Status of ANSYS PS main magnet model

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AB-ABP/LIS Section Meeting

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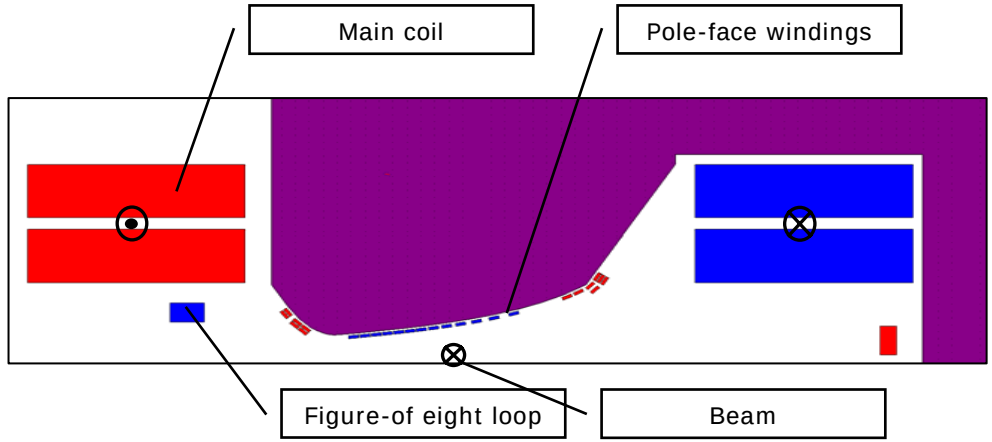
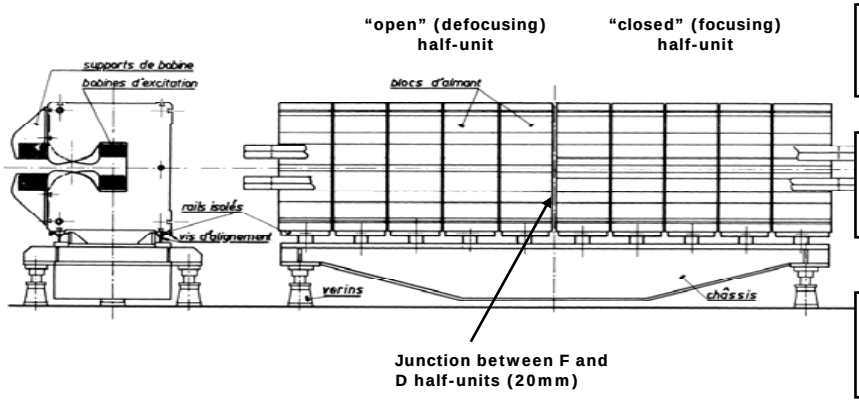
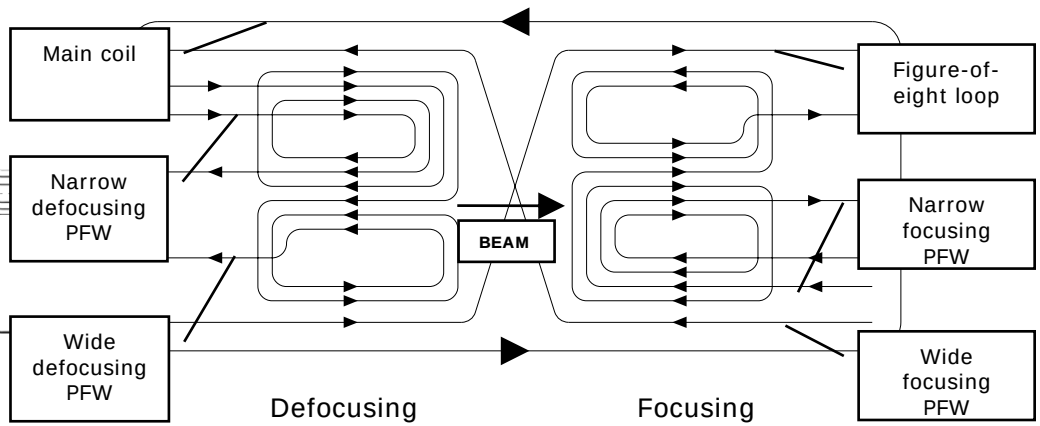
Thanks to: Simone Giladroni, Thys Risselada

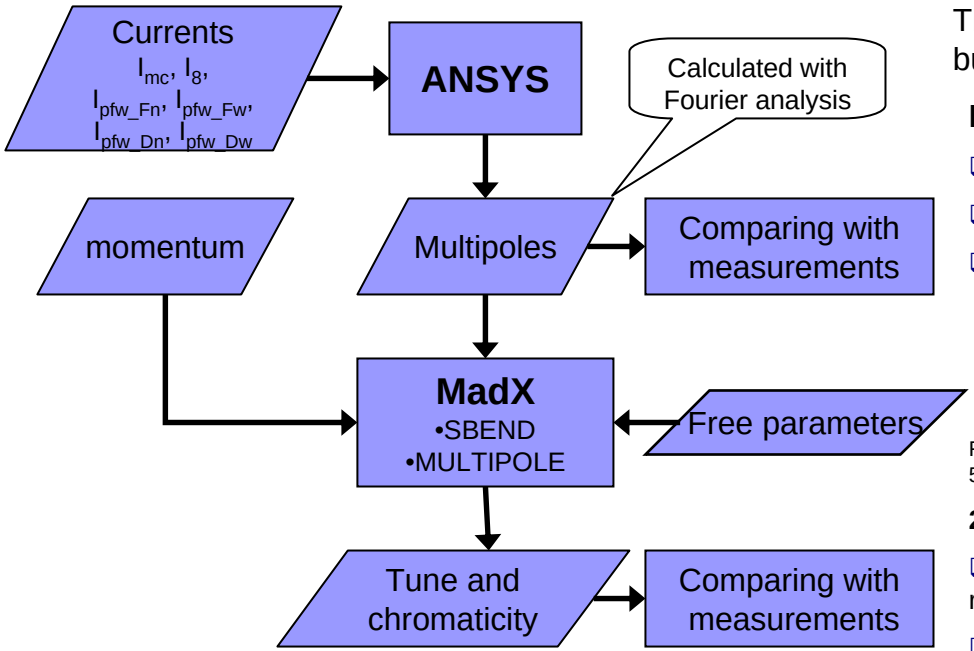
PS main magnet unit







Calculation Process



This flowchart is valid for both 2D and 3D calculation, but for 3D model multipoles are defined differently.

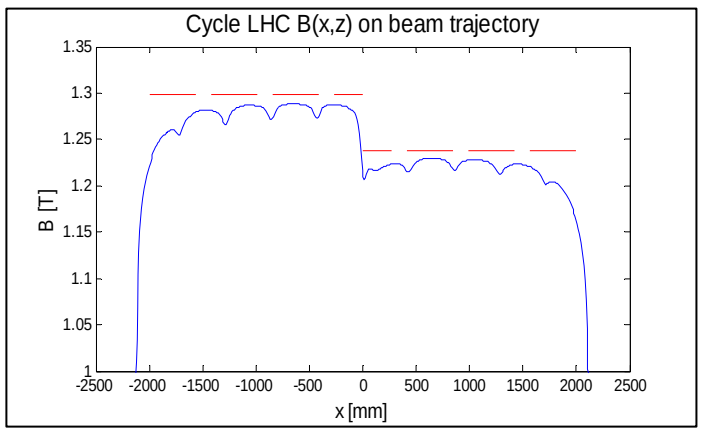
Data for MadX:

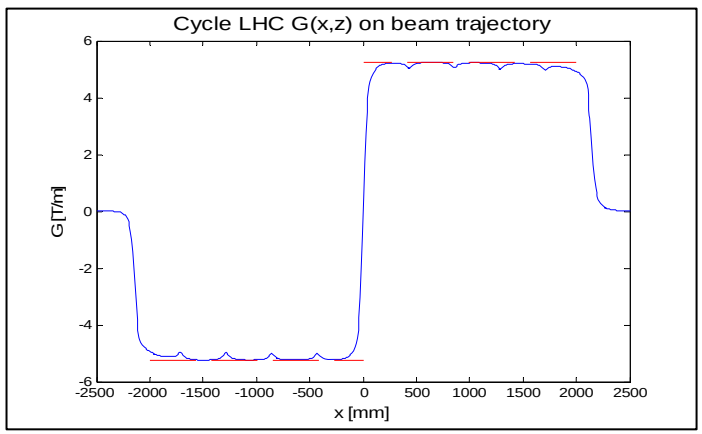
- Multipoles
- Momentum
- Free parameters
  - correction bending lengths (DLD, DLF)
  - end pole-face angles (ED, EF)
  - junction (K1J, K2J, LJ)

Free parameters are based on old raports (CERN-PS/MM-Int 9, PS/Int. MM 59-5, PS/SM/Note 77-12), contain correction to model simplification

2D ANSYS model limitations:

- Infinitively long magnet (field differences between blocks in real magnet
- Junction and stray field cannot be calculated





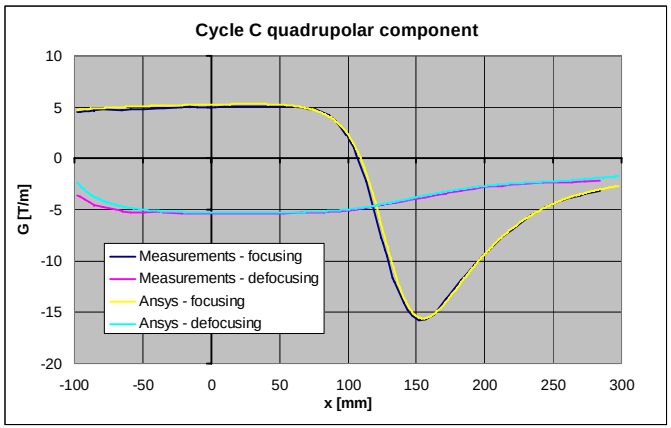
Field on beam trajectory compared with ANSYS solution (for 26 GeV)

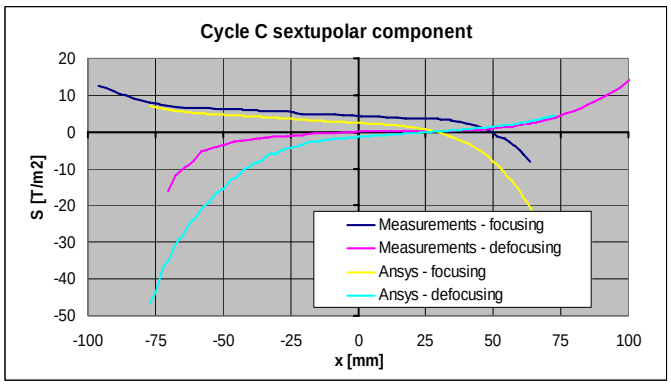
Comparing 2D ANSYS solution with measurements

Cycle C: 26 GeV for ejection of protons and antiprotons to SPS, as well as ejection of protons to the AA target area where antiprotons are produced.

Currents: I_{mc} = 5413.15 A, I_8 = 1257.9 A,

I_{pfwF} = 200.7 A, I_{pfwD} = 99.75 A





Estimated error for sextupolar measurement is around 45%

Measurements from D. Cornuet, Z. Sharifullin *"Magnetic measurements on the PS magnet unit U17"*, AT/MA Note 92-23

Data measured in 1991, used in old Mad 8 files

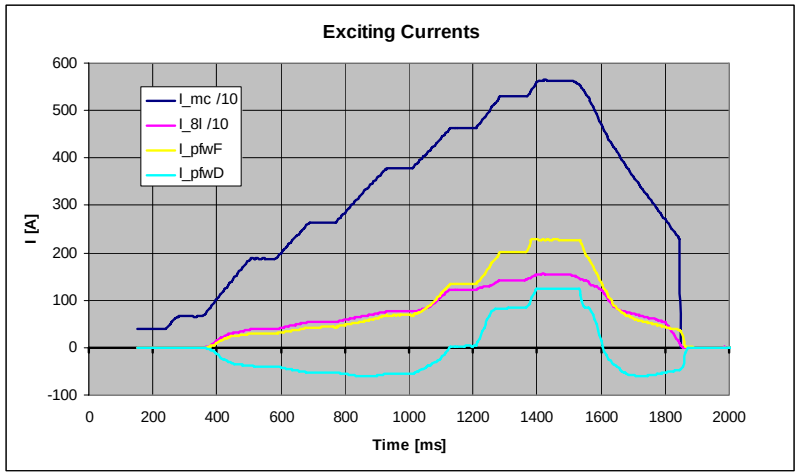
	3.5 GeV			24 GeV			26 GeV		
FOC	**ANSYS**	**MEAS**	**ERR [%]**	**ANSYS**	**MEAS**	**ERR [%]**	**ANSYS**	**MEAS.**	**ERR [%]**
K0	0.168	0.166	0.86	1.153	1.148	0.38	1.245	1.234	-0.90
K1	0.691	0.682	1.21	4.783	4.762	0.45	5.258	5.209	-0.95
K2	-0.008	-0.022	-64.03	0.457	0.506	-9.71	2.445	2.471	1.05
K3	0.64	0.69	-5.90	-15.00	-18.21	-17.62	-36.60	-30.08	-21.69
DEF	**ANSYS**	**MEA.**	**ERR [%]**	**ANSYS**	**MEAS.**	**ERR [%]**	**ANSYS**	**MEAS.**	**ERR [%]**
K0	0.168	0.167	0.77	1.152	1.147	0.43	1.297	1.282	-1.17
K1	-0.692	-0.685	1.06	-4.797	-4.765	0.66	-5.272	-5.198	-1.43
K2	0.001	-0.001	-209.99	0.752	0.709	6.12	-1.319	-1.283	-2.79
K3	-0.59	-0.57	2.62	15.05	18.16	-17.10	55.58	32.98	-68.54

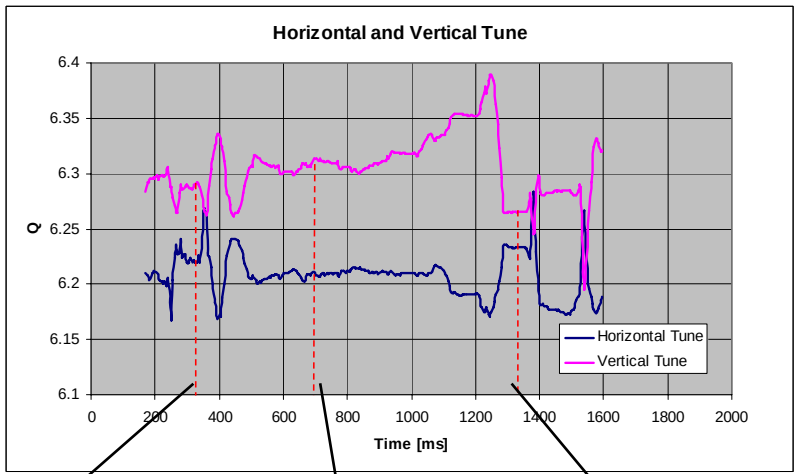
FOC	**ANSYS**	**BBM**	**ERR [%]**
K1	5.2475	5.0668	3.44
K2	2.7452	3.2106	-16.96
K3	-34.5229	-50.0451	-44.96
DEF	**ANSYS**	**BBM**	**ERR [%]**
K1	-5.2600	-5.0652	3.70
K2	-1.7003	-2.5045	-47.30
K3	55.0327	54.0591	1.77

ANSYS solution compared with multipoles fitted to data from beam based measurements for 26 GeV (meas. 27/09/2002)

Comparing MadX solution with measurements

Cycle built to measure PFW matrices





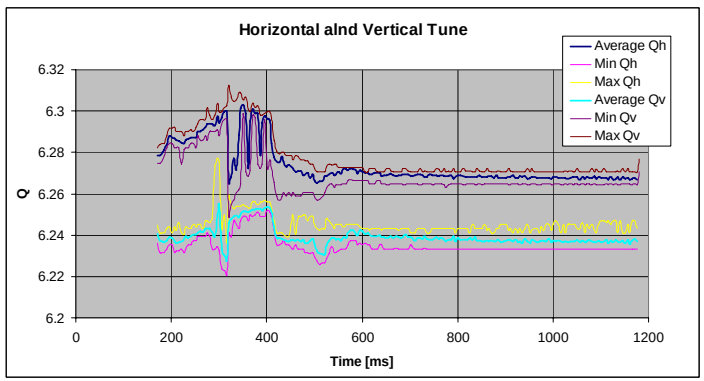
3.5 GeV
Measured: Qh=6.2216, Qv=6.2899
Calculated: Qh=6.1648, Qv=6.2725

14 GeV
Measured: Qh=6.2068, Qv=6.3126
Calculated: Qh=6.2231, Qv=6.2223

26 GeV
Measured: Qh=6.2332, Qv=6.2651
Calculated: Qh=6.2165, Qv=6.2942

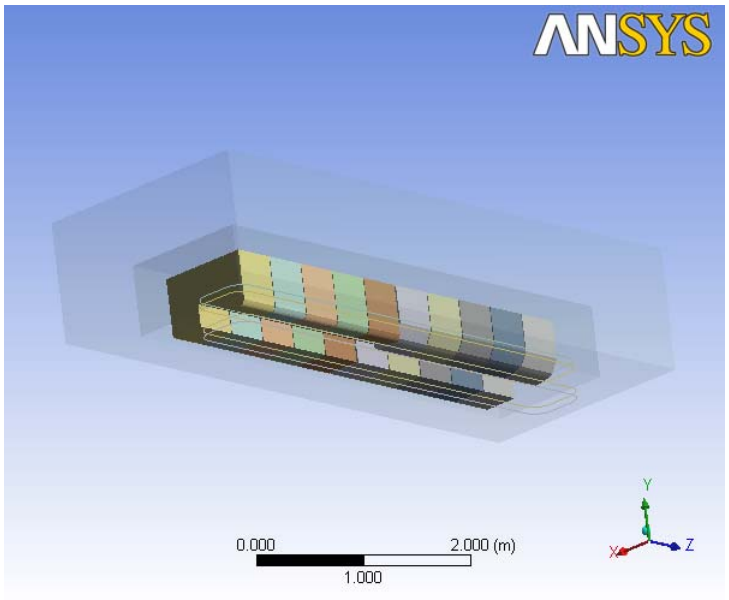
Doubts concerning precision of tune and chromaticity measurements

- 5 currents mode – different currents in narrow and wide pole-face winding
- Sampler error bar (around 1A) and current ripple in power source
  - $I_{programmed}$ -> $I_{obtained}$->Tune
- Energy (momentum) measurements based on revolution frequency of beam
- Differences in tune measurements between cycles of the same type



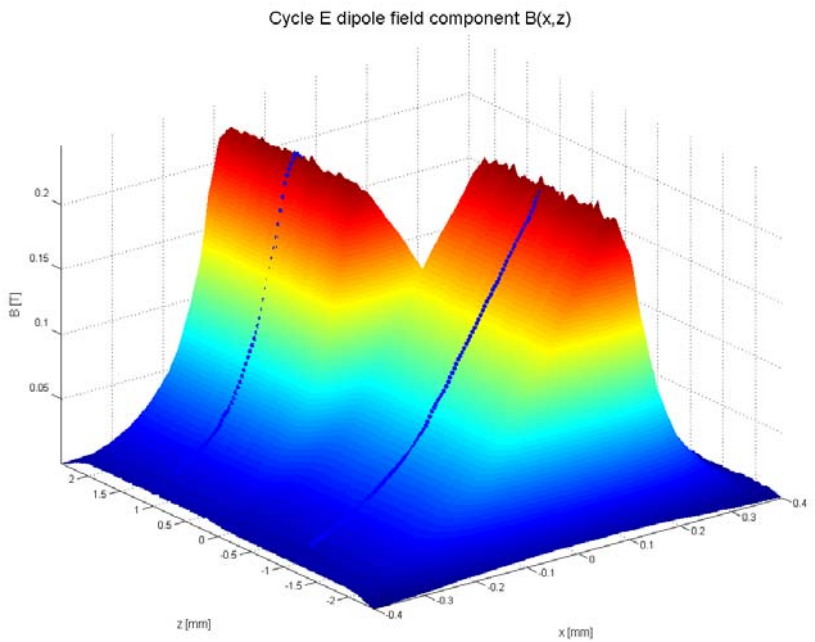
Bare machines cycle without figure-of-eight loop and pole-face windings

3D ANSYS model



Problems:

- Full model needs lots of computer resources
- Solution not accurate
- Problems with pole-face windings and figure-of-eight model



Conclusions

- 2D model is working correctly
- There are still doubts concerning precision of ANSYS input data and measurements of tune and chromaticity

What next

- Changing power back to 3 current mode
  - Redo measurements and simulation
- Adjusting free parameters or mad model
- 3D model for extraction (full or divided into parts)