The energy of the protons give a high degree of forbidness of the possible reactions with the same final products: (p,dn) and (p,p2n).
The residual activity determination compared with measurements on line gives the allowance of use of natural elements, and the possibility of determination of the cross-section for different energies in the same irradiation. The characteristic gamma-rays and the half-life allows an unambiguous determination of the nuclides of interest.
The experimental device used for the measurements was a high-resolution Ge detector with the associated electronics. The results were obtained with the help of a set of existing programs in the "Laboratorio do Acelerador Linear". The determined excitation functions were compared with other published results, exhibiting a good agreement. Our results are importants due to the reduce number of published data for these reactions at the studied energy interval.

[02/09/03 - Poster]

Measurement of inelastic scattering cross sections in the $^{16}O + ^{28}Si$ system to discriminate regular and chaotic regimes

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Coupled channel calculations for inelastic-scattering reactions in systems such as $^{16}O+^{28}Si$ predict, distinctive cross-section patterns in correspondence with the classical occurrence of either regular or chaotic regimes [1]. According to these, each type of behavior should become apparent when examining two-dimensional plots of the cross sections as a function of the bombarding energy and the scattering angle over appropriately selected regions. The results of measurements at the TANDAR laboratory in Buenos Aires for the $^{16}O + ^{28}Si$ system over two energy regions, one close to the Coulomb barrier and the other well above, are in reasonable agreement with the theoretical predictions [2]. However new experiments to extend the angular range of the measurements and to increase the statistics of the data in order to improve the study of the behavior of the two regimes was carried out. Furthermore, the used technique to obtain angular distributions taking advantage of the large sensitivity of Gammasphere [3] and the wide angular coverage and efficiency provided by the particle spectrometer CHICO [4] was tested for the first time to measure light-ion reaction systems. In this contribution we summarize the most relevant characteristics of the developed method and discuss the preliminary results.

[1] C.Dasso et al. NPA 602 (1996) 77.
[2] G.V.Martí et al. PLB 447 (1999) 42.
[3] M.A.Deleplanque et al. (Eds), GammaSphere, LBL Publ., (1988) 502.
[4] M.W.Simon et al. NIM A452 (2000) 205.

[02/09/03 - Poster]

Fusion cross section measurements for systems $^{6}Li + ^{27}Al, ^{64}Zn$ at sub-barrier energies.

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The influence of the break-up of stable and radioactive nuclei on the fusion process at energies above and below the Coulomb barrier, became a subject of great interest in the last years. In order to contribute to this field we have recently studied fusion cross sections at energies well above the Coulomb barrier for the $^{6}Li + ^{27}Al$ and $^{6}Li + ^{64}Zn$ systems [1]. As a continuation of those previous measurements a new experiment has been carried out to measure the same systems at energies below the Coulomb barrier. Beams of ^{6}Li were provided by the TANDAR accelerator with energies ranging from 14 to 24 MeV. The detector system was a time of flight consisting of a zero-time detector (Micro Channel Plate (MCP)) and a surface barrier detector. In the present work the preliminary results of that experiment are presented and discussed.

[1] I.Padron et al. PRC 66 044608 (2002).

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[02/09/03 - Poster]

Nuclear Reactions, Applications and Computation

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Nuclear Physics had allowed progresses in many academic areas, like atomic nucleus and nuclear reactions, but also enable important applications of nuclear energy in modern life, as those ones related to power generation from nuclear reactors. Other important applications are related to medicine, mainly cancer therapy. Indeed, at the hospitals, one can find the most different kind of radiation sources, from gamma, electrons and X ray sources, to electrons accelerators, and, even protons, high energy heavy ions and neutron sources from nuclear reactors. The radiation from these sources is used in radiotherapy, proton therapy, BNCT (boron neutron-capture therapy). Nuclear physics studies and applications have been carried out considering low energies, but modern, studies involving nuclear interests has higher energies. Indeed, there is a great interest to study the nuclear reaction sub-nucleonic degrees of freedom, where JLab, a North American Laboratory where some of the authors of this project has collaboration, is a real example of this interest. Beyond the academic application, the intermediate and high-energy region has great practical applications possibilities, like energy generation as well as cancer therapy. In the first case, the main interest is the called Hybrid Reactors (ADS - Accelerator Driven System). In the second is the possibility of treating deep tumors, located mainly in the brain, using protons. In these techniques, the effects of the secondary particles that eventually could be produced by nuclear reactions induced by protons are not well known, yet. For all those studies and applications, precise knowledge about nuclear structure and nuclear reaction characteristics are needed. Monte Carlo simulations have been used with good results in high and intermediate energies. Recently, the research groups from IFUSP and CBPF made a common effort to develop a computer program to calculate the intranuclear cascade proprieties and the nuclear evaporation process (MCMC/MCEF), present in all nuclear reactions with energies above few tens of MeV, using Monte Carlo techniques. The program has shown very useful to describe actinide and pre-actinide nuclear photofission reactions, what demonstrate that the relevant processes that occurs during the nuclear reaction are correctly calculated. So, is important to expand the applicability of the program in order to use it in the areas previously related. The objective of this Project is to develop the programs MCMC/MCEF including reaction channels that may be relevant for studies presented here, aiming Reactor Physics and Medical Physics applications, and academic studies about hadrons properties in nucleus.

Nuclear Structure

[02/09/03 - Poster]

Bandcrossing in neutron deficient nucleus ^{141}Tb

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Neutron-deficient odd-proton nuclei in the A=140 region display many interesting collective properties. The odd-proton nuclei in this region have moderate prolate quadrupole deformations ($\beta_2 \approx 0.2$) at low spin and are soft with respect to changes in γ deformation, which leads to rich and varied structural characteristics. The $\pi h_{11/2}$ orbital plays a prominent role in the structure of these nuclei. The low-Ω members of this orbital are close to the Fermi surface, giving rise to decoupled yrast bands at prolate deformations. Pairs of $\pi h_{11/2}$ quasiparticles align at modest rotational frequencies stabilizing prolate configurations. The alignment of $\nu h_{11/2}$may drive the core towards oblate shape due to its softness.

We have performed an experiment to produce and investigate extremely neutron deficient nuclei in the A=140 mass region by means of the ^{54}Fe+^{92}Mo reaction at 240-MeV incident energy and the multidetector array GASP, composed of 40 Compton-suppressed high-efficiency HPGe and the 80-element BGO inner ball, used for obtaining γ-ray double and triple coincidence spectra [1]. The incident beam was obtained with the tandem XTU accelerator of Legnaro National Laboratories, Legnaro, Italy. Various nuclei (Z=63 to 66; N=75 to 78) were produced in this experiment, the $3p$ channel leading to ^{143}Tb was the strongest one populated at the incident energy used. The experimental details and results on the high-spin structures populated in this nucleus were described in Ref. [2]. We report here the results on the αp channel leading to the neutron deficient nucleus ^{141}Tb. This nucleus is the heaviest N=76 odd-proton nucleus to be studied at high spin by means of γ-ray spectroscopy. The ground state of this nucleus is known to be $5/2^-$ [3], and previous to this work only the first 3 low-lying γ-transitions emitted from the levels populated with the same fusion reaction at 260 MeV were known [4]. For the yrast $\pi h_{11/2}$ decoupled band, excited states up to 6.7 MeV and spin up to $47/2^-$ have been observed. This band presents an upbend at rotational frequency of $\hbar\omega$=0.38 MeV due to the alignment of $h_{11/2}$ protons. We have found other two sequences of γ-rays, not connected to the yrast band. The results are compared with the odd-isotones and are interpreted in terms of the cranking model.

[1] D. Bazzacco, in Proc. Inter. Conf. on Nuclear Structure at High Angular Momentum, Ottawa (1992) Report No. AECL 10613, Vol. 2, p. 376.
[2] F.R. Espinoza-Quiñones *et al.*, *Phys. Rev.* **C 60** (1999) 054304