



Milby Rockets 2023

CTE Aerospace Engineering

Mr. Shen

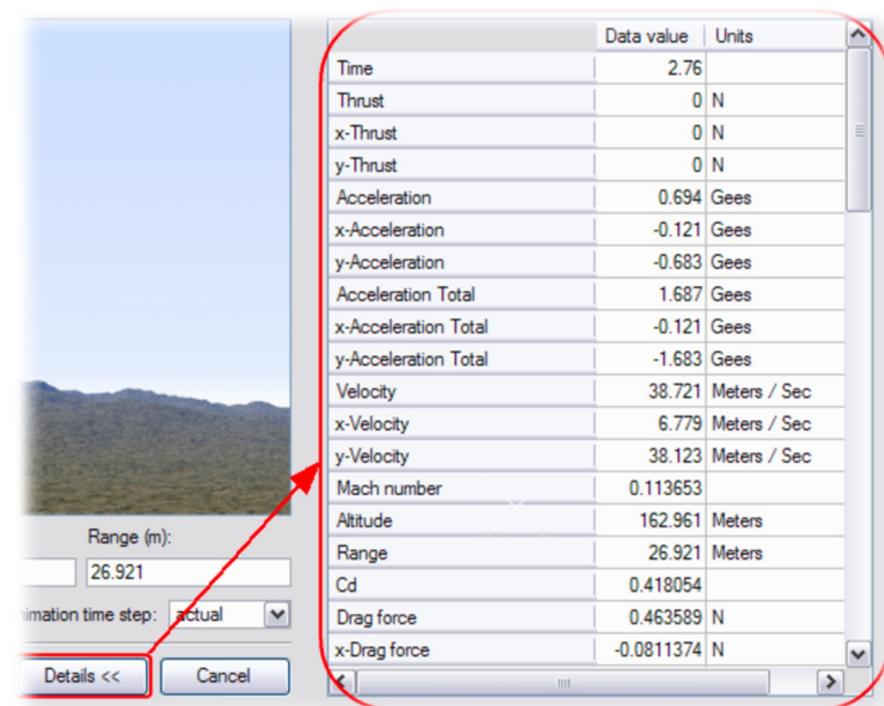
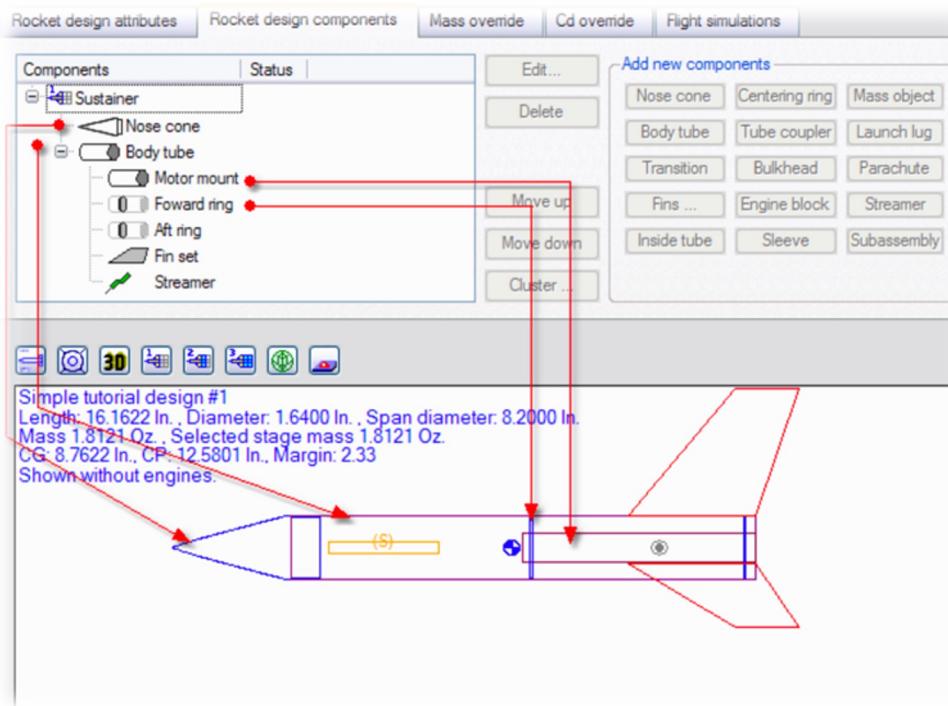
Overview

- Tsiolkovsky Level (DP1, Sophomores)
 - 1" paper rocket
 - 1lb-1mi rocket
 - Rocket launch, at Smithpoint
- Oberth Level (DP2, Juniors)
 - Excel math model, present FPR at NASA JSC
 - Transonic rocket
 - Rocket launch, at Smithpoint

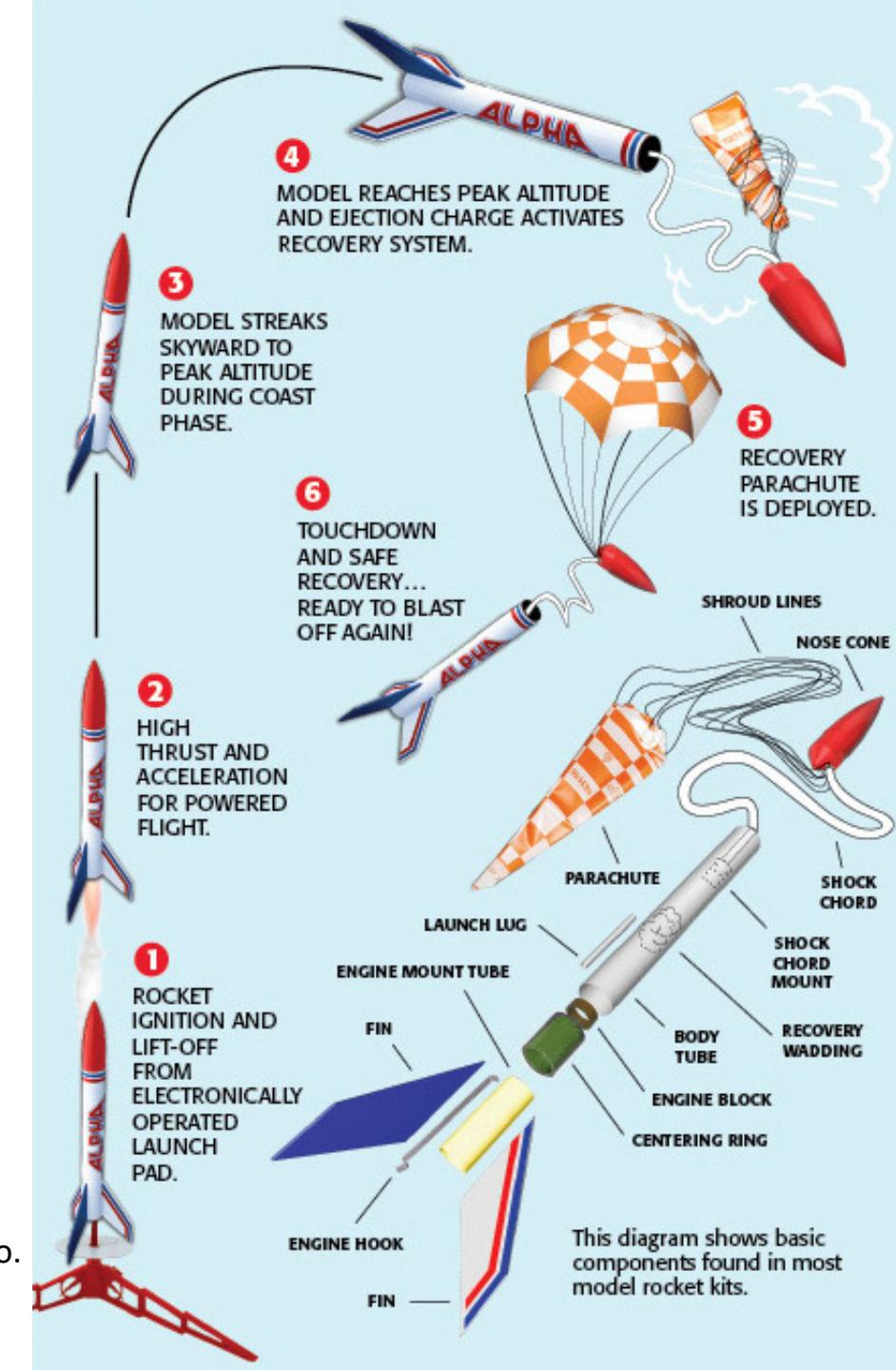
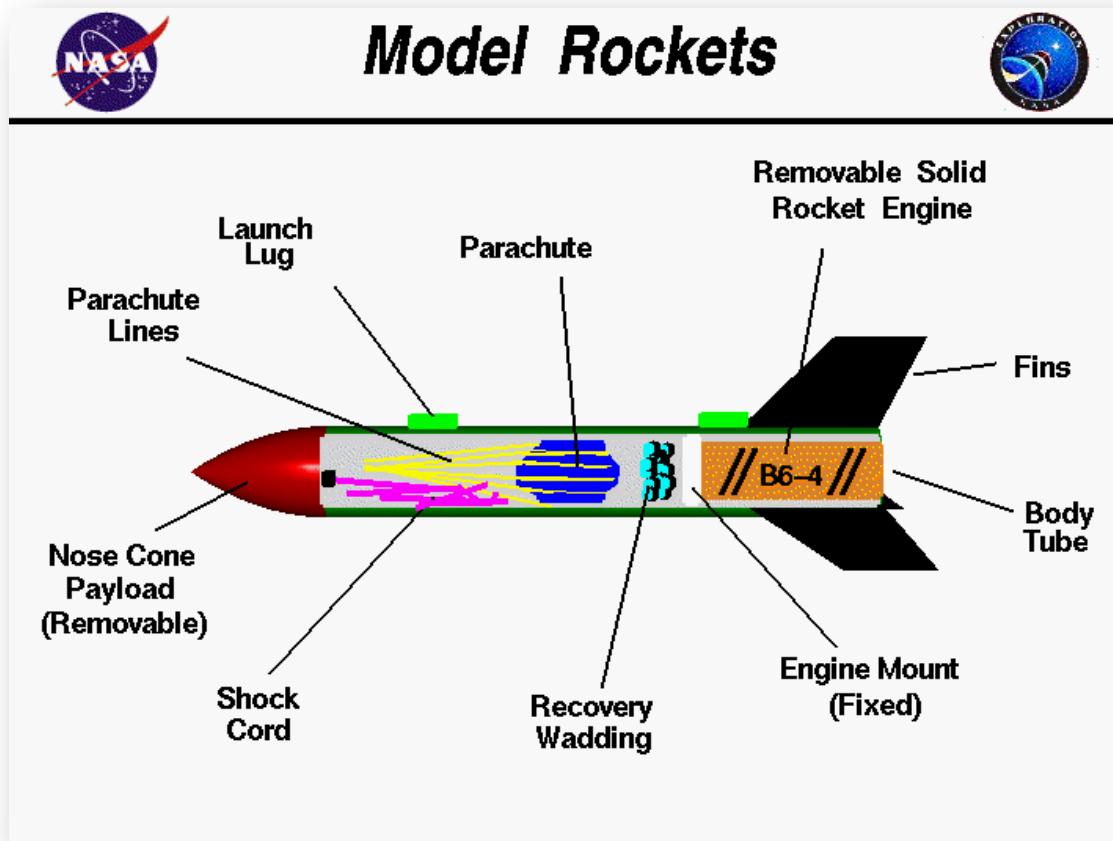


Tsiolkovsky Level

- Focus on the basics of rocketry
 - Understanding of basic physics and how to use Rocksim to simulate the rocket flight profile.
- Making a rocket that could carry a 1-pound payload and reach the 1-mile mark.

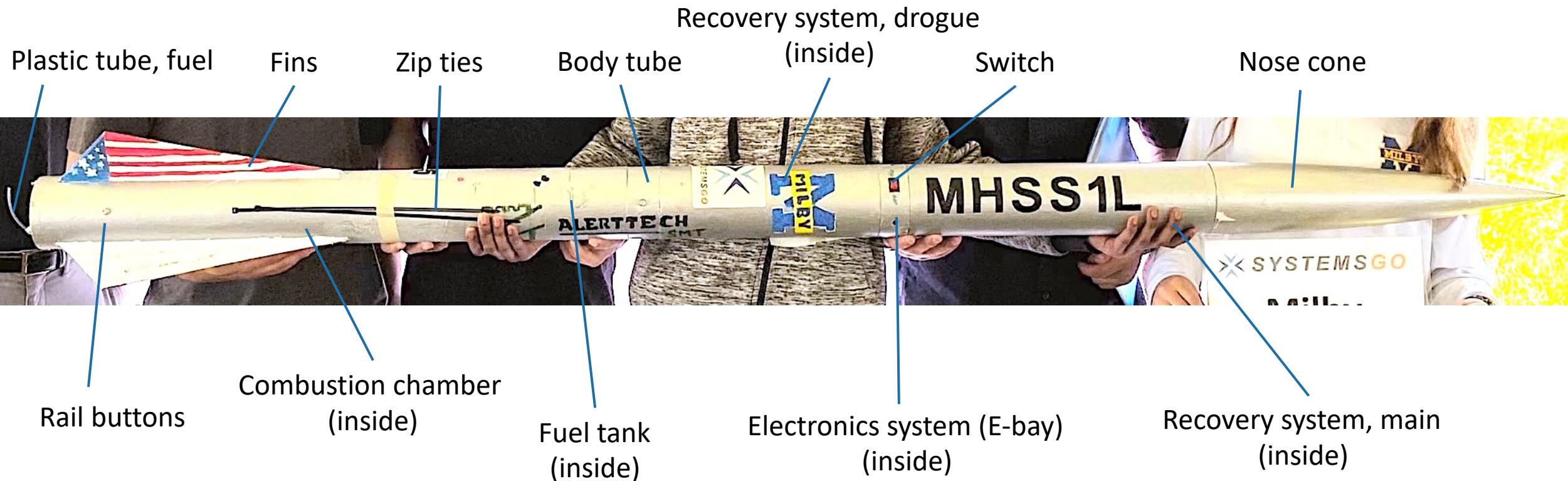


Components for a model rocket



Note: there're many ways to build a rocket, not all parts shown here will be used in the actual class demo.

Components of a two-stage rocket



Note: Other parts not shown here include Nomex cloth, shock cords, stay rods, centering rings, engine block, battery, eye bolts, screws, wing nuts, nyloc nuts, wires, and extra payloads if necessary. Pyro charges will be added onto the E-bay onsite.

Oberth Level

- Create a math model of the flight profile using Excel
- Go transonic
 - Making a rocket that can break the sound barrier while staying under the altitude ceiling.

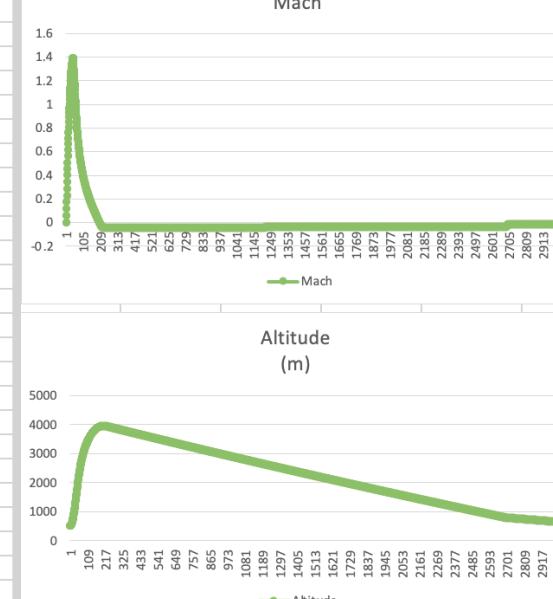
	A	B	C	D	E	F	G	H	I	J	K	L
1	Given	Value	Units	Time (s)	Mass (kg)	Weight (N)	Thrust (N)	Drag Total (N)	Net Force (N)	Acceleration (m/s^2)	Velocity (m/s)	Altitude (m)
2	mass	4	kg	0	4	-39.2	0	0	-39.2	0	0	533
3	g	-9.8	m/s^2	0.1	3.972625	-38.931725	816.849	0	777.917275	195.819458	0	533
4	cd	0.4	(unitless)	0.2	3.94525	-38.66345	816.849	0	778.18555	197.246195	19.5819458	533.979097
5	diameter	0.11253831	m	0.3	3.917875	-38.395175	816.849	-0.8878444	777.565981	198.466255	39.4285714	536.923523
6	burn_time	5.6	s	0.4	3.8905	-38.1269	796.043	-3.5960472	750.320053	193.887689	58.8173402	541.858711
7	v_sound	343	m/s	0.5	3.863125	-37.858625	796.043	-8.0022858	750.182089	194.190478	78.236388	548.709884
8	radius	0.05626916	m	0.6	3.83575	-37.59035	796.043	-14.144859	744.307791	194.044917	97.6408797	557.504475
9	csa_rocket	0.00994697	m^2	0.7	3.808375	-37.322075	781.861	-22.010084	722.528841	189.721033	116.612983	568.238787
10	m_prop	1.533	kg	0.8	3.781	-37.0538	781.861	-31.333528	713.473672	188.699728	135.482956	580.848691
11	m_dot	0.27375	kg/s	0.9	3.753625	-36.785525	767.44	-42.253326	688.401149	183.396357	153.822592	595.340485
12	delta_t	0.1	s	1	3.72625	-36.51725	767.44	-54.360884	676.561866	181.566418	171.979233	611.639726
13	alt_i	533	m	1.1	3.698875	-36.248975	767.44	-67.885479	663.305546	179.326294	189.911863	629.745482
14	alt_main	800	m	1.2	3.6715	-35.9807	759.627	-82.619254	641.027046	174.59541	207.371404	649.633299
15	cd_drogue	0.20439		1.3	3.644125	-35.712425	759.627	-98.221305	625.69327	171.699179	224.541322	671.243417
16	csa_drogue	1.5		1.4	3.61675	-35.44415	735.948	-114.93602	585.567828	161.904425	240.731764	694.556045
17	cd_main	1.161		1.5	3.589375	-35.175875	735.948	-131.85015	568.92198	158.501683	256.581932	719.438743
18	csa_main	1.8		1.6	3.562	-34.9076	735.948	-149.34674	551.693656	154.883115	272.070244	745.889445
19	motor	L550		1.7	3.534625	-34.639325	714.454	-167.42942	512.385252	144.961701	286.566414	773.870885
20				1.8	3.50725	-34.37105	714.454	-185.20232	494.880631	141.102183	300.676632	803.252335
21	Limits			1.9	3.479875	-34.102775	701.582	-203.29254	464.186682	133.391769	314.015809	834.025509
22	max_alt	3962	m	2	3.4525	-33.8345	701.582	-221.08103	446.666471	129.374792	326.953288	866.094049



Flight Profile Review (FPR)

- (Basic) Ball toss experiment
- (Advanced) Transonic rocket flight profile

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	U	V	W	X	Y	Z
1	Given	Value	Units	Time (s)	Mass (kg)	Weight (N)	Thrust (N)	Drag Total (N)	Net Force (N)	Acceleration (m/s^2)	Velocity (m/s)	Altitude (m)	ATM Density	Drag Rocket	Drag Drogue	Drag Main						
2	mass	4	kg	0	4	-39.2	0	0	-39.2	0	0	533	1.16387	0	0	0						
3	g	-9.8	m/s^2	0.1	3.972625	-38.93173	816.849	0	777.9173	195.8195	0	533	1.16387	0	0	0						
4	cd	0.4	(unitless)	0.2	3.94525	-38.66345	816.849	0	778.1856	197.2462	19.58195	533.9791	1.16387	0	0	0						
5	diameter	0.112538	m	0.3	3.917875	-38.39518	816.849	-0.887844	777.566	198.4663	39.42857	536.9235	1.16387	-0.887844	0	0						
6	burn_time	5.6	s	0.4	3.8905	-38.1269	796.043	-3.596047	754.3201	193.8877	58.81734	541.8587	1.16274	-3.596047	0	0						
7	v_sound	343	m/s	0.5	3.863125	-37.85863	796.043	-8.002286	750.1821	194.1905	78.23639	548.7099	1.16274	-8.002286	0	0						
8	radius	0.056269	m	0.6	3.83575	-37.59035	796.043	-14.14486	744.3078	194.0449	97.64088	557.5045	1.16161	-14.14486	0	0						
9	cfa_rocket	0.009947	m^2	0.7	3.808375	-37.32208	781.861	-22.01008	722.5288	189.721	116.613	568.2388	1.16048	-22.01008	0	0						
10	m_prop	1.533	kg	0.8	3.781	-37.0538	781.861	-31.33353	713.4737	188.6997	135.483	580.8487	1.15823	-31.33353	0	0						
11	m_dot	0.27375	kg/s	0.9	3.753625	-36.78553	767.44	-42.25333	688.4011	183.3964	153.8226	595.3405	1.1571	-42.25333	0	0						
12	delta_t	0.1	s	1	3.72625	-36.51725	767.44	-54.36088	676.5619	181.5664	171.9792	611.6397	1.15485	-54.36088	0	0						
13	alt_i	533	m	1.1	3.698875	-36.24898	767.44	-67.88548	663.3055	179.3263	189.9119	629.7455	1.15373	-67.88548	0	0						
14	alt_main	800	m	1.2	3.6715	-35.9807	759.627	-82.61925	641.027	174.5954	207.3714	649.6333	1.15148	-82.61925	0	0						
15	cd_drogue	0.20439		1.3	3.644125	-35.71243	759.627	-98.2213	625.6933	171.6992	224.5413	671.2434	1.14812	-98.2213	0	0						
16	cfa_drogue	1.5		1.4	3.61675	-35.44415	735.948	-114.936	585.5678	161.9044	240.7318	694.556	1.14589	-114.936	0	0						
17	cd_main	1.161		1.5	3.589375	-35.17588	735.948	-131.8501	568.922	158.5017	256.5819	719.4387	1.14365	-131.8501	0	0						
18	cfa_main	1.8		1.6	3.562	-34.9076	735.948	-149.3467	551.6937	154.8831	272.0702	745.8894	1.14031	-149.3467	0	0						
19	motor	L550		1.7	3.534625	-34.63933	714.454	-167.4294	512.3853	144.9617	286.5664	773.8709	1.13697	-167.4294	0	0						
20				1.8	3.50725	-34.37105	714.454	-185.2023	494.8806	141.1022	300.6766	803.2523	1.13364	-185.2023	0	0						
21	Limits			1.9	3.479875	-34.10278	701.582	-203.2925	464.1867	133.3918	314.0158	834.0255	1.13032	-203.2925	0	0						
22	max_alt	3962	m	2	3.4525	-33.8345	701.582	-221.081	446.6665	129.3748	326.9533	866.094	1.12701	-221.081	0	0						
23				2.1	3.425125	-33.56623	701.582	-238.9695	429.0463	125.2644	339.4797	899.4363	1.1237	-238.9695	0	0						
24				2.2	3.39775	-33.29795	674.667	-256.6249	384.7442	113.235	350.8032	934.0105	1.11931	-256.6249	0	0						
25	Current			2.3	3.370375	-33.02968	674.667	-273.2246	368.4127	109.3091	361.7341	969.657	1.11602	-273.2246	0	0						
26	max_Mach	1.390832		2.4	3.343	-32.7614	656.493	-289.3769	334.3547	100.0164	371.7358	1006.377	1.11164	-289.3769	0	0						
27	max_alt	3961.999		2.5	3.315625	-32.49313	656.493	-304.4015	319.5983	96.39158	381.3749	1044.051	1.10728	-304.4015	0	0						
28	min_diamete	0.08	m	2.6	3.28825	-32.22485	656.493	-319.1339	305.1343	92.79534	390.6545	1082.67	1.10293	-319.1339	0	0						
29	min_mass	4	kg	2.7	3.260875	-31.95658	636.076	-333.5384	270.581	82.97804	398.9523	1122.2	1.0986	-333.5384	0	0						

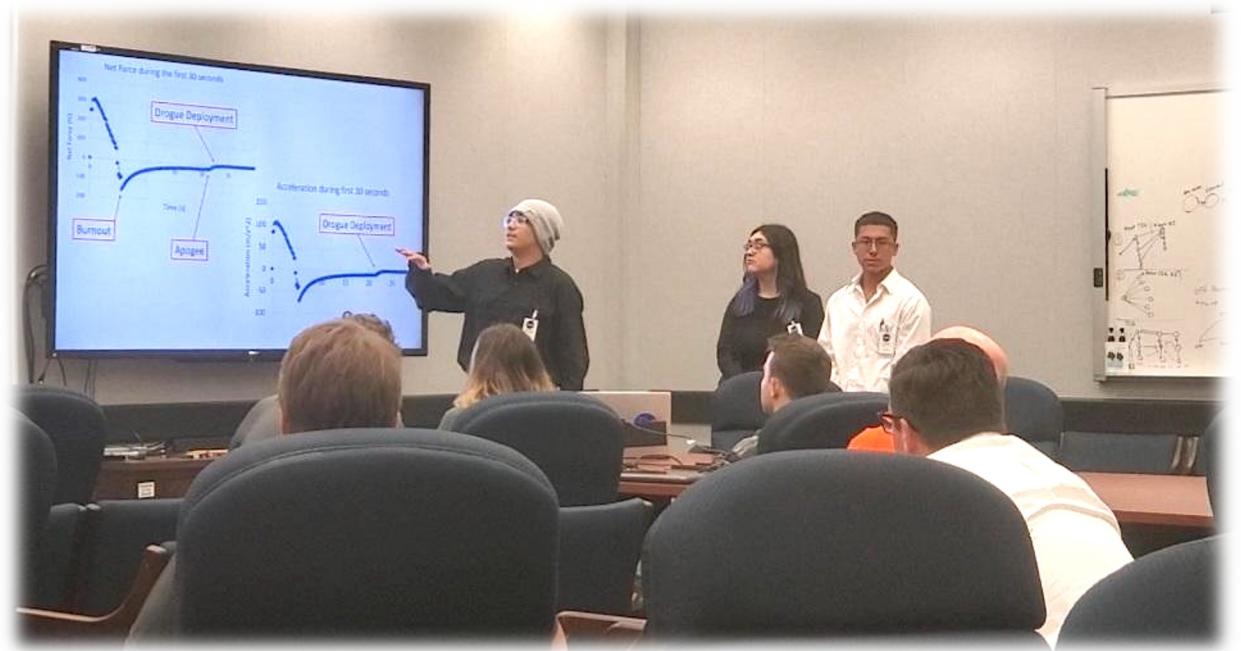


Transonic teams presenting their FPR to the audience at NASA JSC in Fall 2023



The presenter need to explain everything he knows about the rocket from free body diagrams to excel math models. No Rocksim. The audience include engineers from NASA JSC along with other students and staff associated with the SystemsGo program.

This event is coordinated by SystemsGo every year and only applies to Oberth and higher levels (Goddard and von Braun)



SystemsGo Rockets 2023





Community Outreach (ES, MS)



Industrial Partnerships



Other CTE events





Thank you for your time!

There're many other things that could not be covered here due to time, but are also considered important learning aspects of this program, such as doing fundraisers, laser-cutters and 3D printers, drones, and the High school Aerospace Scholars program (HAS), etc.

