# Test of bad magnetization

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After RHIC regime was checked, the ratio of $\rho_{max}/r_L$ was decreased in an attempt to observe different dependence of the friction force on ion velocities and electron temperature.

$\rho_{max}/r_L=1.3$

Still no "bad magnetization" was observed.

This is because typical cooling Logs (like D-S-M) were used

in scaling: $Log[\rho_{max}/r_L]$ -> which do not provide a clear transition to a new regime.

$$\ln\left(\frac{\rho_{\max}}{r_L}\right)$$

$\rho_{max}=r_L$

**What to we learn from this?**

# VP formula


**V. Parkhomchuck (VP) - empiric**

$$\mathbf{F} = -\frac{1}{\pi}\omega_{pe}^2 \frac{(Ze)^2}{4\pi\varepsilon_0} \ln\left(\frac{\rho_{\max}+\rho_{\min}+r_L}{\rho_{\min}+r_L}\right) \frac{\mathbf{V}_{ion}}{\left(V_{ion}^2+V_{eff}^2\right)^{3/2}}$$

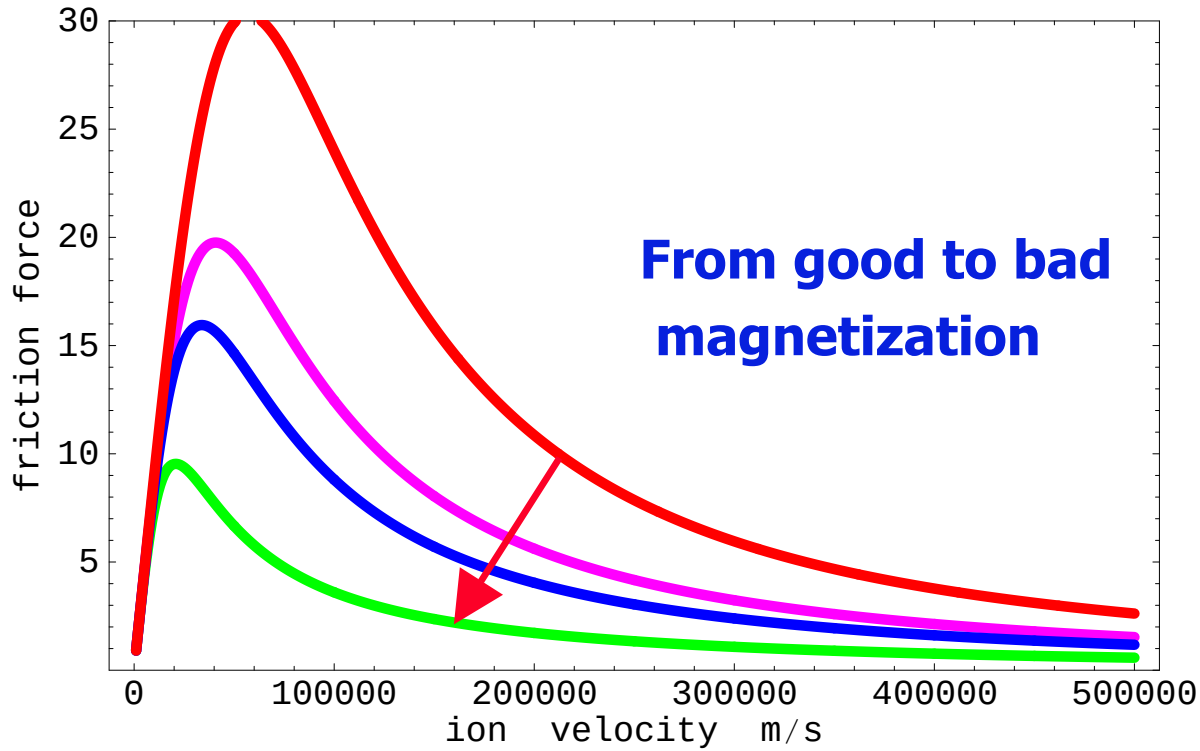
such Log can provide simple transition to a new regime


$$L_{vp} = \ln\left(\frac{\rho_{\max} + \rho_{\min} + r_L}{\rho_{\min} + r_L}\right) \xrightarrow{\rho_{min} << r_L} L_{vp} = \ln\left(\frac{\rho_{\max}}{r_L} + 1\right) = \frac{\rho_{\max}}{r_L}$$ for $\rho_{max} < r_L$

$$\mathbf{F} = -\frac{1}{\pi}\omega_{pe}^2 \frac{(Ze)^2}{4\pi\varepsilon_0}\frac{1}{\left(V_{ion}^2\right)}(V\tau eB/m\Delta_{et}) \qquad \mathbf{F} -> \frac{1}{V_{ion}\Delta_{et}}$$

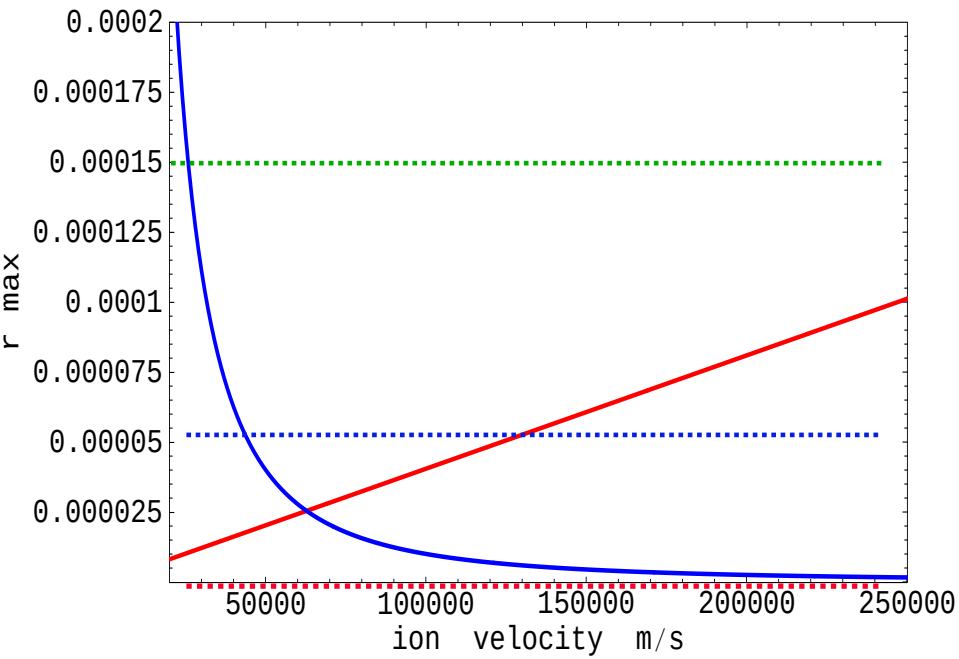
1. **one gets only 1/V instead of 1/V^2 dependence**
2. **in addition 1/Δ dependence**

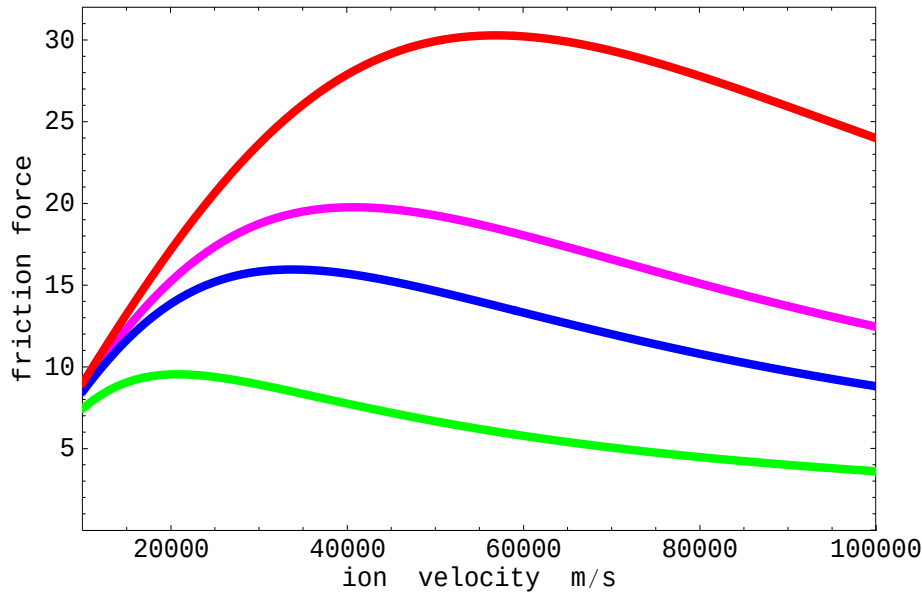
# Friction force for scaled RHIC parameters

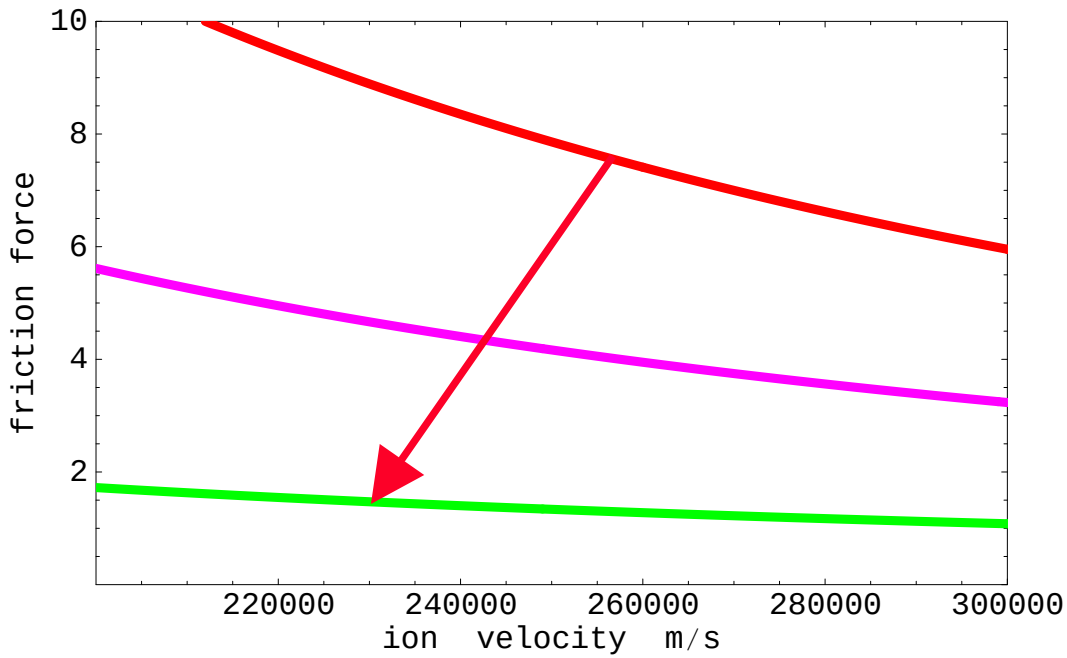
## force

## impact parameters



# force


10
8
6
4
2
friction force
220000
240000
260000
280000
300000
ion velocity m/s

# Vorpal results and comparison with VP


**V dependence**

**was studied for two electron velocities: Δ_et=4*10^6 and Δ_et=8*10^6**

**Example for Δ_et=4*10^6, B=0.1T:**

| $V_{ion}$ | $dv_{-vorpal}$ | $dv_{-vp}$ |
|---|---|---|
| 1*10^5 | -0.3 | -0.7 |
| 0.5*10^5 | -0.6 | -1.4 |
| 0.25*10^5 | -1.3 | -2.4 |

**Similar behavior for Δ_et=8*10^6**

## Δ dependence

For $V_{ion}$=0.5*10^5

| $\Delta_{et}$ | $dV_{vorpal}$ | $dV_{VP}$ |
|---|---|---|
| 2*10^6 | -2.1 | -2.5 |
| 4*10^6 | -0.6 | -1.4 |
| 8*10^6 | -0.2 | -0.8 |

Even stronger than 1/Δ dependence is observed. However, accuracy of $dV_{vorpal}$ is +/- 0.2 (only longitudinal force is compared, diffusion in transverse coefficient is bigger than the absolute value)

# Summary


- **Runs with Vorpal seem to confirm transition to "bad magnetization" with a new dependence on $V_{ion}$ and $\Delta_{et}$:**

**1. 1/V behavior**

**2. Even stronger than 1/Δ dependence – maybe still 1/Δ within the error bar which increases for small dV.**

**3. Larger disagreement with VP than for regime of "good magnetization"**