

## REPORT ON A VISIT TO JAEA (TOKAI) AND RIKEN 12/15/08 to 1/16/09

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I visited Tokai Dec 14–18. I gave three seminars there: "FISSION AT THE END OF THE NUCLEAR CHART (1): Fission of normal and muonic atoms", "FISSION AT THE END OF THE NUCLEAR CHART (2): Calculated Fission Properties of  $^{180}\text{Hg}$  following EC capture on  $^{180}\text{Tl}$ ", and "FISSION AT THE END OF THE NUCLEAR CHART (3): The fission barrier and associated level densities from a new level density model." In Tokai I had extensive discussions with Nishio and Andrei Andreyev (who was visiting from Leuven) about their experiments on EC- and  $\beta$ -delayed fission. In particular I explained our theoretical work on fission potential-energy surfaces. I made a schematic model in clay of some features of the five-dimensional surfaces and this helped our discussion enormously. Stimulated by our theoretical collaboration there is a proposal submitted to study the compound system  $^{180}\text{Hg}$  formed both in symmetric and asymmetric heavy-ion collisions as a function of compound system excitation energy. I also discussed with H. Iimura his studies of charge radii. I had recently provided him with a data file of a new calculation of ground state nuclear shapes that determines the shapes more accurately than in our FRDM (1992) mass calculation. We now investigate a full four-dimensional deformation space with a denser grid spacing (0.01 versus 0.05 earlier). We have already found this leads to more accurate nuclear ground-state masses. He provided me with a preprint of his studies.

My longest stay was at Riken (one month) where I gave a seminar "Fission At The End Of The Nuclear Chart" which was followed by a seminar by Andreyev on his EC-delayed fission studies. We finalized, together with the Lund collaborators, a paper on level densities based on folded-Yukawa single-particle levels. It is posted on It can be found at <http://arxiv.org/abs/0901.1087>. The superheavy element group at Riken is currently conducting an experiment  $^{23}\text{Na} + ^{248}\text{Cm} \rightarrow ^{266}\text{Bh} + 5n$ . This is in the  $\alpha$ -decay chain from  $^{278}113$  and observation of this isotope and its decay would be valuable in interpreting the 113 results. We made theoretical estimates of the  $\alpha$  and fission decay rates for the isotope  $^{266}\text{Bh}$  and found  $\alpha$  to be dominating.

We finished the revision of the fission paper we had submitted to PRC, addressing the concerns of the referee. In addition we expanded on the discussion of EC-delayed fission and also plotted the calculated fission barrier heights in terms of a color plot in terms of neutron number  $N$  and proton number  $Z$ . I also discussed and investigated with Takatoshi Ichikawa issues related to our computer codes for fission studies and interesting issues to address in future work.

We wrote a paper for Physical Review on shape coexistence in nuclei. This paper is based on calculated potential-energy surfaces in a three-dimensional deformation space ( $\epsilon_2$ ,  $\epsilon_4$ , and  $\gamma$ ) for more than 7000 nuclei. In this work we collaborated extensively with H. Sagawa who visited Riken several times during my stay to work on this paper. We find our results in excellent agreement with known data in the Kr and Pb regions. In addition we show interesting shape coexistence in the light actinide region "northeast" of  $^{208}\text{Pb}$ . We summarize our results in terms of a contour diagram versus  $N$  and  $Z$  showing the number of minima we calculate for each  $Z$  and  $N$ , counting only minima deeper than 0.2 MeV and below 2.0 MeV excitation energy.

During my stay I met several other visitors to RIKEN, including my collaborator A. Iwamoto. I was delighted to learn about the progress with experiments at RIBF.

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