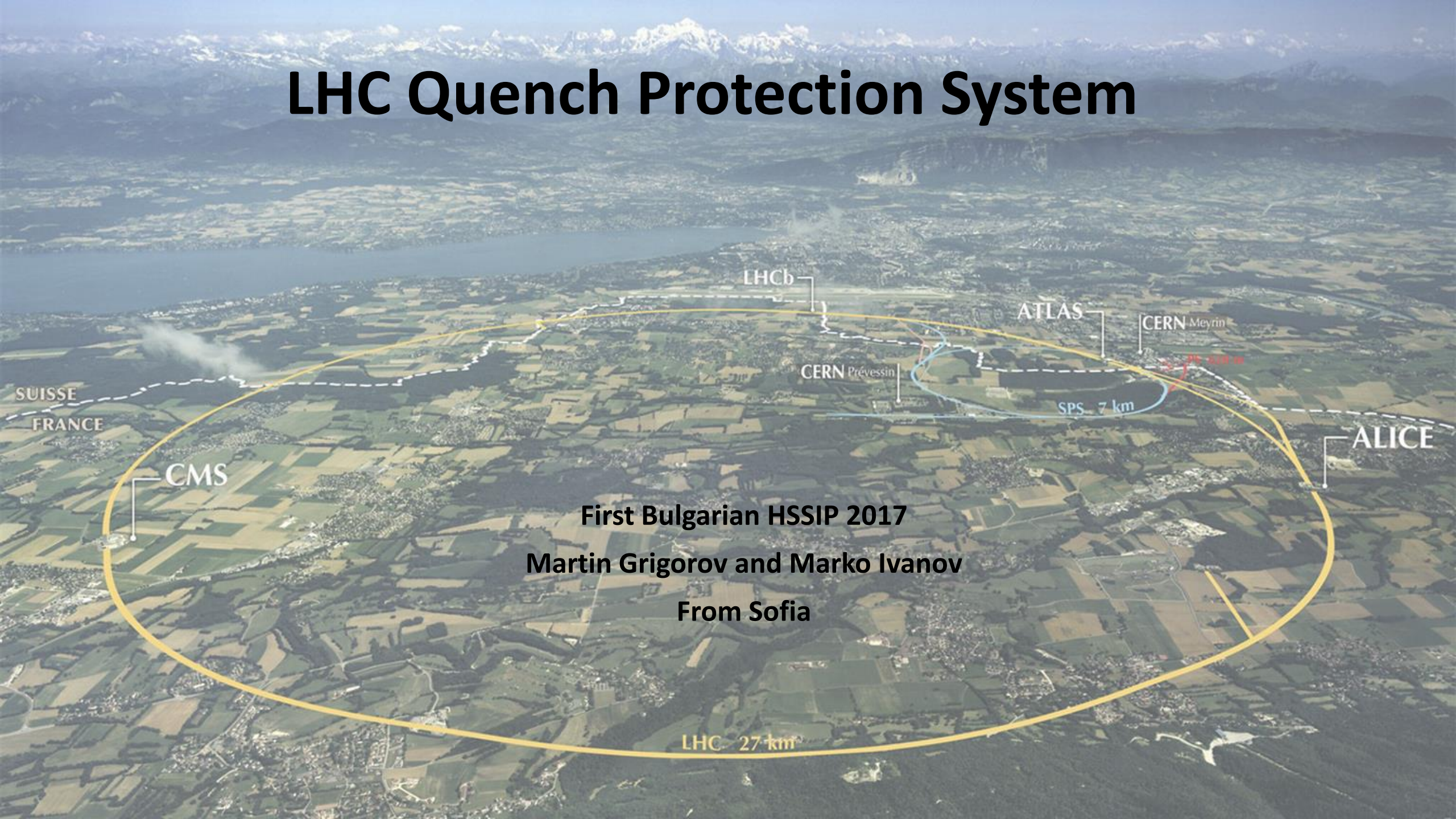


# LHC Quench Protection System



SUISSE  
FRANCE

LHCb

ATLAS

CERN Meyrin

CERN Prévessin

SPS 7 km

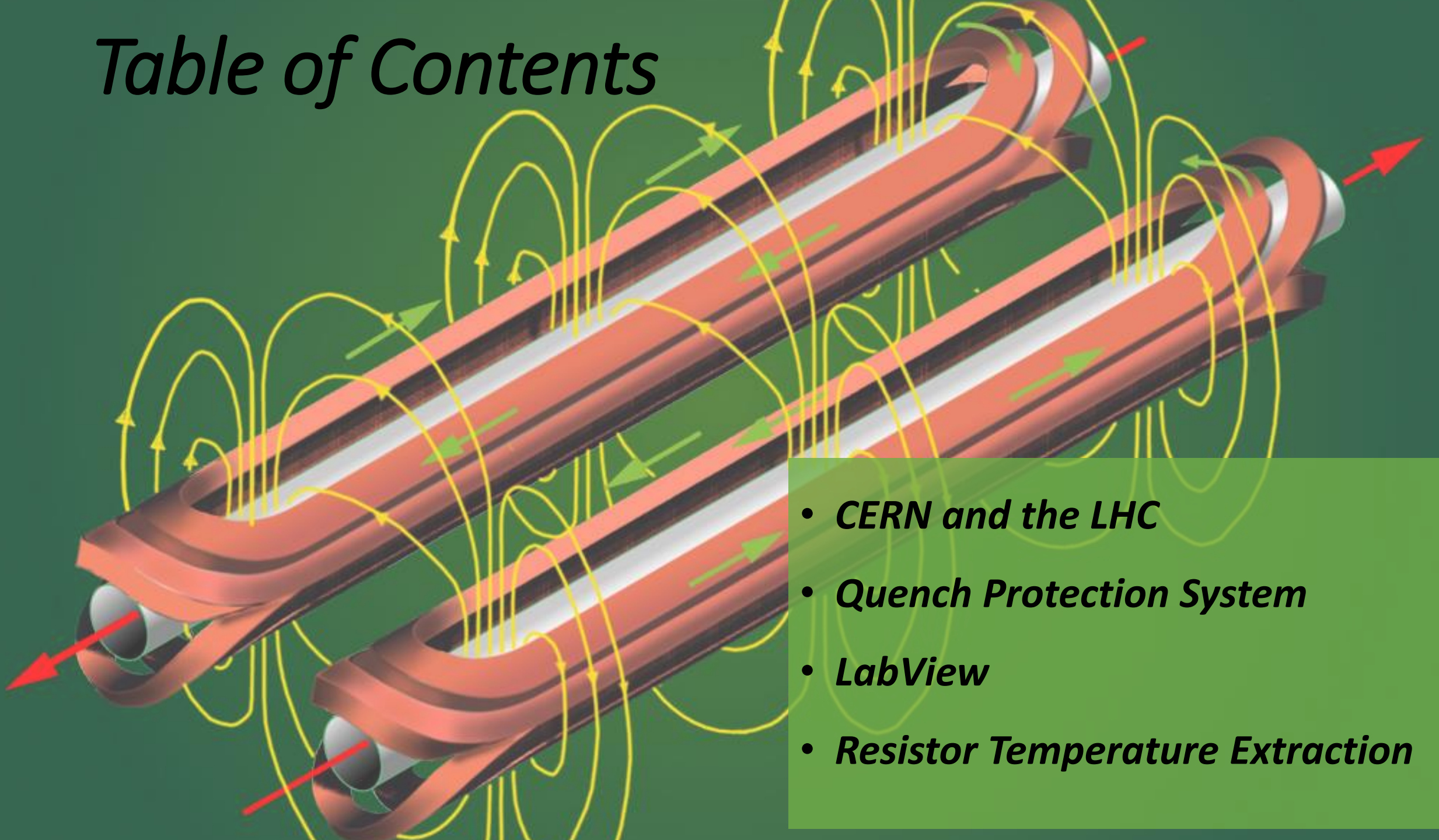
CMS

ALICE

**First Bulgarian HSSIP 2017**  
**Martin Grigorov and Marko Ivanov**  
**From Sofia**

LHC 27 km

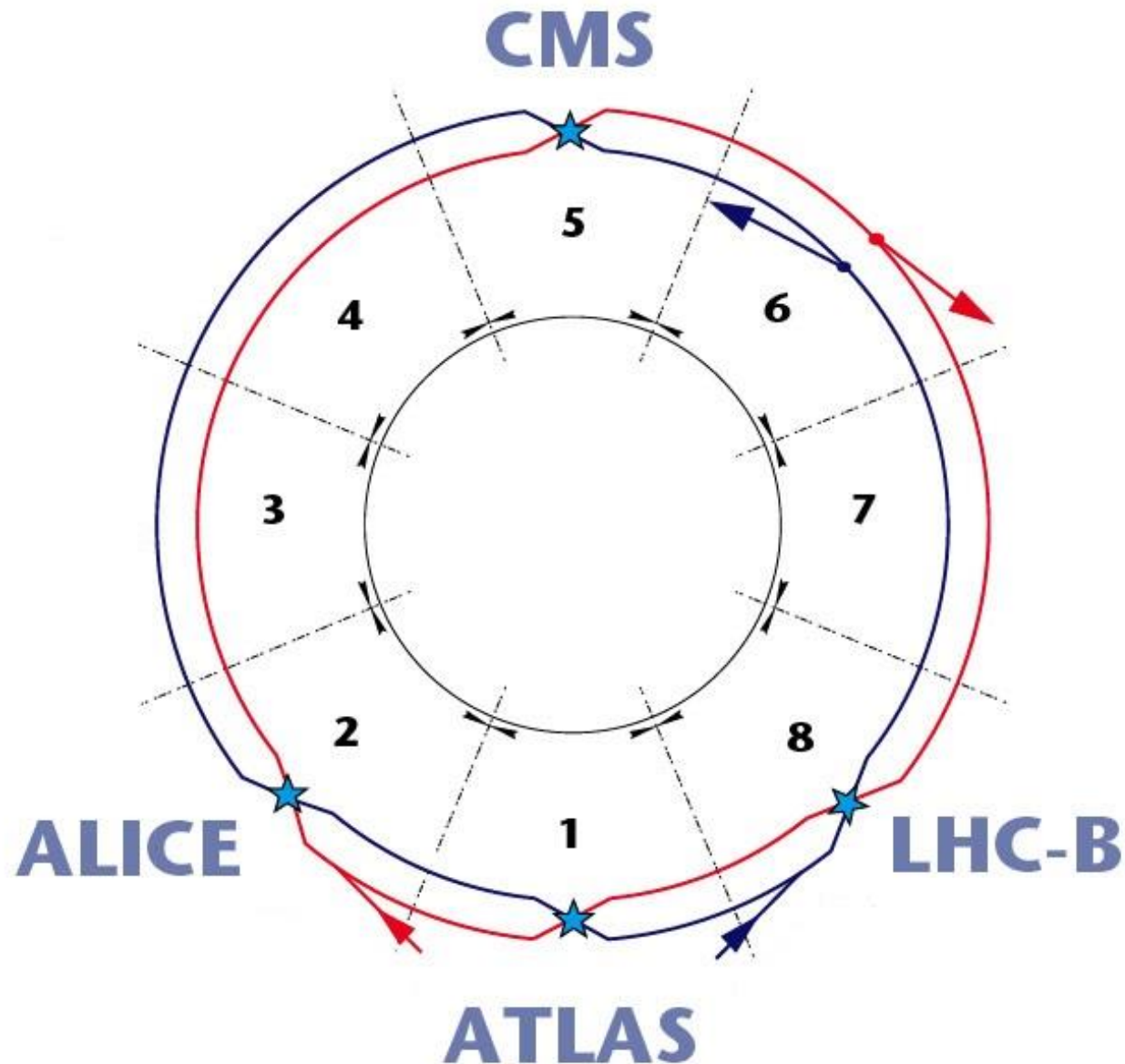
# *Table of Contents*



- ***CERN and the LHC***
- ***Quench Protection System***
- ***LabView***
- ***Resistor Temperature Extraction***

# The LHC

- 154 Dipole Magnets in each sector – a total of 1232
- A total of 392 quadrupole magnets
- 4 major experiments – ATLAS, ALICE, CMS and LHCb
- A temperature of 1.9K (-271 C) is kept inside the cold mass of the magnets





15m

Accelerating Science

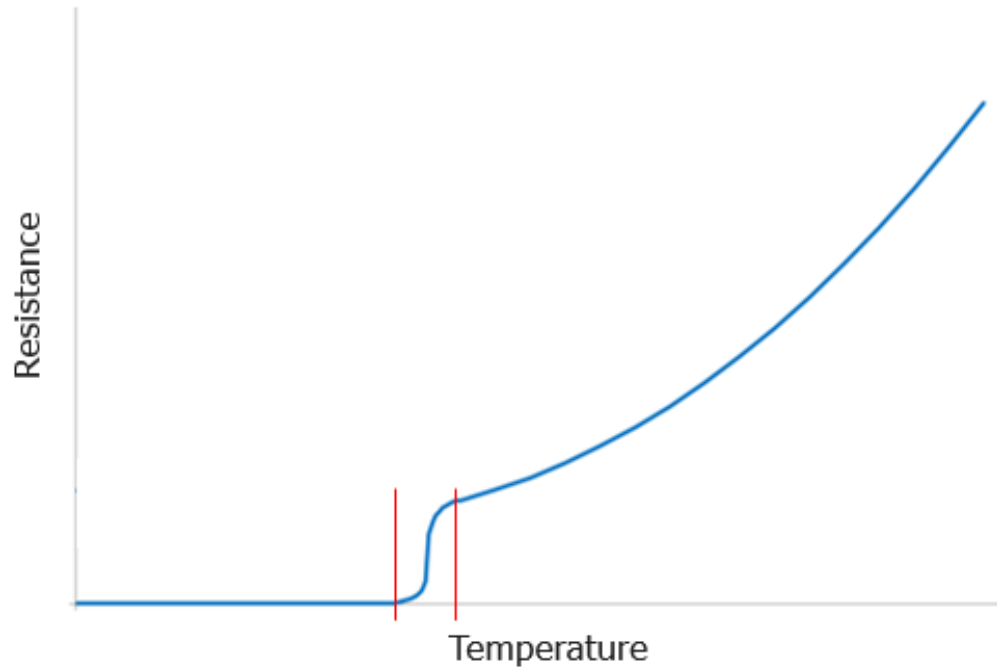
Accélérateur de science

www.cern.ch

www.cern.ch

# Quench – what is it?

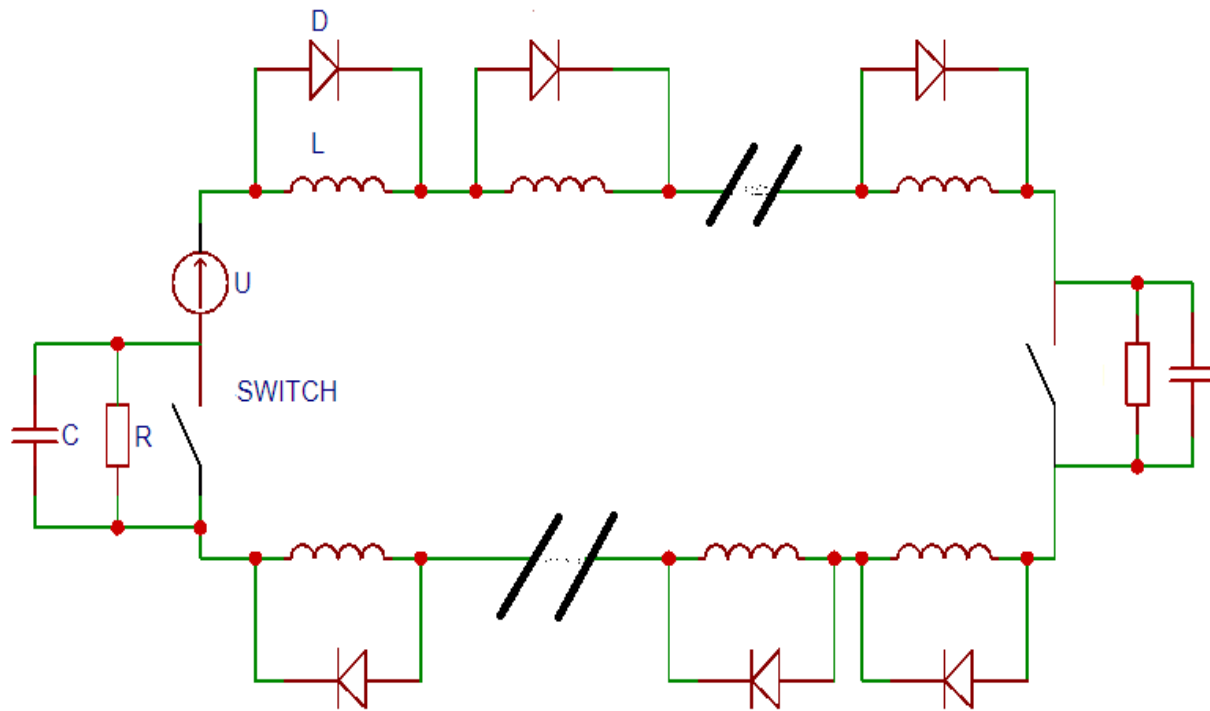
- The superconducting coil suddenly loses its superconductivity and goes to the normal resistive state due to mechanical movement inside the magnet



# LHC Magnets

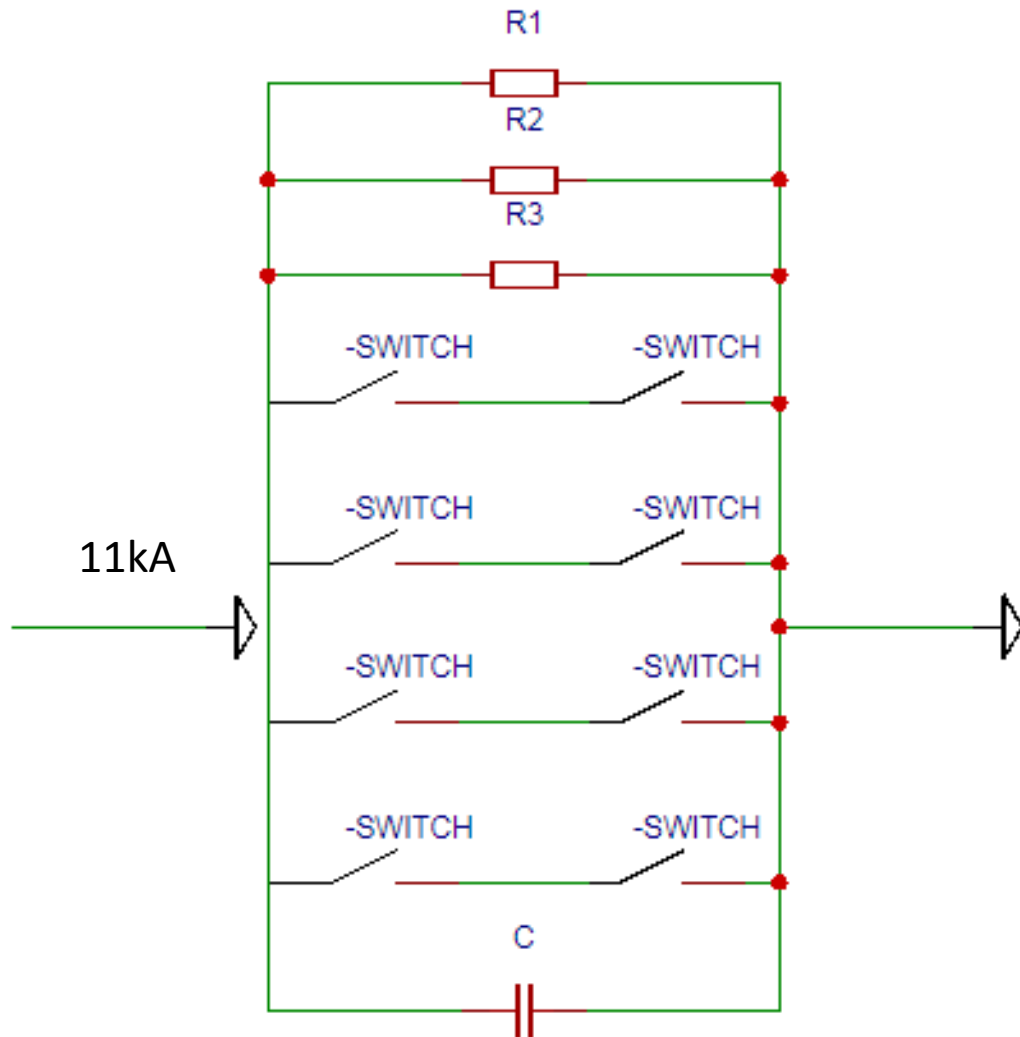


# Principal Diagram for The Main Dipole Superconducting Circuit



- 154 Dipole magnets per sector
- $I = 11\text{kA}$
- $L_{\text{magnet}} = 100\text{mH}$
- $L_{\text{total}} = 15.7\text{H}$
- $E = \frac{1}{2}LI^2 \approx 1.3\text{GJ}$
- Length of sector = 3km

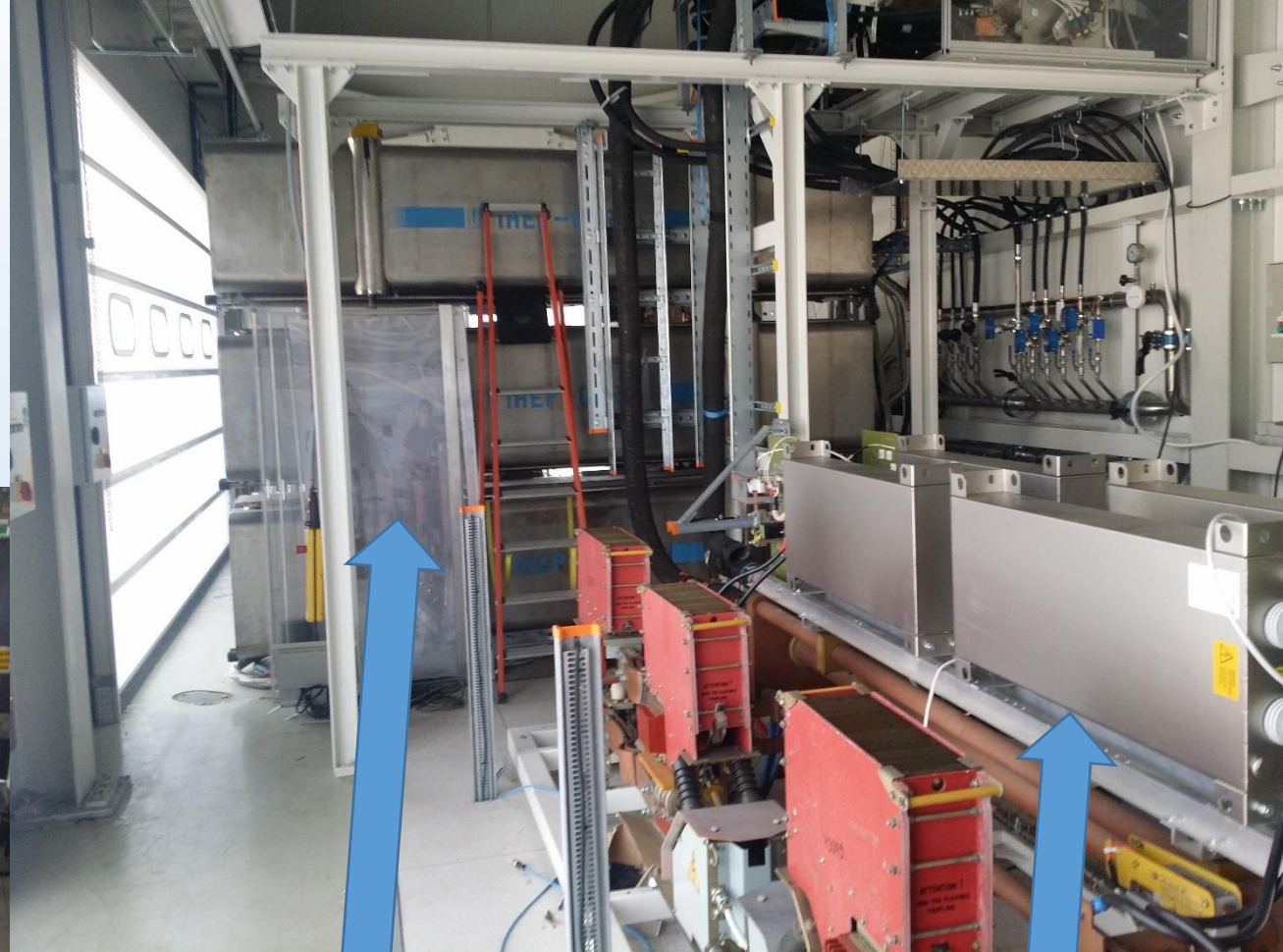
# 13kA Energy Extraction Systems at LHC



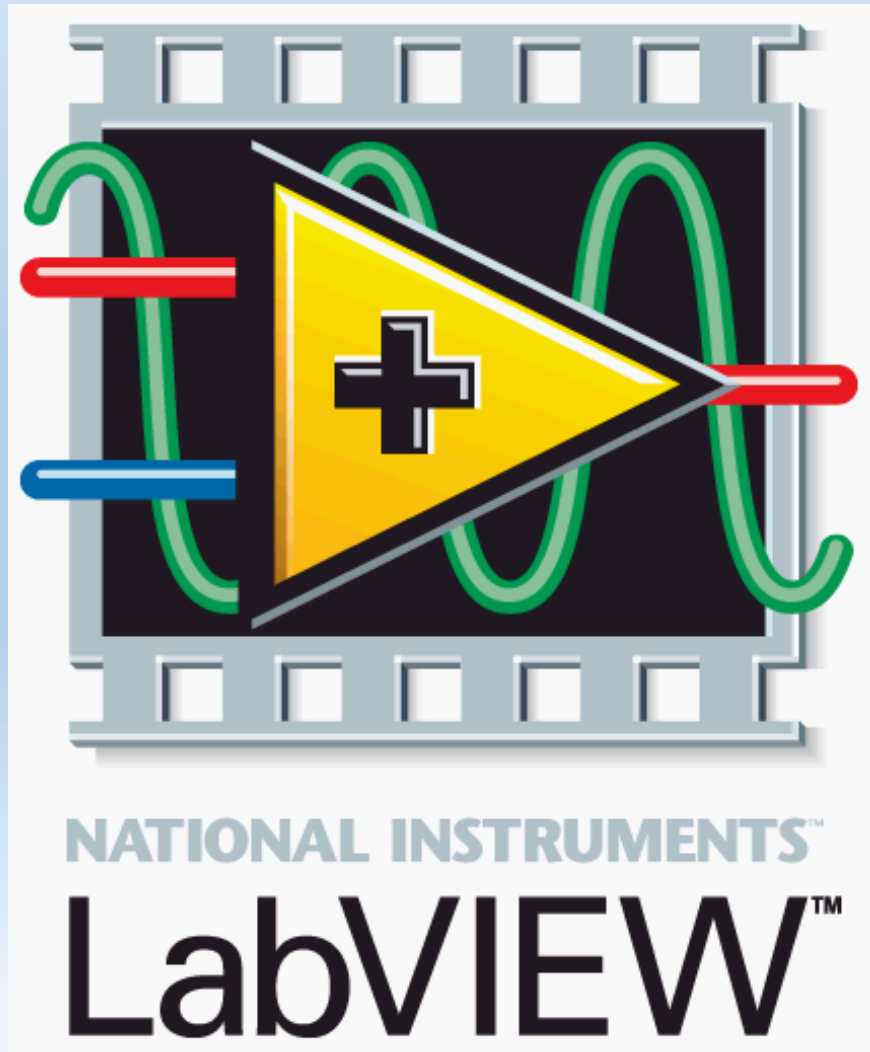
- Protect the main dipole and quadrupole circuits as it performs a safe discharge of the energy stored in their magnetic fields
- $R_{\text{total}} = 70\text{m}\Omega$
- $C = 13.3\text{mF}$



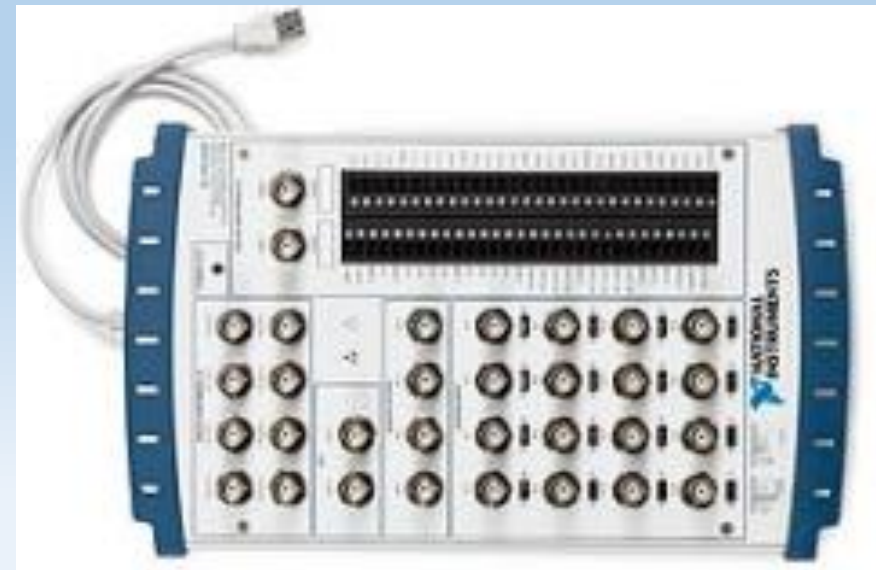
# 13kA EE System Lab



- Dump Resistor
- Snubber Capacitor
- Circuit Breaker



- LabVIEW is systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights



# Dump Resistor Temperatures

## Time Period of Measurements

Start of Period

20:00:00  
22/07/2017

End of Period

23:00:00  
22/07/2017

## Displayed Resistor's Temperatures

Resistor Groups

RQD\_UA63

DQRQ.UA63.RQD.A56:T\_RES

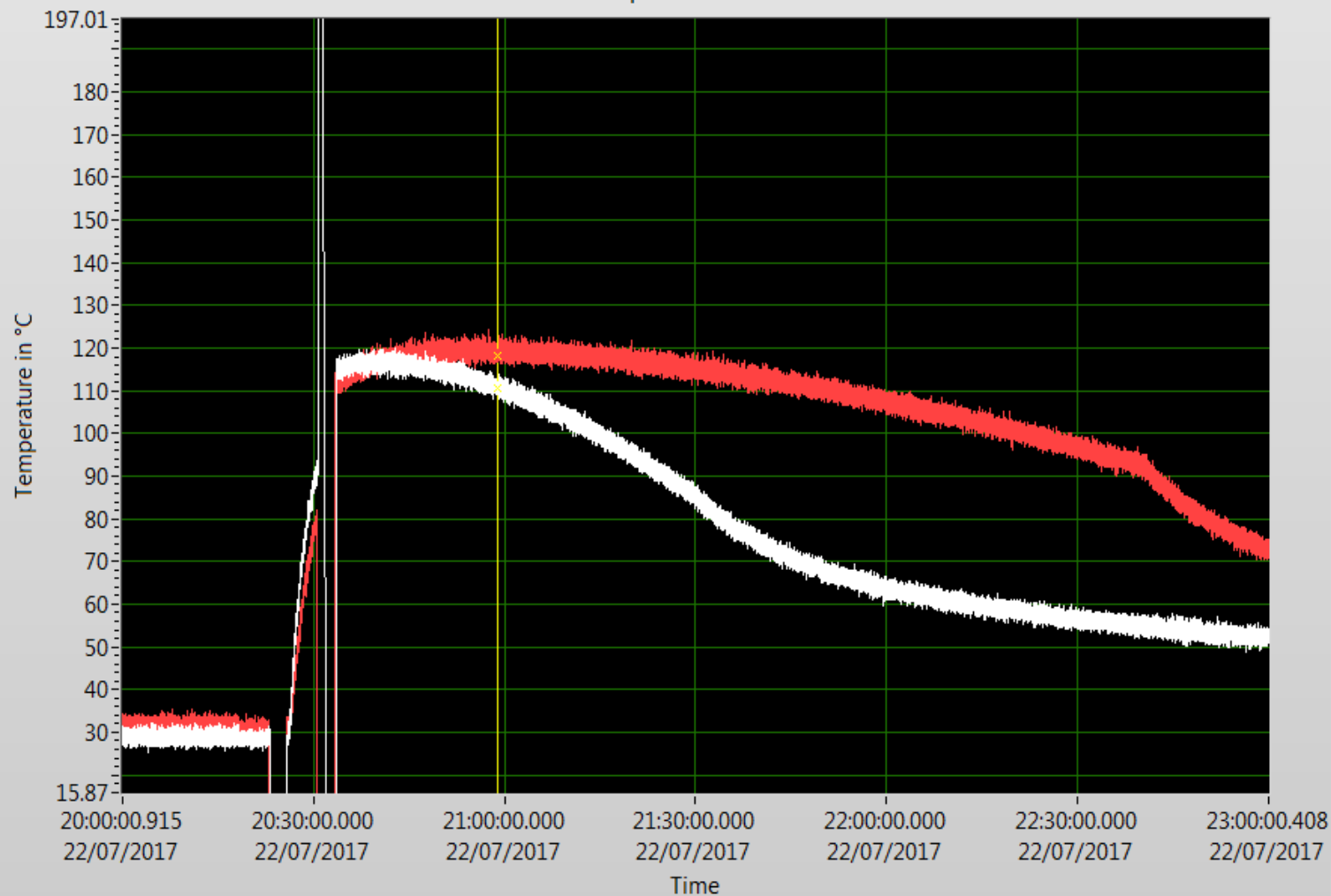
DQRQ.UA63.RQF.A56:T\_RES



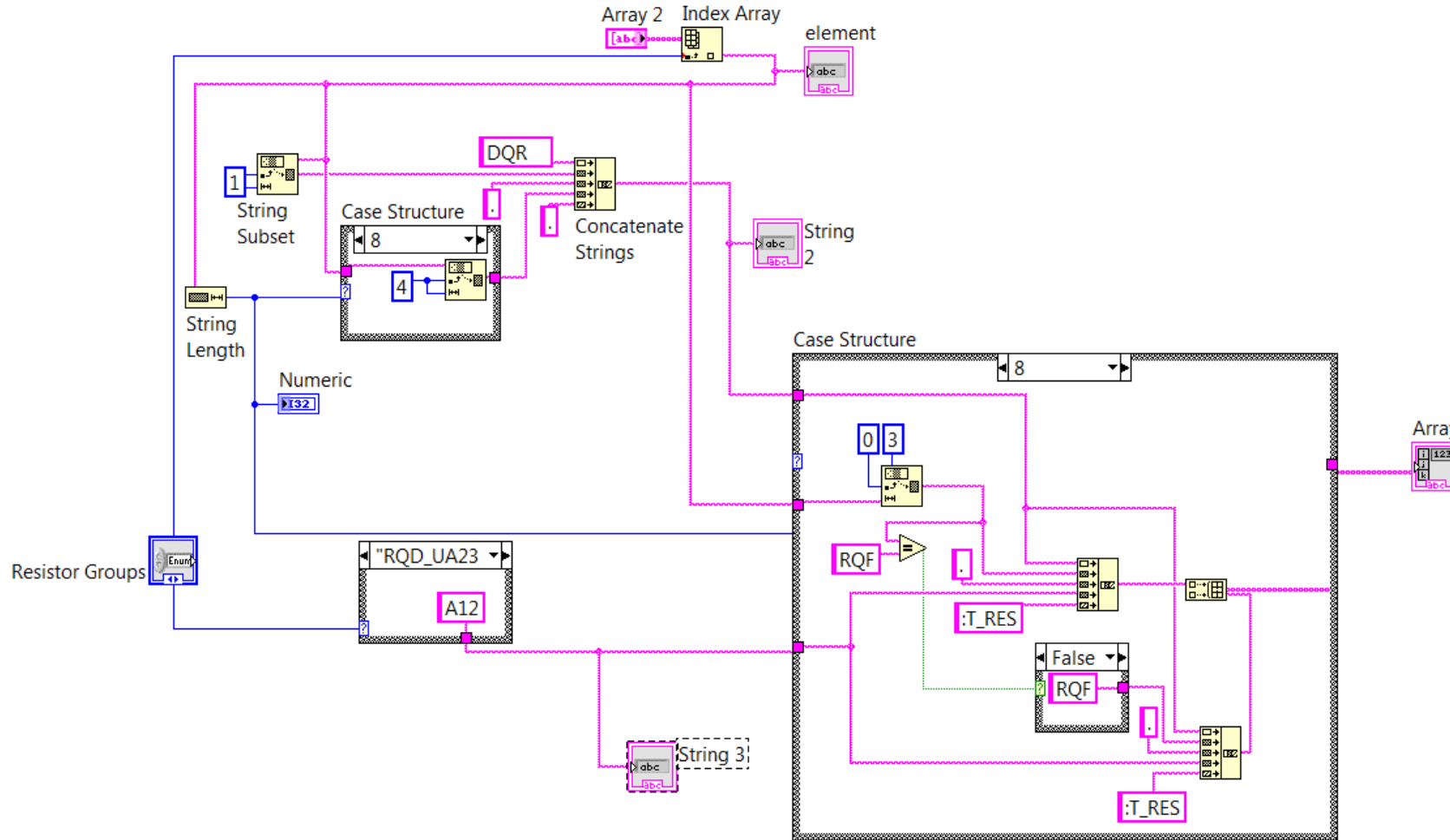
## Cursors:

	Time	Temp.
<input checked="" type="checkbox"/> Exact Values		
└─ DQRQ.UA63.RQD.A56:T_RES	20:58:58.205 22/07/2017	110.65
└─ DQRQ.UA63.RQF.A56:T_RES	20:58:58.205 22/07/2017	118.18

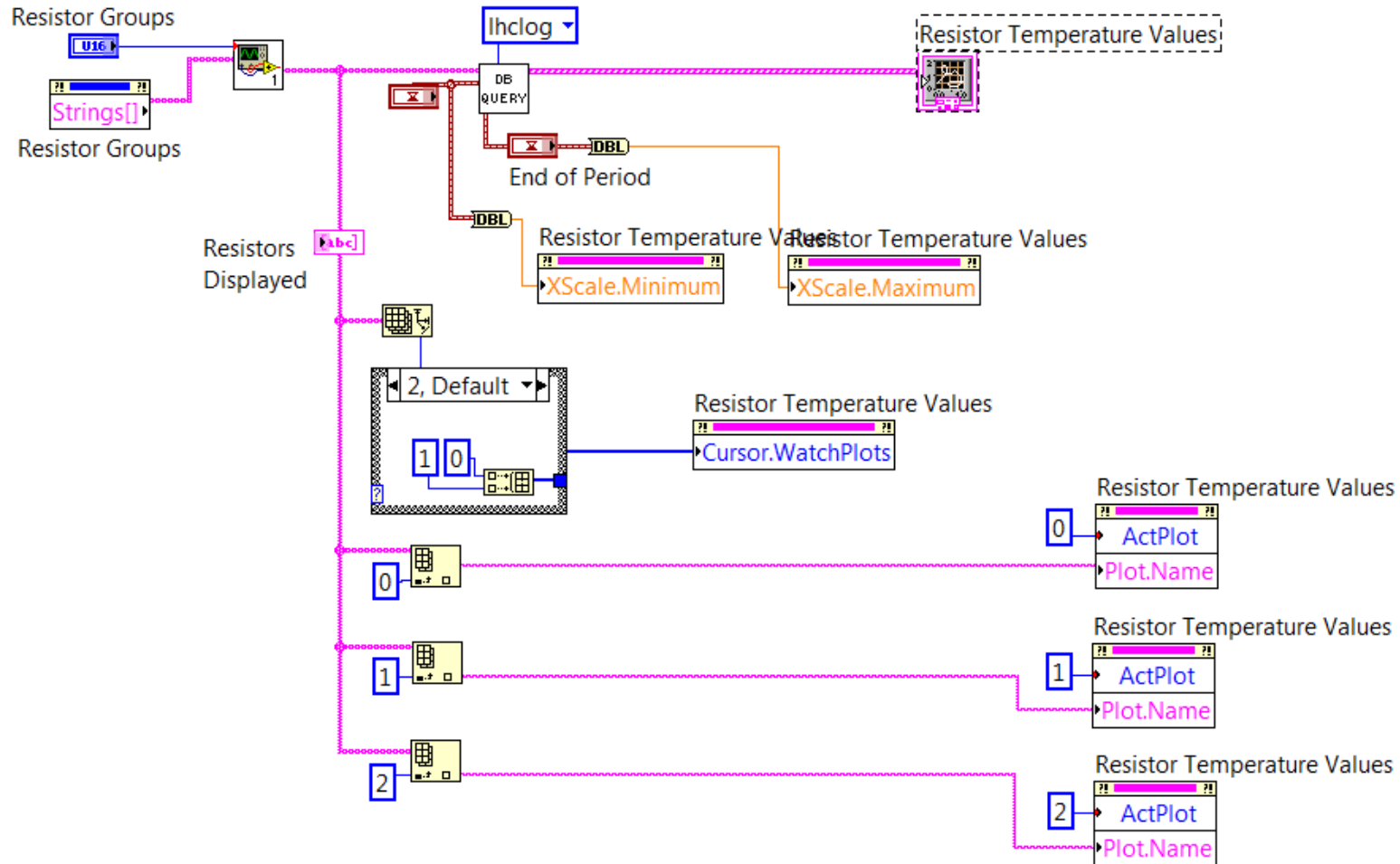
## Resistor Temperature Values




# Signal Name Generator Block Diagram



# Main Block Diagram



A glowing blue brain is shown inside a human head silhouette. The brain is the central focus, with light rays emanating from it. The background is a dark blue gradient with binary code (0s and 1s) and light rays. The text "Fun Facts" is written in a stylized font over the brain.

*Fun  
Facts*

