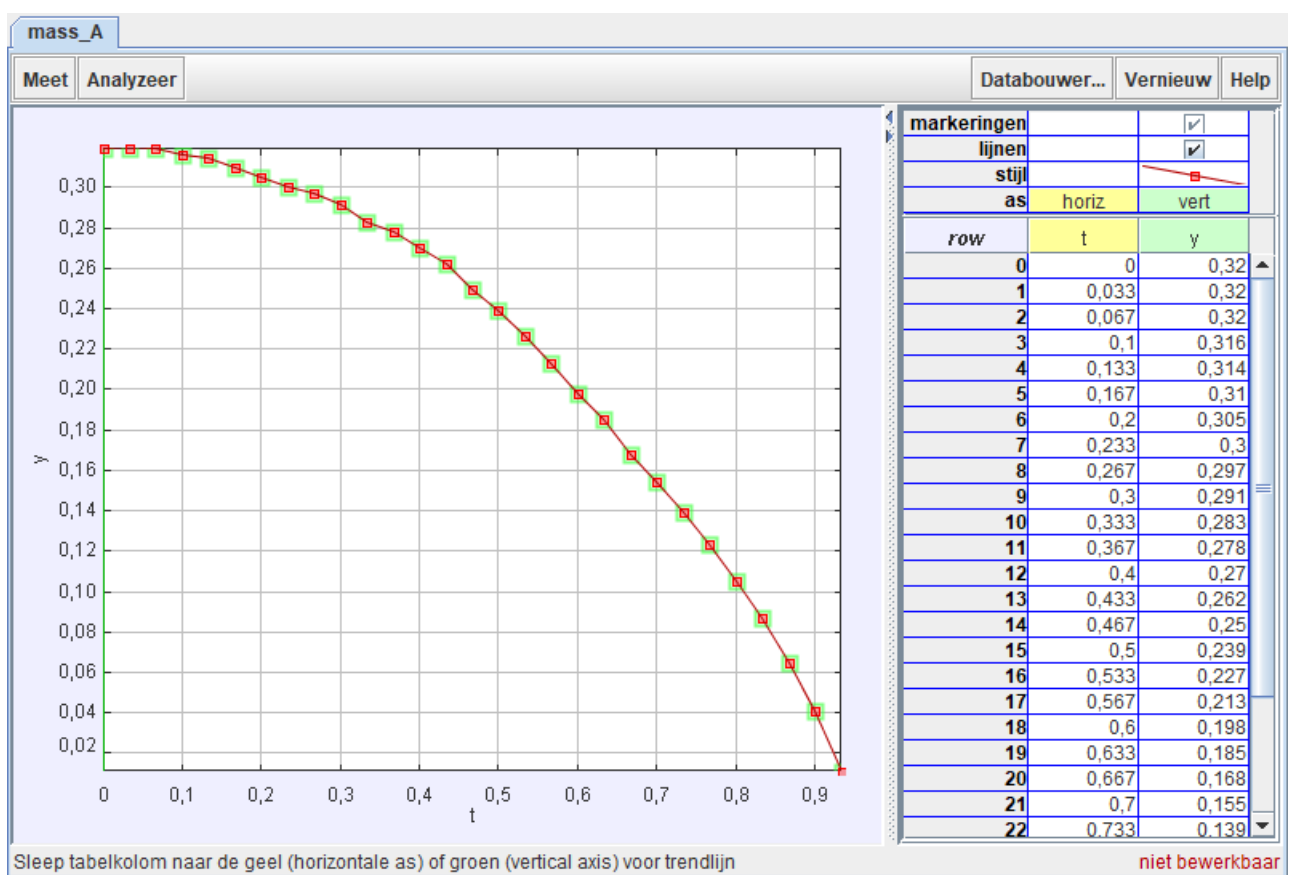




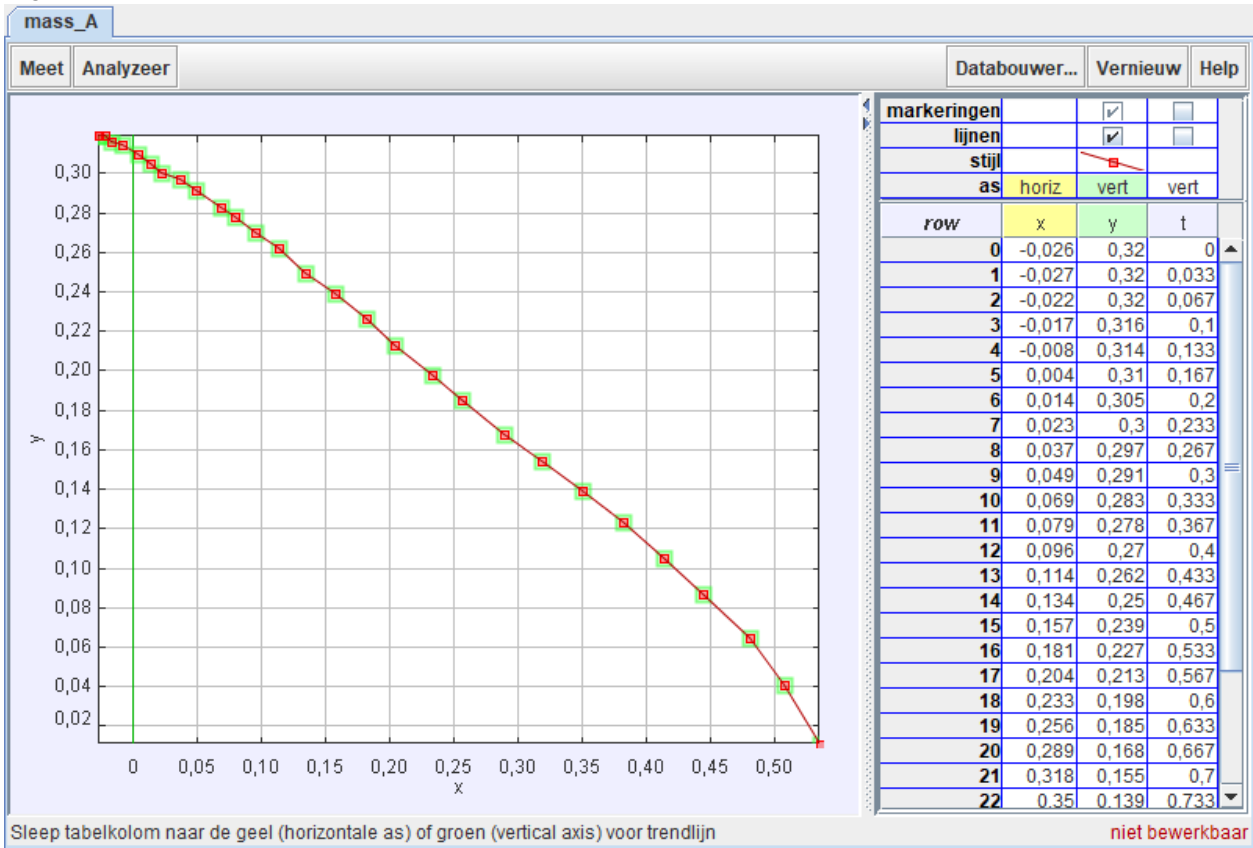
Let's go for a ride! The physics of roller-coasters

Creating a scale model and performing measurements on the model



Let's go for a ride





$$E_{\text{pot}}(\text{beginning}) = 3 \times 10^{-3} \times 9,81 \times 0,32 = 9 \times 10^{-3} \text{ J/Kg}$$

$$E_{\text{pot}}(\text{middle}) = 3 \times 10^{-3} \times 9,81 \times 0,24 = 7 \times 10^{-3} \text{ J/Kg}$$

$$E_{\text{pot}}(\text{end}) = 3 \times 10^{-3} \times 9,81 \times 0 = 0 \text{ J/Kg}$$

$$E_{\text{kin}}(\text{beginning}) = 0 \text{ J/Kg}$$

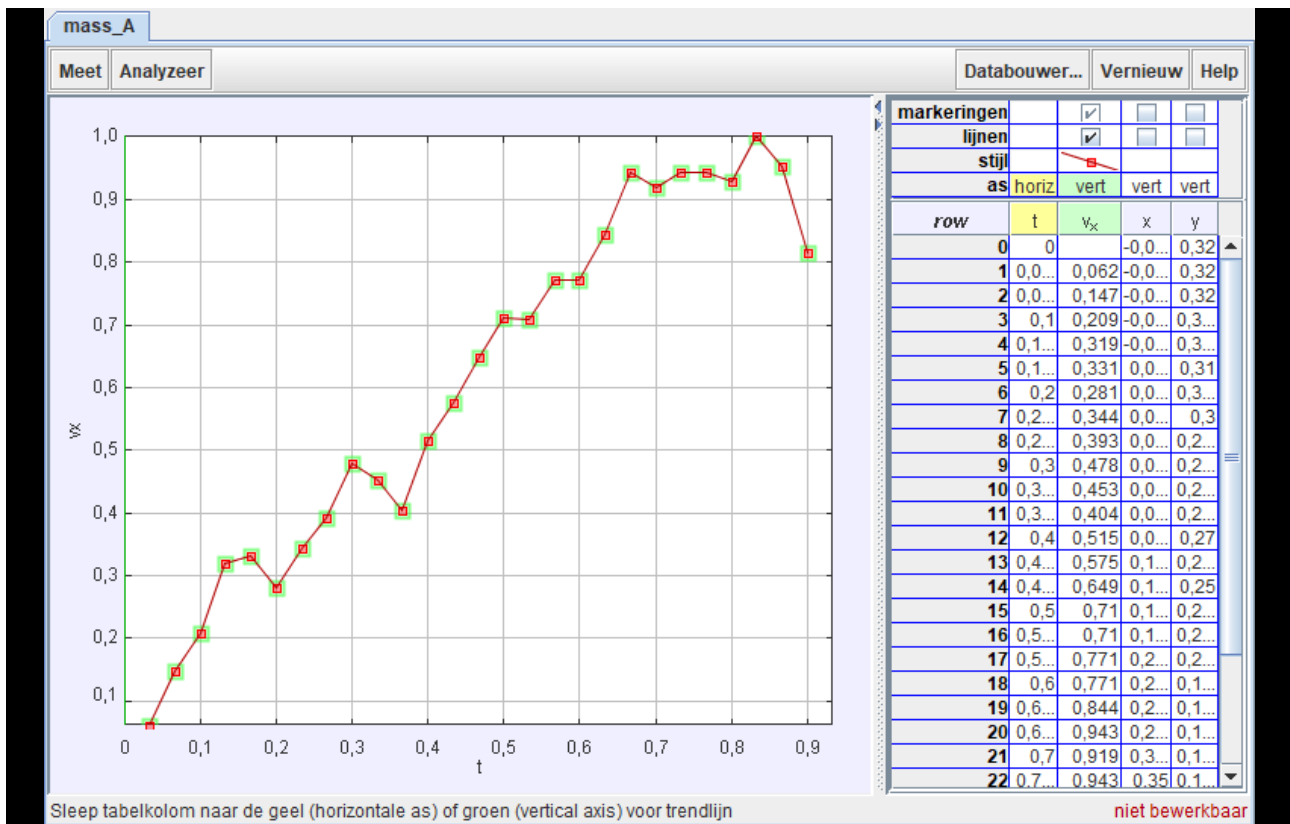
$$E_{\text{kin}}(\text{middle}) = 9,4 \times \text{J/Kg}$$

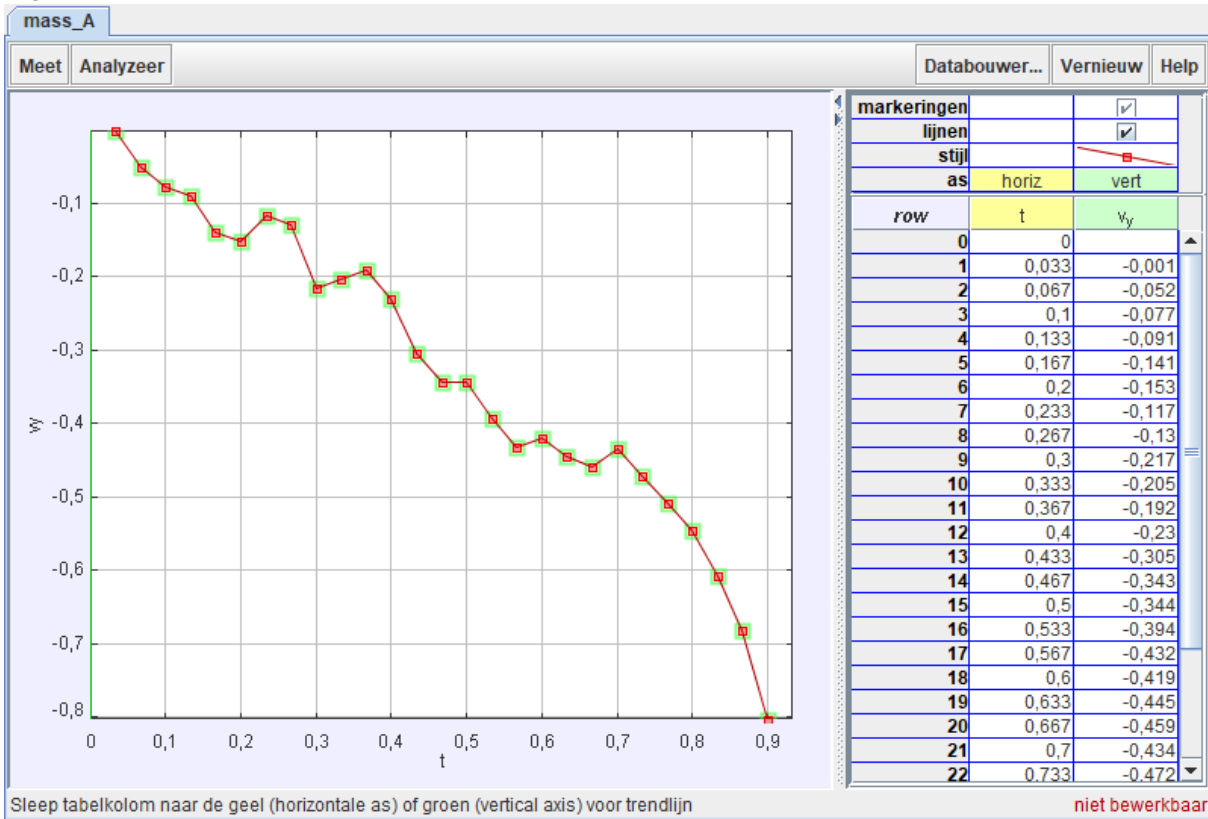
$$E_{\text{kin}}(\text{end}) = 2,2 \times \text{J/Kg}$$

$$E_{\text{mech}}(\text{beginning}) = 9 \times 10^{-3} \text{ J/Kg}$$

$$E_{\text{mech}}(\text{middle}) = 7 \times 10^{-3} \text{ J/Kg} + 9,4 \times \text{J/Kg} = 8 \times \text{J/Kg}$$

$$E_{\text{mech}}(\text{end}) = 2,2 \times \text{J/Kg}$$

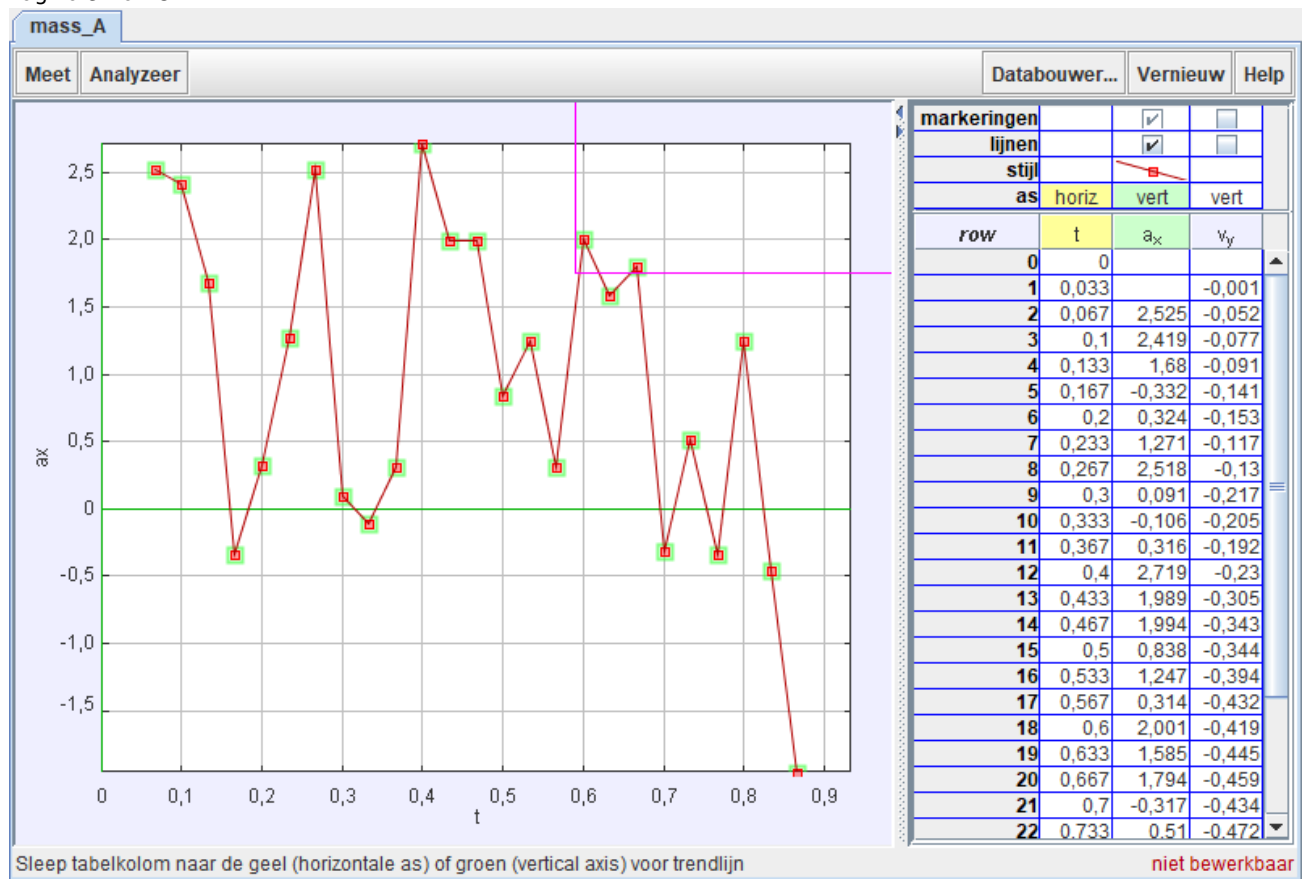




$v(\text{beginning}) = 0 \text{ m/s}$

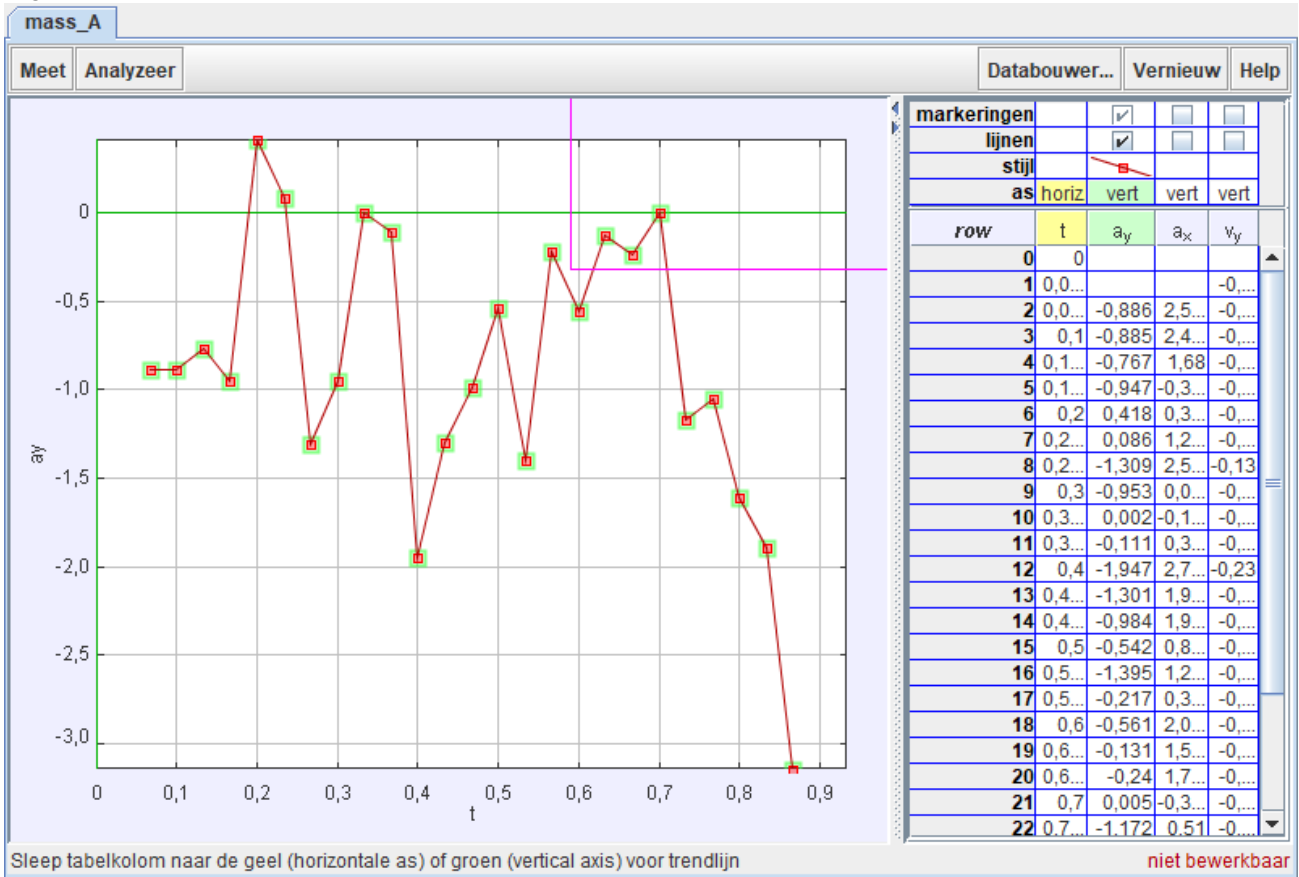
$v(\text{middle}) = 0,79 \text{ m/s}$

$v(\text{end}) = 1,2 \text{ m/s}$



Let's go for a ride





$a(\text{beginning}) = 0 \text{ m/s}^2$

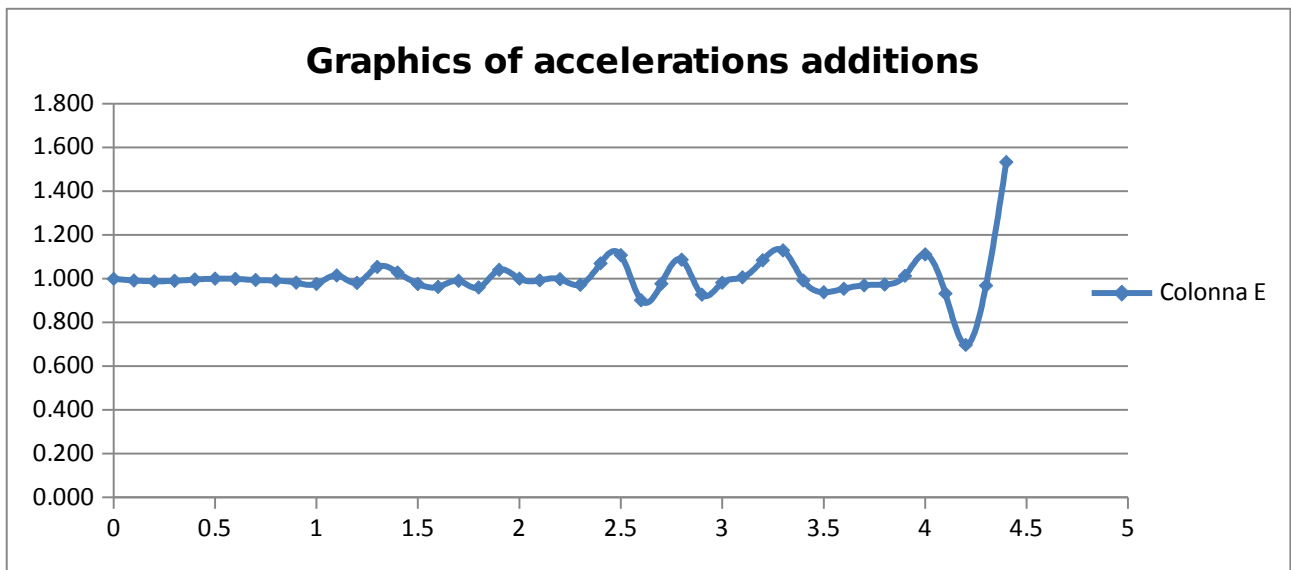
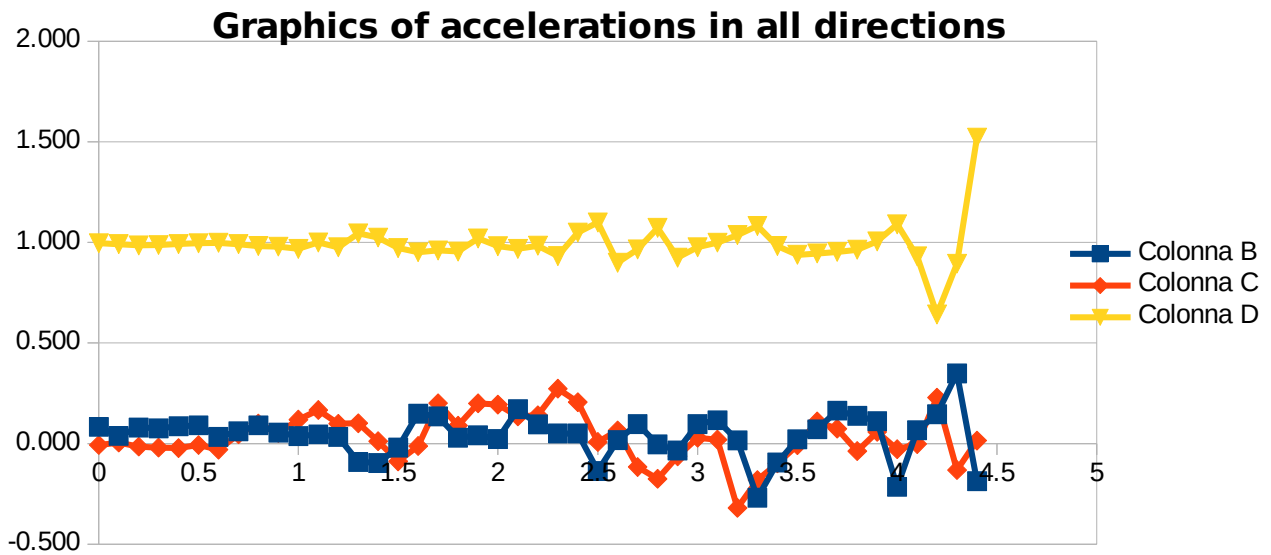
$a(\text{middle}) = 1,0 \text{ m/s}^2$

$a(\text{end}) = 2,0 \text{ m/s}^2$

ITALY SCALE MODELS

| Time | Acceleratbn(gy) | Acceleratbn(gx) | Acceleratbn(gz) | Acceleratbns additbn |
|------|-----------------|-----------------|-----------------|----------------------|
| 0 | 0.083 | -0.007 | 0.996 | 0.999 |
| 0.1 | 0.038 | 0.005 | 0.991 | 0.992 |
| 0.2 | 0.080 | -0.015 | 0.985 | 0.988 |
| 0.3 | 0.076 | -0.020 | 0.987 | 0.990 |
| 0.4 | 0.086 | -0.022 | 0.992 | 0.996 |
| 0.5 | 0.091 | -0.007 | 0.996 | 1.000 |
| 0.6 | 0.034 | -0.030 | 0.998 | 0.999 |
| 0.7 | 0.061 | 0.046 | 0.991 | 0.994 |
| 0.8 | 0.091 | 0.100 | 0.982 | 0.991 |
| 0.9 | 0.055 | 0.053 | 0.979 | 0.982 |
| 1 | 0.037 | 0.119 | 0.968 | 0.976 |
| 1.1 | 0.046 | 0.167 | 1.000 | 1.015 |
| 1.2 | 0.033 | 0.099 | 0.975 | 0.981 |
| 1.3 | -0.091 | 0.101 | 1.045 | 1.054 |
| 1.4 | -0.096 | 0.012 | 1.024 | 1.029 |
| 1.5 | -0.020 | -0.088 | 0.972 | 0.976 |
| 1.6 | 0.149 | -0.012 | 0.951 | 0.963 |
| 1.7 | 0.135 | 0.201 | 0.960 | 0.990 |
| 1.8 | 0.029 | 0.089 | 0.955 | 0.960 |
| 1.9 | 0.041 | 0.200 | 1.020 | 1.040 |
| 2 | 0.023 | 0.194 | 0.981 | 1.000 |
| 2.1 | 0.171 | 0.135 | 0.968 | 0.992 |
| 2.2 | 0.095 | 0.141 | 0.983 | 0.998 |
| 2.3 | 0.050 | 0.273 | 0.932 | 0.972 |
| 2.4 | 0.050 | 0.206 | 1.049 | 1.070 |
| 2.5 | -0.136 | 0.008 | 1.099 | 1.107 |
| 2.6 | 0.017 | 0.066 | 0.899 | 0.902 |
| 2.7 | 0.097 | -0.116 | 0.965 | 0.977 |
| 2.8 | -0.004 | -0.175 | 1.072 | 1.086 |
| 2.9 | -0.034 | -0.063 | 0.924 | 0.927 |
| 3 | 0.097 | 0.029 | 0.976 | 0.981 |
| 3.1 | 0.116 | 0.020 | 0.999 | 1.006 |
| 3.2 | 0.016 | -0.319 | 1.036 | 1.084 |
| 3.3 | -0.269 | -0.181 | 1.082 | 1.130 |
| 3.4 | -0.094 | -0.098 | 0.982 | 0.991 |
| 3.5 | 0.021 | -0.008 | 0.938 | 0.938 |
| 3.6 | 0.071 | 0.110 | 0.945 | 0.954 |
| 3.7 | 0.164 | 0.074 | 0.953 | 0.970 |
| 3.8 | 0.138 | -0.037 | 0.963 | 0.974 |
| 3.9 | 0.112 | 0.058 | 1.005 | 1.013 |
| 4 | -0.215 | -0.028 | 1.090 | 1.111 |
| 4.1 | 0.067 | -0.002 | 0.930 | 0.932 |
| 4.2 | 0.146 | 0.229 | 0.642 | 0.697 |
| 4.3 | 0.349 | -0.131 | 0.894 | 0.969 |
| 4.4 | -0.187 | 0.015 | 1.521 | 1.533 |

Table with all measurements



Because our rollecoaster has a constant speed, the accelerations doesn't almost never changes except in the small downhill after the first curve and in the final downhill and uphill point where, in the graphic, it can see clear changes of direction.