Introduction

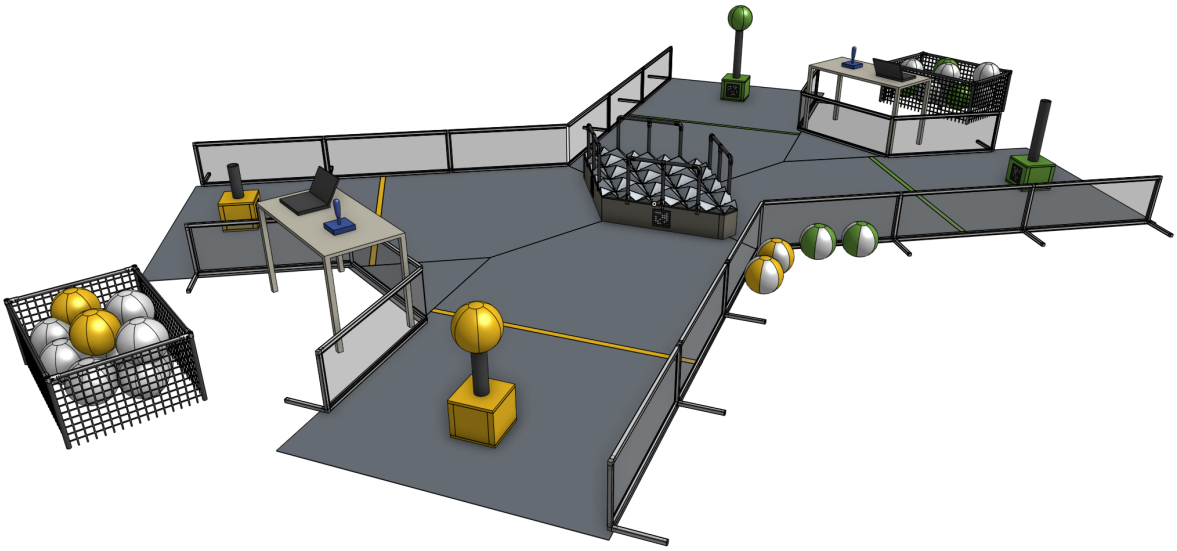
At the atomic scale, all (solid) metals are crystals, with their atoms arranged neatly into rows and layers. Sometimes though the arrangement is not so perfect, and defects in the crystal lattice, known as dislocations, are formed as the metal cools. These imperfections reduce the ultimate strength of the material, by allowing the atoms to more easily slide out of place when a force is applied. While the maximum theoretical strength is reduced, the improved malleability greatly increases the usefulness of metals, allowing them to be formed into useful products.

Few metals are used in their pure form, even gold rings have an alloying element to increase their strength. The addition of different metal atoms into the mix again changes how the atoms slide against each other, creating a wide range of alloys with a range of properties to suit every application.

In this simulation you'll be sliding atoms along rows, and 'alloying' atoms of different types to make a challenging game. Be sure to 'Read The Manual' to fully understand how the scoring works!

This game is dedicated to the late Professor Emeritus Dr. Hugh McQueen from the Faculty of Engineering, Concordia University

Field



The Field is an ‘X’ shaped carpeted area, approximately 30 feet long and 21 feet wide at the largest measure, but only about 9 feet across in the middle. It has 18” walls around the sides, but is open at the points of the X for human player access.

At the crossing point of the X is the Lattice, where up to 16 Atoms can be scored. Around the lattice is a cage which is intended to stop robots from haphazardly knocking balls around.

Atoms are ~12” (inflated) diameter beachballs in one of five styles: Yellow, Green, and White; and Yellow/White and Green/White autonomous bonus Atoms.

An Atom must be properly located on the Lattice to score. Magnets are positioned on the Lattice at the scoring locations, and ball bearings inside the beachball help to arrange them in correct crystalline order.

Atoms are retrieved from atop a weighted Loading Box. Teams must make two support tubes of any length from 4” ABS pipe to hold the Atom atop each Loading Box.

Consult the CAD drawings here for more detailed information.

Game

- Each match lasts 3 minutes. This begins with a 15 second Autonomous Period, followed by 2 minutes and 45 seconds of Teleoperated play.
- Throughout the match, robots attempt to place Atoms on the Lattice in a manner to maximize their score.
- Each team begins with four coloured and eight white Atoms, which can be used in any order.
- Robots begin each match touching their Loading Box, and one Atom loaded on their robot. A second Atom is pre-loaded on the opposite Loading Box.
- Drivers and Human Players may not interact with any controls or game pieces during the Autonomous Period.
- If a team scores an Atom during the autonomous period, that team receives an Autonomous Atom (bi-colour) given to their human player which can be used at any time.
- If a team can score a *second* Atom during the autonomous period, that team will receive a second Autonomous Atom.
- A team may push a row with an Atom and in doing so eject an Atom from the Lattice on the other side. If this occurs the team must release the Atom they possess in the location where this happened. [**Penalty 4 Points**]
- Balls that have been ejected from the Lattice may be pushed by the robot back into a loading zone for a human player to retrieve. They may not be picked up directly by the robot.
- Human players may only load an Atom onto the Loading Box while their robot is in the *opposite* Loading Zone. [**Penalty 4 Points**]
- At the end of a match, when all game pieces have come to rest, the Match Score is determined.

Scoring

Points are earned for each coloured Atom on the Lattice, and for making Rows, Tris, and Mids (RTM) with coloured and white Atoms. Parking your robot in the Loading Zone at the end of the match also earns points.

The team with the highest Match Score wins the Match.

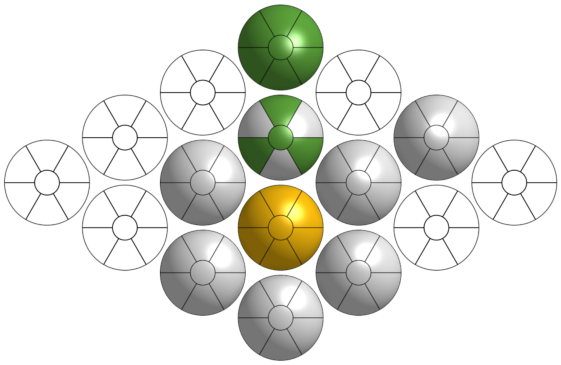
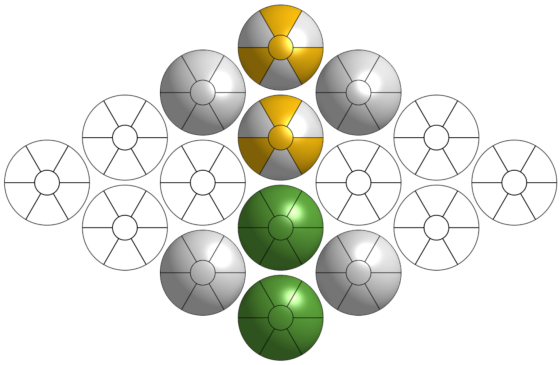
Teams earn 2 Ranking Points for a Win, 1 RP for a Tie, and 0 RP for a Loss.

- Each coloured or Autonomous Atom scored on the Lattice is worth 1 point.
- A Row is scored if one coloured and two white Atoms are in a straight line.
- A Tri is scored if one coloured and two white Atoms form a triangle.
- A Mid is scored if a coloured Atom is in one of the four middle scoring locations.
- Bi-colour Autonomous Atoms are used as white *and* coloured balls in evaluating Rows, Tris, and Mids. An Atom may count as white for one row, and coloured for another,

whichever maximises the score for that team. Autonomous balls of the other team are always considered to be white.

- Before each match starts both teams secretly assign a value of 2, 3, or 4 points to the Tris, Rows, and Mids. This is revealed at the end of the match when the score is calculated.
- A Robot ending the match parked in either Loading Zone scores 5 points.

Examples:

<table>
<tr>
<td> 
Green : 2 atoms + 1 mid
Yellow : 1 atom + 4 rows + 6 triangles + 1 mid</td>
<td> 
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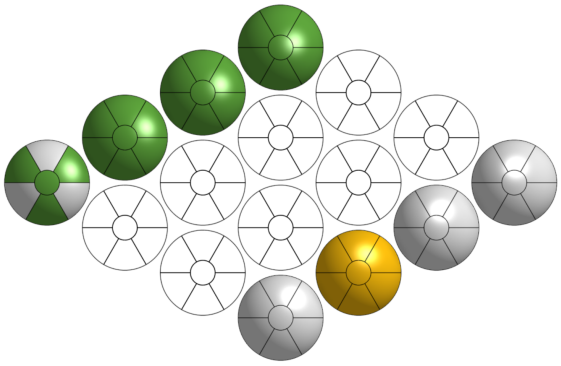
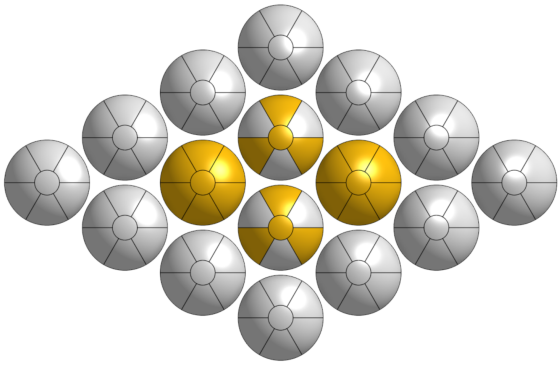
<td> 
Green : 4 atoms
Yellow : 1 atom + 2 rows</td>
<td> 
Green : 0
Yellow : 4 As + 14 R + 16 T + 4 M</td>
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Robot

R1. The Robot perimeter is a maximum of 120 inches.

R2. A mechanism may extend up to 10 inches beyond the Robot perimeter.

R3. There is no weight limit, but be reasonable.

R4. There is no height limit, but again, be reasonable.

R5. Robots must have bumpers covering the entire front and rear of the robot, manufactured in the style of the 2023 bumper rules. Omni-directional driving robots (e.g. Swerve) must protect all sides. Only one set of bumpers of any colour is required.

R6. Electrical & pneumatic construction and safety rules follow 2023 *FIRST* competition robot rules.

R7. Robots must be inspected before the first match. Inspectors will indicate any changes that must be made before that robot is allowed to play. Changes made during the competition require a re-inspection.

Tournament

T1. The tournament is divided into two parts, the Qualification and the Playoff rounds.

T2. During the qualification round, teams play randomly assigned matches. All teams play an equal number of qualification matches.

T3. Each team must use 4 drive teams (red, blue, purple and orange), each consisting of 1 or 2 student drivers and 1 student human player. Drive team colours will be listed in the match schedule.

- An individual may not be on more than one drive team or change teams during the Tournament.
- A team will not be allowed to play a match without the correct drive team.

T4. There is no restriction on drive teams during the playoffs.

T5. A coach is permitted at the driver station. The coach may be an adult, and is not restricted by the drive team colour rules.

- The coach must be wearing the coach button.
- The coach may not touch any of the robot controls except to e-stop during an emergency.

T6. Drive teams and coaches must remain at their driver station during the entire match.

T7. At the end of the qualification matches, the final ranking will determine which teams move into the playoffs. Ranking is determined by the teams' cumulative Ranking Points.

Awards

T.B.D.