Irfu

cea

saclay

SAFIRS project overview

M.Durante

CEA Saclay - IRFU - SACM - LEAS

Outline

- SAFIRS project
- Framework
- SAFIRS : Organization, collaborations and funding
- SAFIRS - NbTi Triplets
- SAFIRS - Nb_3Sn HFM
- SAFIRS - HTS HFM

SAFIRS project

SAFIRS means

Supraconductivité dans les **A**imants du **F**utur :

Innovation et **R**echerche pour **S**LHC

Or

Superconducting magnet **A**ctivities

for **F**uture **I**nteraction **R**egions of **S**LHC

SAFIRS project coordinates IRFU/SACM activities on superconducting magnet developments for future upgrade of LHC

Framework : LHC Upgrade

LHC Interaction Region Phase I Upgrade (SLHC) → 2013

Increase of a factor of 2 with respect to the nominal luminosity, i.e 2 $10^{34}cm^{-2}s^{-1}$ while maximising the use of the existing infrastructure.

- Design high-luminosity ATLAS and CMS interaction region upgrades without changing the interfaces between the LHC and the experiments
- Stronger focusing of the beams to b*=0.25 m, replacing the present inner triplets with wide aperture quadrupole magnets

  → NbTi technology

LHC Interaction Region Phase II Upgrade → 2017

Increase of a factor of 10 with respect to the nominal luminosity, i.e. $10^{35}cm^{-2}s^{-1}$

New magnets for the arcs and Interaction Regions, beyond NbTi technology

New tests facilities

→ Nb_3Sn technology

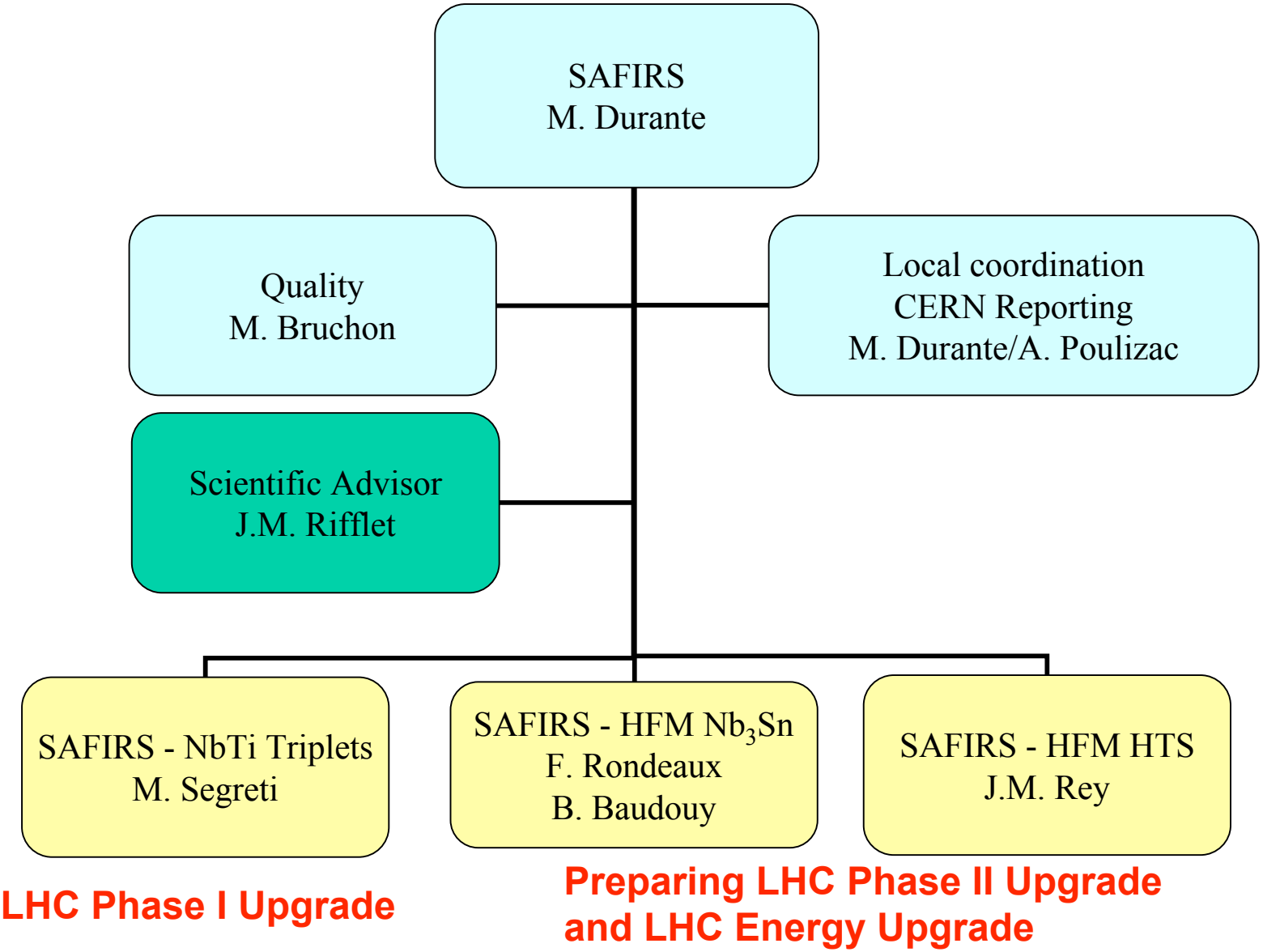
LHC Energy Upgrade → LHC doubler → after 2020

Increase of a factor of 2 the nominal energy

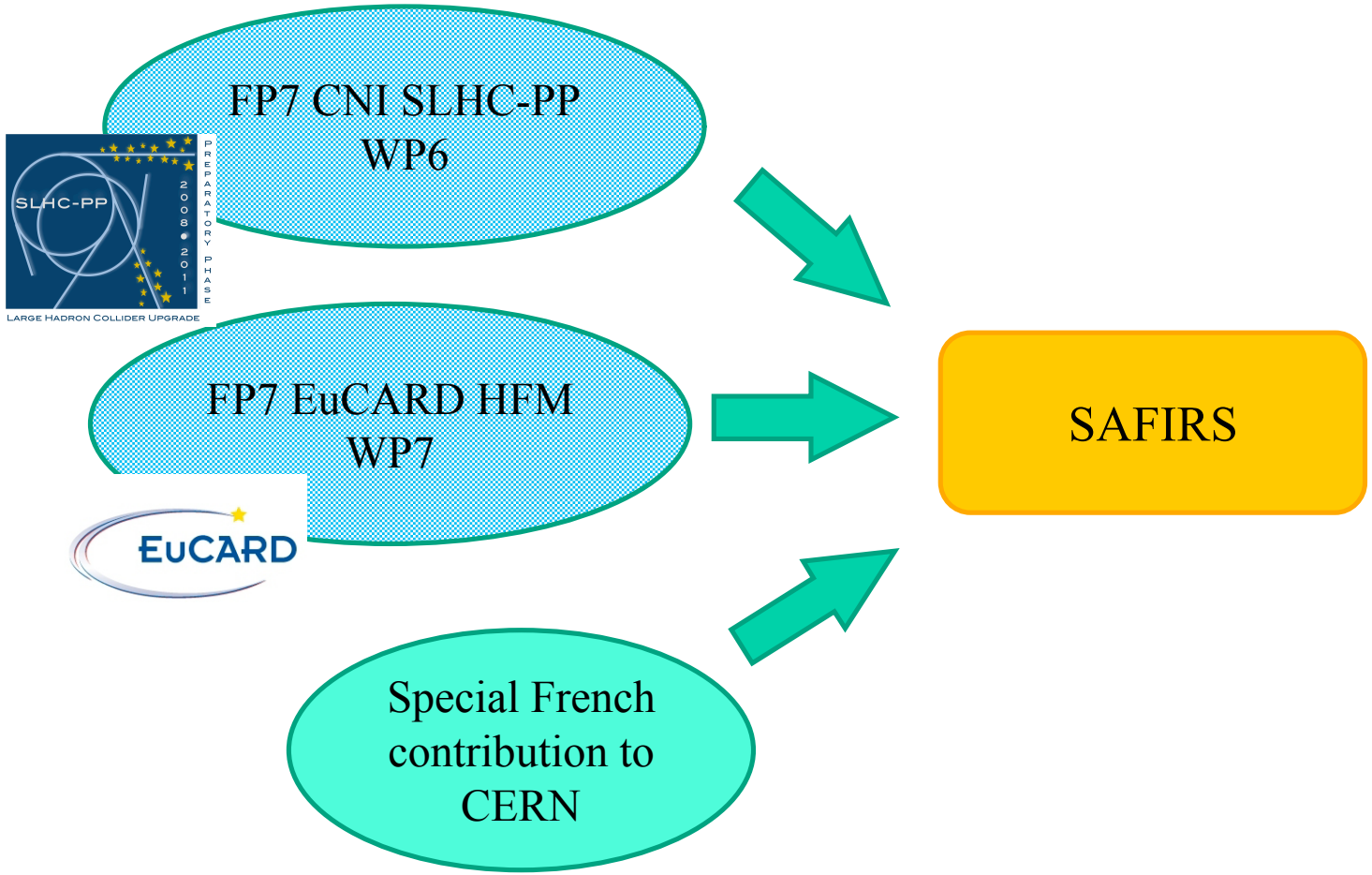
Magnets in the 20 T range will be needed

→ hybrid HTS-Nb_3Sn magnets

SAFIRS organization



SAFIRS - Collaborations and funding

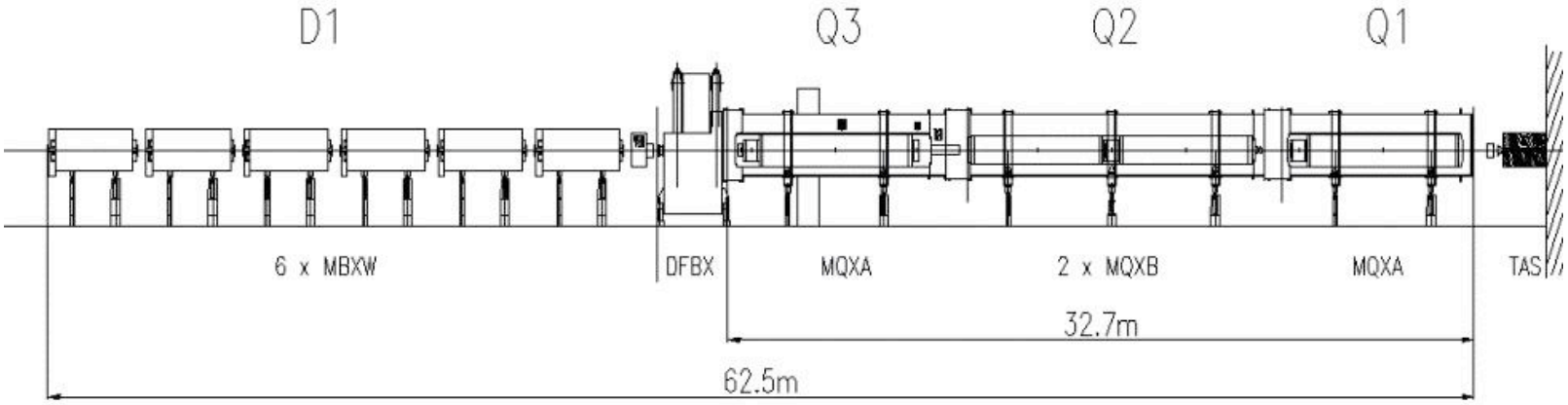


SAFIRS - NbTi Triplets

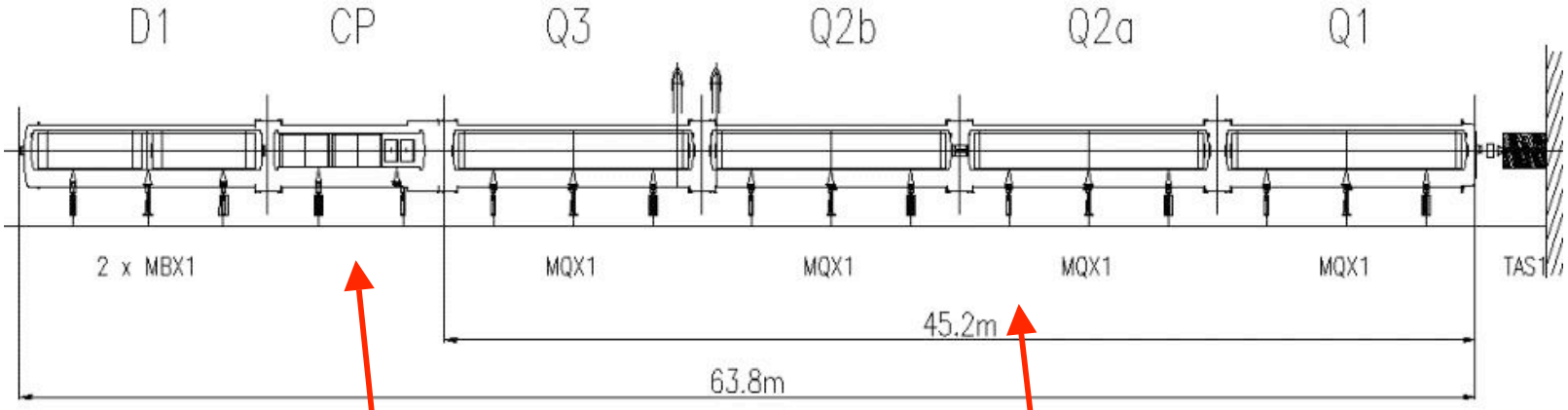
In collaboration with CERN, CNRS-IN2P3, CIEMAT and STFC

- Designing inner triplet low beta quadrupole and corrector magnets
  Quadrupole magnet designing by CERN and CEA
  Corrector magnet designing by CERN, CIEMAT and STFC
- Manufacturing and cold testing a short Nb-Ti quadrupole model in order to qualify the retained procedure and the actual field quality
  Model coil manufacturing by CEA
  Model assembling and testing at CERN, with the participation of CEA
- Constructing and testing a full scale prototype made of a complete quadrupole with the cryostat and the correctors.
  Quadrupole prototype manufacturing at CERN, with the participation of CEA
  Corrector prototype manufacturing by CERN, CIEMAT and STFC
- Production of components for quadrupole magnets for S-ATLAS and CMS2 Interaction Regions
  - Quench heaters
  - Cold tubes
  - Collars
- Production of corrector magnet packages for S-ATLAS and CMS2 Interaction Regions

SAFIRS - NbTi Triplets : Triplet layout



LHC present triplet

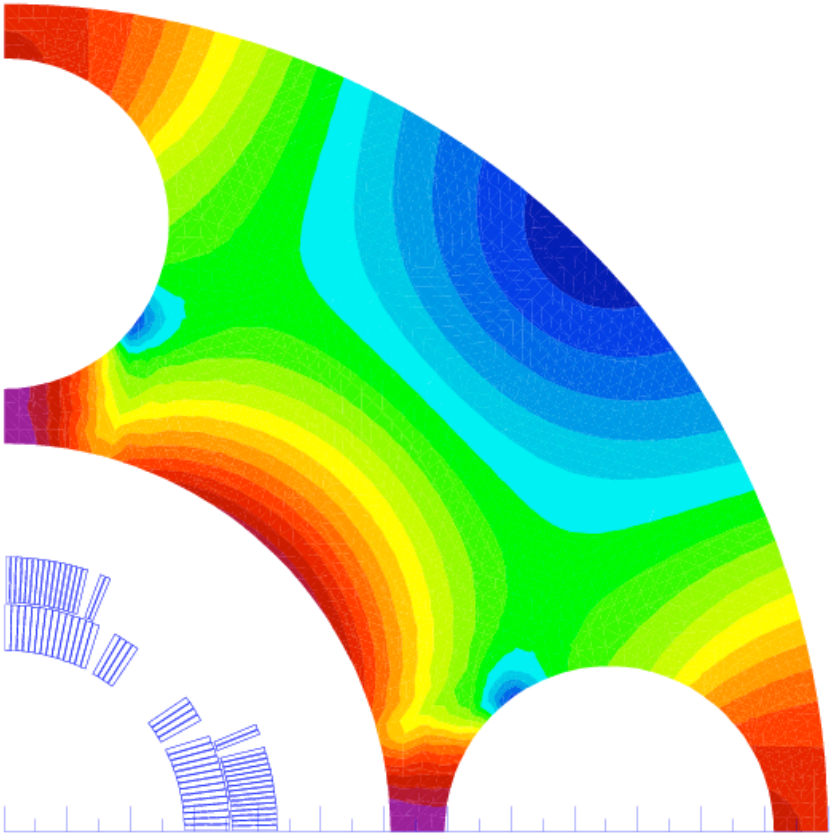


Phase-I Triplet

Separate cryo-unit for corrector magnets

Four cryo-quadrupoles :
- same length of about 10.3 m
- or 2 units of 10.3 m + 2 units of 8.8 m

SAFIRS - NbTi Triplets : Low-β quadrupole design



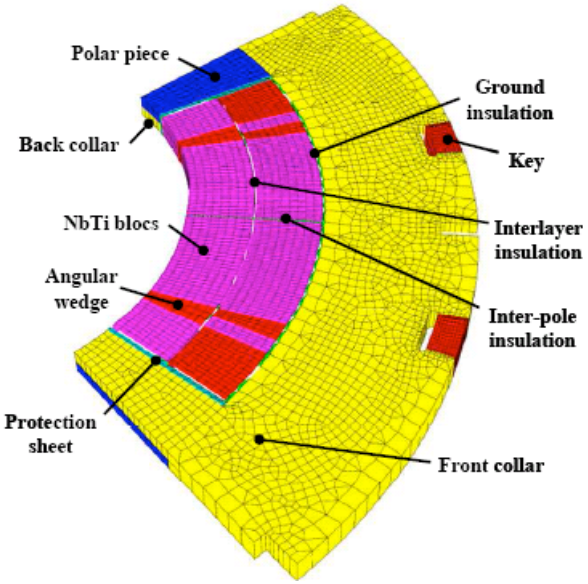
- Coil aperture 120 mm
- Gradient 120 T/m
- Operating temp 1.9 K
- Current 13 kA
- Inductance 5 mH/m
- Yoke ID 260 mm
- Yoke OD 550 mm

- LHC main dipole cables
- Enhanced cable polyimide insulation
- Self-supporting collars
- Single piece yoke
- Welded-shell cold mass

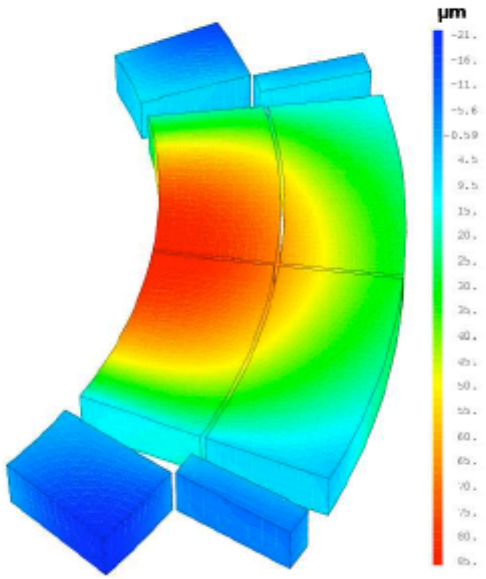
SAFIRS - NbTi Triplets : Low-β quadrupole design

Coil electromagnetic design is under optimization at CERN → End of April

Mechanical design will then be optimized at CEA → End of May



Model 1

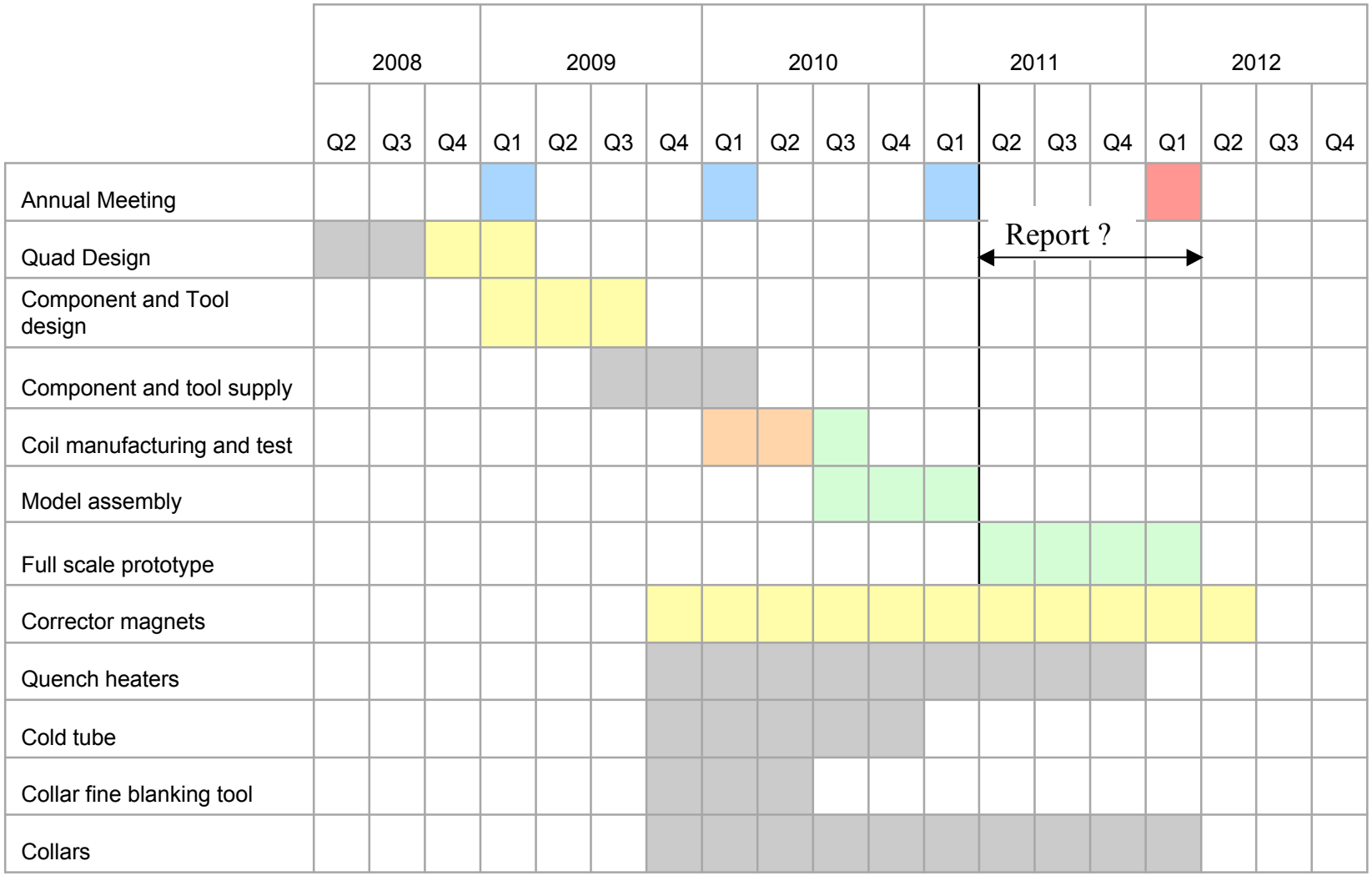


Coil radial displacement due to Lorentz forces

Coil manufacturing tool design has been started at CEA

SAFIRS - NbTi Triplets : Schedule (to be confirmed)

1 year report to be confirmed

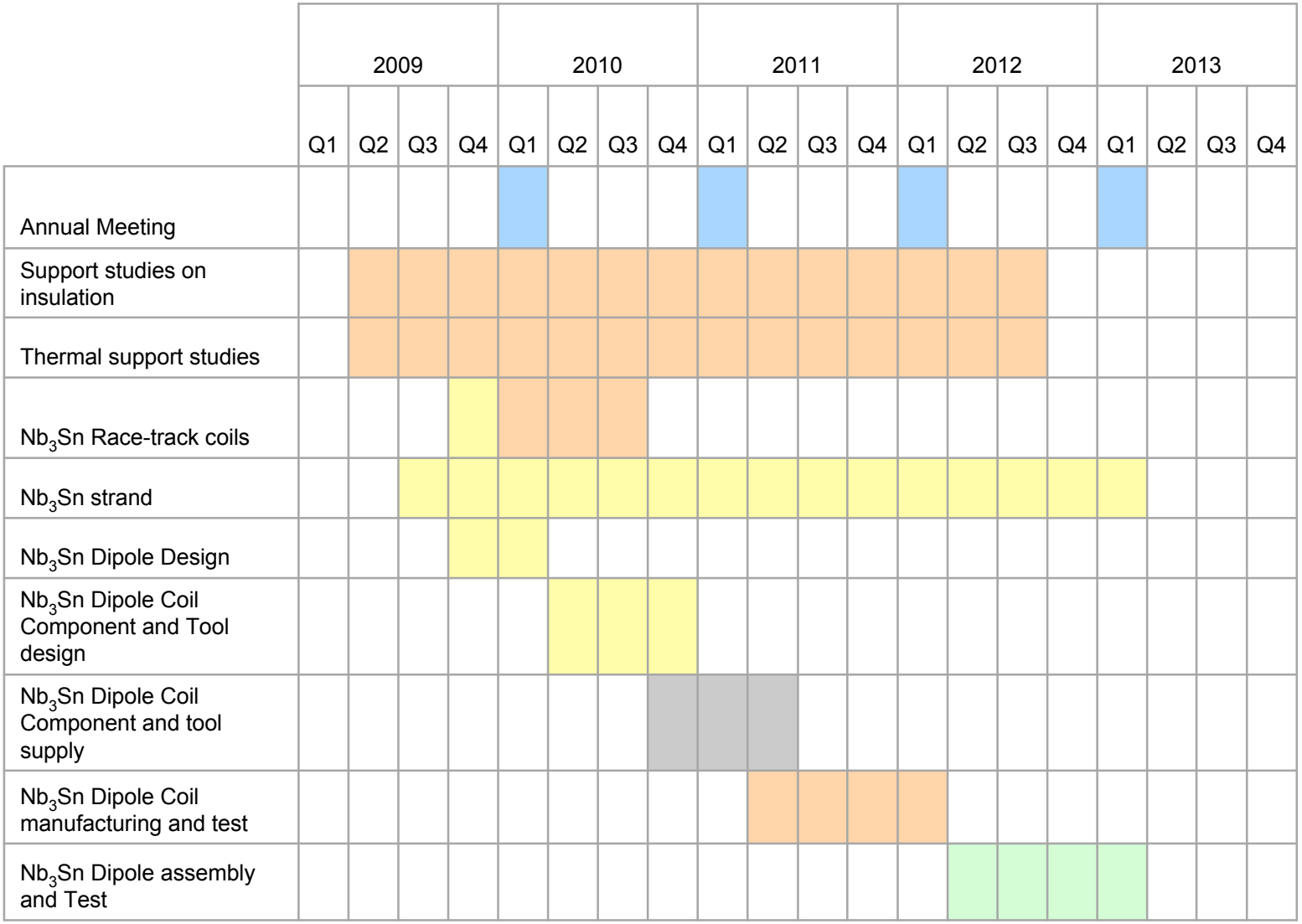


SAFIRS - HFM Nb_3Sn

In collaboration with CERN and Wroclaw Technical University

- Design, build and test a 1.5 m long, 100 mm aperture dipole model with a design field of 13 -15T using Nb_3Sn high current Rutherford cables.
  Nb_3Sn dipole coil will be manufactured at CEA - Saclay
  Nb_3Sn dipole magnet will be assembled at CERN.
- Support studies on insulation system : certify radiation resistance of radiation resistant coil insulation and impregnation.
- Support studies on thermal models : make a heat deposition and heat removal model for the dipole Nb_3Sn model with experimental validation and determine the thermal coil design parameters for the dipole model magnet.
- Manufacture Nb_3Sn racetracks coil with classical and with ceramic insulation to be tested in SMC test facility at CERN.
- Production of Nb_3Sn strand for future developments.

SAFIRS - HFM Nb_3Sn : Schedule (to be validated)



SAFIRS - HFM HTS

In collaboration with CNRS Grenoble, FZK, INFN-Milano, Tampere University of Technology, UNIGE, Wroclaw Technical University.

- Design, build and test HTS solenoid insert coils for a solenoid background magnet aiming at a field increase up to 6 T.
- Conductor specification and characterization.
- Support studies on quench model
- Design a HTS dipole insert for Nb_3Sn dipole of HFM Nb_3Sn aiming at a field increase of about 6 T.
- Dipole insert Coil manufacturing and assembly.

SAFIRS - HFM HTS : Schedule (to be validated)

	2009				2010				2011				2012				2013			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Annual Meeting																				
Preliminary studies																				
Design studies																				
Manufacturing and heat treatment tools																				
Insert manufacturing																				