Irradiation test of Pressure Transducers for the LHC machine

Results from 2002 test-campaign in TCC 2.

Piezo resistive transducers

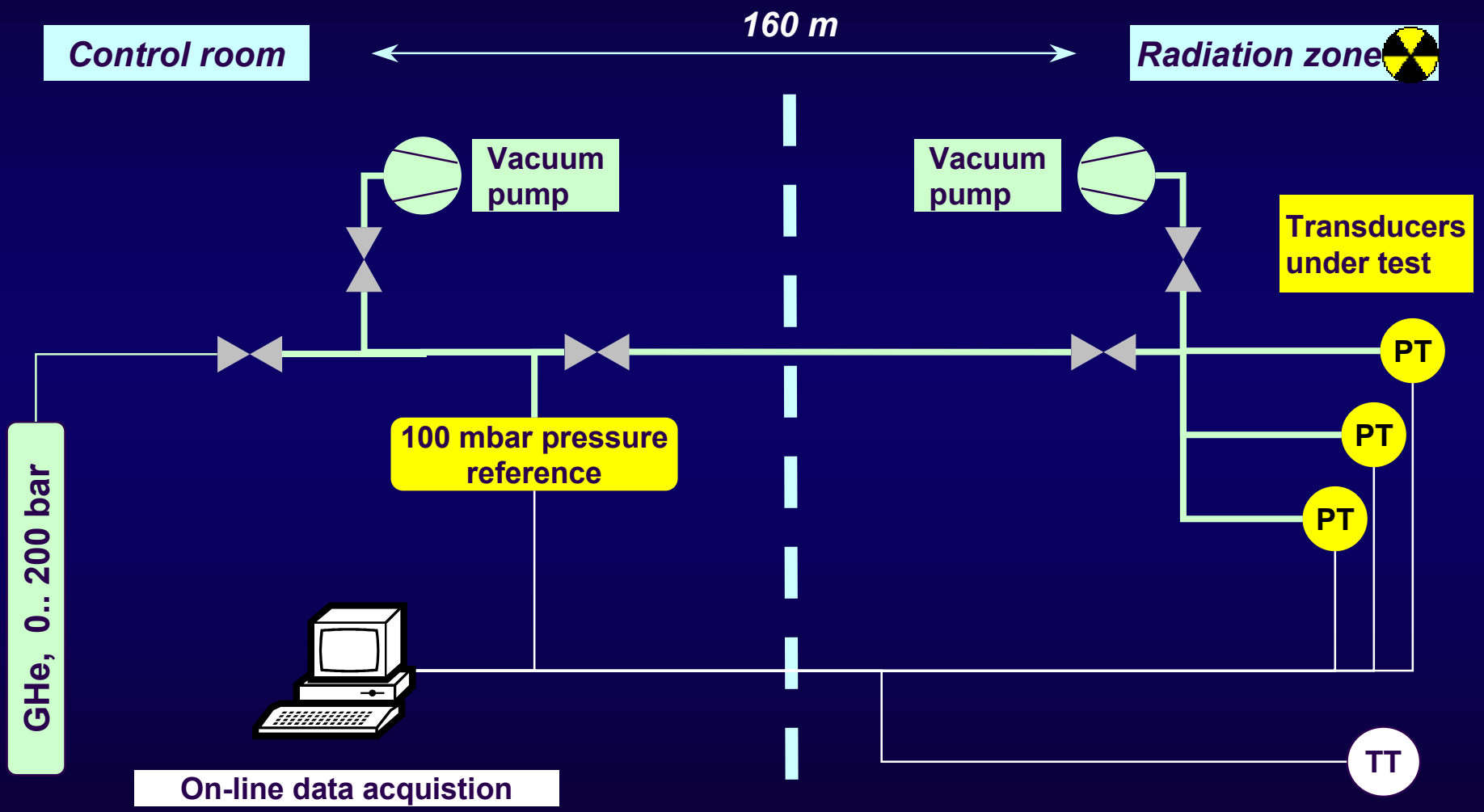
LHC requirements

Position (@ room temperature)	Purpose	Range (abs)	Accuracy
SSS	1.8 K phase separator	0..100 mbar	0.3 %FS
	Cold mass	0..20 bar	0.5 %FS
QRL	line C		
	line D		
DFB	Helium bath	0..4 bar	1.5 %FS

↓

Poorly protected → high radiation dose

TCC 2, Pneumatic and electric layout



Transducers under test

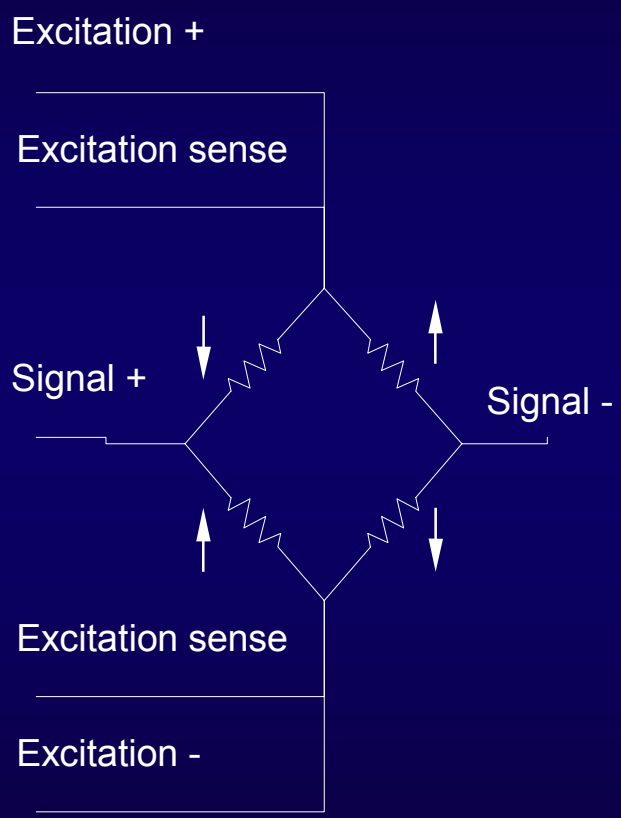
Membrane with 4 strain sensitive resistances moves with pressure.

Resistances can be either metallic or piezo resistive.

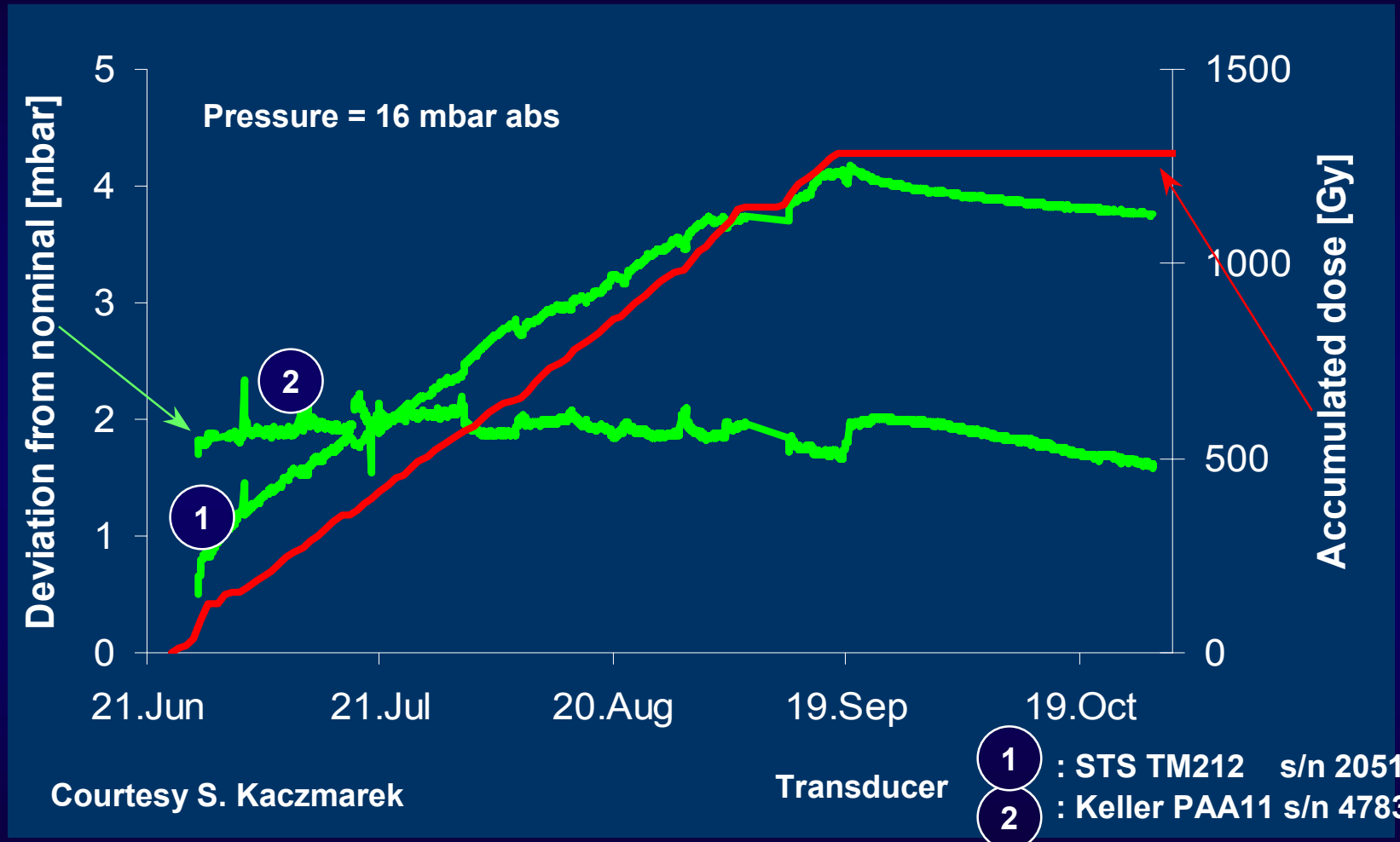
Bridge un-balance measured by remote electronic using either AC or DC excitation.

In 2002 is only tested transducers based on piezo resistive technology.

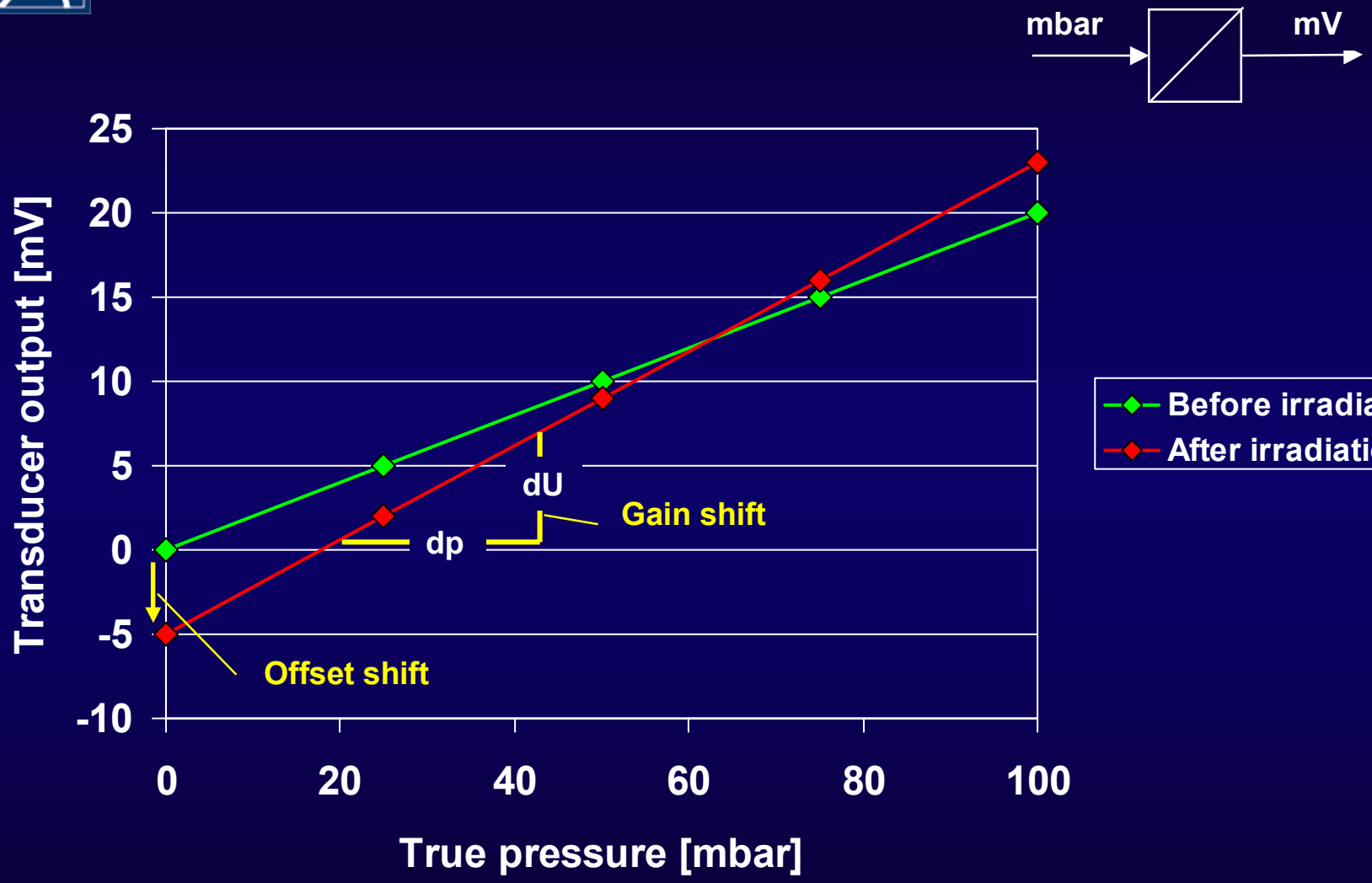
3x Keller PAA 11 and 3x STS TM212



On-line monitoring @ constant true pressure

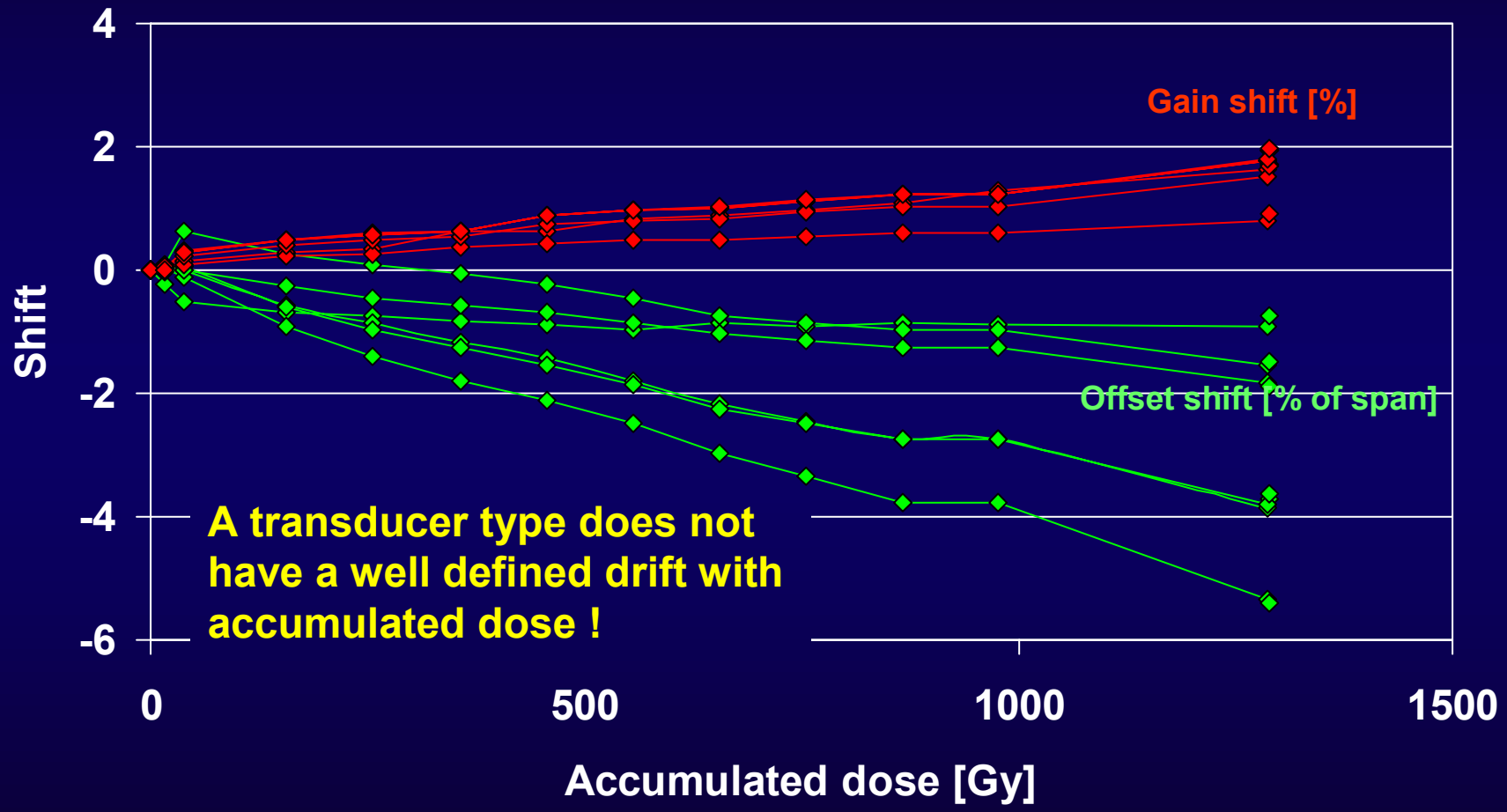


Evolution of transfer function

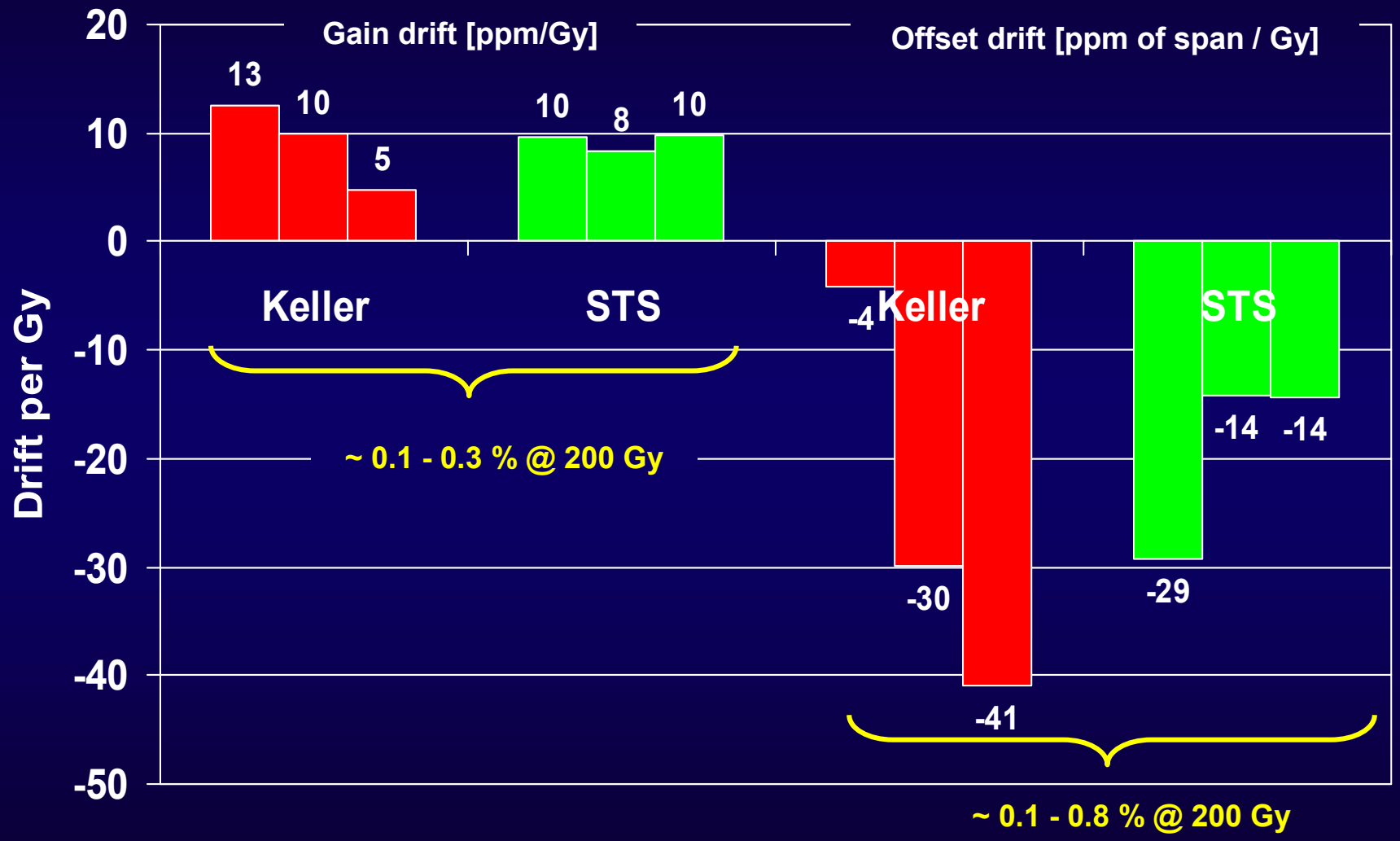


Piezo resistive transducers, evolution with dose

6 sensors of 2 types



Piezo resistive transducers, gain and offset drift with radiation.



Estimated survival time in LHC tunnel

Requirement : radiation caused drift < 0.1 %FS

Transducer type	Arc (10-20 Gy/y)	DS (20-200 Gy/y)
Piezo resistive strain gauge	~ 1 year	~ 1 month
Integrated electronic	< 1 month	< 1 week
Metallic strain gauge	> 60 years	> 6 years

Conclusion: the test facility

- A facility allowing on-line monitoring of pressure transducers is operational in TCC 2.
  - Operation during radiation
  - Remotely controlled valves & vacuum pumps
  - 10^{-2} mbar – 20 bar absolute
  - 3 pressure reference instruments
  - Multimeters & scanners and voltage/current supplies
- Possible improvement : better information on the spatial distribution of radiation in TCC 2 zone

Outlook

High pressure range

- Pressure transducers for the 4 and 20 bar ranges are chosen => Based on metallic strain gauges with remote electronic.

100 mbar abs range

- Presently the only potential suitable candidate refuses to cooperate with CERN allegating intellectual property issues.
- Inductive, capacitive, Siemens piezo and vibrating beam technologies will be tested in 2003. All applying remote electronic.
- A decision regarding the application of this transducer channel in the LHC control system shall be taken by the end of 2004.

Appendix : Calibration shift of metallic and piezo resistive sensors