LNL **TANDEM-ALPI NEWSLETTER** N^0 13, July 1997
Laboratori Nazionali di Legnaro, Via Romea 4, I-35020 Legnaro, Italy

Calendar

November 21, 1997	Users meeting
Dec. 10, 1997	**Deadline for proposals** (for the period March-July 98)
January 12-14, 1998	PAC meeting

The Tandem-ALPI accelerator

The XTU-Tandem accelerator has been working without major problems during the first half of 1997 delivering beams for about 3800 hours. There has been only one unscheduled tank opening.
The ALPI post-accelerator was stopped during the first six months of 1997 because of a failure of the cryogenic plant. The cryogenic plant started again at the end of June after a first campaign of interventions mainly devoted to the cycle helium compressors with the goal to improve their reliability.
During the ALPI shutdown a new cryostat, acting as a buncher, was installed at the end of the high energy branch in order to reduce the beam energy spread and the bunch length on the experimental target area.
The operation of ALPI resumed in July and a beam of ^{30}Si was delivered for two days to the experimental halls. The experiment could not continue because of a breakdown on the XTU terminal which deteriorated the bunched beam and made difficult the recovering of the transport conditions. During the same run the cryogenic plant worked with good reliability, delivering liquid helium to all the cryostats of the medium-β section and to the 3 buncher cryostats (15 cryostats).
A new run with ^{90}Zr is foreseen in the last week of July.

The list of experiments completed in the first semester 1997 is given in Table 1.

Table 1 – Experiments performed at the Tandem-ALPI accelerator in the period January-July 1997.

a) GASP experiments

96.T27 Alpha particles in coincidence with superdeformed states in ^{191}Hg.
G. Viesti (Padova)

96.T50 High spin states in N=Z ^{46}V.
S. Lenzi (Padova)

97.01 Search for magnetic rotation in the N=46 nucleus ^{83}Rb.
R. Schwengner (Dresden)
97.22 The level density of ^{200}Pb.
M. Lunardon (Padova)
97.23 Study of fission fragments spin distributions at near and sub-barrier energies in ^{12}C, ^{16}O+^{232}Th, ^{209}Bi reactions.
R.K. Choudhury (Bombay)
97.46 Ultra-cold fusion by symmetric reactions as a gateway to hyperdeformation.
B. Herskind (NBI)
95.53 Octupole deformation in the neutron deficient ^{223}Pa.
D. R. Napoli (LNL)
97.54 Test of a new detector and setup for recoil-decay tagging with the system GASP+RMS.
P. Spolaore (Legnaro)
97.55 Investigation of the backbending region of heavy Dy isotopes via incomplete fusion.
T. Härtlein (Heidelberg)
97.S04 Spectroscopy of the highly neutron deficient ^{141}Dy.
M. N. Rao (Sao Paulo)
97.S18 Loss of alignment gain in the $\pi h_{9/2}[541\ 1/2^-]\ \times(\nu i_{13/2})^2$ band in ^{167}Tm and neighboring odd-Z N=98 nuclei.
H. J. Jensen (Jülich)
97.91 DSAM lifetime measurements in the N=Z nuclei ^{46}V and ^{44}Ti.
S. M. Lenzi, F. Brandolini (Padova)

b) Euroball experiments

97.03 A study of the N=72 shell gap and $i_{13/2}$ intruder orbital occupation in the superdeformed mass A=130 region.
A. T. Semple (Liverpool)
97.09 RDTF g-factor measurement in the dipole yrast superdeformed band in ^{192}Hg.
A. Jungclaus (Göttingen)
97.10 Lifetime measurements and collectivity in ^{114}Te: from discrete rotational bands to the chaotic regime.
A. Bracco (Milano)
97.14 Decay out and other aspects of superdeformation in ^{143}Eu.
A. Atac (Uppsala)
97.16 The level scheme of superdeformed ^{196}Pb: search for linking transitions.
H. Hübel (Bonn), F. Azaiez (IPN Orsay)
97.17 A study of superdeformation and search for superdeformed-normaldeformed linking transitions in ^{154}Er.
B. Cederwall (Stockolm)
97.30 Decay-out of the yrast superdeformed band in ^{144}Gd.
S. Lunardi (Padova)
97.37 Collectivity of low-lying SD states and members of the ΔI=1 bands in ^{196}Pb.
I. Wiedenhover (Köln)
97.47 Tilted rotation in a triaxial SD well and ND residual interaction.
G. Hagemann (NBI)

97.49 Spectroscopy in the unpaired regime of ^{161,162}Er.
J. Simpson (Daresbury)

97.57 Study of the superdeformed octupole vibrational structures in ^{190}Hg.
A. Korichi (CSNSM Orsay)

97.76 Lifetime of the quasi-continuum in the highly-deformed minimum, shell structure and polarization effects in ND nuclei.
C. M. Petrache (Padova)

96.T31 Lifetimes of the low-spin termination of the superdeformed band in ^{135}Nd.
R. Krücken (Berkeley)

c) Other experiments

96.T30 Test of a new RMS focal plane detector.
C. Signorini (Padova)

96.T40 Molecular and cellular effectiveness of accelerated charged particles and neutrons.
R. Cherubini (LNL)

96.T48 The fusion barrier distribution of ^{40}Ca+ ^{124}Sn.
F. Scarlassara (Padova)

97.11 Detector tests for the PRISMA spectrometer.
A. M. Stefanini (LNL)

97.24 Pre-scission emission in the decay of ^{209}Bi nuclei: exploring the role of the shell effects in fission.
G. Prete (Legnaro)

97.35 Latent track formation induced by high energy in HTSC materials and their interaction with flux lines.
E. Mezzetti (Torino)

97.45 GARFIELD: simultaneous detection and identification of light charged particles and heavy fragments.
F. Gramegna (LNL)

97.S08 Calibration of track detectors for cluster radioactivity experiments.
R. Bonetti (Milano)

97.S20 Multi-nucleon transfer reactions of ^{40}Ca+^{90,96}Zr.
G. Montagnoli (Padova)

97.31 SIRAD: a dedicated beam line at the LNL tandem accelerator for radiation-damage and single-event phenomena studies on silicon detectors.
D. Bisello (Padova)

The Tandem-ALPI pulsing system

The Tandem-Alpi pulsing system consists of a double drift buncher, a travelling wave chopper, three high energy choppers and a phase stabilization system including a resonant phase pickup and slits-based phase pickup's. The main bunching frequency is 5 MHz and the typical bunch width is 1-2 ns, depending mainly on the ion mass; at 5 MHz the bunching efficiency exceeds 50The system can bunch all kind of ions, with lighter ions having generally better timing than the heavier ones. The frequency can be easily scaled down to $5/2^n$ MHz (n=1,2,..,32) by means of the low energy chopper; for n=8,9,...,32 the beam duty cycle can be varied in small steps from 0.4% to 99.6%

of the period. In order to match special requirements in frequency and duty cycle, the reference signal can also be provided through an external generator. The beam, after acceleration in the Tandem, can either be sent to the experimental halls or into the ALPI linac; in this second case the beam is being further bunched by the linac itself and usually it reaches the experimental area with a the time-width of about 1 ns.

Euroball: a status report.

After few short commissioning runs in January-March 1997, experiments have started with Euroball on April 14 and up to now 13 experiments have been performed (see also Table 1), for a total of 61 days of beam time.
At present, as far as the detectors are concerned, the situation is the following:
Cluster detectors: 105 capsules delivered and accepted out of 119. 14 clusters are in use (out of 15).
Clover detectors: 25 are in use out of 26. The 26^{th} anticompton shield is still missing and has been ordered.
Tapered detectors: 27 (out of 30) are in use.
With the detectors in use at the moment Euroball is at 93% of the expected final efficiency.
The reliability and performances of the array have steadily improved and by now the stability of the whole system is satisfactory. Some work has still to be done, on the side of the electronics, in order to improve the resolution of some of the Clusters channels and also to increase the efficiency at low γ-ray energy.
After the summer maintenance, experiments will resume at Euroball requiring the use of a variety of ancillary detectors. Diamant, Saphir and ISIS will be the first to be mounted, followed by the PPAC array. Other ancillary detectors will be available at the beginning of 1998. Users are reminded that, before installing any new detector at Euroball, the following information has to be provided:

- Time needed to mount and to dismount the detector or chamber.
- Requests of mechanical modifications needing support of the mechanical workshop.
- Procedures to align the chamber to the beam.
- Needs of electric power, water, compressed air, etc.
- Cable connections between experimental room and acquisition room.
- Use of dangerous materials.
- Interfacing with the Data Acquisition System.
- Special instruments needed, e.g. pulsers, special oscilloscopes,... ...

Users are also invited to come a few days in advance before the beginning of their experiment in order to get acquainted with the on-line aquisition system and to check the electronics set-up. Since also in the next period the Euroball schedule will be very tight, with many experiments running one after the other, any extra time needed for calibrations with sources has to be agreed with the following or preceding group or (in case no other experiments are scheduled) with D. R. Napoli, G. Maron and C. Rossi Alvarez. In fact, change of detectors (the change of one Cluster requires $\approx$ 2 hours), implementations of the electronics and/or the acquisition system are often planned in the periods left free from experiments. Therefore, users needing to perform some tests at Euroball outside the scheduled beam time have to contact the above people.
Usually, detectors with bad performances are substituted from 10 am to 3 pm in the working days.

Other important rules:

Every group has to leave, after the experiment, a copy of the calibrations in order to update the detectors performances.

Users cannot substitute a Ge-detector or an electronic card without having contacted D. R. Napoli (detectors) and S. Canella (electronics).

If problems arise during an experiment related to detectors, electronics, HV system, liquid nitrogen filling, etc, they should always be reported in the proper log books.

The 4π Light Charged Particle Detection System 8πLP

The 8πLP apparatus, an hodoscope for light charged particles, has been completely mounted at the -40^0B experimental point. The identification is made by ΔE-E technique coupled to Time of Flight (TOF) or Pulse Shape Discrimination (PSD) to lower the identification thresholds. Each telescope is made by 300 μm large area silicon detector followed by a CsI(Tl)crystal with photo-diode read-out. 136 telescopes are mounted the forward direction, 60 cm from the target, covering the angular range up to 33^0; the others angles, up-to 177^0, are covered by 126 telescopes located at 15 cm. This last set of silicon detectors are mounted in "flipped" configuration, to allow the use of the PSD technique to identify the particles which stop inside the detector. A number of tests were performed to study the PSD response of silicon detectors as a function of the material resistivity and depletion voltage. Good identification and energy linearity have been obtained also with overbiased, high resistivity, detectors. In the last two runs, performed in December 96 and June 97, the trigger detectors for residues have been successfully tested in the reaction ^{100}Mo+^{32}S at 196 MeV. A PPAC+Bragg Chamber was operated at 5^0 and residues were clearly discriminated from elastic and two-body reactions in the matrix TOF vs RANGE. The plan is now to test at the beginning of 1998 the data acquisition system and the front-end electronics and to start then with experiments.

The PAC meeting

In the meeting held on July 1-3, 1997 the PAC has examined the experimental proposals presented for the period September 1997- February 1998. The proposals presented were 48 requesting for 235 days of beam-time: 33 of them were Euroball proposals with a beam time request of 169 days.
The proposals approved (for a total of 77 days) for both the Tandem and Linac accelerators are listed in Table 2.

Table 2– Proposals approved by the PAC for the period September 1997- February 1998.

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a) Euroball proposals

97.61 Octupole structure of ^{224}U.
P. A. Butler (Liverpool)

97.68 Search for coexistence of highly and superdeformed shapes in ^{142}Gd.
R. M. Lieder (Jülich)

97.75 Decay out mechanism of superdeformed bands in ^{151}Tb.
G. Duchene (Strasbourg)

97.83 Deformed structures in light radon nuclei.
S. Freeman (Manchester)

97.88 A search for a band termination in the deformed odd-A $f_{7/2}$ nuclei: ^{45}Sc and ^{45}Ti.
P. Bednarczyk (Kracow)

97.89 Search for hyperdeformation in $^{168-170}$Hf by use of the very cold near symmetric reaction ^{76}Ge+^{96}Zr$\rightarrow$^{172}Hf.
B. Herskind (NBI)

97.92 Investigation of SD states in ^{236}U populated by a transfer reaction.
Th. Kroll (Padova)

97.93 Lifetime measurement for a three octupole-phonon state in ^{148}Gd.
Zs. Podolyak (LNL)

97.101 Investigation of prolate-oblate shape mixing in the N=Z+1 nucleus ^{73}Kr: a precise measurement of transition probabilities.
J. Eberth, S. Skoda (Köln)

97.102 Fission induced by heavy-ions: pairing correlations in highly-deformed neutron-rich A$\approx$100 nuclei.
M. G. Porquet (CSNSM Orsay)

97.103 The intensity distribution of primary SD decay-out lines in ^{194}Pb.
A. Lopez-Martens (CSNSM Orsay)

97.106 In beam spectroscopy near the neutron drip line.
D. R. Page (Liverpool)

b) Non-Euroball proposals

97.60 Population of isovector GDR in the intermediate system formed in heavy-ion deep inelastic collisions.
M. Sandoli (Napoli)

97.70 Pre-scission emission in the decay of ^{209}Bi nuclei: status report of the 8πLP experiment.
G. Prete (LNL)

97.72 SIRAD: a dedicated beam line at the LNL tandem accelerator for radiation-damage and single-event phenomena studies on silicon detectors.
D. Bisello (Padova)

97.78 Detector tests for the PRISMA spectrometer.
A. M. Stefanini (LNL)

97.81 Search for proton radioactivity of ^{117}La and ^{173}Au.
F. Soramel (Udine)

97.105 GARFIELD: simultaneous detection and identification of light charged particles and heavy fragments.
F. Gramegna (LNL)

The Next Users and PAC Meetings

The next meeting of the Tandem-ALPI users will take place on November 21 at LNL, at 10 am. During the meeting complete information will be provided on the beam time available with the Tandem and Linac accelerators in the period March-July 1998.

Deadline for the presentation of experimental proposals is December 10, 1997.

The next PAC meeting will take place on January 12-14, 1998.

Forms for presentation of proposals will be mailed in the middle of October 1997 to those receiving the present newsletter. If you wish to receive the "call for proposals" but you are not in our mailing list, please contact the coordinator of the Tandem-ALPI accelerator (see address below).

News from physics

Evidence for double-octupole excitation in ^{146}Sm

Low-lying excitations of collective octupole character are known to exist in many nuclides near to closed shells, but not so much is known about the expected two-phonon states of the octupole excitation. At the moment, only two cases have been clearly identified in the Gd isotopes of mass 147 and 148, where levels $I^\pi = 19/2^-$ and $I^\pi = 12^+$ result from the stretched coupling of two octupole phonons with the $\nu f_{7/2}$ or $[(\nu f_{7/2})^2]_{6^+}$ shell–model configuration.
In addition, good candidates for double octupole excitations have been recently identified in ^{208}Pb (a 0^+ level at twice the energy of the lowest 3^-) and in the isotones ^{146}Sm, ^{144}Nd (a 12^+ level with the same decay pattern as in ^{148}Gd). A measurement of the mean life of the candidate levels is however necessary to confirm the collective nature of their E3 decay.
To this purpose, we have investigated the 12^+ state of ^{146}Sm. This state decays mainly with an E1 transition of 411 keV to an 11^- state, but presents a weak E3 branch to the lowest 9^- state which, in turn, decays to the lowest 6^+ state with a strongly enhanced E3 transition. We have measured the mean life of the 12^+ level with the Recoil Distance method, using the GASP array of LNL and the Plunger set-up of the group of Köln. The reaction ^{124}Sn(^{26}Mg,4n)^{146}Sm, at $E_{^{26}Mg} = 108$ MeV , has been used to populate the relevant states. Intensities of the Doppler–shifted and of the unshifted components of the 411 keV transition, deexciting the 12^+ level, have been measured in coincidence with the in–flight component of the 1011 keV feeding transition, for flight paths ranging from 8μm up to 6 mm. The data analysis has been performed with the Differential–Decay–Curve method.
The preliminary "best average" gives $\tau_m = 15 \pm 2$ ps for the mean life of the 12^+level. As the measured E3 branch is $\approx 0.7\%$ of the total decay intensity, the E3 strength comes out to be $B(\mathrm{E3}, 12^+ \to 9^-) \approx 60$ W.u., *i.e.* about twice the strength of the $9^- \to 6^+$ transition, confirming the double-octupole nature of the 12^+ state.

Any correspondence related to the use of the Tandem or ALPI linac has to be addressed to the coordinator of the Tandem-ALPI accelerator

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