Introduction

The mission of the LNL is the activity research on nuclear physics, fundamental physics and astrophysics as well as the development of nuclear technologies. Key points are the development of particle accelerators and of nuclear radiation detectors. More than 800 scientists, from many countries, take part to the ongoing research programs. Among the people every day present at the LNL half are INFN physicists, engineers or technicians, while the rest comes from Italian or foreign research institutes and universities.

Three important infrastructures are in progress at LNL:

- The SPES project: to realize a facility capable to produce radioactive nuclei, of interest for nuclear astrophysics and medical applications
- The IFMIF project: LNL, together with the INFN sections of Padova, Torino and Bologna, are deeply involved in the construction of the RFQ, which is the heart of the IFMIF laboratory, whose aim is the study of materials for the future fusion nuclear reactors.
- The project Galileo, to realize a new generation gamma detector.

The annual budget of LNL is close to 20 Milions of Euros per year, half for the research and the other half for the personnel costs. Concerning the equipment for year 2013 the breakdown is as follows:

- Without third parties funds (i.e. without the sum of the external funds and of the funds from the Ministry of research for dedicated special use) the budget of LNL was 6.8 MEuros, 1.4 for the experiments approved by the INFN research commissions and 5.4, fully used, for the normal running of the Laboratory.
- Furthermore 6 Meuros from the “progetti premiali”, as ITALRAD, SPES, MUNES, and from special projects as IFMIF have been used.

In other words the internal funds and the third parties funds equally contribute to the realization and maintenance of research apparatus.

At the end of 2013 LNL personnel included 126 staff, 24 of which with a limited duration (LD) contract. Half of the LD is financed with the third parties funds as well as the major part of the cost of the personnel in training (36 units as people having a grant, doctorands, “assegnisti di ricerca” CoCoCo, partly also financed by LNL).

The SPES project has kept its schedule:

a) The Company NBI, which won the bid for the construction of the buildings and related conventional facilities has completed the excavation of the new site in 2013, the foundations including the perimetrical concrete wall.

b) The 70 MeV cyclotron has been assembled in Canada at the BEST manufacturing company premises.

c) The two ion sources SIS and PIS for the ISOL system have been installed and characterized. In order to improve the source selectivity, SPES uses also a laser ionization system (LIS). During 2013 a dedicated Laser laboratory and an international call for tender has been started to obtain a three wavelength tunable Laser.

d) The AGV (Automated Guided Vehicle) to remotely manipulate the target has been delivered and its tests have been started.

e) In order to realize the radioactive beams of SPES re-acceleration, a number of modifications/upgrades of ALPI, and related beam lines, are needed: a program of refurbishing of the cryogenic control and of the RF control system has started, works are in progress to modify the experimental hall 3 to allow the installation of the beam transfer line of SPES. The new access controls for Hall 3 and ALPI have been designed.

f) The Ministry of Education and Research (MIUR) has approved the 7 MEuros funding, as Progetto premiale 2012 of the LARAMED, a laboratory for the production and the study of new radio-isotopes for medicine. The design of the laboratory for radio-isotopes of medical interest have been concluded.

At present at LNL there are five accelerators: AN2000, CN, TANDEM, ALPI and PIAVE. These two last have been completely designed, constructed and commissioned by LNL. A total amount of 6700 hours of beam per year are available and given by the accelerators.

A reduced working time (i.e. one semester per year) for ALPI and PIAVE accelerators was planned from 2013 on, in order to allow the installation, up to its completion, of SPES complex. The consolidation of the cryogenic plant, after the installation of an additional turbine, has been completed in 2013. Furthermore with the aid of a LASER tracker and of a non-accelerated Br beam the alignment of ALPI has been verified resulting in a 95% measured transmission. The
upgrade of the low energy ALPI cavities has been completed by adding an additional RF antennas cooling system.

Following the indications of the User’s Committee new heavy beams (Mo and Ca) have been developed by means of the ECR ion source.

The apparatus below have been realized by LNL during 2013:

a) The high resolution gamma spectrometer Galileo, based on a configuration which combines single “tapered” and cluster detectors assembled in a triple configuration. The new spectrometer combines efficiency, easy use and a high granularity for an adequate Doppler correction. The commissioning of the apparatus is foreseen for the year 2014.

b) Up-grading of Prisma for the measurements of high precision multi-nucleon transfer cross-sections. This include the development of a second arm per high resolution measurements of kinematic coincidences (new Bragg chamber, Parallel Plate and associated electronics, etc.)

c) Development of Neda, a detector for neutrons, with a large solid angle and granularity, to be used with a gamma spectrometer (AGATA, Galileo, etc.). It will be used with stable and exotic (SPES) beams. During 2013 the new detector prototype and the new digital electronics based on GTS have been developed.

d) Up grading of Ripen: development of the digital electronics and of its related acquisition system

e) Neutron detectors for the experiment n-TOF: characterization with the beam and the measurement of the “neutron sensitivity” to the C6D6 detectors (called L6D6) designed and realized at LNL

f) The study of the active target prototypes to be used with the SPES beams. A “time projection chamber” is under study to be used both as target and as detector for exotic beams of low and medium intensity

g) The production of Germanium detectors for high resolution spectroscopy: the development of inert deposit for ieper-pure Germanium crystals. During 2013 the successful procedure to realize the deposit on planar Ge crystals has been verified.

The experimental activity at the AN2000 and CN accelerators was carried out for a total of 3000 hours of beams following the programs approved by USIP in the framework of interdisciplinary and applied physics. This includes 30 research groups from Italian and foreign universities and institutes, and INFN CSN3 and CSN5 research groups. There was an increase of demand both of beam time for the micro-beam at AN2000 and of experiments to measure the cross-sections at low energy for nuclear astrophysics. A new scattering chamber has been installed on the -15° beam line of CN for experiments of Ion Beam Analysis with the simultaneous detection of X-rays, gamma-rays, (d,p) and (d,alpha) reaction products and elastic scattering.

In the framework of the project IFMIF a RFQ of very high intensity is under construction and which will be installed in 2015 in Rokkasho (Japan), together with other accelerator components realized by the European collaboration. The production and test of the RFQ is quite advanced and it is on schedule with agreed collaboration program.

The scope of the MUNES project is the development of a high intensity and compact neutron source for the BNCT (new cancer treatments) and for the radioactive waste characterization. For this purpose high power solid state RF systems (125 kW each) have been ordered to industry, which are suitable for the installation of a RFQ type accelerator in a small laboratory or in a hospital.

For the ITALRAD project, the map of the radioactivity of the Veneto region has been completed, while the one of Sardinia is in progress. Furthermore the detailed design of a small aircraft for the monitoring using gamma spectroscopic techniques has been defined.

Sadly during 2013 the LNL have had to face the loss of two greatly appreciated colleagues, the physicists Enrico Farnea and Luigi Vannucci, who were involved in frontier research both at LNL and CERN, a memoir of whom is outlined below.

Prof. Giovanni Fiorentini
Director
Enrico Farnea (1970-2013)

Our colleague and friend Enrico Farnea died on April 14 2013, due to a fast malignant disease against which he fought, with all his considerable mental and physical strengths, for about six months.

Enrico was born on August 29 1970 in Verona. He studied Physics at the University of Padova and graduated in 1995 with a thesis done at LNL on the development of ISIS, a 4-inch light charged particle detector for the gamma-ray detector array GASP. After the thesis he continued working with the gamma-ray spectroscopy group on the EUROBALL project, and in particular to the development of the light charged particle detector ISIS, which was very much used in the Physics campaigns at LNL and at IReS (Strasbourg). Between 1998 and 2000 he was at IFIC Valencia with a “Marie Curie” fellowship. In 2001 he got his PhD, at the University of Surrey (UK), with the thesis “Spectroscopic studies of Isospin Mixing in 64Ge” based on experiments performed with EUROBALL using the instrumentation he contributed to build. This work has been an important contribution to the complex topic of isospin mixing in nuclear states.

At the end of 2001, when Enrico got his position at INFN Padova, the strength and the future perspectives of the Padova/LNL Nuclear Spectroscopy group got indeed a very significant boost.

In parallel with the experimental activity at LNL with GASP, EUROBALL and later on with CLARA, Enrico was involved since the beginning in the efforts of the AGATA collaboration to develop the gamma-ray tracking paradigm, which is based on the precise identification of the energy-release points inside large-volume high-purity segmented germanium crystals and the reconstruction of individual gamma transitions that generated them. In particular, he developed the Monte Carlo simulation codes used to define the geometrical structure and the performance of AGATA and also of the US project GRETA. Considering the cost and complexity of a full gamma-ray tracking array the AGATA collaboration decided to proceed in phases, starting with a Demonstrator composed of 15 crystals (out of the 180 needed for the complete array) to be constructed and operated first at LNL. As Local Project Manager and as a member of the AGATA Management Board (AMB) Enrico was in charge of the installation of the Demonstrator at the target point of the PRISMA spectrometer and of the ensuing 2010-2011 experimental campaign.

Besides the efforts to develop AGATA, Enrico has been for many years the representative of the Padova group in the INFN Nuclear Physics Scientific Committee. Since about one year he was Group Leader of the INFN-experiment GAMMA, which involves about 50 physicists of from Firenze, Legnaro, Padova, Milano and Camerino.

An excellent physicist and a wonderful person with many interests in literature, music and movies, Enrico was fully committed to his research work and was always ready to help, in particular the younger colleagues. His untimely passing away is a major loss for our community, first of all from the human point of view but also for the effect on the many activities in which he was so essential.

DINO BAZZACCO, INFN Padova, Italy
ANDRES GADEA, IFIC Valencia, Spain
Luigi Vannucci (1953-2013)

Luigi Vannucci, passed away, on Friday April 18th, 2013, just during a cardiac test, leaving all of us completely astonished and distressed. His death, so much unexpected and disconcerting, particularly shocked all those who had the chance to really know and love him as a physicist and as man.

Luigi Vannucci obtained his degree (the “laurea”) in Physics in 1982 at the University of Padova, discussing with me a thesis on the realization of an apparatus to detect the products of heavy-ion induced reactions in view of the first experiments to be performed at the 16 MV Tandem Accelerator. Already in 1983 he was engaged as permanent researcher at the INFN-National Laboratory in Legnaro. The first part of his scientific career was therefore concentrated in the investigation of the reaction mechanism of the heavy-ion reactions, particularly in the region of medium-mass nuclei (A around 100), at colliding energies of 1.5 to 3 times the Coulomb barrier with the aim of studying the variety of dissipative phenomena with interesting results concerning the evidence of new intermediate mechanisms between the fission (or quasi-fission) and deep inelastic processes (FUFI-EVA experiment). His precious and competent collaboration was immediately recognized and greatly appreciated during the evolution of the various experiments performed at the Tandem, namely the systematic investigation of the dissipative processes with the production of more than two massive fragments in the final state; - the study of the reaction time of the fusion-fission processes; - the search of quasi-molecular resonances in heavy-ion systems (door-states) also in some medium-mass systems (A near 100); - the study of the dynamics of excited medium-mass nuclei by measuring the gamma-charged particle coincidences following the production of Giant Dipole Resonance (pre-equilibrium states). Starting from the 90’s, when I suggested to some of the members of the group (P. Boccaccio, L. Vannucci, M. Lombardi), to move to CERN and join the OBELIX collaboration already active in performing interesting experiments concerning the nuclear behavior in the interactions with low-energy antiprotons at the LEAR facility, Luigi was one of the more convinced of the interest of forming a special Legnaro group engaged in a CERN programme. The contribution of the group to the achievement of important results concerning the meson spectroscopy, the annihilation dynamics (hadronic branching-ratio) and the study of the annihilation processes on nuclei as compared with that on nucleons, so as the measurement of the antiproton stopping power in atomic targets (Barkas effect), was particularly appreciated, especially for the realization of a vertex detector (the SPC, ”Spiral Projection Chamber”) thanks also to the qualified participation of Luigi.

The experience acquired with heavy ions and the possibility to make a jump into the domain of relativistic heavy ion collisions, was the main argument to maintain our presence at CERN and join the Padova group (M. Morando, F. Antinori, A. Dainese) in the Italian participation to the experiments at the SPS devoted to the search of signatures of the QGP (Quark Gluon Plasma). The Legnaro participation with Luigi as a group leader, was the NA57 dealing with the measurement of the production of strange particles in p-Be, p-Pb, Pb-Pb collisions at 40 and 138 A GeV, by using a telescope formed by silicon pixel and silicon detectors, a matter which became very familiar to Luigi and that was quite appreciated later by the ALICE collaboration. As a consequence, his strong involvement in the ALICE programme consecrated his maturity as a qualified physicist and as a research group leader assuming any responsibility in the participation in the various activities established by the ALICE Collaboration Board and in the contacts with the Padova group and CERN.

At Legnaro we should remember also the various duties and responsibilities he accomplished as a Coordinator of experimental set-ups at the Tandem Laboratory, as a member of the Advisory Committee of the Research Division, as a Responsible of the Library and Documentation Service, as a Coordinator of the promotion of the scientific culture and as a member of many Conference Organizing Committees. Moreover he was also involved in teaching activities on General and Nuclear Physics, at the Padova University. Remembering Luigi and his personality not only as a collaborator and as a friend since the time he went to Legnaro, but especially as a very human person of invaluable qualities, is certainly a duty we have to accomplish with the consciousness of a great loss as shown by his team and solidarity spirit, his admirable and intelligent discretion together with an exceptional goodness of heart.

Renato Angelo Ricci