

# PROTOTYPE NEGATIVE ION SOURCES FOR RADIOACTIVE ION BEAM GENERATION<sup>1</sup>

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Radioactive ion beams (RIBs) of  $^{17}\text{F}$  and  $^{18}\text{F}$  are of interest for investigation of astrophysical phenomena such as the “hot” CNO cycle and the rp stellar nuclear synthesis processes. In order to generate useful beam intensities of atomic  $\text{F}^-$ , the species must be efficiently and expediently released from the target material, thermally dissociated from fluoride release products during transport to the ionization chamber of the ion source, and efficiently ionized in the source upon arrival. We have conceived and evaluated two proto-type negative ion sources for potential use for RIB generation: (1) a direct extraction source and (2) a kinetic ejection source. Both sources utilize Cs vapor to enhance  $\text{F}^-$  formation. The mechanical design features, operational parameters, ionization efficiencies for forming atomic  $\text{F}^-$  and delay times for transport of F and fluoride compounds for the respective sources are presented. The efficiency  $\eta$  for formation and extraction of  $\text{F}^-$  for the direct extraction negative ion source is found to be  $\eta \sim 1.0\%$  while the characteristic delay time  $\tau$  for transport of F and fluorides through the source is typically,  $\eta \sim 120\text{s}$ ; the analogous efficiencies and delay times for the kinetic ejection negative ion source are, respectively:  $\eta = \sim 3.2\%$  and  $\tau = \sim 70\text{s}$ .

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