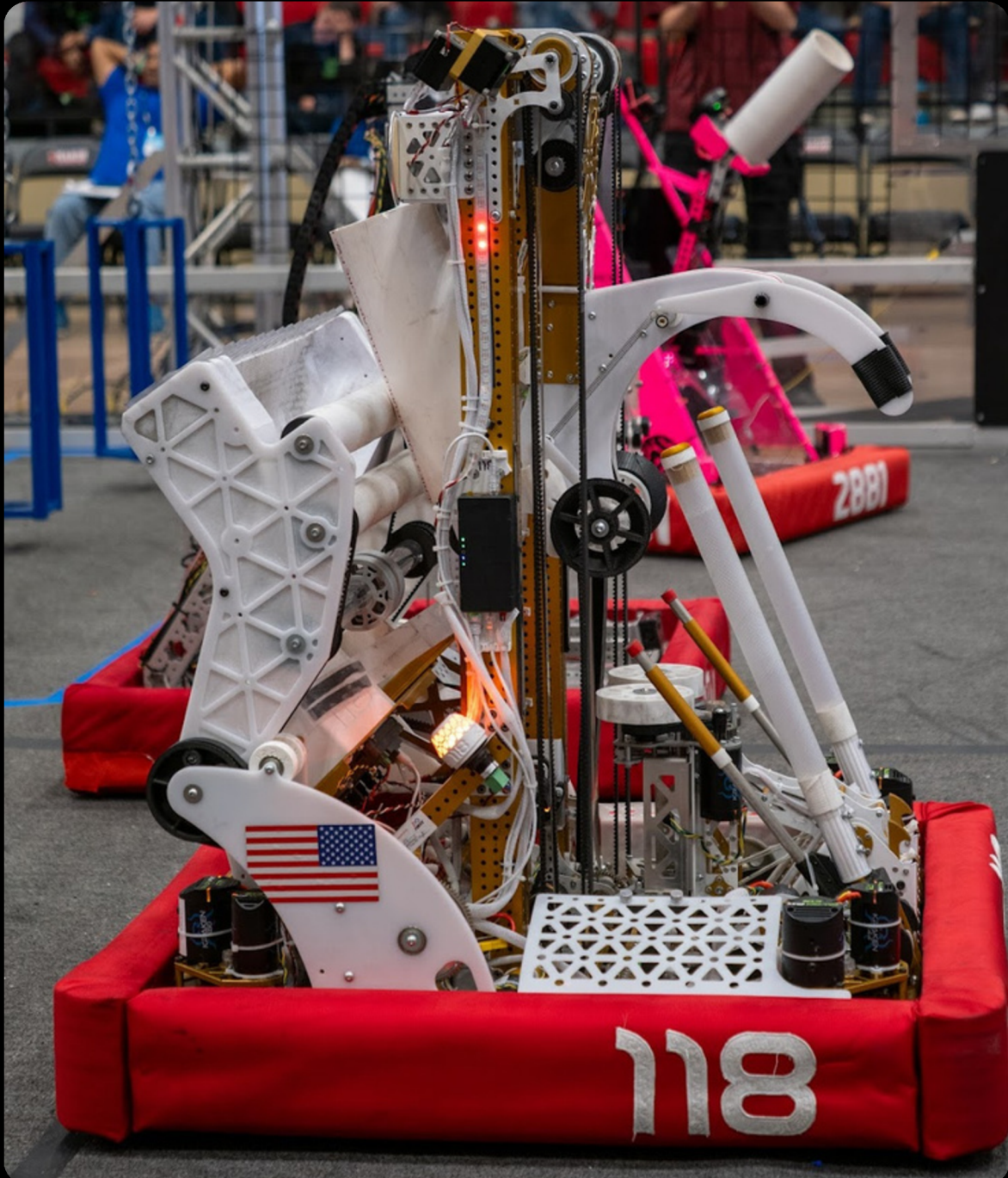


THE ROBONAUTS

2025 TECHNICAL BINDER



2025

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THE ROBONAUTS
FRC TEAM 118

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OVERVIEW

The Robonauts were founded 29 years ago, based on a partnership between NASA's Johnson Space Center and Clear Creek Independent School District. During the 2025 season our team of 92 students and 19 mentors competed at 7 events during the official Reefscape season.



ROBONAUTS' GOALS

1. Educate our students in the field of engineering
2. Engage our community in engineering and STEM education
3. Field a competitive team
4. Grow and nurture the Robonauts' Family

SEASON STATISTICS

122
MATCHES
PLAYED

Most of any team
during the 2025
official season

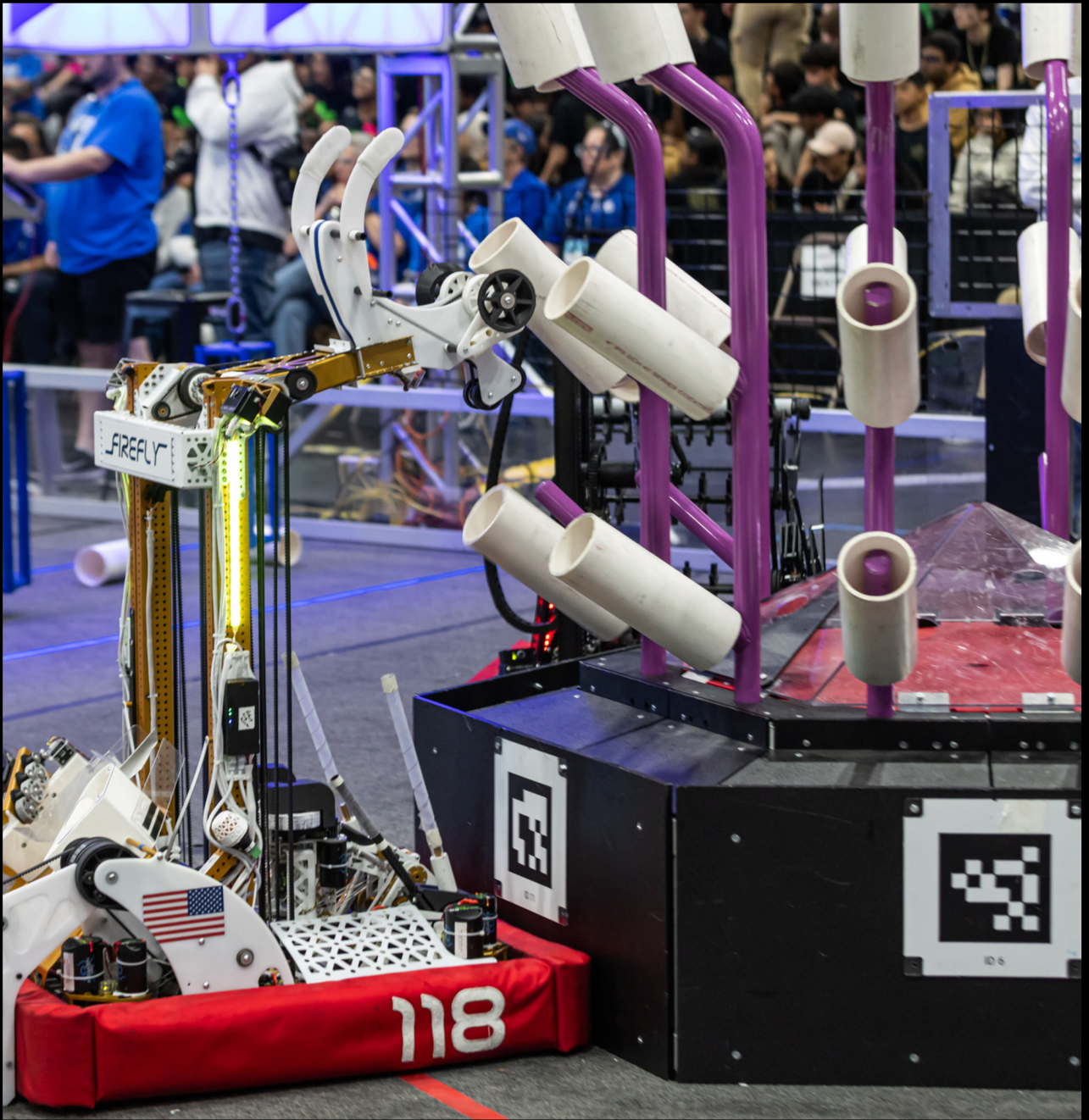
133 UNIQUE
ALLIANCE
PARTNERS

7 BLUE
BANNERS

MILSTEIN
DIVISION
WINNERS

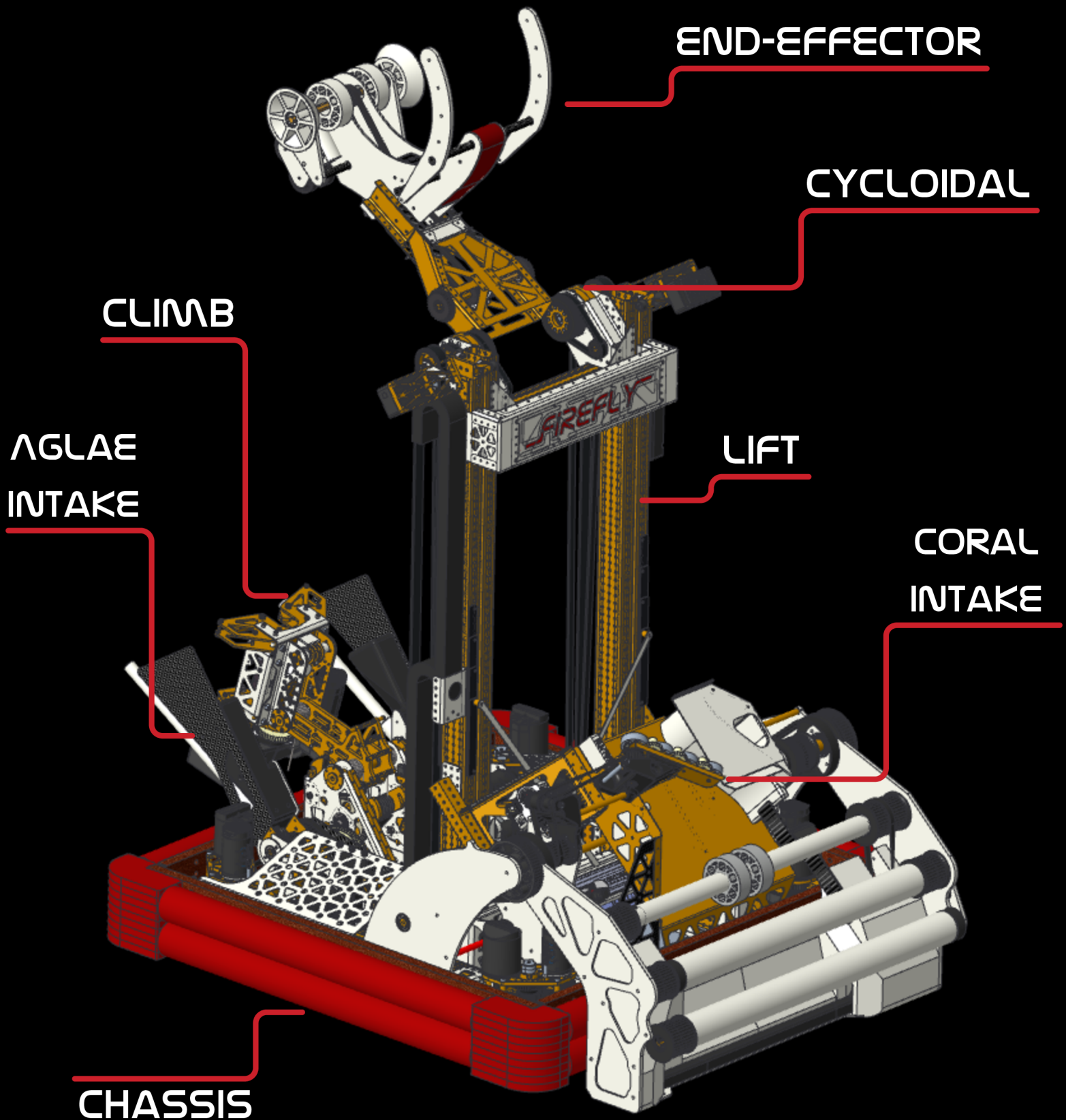


FIREFLY



BUILT FOR THE 2025 FIRST ROBOTICS
COMPETITION GAME: REEFSCAPE

FINAL DESIGN



GAME ANALYSIS

Qualifications

- *Maximize acquisition of Ranking Points*

Eliminations

- *Maximize alliance score*

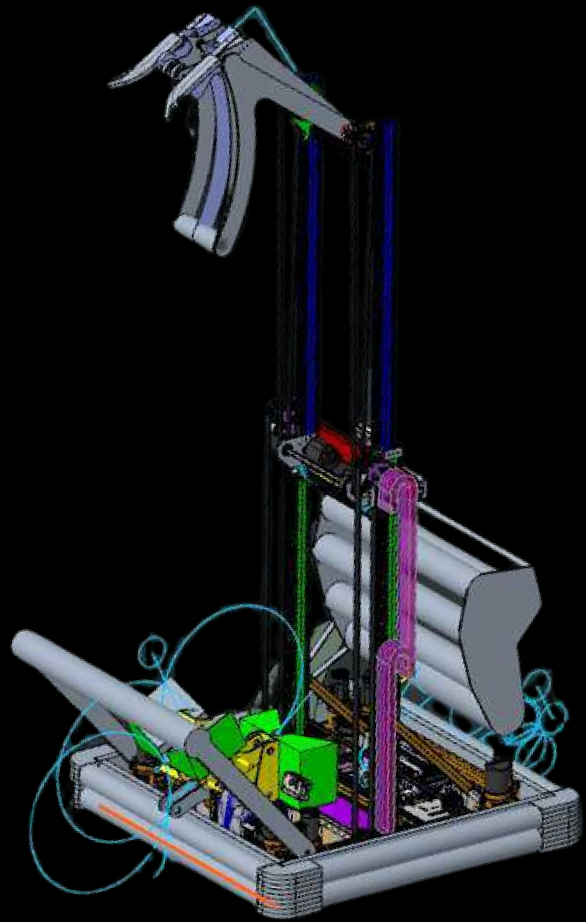
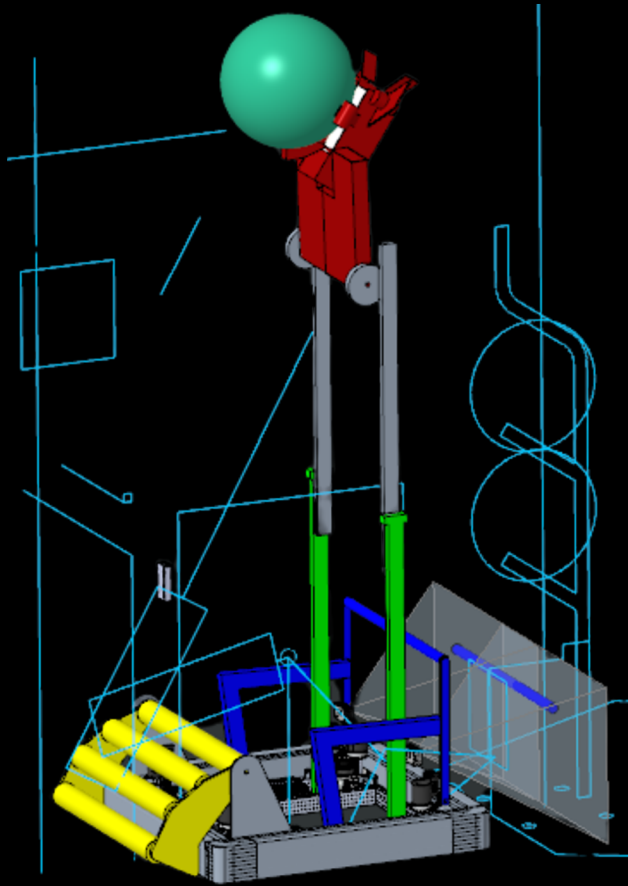
Ranking Points

- *There are 6x Ranking Points available in every Qualification match*
 - *3x are awarded to the winning alliance*
 - *1x is awarded for the Auto RP*
 - *all non-BYPASSED ROBOTS LEAVE and at least 1 CORAL scored in AUTO*
 - *1x is awarded for the Coral RP*
 - *If at least 7 CORAL scored on each level. If Coopertition achieved, at least 7 CORAL must be scored on each of 3 levels*
 - *1x is awarded for the Barge RP*
 - *at least 16 BARGE points are scored*

Maximizing Ranking Points

- *Win: Score more Coral and Algae*
- *Auto RP: Include time to push alliance robots off of starting line to ensure all robots leave*
- *Coral RP: Minimize scoring cycle time and maximize scoring locations*
 - **Achieve Coopertition by having ability to score in opposing Processor*
- *Barge RP: Ensure a Deep Climb to give maximum points toward Brage RP point total*

ROBOT ANALYSIS



Overall Robot Architecture Goals

- *Robot should never be waiting on game object to be delivered to scoring mechanism*
- *Robot must maximize operational functions with the loss of a single mechanism in a match*
- *Low Center of Mass*

Systems Integrations Goals

- *Avoid passing Game Objects through the Lift (Arm, EE, & Lift)*
- *Deep Cage and Algae intake must not collide (Algae Intake & Climb)*
- *Coral Intake delivers directly to End-Effector. No staging game piece for hand off. (Coral Intake & EE)*
- *Deep Cage, Chain, & Lift must not collide (Climb & Lift)*

SEASON SCHEDULE

PLANNED

ACTUAL

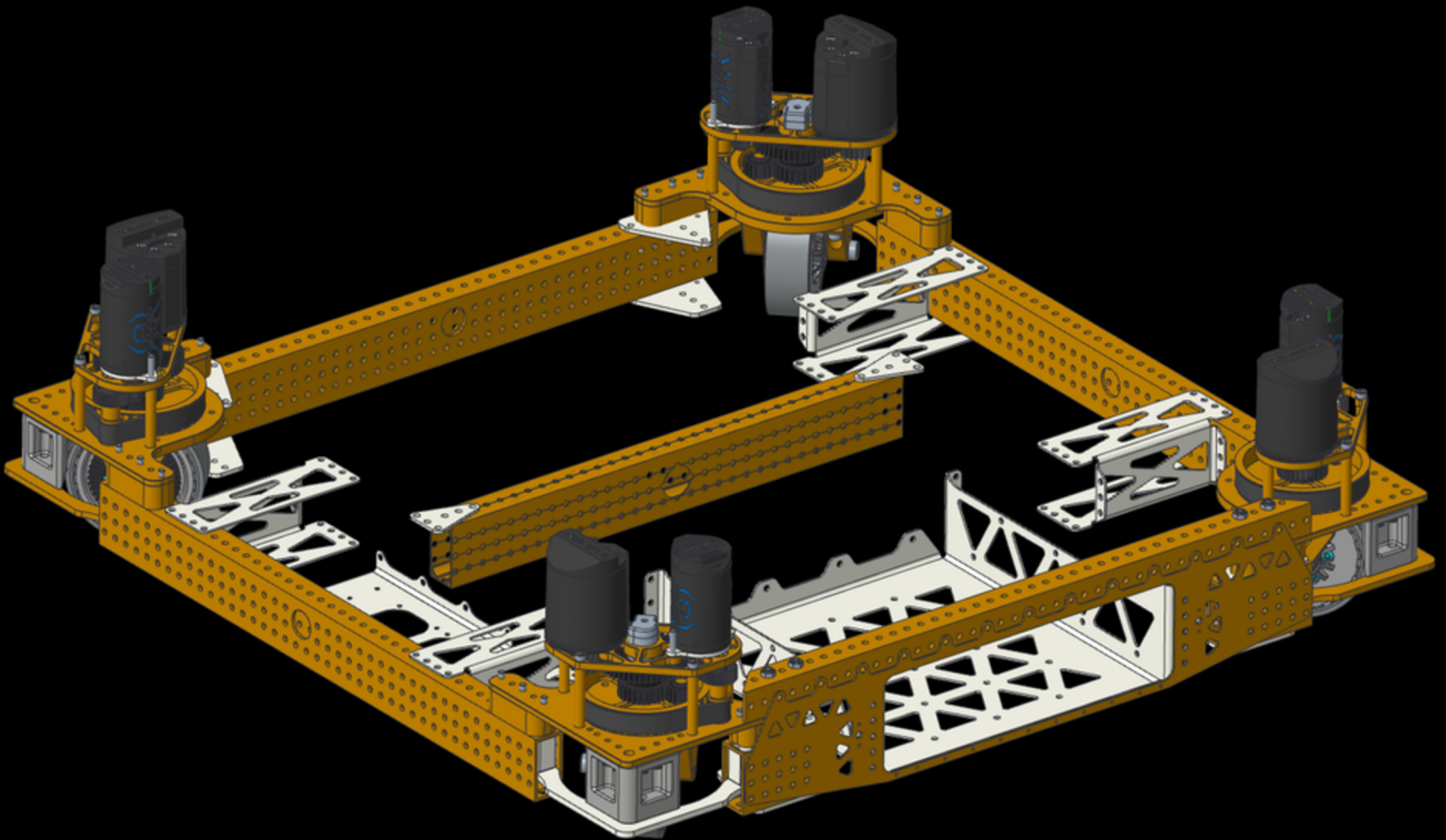
Jan 4th-Kickoff	Jan 4th-Kickoff
	Jan 8th-Drivebase Size Selected
	Jan 11th-Crayon CAD Review
	Jan 12th-Silver Robot Assembly Begins
	Jan 17th-Red & Blue Robot Assembly Begins
Jan 18th-Crayon CAD Review	Jan 21st-Snow Day
Jan 25th-Integrated Design Review	Jan 25th-Lift, Climb, & Base Design Review
	Jan 27th-Coral Intake Design Review
	Feb 5th-End Effector Design Review
Feb 8th-Software Gets Red Robot	Feb 7th-Silver Robot Goes to Software
	Feb 10th-Silver Robot "Runs the Mission"
Feb 14th-Software Gets Blue Robot	Feb 13th-First Kraken X44 Shipment Arrives
Feb 14th-Red Robot "Runs the Mission"	
Feb 21st-Reveal Video	
	Feb 23rd-Red Robot Starts Reveal Filming
	Feb 27th-Reveal Video Posted

COMPETITION SEASON

Feb 28th-Tomball District Event	Feb 28th-Tomball District Event
	Mar 4th-Conical End Effector Rollers Added
Mar 5th-Arkansas Regional	Mar 5th-Arkansas Regional
	Mar 6th-Climb Limit Switches & Lights Added
	Mar 11th-Algae Intake Runs the Mission
	Mar 13th-Cage Intake Rollers Added
	Mar 14th-Manor District Event
	Mar 18th-Brackets added to Elevator to Increase Stiffness
	Mar 19th-Fast Climb Software Implemented
Mar 20th-Houston District Event	Mar 20th-Houston District Event
	Mar 25th-Automated Barge Scoring Added
	Mar 26th-Blue Robot First Drive
	Mar 26th-Both robots swap from L2+ to L1+ Gear Ratio
	Mar 26th-New Coral Intake Added
Mar 27th-Space City District Event	Mar 27th-Space City District Event
	Mar 28th-Magnet Climb Wheels & Auto Climb Software Added
Apr 2nd-FiT District Championship	Apr 2nd-FiT District Championship
	Apr 10th-Algae Autos Developed
	Apr 12th-4 Piece Coral Auto Developed
Apr 16th-FIRST Championship	Apr 16th-FIRST Championship

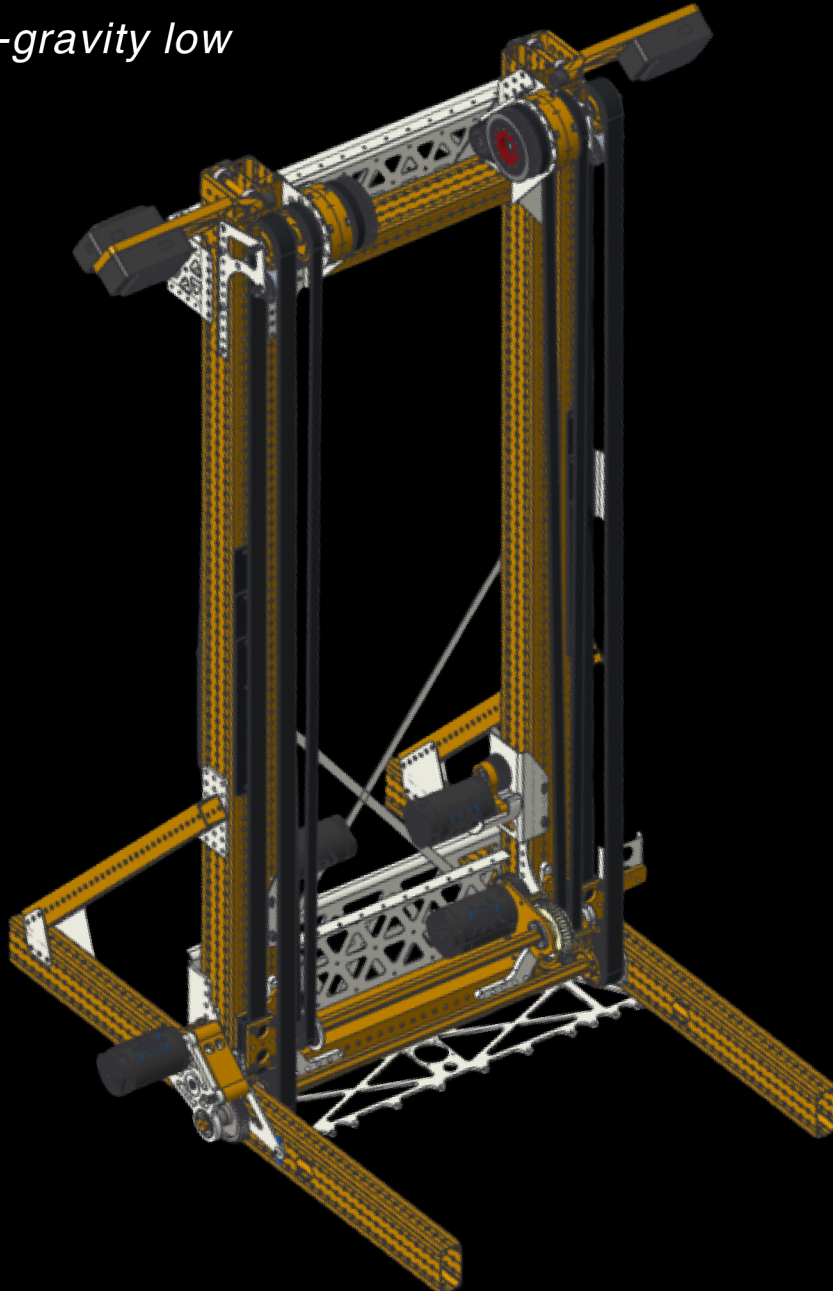
CHASSIS

- *29" X 29" Frame*
- *Equipped with L1+ SDS Mk4-C swerve modules*
- *Kraken X60 on propulsion and Kraken X44 on steering*
- *Kraken shafts are cut down to eliminate spacers and save ~1/2 pound across the robot*
- *Steel backed bumpers with quick-attach pip pins*
- *Garolite Spacers to lower frame 3/4"*
- *Custom hubs in Grip Lock wheels to eliminate tire flex*



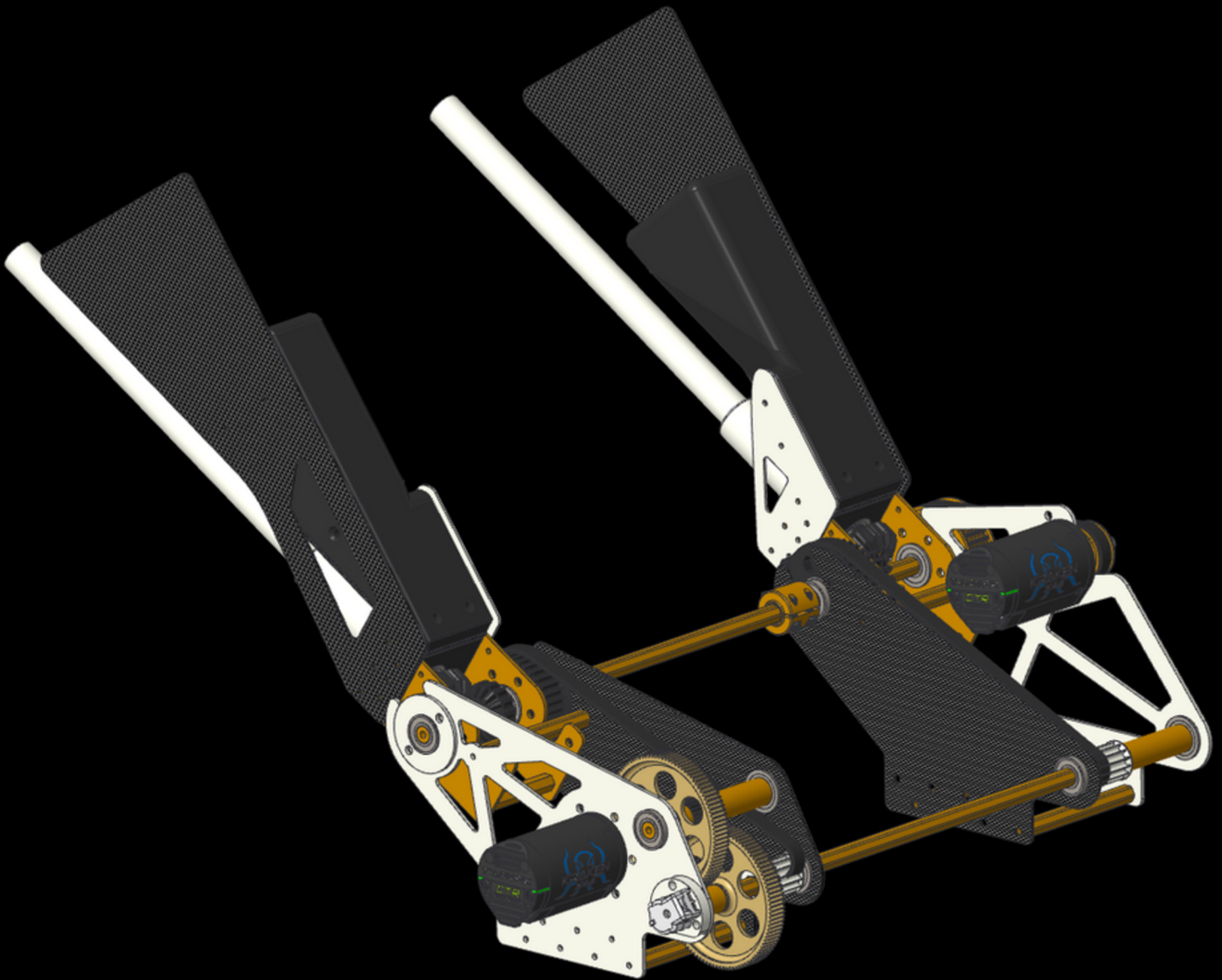
LIFT

- *Single stage elevator using SDS bearing blocks*
- *Lift powered by 1x Kraken X44 with 6:42:1 ratio*
- *Elevator off-loaded with constant force springs*
- *Custom vernier scale tensioning system for tensioning belts on arm and elevator*
- *Constructed from 0.040" thick 1"x2" Maxtube*
- *1x Kraken X44 for Algae rollers, 1x Kraken X44 for Coral rollers, and 1x Kraken X44 for arm pivot in base of elevator carriage to keep center-of-gravity low*



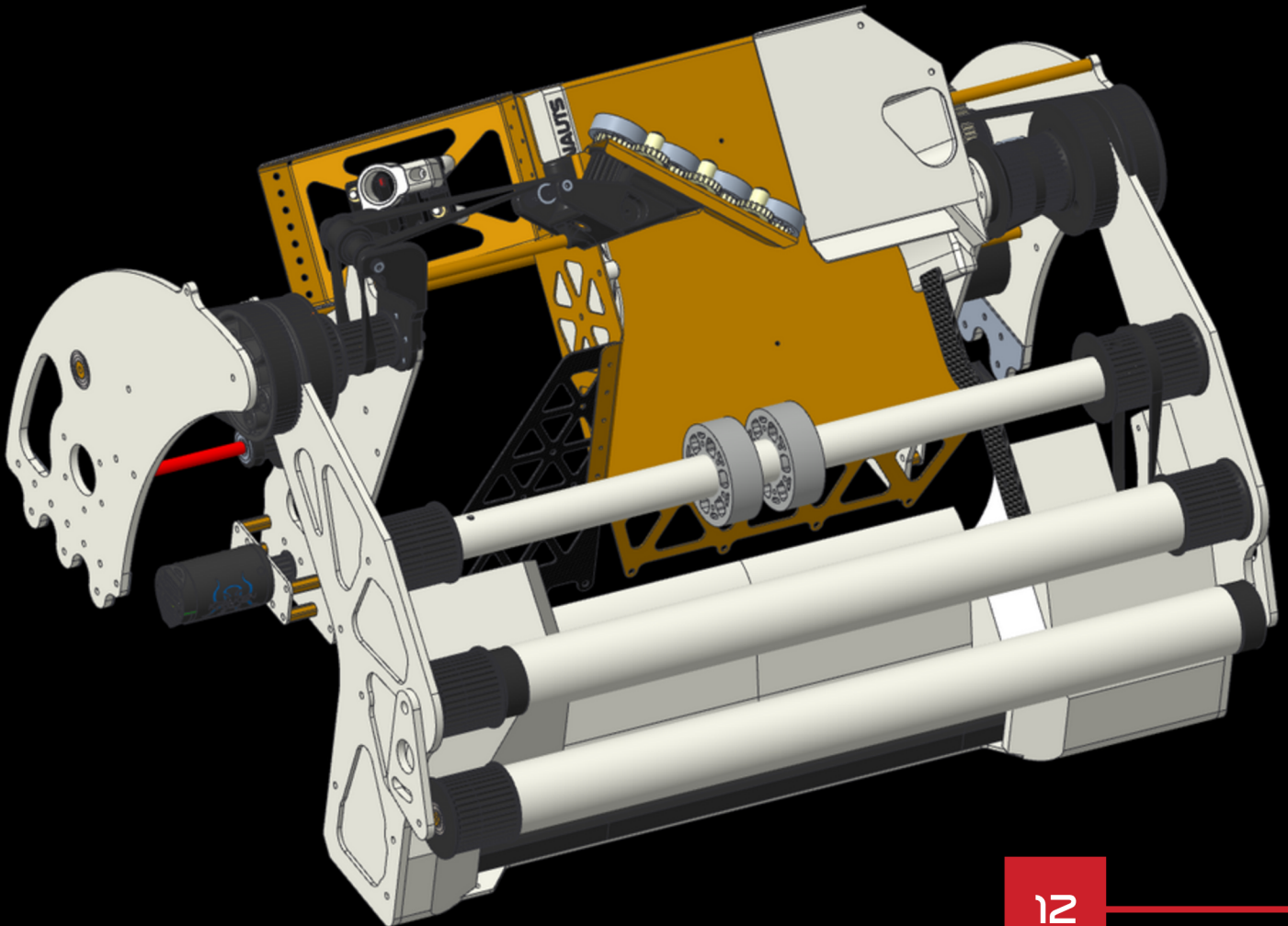
ALGAE INTAKE

- *Two counter-rotating rollers intake Algae from the floor*
- *Hands Algae off to end-effector on arm*
- *1x Kraken X44 powers rollers and 1x Kraken X44 powers pivot*
- *Custom 3D printed 15T bevel gears with reinforced tooth geometry*
- *3 piece jackshaft for installation and integration with Climb assembly*



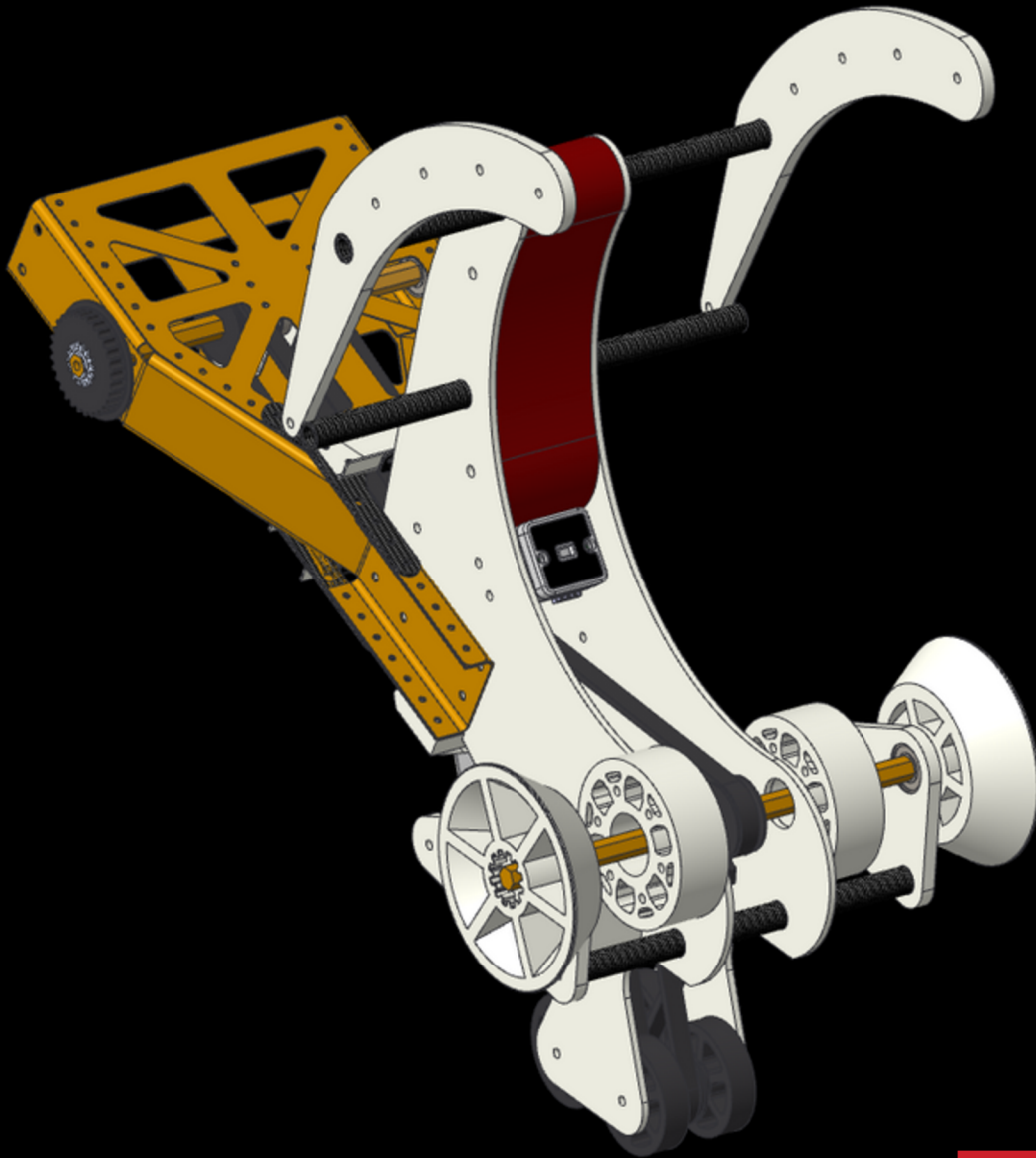
CORAL INTAKE

- *Collects Coral from the floor in any orientation with a sideways re-orienting belt*
- *Hands off Coral to end-effector on arm while always maintaining control of the Coral*
- *Intake pivot driven by Kraken X44 on custom 23:1 cycloidal gearbox*
- *1x Kraken X60 and 1x Kraken X44 used to power rollers*
- *Rollers are made of pool noodles & custom TPU covered in silicone tubing*
- *Dual motor rollers allow Coral to be stopped in the intake to be scored into L1 Trough or handed off to end-effector*
- *Multiple bent & twisted belts to deliver torque to off-axis and out of plane shafts*



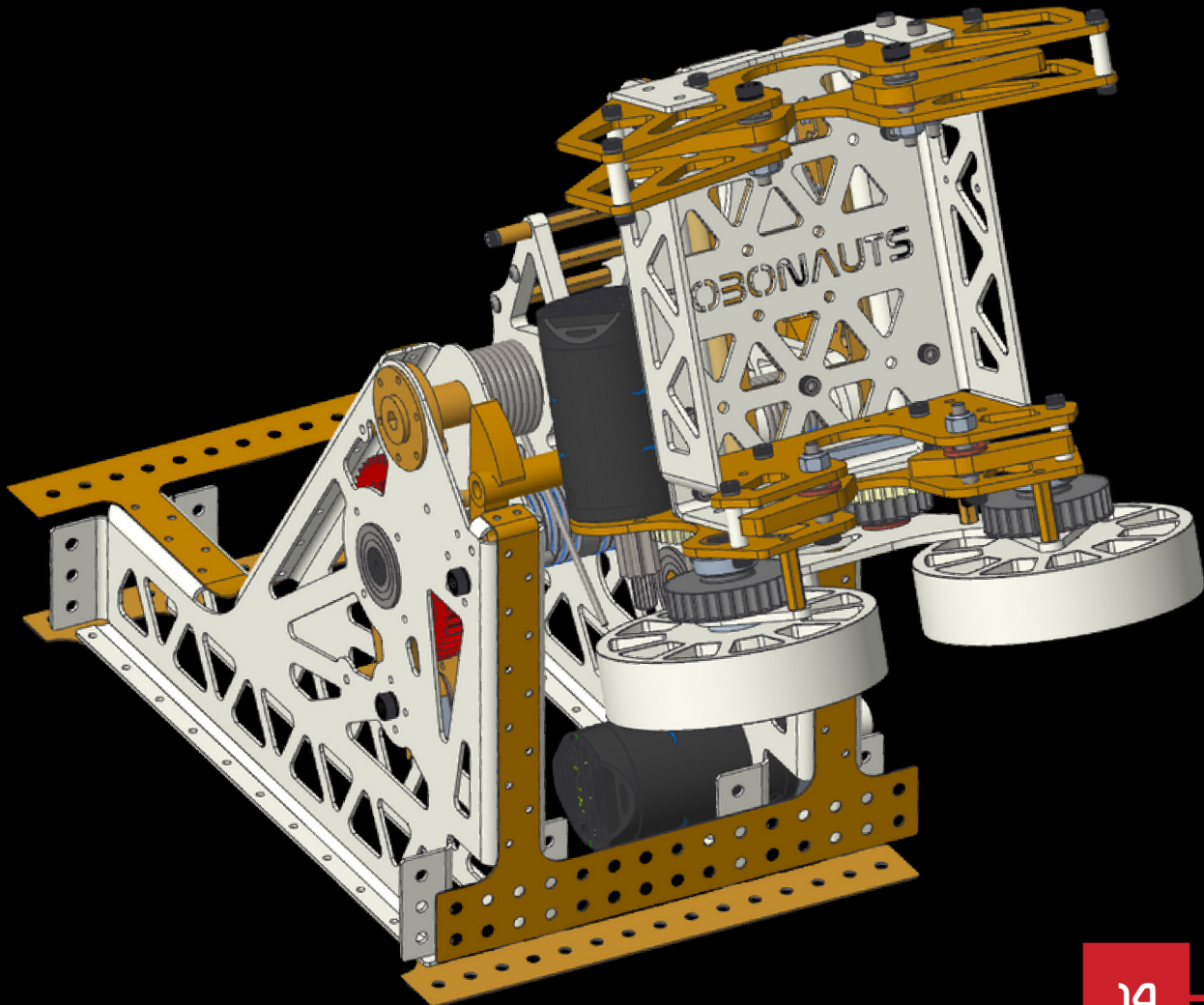
END-EFFECTOR

- *End-effector grabs the inside of Coral from the floor intake or from the human player loading station*
- *End-effector also acquires Algae from the Reef and from the floor intake with the ability to score into the Processor and the Barge*
- *Constructed primarily from polycarbonate to save weight and to be impact resistant*
- *Unique geometry around Coral rollers allows for additional compliance while placing Coral on L4*



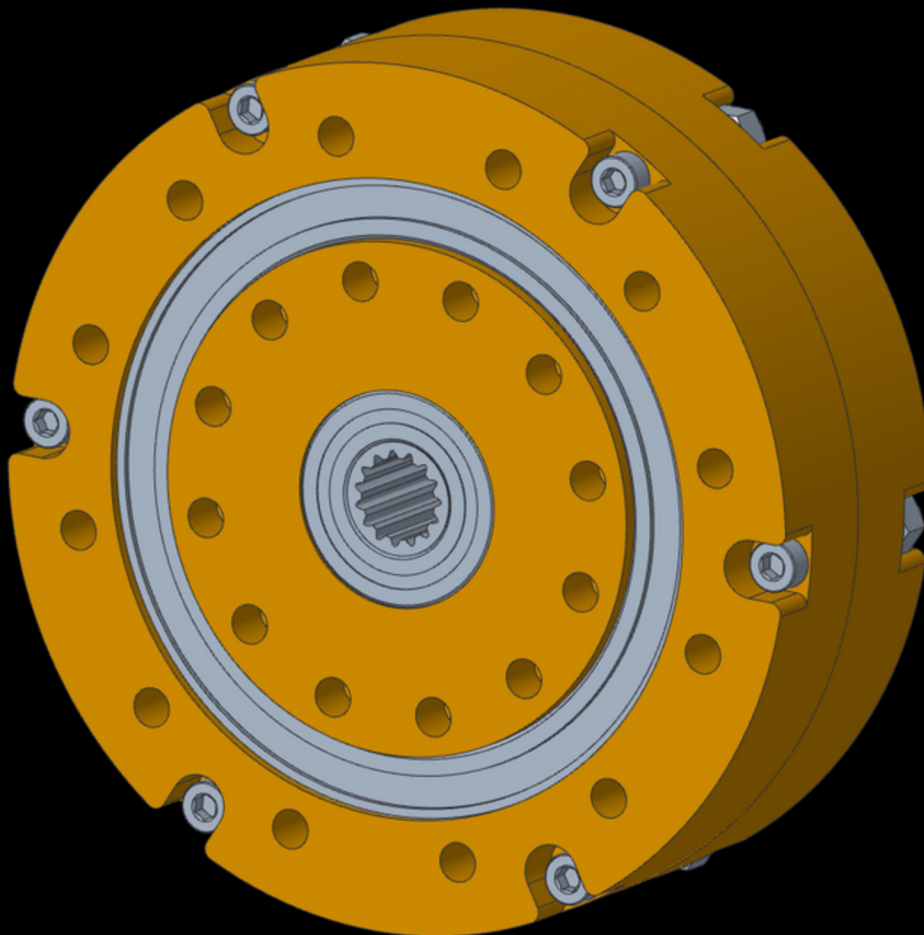
CLIMB

- *Climb motor is an Kraken X44 with a gear reduction of 33.6:1*
- *Spectra cable winch used to rotate climb intake structure to lift robot*
- *1x Kraken X44 used for winch*
- *Climb deploy and final climb rotation use shared X44 motor*
- *Kraken X44 driven cage intake rollers*
- *Intake rollers are custom TPU rollers with embedded rare-earth magnets to attract cage*
- *Rollers pull cage into two 1 way latches*
- *Torsion springs passively deploy climb intake*
- *Limit switches wired to CanDi are used to automatically climb when both latches have captured the cage*

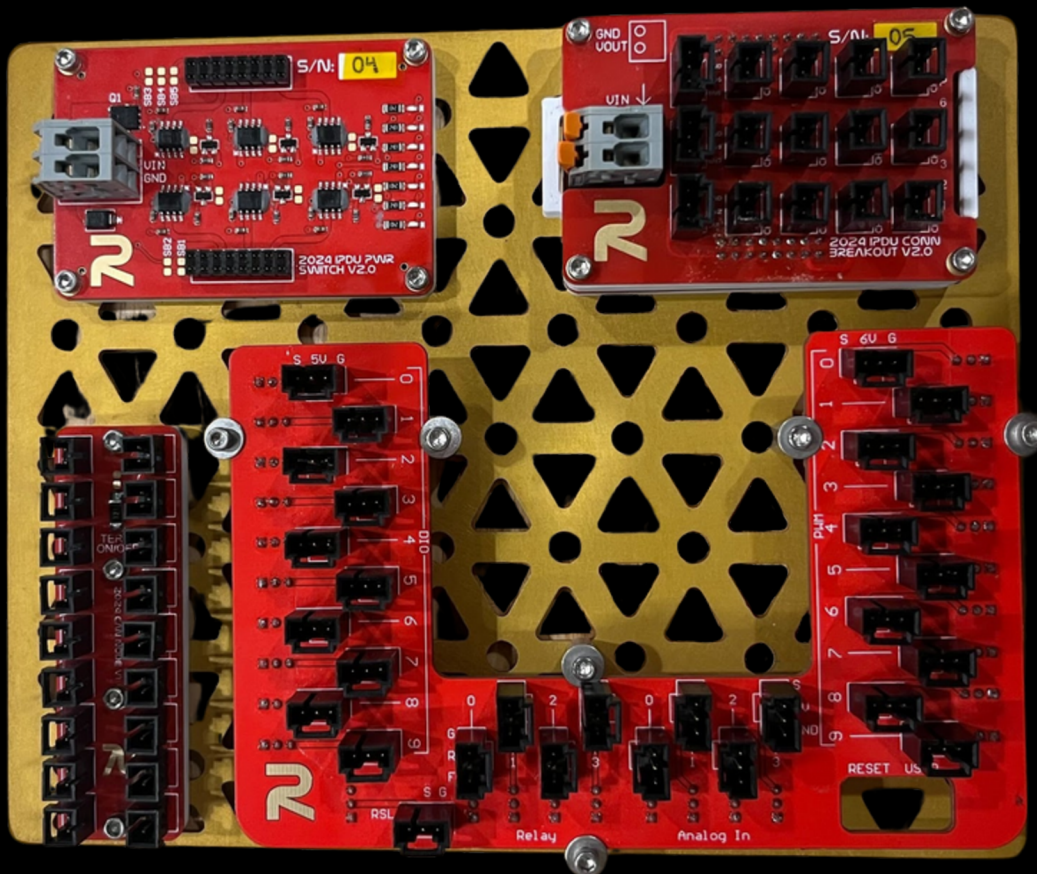


CYCLOIDAL

- *Custom 23:1 cycloidal gearbox*
- *2x used on arm pivot and 1x used on intake pivot*
- *Contains two offset cycloid discs to minimize vibration*
- *Gearbox rolling elements are steel tubes rolling on dowel pins*
- *Cycloid discs are machined from 4140 steel and heat-treated*
- *Only $\sim 0.3^\circ$ of backlash*
- *The gearbox is more compact and lighter than COTS planetary gearboxes*
- *Designed in 2024 off-season*
- *2025 design is the 5th design revision*

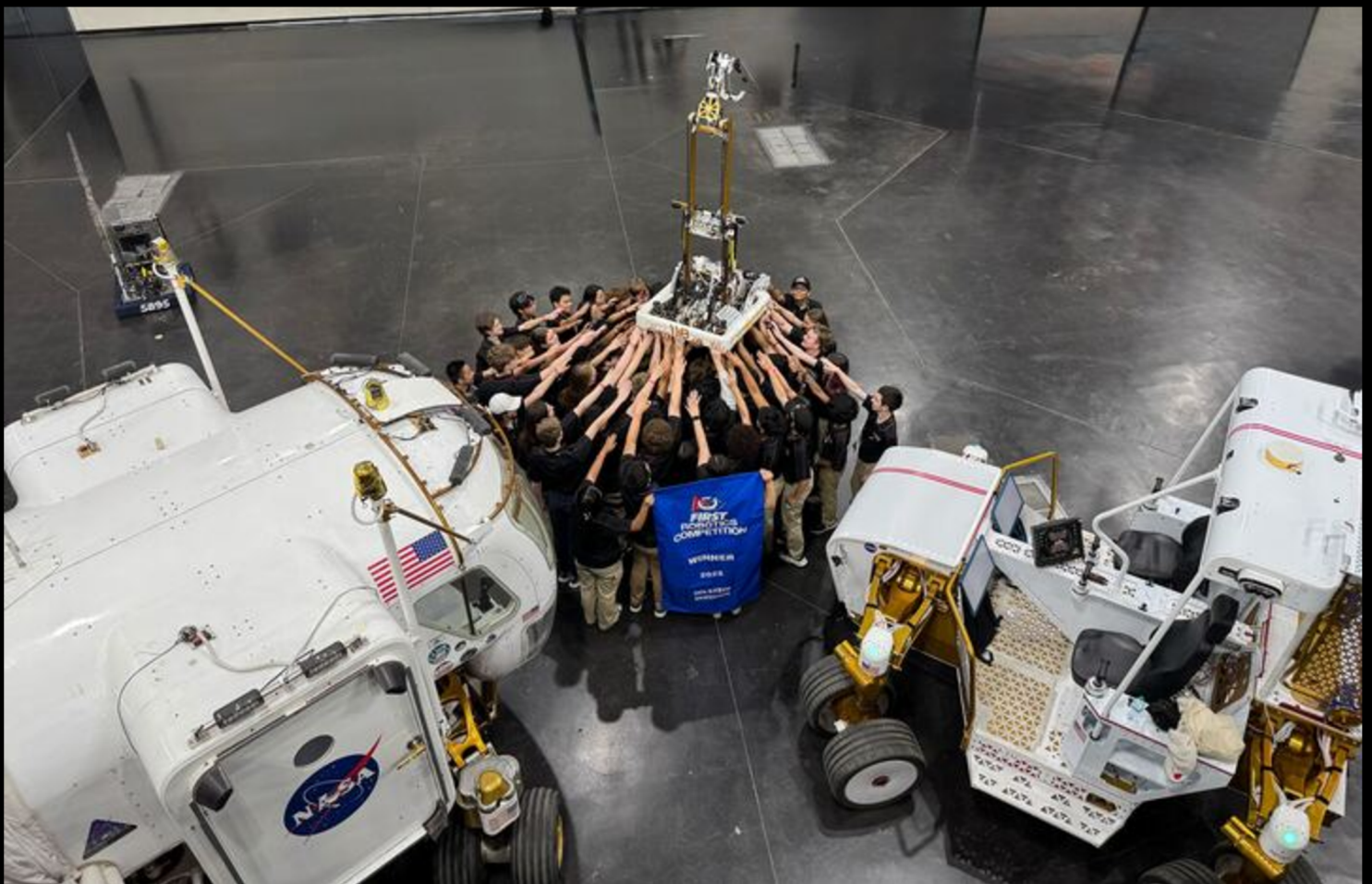


- 18 Channel CAN Node
 - Custom CAN Bus Board to Implement Star Topology
 - One Channel Per Device/subsystem
 - Optional On-Board Termination
- Intelligent Power Distribution Unit
 - Power Distribution to Low-Current Devices (CANcoders, Limelight, Pigeon, etc.)
 - 12V Regulator for Network Switch
 - 6 Switchable Channels using roboRIO DIO Ports
 - Short-Circuit Protection
 - Thermal Shutdown Protection
 - Slew Rate Control
 - ESD Protection
 - Reverse Voltage Protection
 - Status LED for each Channel



SOFTWARE

- *Robot Programmed in C++*
- *Lua scripted autonomous and driver sequences*
- *Automated coral scoring using 2x Limelight 4s*
- *Automated Barge net scoring using Canrange to detect distance to Barge*
- *All branch positions are measured during field calibration period and the real position offsets are adjusted in code to improve automated scoring accuracy*
- *Fully automated climb sequence that uses limit switches in cage intake and robot gyro to automatically climb in less than 2 seconds*



MANUFACTURING

IN HOUSE RESOURCES

- 1x Omax Protomax Waterjet
- 1x Omio X8 CNC Router
- 1x XCarve Pro CNC Router
- 1x Glowforged Pro Laser Cutter
- 1x Langmuir Titan 25T CNC Sheet Metal Press Brake
- 1x Bridgeport Series 1 Manual Mill with DRO
- 1x Precision Matthews 950V-1PH Manual Mill with DRO
- 1x Hardinge HLV Manual Lathe with DRO
- 1x Precision Matthews 1340GT-1PH Manual Lathe with DRO
- 1x Precision Matthews 1022V Manual Lathe with DRO
- 5x Bambulabs X1C 3D Printers
- 4x Bambulabs P1S 3D Printers
- 4x Markforged Onyx One 3D Printers
- 1x Markforged Mark Two 3D Printer
- 3x Prusa Mk3 3D Printers
- 1x Prusa Mk4 3D Printer
- 1X Langmuir MR1 CNC Milling Machine (On Order)

SPONSOR RESOURCES

- 1X Omax 2652 Waterjet
- 1x Amada 4010 CNC Sheet Metal Press Brake
- 1x Atek Bantam CNC Sheet Metal Press Brake
- 5x Markforged Onyx One 3D Printers
- 1x Hardinge Turret Lathe
- 1x Haas VF2 CNC Milling Machine
- 1x Harig Super 612 Surface Grinder

THANKS TO OUR 2025 SPONSORS



