

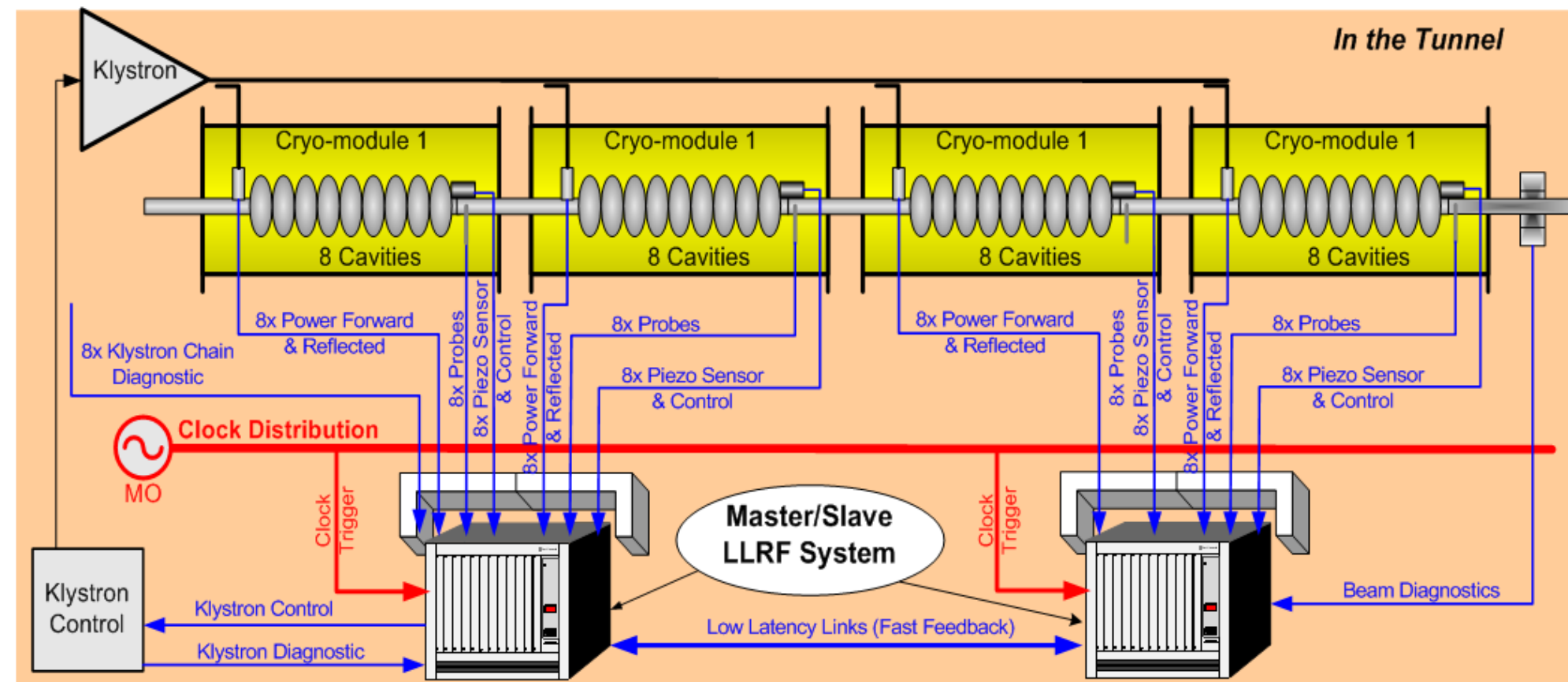
COAX CABLE DRIFT MEASUREMENTS FOR LLRF SYSTEM



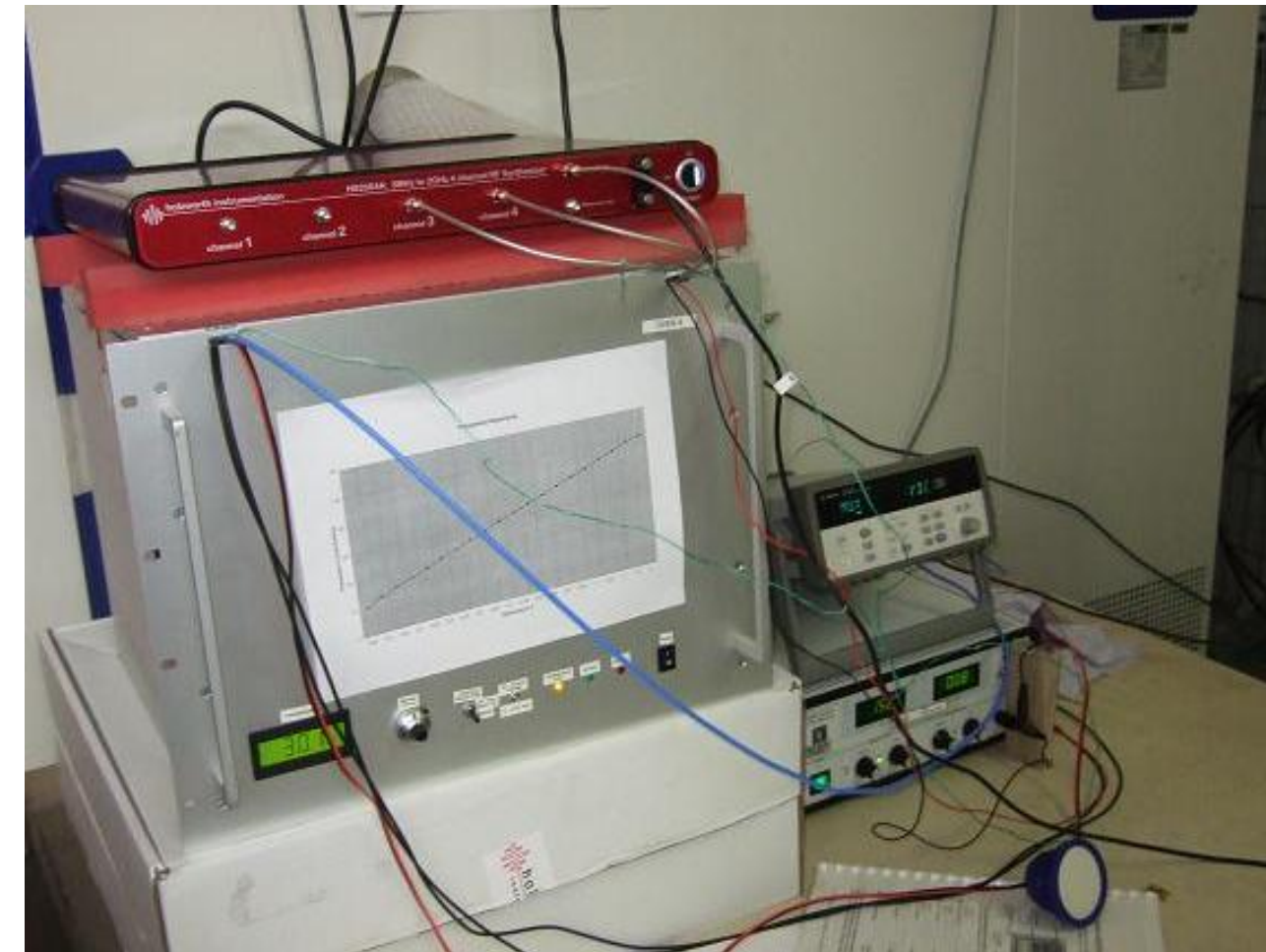
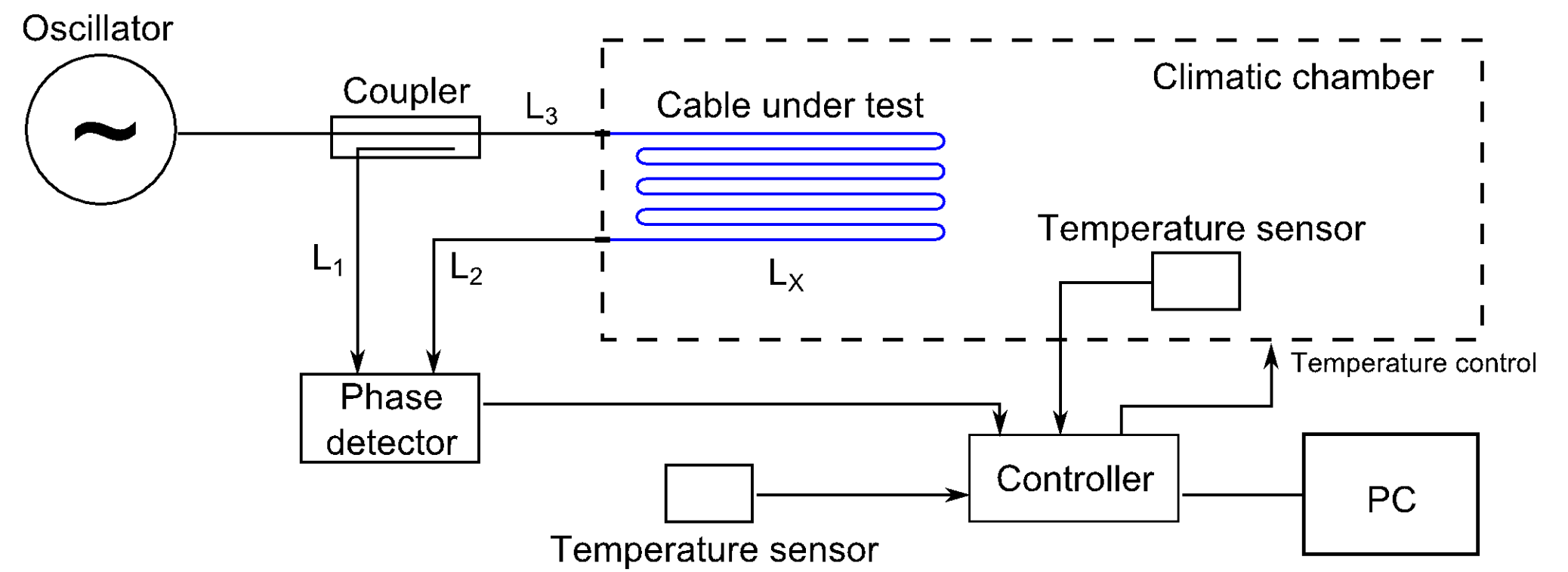
Dominik Sikora, Institute of Electronic Systems, Warsaw University of Technology, Poland

Introduction

Modern high-energy particle accelerators and free-electron lasers incorporate large quantities of sensitive RF and microwave frequency electronic devices of the LLRF system distributed over kilometer distances. Such a system requires an extreme phase stability of high frequency signals used by the accelerator control electronics.

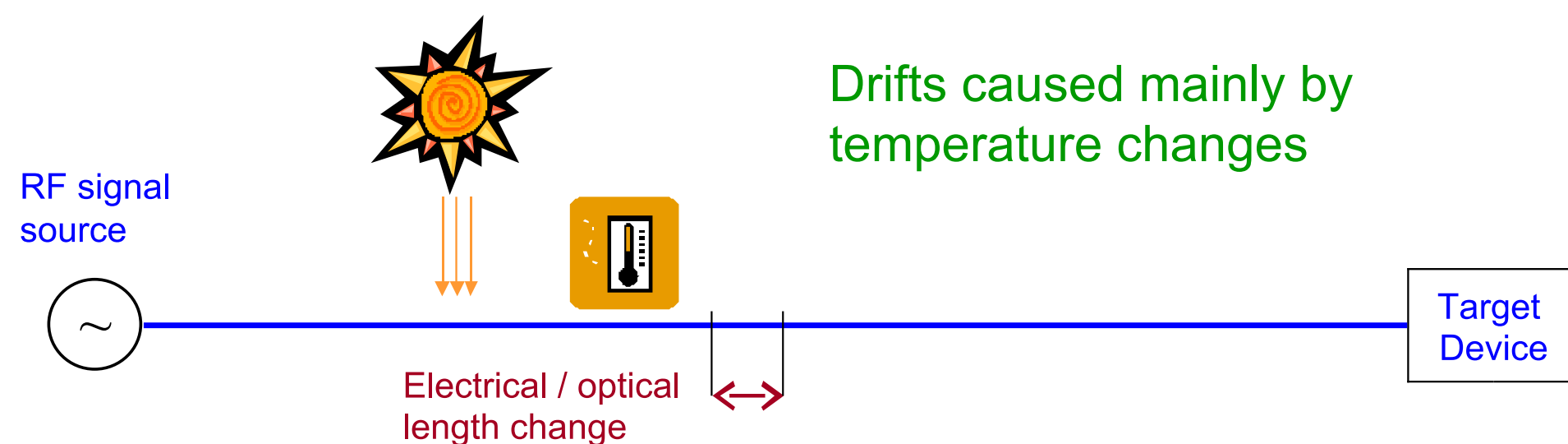


The phase of the signals such as power forward and reflected, probes etc. have to be very stable. Therefore coaxial pickup cables should be characterized with low drifts.



The measurement setup could easily be used for characterization of other cable types.

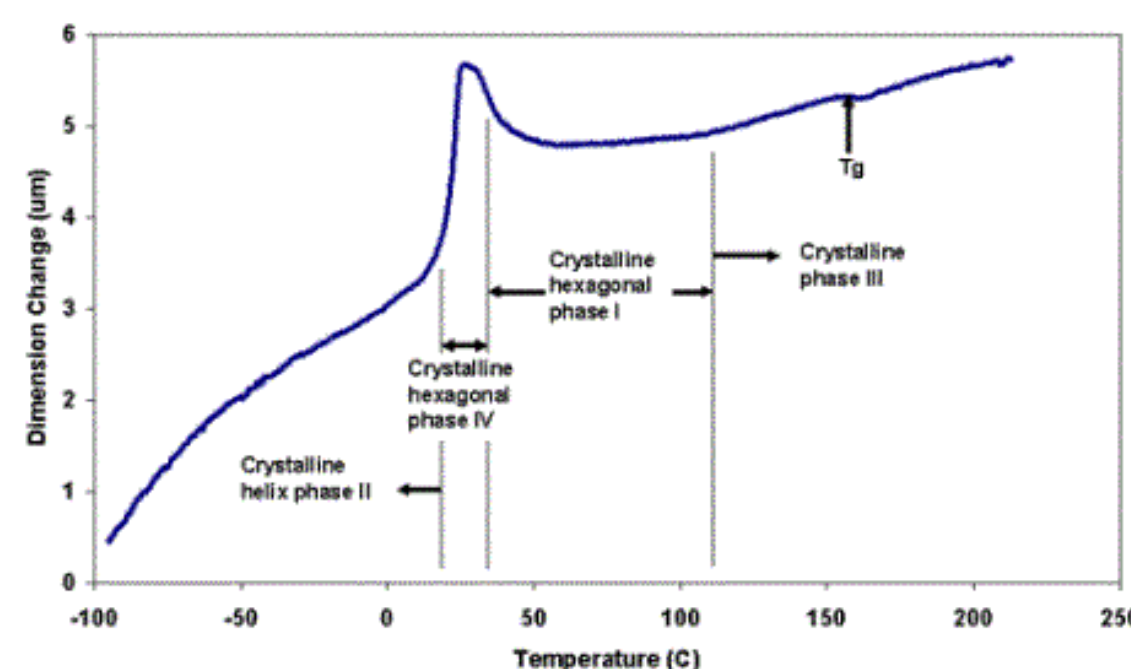
Phase drifts in coaxial cables



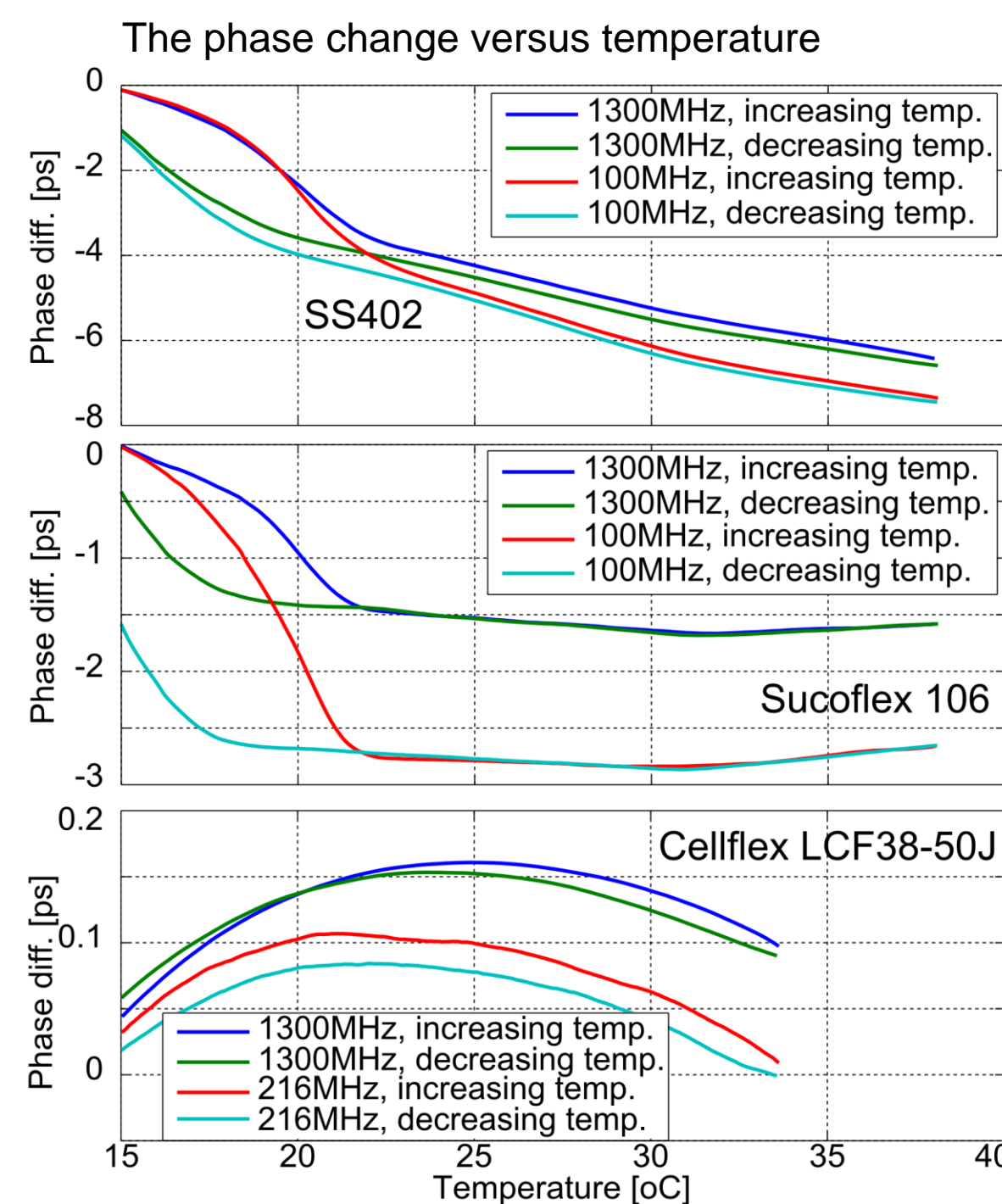
Phase drifts in coaxial cables are influenced by:

- cable mechanical dimension changes
- changes of the dielectric constant (complex and strongly depends on the type of dielectric material)

Teflon™ is one of the most frequently used insulator materials. But around 19°C it exhibits a steep change in the dielectric constant – so called Teflon™-knee.



Cable selection and measurement results

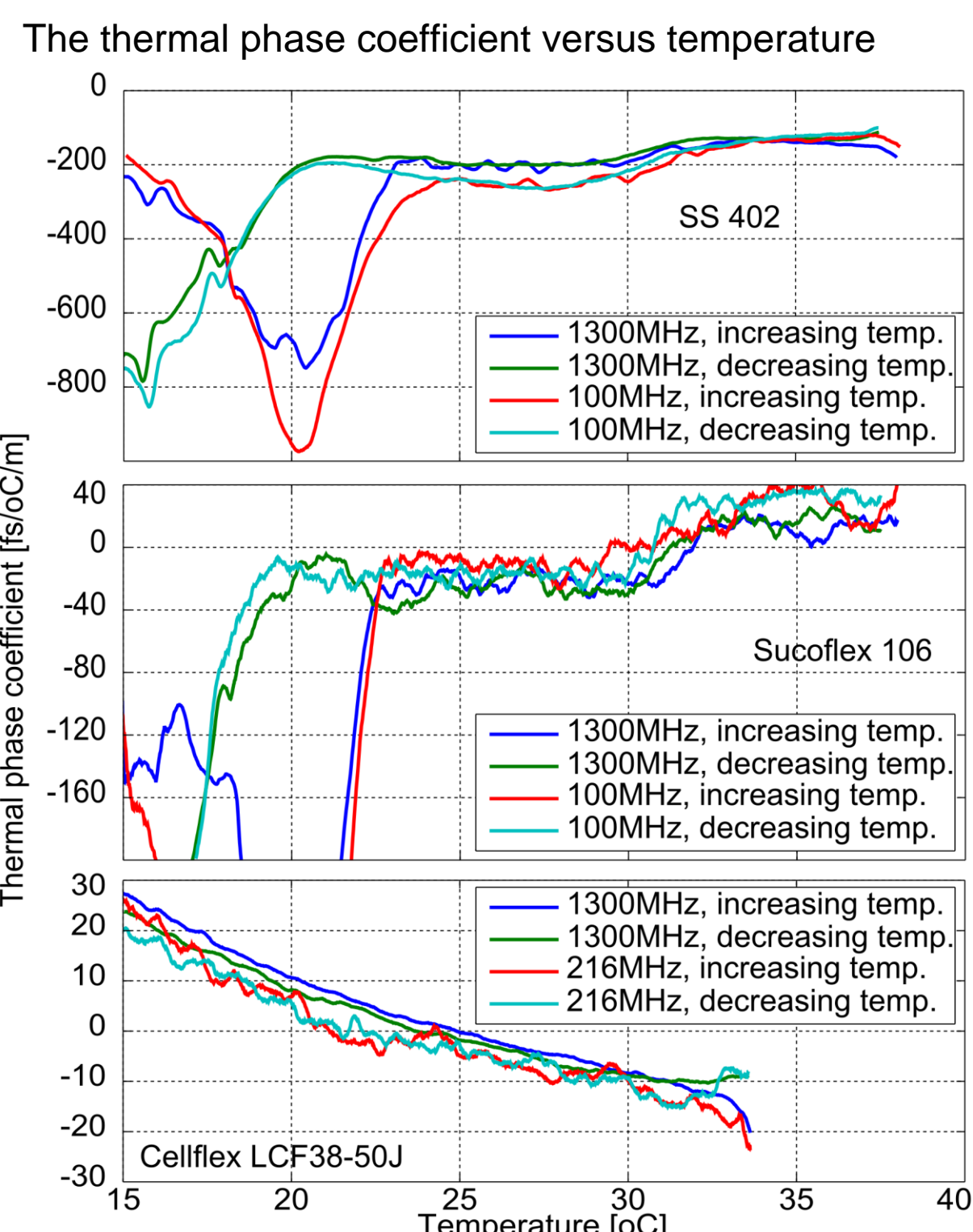


Various cable samples were characterized during this experiment. Results for three selected cable types are presented here:

- ❖ SS402
 - ❖ Sucoflex 106
 - ❖ LCF38-50J
- Include Teflon™
Without Teflon™

Results:

- ❖ The Teflon™-knee is visible for the SS402 and Sucoflex 106
- ❖ The hysteresis exhibited by Teflon™ based cables (SS402 and Sucoflex 106)
- ❖ Thermal phase coefficient of Teflon™ cables for above 22°C is almost constant
- ❖ Very small phase coefficient visible for the Cellflex LCF38-50J cable



Measurements setup for phase drift characterization

- ❖ Measurements performed at two frequencies: 1300MHz and 100MHz (or 216.7MHz),
- ❖ Phase change measured by a calibrated phase detector,
- ❖ Chamber temperature was recorded,
- ❖ Setup was controlled by a PC, where the temperature profile of the chamber was programmed,
- ❖ The chamber temperature changed between 15°C and 40°C,
- ❖ Slow temperature steps lasted about 4 hours,
- ❖ Phase drifts of the measurement setup cables (L_1 , L_2 , L_3) were calibrated out,
- ❖ Results were processed and normalized to 1 meter cable length.

The Cellflex LCF38-50J 3/8" cable is recommend to use as a coax pickup cable.