Poster ID:	P17 – 1st Day
Title:	Optical Fibre at HL-LHC
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Optical Fibre for HL-LHC

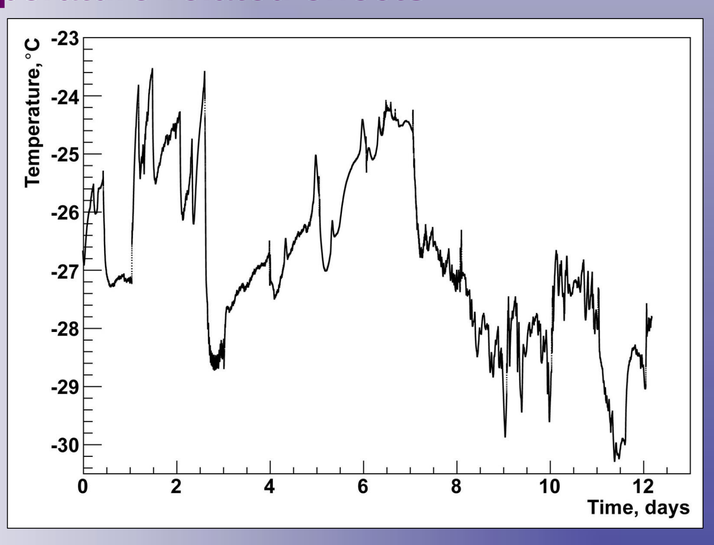
Qualifying optical fibres for high Radiation enviroments

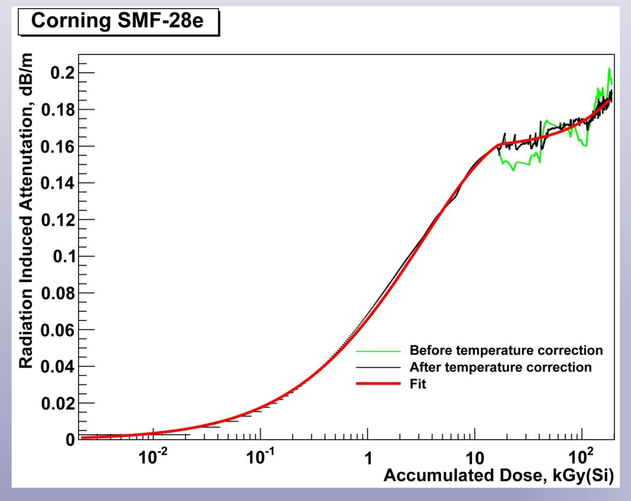
Ionizing Radiation + Optical Fibres = → **Test Fibres in Gamma Ray sources**

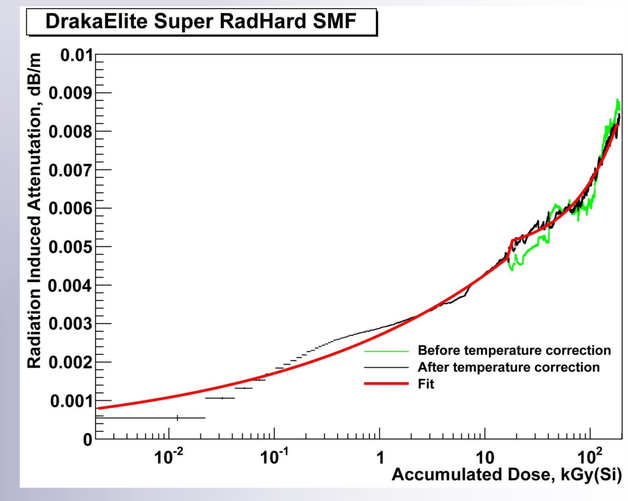
Fibre optical test details

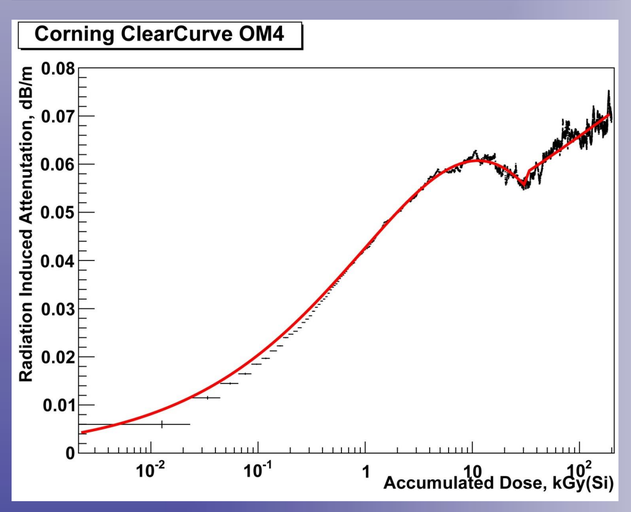
- In-situ measurment of Radiation Induced Absorption (RIA)
- Use ^{60}Co array at RITA (SCK·CEN, Belgium)
  - Provides γ radiation at ~0.7 kGy(Si)/hr
  - Large water heat bath
  - A dose of 200 kGy(Si) was accumulated over 2 weeks
- Liquid CO_2 evaporative cooling system kept fibres cold
- Correct RIA for Temperature-related effects

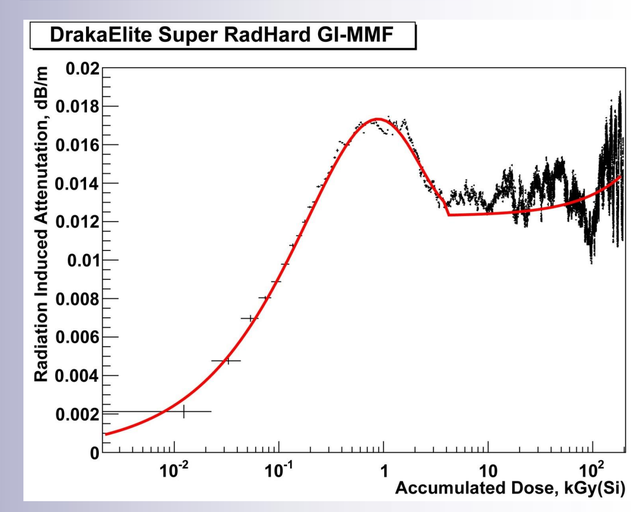
D. Hall, *et al.* JINST 7 C01047









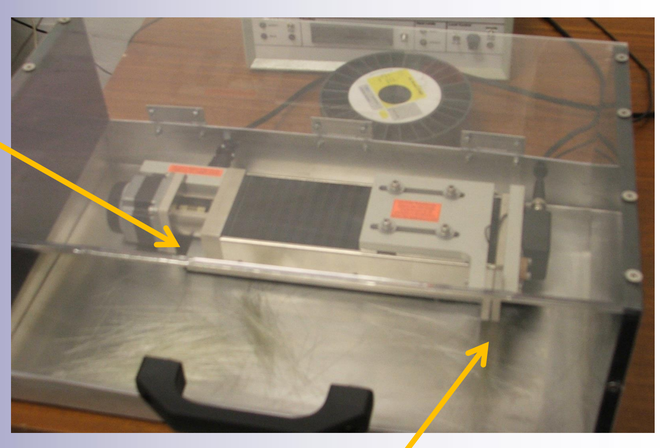


Ionizing Radiation + Optical Fibres = → **Test irradiated Fibres for Tensile Strength**

Fibre mechanical test details

- "Before-and-After" test. Fibres sent away, irradiated, returned.
- Use Mega Curie ^{60}Co array at Inst. Nuclear Energy Research, Taiwan
  - Provides γ radiation at ~8.0 kGy(Si)/hr
  - Highly uniform exposure of fibre spool.
  - Control spool travels with spool under test
- Irradiated and un-irradiated spools simultaneously tested
- Tensile strength of fibres tested with 2pt Bend Tester
- Compare tensile breaking stresses and try to fit an "n-value"

Linear precision motion stage



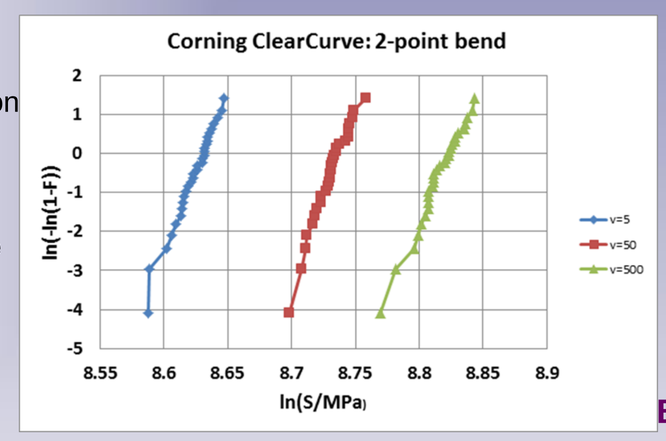
Fibre crushing jaws

"weakest-link" hypothesis leads to a Weibul distribution. The breaking stress of the fibres follows a statistical distribution

$$P(\sigma,L) = \exp[-(\frac{\sigma}{\sigma_0})^m \frac{L}{L_0}]$$

Fit this distribution to find "m" (a nuisance parameter) and the median breaking stress (σ_m).

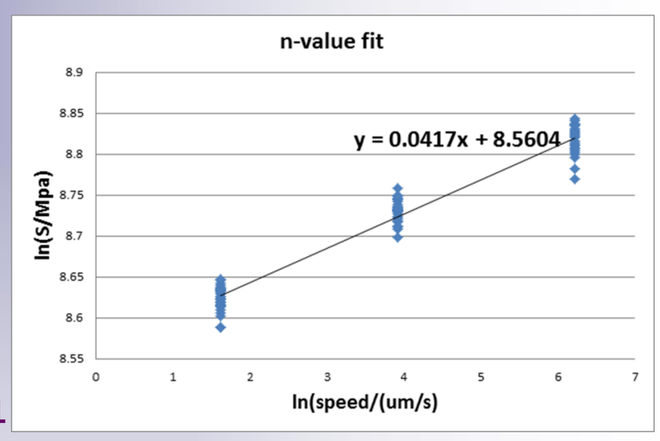
Repeat this for three jaw closure speeds.



$$\ln \sigma_m = A + \frac{\ln(\sigma_0)}{n+1}$$

The mean time to fibre failure is related to the **"n-value"** above and this is fit in the graph to the right. .

B. Arvidsson, et al., 2013 JINST 8 P05011



Outlook

- SM & MM fibres have been qualified Rad. Hard
- Standard COTS small-form factors LC connectors have also passed the test.
  - [D. Hall, et al., JINST 7 P04014]
- Bandwidth of MM fibres shows very little effect due to ionizing doses. [F.J. Achten, *et al*., 2012 JINST **7** P10021]
- Full Cable prototype has been bend tested.
- **Ready for Pre-Production Testing!**

Radiation Qualified Fibres

Type	Wavelength	Fibre name
SM	1310 nm	Corning SMF-28e
SM	1310 nm	DrakaElite Super RadHard SMF
MM	850 nm	Corning ClearCurve OM4
MM	850 nm	DrakaElite Super RadHard GI-MMF