Radiation Studies of Single Transistors

Single transistors have been laid out on the VDC chip in order to assess the radiation effects on the npn bipolar transistors in the AMS 0.8 \( \mu \text{m} \) BiCMOS process. The small signal current gain versus collector current has been measured for two irradiated and two unirradiated transistors. The results are shown in Figure 1 below. The irradiation, consisted of a fluence of (equivalent 1 MeV neutrons) of \( 3 \times 10^{14} \) n/cm\(^2\) at Ljubljana and a dose of 10 Mrad with gammas from the Co\(^{60}\) source at Birmingham. The transistors were not biased during the irradiation (however VDC and DORIC were powered during earlier gamma irradiations).

The results are based on measurements of the average of two transistors but other transistors on the same wafer showed very similar results. The fall of current gain with high current for the unirradiated devices is a normal feature. The fall of current gain at low values of collector current for the irradiated transistors is due to the radiation induced leakage current causing an increase in the base current. The DORIC and VDC ASICs have been simulated to work with \( h_{fe} \) as low as 10. These transistors are operated at a \( I_C = 125 \mu \text{A} \), therefore we can now understand the fact that they work correctly irradiation.