of ILC and CLIC.

Deliverables & Milestones

Deliverable	Description/title	Nature	Delivery month
9.3.1	CLIC Quadrupole Module final report	R	M48
9.3.2	Final Focus Test Stand final report	R	M48

Milestone	Description/title	Nature	Delivery month	Comment
9.3.1	Characterization of noise/vibrations sources in an accelerator	O	M24	
9.3.2	Installation of interferometers at CTF3 Module	D	M24	
9.3.3	Installation of ATF2 final-focus alignment monitoring system	D	M6	
9.3.4	Installation of ILC prototype FB/FF at ATF2	O	M24	
9.3.5	Commissioning of CLIC quadrupole module	D	M30	Complete module with girder and accelerating structure
9.3.6	Quadruple mock-up manufactured and ready for installation	D	M30	

Budget

EuCARD - WP9 NCLinac - Task 9.3: Linac and FF stabilization										
Beneficiary short name [a]	Average direct monthly salary * (€)	Rate for personnel indirect costs (%)	Rate for material and travel indirect costs (%)							
CERN	6,200 €	60	60							
CERN	6,200 €	60	60							
CERN	6,200 €	60	60							
LAPP	5,185 €	60	60							
UOXF-DL	6,200 €	60	60							
Beneficiary short name (all costs in €)	Person-Months	Personnel direct costs	Personnel indirect costs	Consumable and prototype direct costs	Travel direct costs	Material and travel indirect costs	Total direct costs	Toal indirect costs	Total costs (direct +indirect)	EC requested funding[1]
CERN	12	74,400	44,640	58,000		34,800	132,400	79,440	211,840	59,339
CERN	39	241,800	145,080	8,300		4,980	250,100	150,060	400,160	116,700
CERN	6	37,200	22,320	39,000		23,400	76,200	45,720	121,920	35,603
LAPP	50	259,250	155,550	28,000		16,800	287,250	172,350	459,600	163,000
UOXF-DL	53	328,600	197,160	47,000		28,200	375,600	225,360	600,960	182,700
…		0	0			0	0	0	0	
…		0	0			0	0	0	0	
…		0	0			0	0	0	0	
Totals:	**160**	**941,250**	**564,750**	**180,300**	**0**	**108,180**	**1,121,550**	**672,930**	**1,794,480**	**557,342**

People

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- ***CERN:*** Michele Modena, Claude Hauviller, Helene Mainaud-Durand