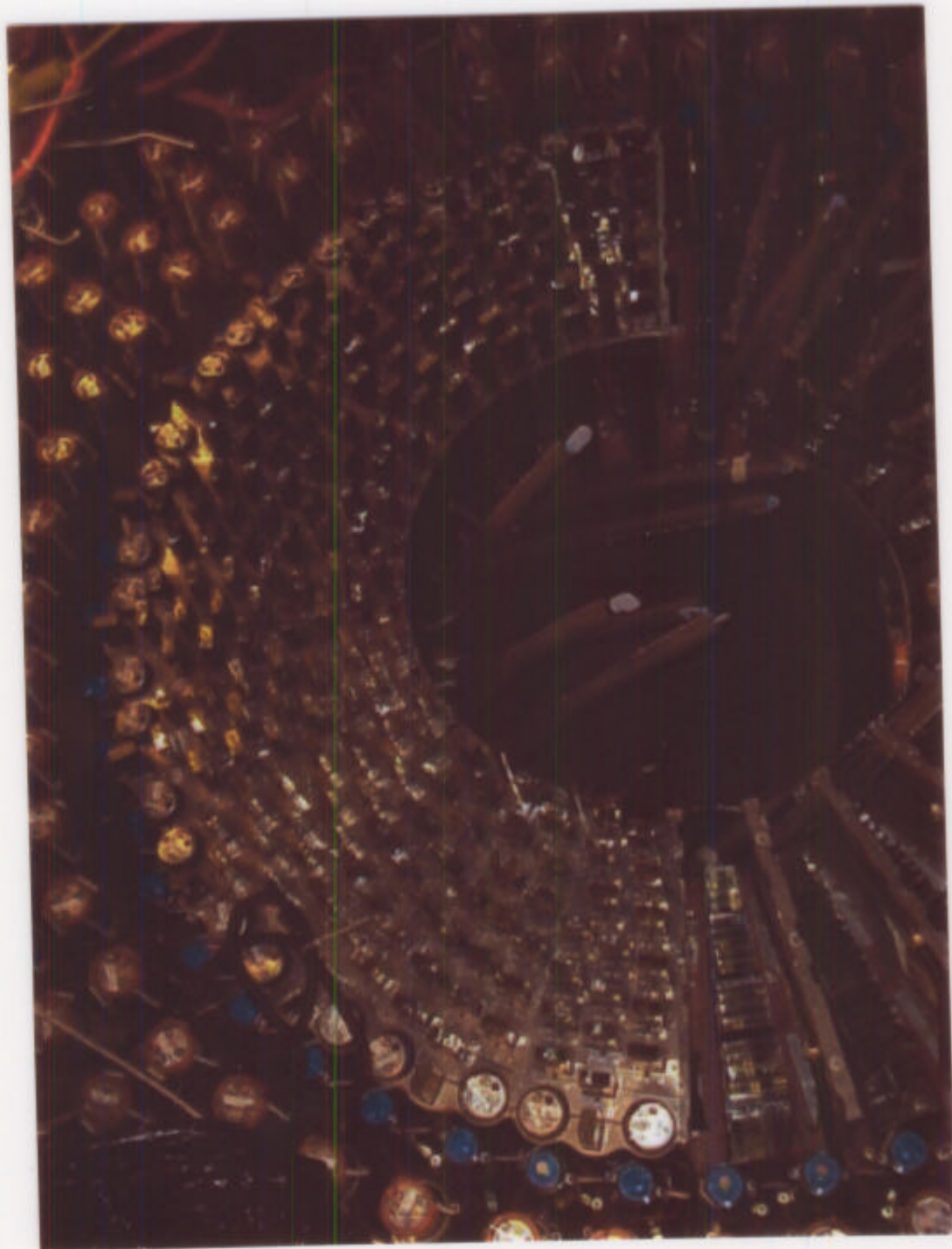


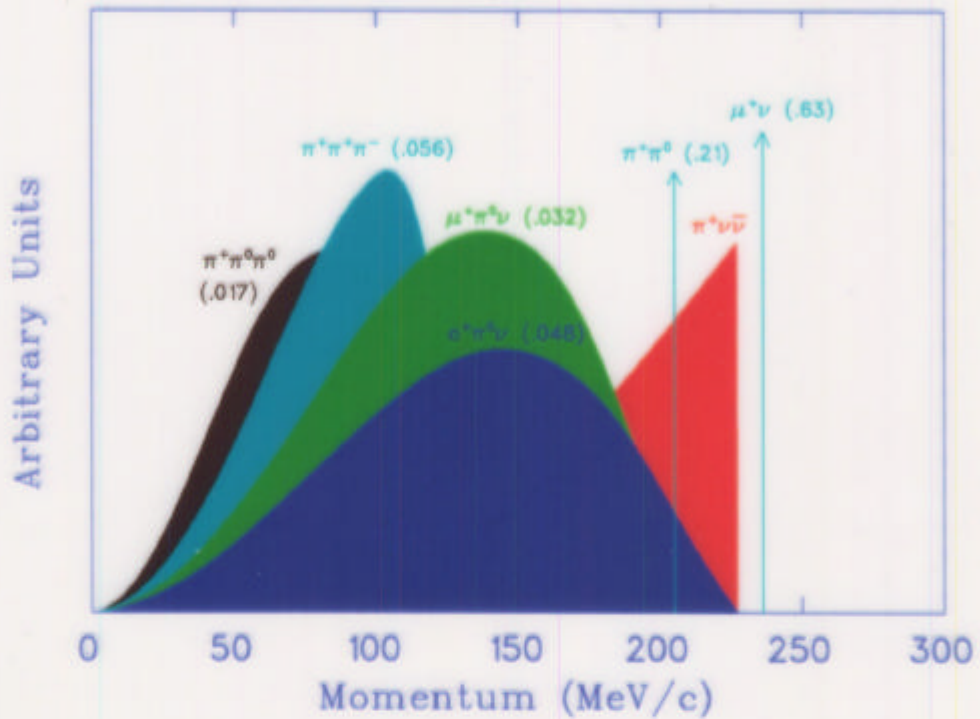
Gain Monitoring System Using LEDs (BNL-E949)

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February 15, 2001

1. Overview
2. E949 Gain Monitoring System
 - explanation of the system
 - expected performance
(especially in the light source part)
3. Summary





B.G.	weapons
$K_{\pi 2}$	kinematics & veto. $\rightarrow P$ (or \underline{E})
$K_{\mu 2}$	kinematics particle ID ... $\underline{R - P}$ (or \underline{E}) relation $\underline{\pi^+ \rightarrow \mu^+ \rightarrow e^+}$ chain.

Especially, ...

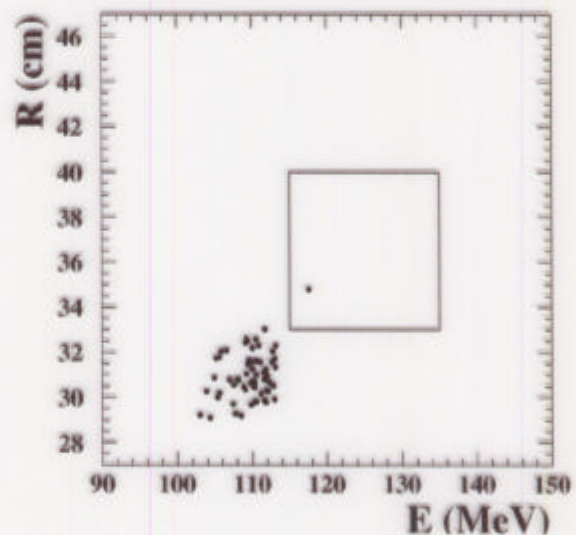
RS is the most important component in E787/E949

- Energy (and range) measurements
- Rejection of $K_{\mu 2}$ ($\pi^+ \rightarrow \mu^+ \rightarrow e^+$ chain)



Amazing that **there was no monitor system** on RS.

Resultant plot of
Range
vs
Energy
(E787 '95-'97)



Gain monitoring and calibration is quite important to explore more precise region.

(for ex., to get more reduction against backgrounds.)

In E787, the RS gain calibration was done by using ($K_{\pi 2}$, $K_{\mu 2}$ data (special run / standard mixed data).



It could not follow short term variations, due to

- counting rate in a spill
- temperature in day-night



Need a new tool for understanding performance of the RS

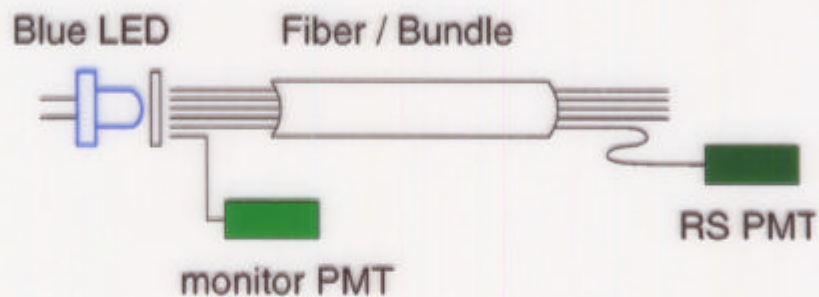


Monitoring system based on LED + optical fibers.

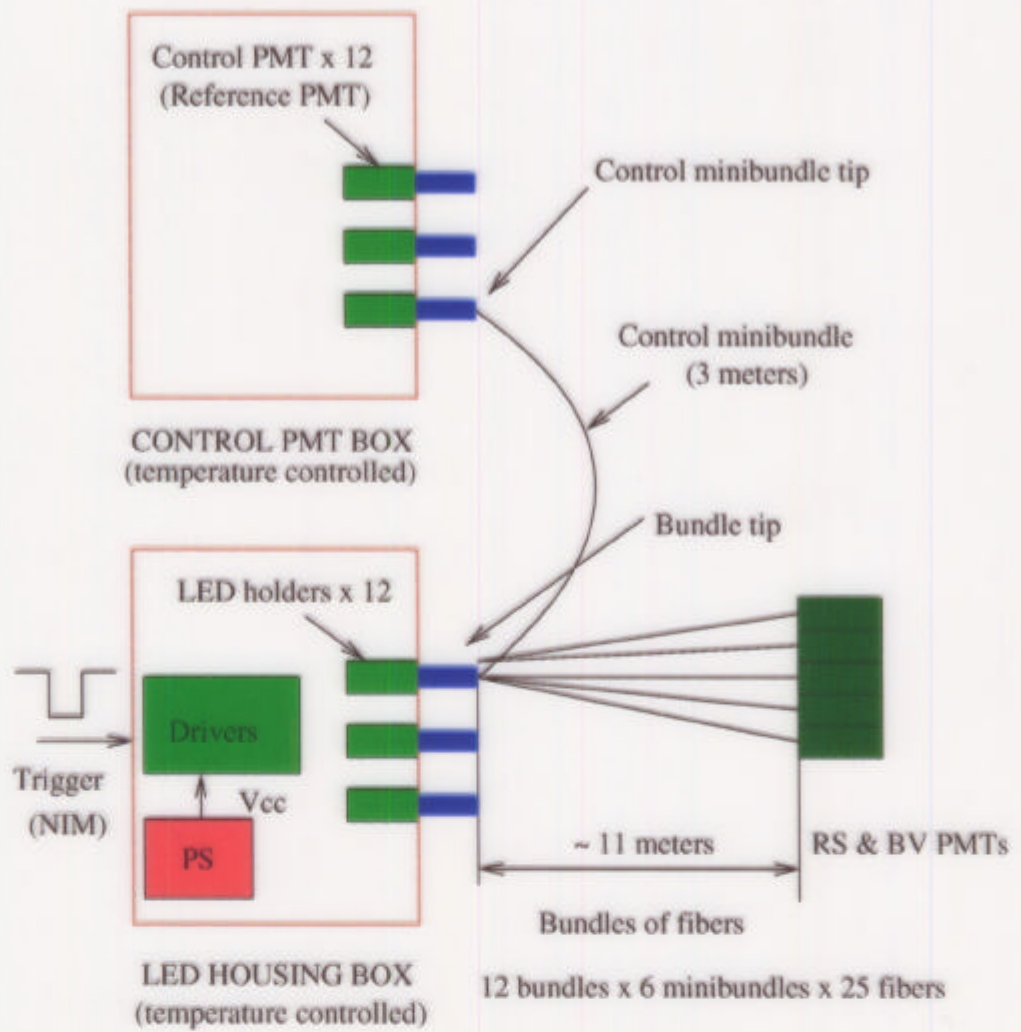
(It can also help to detect problems rapidly.)

2. E949 Gain Monitoring System

High quality LED / driver
(Japan)
+
Fiber network
(Russia (IHEP))

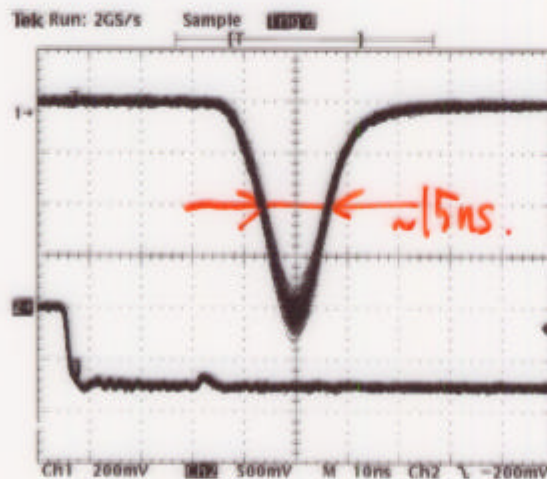
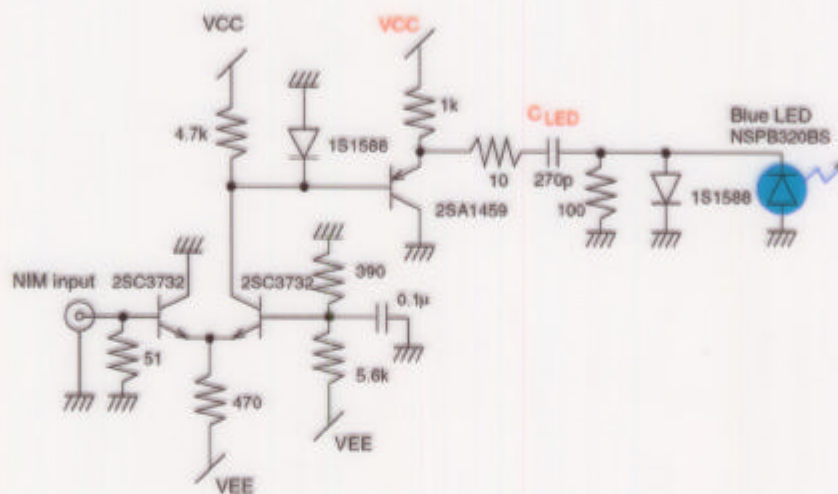


- 8 subsystems for RS
(4 sector groups in up- and downstream)
- 2 for BV (up- and downstream)
- 2 for BVL (up- and downstream)

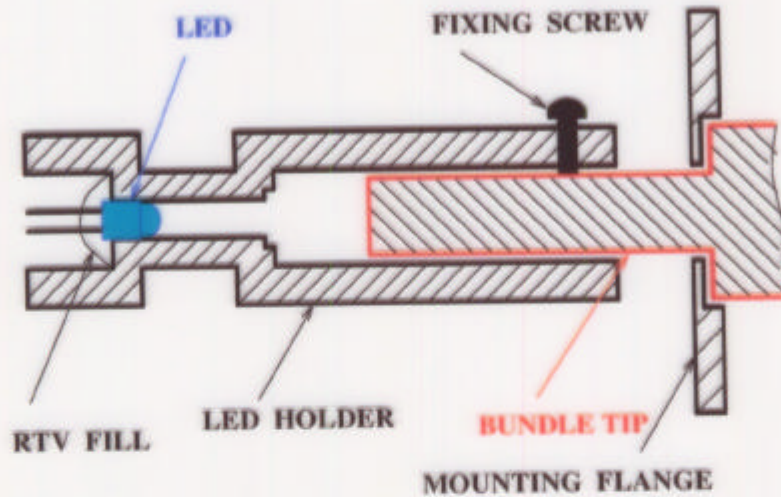


Light source part

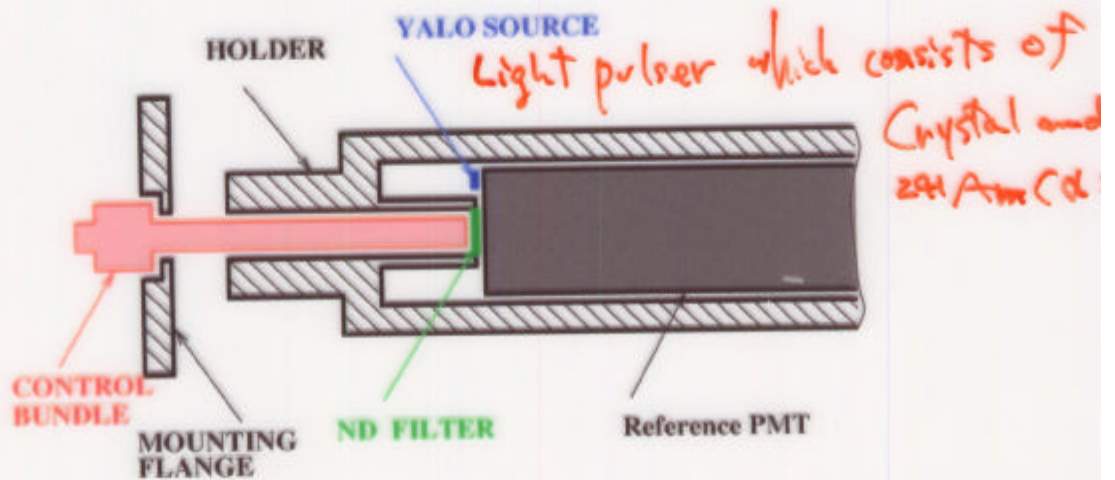
- Blue LED ... NSPB320BS (Nichia)
Peak wavelength = 460 nm
Directivity ($2\theta_{1/2}$) = 45°
- Driven by capacitor-discharge pulser



LED light
viewed by
RS PMT
(10 ns/div)

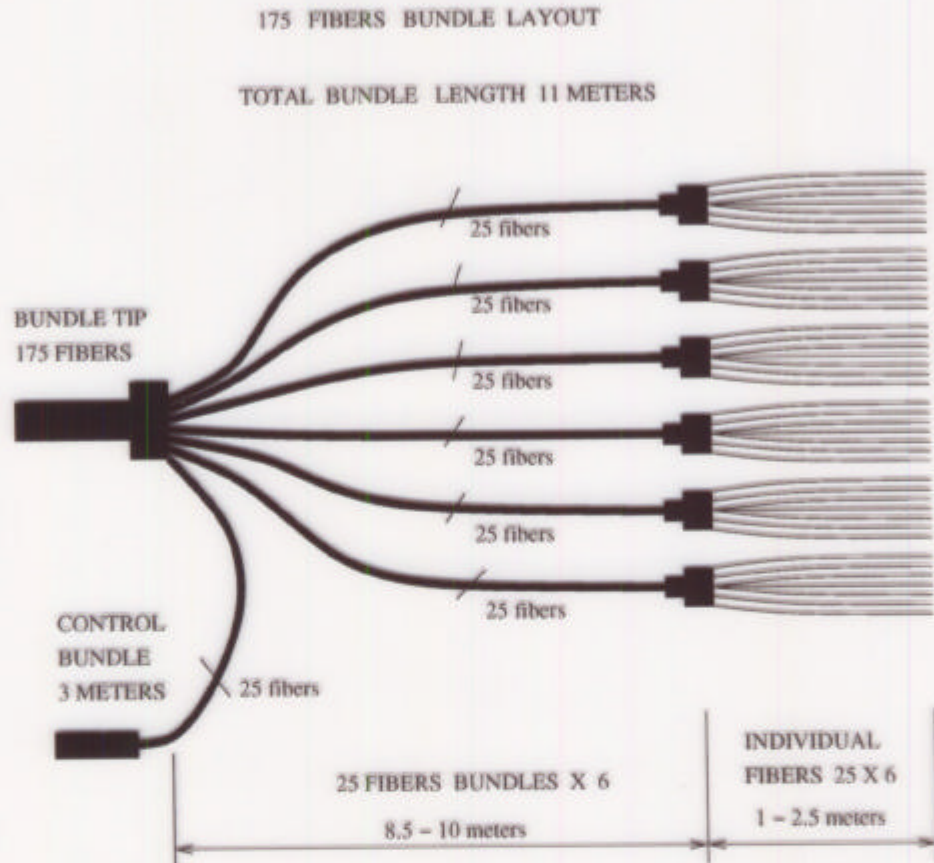
LED-Bundle tipLight intensity monitor

- 12 1-1/8" PMTs (Hamamatsu H3171-03MOD) with RI source (YA10) on their window.
- put in 2nd temperature-controlled box.

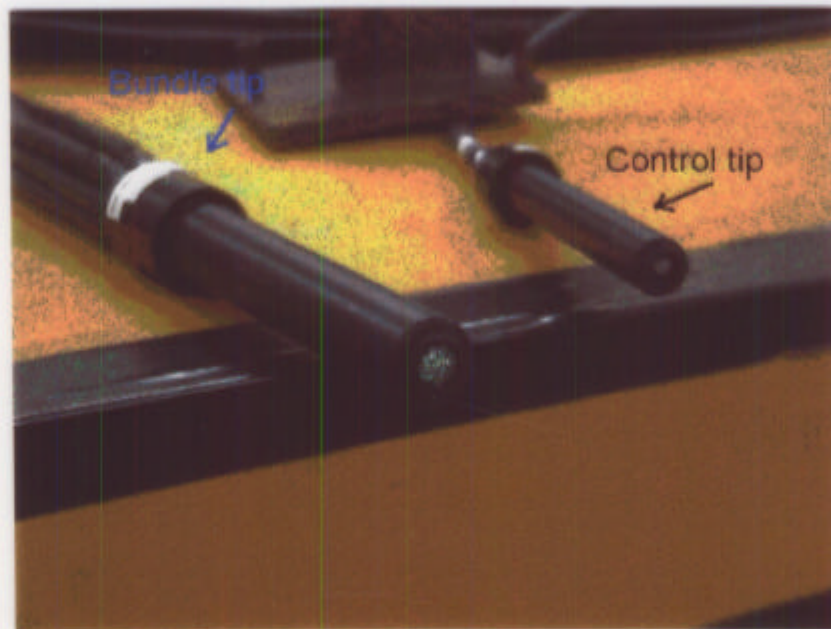
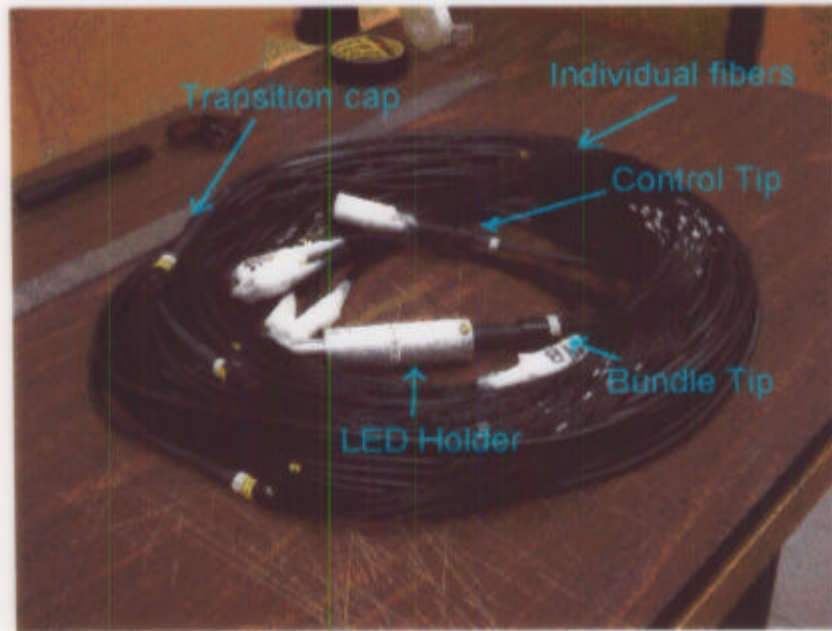


Light distribution part

(optical fibers made of PMMA)



Eska Premier GK-20 (Mitsubishi Rayon Co. Ltd.)	
Core diameter	500 $\mu\text{m}\phi$
N.A.	0.51
Attenuation	0.14 dB/meter (typ.)

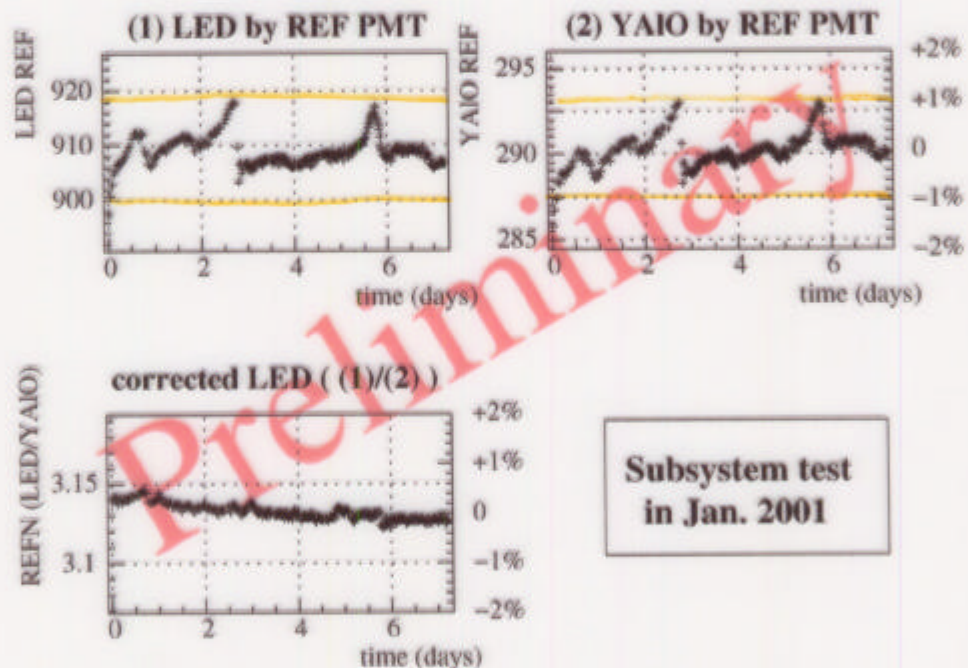


Expected performance

We have measured the light intensity dependence on various parameters, for example, ...

LED	Temperature	+0.1%/°C
Driver	Temperature	-0.4%/°C
	supplied V_{CC}	+0.08%/mV

Assuming $\pm 0.3^\circ\text{C}$ and $\pm 1\text{ mV}$
(those were demonstrated with actual system),
expected **short-term stability** is **< 0.2%**



3. Summary

- We built a new gain monitoring system for RS, BV and BVL, based on **blue LED + fiber network**.
- Its stability is expected to be quite good. **< 0.2%** in the light source part

Schedule

- All fibers have been strung.
- All light source parts will be installed by the end of Feb.
- Cosmic test and calibration in March.
- Combined with $K_{\mu 2}$, $K_{\pi 2}$ data, detailed study on RS gain (and resolution) will be performed.