Radiation hardness of WLS Fibres and other optical components of the Tilecal calorimeter

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**LAYOUT**

- Setup for Fiber Measurements
- Setup for Fiber Irradiation
- Dose Profile
- Fiber Light Loss After Irradiation
- Irradiation of Plastic Profiles
- Conclusions
Experimental and irradiation setups

Setup for the fibre measurement

Side view

Top view

Stepping motor for source holder
Stepping motor for supporting table
Fibres holder
Setup for the fibre irradiation
Total dose: 1.44 kGy

Dose rate: 6.4 Gy/hour

Dose profile:
Irradiated fibres

Ratio $R(x)$ of the light output of the fibres after irradiation $I_{irr}(x)$ over the light output of the fibres before irradiation $I_{nir}(x)$, as a function of excitation point $x$

$$R(x) = \frac{I_{irr}(x)}{I_{nirr}(x)}$$

Measurement performed 6 days after the end of irradiation
Ratio $R(x)$ for the S248-100 fibres. 3 measurements after the end of irradiation to monitor the recovery of the fibres.
Ratio $R(170)$ for all fibre types, 3 measurements after the end of irradiation.

In light blue is the result of a previous experiment with similar fibre types and in similar conditions.

For the previous experiment, the values shown are for 2 months after the end of irradiation, and for $R(180)$.

<table>
<thead>
<tr>
<th>Fibre type</th>
<th>$R(170)$ Time after irradiation</th>
<th>Previous Irradiation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 hours</td>
<td>1 day</td>
</tr>
<tr>
<td>BCF99-28 DC</td>
<td>80.5 (1.3%)</td>
<td>82.2 (1.4%)</td>
</tr>
<tr>
<td>BCF99-28</td>
<td>82.9 (3.3%)</td>
<td>84.8 (3.6%)</td>
</tr>
<tr>
<td>BCF91A DC</td>
<td>86.6 (1.1%)</td>
<td>86.2 (1.7%)</td>
</tr>
<tr>
<td>Y11(200)MS</td>
<td>81.2 (0.4%)</td>
<td>86.5 (2.0%)</td>
</tr>
<tr>
<td>S248-100</td>
<td>45.5 (1.6%)</td>
<td>50.2 (3.4%)</td>
</tr>
<tr>
<td>S048-100</td>
<td>45.0 (3.1%)</td>
<td>48.7 (2.2%)</td>
</tr>
</tbody>
</table>
THE PLASTIC PROFILES

PROFILES PAINTED (WHITE OR ALUMINUM) TO:

- IMPROVE OPAQUITY (SEVERAL LAYERS OF INK)
- IMPROVE REFLECTIVITY/DIFFUSION (WHITE INK)

TESTED:

| WHITE INKS | Bicron
| acrilic
| A (serigraphic)
| B
| ALUMINUM INK | without varnish
| with varnish
REFLECTIVITY (LIGHT OUTPUT) OF THE PROFILES

light output

relative light output of profiles
RADIATION DAMAGE OF THE PROFILES

\[ \text{total dose } \approx 150 \text{ krads} \]

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**Diagram:**

- **Axes:**
  - Y-axis: light output
  - X-axis: relative light output of profiles

- **Data Points:**
  - Open circles (○) indicate not irradiated.
  - Black dots (●) indicate 2 weeks after irradiation.

**Legend:**

- Open circles (○) for not irradiated.
- Black dots (●) for 2 weeks after irradiation.
CONCLUSIONS

- Radiation hardness of Bicron BCF91A and Kuraray Y11 fibers is similar, and much better than Pol. Hi. Tech 5048, 5248 fibers (new fibers from Pol. Hi. Tech are being tested now).

- White plastic profiles, unpainted or painted with aluminium ink are radiation hard up to 150 krad. For the same dose, a light loss of about 10% is seen when the profiles are painted with the white inks tested.