3 - 15 Storage Lifetime Measurements of the Highly Charged Ions in the CSRe*

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Exotic decay modes of highly charged radioactive ions[1] is one of the research subjects at the experimental Storage Ring CSRe in Lanzhou. In order to measure the nuclear decay half-life of the radioactive ions, the storage ring should have a high preservation ability for ions, *i.e.* long enough storage lifetime of the highly charge ions. In the past few years, we have installed a new data acquisition system for the CSRe Schottky detector and measured the storage lifetimes of fully stripped ions in the CSRe under different conditions[2]. The storage lifetimes of several ions were measured in successive experiments over the years.

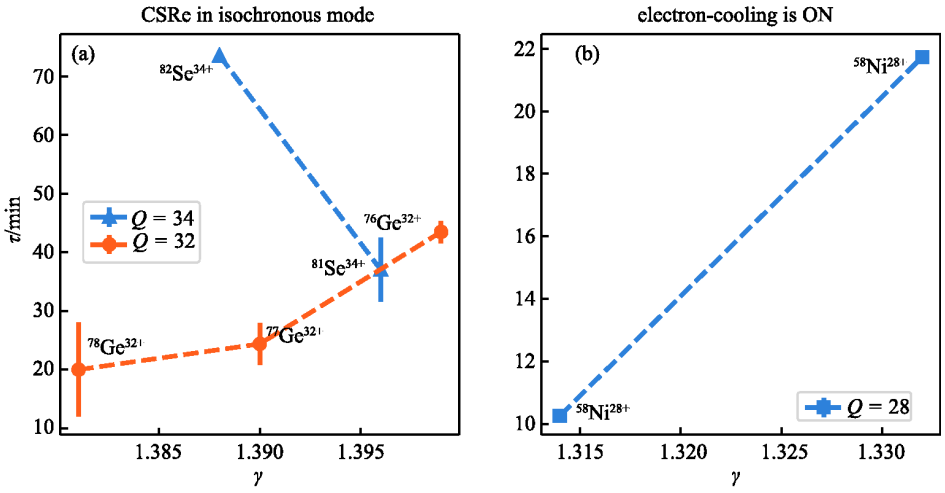

Fig. 1 (color online) The $1/e$ storage lifetime τ in the laboratory coordinates as a function of ion velocity (represented by Lorentzian factor γ) for fully stripped ions under different conditions: (a) The ^{86}Kr projectile fragments are stored in CSRe under isochronous mode: full circles are for ($^{81}Se^{34+}$, $^{82}Se^{34+}$) and triangles are for ($^{76}Ge^{32+}$, $^{77}Ge^{32+}$, $^{78}Ge^{32+}$), (b) The $^{58}Ni^{28+}$ ions under two γ settings in the year 2018 beam cooling test.

In December 2018, the $1/e$ storage lifetime τ for the ^{86}Kr projectile fragments were measured. The experiment was done in the CSRe operated in isochronous mode. The results of the five ion species are shown on the left-hand side of Fig. 1. Among these ion species, only ^{82}Se and ^{76}Ge are stable ions. The storage lifetime of the radioactive ions are deduced from measured storage time and the well-known nuclear decay rate. It turned out that the storage lifetime is far shorter than experiments done in 2014 wherein the $1/e$ storage life time were 9.0(26) hours for $^{54}Fe^{26+}$ and 7.2(19) h for $^{50}Cr^{24+}$[3]. Beside that, the trend of τ as a function of ion velocity for selenium isotopes differs very much from the excepted trend. While, the germanium isotopes follow the excepted trend as the storage lifetime increases with increasing velocity. To verify this expected trend, considering the strong control of the ion velocity by electron cooling, we measured the he electron-cooled $^{58}Ni^{28+}$ ions in the CSRe. The result are shown on the right-hand side of Fig. 1 and it is clear that τ increases as velocity increases. Therefore the trend measured for selenium isotopes in the Fig. 1(a) can not be understood right now.

References

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