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Gas impedance measurements for straw tubes: test setup and status report

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Abstract

A simple setup to measure gas flow impedances has been realized, in order to determine a suitable device which provides a stable, well-reproducible impedance for the straw tubes in the FINUDA experiment. A status report of results obtained so far is presented, an overview of what it is still to be done is given.

The straw tube detector under construction at LNF for $DA\Phi NE$'s FINUDA experiment is composed of 2424 aluminized-mylar straws, fluxed in parallel through a 1-mm-ID rilsan tubing [1]. The operational overpressure, to be kept as stable and as uniform as possible, is within the range 5-50mbar at the operational flux ranging from 3 to 30 volumes per day. The specific impedance of the 1-mm-ID rilsan tubing is too low to provide with such overpressure. Therefore, a suitable device connected in series to each straw tube needs to be designed, with additional requirements:

1. time stability;
2. absence of clogging due to gas impurities;
3. uniformity.

1 Test setup

The test setup shown in fig.1 is composed of:

- P1, P2 H_2O manometers to measure the pressure drop of the impedance
- F1 rotameters, either:
    1. Vögtlin V100/3.3.86, max flux $2N\ell/h$
    2. GEC-Elliot Series 1100, n.945038, tube n.945038/03, max flux $20N\ell/h$
- F2 bubble fluxmeter Carlo Erba max volume $5cm^3$.

The impedance under measurement is plugged between C1 and C2. F2 is used in the low-flux region: flux is determined by measuring the speed of a gas bubble inside the glass tube.

Gas used is dry and filtered air at 24^oC. During each measurement, temperature is stable at $\pm 0.5^oC$.

2 Results

Impedance curves (pressure drops Δp [1] in cm_{H_2O} vs air flux φ in $N\ell/h$) are shown in fig.2.

The impedance of the 1-mm-ID rilsan tubing was also measured. The data points in fig.2 show the dependance of the pressure drop Δp as a function of flux, which approximately scales with the length of tubing L.

Five impedance prototypes have been realized:

[1] 1 bar = 1020 cm_{H_2O}

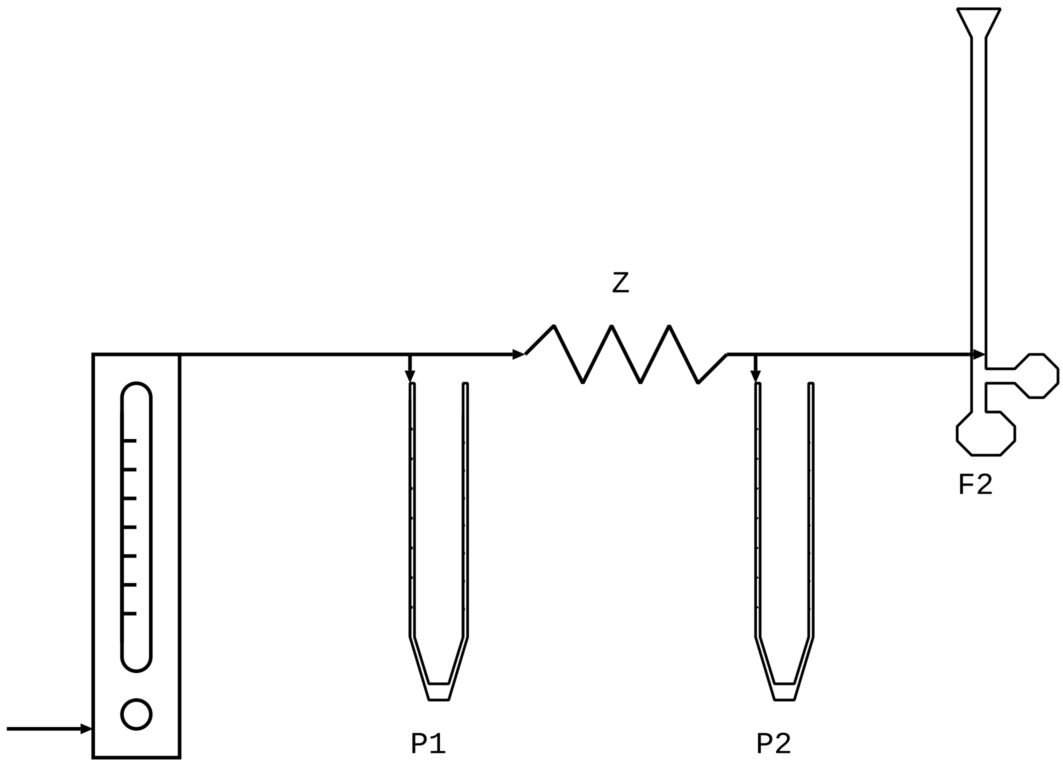

Figure 1: The test setup.

- A 1.2mm-diam, 1mm-long screw inside a 25cm-long, 1mm-ID rilsan tubing
- B "blue pin" inside a 25cm-long, 1mm-ID rilsan tubing
- C steel, 0.9mm-diam, 1cm-long inside a 25cm-long, 1mm-ID rilsan tubing
- D 1mm-diam, 3.5mm-long screw inside a 25cm-long, 1mm-ID rilsan tubing
- E 1mm-diam, 1mm-long screw inside a 25cm-long, 1mm-ID rilsan tubing

Table 1 shows the measured impedances Z for prototypes A-E

$$Z = \frac{\Delta p}{\varphi}.$$

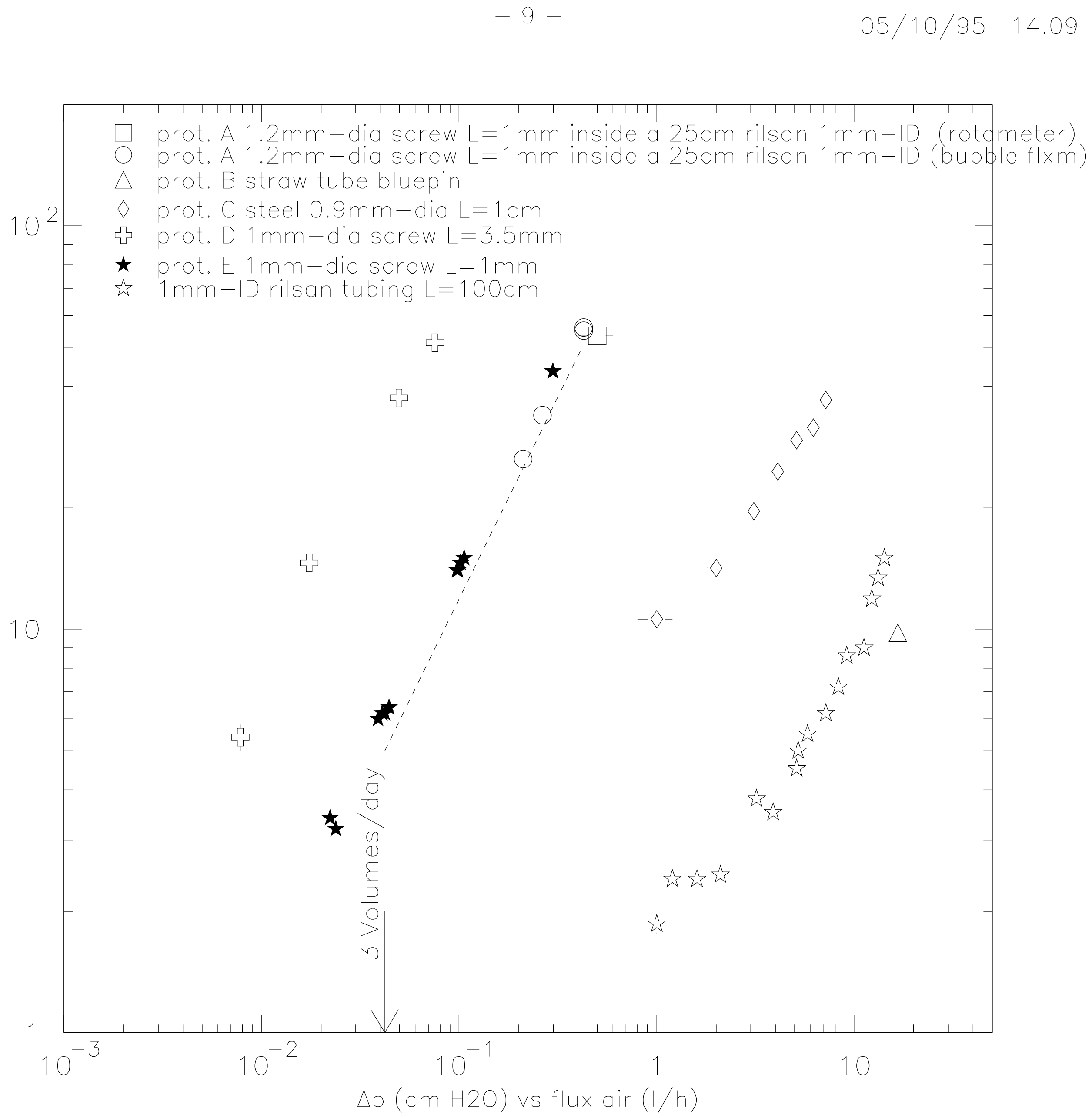

Figure 2: Impedance curves for prototypes A-E, and 1-mm-ID rilsan tubing L=100cm, 200cm, 10000cm (normalized to L=100cm). The requested impedance is also shown (dash).

Table 1: Impedances Z for prototypes A-E, and 1mm-diam rilsan tubing

Prototype	$Z[cm_{H_2O}\ell^{-1}h]$
A	130
B	$\sim$0.5
C	$\sim$6
D	780
E	145
1mm-diam L=100cm rilsan tube	$\sim$1

3 Conclusions

The results described show how realizing a device with an impedance of order $Z = 100\,cm_{H_2O}\ell^{-1}h$ is technically feasible. However, none of the devices tested is regarded as reliable enough. We plan to complete the study by testing two new prototypes: a very thin steel spiral, and a 2mm-ID Cu cylinder multiply clamped around the rilsan tubing.

References

[1] S. Sarwar *The Straw Tube Gas System* , FINUDA note (in preparation).