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Caesium Balance of the ISIS H^- Penning Ion Source in Long Pulse Operation

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We have developed a semi-empirical model predicting the equilibrium caesium coverage (in monolayers) and the resulting work function of the ISIS Penning ion source cathode (in eV) in long pulse operation. We use the caesium balance model to predict the temporal structure of the extracted H^- beam current pulses and compare the model predictions to experimental data with 60 mA, 2 ms beam pulses at 50 Hz. The experimentally observed droop of the beam current is reproduced by the model. The results imply that extracting square beam pulses in the long pulse operation mode requires more efficient cathode cooling. We apply the model for 70 mA, 3 ms beam pulses at 14 Hz, relevant for ESSνSB project. We conclude that achieving these parameters requires reducing the cathode temperature by 200 °C, and ramping the discharge current to cancel the discharge voltage droop.

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