Magnetic diagnostic and MHD analysis for JT-60SA IC

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Overview

- Summary of 2020/21 activities
  - Data access and selected pulses
  - Models: CREATE-L & FIESTA
  - Analysis of energization shots: examples for CS2, CS3
- Outlook for 2022

Data access

Data from the EDDB database can be reached with python through the ‘eddb_pwrapper’ module, located in /analysis/src/eddb/eddb_pwrapper.py

! On Naka server accessible through VPN

This module contains the python **class** ‘eddbWrapper’ which builds a data type linking to the EDDB database through the ‘libeddb.so’ library.

Partial documentation (evolving) is available online
https://iterphysicswiki.euro-fusion.org/index.php/JT-60SA_EU_IC_team_2020-21:_Magnetics_validation_and_MHD/Disruption_analysis

A set of scripts exploiting ‘eddbWrapper’ is available (M.Iafrati):
https://iterphysicswiki.euro-fusion.org/index.php/D200025_public

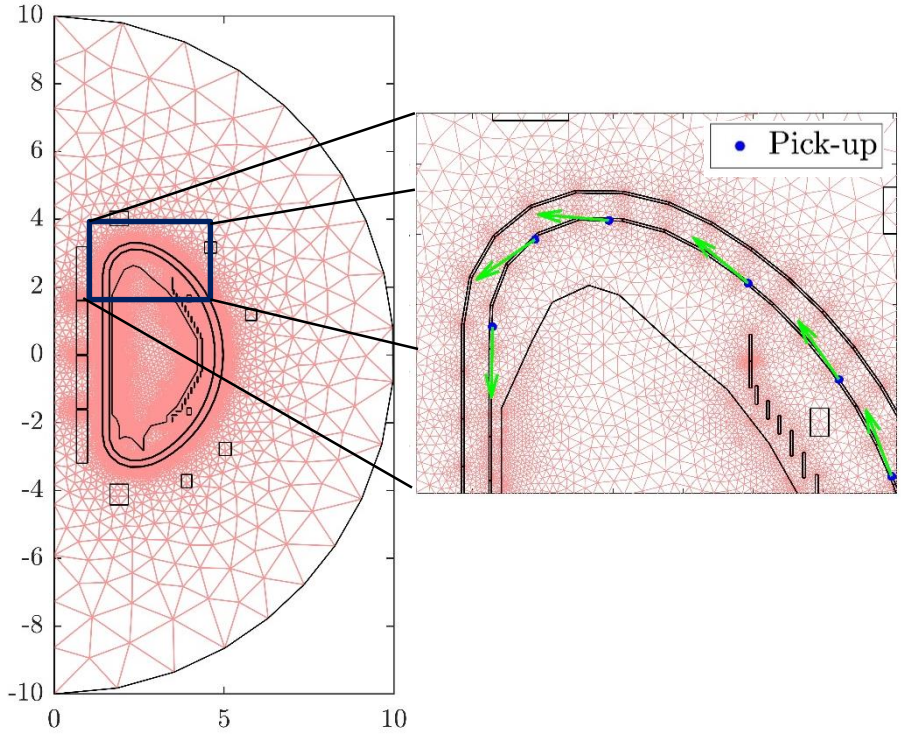
Fetching and plotting time-series data [edit]

Time series data can be gathered with the ***eddbreadTime*** method. A simple example is given below

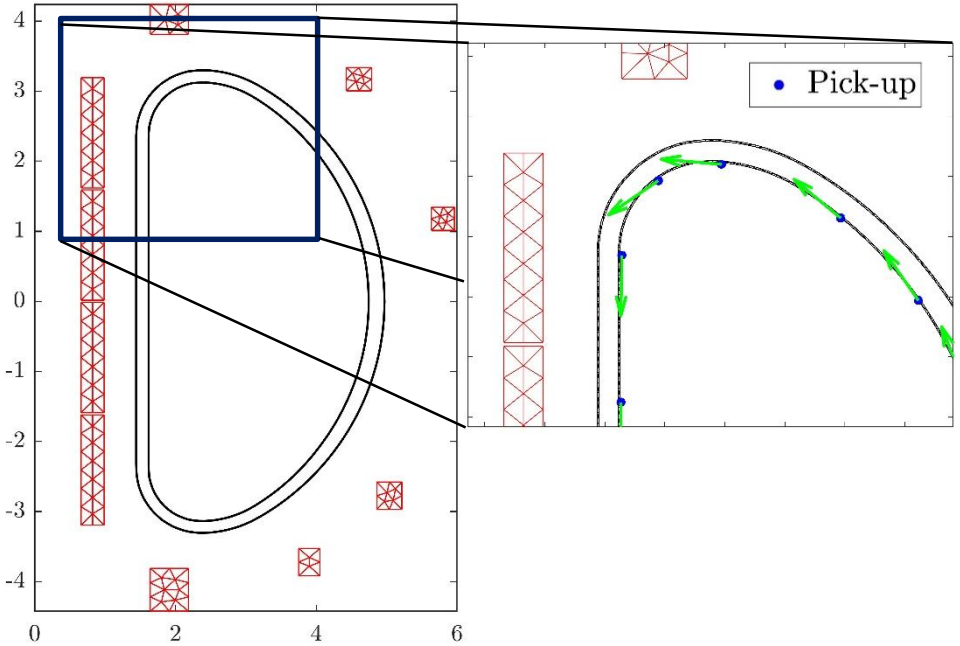
```
import sys
import numpy as np
import matplotlib.pyplot as plt
from ctypes import *

# Set path and import eddb_pwrapper
PATH_TO_LIB ='/analysis/lib/libeddb.so'
lib = cdll.LoadLibrary(PATH_TO_LIB)
sys.path.append("/analysis/src/eddb/")
from eddb_pwrapper import *

# Constructor & opening connection
eddb = eddbWrapper(PATH_TO_LIB)
# if .NUMPY = True data is stored as numpy arrays
# if .NUMPY = False data is stored as python lists
eddb.NUMPY = True
rtn_bool = eddb.eddbOpen()

# Example input to eddbreadTime
shot = 'E100127'
cat = 'MDAC'
dname = 'magPbTC1'
# Time window [s]
t1 = '-50.0'
t2 = '200.0'

# Fetching data
rtn_bool, shot_data = eddb.eddbreadTime(shot,cat,dname,t1,t2)

b_probe = shot_data['data']
t_probe = shot_data['time']

plt.figure()
plt.plot(t_probe, b_probe, label=dname)
plt.legend(loc=0)
plt.xlabel('t [s]')
plt.ylabel('B probe [T]')
plt.show()
```

Overview of applied models

CREATE-L



FIESTA



Probe polarity history

Early vs late shot comparison shows corrections on polarity and conversion coefficients of pick-ups & flux loops

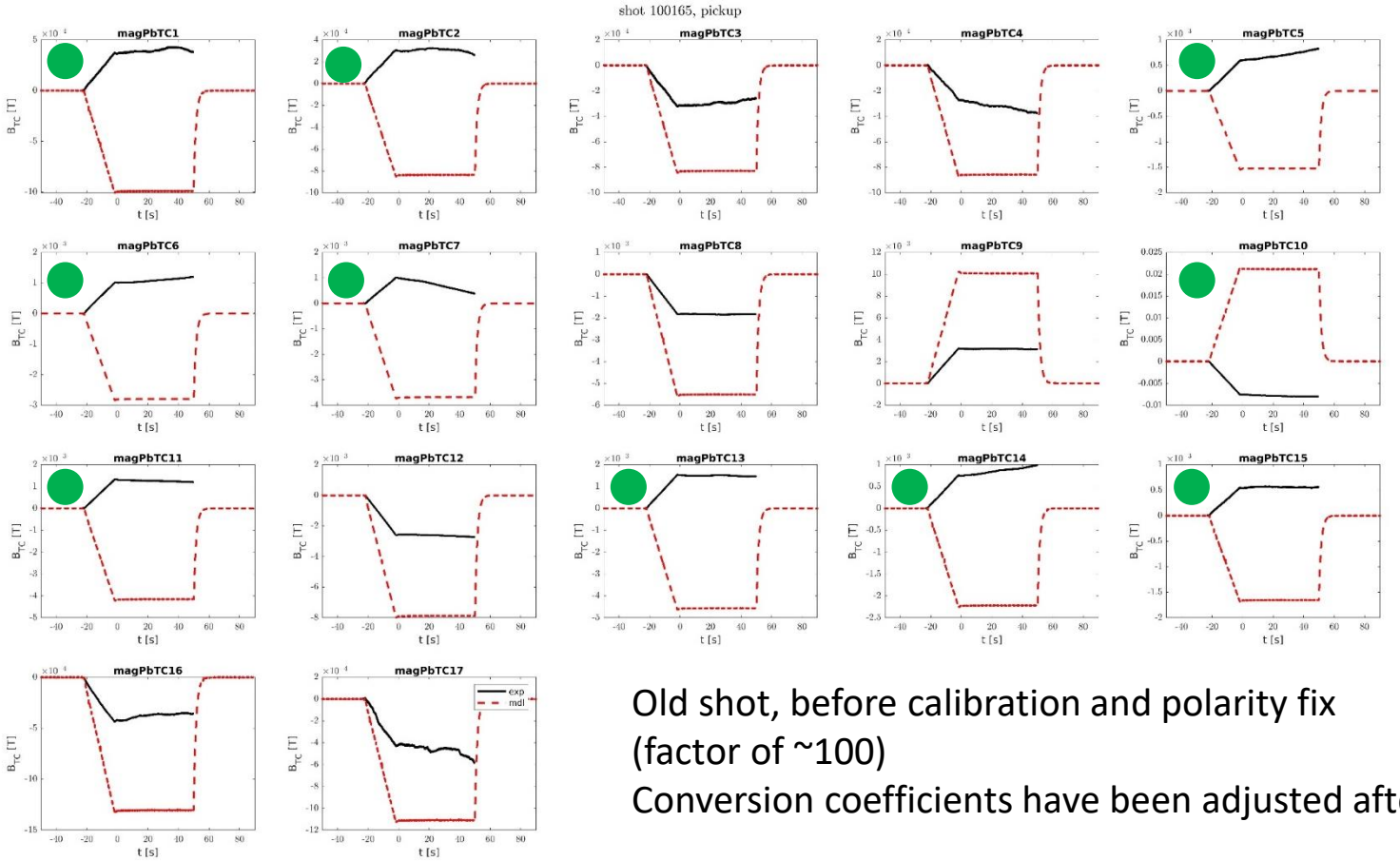
R (mm)	Z (mm)	θ_2 (deg)	NS [m2]	PID	connection inversion
4735,5	-28,346	0,28	0,3406	magPbTC1	o
4487,26	1280,48	21,2	0,3367	magPbTC2	o
4111,42	1969,39	34,89	0,3373	magPbTC3	
3464,51	2653,87	50,39	0,3384	magPbTC4	
2471,23	3100,36	85,14	0,3402	magPbTC5	o
1945,48	2965,08	124,41	0,3393	magPbTC6	o
1641,4	2344,88	179,06	0,3405	magPbTC7	o
1634,2	1123,1	180,01	0,3386	magPbTC8	
1635,6	-0,2403	180,21	0,3387	magPbTC9	
1635	-1127,7	180,17	0,3400	magPbTC10	o
1640,3	-2348,1	180,27	0,3387	magPbTC11	o
1931,77	-2964,5	234,21	0,3416	magPbTC12	
2470,92	-3097,7	274,28	0,3398	magPbTC13	o
3549,92	-2573	311,04	0,3420	magPbTC14	o
4104,26	-1973	324,55	0,3404	magPbTC15	o
4485,63	-1283,4	338,37	0,3462	magPbTC16	
4674,74	-620,06	350,24	0,3420	magPbTC17	

2021-02-15

Number		R [mm]	Z [mm]	S[m2]	PID	connection inversion
1	I-1	1879,8	2933,1	11,1	magFlxLp1	o
2	I-2	1641,4	2520,2	8,46	magFlxLp2	o
3	I-3	1626,2	1976,9	8,31	magFlxLp3	o
4	I-4	1624,6	1427	8,29	magFlxLp4	o
5	I-5	1624,1	976,9	8,29	magFlxLp5	o
6	I-6	1623,7	377	8,28	magFlxLp6	o
7	I-7	1622,9	-73	8,27	magFlxLp7	o
8	I-8	1623,8	-373	8,28	magFlxLp8	o
9	I-9	1623,8	-973	8,28	magFlxLp9	
10	I-10	1624,3	-1423	8,29	magFlxLp10	
11	I-11	1624,8	-1745,4	8,29	magFlxLp11	
12	I-12	1691,8	-2688,3	8,99	magFlxLp12	
13	I-13	2021,2	-3038,4	12,83	magFlxLp13	o
14	I-14	2302,3	-3120,9	16,65	magFlxLp14	
15	O-1	2392,2	3117,5	17,98	magFlxLp15	o
16	O-2	2775,6	3058,4	24,2	magFlxLp16	o
17	O-3	3416,7	2699,6	36,67	magFlxLp17	o
18	O-4	3758,1	2397,6	44,37	magFlxLp18	o
19	O-5	3966	2166,3	49,42	magFlxLp19	o
20	O-6	4296,5	1680,1	57,99	magFlxLp20	o
21	O-7	4619,3	882,7	67,04	magFlxLp21	o
22	O-8	4693,4	532,2	69,2	magFlxLp22	o
23	O-9	4297,4	-1676	58,02	magFlxLp23	
24	O-10	3969,3	-2161,8	49,5	magFlxLp24	
25	O-11	3760,4	-2399,2	44,42	magFlxLp25	
26	O-12	3497,1	-2624,3	38,42	magFlxLp26	
27	O-13	2753	-3059,9	23,81	magFlxLp27	

2021-02-15

CS3 – 100165 TC probes*1/100



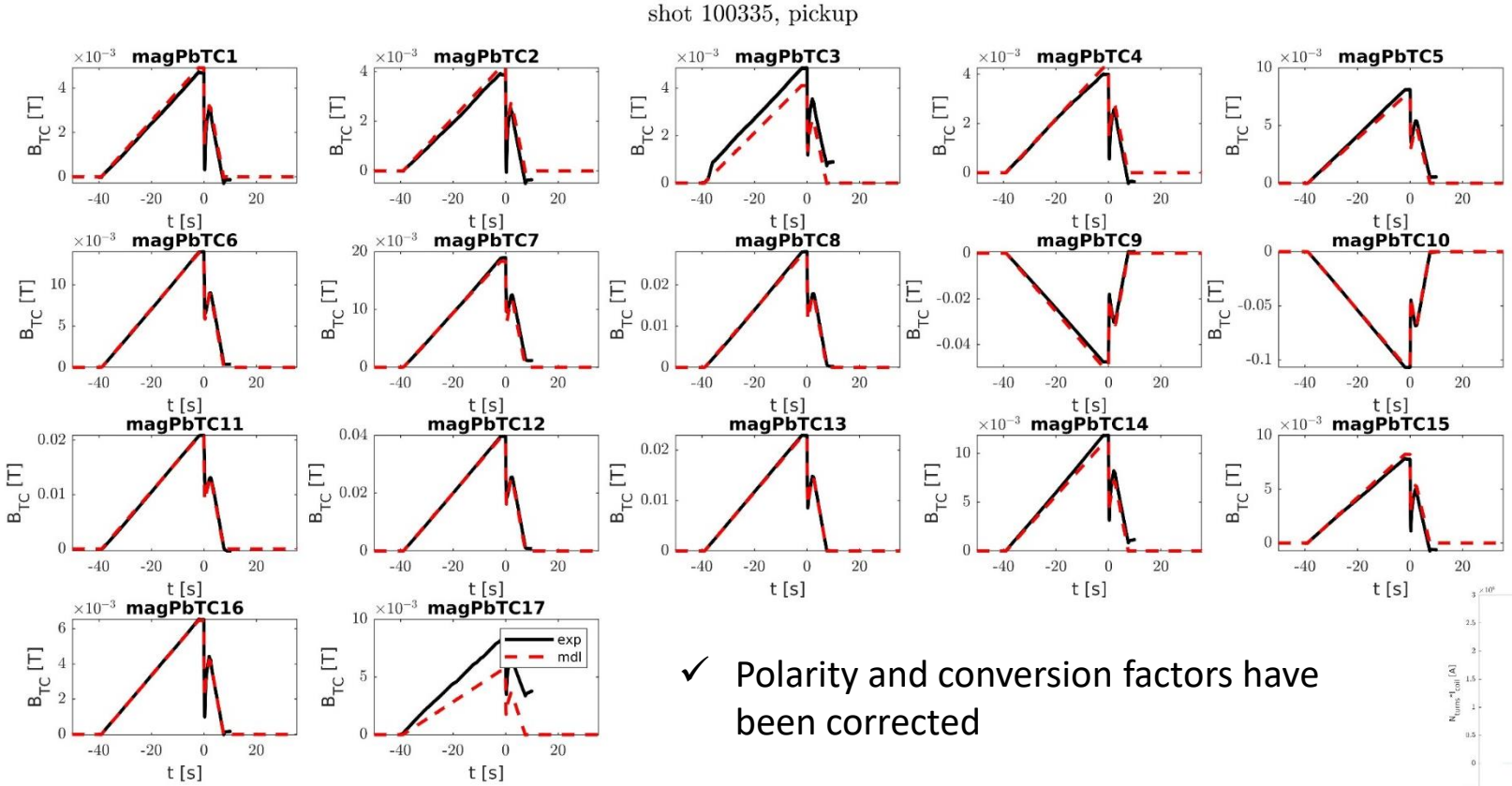
TC probes showing switched polarity: 01, 02, 05, 06, 07, 10, 11, 13, 14, 15

These have been switched after E100203

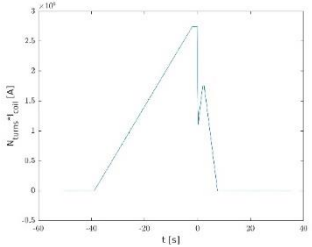
Old shot, before calibration and polarity fix (factor of ~100)

Conversion coefficients have been adjusted after **E100210**

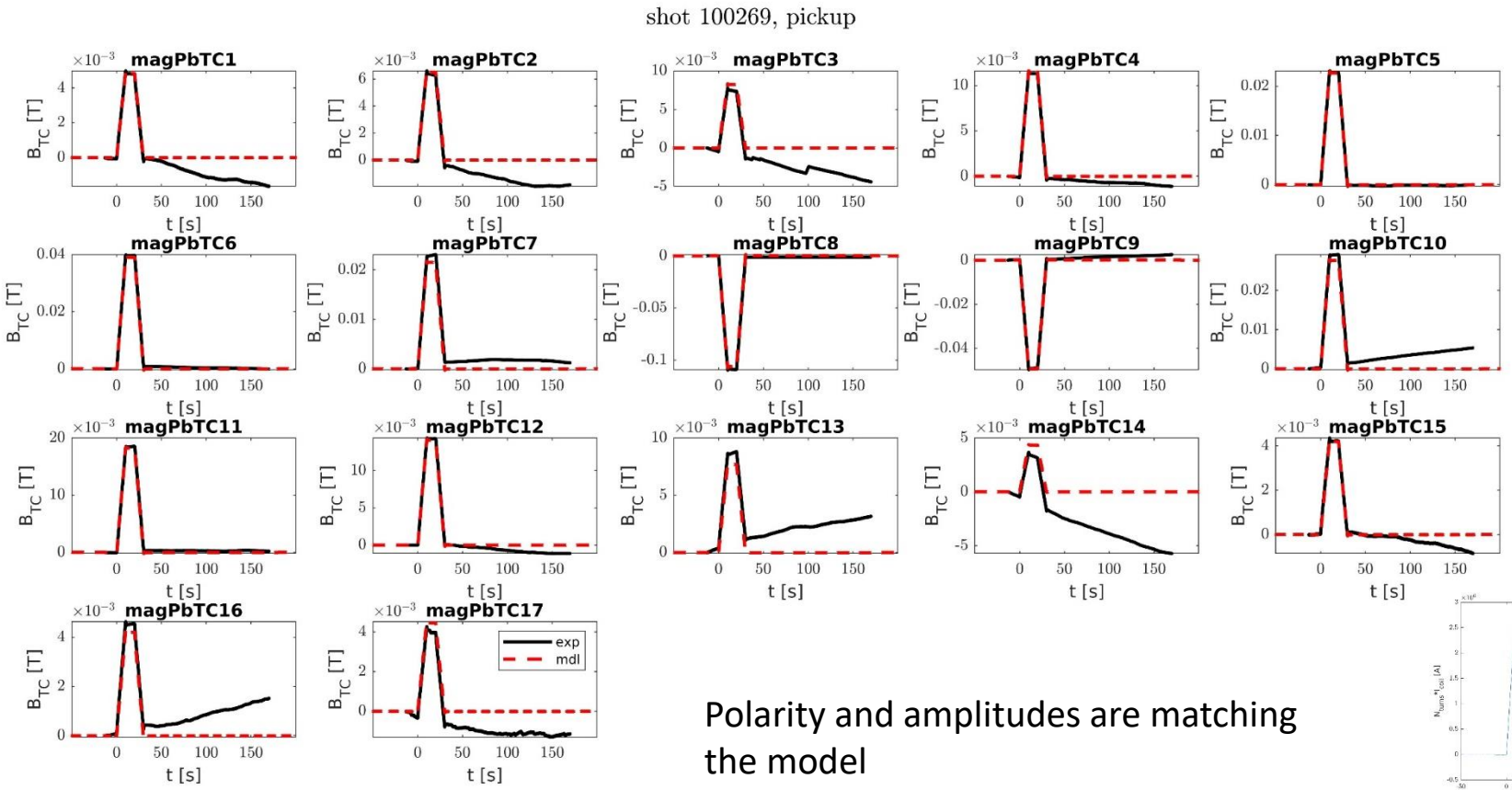
CS3 – 100335 TC probes



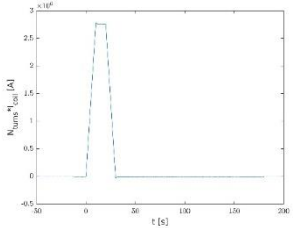
- ✓ Polarity and conversion factors have been corrected



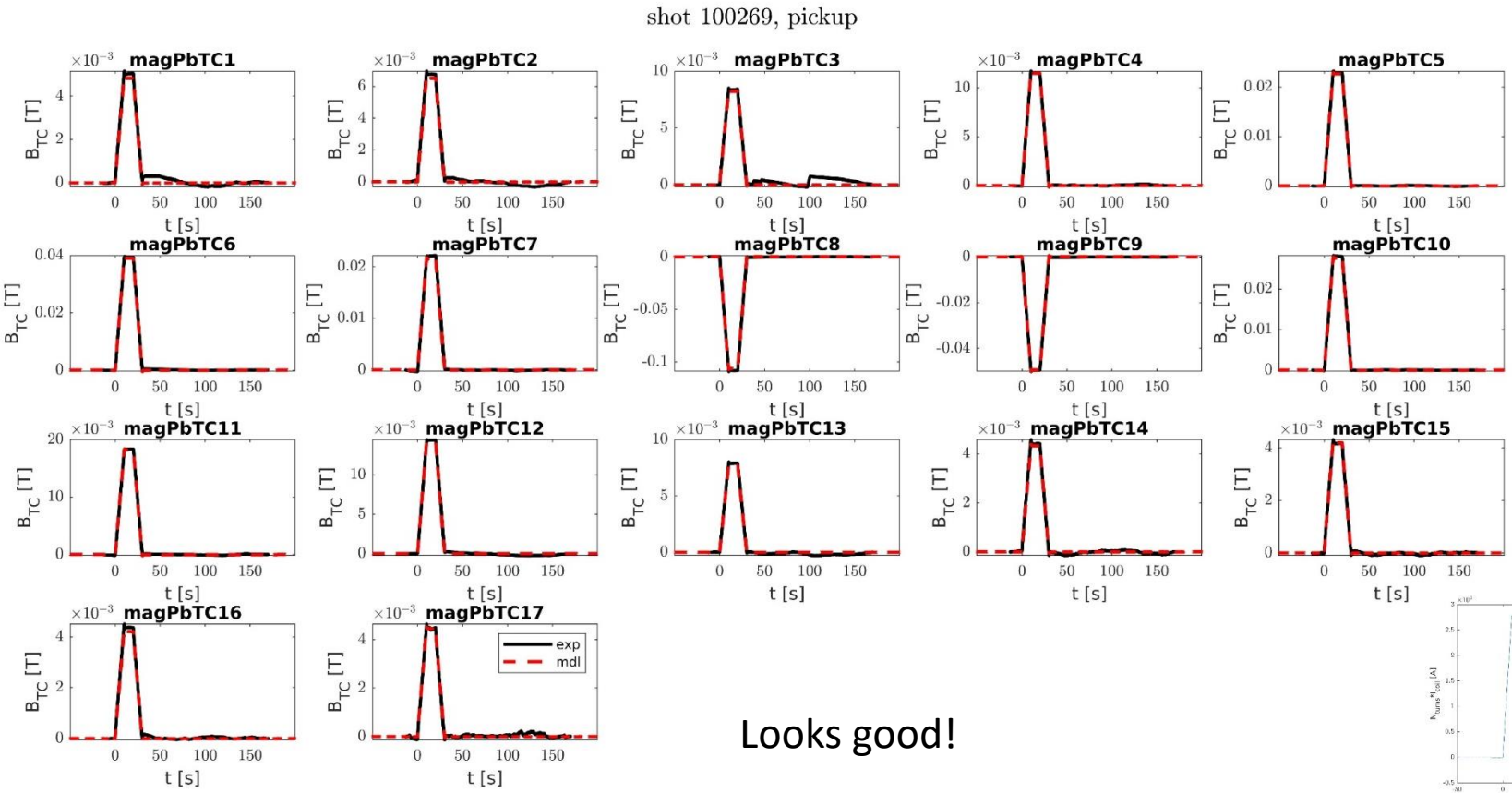
CS2 – 100269 TC probes



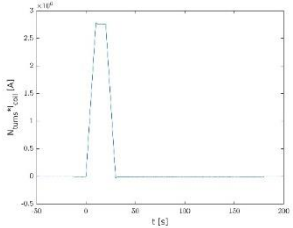
Polarity and amplitudes are matching the model



CS2 – 100269 w/ 2nd order correction



Looks good!



Summary & outlook

- ✓ Two models are available to simulate magnetic data: good match between signals and both models for all the analyzed cases. Some cases would need individual analysis.

- Links to Code Management area:
  - Support MHD and control modeling with magnetic sensor data

- Join 2022 IC activities on-site and off-site
  - Collaborate to the definition of calibration and sensor identification shots for machine restart
  - Control room work and data analysis
  - Documentation