MAGNET STATUS AND OPEN ISSUES

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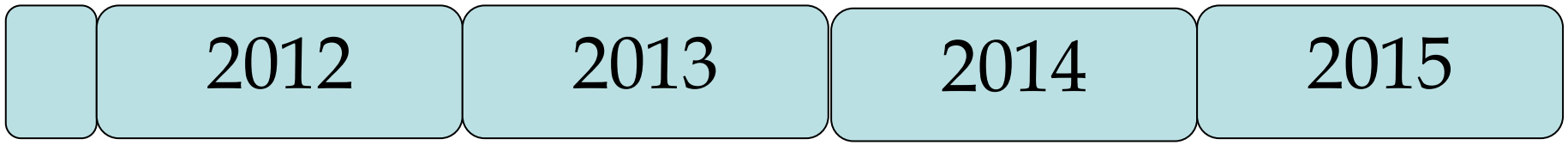
PROJECT TIMELINE

Exploration of four layouts 120/140 mm Nb_3Sn Nb-Ti

Selection of 150 mm aperture for triplet



Start of D1 design

Start of triplet design
Start of Q4 design

Selection of apertures, technology, field, lengths, margin – first baseline Q1-D1
Radiation damage, shielding, heat loads for 150 mm layout, cooling scheme

Layout Q1-D1-D2-Q4

Target:
Models tested

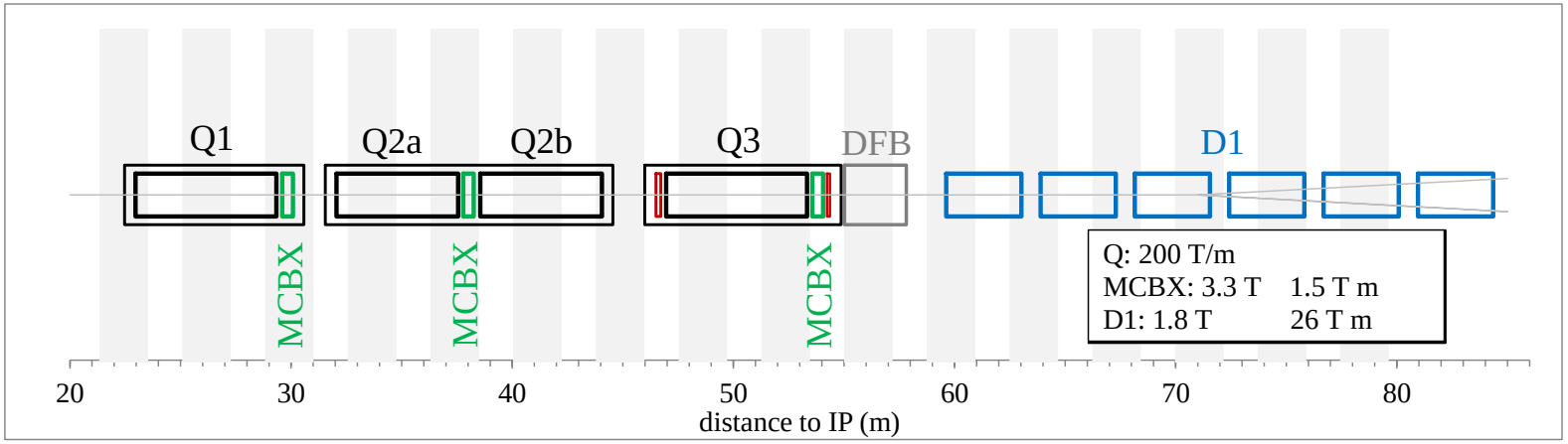
WHERE ARE WE

- Past six months
  - Engineering design phase for Q1-3, D1, Q4 [P. Ferracin, T. Nakamoto talks]
  - First analysis of D2 conceptual design [G. L. Sabbi, R. Gupta talk]
  - Integration issues [see P. Fessia talk]
  - Beam screen [see R. Kersevan talk]
  - Cooling [see R. V. Weelderen talk]
  - First energy deposition on D2, Q4, and matching section [see F. Cerutti talk]

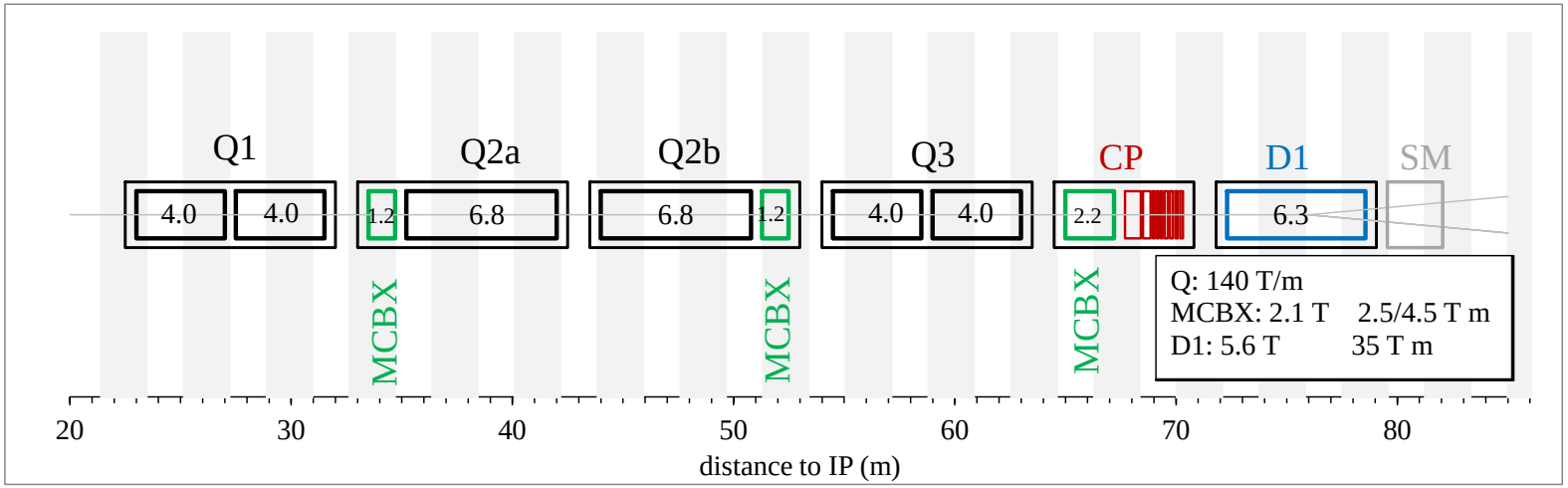
LAYOUT

Thick boxes are magnetic lengths
Thin boxes are cryostats

LHC

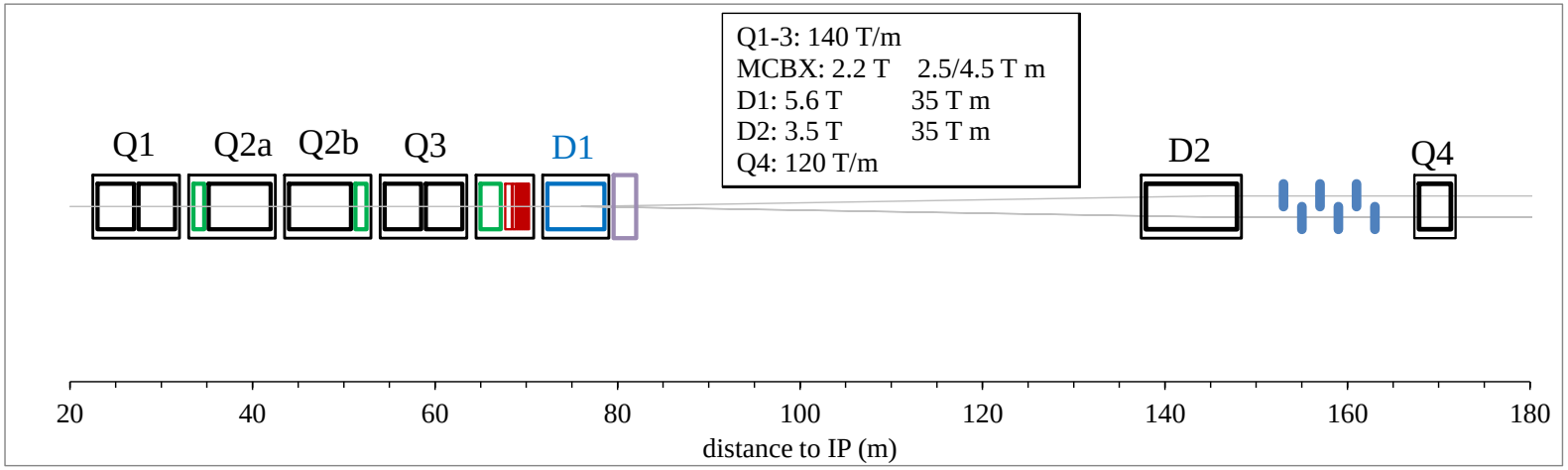


HL LHC



LAYOUT AFTER D1

Thick boxes are magnetic lengths
Thin boxes are cryostats



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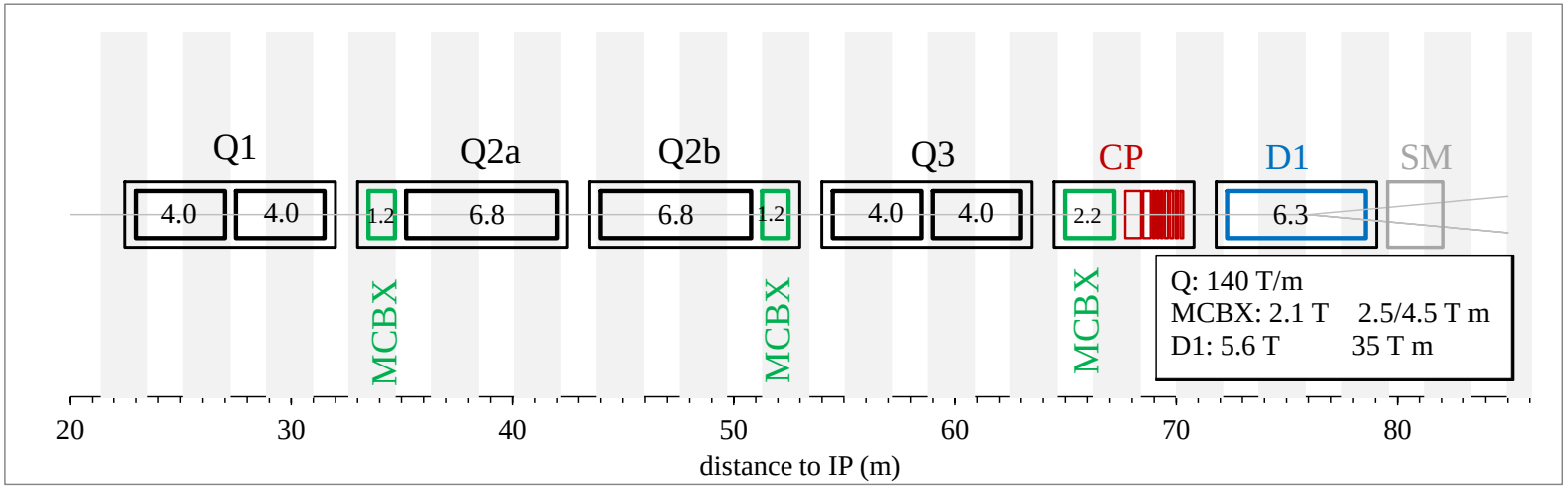
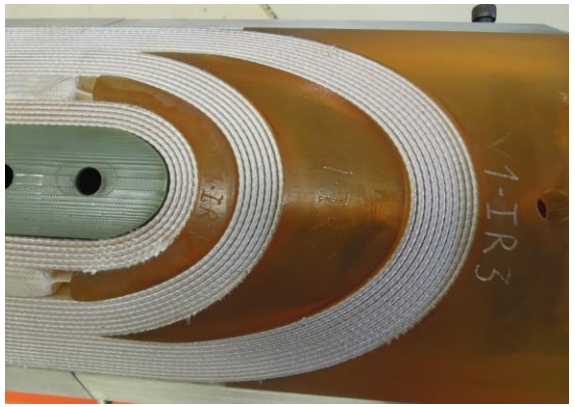


HL LHC

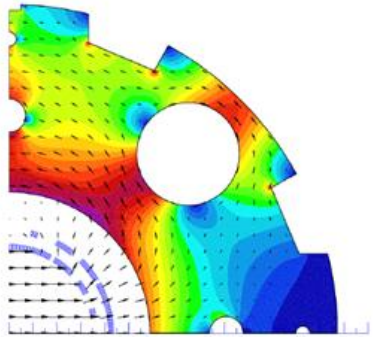
TRIPLETS

- Design completed [see P. Ferracin talk]
  - Procurement in progress
- First dummy coils wound at CERN and in US
  - Two strands manufacturers
- Cryostat design being addressed
  [D. Duarte Ramos, M. Anarella]
- HQ (120 mm, father of QXF)
  - HQ02 succesful second test at FNAL
    - 89% short sample at 2.2 K achived
    - 80% after thermal cycle without training
  - HQ03 coils in progress, test in 2014
- Plans
  - 5 short models foreseen, first in mid 2015
  - 3 prototypes, first in end 2016



ORBIT CORRECTORS

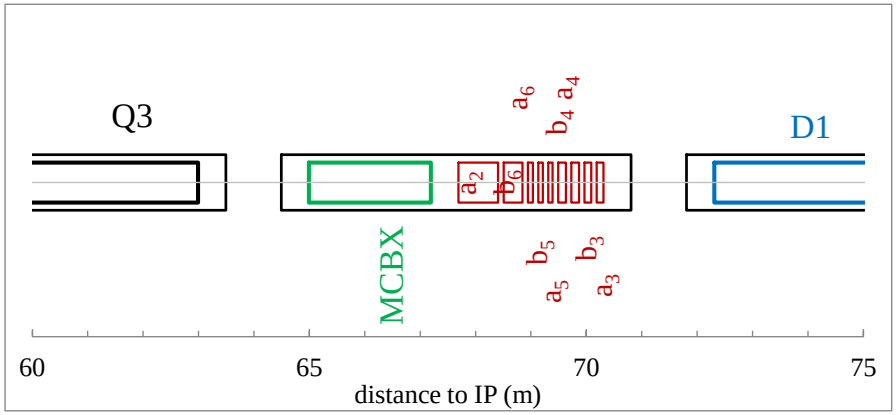
- Field 2.1 T (in each plane)
  - Two lenghts, 1.2 and 2.2 m
  - Nb-Ti, Rutherford cable 4.5 mm width of SLHC, wide margin
  - Mechanical lock needed
- Construction of a 1.2-m-long prototype by CIEMAT (ES)
  - January 2014 – kick off
  - June 2014 – conceptual design
  - February 2015 – engineering design
  - June 2016 – test at 4.2 at Ciemat
  - November 2016 – test at 1.9 K at CERN
- Options
  - Raising the field to 3 T, and having a larger cable width
  - This would leave 40 cm more around Q1, Q2, and 80 cm more around Q3

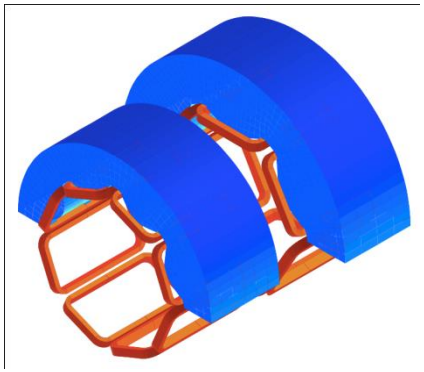


Orbit corrector design for SLHC
[M. Karppinen, D. Smekens]

NONLINEAR CORRECTORS

- Superferric technology used for SLHC
  - No nested, easier operation
  - Short heads
  - Pole field of around 2 T
  - About 10% saturation
- Main choices to be done
  - Iron shape and alignement
  - Wire and insulation
- Construction of 5 prototypes by INFN
  - January 2014 – kick off
  - March 2015 – sextupole test
  - March 2016 – octupole and decapole test
  - July 2016 – Quadrupole and dodecapole test

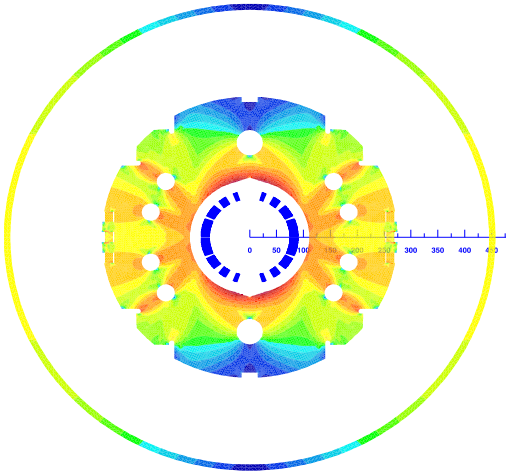




Superferric correctors
[F, Toral]

D1

- Field: 5.6 T, length 6.25 m
  - Nb-Ti technology, LHC dipole outer layer cable
  - Challenges: large aperture, large saturation

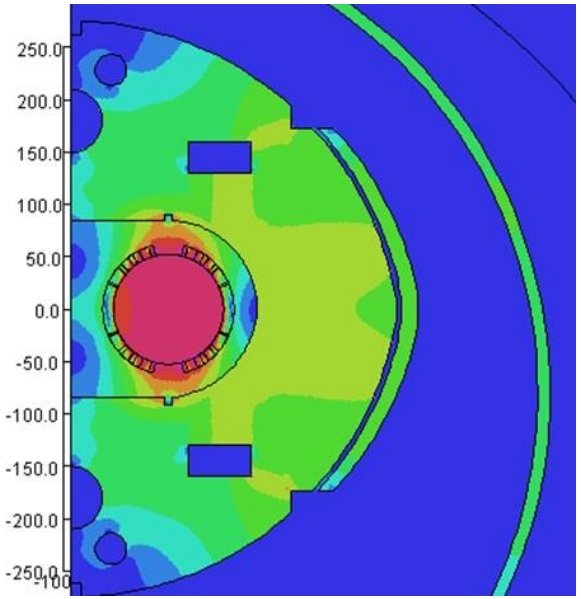


D1 design
[Q. Xu, T. Nakamoto]

- Recent design tuning
  - Margin reduced from 30% to 25%
    - Field increased from 5.2 to 5.6 T, length from 6.7 to 6.25 m
    - Mainly done to fit test station constraints
- Construction of a short (2-m-long) model by KEK
  - Mid 2015: short model test
  - 2016-2017: tentative dates for full prototype including cryostat
  - 2018-2011: production of 4+2 magnets

D2

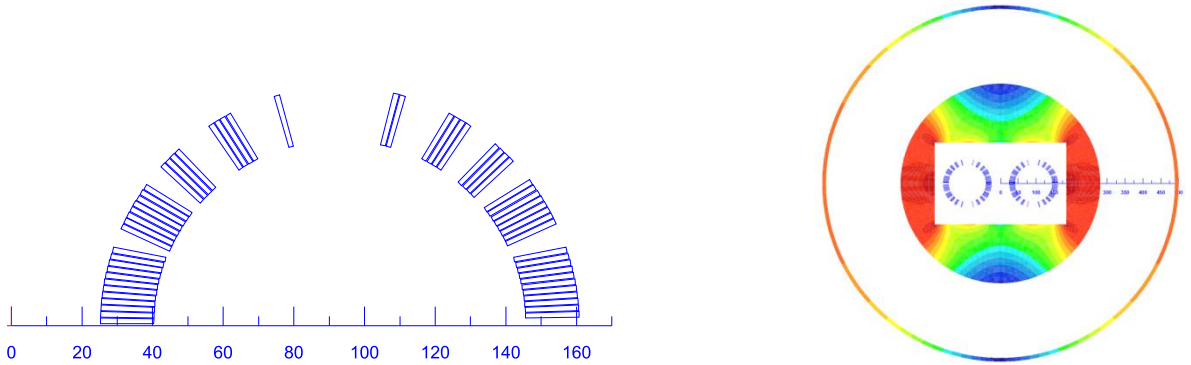
- This is the magnet less developed
- Specifications: 35 T m, max lenght of 10 m, 105 mm aperture
- Challenges: strong cross-talk, large fringe field
  - Better to stay with low field of 3.5 T with 10 m length
- Iron shaping to optimize field quality
  - Work is in progress
  - Saturation can be compensated, but
    - compensation of cross talk is critical
  - Field has the same direction in apertures
    - This complicates the situation
    - And adds fringe field



D2 design [R. Gupta]

D2

- Another option being explored
  - Left-right asymmetric coil to compensate cross-talk

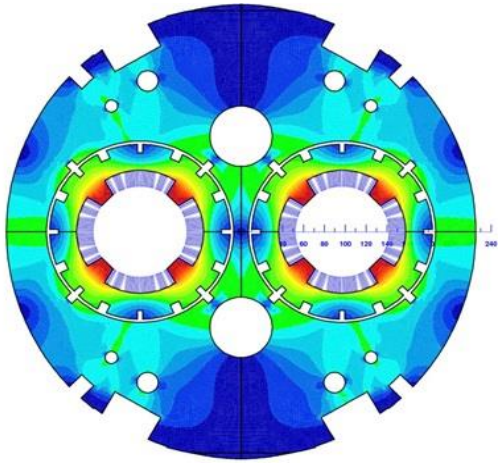


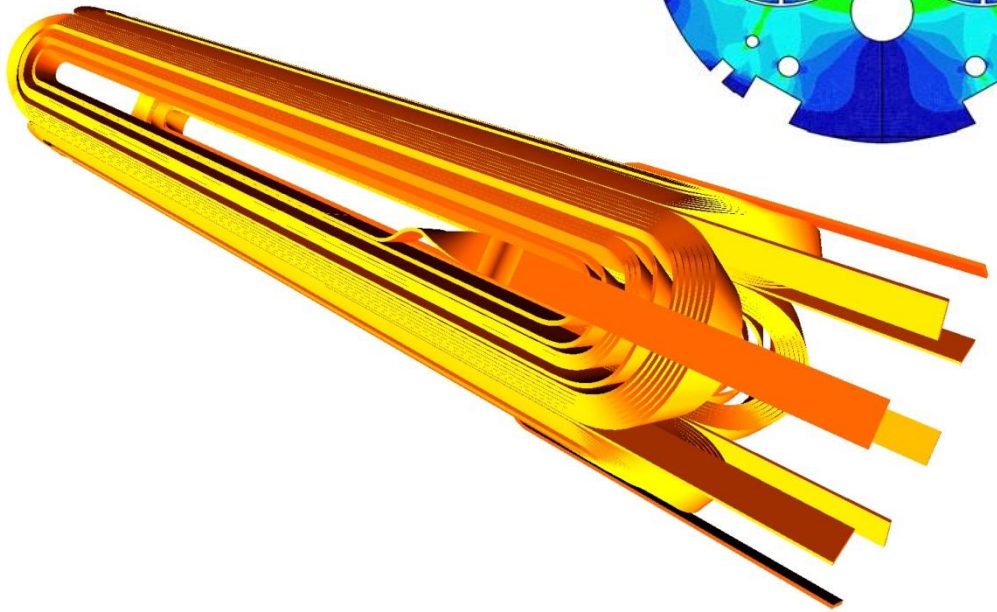
Ironless D2 with asymmetric cross-section [X. Wang, G. L. Sabbi]

- D2 design will be taken over by INFN-Genova
  - Conceptual design starting from 2014
  - June 2015: Magnetic design
  - December 2015: Mechanical design
  - December 2016: Engineering design

Q4

- Design done, engineering details being completed
- Agreement with CEA-Saclay for single aperture 2-m-long model [J. M. Rifflet, M. Segreti]
  - December 2014: engineering design completed
  - September 2015: first coil
  - June 2016: test





- One layer
  - LHC dipole cable
  - 20% margin

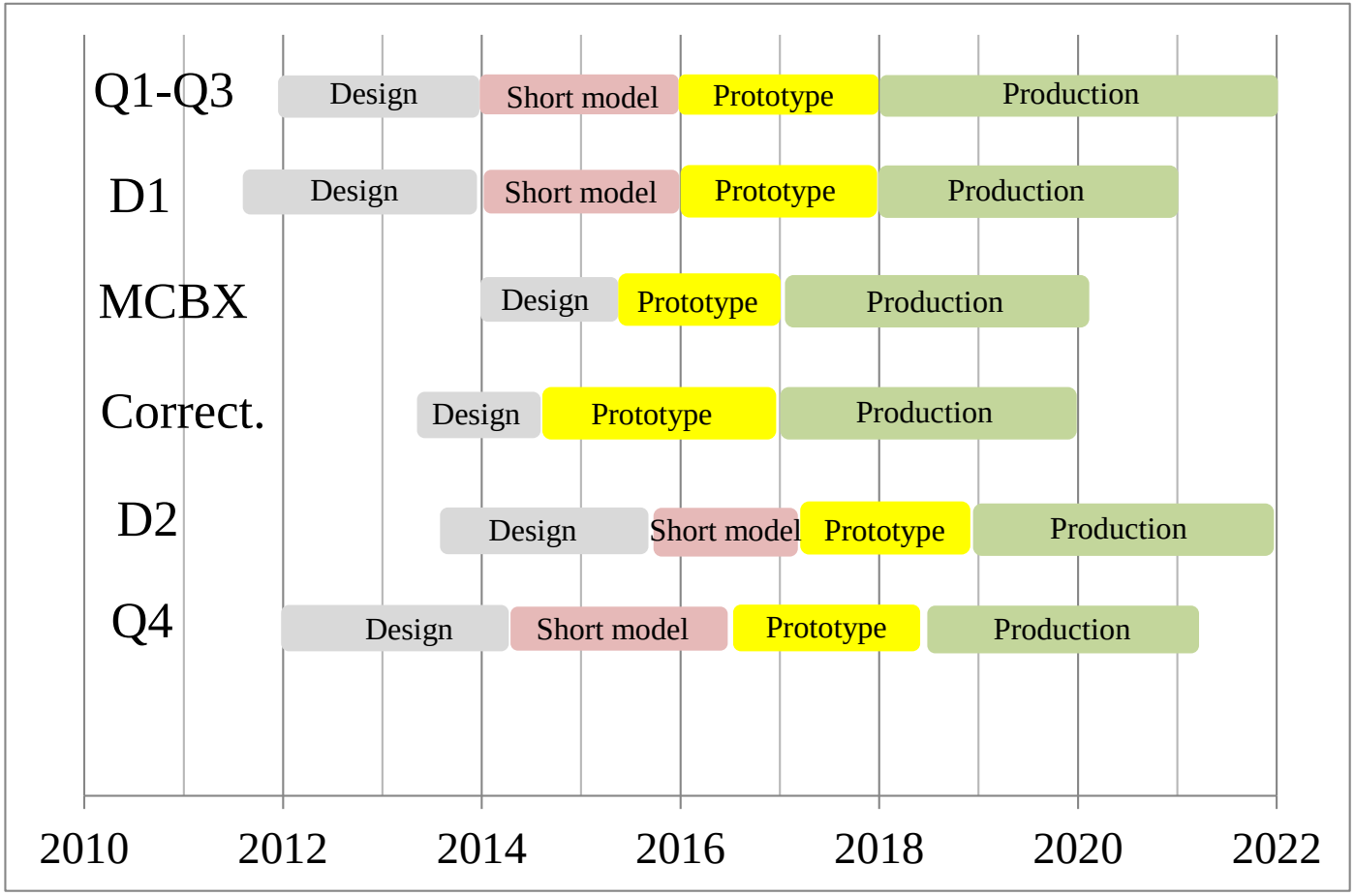
SUMMARY OF DESIGN CHOICES

		Triplet Q1,Q3/Q2a,b	Orbit corrector MCBX	Sep. dipole D1	Recom. dipole D2	Large 2-in-1 quad Q4
Aperture	(mm)	150	150	150	105	90
Field	(T)		2.1	5.6	3.5	
Gradient	(T/m)	140				120
Mag. Length	(m)	8.0/6.8	1.2/2.2	6.3	10.0	4.5
Int field	(T m)		2.5/4.5	35	35	
Int gradient	(T)	1120/938				544
Peak field	(T)	12.1	3.9	6.5	4.1	5.9
Current	(kA)	17.5	2.2	11.8	6.8	16.0
j overall	(A/mm^2)	528	455	1816	1040	2458
Loadline margin	(%)	18%	45%	25%	56%	20%
Stored energy	(MJ/m)	1.440	0.090	0.338	0.140	0.204
Saturation	(%)	9.0%	0.0%	12.0%	13.0%	
Material		Nb_3Sn	Nb-Ti	Nb-Ti	Nb-Ti	Nb-Ti
N. layers		2	1+1	1	1	1
Cable width	(mm)	18.1	4.37	15.1	15.1	15.1

TENTATIVE PLAN

Note: phases overlap, for each year we show the dominant phase

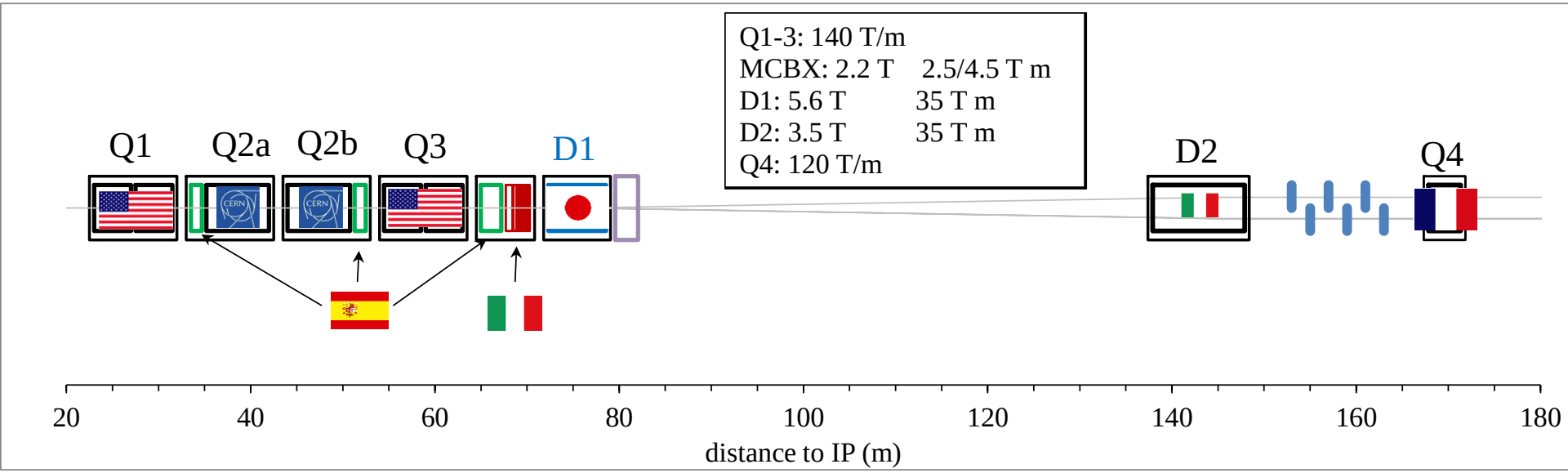
Note: short model partly includes final part engineering design



A GLOBAL PROJECT

As for Charles V empire, the sun never sets on HiLumi

this poses some problems when organizing videconferences



Note: models/prototypes agreed, production partly to be attributed

Note: Italy contribution to D2 is design only, model TBD

CONCLUSIONS

- Design phase being completed for triplet, D1, Q4
  - First dummy coil wound for the triplet
  - Good quench performance of HQ02
  - First short models in 2015
- Design phase for orbit correctors and non linear correctors
  - To be started in 2014 – CIEMAT and INFN
- Design phase for D2 (LARP, then INFN)
  - Conceptual design in progress
- Agreements being signed for the model phase
  - Aiming at having first models in 2015, models of all magnets by 2016
- First analysis of integration aspects
- First planning for prototypes and production