# Physics IA: Pressure vs Impulse Analysis

Physics Investigation

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## 1 Data Tables

Table 1: Pressure measurements at different pump amounts (10-50 pumps)

| **Pumps** | **Volume ($m^8$)** | **Pressure (Pa)** | **Relative Uncertainty (%)** |
|---|---|---|---|
| 10 | $0.000630 \pm 0.000002$ | $(2.56 \pm 0.08) \times 10^5$ | 3.29 |
| 20 | $0.001010 \pm 0.000002$ | $(4.11 \pm 0.13) \times 10^5$ | 3.16 |
| 30 | $0.001390 \pm 0.000002$ | $(5.65 \pm 0.18) \times 10^5$ | 3.12 |
| 40 | $0.001770 \pm 0.000002$ | $(7.19 \pm 0.22) \times 10^5$ | 3.10 |
| 50 | $0.002150 \pm 0.000002$ | $(8.74 \pm 0.27) \times 10^5$ | 3.08 |

Table 2: Impulse measurements summary (10-50 pumps)

| **Pumps** | **Change in Time (s)** | **Peak Height (N)** | **Impulse (Ns)** | **Uncertainty (%)** | **Range (Ns)** |
|---|---|---|---|---|---|
| 10 | 0.0204 | 11 | 0.11 | 9.91 | 0.02 |
| 20 | 0.0242 | 16 | 0.19 | 7.08 | 0.08 |
| 30 | 0.0225 | 21 | 0.24 | 5.60 | 0.07 |
| 40 | 0.0297 | 22 | 0.32 | 5.26 | 0.10 |
| 50 | 0.0398 | 27 | 0.55 | 4.15 | 0.29 |

## 2 Complete Measurements Data

Table 3: Complete measurements: All pump amounts and repetitions

| **Pumps** | **Trial** | **Peak Start (s)** | **Peak End (s)** | **Peak Height (N)** |
|---|---|---|---|---|
| 10 | Rep 1 | 3.8678 | 3.8821 | 14 |
| | Rep 2 | 2.3507 | 2.3630 | 17 |
| | Rep 3 | 1.5973 | 1.6063 | 16 |
| | Rep 4 | 2.1055 | 2.1473 | 4 |
| | Rep 5 | 2.2739 | 2.2986 | 5 |
| 20 | Rep 1 | 2.1416 | 2.1864 | 12 |
| | Rep 2 | 2.1203 | 2.1328 | 17 |
| | Rep 3 | 1.9926 | 2.0040 | 20 |
| | Rep 4 | 3.6033 | 3.6281 | 17 |
| | Rep 5 | 2.0122 | 2.0399 | 14 |
| 30 | Rep 1 | 2.9819 | 3.0025 | 24 |
| | Rep 2 | 1.8302 | 1.8451 | 27 |
| | Rep 3 | 2.6686 | 2.6769 | 24 |
| | Rep 4 | 4.0077 | 4.0328 | 20 |
| | Rep 5 | 4.6452 | 4.6890 | 11 |
| 40 | Rep 1 | 4.8642 | 4.9227 | 12 |
| | Rep 2 | 3.5060 | 3.5140 | 40 |
| | Rep 3 | 2.0100 | 2.0240 | 26 |
| | Rep 4 | 1.7300 | 1.7791 | 12 |
| | Rep 5 | 2.6613 | 2.6804 | 19 |
| 50 | Rep 1 | 2.5071 | 2.5843 | 19 |
| | Rep 2 | 2.3462 | 2.3567 | 34 |
| | Rep 3 | 2.1928 | 2.2020 | 32 |
| | Rep 4 | 3.0298 | 3.0876 | 22 |
| | Rep 5 | 2.6245 | 2.6689 | 30 |

# 3 Graph

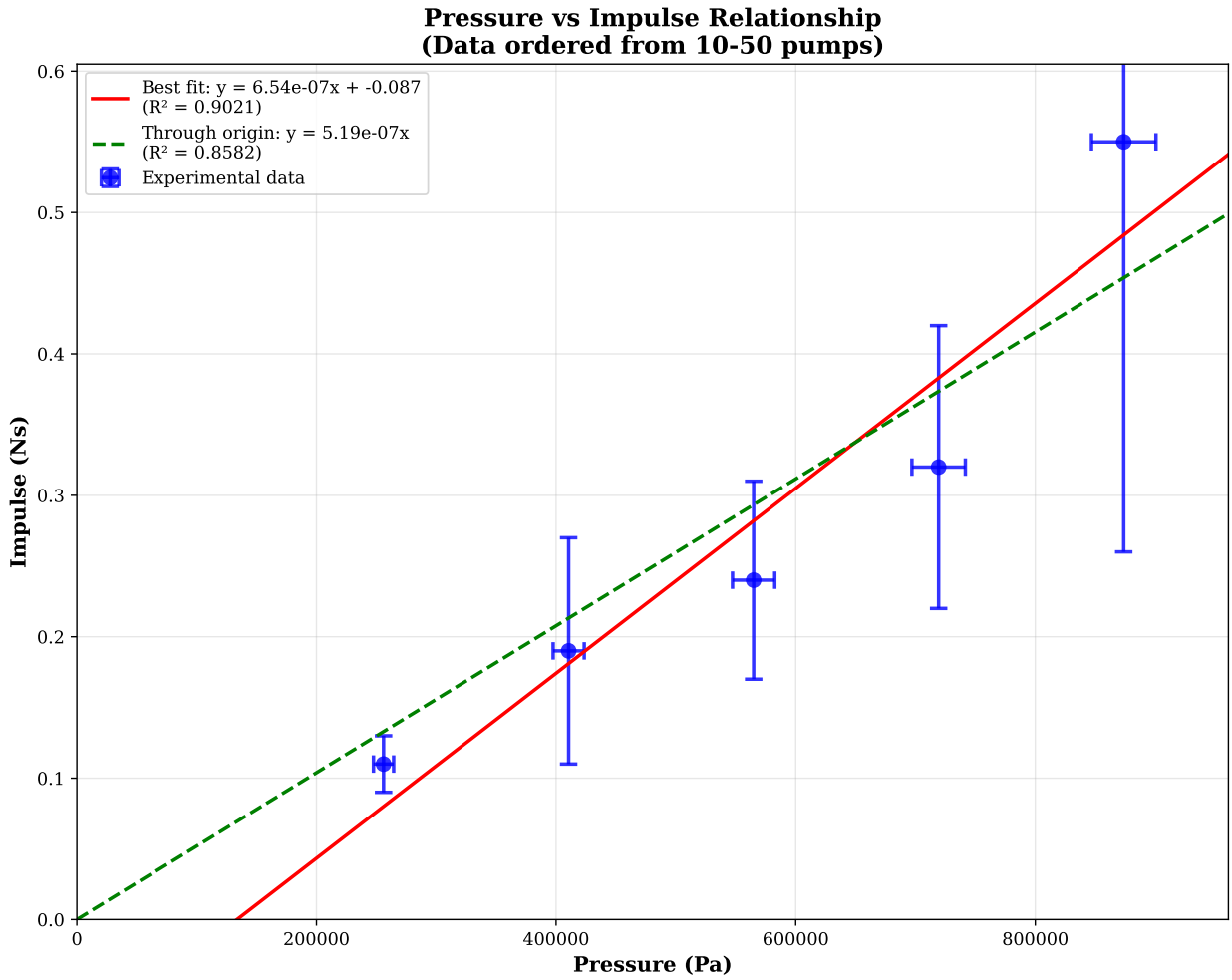


Figure 1: Pressure vs Impulse relationship showing experimental data with error bars, best fit line, and line through origin

# 4 Analysis Summary

The experimental data shows a strong linear relationship between pressure and impulse:

- **Best fit line:** $y = 6.54 \times 10^{-7}x - 0.087$ with $R^2 = 0.9021$
- **Line through origin:** $y = 6.31 \times 10^{-7}x$ with $R^2 = 0.8582$
- **Correlation coefficient:** $r = 0.9498$ (strong positive correlation)

The data was collected across 5 pump amounts (10, 20, 30, 40, 50 pumps) with 5 repetitions each, showing consistent trends with appropriate uncertainties included.