Beam Physics Note
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RPM Noise Record

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Abstract: Persistent noise features on the ISAC rotary position monitor (RPM) transverse beam intensity profiles are recorded and investigated. Results of a device inspection after venting HEBT diagnostic box-0 are recorded.

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1 Vented HEBT Diagnostic Box-0

- HEBT-DB0 was vented on 2024-01-05 and opened for access.
- The RPM noise profile shown in Figure 1 was captured at atmosphere.
- The amplitude of the noise feature decreased by a factor of ∼40 after venting. The overall shape remained essentially unchanged.
- The in/out positioning of HEBT:FC0 did not affect HEBT:RPM0 readback.
- On Figure 1, the top-left, higher-frequency noise was found to correlate with the position of the RPM's BNC 90° connector, shown in Figure 2.
- A field of roughly 4-5 G was found near the solenoid valve, at the rough location of the BNC right-angle.

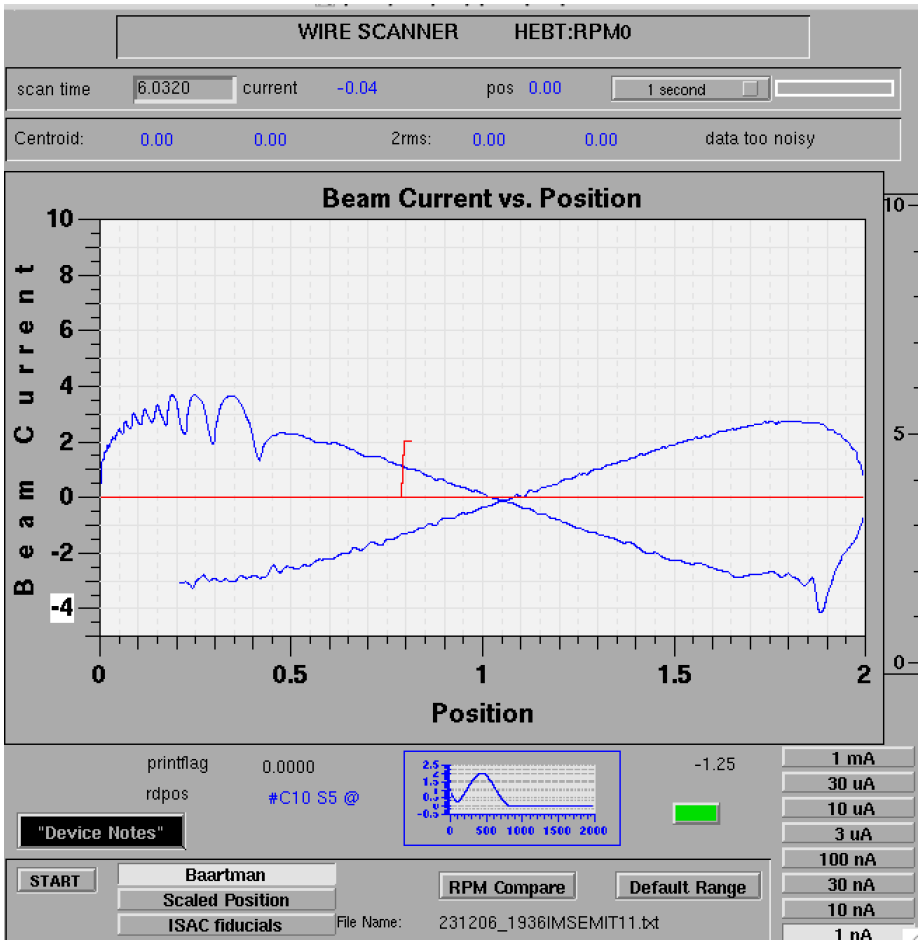

Figure 1: HEBT:RPM0 noise profile, scanned at atmosphere with HEBT diagnostic box-0 open.

- Roughly 30 G magnetic field was induced within the diagnostic box by magnetic steerer HEBT:X/YCB0. This had no effect on the RPM trace.
- Introduction of a metal object (screwdriver) near the RPM during scanning introduced high frequency noise on top of Figure 1's profile, but otherwise did not change its overall shape.
- A grounded screwdriver was used to gently scrape the surface of the RPM's insulated base (Fig. 3). **This was found to significantly alter the RPM's readback noise profile.**
- Figure 3 shows the resting position of the RPM, which is tilted to avoid beam trajectory interference. This rendered only one half of the RPM accessible for contact with grounded metal. Only the accessible face was contacted for this report.
- Figure 4 shows the effect of two separate contacts between grounded screwdriver and RPM. Observe the asymmetrization of the noise profile, which increases in amplitude on the right hand side. The zero-crossing also shifts toward the left.

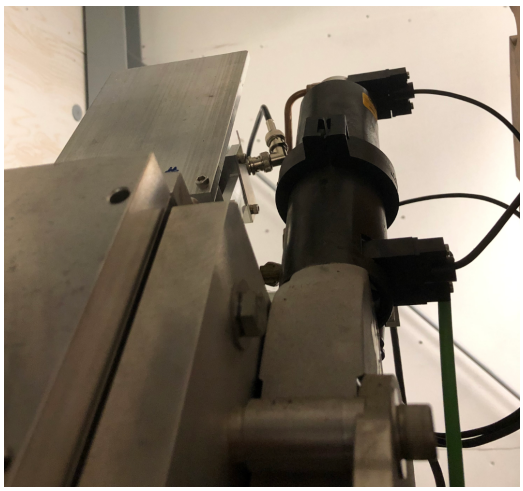

Figure 2: HEBT:RPM0's readback signal is connected to a BNC cable, including a right angle adapter, to avoid cable collision with HEBT isolation valve-0 (HEBT:IV0)'s solenoid valve, which is the black cylindrical object on the top right hand side of the image.

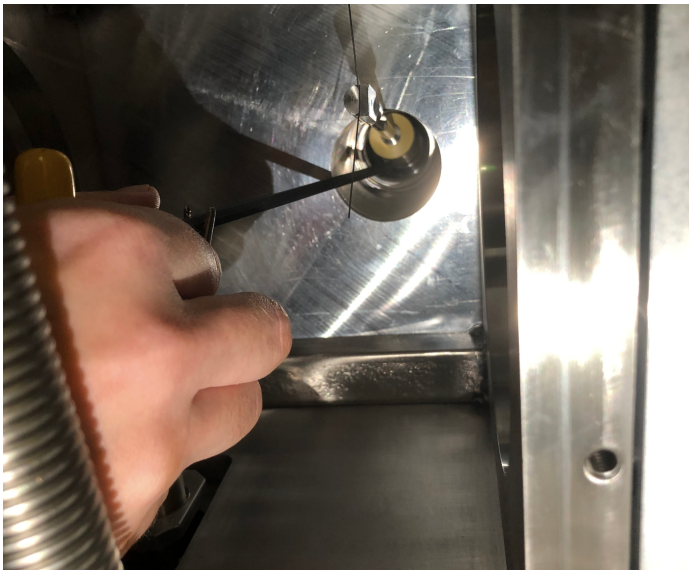

Figure 3: A grounded screwdriver is used to gently scrape the surface of the RPM's insulated base. This was found to alter the RPM's readback noise profile.

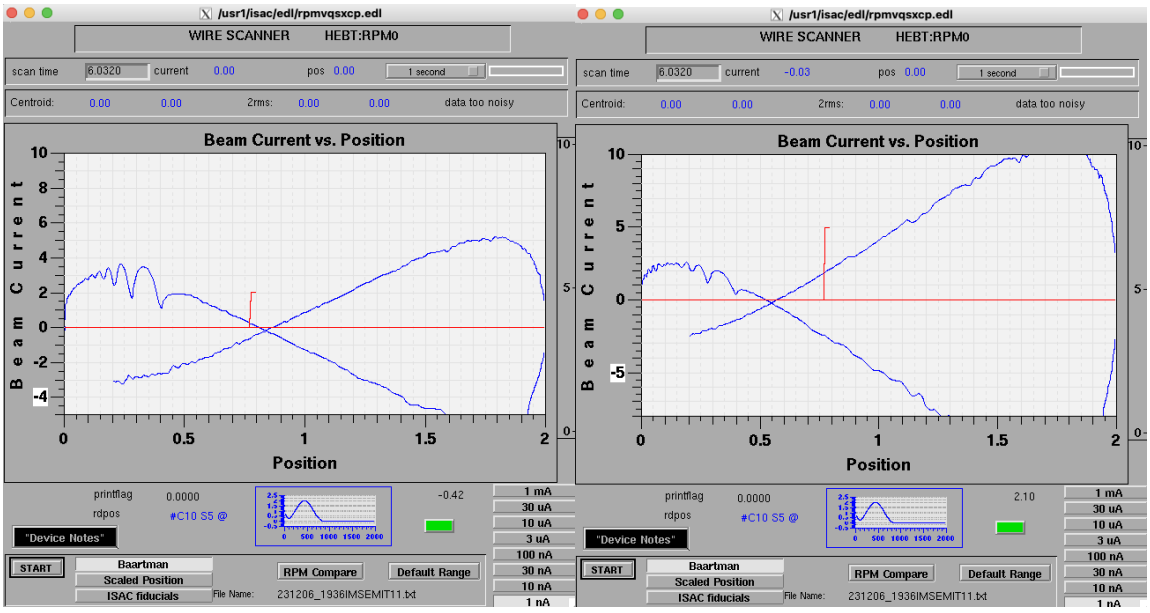

Figure 4: **Left:** HEBT:RPM0 noise profile after a roughly 1 second contact between screwdriver and RPM. **Right:** RPM profile after another $\sim$1 second contact.

2 HEBT:RPM0 Investigation

- On 2024-01-11, HEBT-DB0 was vented and opened again.
- Compressed CO_2 from a cannister was sprayed onto the exposed RPM's base, this was found to reduce the noise feature by a factor of roughly two, shown in Figure 5.

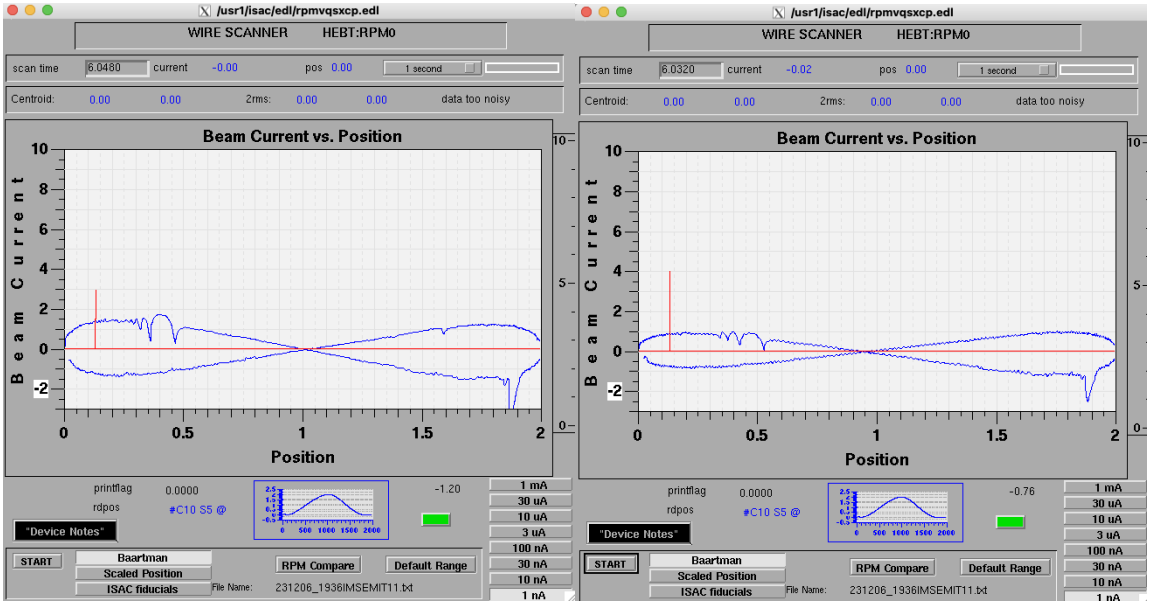

Figure 5: **Left:** An initial application of compressed CO_2 was carried out on the RPM's base, reducing the noise from that shown in Figure 1. **Right:** After several applications of CO_2, a minimum amplitude in the noise profile was reached, beyond which more compressed gas had no effect.

2.1 Sweep Speed

- A potentiometer was installed on the RPM, allowing for variation of its sweep speed.
- It was found that the persistent noise pattern's amplitude correlated strongly with the sweep speed. Slower sweeps produced less noise; faster sweeps caused larger noise.

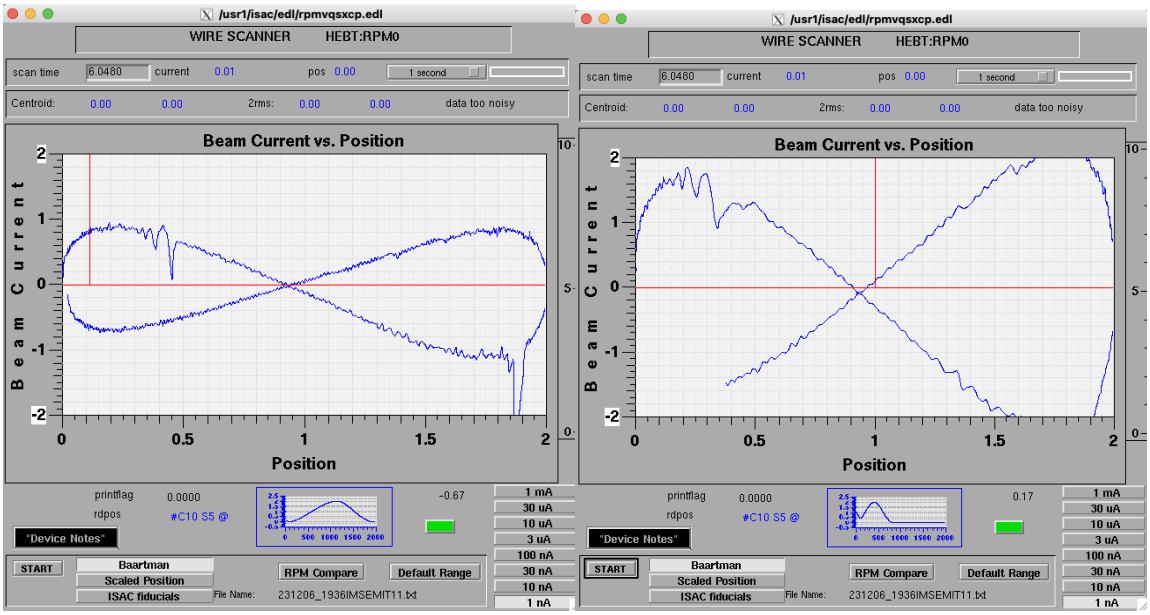

Figure 6: **Left:** RPM0's sweep was run at relatively normal speed, producing the shown noise patter. **Right:** The RPM's speed was increased, producing a larger noise amplitude. In both images, the position vs time array is shown at the bottom of the plots. For the left plot, the relatively slow sweep fills the position plot, while for the right plot the scan is completed after about one third of the position array.

3 Conclusion

This report records a physical inspection performed on HEBT:RPM0, following a persistent background noise offset observed during beam delivery. It was found that proximity to the solenoid valve may cause high-frequency noise ripples on the RPM trace. The principle noise feature can be influenced by contacting the base of the RPM with a grounded metal object. While this report comes to no conclusion as to the definite cause, the evidence suggests the issue may be electrostatic in nature.