REZULTATE

Etapa 1

- efectuarea la IDS/ISOLDE/CERN a experimentului de spectroscopie gamma in dezintegrarea beta a ^{34}Mg si ulterior a dezintegrarii beta a ^{34}Al ;
- analiza preliminara realizata, cu obtinerea urmatoarelor rezultate:
  - corectarea timpului de viata al 34Mg;
  - peste 20 de noi tranzitii gamma observate in schema de nivele (complet noua) a ^{34}Al;
  - cateva noi tranzitii gamma apartinant 34Si (in dezintergrarea beta a 34Al);
- dezvoltare de instrumetatie:
  - proiectarea si utilizarea in experiment a unui prototip de detector veto (scintilator plastic) pentru electronii beta plasat in fata detectorilor de GeHP. Rezultatele obtinute confirma o scadere importanta a fondului in spectrele gamma la energii mari, fond datorat radiatiei de franare a electronilor beta in carcasa si cristalele detectorilor gamma;
  - proiectarea/utilizarea unui nou plastic scintilator (in centrul setup-ului) trigger beta cu o eficacitate totala de ~90%, prag de detectie practic zero prin utilizarea a doi fotomultiplicatori si digitizarea semnalelor cu digitizor rapid (1GHz).

Etapa 2

- efectuarea la ISOLTRAP/CERN a experimentului de masurare a maselor starilor 1+ si 4– din ^{34}Al, in vederea stabilirii ordinii celor doua stari in acest nucleu. Concluziile si rezultatele preliminare ale acestui experiment:
  - masa ^{34}Al in starea 4– a fost determinata cu ajutorul trapei Penning de precizie;
  - masele izotopilor $^{33, 34}$Mg au fost determinate utilizand trapa Penning de precizie;
  - masele izotopilor $^{33, 34}$Al au fost determinate cu ajutorul trapei Penning de precizie, in urma dezintegrarii beta in trapa inferioara a $^{33, 34}$Mg. In faza de analiza online nu a putut fi observata o diferenta intre masele celor doua stari 1+ si 4– ale ^{34}Al. O analiza detaliata offline ar putea clarifica acest ultim aspect in urma estimarii gradului de contaminare cu ^{34}Al(4-) in fascicolul radioactiv de ^{34}Mg.
  - masa ^{34}Si - nucleu nepoata al ^{34}Mg – a fost obtinuta utilizand trapa Penning de precizie in urma dezintegrarii succesive ^{34}Mg$\rightarrow$^{34}Al(1+)$\rightarrow$^{34}Si;
  - prezentul experiment a condus si la imbunatatirea unui record la ISOLTRAP – cel mai scurt timp de viata pentru care s-a realizat dezintegrarea in trapa si masurarea nucleului fiica in trapa superioara: ^{34}Mg$\rightarrow$^{34}Al(1+).
- analiza detaliata a datelor experimentale obtinute in urma experimentului de spectroscopie gamma in dezintegrarea beta a ^{34}Mg si ^{34}Al efectuat in etapa 1, cu obtinerea schemei de nivele a 34Al (intensitati absolute gamma, factori de ramificare, intensitati de beta feeding). In afara rezultatelor deja obtinute in analiza preliminara, cel mai important rezultat a fost stabilirea ordinii si distantei dintre starile 1+ si 4– din ^{34}Al in urma analizei detaliate a coincidentelor beta-gamma-gamma. Cele doua stari sunt separate de 46.6 keV, cu 4– starea fundamentala si 1+ starea izomera.

RESULTS

Stage 1

- the gamma spectroscopy experiment in the beta-decay of ^{34}Mg and subsequently the decay of ^{34}Al was performed at IDS/ISOLDE/CERN;
- the preliminary data analysis was performed, revealing the following results:
    - an important correction of the ^{34}Mg lifetime;
    - more than 20 new gamma transitions observed in the completely new level scheme of ^{34}Al;
    - several new gamma transitions for ^{34}Si (observed in the beta-decay of ^{34}Al);
- instrumentation development:
    - the design, construction and employment in the performed experiment of a veto detector prototype (plastic scintillator) for the beta electrons, to be placed in front of the GeHP detectors. The preliminary results showed an important background reduction in the gamma spectra especially in the high-energy part, the background in this region being mainly due to the bremsstrahlung radiation of electrons interacting in the Ge detector casing and crystals;
    - the design and use in the experiment of a new plastic scintillator (in the center of the detection setup) used as beta trigger with a total efficiency of ~90%, and virtually a zero detection threshold ensured by the use of two photomultipliers in coincidence and a fast digitizer (1GHz) to record their traces.

Stage 2

- the mass measurement experiment was performed at ISOLTRAP/CERN for the 1+ and 4– states in 34Al, in order to establish the sequence of these two states in the level scheme. The preliminary results and conclusions of this second experiment are:
    - the mass of ^{34}Al in the 4– state was measured with the precision Penning trap;
    - the masses of $^{33, 34}$Al were measured using the precision Penning trap, following the beta decay of 33, 34Mg in the lower trap of ISOLTRAP. In the online data analysis, a difference between the masses of the 1+ and 4– states could not be observed. A more detailed offline analysis could clarify this last point after an estimation of the contamination percentage with ^{34}Al(4-) in the incoming radioactive beam of ^{34}Mg;
    - the mass of 34Si – granddaughter nucleus of 34Mg – was measured using the precision upper trap following the subsequent decay $^{34}\text{Mg}\rightarrow{}^{34}\text{Al}(1+)\rightarrow{}^{34}\text{Si}$ – an ISOLTRAP record in this lifetime region;
    - the same experiment led to a second record for ISOLTRAP – the shortest lifetime for which the mass of the daughter nucleus was measured in the upper trap following the decay of the parent nucleus in the lower trap: $^{34}\text{Mg}\rightarrow{}^{34}\text{Al}(1+)$.
- the detailed analysis was performed for the experimental data of the gamma spectroscopy experiment (beta decay $^{34}\text{Mg}\rightarrow{}^{34}\text{Al}(1+)\rightarrow{}^{34}\text{Si}$) performed during the first stage of the project, leading to a detailed level scheme of ^{34}Al (gamma absolute intensities, branching ratios, beta feeding intensities). Besides the results that were partially obtained during the preliminary analysis, the most important result of the detailed one was the finding of the ordering and energy distance between the 1+ and 4– states of ^{34}Al. The detailed analysis of the beta-gamma-gamma coincidences revealed a separation energy of only 46.6 keV with 4- being the ground state and 1+ the isomer.