AD E-cooler PRR

Magnetic system

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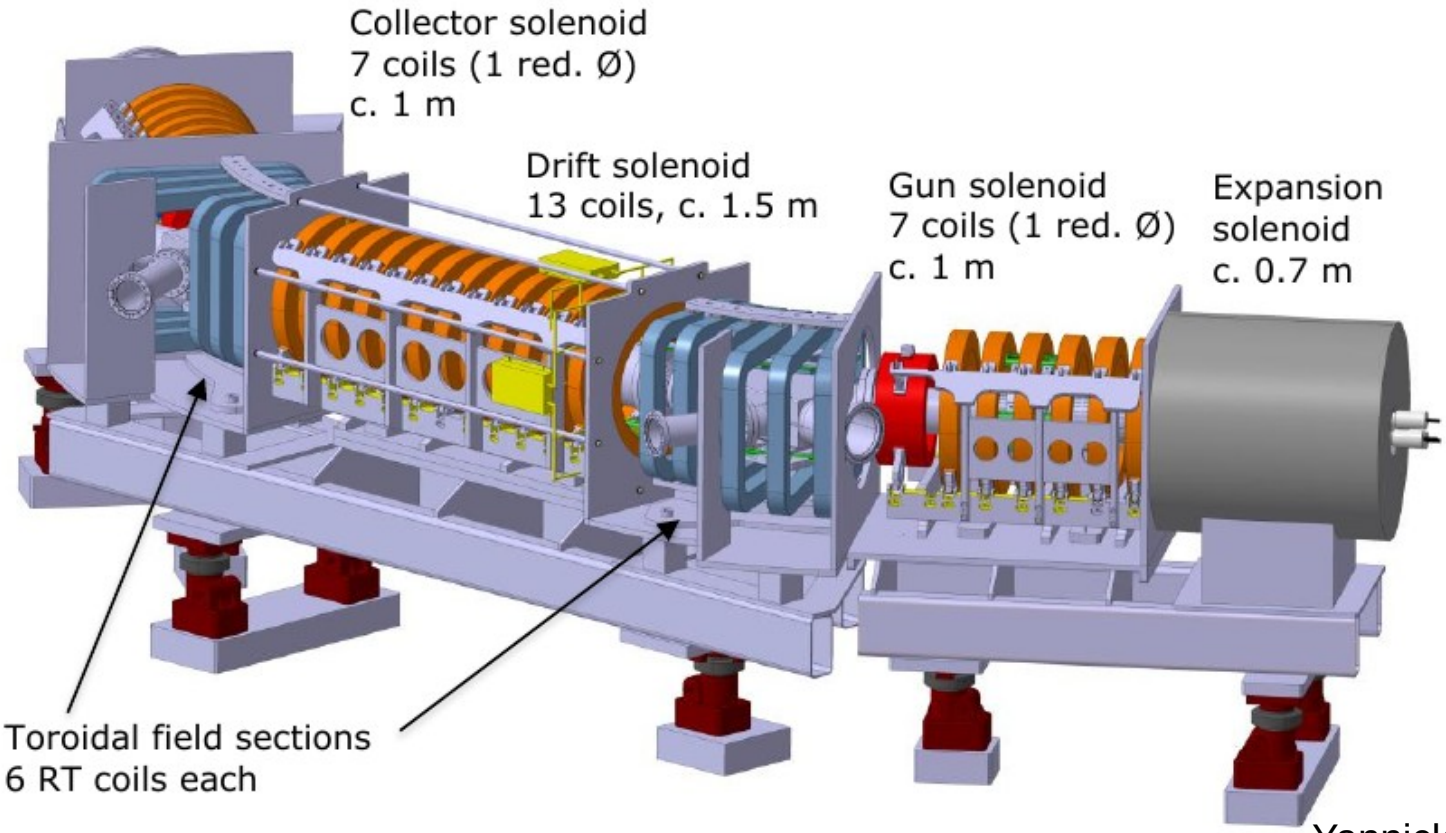
19 May 2022

Overview

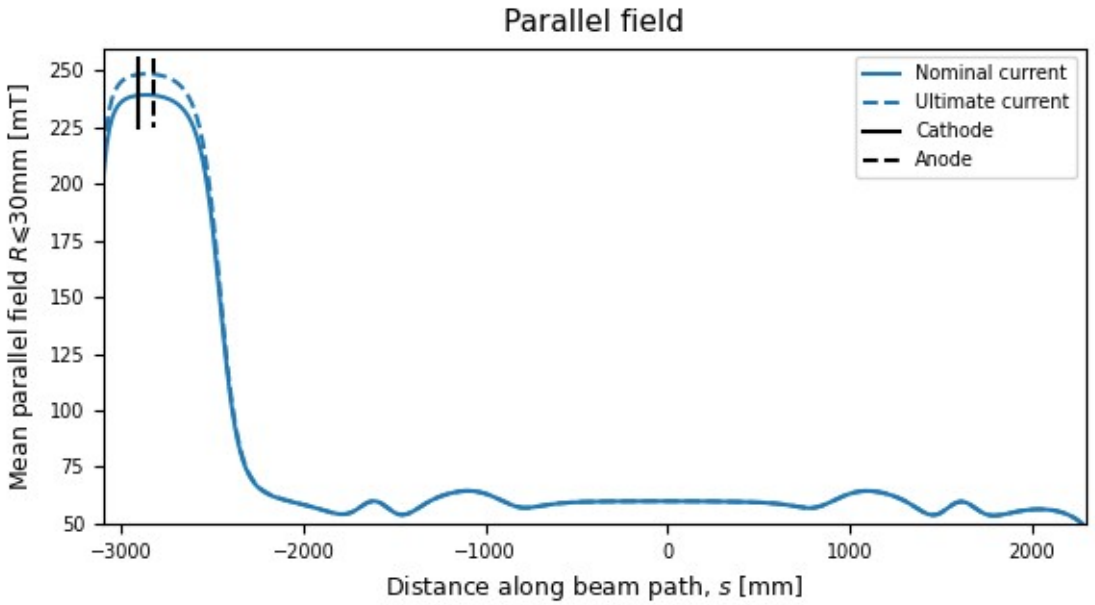


Yannick Coutron EN-MM

Parallel field

Nominal field of 240 mT and 60 mT achieved

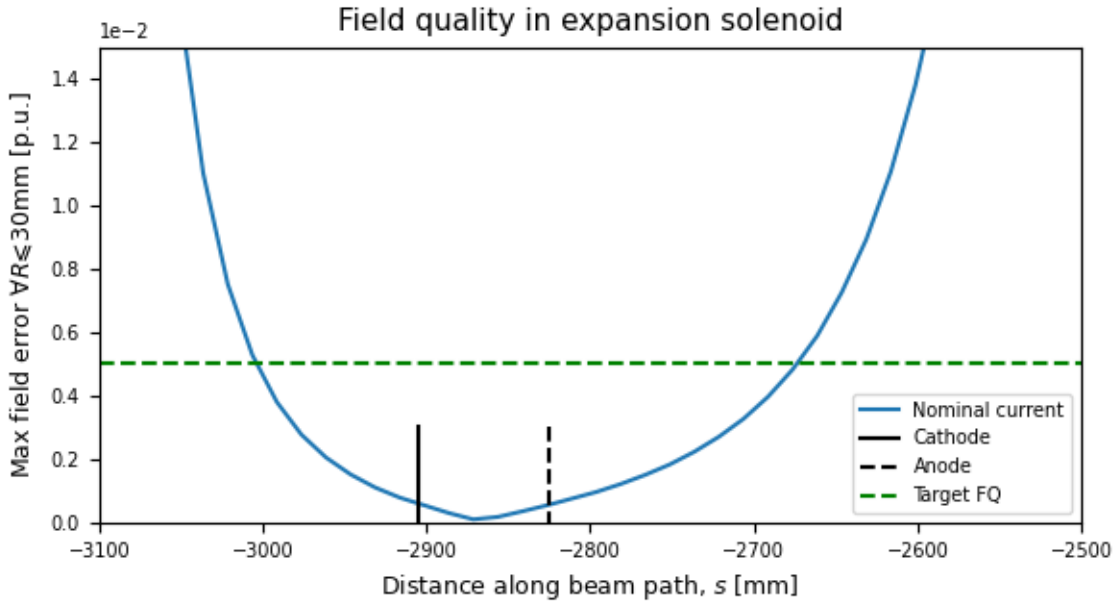
3.5% margin in expansion solenoid as electron angle sensitive to field



Field quality in expansion solenoid

Field quality between cathode and anode < 6.1×10^{-4}

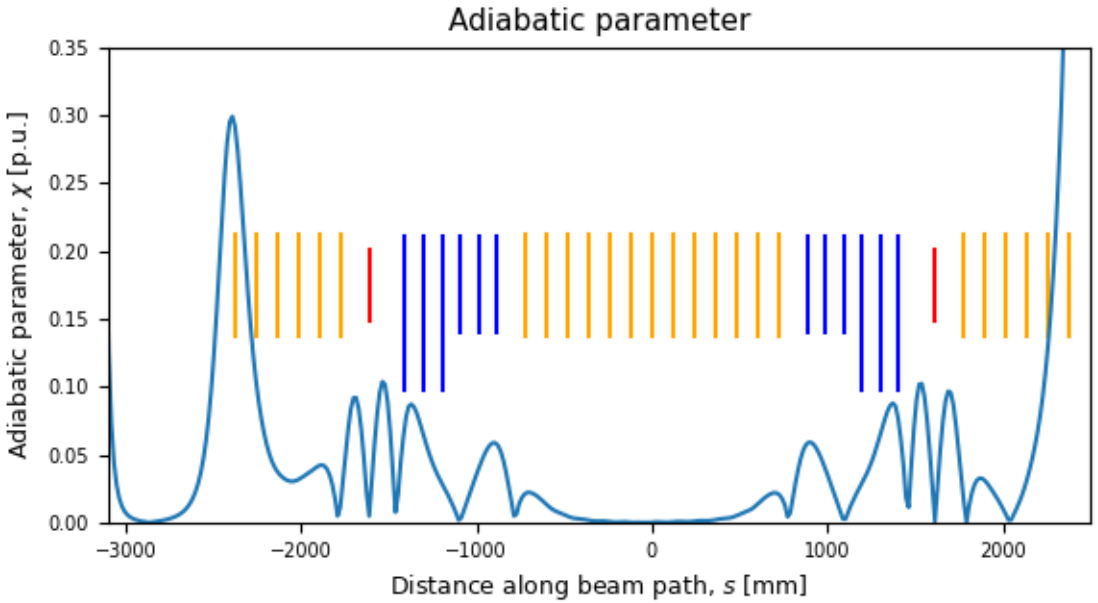
$$q_f = \frac{|B_\perp|}{|B_{||}|}$$



Smooth transport

Adiabatic parameter largest in expansion → rest of system OK

$$\chi = \frac{\lambda_c}{|B|}\left|\frac{dB}{ds}\right|$$

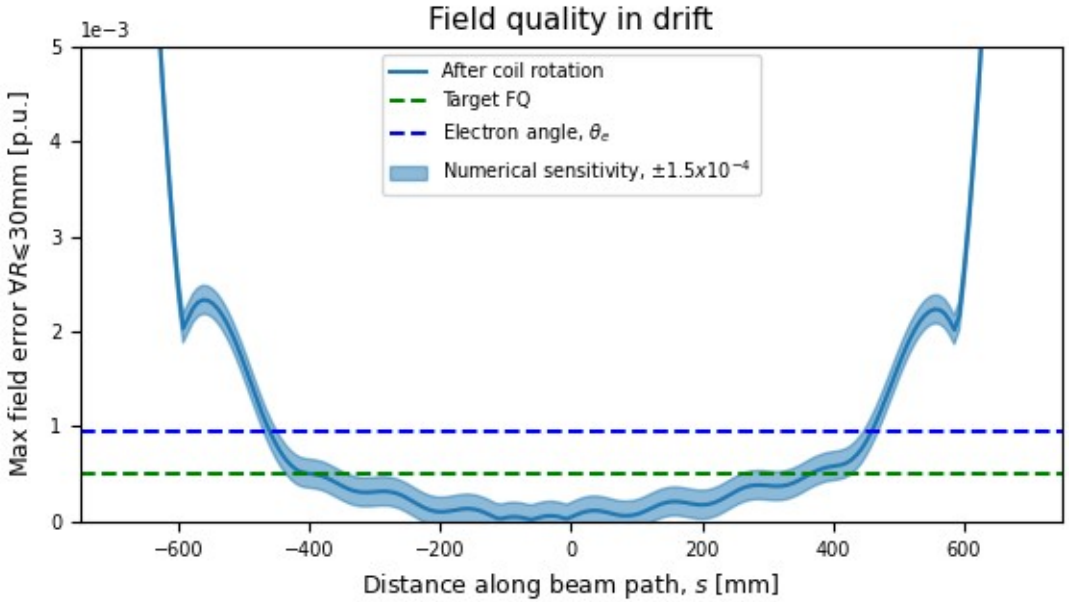


Field quality in drift

Field quality < 5×10^{-4} over central 50%, targeting 65%

Field quality < 9×10^{-4} over central 61%

$$q_f = \frac{|B_\perp|}{|B_{||}|}$$



Details on drift correction

Coils are iteratively counter rotated by $\tan^{-1}(q_f)$

Magnetic design limited to ±1.0° → 0.5° margin for angular manufacturing errors

Robust against positional error, 2.5 mm error corrected to 3.5×10^{-4}

Field alignment and qualification

Development of bespoke system required

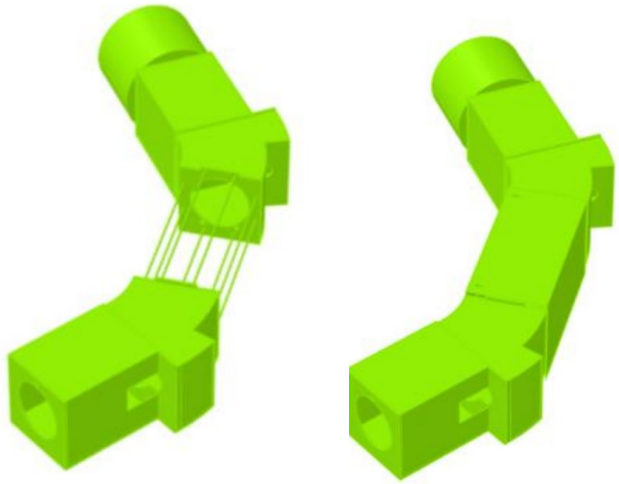
Process (Survey, Measurement and Magnets):

1. Measure axis vs. survey targets coil by coil
2. Assemble magnetic elements with as designed coil rotation
3. Measure field and update rotations
4. Survey corrected cooler
5. Release to project

Return path and shielding

Contingency for complete shielding in drift

Increase shielding factor from 2.1 to 8.0



Powering scheme

Matched to [100 A, 120 V] PSUs

	Current [A]		Voltage [V]
	Nominal	Ultimate	Ultimate
Drift	90	90	77
Toroidal field	90	90	94
Gun, collector, and reduced diameter	90	90	85
Expansion	87	90	109

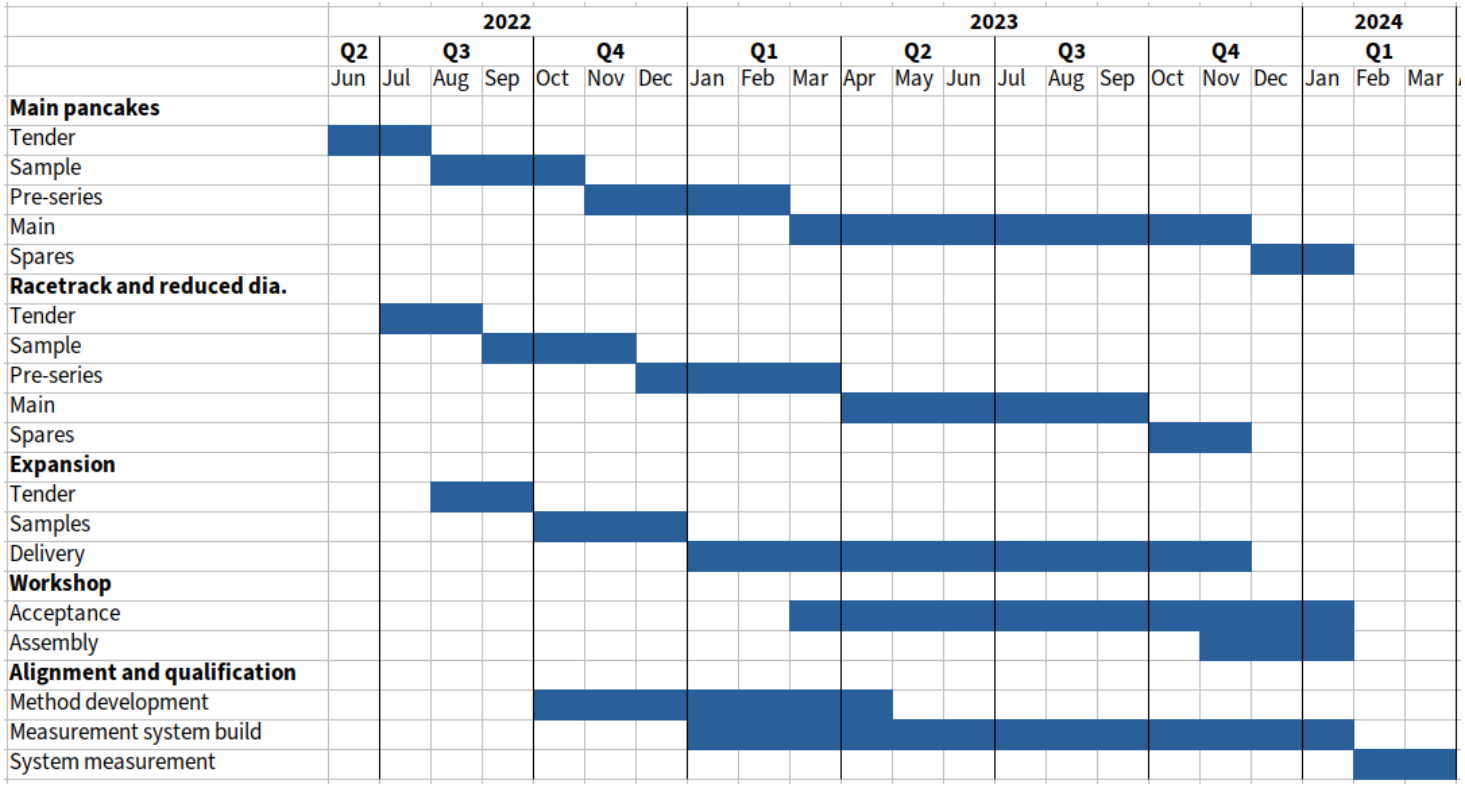
Cooling scheme

Manifold pressure	10 bar to 14 bar
Total flow	30 l/min
Total heat rejection	30 kW
Protection	Thermal switches, flow switches optional
Coolant velocity	< 1.6 ms^{-1}
Temperature rise	< 31.1 ºC

Documentation

	Status	EDMS №
Design report	Released	2731780
Specification, main pancakes	Released	2733057
Specification, race tracks and reduced diameter	First draft	
Specification, expansion solenoid		

Schedule


2022
2023
2024
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar
Main pancakes
Tender
Sample
Pre-series
Main
Spares
Racetrack and reduced dia.
Tender
Sample
Pre-series
Main
Spares
Expansion
Tender
Samples
Delivery
Workshop
Acceptance
Assembly
Alignment and qualification
Method development
Measurement system build
System measurement

Cost estimate, 633 kCHF

	Total [kCHF]	2022 [kCHF]	2023 [kCHF]	2024 [kCHF]
Main pancakes (+5)	180	18		162
Race tracks (+2) and reduced dia (+1)	140	14	126	126
Expansion solenoid (+1)	70	7	63	63
Acceptance and assembly	90		70	20
Alignment and qualification	108	10	66	32
Dipole correctors (+1)	45		5	40
Year totals	633	49	330	254

Not included: shielding, transport, installation

Status summary

The magnetic system is designed and specified

The performance of the magnetic system has been accepted

Tender phase imminent

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