# TIARA WP8 Status

M. Biagini, INFN-LNF, for WP8

TIARA Mid-Term Meeting

Madrid, June 13th 2012



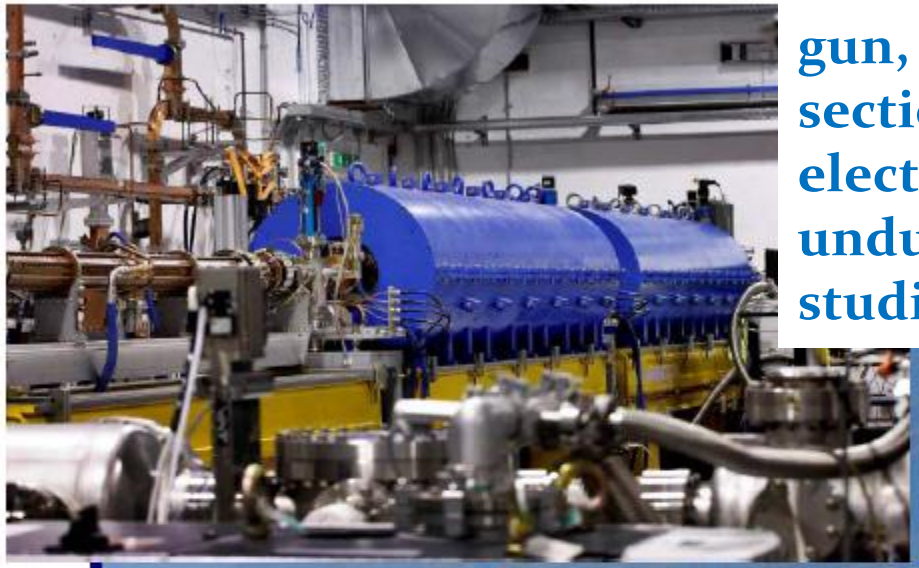

# WP8 – HGA

WP coordinator: M. Biagini (INFN). WP deputy: A. Gallo (INFN)

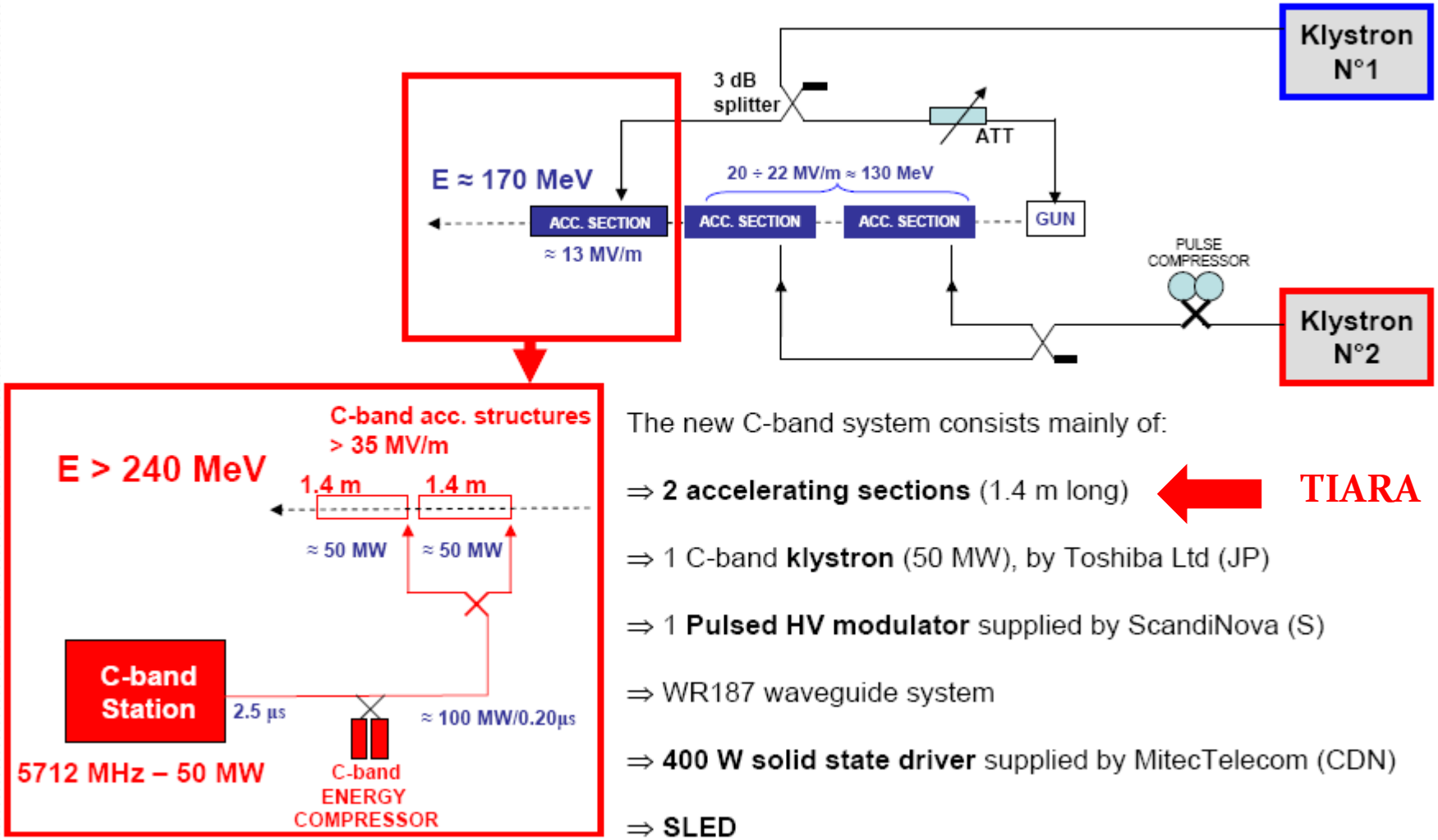
- Goal: energy upgrade of the Frascati SPARC test-facility linac by designing, constructing and commissioning 2 C-band (f=5712 MHz) TW high-gradient accelerating structures
- Partners: INFN, PSI, University of Rome "La Sapienza" as sub-contractor
- Duration: 3 years
- Work Breakdown:
  - WP8.1 : Study of SPARC upgrade in Energy (INFN)
  - WP8.2 : RF Low level Electronics for SPARC (PSI)
  - WP8.3 : Construction and test of 2 C-band sections (INFN)

# SPARC @ LNF

**SPARC:**
**Photoinjector with low emittance RF gun, 3 S-band sections for 170 MeV electrons, undulators for FEL studies**



# SPARC upgrade (hybrid S-C band)




The new C-band system consists mainly of:

⇒ **2 accelerating sections** (1.4 m long) ← **TIARA**

⇒ 1 C-band **klystron** (50 MW), by Toshiba Ltd (JP)

⇒ 1 **Pulsed HV modulator** supplied by ScandiNova (S)

⇒ WR187 waveguide system

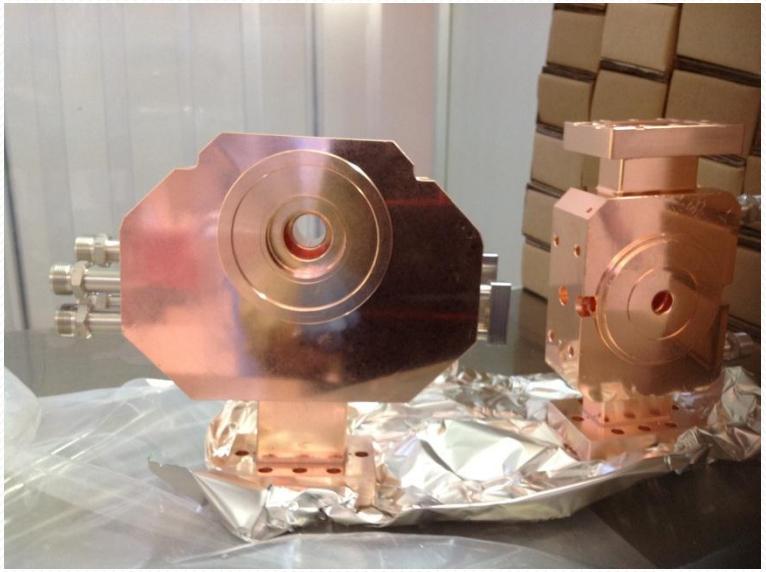
⇒ **400 W solid state driver** supplied by MitecTelecom (CDN)

⇒ **SLED**

# Task 8.1, 8.3 – C-band sections at LNF: status of design and fabrication

1) The cells of the **first accelerating structure** prototype have been fabricated

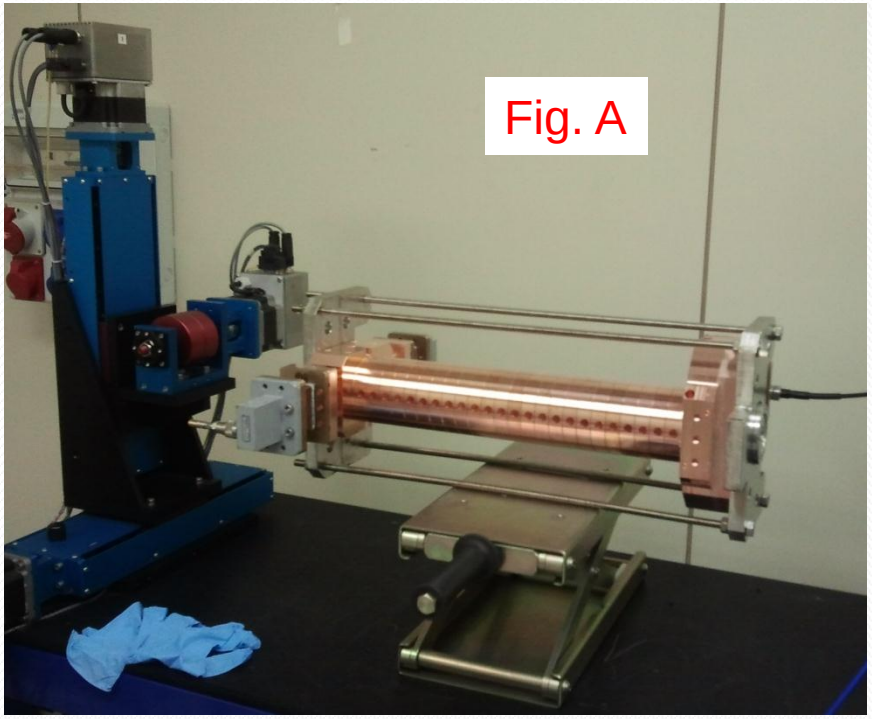
2) The **input/output couplers of the first accelerating** structure prototype have been fabricated and the brazing of the input and output couplers with vacuum stainless steel flanges has been done

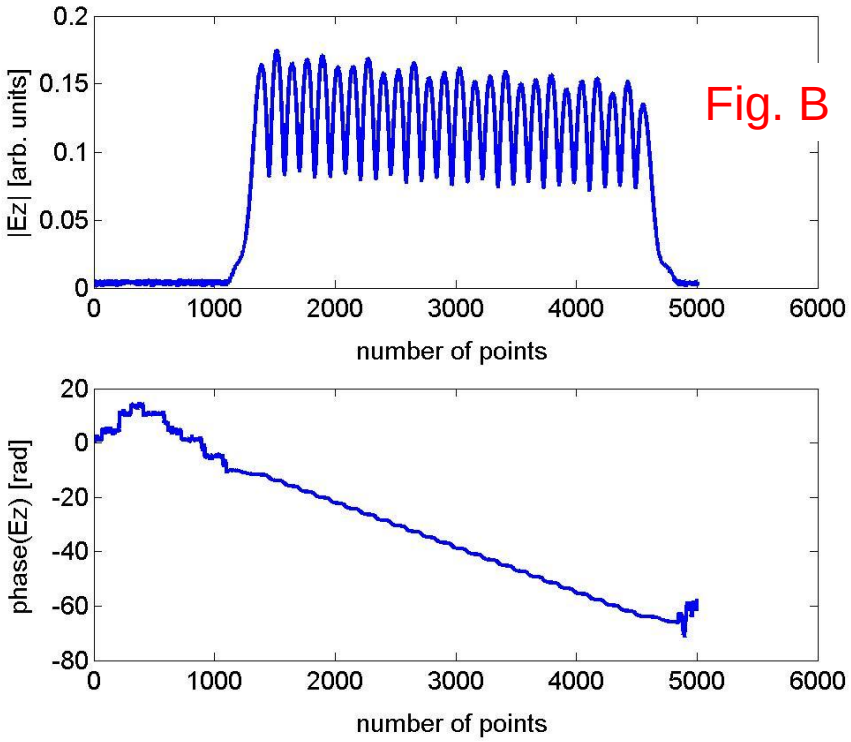


3) Preliminary RF measurements of pre-assembled structures (few cells + input and output couplers) have been done (see Fig. A). They are used to characterize the cells and monitor the quality of the input and output coupler realization. An example of measured accelerating field in magnitude and phase is given in Fig. B

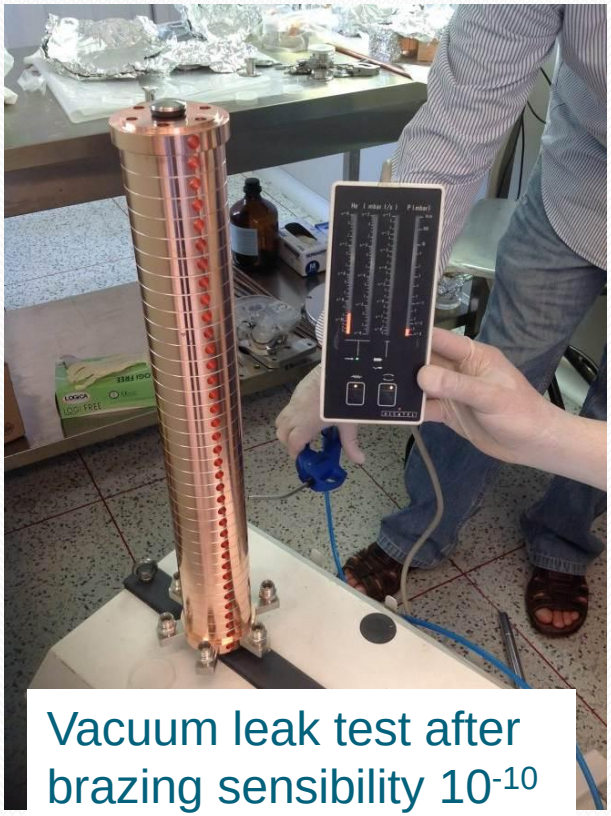
4) The cells of the **second accelerating structure** are still under fabrication

5) The **input/output couplers of the second accelerating** structure are still under fabrication



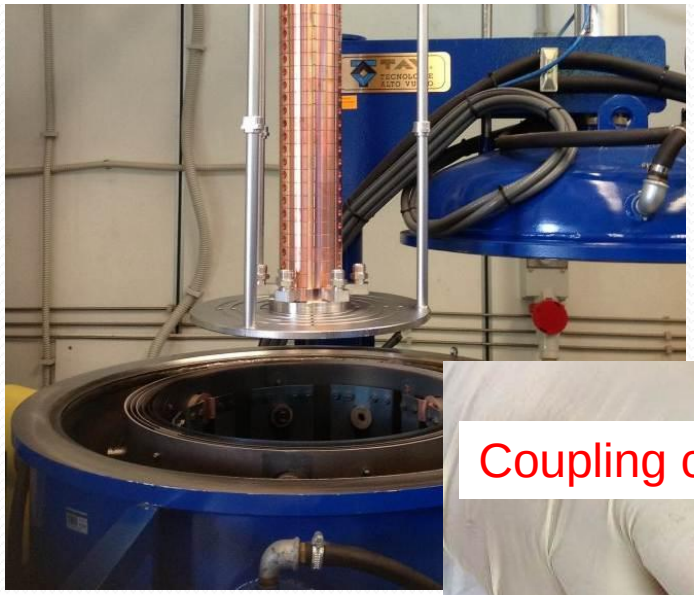



# Task 8.3 – C-band sections fabrication

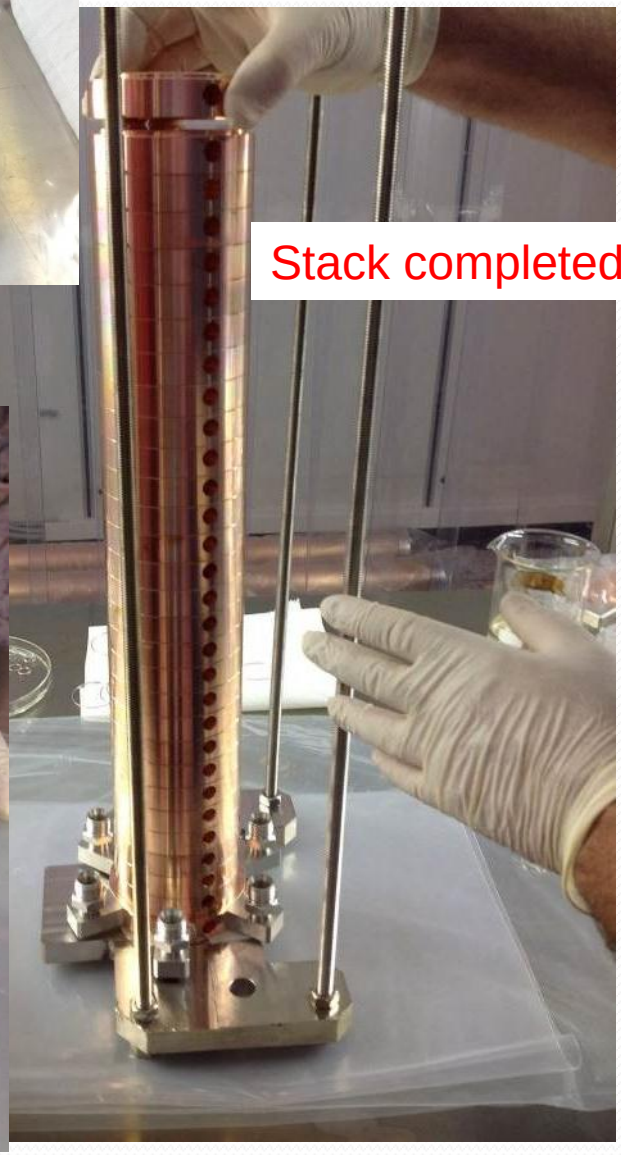
Vacuum leak test after brazing sensibility $10^{-10}$

Insert cells into the vacuum oven

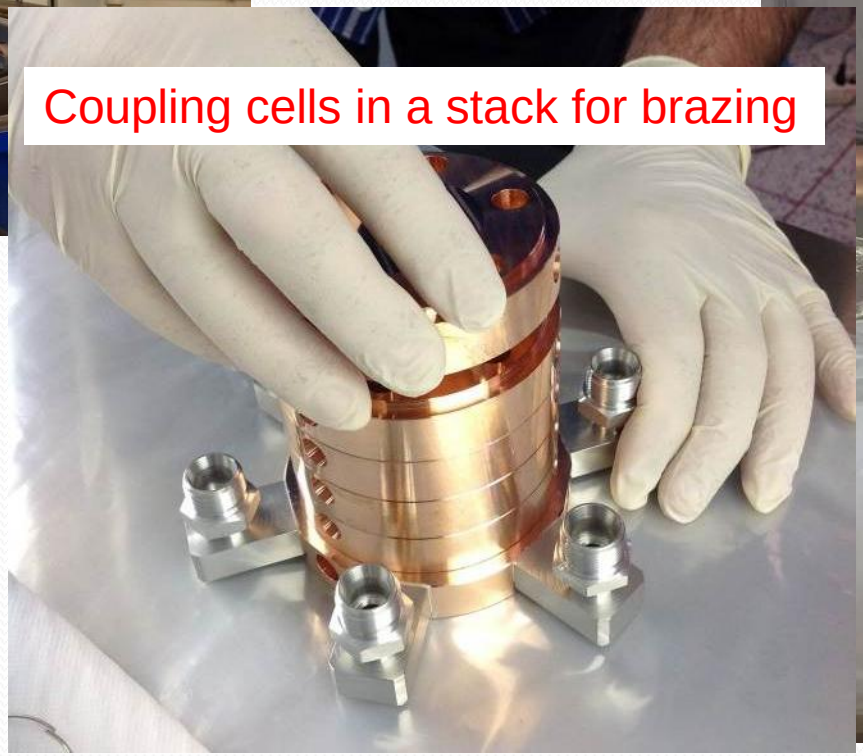


Insert rings for brazing

Stack completed



Coupling cells in a stack for brazing

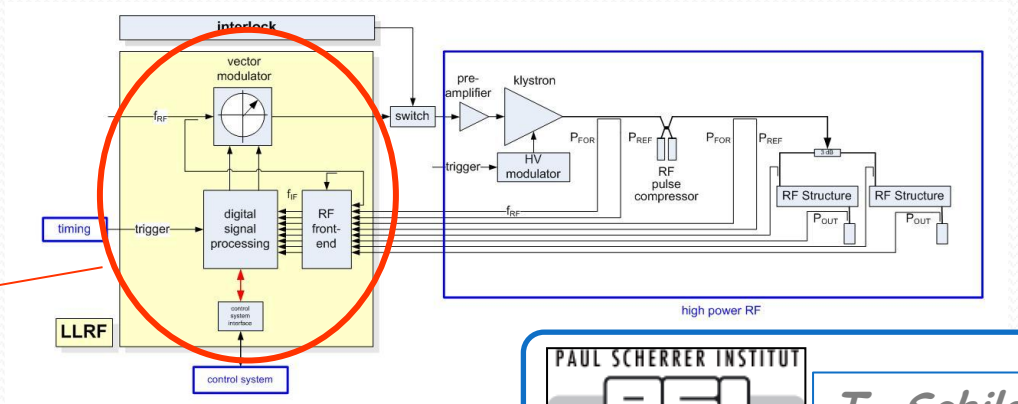


# Task 8.2 - RF Low Level Electronics for SPARC

- Task: design a flexible and high performance Low Level RF system for 5712 MHz (C-band)
- The control of high gradient C-band accelerating structures will be achieved by a digital low level RF (LLRF) system where all RF signals are down-converted to intermediate frequencies which are then digitized and processed on powerful digital processing platforms. The drive signal is finally up-converted to control the RF high power chain
- This system is studied and realized at PSI and will be tested at SPARC

## System layout

*scope of the WP 8.2*




PAUL SCHERRER INSTITUT PSI

T. Schilcher

This topic will be discussed
by Manuel Broennimann (PSI)
in the second half of my time slot

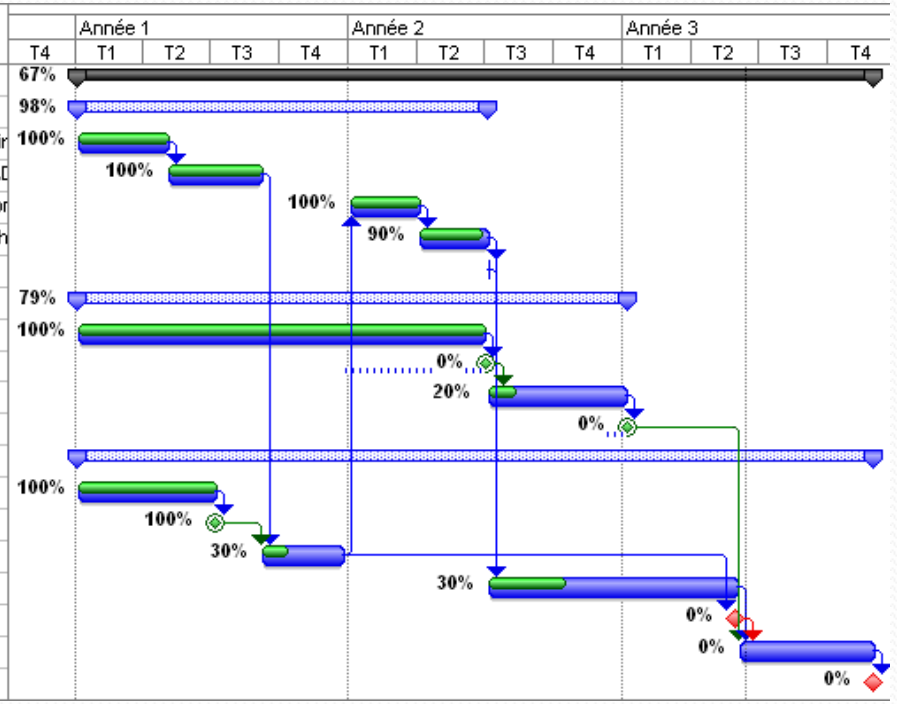
# Task 8.2 - LLRF at PSI → Milestone delayed

- Request from PSI to move Milestone 32 (RF-LLE-P) from Dec. 2012 to June 2013 (see letter from PSI Task leader T. Schilcher)
- Due to the tight specifications of the system the design work took longer than predicted, and an RF engineer who should have supported the senior RF engineer in the design has left PSI. As a consequence, a replacement needs to be hired and requires about 6 months to resume the work
- In the meanwhile, the design tasks of the RF front-end modules can only be processed sequentially instead of parallel as originally foreseen
- PSI is confident to deliver a C-band LLRF system which meets the specifications by the latest June 2013
- This delay (if kept to 6 months) means that the LLRF system will not be tested before its installation on SPARC. This may not represent a real problem, but the delay should not exceed the 6 months
- Discussion on this topic will be carried out during the WP8 parallel session today

# Milestones and time schedule

| Num | Short name | Description | Month | Status* |
|---|---|---|---|---|
| **MS29** | HARDW-A | Purchase of crucial hardware components | 6 | Achieved |
| **MS30** | ACC-D | Design of accelerator structures | 18 | Done at 90% |
| **MS31** | RF-LLE-D | Design LLRF | 18 | Achieved |
| **MS32** | RF-LLE-P | First LLRF prototype | 24 | In progress (to be delayed by 6 months) |

| N° | WBS | Task Name |
|---|---|---|
| 1 | **8** | **WP8: High Gradient Acceleration (HGA) R&D Infrastructure** |
| 2 | **8.1** | **8.1 SPARC-UP: Study of SPARC upgrade in energy** |
| 3 | 8.1.1 | 8.1.1 ACCP-DES: Design of a C-band accelerating structure prototype: simulation and optir |
| 4 | 8.1.2 | 8.1.2 ACCP-CAD: Design of a C-band accelerating structure prototype: preparation of CAD |
| 5 | 8.1.3 | 8.1.3 ACC-DES: Design of a C-band final accelerating structure: simulation and optimizatior |
| 6 | 8.1.4 | 8.1.4 ACC-CAD: Design of a C-band final accelerating structure: preparation of CAD mech |
| 7 | **M8.2** | **M8.2 ACC-D: Accelerating structures designed** |
| 8 | **8.2** | **8.2 RF-LLE: RF Low Level Electronic** |
| 9 | 8.2.1 | 8.2.1 LLE-DES: Design of a digital RF-LLE electronics |
| 10 | **M8.3** | **M8.3 RF-LLE-D: RF-LLE-D: Low Level Electronic RF designed** |
| 11 | 8.2.2 | 8.2.2 LLE-CON: Construction and test of a prototype at SPARC |
| 12 | **M8.4** | **M8.4 RF-LLE-P: RF-LLE-P: First RF-LLE prototype** |
| 13 | **8.3** | **8.3 SPARC_COIl: Construction and test of SPARC C-band section** |
| 14 | 8.3.1 | 8.3.1 HGA-HDW: Hardware and material acquisition |
| 15 | **M8.1** | **M8.1 HARDW-A: Hardware and material acquisition** |
| 16 | 8.3.2 | 8.3.2 ACC-PROT: Construction and test of an accelerating structure prototype |
| 17 | 8.3.3 | 8.3.3 ACC-CON: Construction of two final accelerating structures |
| 18 | **D8.1** | **D8.1 SPARC-C: Construction of accelerating structures finished** |
| 19 | 8.3.4 | 8.3.4 ACC-TEST: Test of SPARC C-band upgrade |
| 20 | **D8.2** | **D8.2 SPARC-T: Report on commissioning of accelerating structures** |



# Conclusions

- Tasks 8.1 and 8.3 are proceeding on schedule, procurement of hardware accomplished, design of cavities accomplished, assembling and brazing of cells in progress
- Task 8.2, design of LLRF system done
- Milestone 32 (LLRF prototype ready, PSI): a 6 month delay will allow for delivering the LLRF prototype with all specifications met