# Z-IDENTIFICATION OF HEAVY-IONS BY ENERGY LOSS IN CARBON FOILS: CALCULATION OF THE MAXIMUM RESOLVING POWER

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The identification of the nuclear charge Z of heavy ions by measuring the energy loss in a homogeneous absorber, has been successfully performed in the region $Z\sim 40$, $A\sim 100$ (1) at the recoil mass spectrometer Lohengrin in Grenoble, achieving higher Z-resolving power than in conventional ΔE-E telescopes. We are interested in applying this technique to the study of heavy-ion induced reactions at the 16 MV Tandem in Legnaro. The maximum Z-resolving power is determined by the condition $\delta\Delta E/\delta E_{res} \sim 1.$, $\delta\Delta E$ being the energy width after the absorber and $\delta E_{res}$ the difference in energy loss of two neighbouring isobars incident on the absorber with the same velocity. Assuming that $\delta\Delta E$ is due to the energy loss straggling, the limits of the method can be estimated starting by realistic calculations of the stopping-power and straggling.
We calculated the stopping-power of heavy-ions in Carbon in the frame of the Bethe-Bloch formalism, including corrections for the projectile low velocity effect and ionic charge state. The energy loss straggling in C has been estimated starting from a semiempirical formula for the straggling due to the charge-change process of heavy-ions in gases [2].
By fitting a number of experimental data[3] with C-foils, a new formula has been derived which includes an additional dependence of straggling on the energy loss not evidenced in the case of gases.

Using this calculation technique, we are able to fit well the Lohengrin experimental data.

The following conclusions can be drawn about the maximum resolving-power:

a) for ions at 1. MeV/amu, $Z/\Delta Z$ increases as the energy loss $\Delta E$ increases, so that no $\Delta E/E$ value exists which optimizes the $\delta\Delta E/\delta E_{res}$ ratio, as reported in previous calculations[4) ] (Of course, one must consider the experimental problems arising in the detection of very slow heavy-ions);

b) for C-absorbers, $\delta\Delta E/\delta E_{res} \sim 1.$ for $Z \sim 52$ at $E/A = 1.$MeV/amu, and for $Z \sim 55$ at $E/A = 2.$MeV/amu ($\Delta E/E \sim 0.8$).

Performing the same calculations also for plastic materials like Mylar and Polyethylene , higher maximum $Z/\Delta Z$ have been obtained ranging between 57-62 (1.MeV/amu) and 60-67 (2.MeV/ /amu), depending on the absorber $\bar{\bar{Z}}$.

This last result is in agreement with the finding $Z/\Delta Z = 58$ at $Z = 39$ experimentally determined using a Parylène-C foil as absorber[5)].

## References.


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