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Measured Characteristics of NIKHEF "Honeycomb" Strip Material

Cas Milner
SSC Laboratory

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Abstract:

Evaluation of strip material developed at NIKHEF as a possible replacement of printed-circuit strips in the CSCs.

Superconducting Super Collider Laboratory
Physics Research Division
Experimental Physics

Memorandum

To: Mike Marx, Gena Mitselmakher, Mike Harris, Jacques Pier-Amory, Coleman Johnson

From: Cas Milner

Subject: Measured characteristics of NIKHEF "honeycomb" strip material

Date: January 14, 1993

When Harry van der Graaf visited the lab in November, he gave us some samples of the strip material developed at NIKHEF for use in the honeycomb chambers. This material has some remarkable characteristics that make it a candidate for replacing the printed-circuit strips in the CSCs. The important features are:

- high precision in strip positions, widths, and uniformity
- much lower cost of the honeycomb strips versus printed-circuit boards
- strip material is much longer than printed-circuit boards.

To verify some of the strip properties reported in papers from the NIKHEF group some measurements have been performed. There are two kinds of measurements reported in this memo; strip position, and strip electrical characteristics.

The strip positions were measured at Crescent Gage, Inc., in Rowlett, using a "Smart Scope" video measuring microscope made by Optical Gaging Products. The strip sample sizes were 200-mm x 150-mm, containing about 40 strips. The microscope had a reproducible precision of about 3 microns, and was calibrated and controlled via computer interface. Resulting measurements are shown in Figures 1 and 2, where histograms display the distance between strips for samples 1 and 2. To the naked eye, sample 1 was inferior to sample 2 because more etching imperfections were visible. While the sigma of the Gaussian curve fitted to the data is higher for sample 1 (16.2 μm) than sample 2 (13.8 μm), both of these values represent excellent precision. In addition, the mean of the strip distance, or pitch, matches the manufacturing specifications: 5.08 mm (200 mils).

Electrical measurements were performed by Pascal Kibuule of the Electronics Group using a Hewlett-Packard Spectrum Analyzer. A 12-cm long strip with about 1.2 Ω resistance was placed in the machine. Results shown in Figures 3 and 4 include the Impedance ($|Z|$), Resistance (Rs), and Inductance (Ls) for frequencies between 10 and 100 MHz. For example, $|Z| = 25\ \Omega$ at 63 MHz. This information is necessary for designing a pre-amp matched to the strips.

Because the strip material appears to be an appealing replacement for printed-circuit board strips in the CSCs, I propose making a CSC using material from a new production run that is being made available to us by NIKHEF. I have a tentative agreement from the CSC group at the University of Houston to collaborate in constructing this CSC. It would be built at the SSC using strip boards made by us from the honeycomb strips, and wire modules from Houston.

In parallel, we need to learn more about the strip manufacturing process. Strips made in Europe are constrained to 1-m width by available machine capacities. However, van der Graaf has been told that machines capable of producing material with greater than 2-m width exist in the United States. If this is true, production might shift to this country. Learning the manufacturing procedures will be important to developing production capability here, and can only be learned by visiting the European factories; many details are of course omitted from papers reporting the work of the NIKHEF group. Therefore, I recommend that someone from the SSCL observe the next strip material production run scheduled to occur about 2 weeks from now. At the same time we will begin to develop contacts within the printing industry in this country.

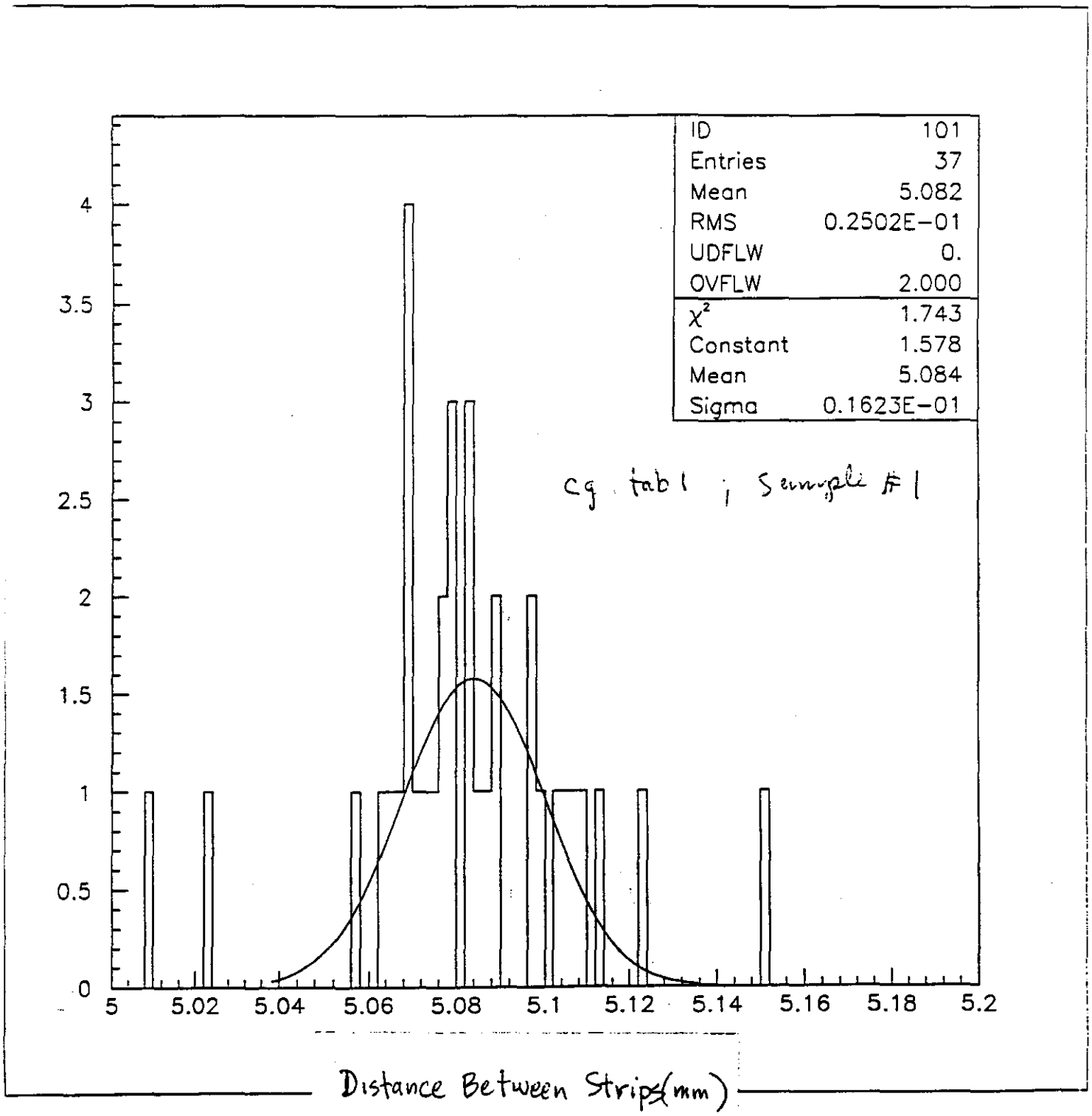

Figure 1 : sample 1

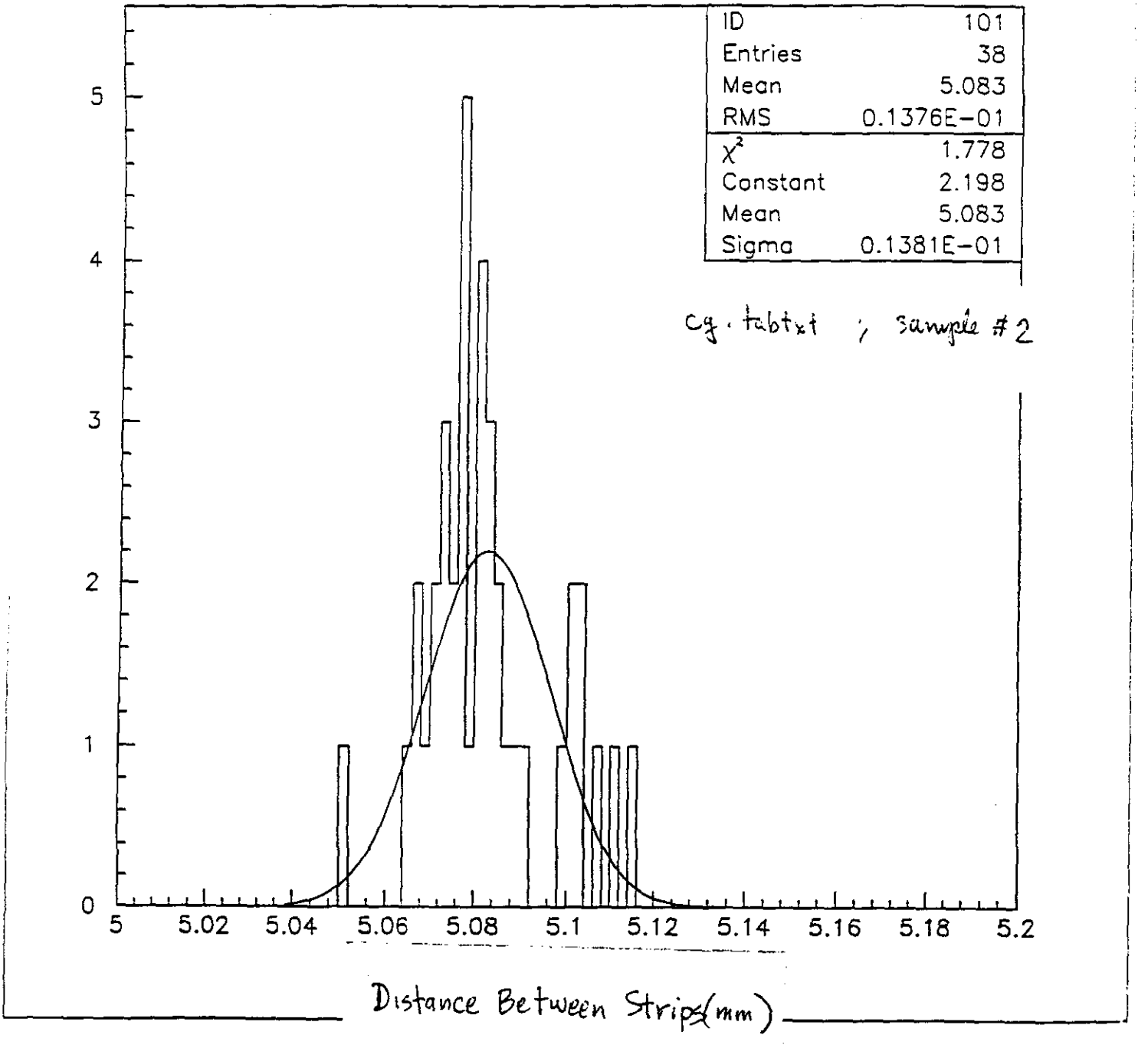

Figure 2: Sample 2

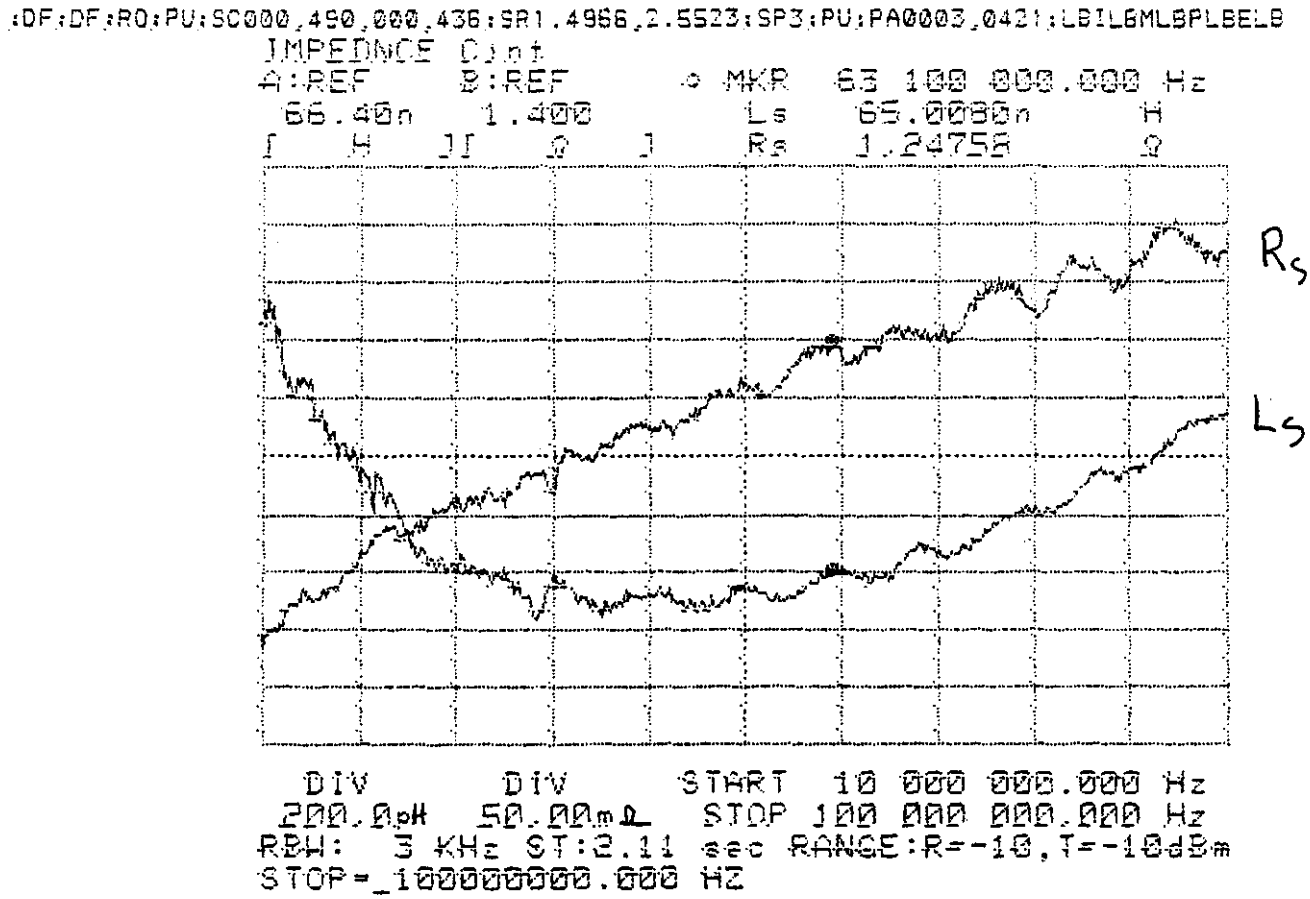

Figure 3: resistance (R_s) and Inductance (L_s) of strip.

strip

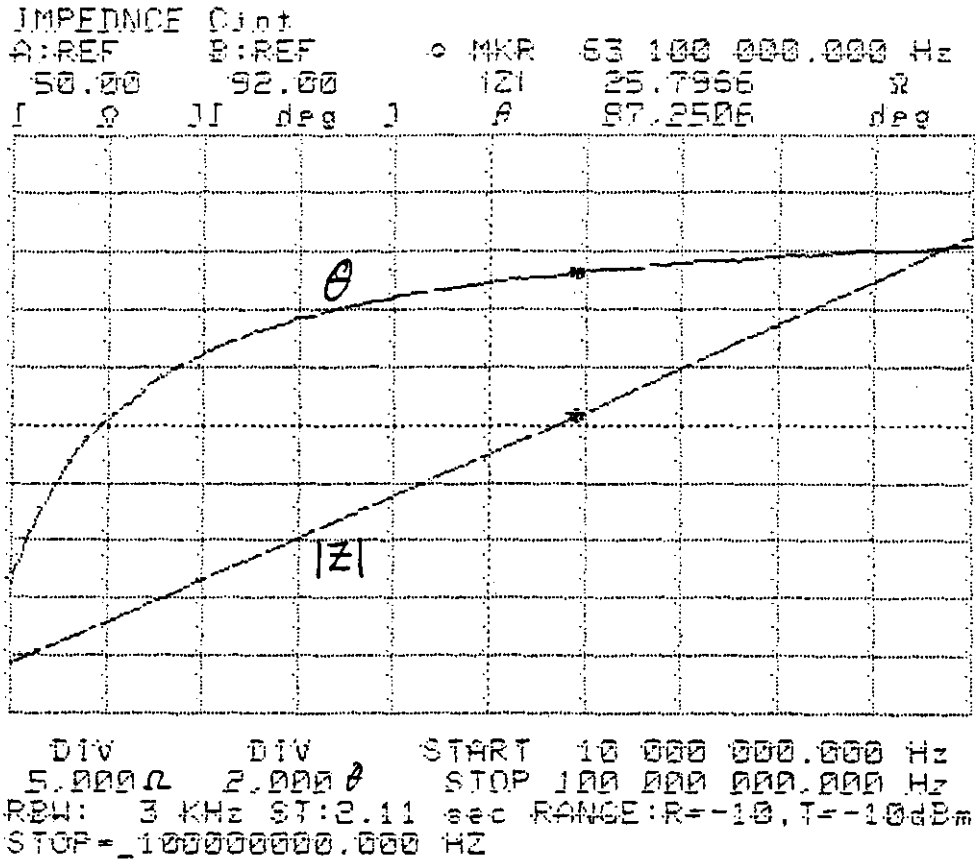

Figure 4: impedance
|Z| of strip