I. INTRODUCTION

Interest in neutrinoless double-beta decay has seen a significant renewal in recent years after evidence for neutrino oscillations was obtained from the results of atmospheric, solar, reactor and accelerator neutrino experiments (see, for example, the discussions in [1–3]). These results are impressive proof that neutrinos have a non-zero mass. However, the experiments studying neutrino oscillations are not sensitive to the nature of the neutrino mass (Dirac or Majorana) and provide no information on the absolute scale of the neutrino masses, since such experiments are sensitive only to the difference of the masses, Δm^2. The detection and study of $0\nu\beta\beta$ decay may clarify the following problems of neutrino physics (see discussions in [4–6]): (i) lepton number non-conservation, (ii) the nature of the neutrino (Dirac or Majorana particle), (iii) absolute neutrino mass scale (a measurement or a limit on m_1), (iv) the type of neutrino mass hierarchy (normal, inverted, or quasidegenerate), (v) CP violation in the lepton sector (measurement of the Majorana CP-violating phases).

The currently running NEMO 3 experiment is devoted to the search for $0\nu\beta\beta$ decay and to the accurate measurement of two neutrino double beta decay ($2\nu\beta\beta$ decay) by means of the direct detection of the two electrons. This tracking experiment, in contrast to experiments with ^{76}Ge, detects not only the total energy deposition, but other parameters of the process. These include the energy of the individual electrons, angle between them, and the coordinates of the event in the source plane. Since June of 2002, the NEMO 3 detector has operated in the Fréjus Underground Laboratory (France) located at a depth of 4800 m w.e. Then in February 2003, after the final tuning of the experimental set-up, NEMO 3 has been taking data devoted to double beta decay studies. The first results with ^{100}Mo, ^{82}Se, ^{150}Nd and ^{96}Zr were published in [7–12].

II. NEMO-3 EXPERIMENT

The NEMO 3 detector has three main components, a foil consisting of different sources of double beta decay isotopes and copper, a tracker made of Geiger wire cells and a calorimeter made of scintillator blocks with PMT readout, surrounded by a solenoidal coil. The detector has the ability to discriminate between events of different types by positive identification of charged tracks and photons. A schematic view of the NEMO 3 detector is shown in Fig. 1.