



THERMAL STABILITY OF THE NEW ESRF EXTREMELY BRILLIANT SOURCE

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- 1. Permanent static errors from the origin
- 2. Permanent variable errors (quick effects)
- 3. Errors triggered by beam operation
- 4. Long period errors



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EBS ELECTROMAGNETS



• 34 different electromagnets



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- Most of their coils are water cooled (in series or parallel)



4 11/09/2016 – MEDSI – Thermal Stability of the new ESRF Extremely Brilliant Source

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 \longrightarrow What % of heat from each electromagnet goes in air?



Pjoule



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Inner volume of electromagnets: natural convection is predominant









- Each coil dissipates 500W of heat (2000W total)
- Coils are water cooled in parallel

0.45L/min Tinlet = 24°C Toutlet = 40°C

• Air: only natural convection is considered

Tambient considered constant at 24°C





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Even simplified, a full 3D model remains too heavy for CFD



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- Local convective coefficients from 2D model: into a 3D model
- A part of the girder is modeled
- Same boundary conditions than 2D model, but without CFD and assuming ground temperature at 24°C
- Initially, quadrupole at 24°C







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Average temperature: 25.4°C (+1.4°C from initial value)





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25.4 25.3 25.2 25.1 25 24.9 24.8 24.7 24.6 24.5 temperature increase by ~1°C 24.4 24.3 not observed experimentally 🙁 24.2 (actually it is $+3^{\circ}C$) 24.1 24 0.5 1.5 2.5 2 3 0 Steady state reached after: 5T ~1.5days Time constant T ~0.3day















FEA	EXP.
Tav. +1°C	Tav. +3°C





FEA	EXP.
Tav. +1°C	Tav. +3°C
1% of heat in air	4% of heat in air











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Displacement = 0



Total displacements [µm]







Full scale mock-up girder prototype with power cables inside







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Mock-up:

- probed with several PT100
- girder is isolated by walls and ceiling to reproduce a cell of the storage ring
- fan is integrated

Time scale [days] in July - August 2016

GIRDER MOCK-UP – TEMPERATURE PROBES

25 No Ventilation on tunnel this period Experiment hall general ventilation 24.5 restart Temperature measurement [°C] 24 23.5 Ventilation cooling start at 25 % of nominal flow 23 start 100% nominal flow 22.5 Lower girder downstream Upper girder downstream 22 8/8 16/8 6/8 10/8 12/8 14/8 18/8 20/8 22/8 24/8 26/8

EBS girder thermal behaviour at Chartreuse test model

Timescale [days during August 2016]

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THANK YOU FOR YOUR ATTENTION

