Linear and Nonlinear Evolution of Longitudinal Instabilities in the ESR*, I. HOFMANN, GSI; G. MIANO, Università di Napoli "Federico II" and INFN Sezione di Napoli; G. RUMOLO, GSI and Università di Napoli "Federico II" - We have investigated the dynamics of longitudinal instabilities of coasting beams in the ESR for different working conditions corresponding to different values of the RF cavity eigenfrequency. The experimental data resulting from measurements have been compared with theory and with the numerical simulations carried out using the particle-in-cell (PIC) code PATRIC. A very good agreement between the linear theory and the first phase of the instability dynamics has been found both for the simulated beam evolution and for the observed one. The nonlinear phase of the instabilities has also been object of attention and study: wave saturation and steepening for a space charge dominated beam, generation and growth of harmonics different from the fundamental mode, beam energy loss and momentum spread increase during the instability have been clearly observed and thus examined with the mechanisms that produce them. The dynamics of the momentum distribution function while the instability develops in time, has been studied in relation to the already existing "overshoot" theory, so as to draw a validity range of the latter in terms of beam and machine parameters.

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