



Two-beam module studies update

07/03/17

*Alex Vamvakas
on behalf of the TBM team*

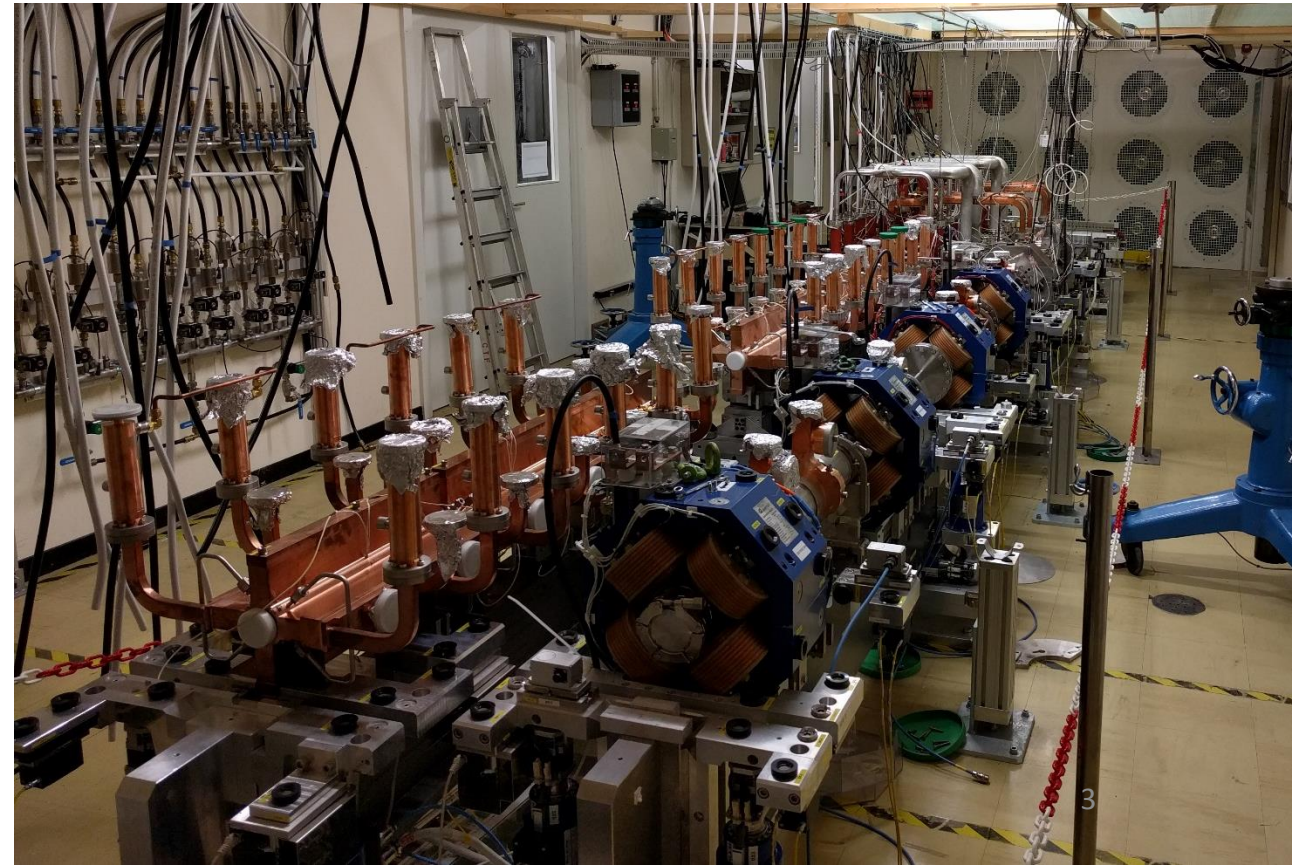


Outline

- 2016 activities:
 - LAB modules installation
 - SAS mock-up production
 - FEA simulator
 - Dogleg structure thermal study
- Future activities:
 - LAB modules testing
 - Transportation test
 - New generation module

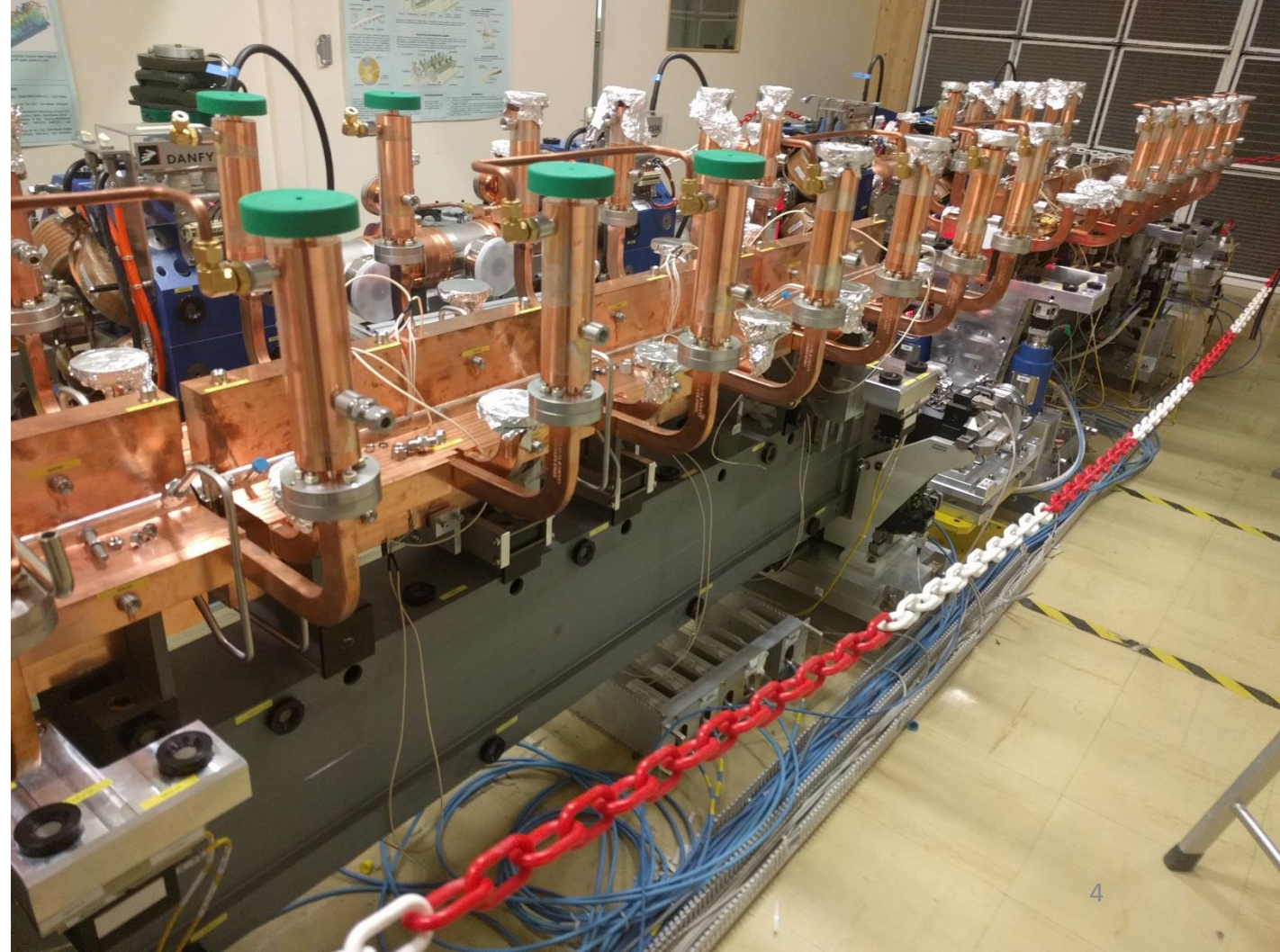
Installation of LAB modules

- All major components installed
- Missing:
 - Waveguides, vacuum and cooling
- First tests already started
 - Measuring the effect of assembling steps on alignment
- Thermal and vacuum tests to follow this year



SAS mock-up production

- Simplified geometry
- Small series production
 - 6 units in industry
 - 1 unit at CERN
- 4 out of 7 units needed reworking
- Finally all pieces accepted

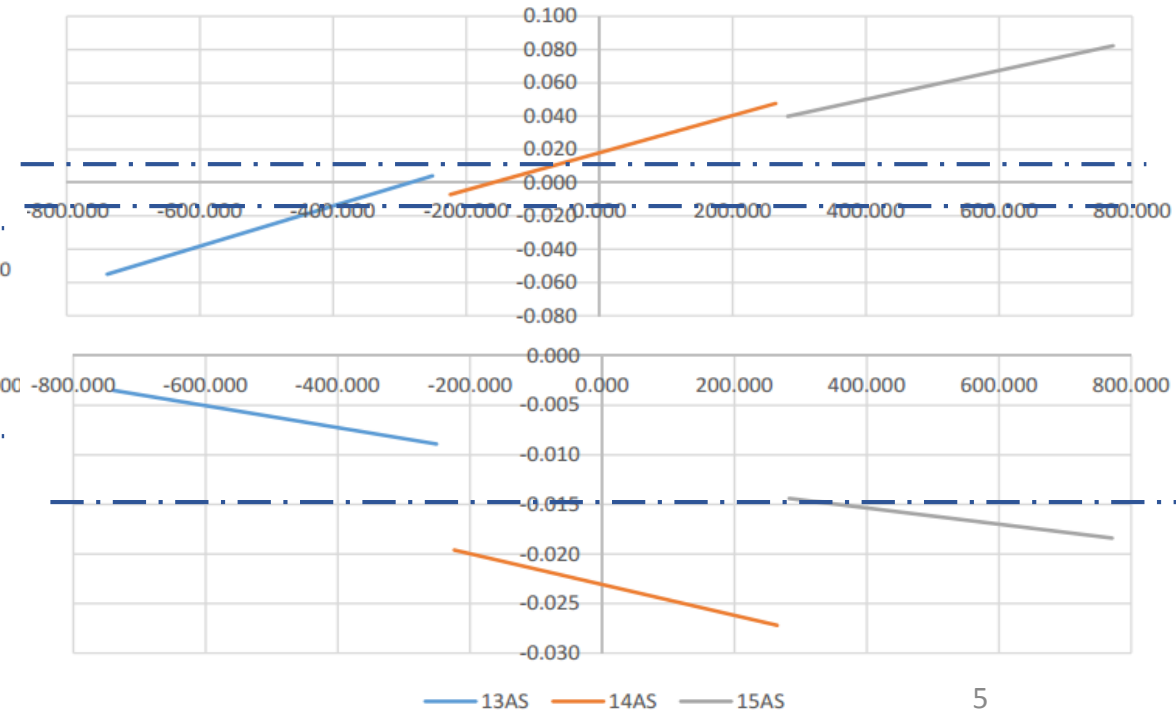
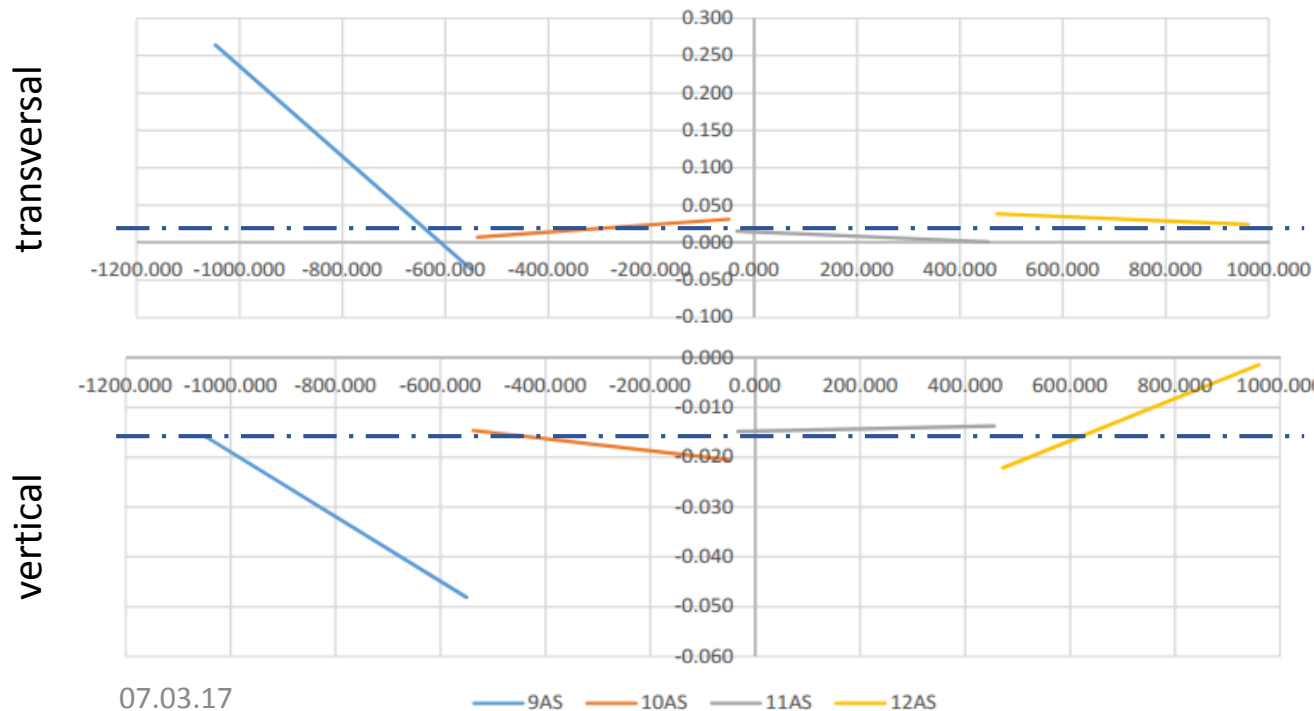




Metrology data

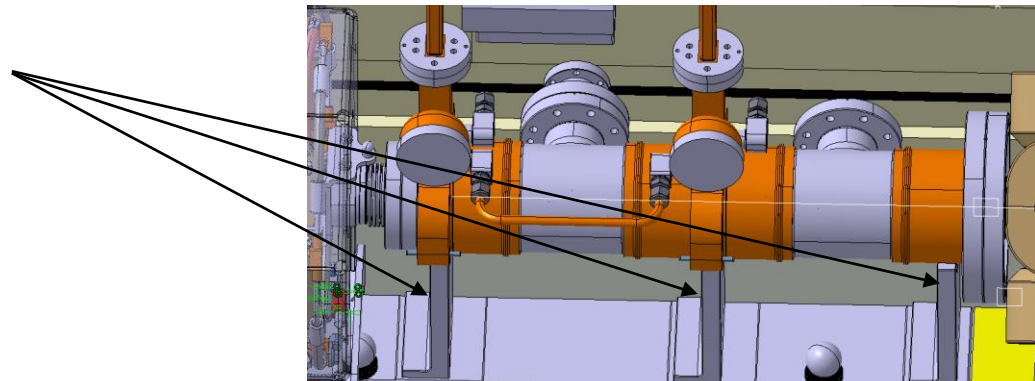
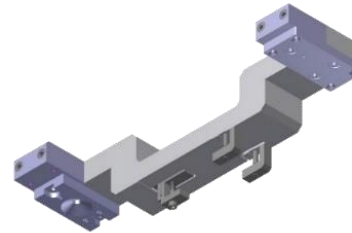
- Measurements from the installed AS
 - Not yet fully understood where errors come from

A. Zemanek, V. rude



Lessons learnt

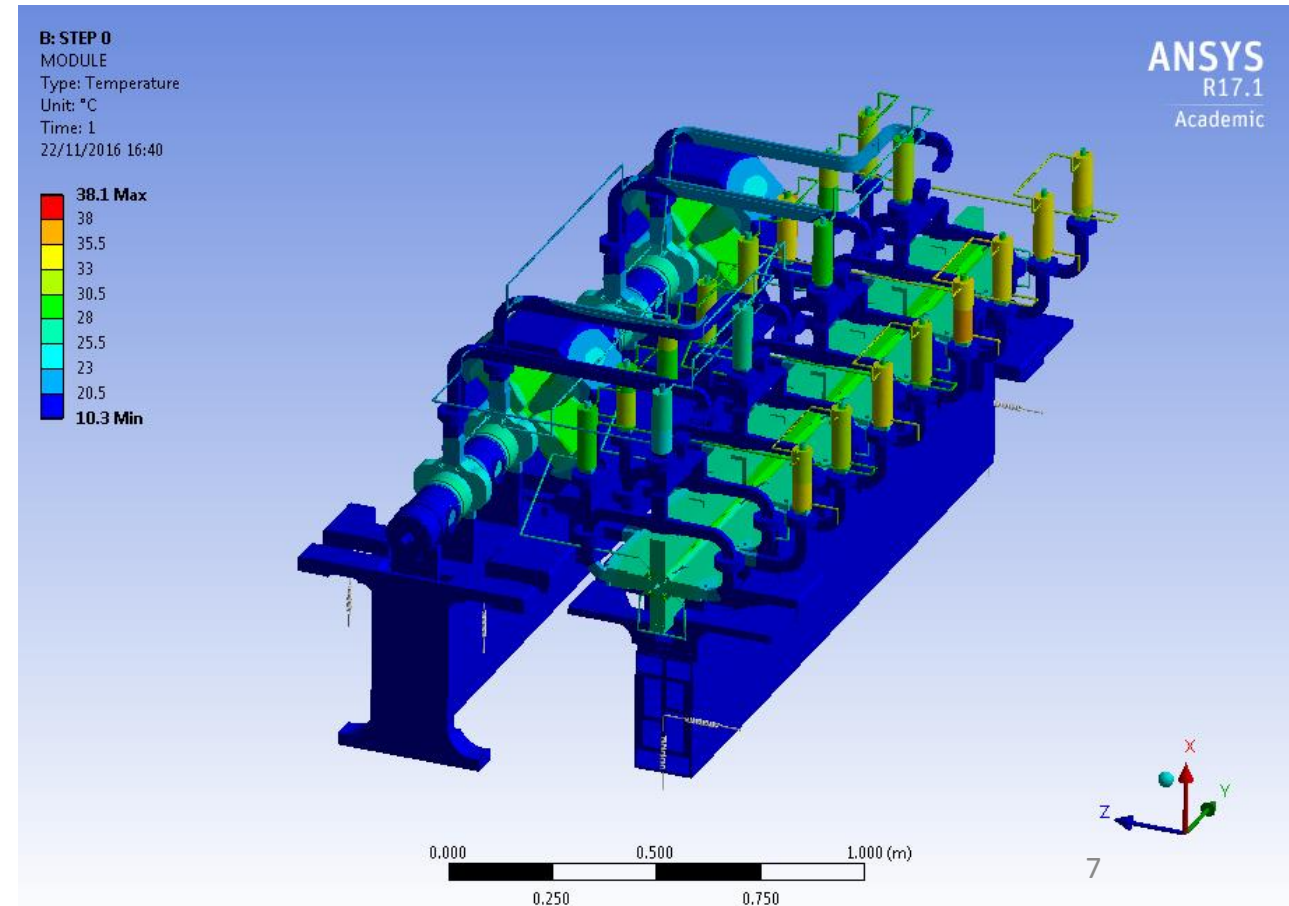
- Very difficult to assemble to required tolerance
- Supporting concept needs to be reworked
 - Too sensitive for real-world assembly
 - Free DoFs need to be fixed
- Flexure based WPS arms work
 - Repeatable through heat cycles
 - Very sensitive to external loads
- DBQ and BPM need a rigid connection
- PETS were over constrained





FEA simulator

- Updated version
- Includes the design changes
- Very clean, neat and coherent
- See A. Moilanen's presentation



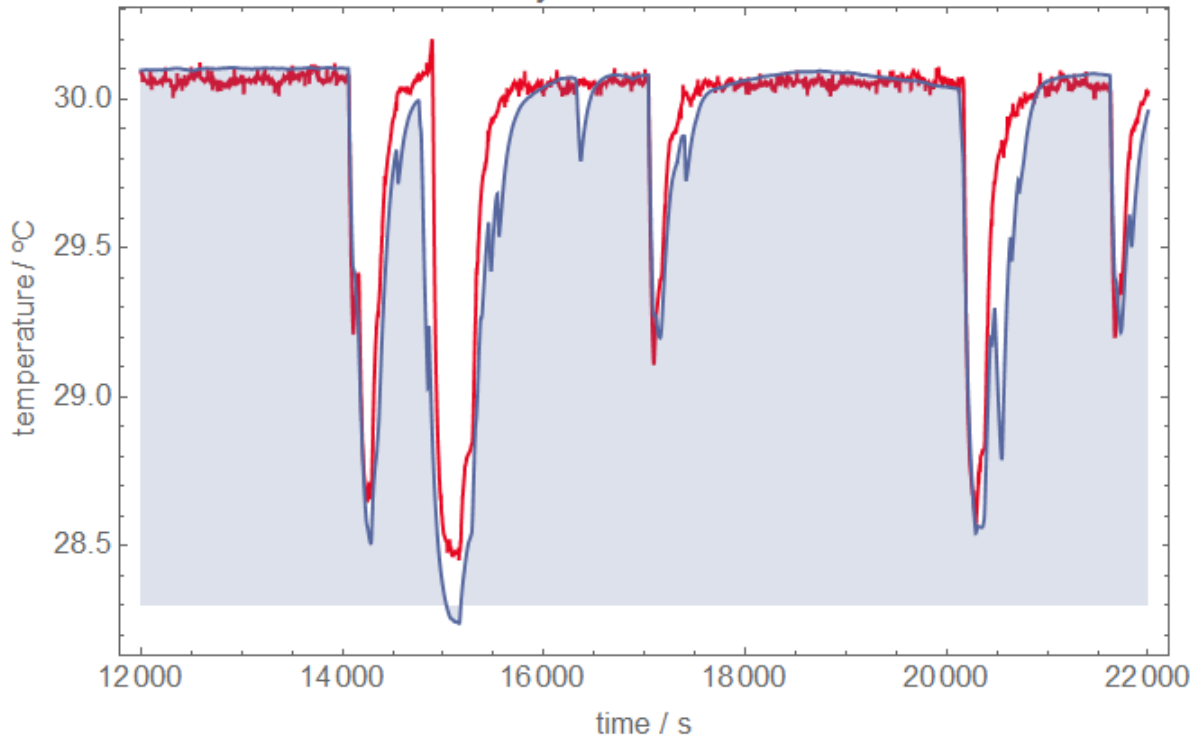
AS transient study in Dogleg

$$P_h = P_{cu} + P_{water} + P_{air}$$

$$\frac{dT_{cu}}{dt} + DT_{cu}(t) + K = P_h(t)$$

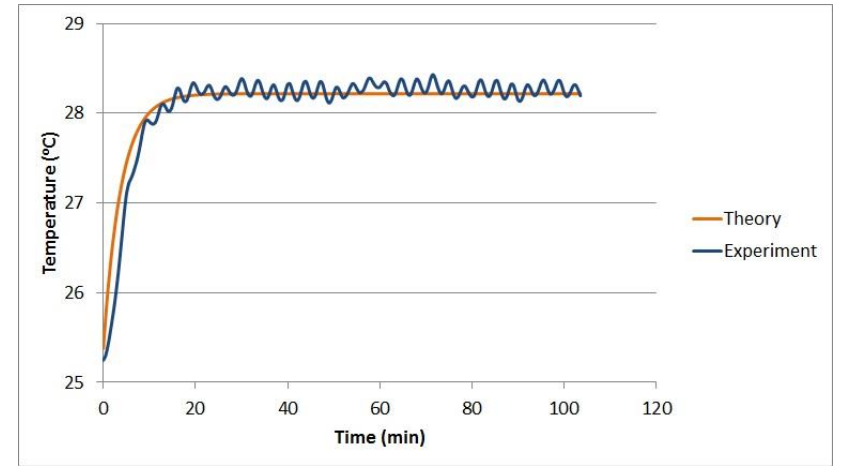
To copper → $P_{cu}(t) = m_{cu}c_{p,cu} \frac{dT_{cu}}{dt}$
To water → $P_{water}(t) = \dot{m}_w c_{p,w} [T_w(t) - T_w(0)]$
To air → $P_{air}(t) = hA_{cu} [T_{cu}(t) - T_\infty]$

Theory vs measurements



— Experiment
— Theory

*Temperature response during breakdowns:
Experimental data vs theoretical model
Dogleg, 2016*



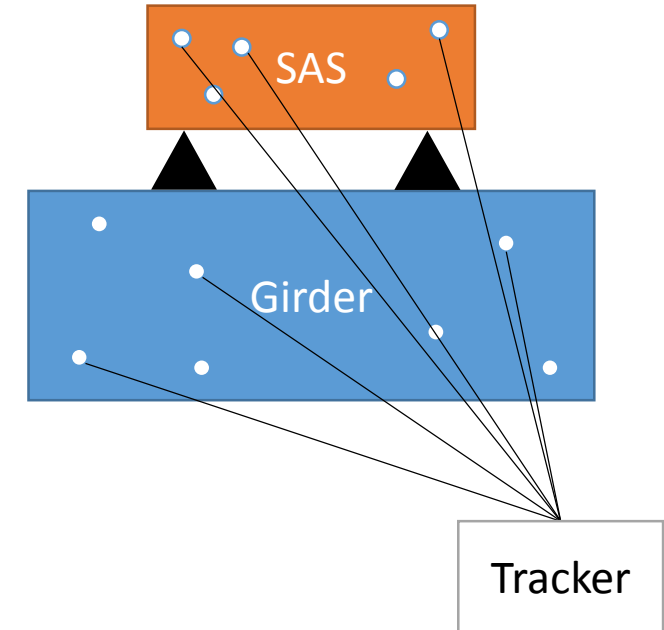
*Temperature response at constant power dissipation:
Experimental vs theoretical data, LAB TBM, 2014 tests*



Future activities

Transportation test

- AS – girder assembly
- Fiducialise before transportation
- Log vibration loads on a typical scenario
- Measure relative movement at the end
- Aims:
 - Evaluate current design
 - Test new design ideas for more robust fixing techniques





New generation module

- CLIC implementation meetings
 - Gather information from all working groups
 - Update specifications
- New design takes into account complete life cycle
 - Manufacturing
 - Conditioning
 - Transportation and installation
 - Commissioning
 - Operation
- 3D integration design
- Updated cost model



Thank you!