# HO Corrector Magnets: decapole test and future plans

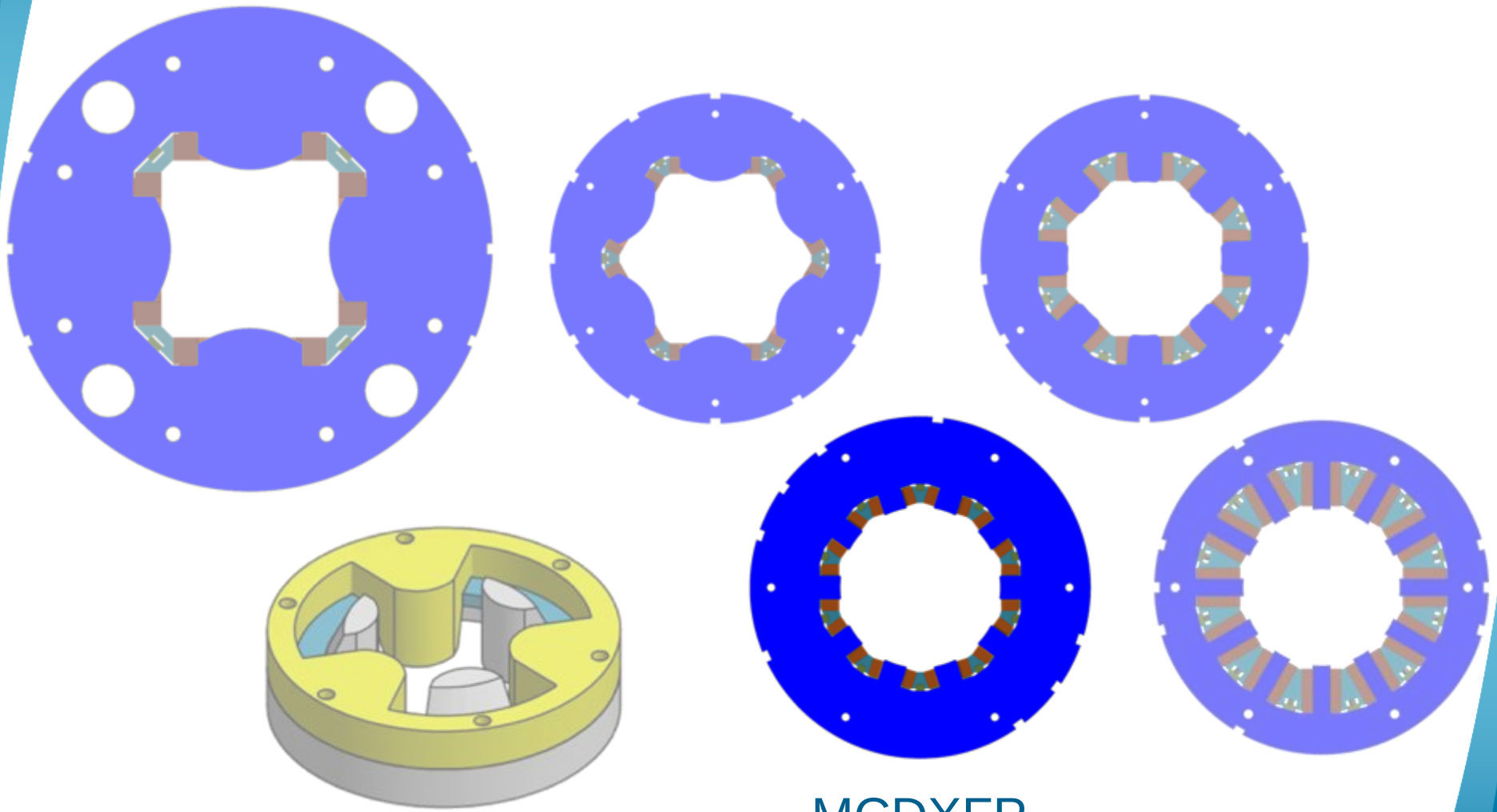
Marco Statera
on behalf of the LASA team
INFN Milano - LASA

CERN – 4 Octobre 2017

# OUTLINE

- MCDXFP (decapole)
  - assembly
  - first cooldown results
- MCQSXFP (4pole) and MCTXFP(12pole) planning
- $MgB_2$ RCSM status and planning

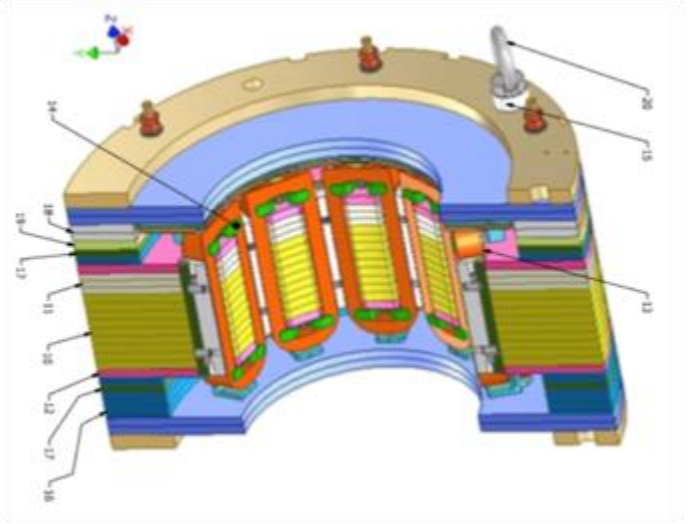
# HO CORRECTOR MAGNETS ZOO

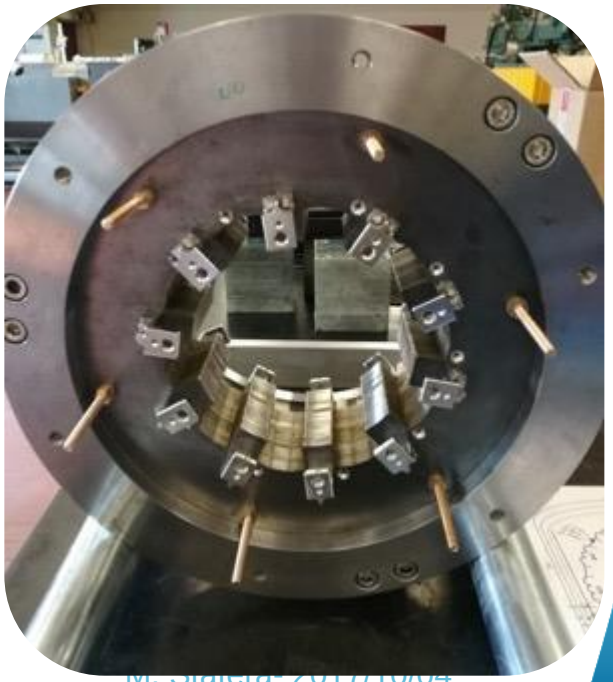


MCDXFP

# MCDXFP 10POLE

| | nominal | simulation |
|---|---|---|
| length | 172 mm | 183 mm |
| integrated field @ Iop @ r50 mm | 25 Tmm | 26 Tmm |
| magnetic length | 95 mm | 97 mm |
| harmonics | | B15=11.6<br>B25=-0.7 |

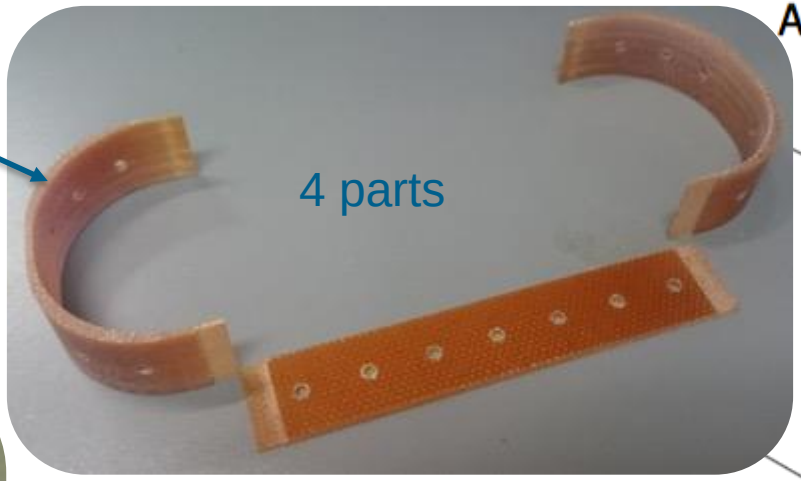




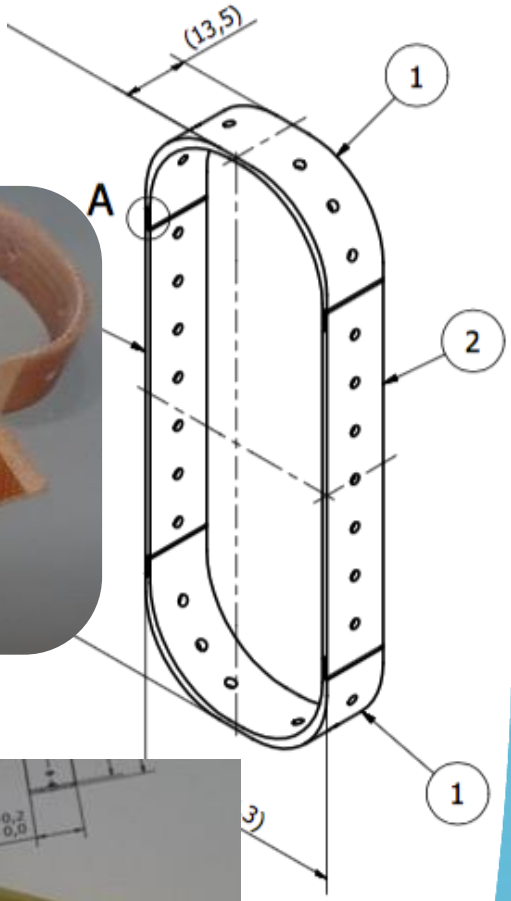
- COILS
  - Updated BTS2 Arisawa design
  - Hybrid BTS2/DURATRON
- Improved electrical connection design

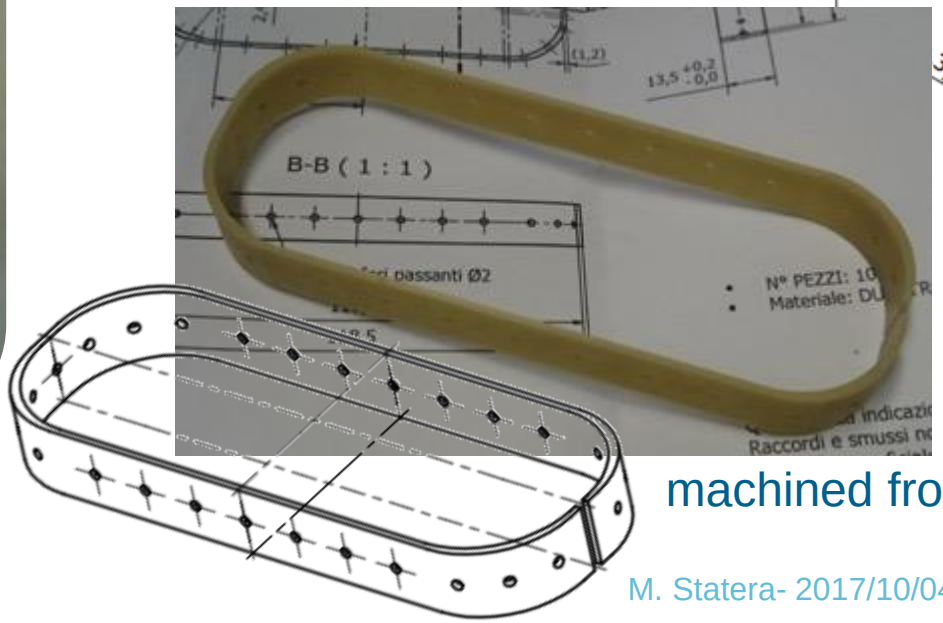
# COILS

machined from bulk





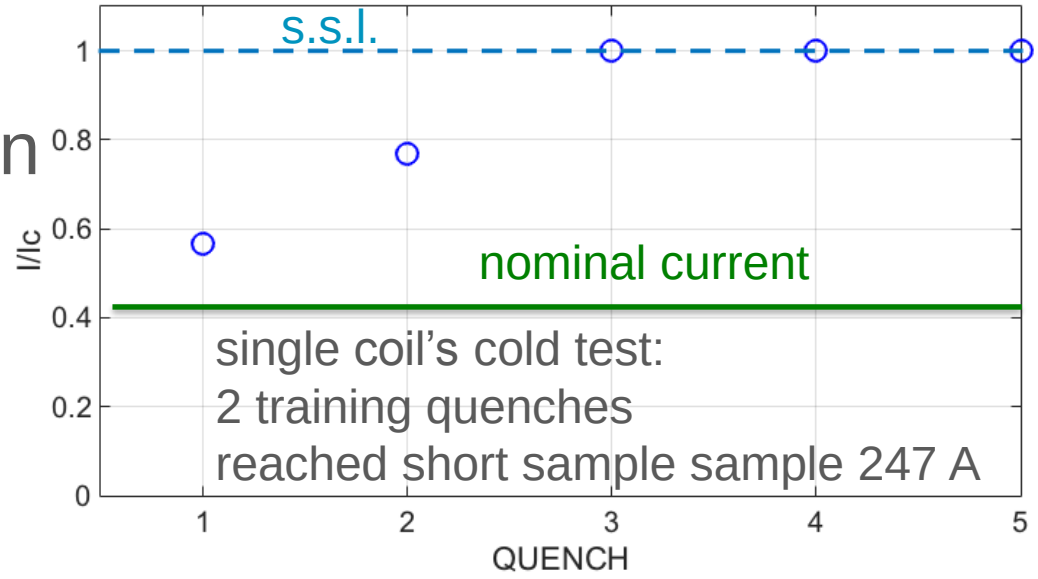



machined from bulk

# COILS' PRODUCTION

- 16 coils produced, 4 batches
- First batch
  - 3 BTS2 to be redesigned
  - 1 hybrid (spare)
- 6 BTS2 final design
- 6 hybrid

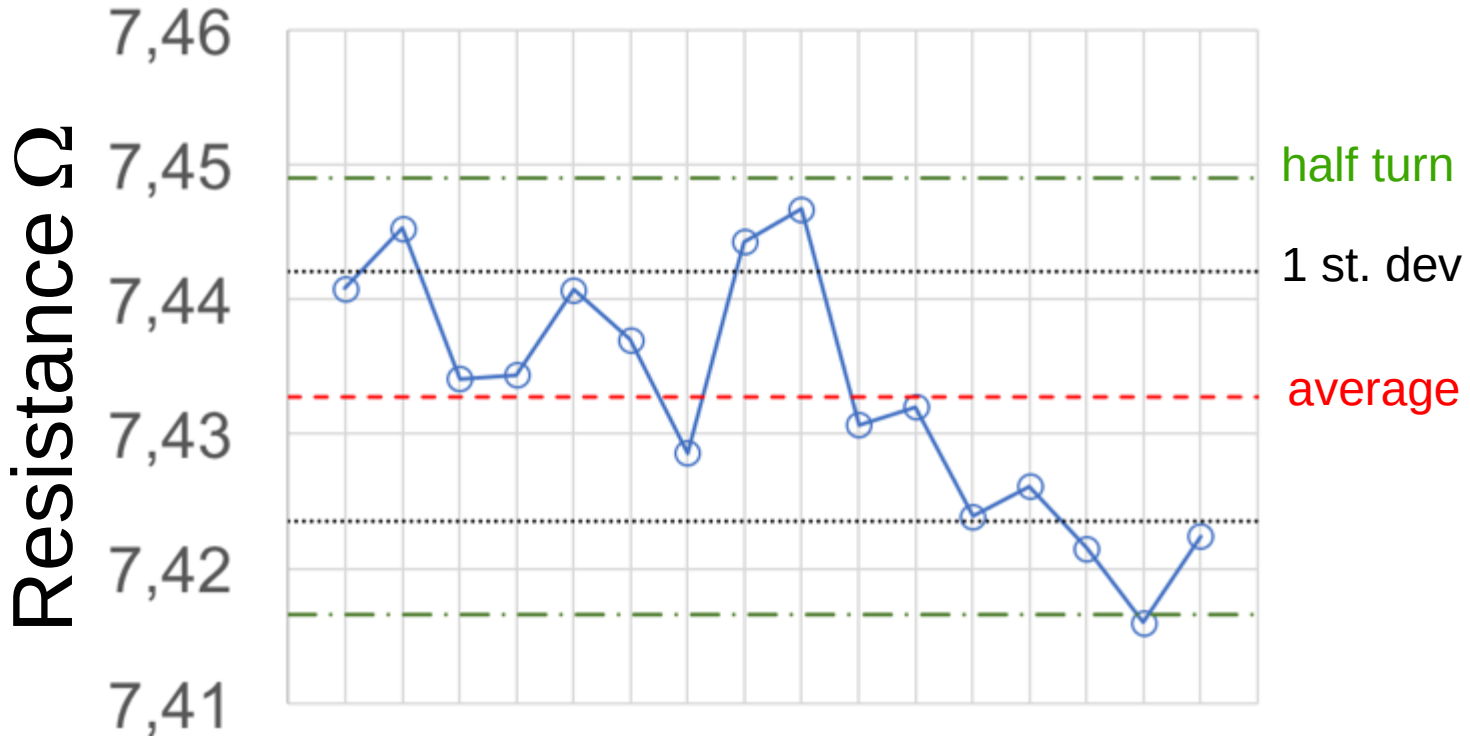



**coils' assesment**

- single coil $I_{max}$
- thermal cycle (2 batches)
- resistance
- HV insulation
- dimentions

# RESISTANCE AND INSULATION

- resistance: we can detect one turn
- ground insulation
  - Al wrap
  - > 36 GΩ @ 2.5 kV



# DIMENTIONAL CHECK

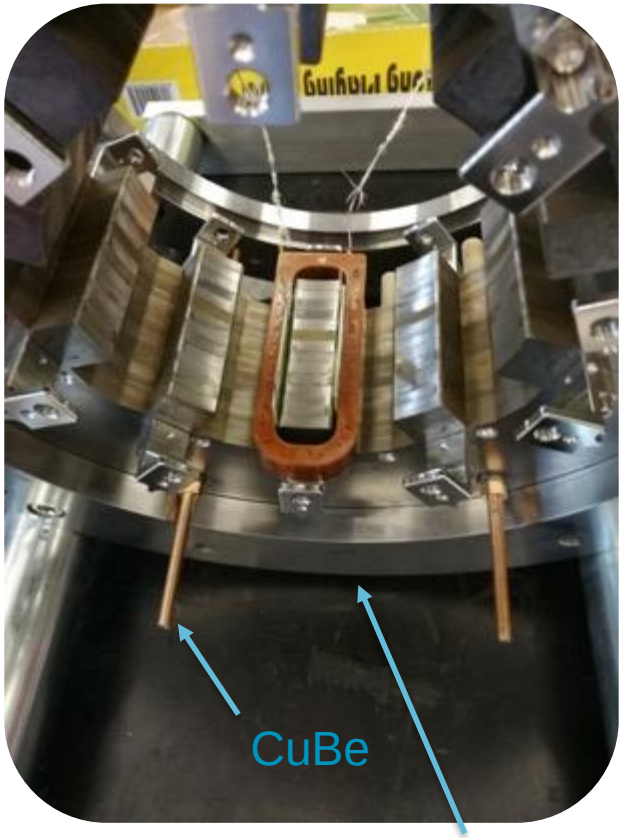
- four moulds overall results
- comparable with sextupole

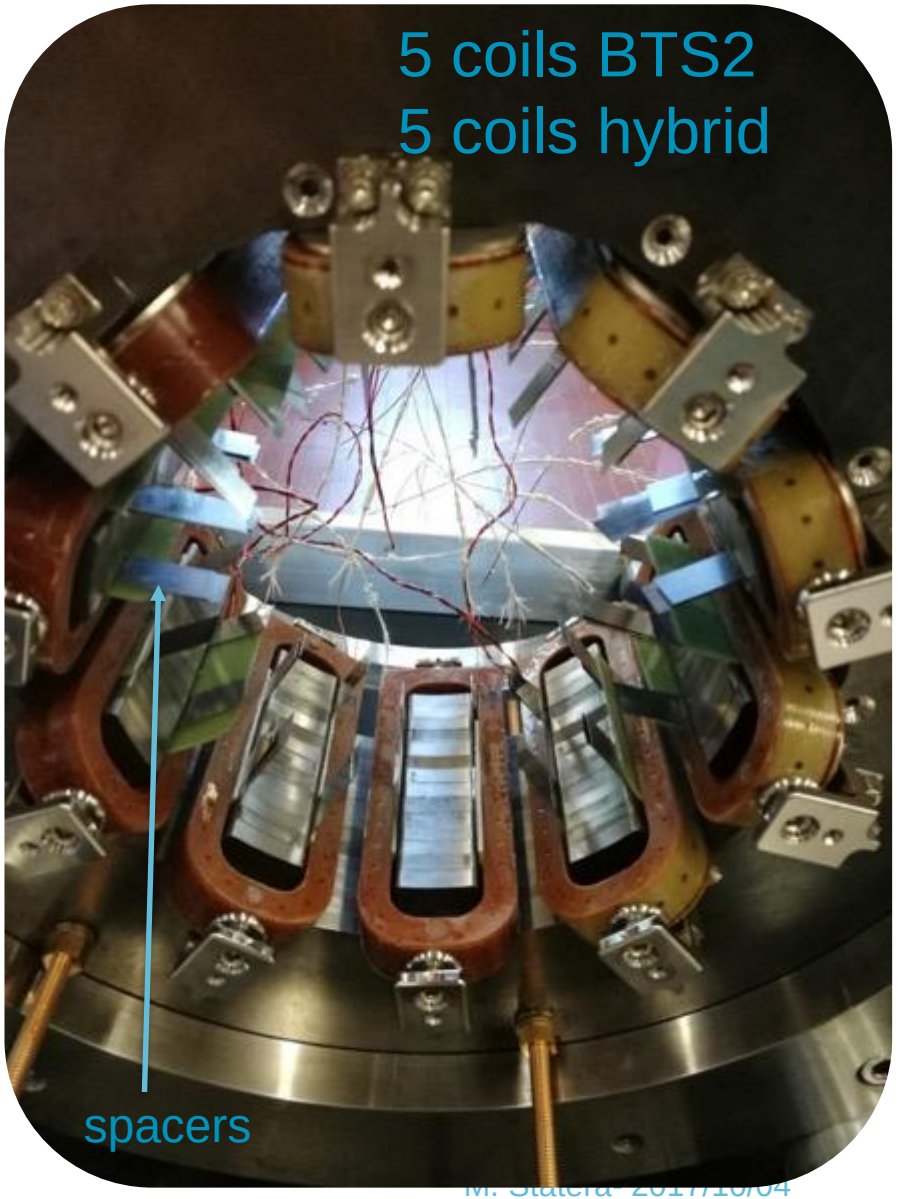
| | NOMINAL | MEASURED | ST. DEV. |
|---|---|---|---|
| **INNER SHORT** | 25.5 mm | 25.52 mm | 0.025 mm |
| **OUTER SHORT** | 43.3 mm | 43.63 mm | 0.086 mm |
| **INNER LONG** | 100.8 mm | 100.79 mm | 0.020 mm |
| **OUTER LONG** | 118.6 mm | 119.00 mm | 0.111 mm |

sextupole coils $\sigma$ = 0.13 mm
octupole coils $\sigma$ = 0.4-0.5 mm

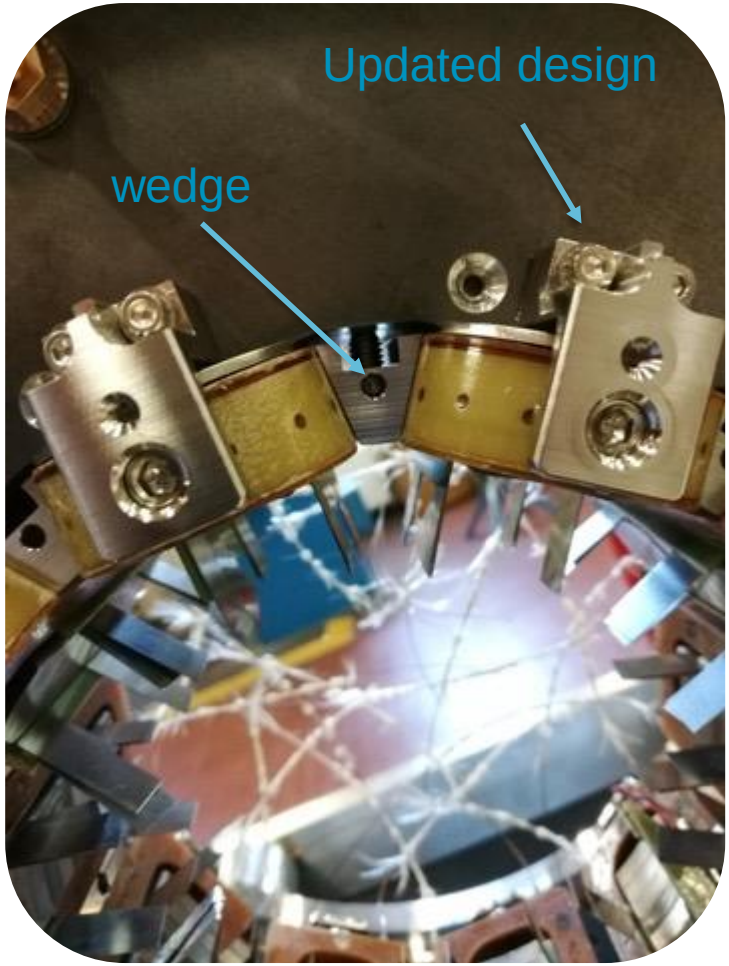
# ASSEMBLY

- same assembly procedure as sextupole MCSSXFP and octupole MCOXFP

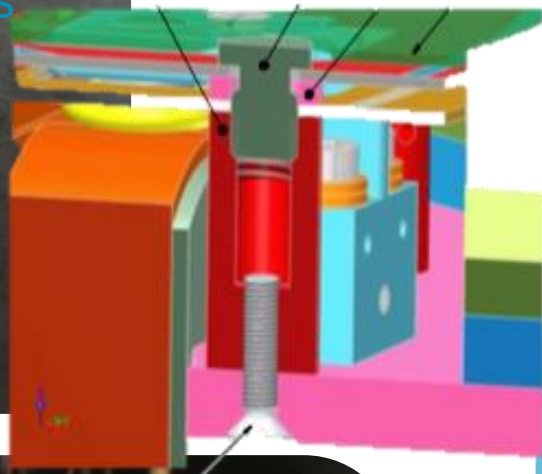


# ASSEMBLY





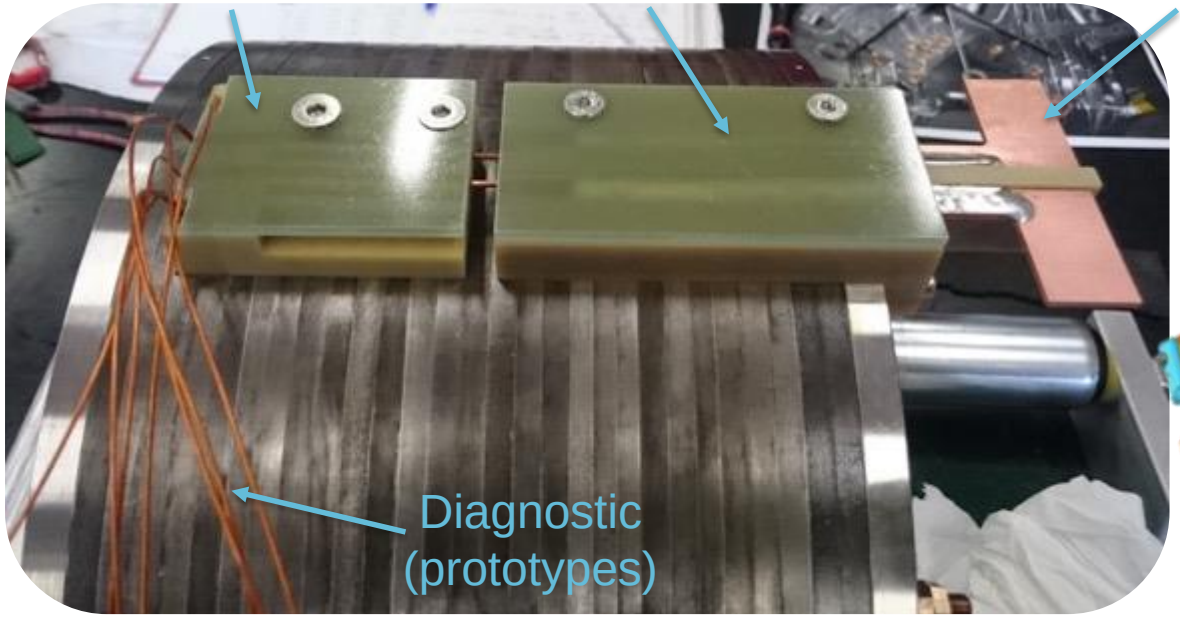


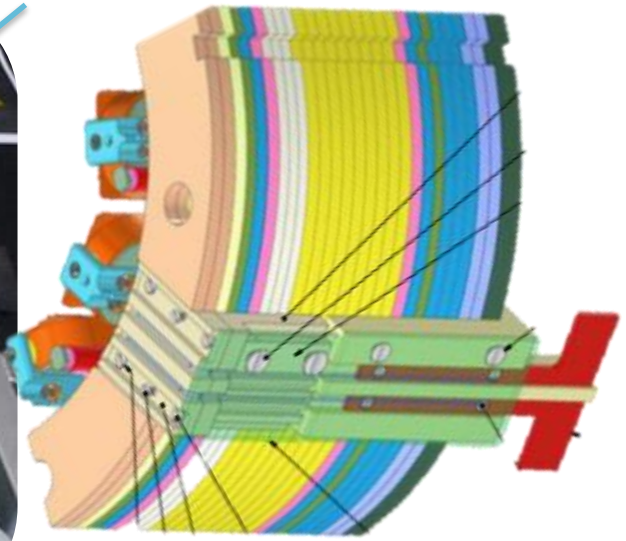
# ELECTRICAL CONNECTIONS

CERN connection box

LASA connection box

copper for bus bar connection

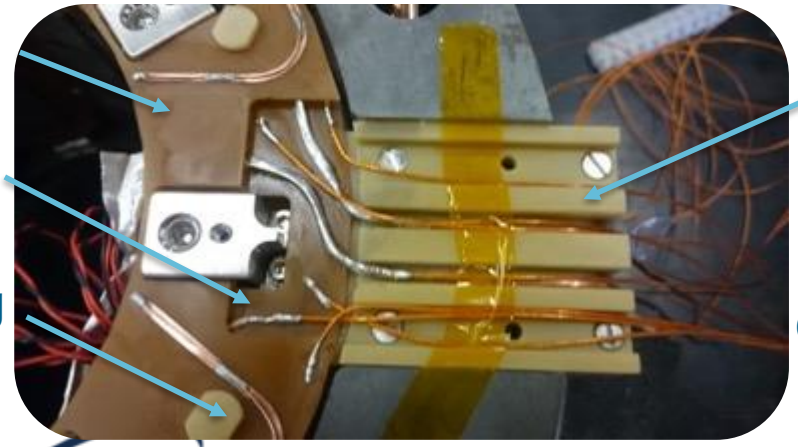


upper PCB

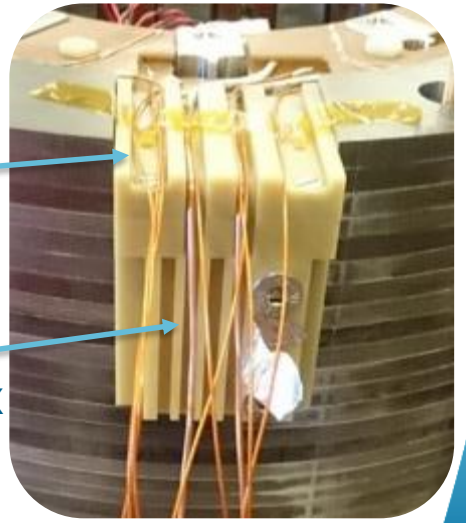
lower PCB

PCBs fixing

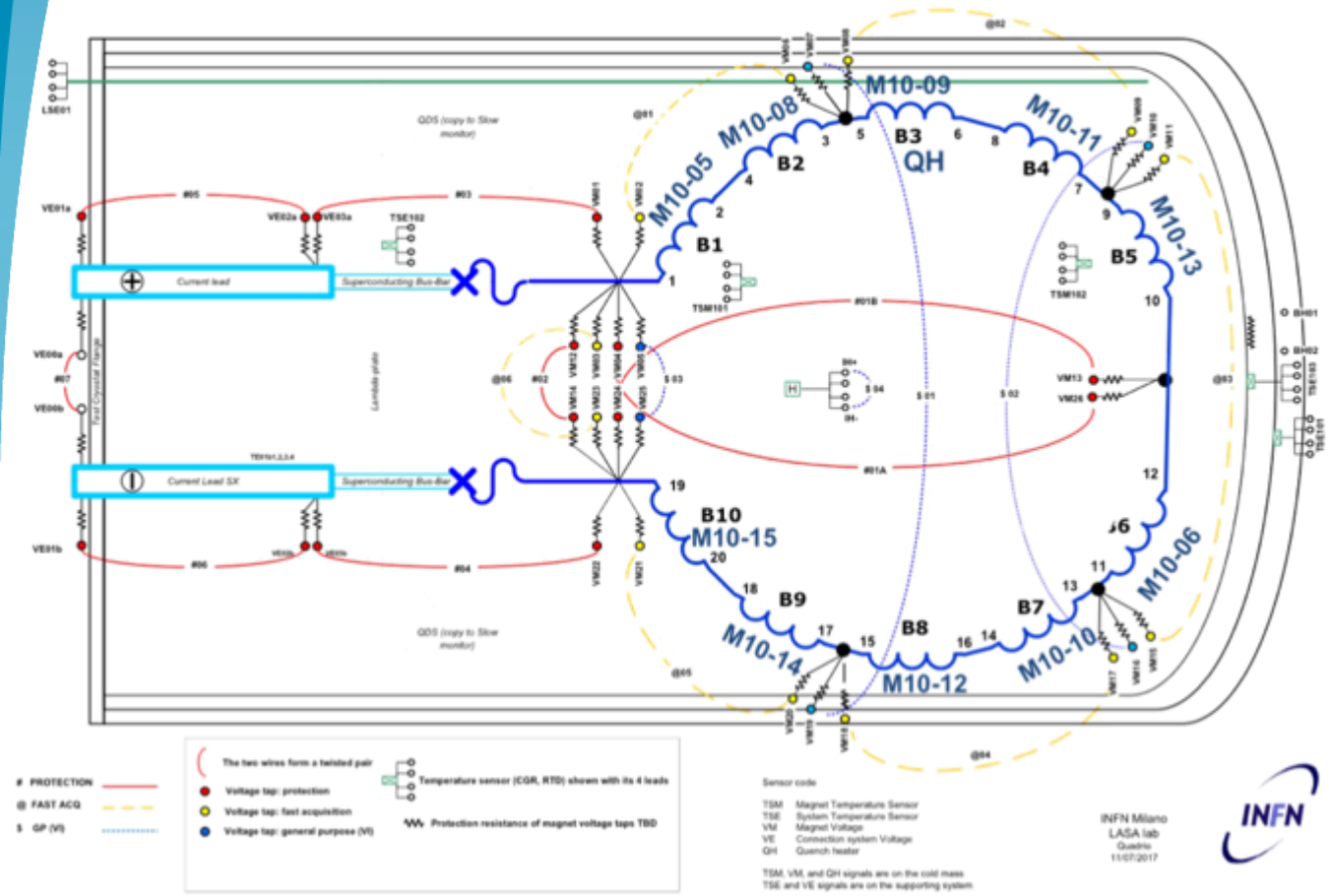


bridge

CERN connection box



# INSTALLED COILS




| | |
|---|---|
| B1 | M10-05 |
| B2 | M10-08 |
| B3 | M10-09 |
| B4 | M10-11 |
| B5 | M10-13 |
| B6 | M10-06 |
| B7 | M10-10 |
| B8 | M10-12 |
| B9 | M10-14 |
| B10 | M10-15 |

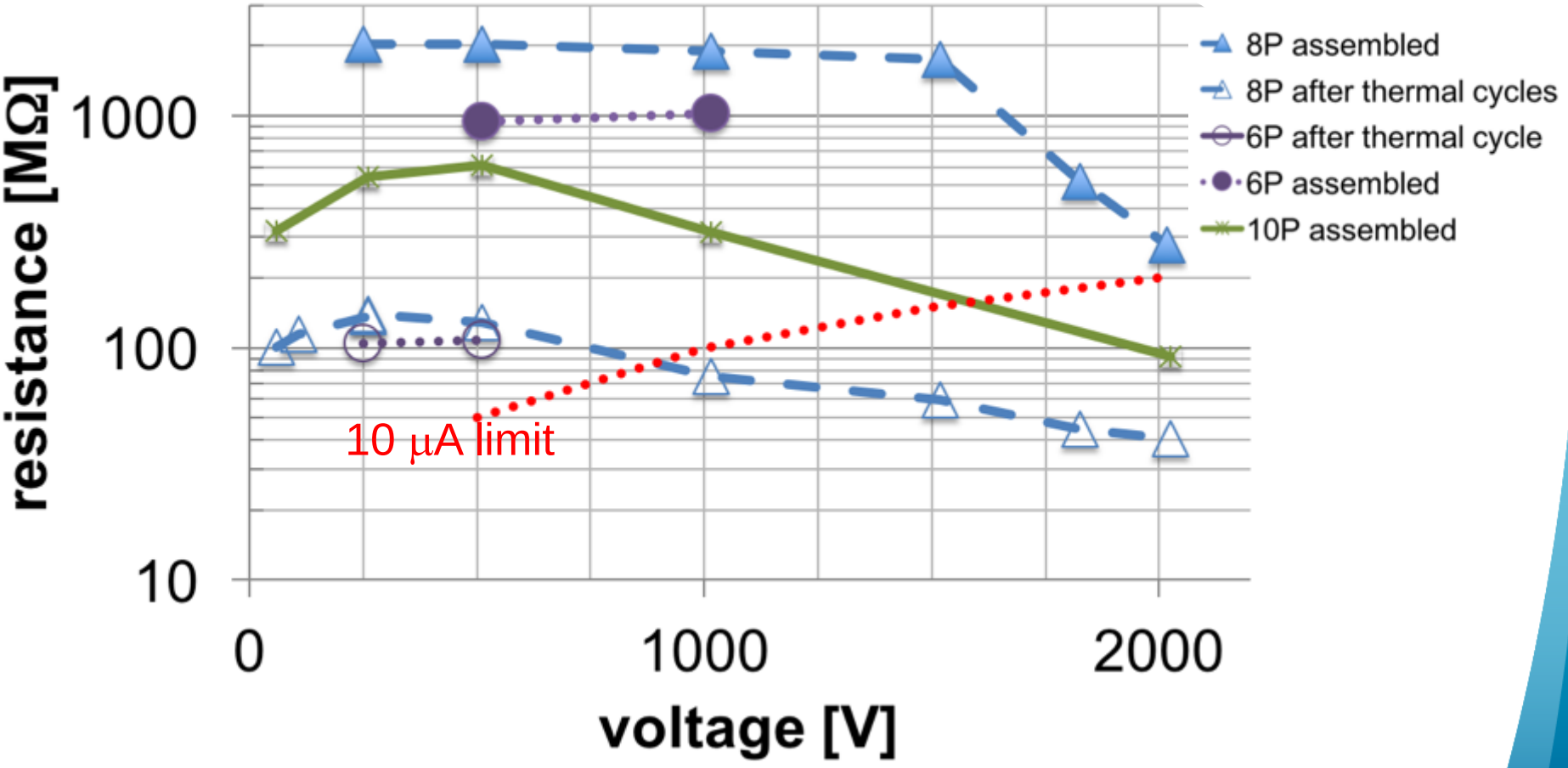
BTS2

DURATRON

# GROUND INSULATION

- max voltage to ground in operation 36 V
- hot spot temperature in operation 122 K

by V. marinozzi

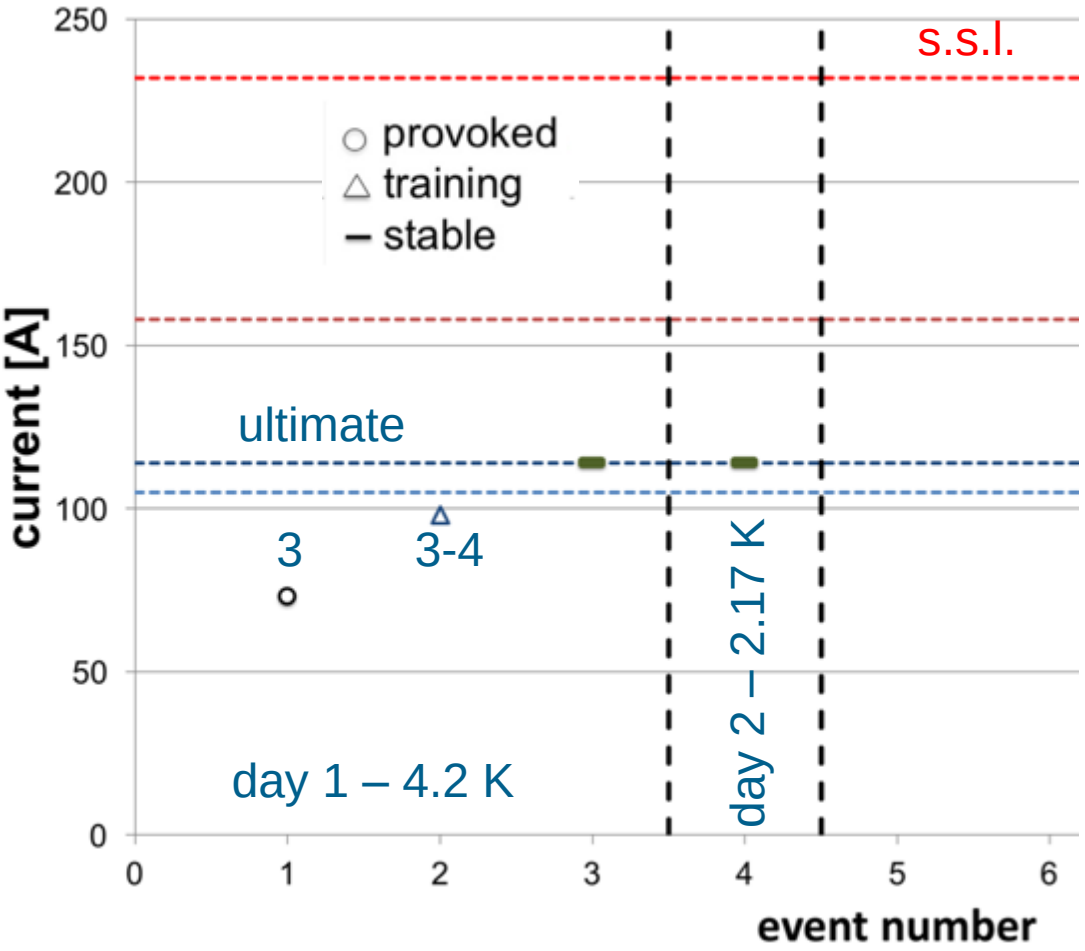


# MCDXFP TEST

- Week 1
  - 4.2 K 1h @ $I_{ult}$ , 121 A (115% $I_{op}$)
  - 2.17 K 1h @ $I_{ult}$ , 121 A
- Week 2 – starting on 9/10/2017
  - 4.2 K 1h @ $I_{ult}$ , 121 A (115% $I_{op}$)
  - no dump resistance quench
  - training

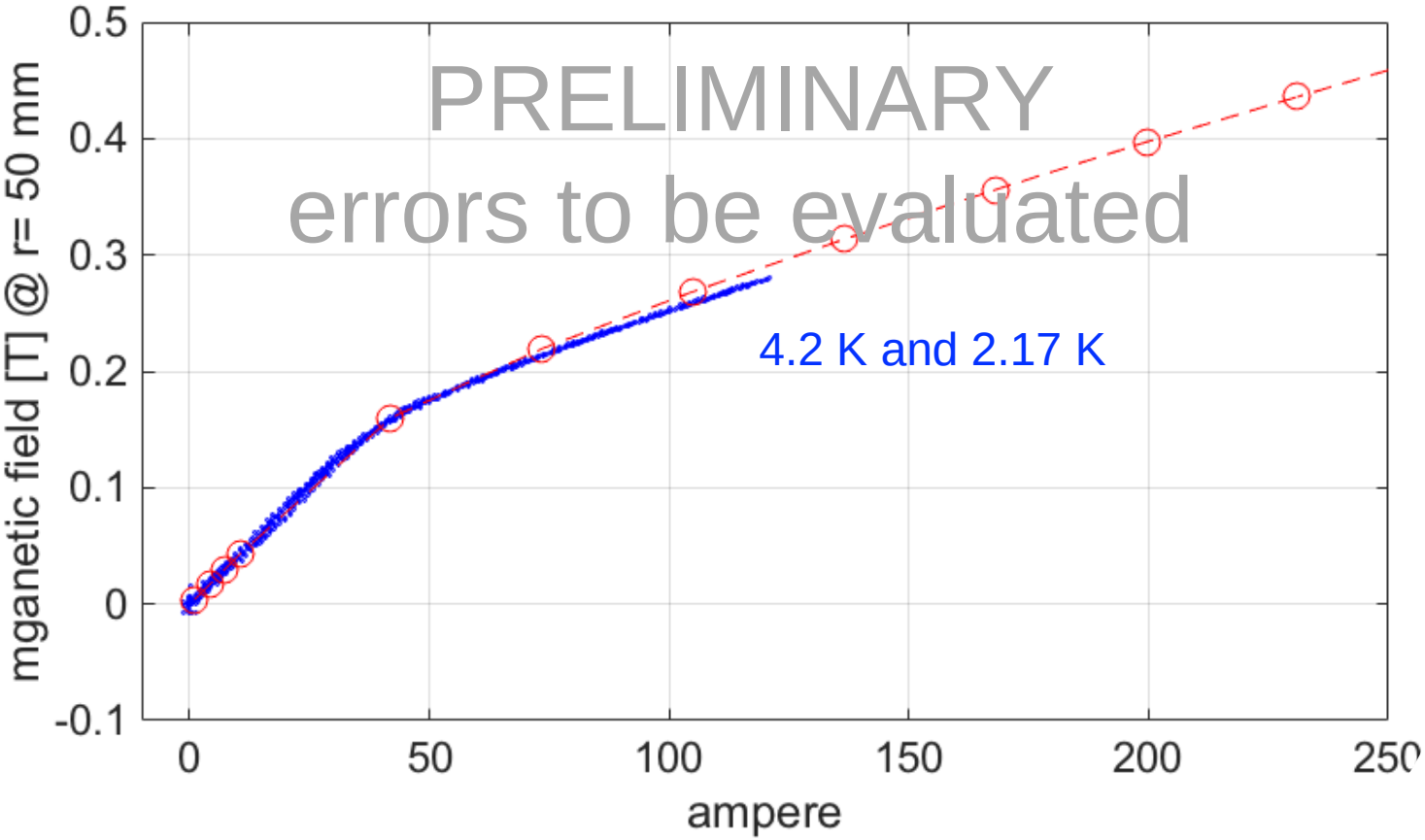
# WEEK 1 PRELIMINARY

- one provoked
- one 98 A quench
- reached ultimate 114 A -1 hour test
- tested up to 121 A



# SINGLE POINT MAGNETIC FIELD

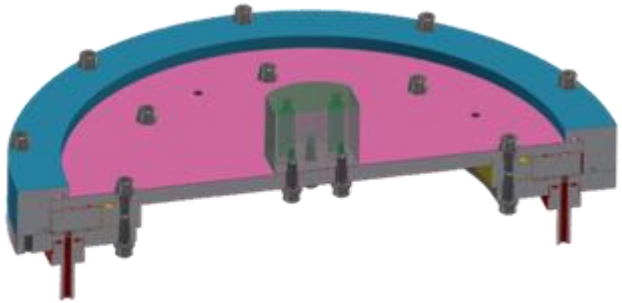
- single Hall probe
- reference radius r= 50 mm



# ROUND COIL MAGNET

**demonstrator**

- mechanics design ongoing
- Winding machine modification ongoing
- mould construction ongoing

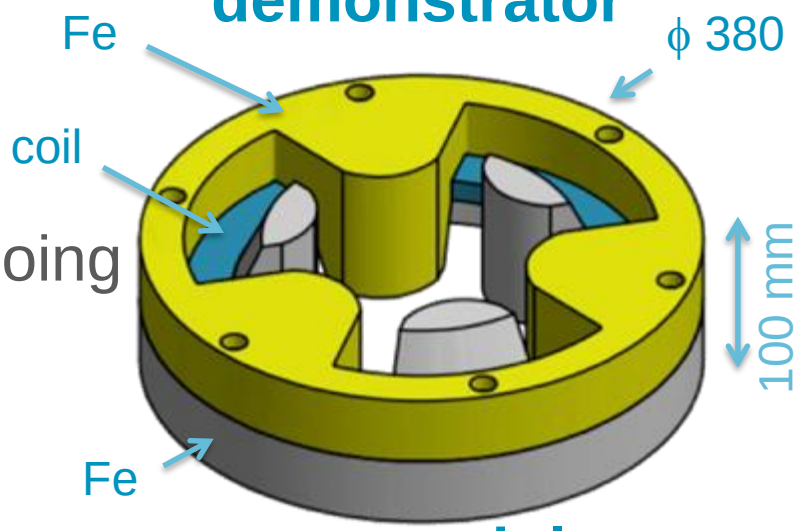


- first batch of insulated $MgB_2$ wire delivered at LASA

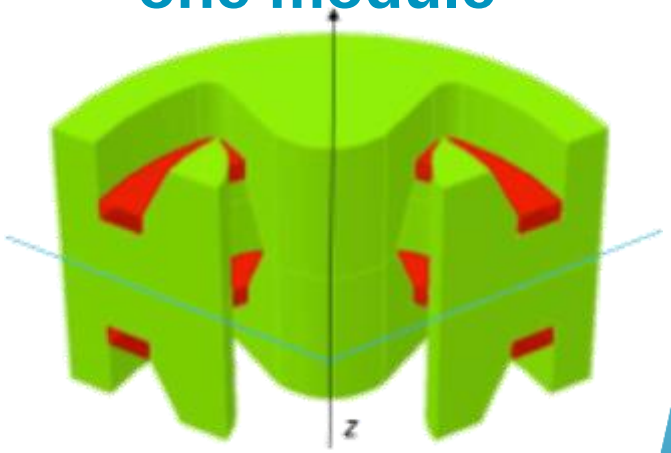
**schedule**

- winding in 2017
- magnet assembly 1Q 2018

**demonstrator**




**one module**



G. Volpini et al. Eletromagnetic Study of a Round Coil Superferric Magnet,IEEE Tr. App. Sup, 26, 4 (2016)

# MCTXFP AND MCQSXFP

- tender approved by INFN
- contract sent to company
- (foreseen) start in October
- Tentative  schedule
  - April 2018 MCTXFP delivered to LASA
  - Sept. 2018 MCQSXFP delivered to LASA

# CONCLUSIONS

- MCDXFP
  - assembled
  - first cooldown preliminary results
- MCQSXFP and MCTXFP: 2018
- $MgB_2$ RCSM
  - assembly 1Q 2018