Decay Studies at Holifield

E. F. Zganjar
Department of Physics, Louisiana State University, Baton Rouge, LA 70803

Most radioactive decay studies at Holifield prior to 1992 involved the isotope separator operated by the University Isotope Separator at Oak Ridge consortium (UNISOR). This separator was originally coupled to the Oak Ridge Isochronous Cyclotron (ORIC). It began on-line experiments in 1972 and was the first accelerator-based ISOL system in the U.S.

The paper will be presented in two parts: Decay spectroscopy prior to 1992 at Holifield as HHIRF (Holifield Heavy Ion Research Facility), and decay spectroscopy after 1992 at Holifield as HRIBF (Holifield Radioactive Ion Beam Facility). Concomitant with Holifield making the transition to a radioactive ion beam facility, the UNISOR collaboration made a transition from the isotope separator, with its half-life limitations, to an on-line recoil mass spectrometer (RMS), and renamed itself UNIRIB (University Radioactive Ion Beam consortium).

The early period was an exciting time where new ideas, new experimental techniques, and a new way of organizing university researchers at a national laboratory were developed. The first clear evidence of shape coexisting structures in heavy nuclei came from studies on $^{184\text{-}188}$Hg at UNISOR [1,2] where weakly deformed oblate and strongly deformed prolate shapes coexist at low energies. Early UNISOR work set the stage for the establishment of ideas involving the relationship between intruder states and shape coexistence [3,4]. The use of E0 transitions as fingerprints to identify the intruding shape coexisting structures was established [5,6], and detailed gamma and conversion-electron spectroscopy on neutron deficient Pt (e.g. [7,8]) and Au (e.g. [9,10]) isotopes established the relationship between shape coexistence and particle-core coupling in this mass region. A laser spectroscopy system added to the UNISOR separator in 1981 enabled one to directly probe nuclear deformations using atomic hyperfine interactions [11]. An on-line nuclear orientation facility based upon a ^{3}He/^{4}He dilution refrigerator, added in 1988, enabled one to orient nuclei for angular distribution and moment measurements [7].

In the current period, decay studies are conducted mainly at the focal plane of the HRIBF RMS by a spectrum of national and international researchers. Decay spectroscopy on the N~Z nuclei ^{66}As, ^{70}Br, ^{80}Y, and ^{80}Zr, which lie near the proton drip line, have yielded important results on the physics of the parent and daughter isotopes, on isomeric states, and on nucleosynthesis. For example, the measurement of the ^{80}Zr half-life is particularly significant since it is a waiting-point nucleus along the astrophysical *r-p* path [12]. One of the earliest results during this period was the discovery of proton radioactivity in ^{145}Tm [13]. This research, beyond the proton drip line, has thus far lead to the discovery of 5 new proton emitters and three cases of fine structure in the decay process [14].

These topics as well as the never-ending quest to improve spectroscopic instruments and spectroscopic techniques will be discussed.

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