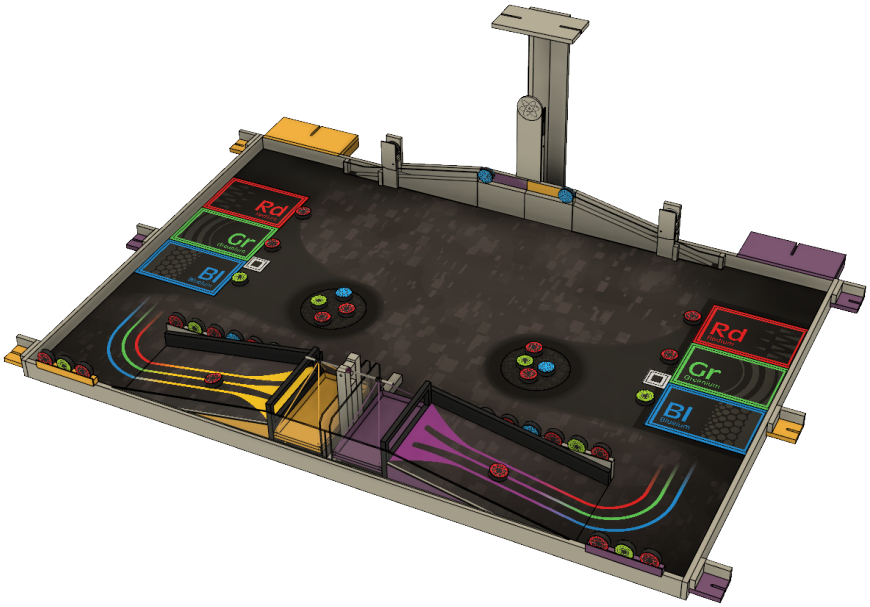
Eurobot Open 2019 Rules

26th edition of the robotic contest - Eurobot
BETA version

ATOM FACTORY



NOTE: all images in this document are provided as a guide to illustrate the various paragraphs. In no case they can serve as a reference. Only the dimensions, colors and materials indicated in the appendix shall be taken into consideration.

. Contents

A. NOTICE

WARNING!

General remarks are also annotated in the document. Please, pay special attention to these points.

This year the rules have been split up. Most parts remain the same for the Eurobot Open and Eurobot Open Junior contests, but to avoid confusion, each contest has its own rules as a single document.

Thus the particular cases inherent to one or the other of the competitions appear only in the document concerning it.

You will find the Eurobot Open and the Eurobot Open Junior rules and other information on the Eurobot Open website (http://www.eurobot.org/)

Please note that the version of this release is noted down at the end of this page. For any inquiry, only an official version should be considered.

Have a good reading!

B. CONTEST PRESENTATION

Eurobot[Open] and Eurobot[Open] Junior are two events adressed to teens and students interested in robotics. Teams are usually composed by students involved in an Eurobot[Open] school project, a group of friends, or independent robotics clubs. They share the same goal: To offer young people an active learning process, to put into practice their knowledge and know-how during a fun and friendly event.

The rules for both events (Eurobot[Open] and Eurobot[Open] Junior) are based on the same concept. As organisers, we intend to provide a common platform for the Eurobot[Open] event. This platform is dedicated to autonomous robots for Eurobot[Open] while for Eurobot[Open] Junior, the robots are wire-guided. In this way, a Eurobot[Open] organiser can easily set up a Eurobot[Open] Junior contest and vice versa. Remember this when you will be organizing your official or unofficial event.

You're currently reading version
Eurobot[Open] BETA
of 2019 rules
(this version concerns fully autonomous robots)

The age limit for participating in the Eurobot[Open] Finals is 30 years. However, each team may have a supervisor whose age limit exceeds 30. It is important to note that teams that do not respect the age limit, will not be allowed to participate in the Eurobot[Open] Finals.
The technical challenge of Eurobot[Open] is to build an autonomous robot alongside with an optional secondary autonomous robot.

A team is a group of young people who have built one or two robots for the event. A person can only represent one team. However, we encourage teams to share their expertise and knowledge.

An organization (club, school, etc.) can supervise and register several teams, if allowed by the registration requirements set by your National Organizing Committee. The acceptance of these requirements is compulsory to validate your registration and your entry.

The project can be supervised by someone over the age limit (teacher, parent, group leader, etc.), but all elements of the robot(s) must be designed by the participants. In this context, robots manufactured from a commercially purchased chassis or rolling base will not be accepted.

In the event that a robot was imagined, built or modified by the tutor alone, organisers can disqualify or reject the participation of the team in the competition. Students must be capable of describing and explaining the manufacture process of their robots. It is strictly forbidden that the tutor modifies the robot during the competition, he can in exchange advise the students and guide them.

Eurobot[Open] and Eurobot[Open] Junior must take place in a friendly, fair-play spirit. As for every sport event, referees' decisions are pronounced without a possible recourse, except if an agreement between all stakeholders is met.

Eurobot[Open] and Eurobot[Open] Junior European Finals gather teams selected after national qualifications. National qualifications take place in Europe, but remain [Open] to all countries. Countries where more than three teams are registered, must organize a national qualification, in order to select teams that will attend the European Finals.

Common parameters can vary from one year to another. Accordingly, please read the rules carefully even if the chapters may seem familiar to you (playing field dimensions, robots dimensions, starting area dimensions etc.).

Robotics contests are public events. Therefore, we ask the teams to respect our rules of decency and safety (electrical, sound level, ettiquete, etc.). These rules apply to the participants, their supporters and all the equipment they bring.

C. THEME PRESENTATION

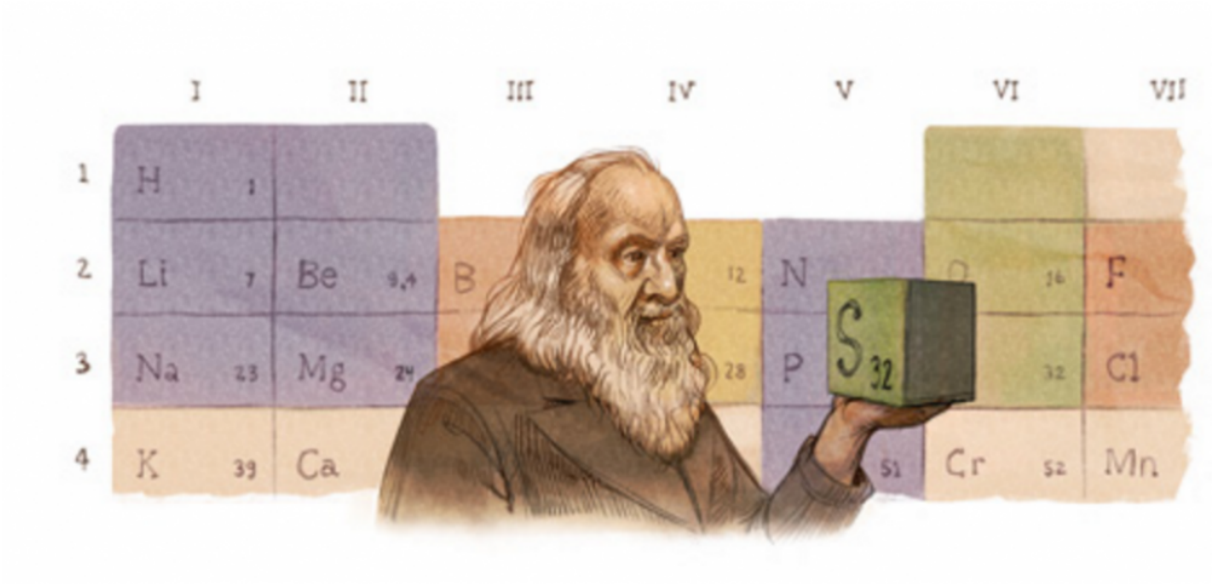


Figure 1 – Dmitri Mendeleev
https://en.wikipedia.org/wiki/Dmitri_Mendeleev

150 years ago Dmitri Mendeleev revolutionized our understanding of the matter, by taking a giant leap forward to sciences once he published his work on the classification of elements.

With his famous Periodic Table he pointed out the composition of atoms and introduced the concept of "void". Few new atoms were discovered since he first published his work, guaranteeing Mendeleev's precision!

Besides the known elements Mendeleev has predicted a century ago, we still have atoms that are unkown. Discovering new atoms can be a difficult task and often requires complex experiments.

Today, we need the help of your robots to do these experiments!

Your missions will be:

- **Classifying atoms.** As in the Periodic Table you'll have to select and classify atoms.
- **Weighing atoms.** Often the rarest atoms are the ones that weigh most, so be careful what you choose.
- **Creating a new element.** And for that nothing beats a good Particle Accelerator.
- **Do your own experiments.** You're free to propose your own experiment!
- **Predicting unknown elements.** Since Dmitri Mendeleev predicted the existence of unkown elements, you can also make a prediction... of your own score for example!

Warning! All actions are independent from one another and no specific sequence is imposed whatsoever. No single action is compulsory. Give careful thoughts to your strategy. It is strongly recommended to design simple and reliable systems over a limited number of actions.

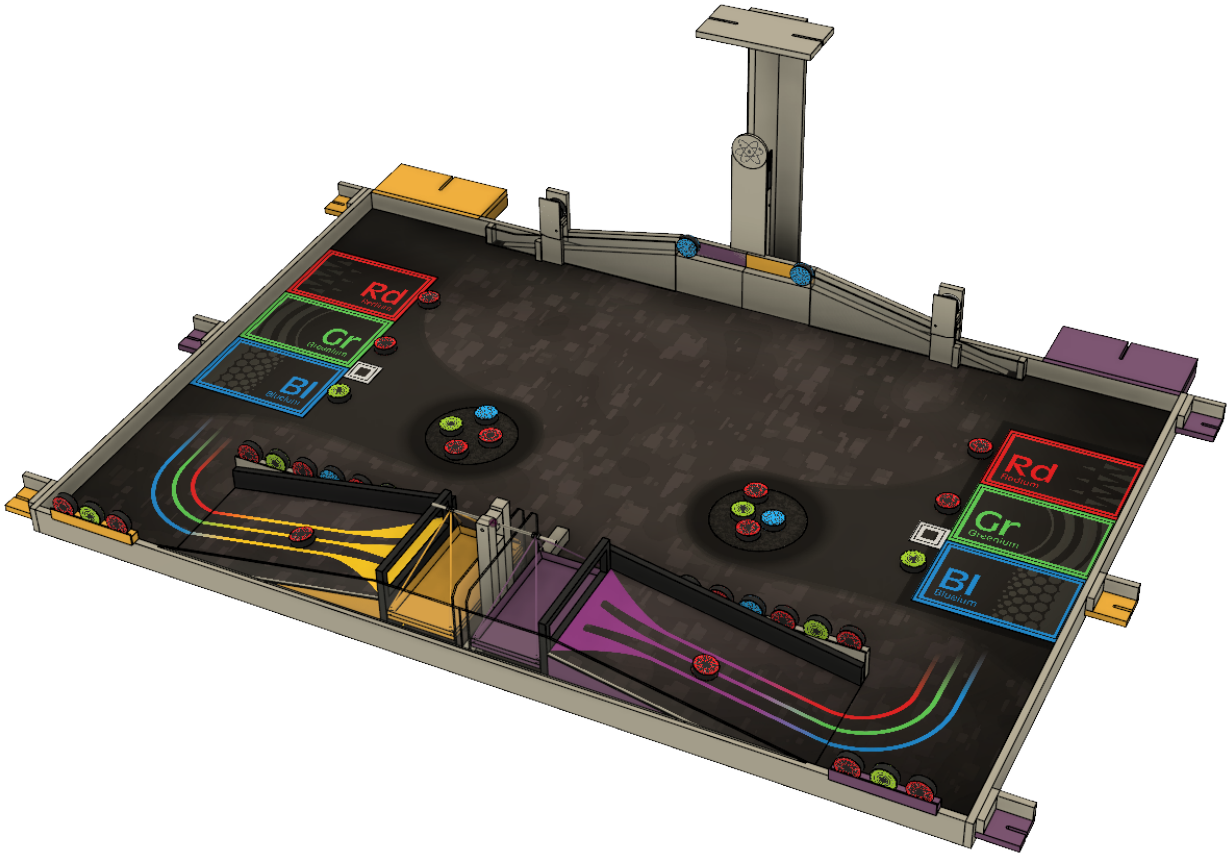


Figure 2 – Overview of the playing area

D. PLAYING AREA AND ACTIONS

D.1. IMPORTANT INFORMATION

Organisers intend to build the playing area with as much accuracy as possible. Nevertheless, they reserve the right to do minor modifications and adjustements. In case these modifications are necessary during the fabrication process, please make sure you follow our updates.

No objections regarding differences in dimensions will be taken into account.

Teams are warned that the surface quality may differ from one playing area to another and may also degrade over time.

Some modifications or improvments can be made on the rules during the year. We therefore strongly encourage all participants to check our website regularly (http://www.eurobot.org/) as well as your NOC's own website for news. You can also follow discussions, ask questions or get further assistance on our forum (http://www.planete-sciences.org/forums/).

Possible changes of the technical specifications will be announced on the Eurobot website, (http://www.eurobot.org/) or on the website of the National Organization Committee (NOC) in your country.

All answers from the forum are provided by an official referee and are taken into account during match plays and approval rounds.

D.2. ATOMS

As you know already, atoms are the core of the matter. At first sight, they are all identical but in reality they differ from one to another. We can distinguish them on their atomic mass. The genius of Dmitri Mendeleev is that he realised how to classify their weight according to the atomic mass and explained the rules that govern their interactions. Atoms are the only playing elements present on the playing area. Robots have to collect and differentiate them in order to score a maximum of points.

D.2.a. DESCRIPTION OF THE PLAYING ELEMENTS

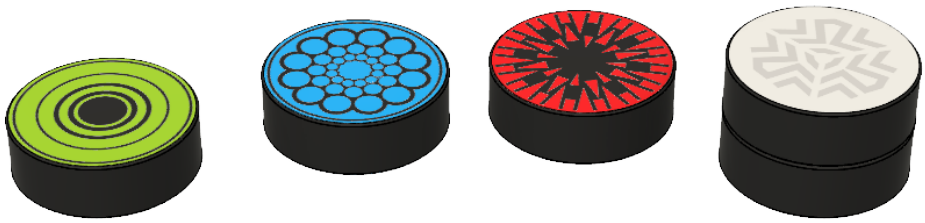


Figure 3 – Playing elements - Atoms

Atoms are represented by rubber ice hockey pucks. There are 4 types of atoms, weighing each a different mass:

- **Redium** (Figure 12), standard, very common and very light, it weighs 60 g.
- **Greenium** (Figure 12), standard, common but a little heavier, it weighs 120 g.
- **Blueium** (Figure 12), standard, rather rare and rather heavy, it weighs 170 g.
- **Goldenium** (Figure 13), special, extremely rare and heavy, it weighs 340 g.

There are 36 standard atoms on the playing area, and 2 additional special atoms (Goldenium), with a total of 38 playing elements.

The 38 standard atoms are shared with both teams, but their initial placement may guarantee the access to some atoms for only one team. For example, some atoms are initally placed in a distributor dedicated to a specific team.)

D.3. PLAYING AREA

The playing area is a horizontal rectangular plan of 3000 mm by 2000 mm with borders on each side. Depending on the carpenters, it may consist of a single piece or several pieces to assemble (eg 3 pieces of 1000 mm per 2000 mm).

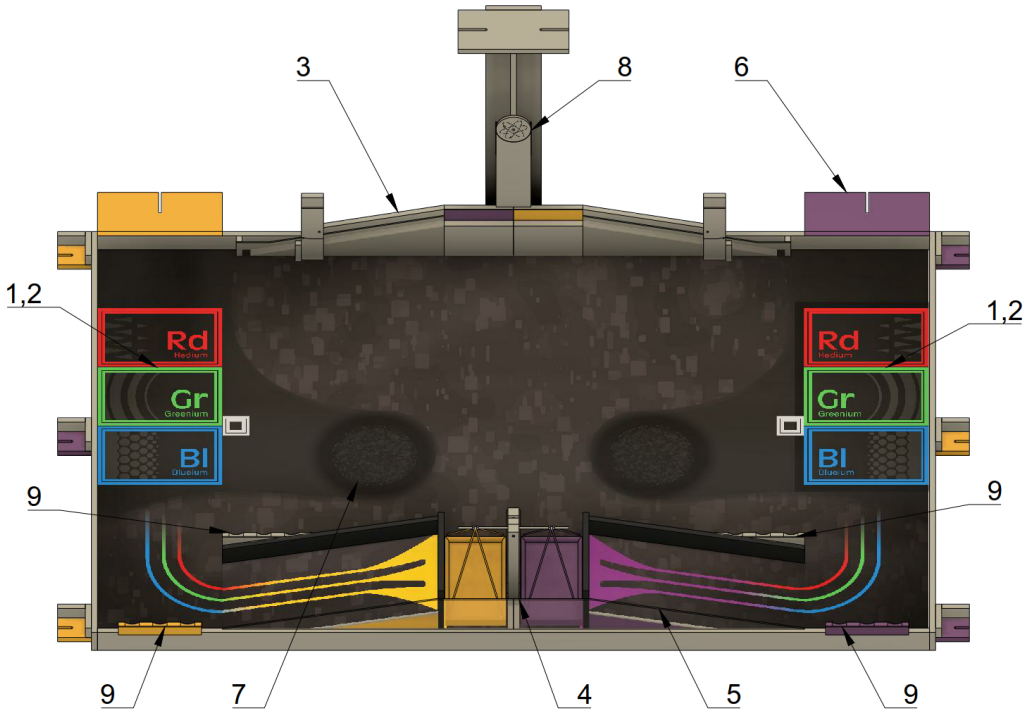


Figure 4 – Detailed view of the playing area

1. Starting areas
2. Periodic table
3. Particle accelerator
4. Weighing scale
5. Access slope for the weighing scale
6. Experiment area
7. Chaos area
8. Oxygen atom
9. Atom distributors
10. Fixed beacons supports
11. Central tracking device

Chaos area: There are two chaos areas drawn on the playing table. Each area contains 4 elements: 2 atoms of "Redium", 1 atom of "Greenium" and 1 atom of "Blueium". Those atoms are placed horizontally and randomly positionned in the area.

Atom distributors: they are linear supports in which the atoms are placed on the edge. Their are 4 atom distributors. 2 large ones which are shared with both teams and 2 small ones which are reserved exclusively for one team which is painted in the concerning teams' color. They are composed as follows:

- The small distributor: 2 atoms of "Redium" and 1 atom of "Greenium"
- The large distributor: 3 atoms of "Redium", 2 atoms of "Greenium" and 1 atom of "Blueium"

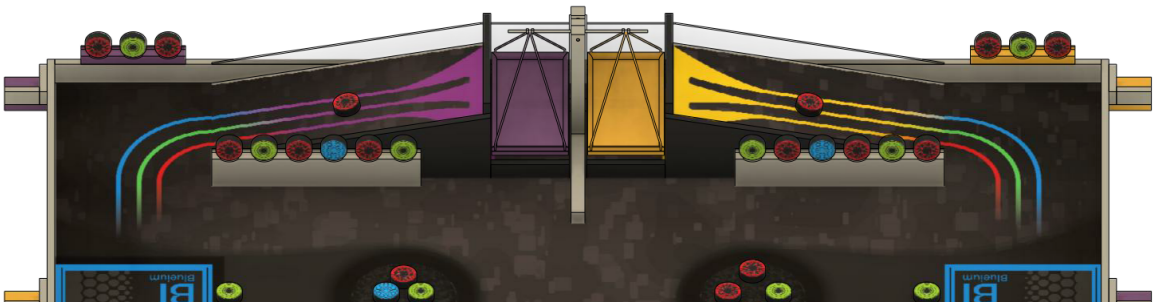


Figure 5 – The distributors

Full specifications of the playing area and game elements (dimensions, positions at the beginning of the match, colors and other references) are listed in the appendix.
In the rest of this document, horizontal and vertical directions are stated relative to the playing area. Notions of left, right, front and back are stated with respect to the spectator's point of view.

D.4. STARTING AREAS

D.4.a. DESCRIPTION

Each team has a part of a periodic table, which will serve as a starting point.

(a) A-team starting area

(b) B-team starting area

D.4.b. CONSTRAINTS

The starting area of a team is included inside the periodic table of the team. Be careful, the starting area consists only of the two first cells of the periodic table, which are the **cells of "Redium" and "Greenium"**.

Before the beginning of the match, the vertical projection of the robots must not exceed the limits of the starting area.

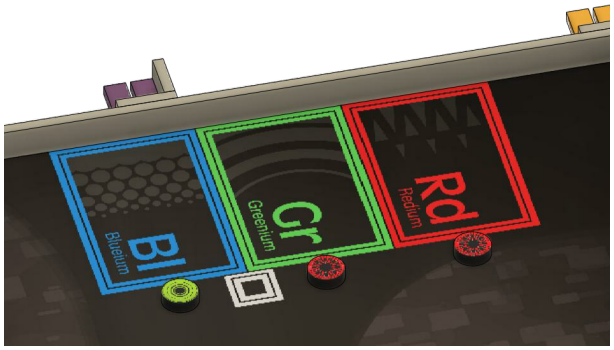
Make sure your robots can enter the starting area completely. Be careful, the edges of the playing area are excluded from the starting area.

The robots are not allowed to enter the starting area of the opposing team during the entire match.

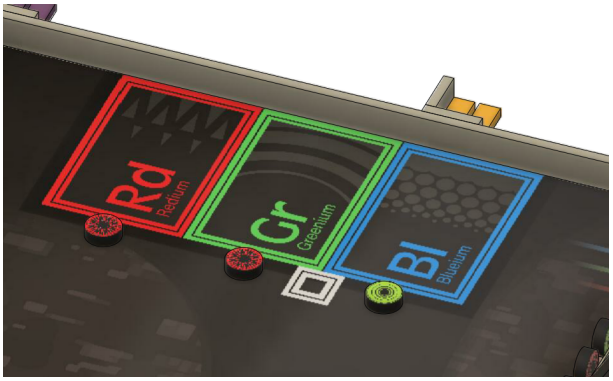
D.5. ATOM CLASSIFYING

Help Dmitri Mendeleev place the atoms in their right compartment of the periodic table.

D.5.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS



(a) A-team cells of the periodic table



(b) B-team cells of the periodic table

The atoms: All atoms previously described are at your disposal on the playing area.

The cells of the periodic table: For each team, a periodic table is available and placed on each side of the playing area (it includes the starting area). Each of those periodic tables is composed by 3 big cells corresponding to the 3 standard elements and one small cell for the atom of "Goldenium".

- The red "Redium" cell, to classify atoms of "Redium"
- The green "Greenium" cell, to classify atoms of "Greenium"
- The blue "Blueium" cell, to classify atoms of "Blueium"
- The white small "Goldenium" cell, to classify atoms of "Goldenium"

D.5.b. ACTIONS AND CONSTRAINTS

Actions: You must classify the atoms of the playing area on your own cells of the periodic table.

Constraints:

- To be valid, the vertical projection of an atom must be located at least partially on any cell of the periodic table. It must be also in contact with the playing area or with another valid atom.
- An atom can be place in any cell of the periodic table. But, if the atom is in the correct cell, it will earn more points.
- It is strictly forbidden to remove the atoms from the cells of your opponent's periodic table.
- The robots are not allowed to enter the periodic table of the opposing team during the entire match.
- In front of each cell of the periodic table of a team is located an atom on the floor at the begining of the match. Those three elements are 2 atoms of "Redium" et 1 atom of "Greenium". The arrangement of elements in front of the periodic table cells are random and changed at every new match. The draw is performed by the referees before starting the match and is identical for the both teams.

D.6. ATOM WEIGHING

In order to highlight elementary chemical properties, Dmitri Mendeleev had the idea of classifying atoms according to their atomic mass. In order to do this, he needed to know the mass of each element!

This is why, the robots can access of a weighing scale.

D.6.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

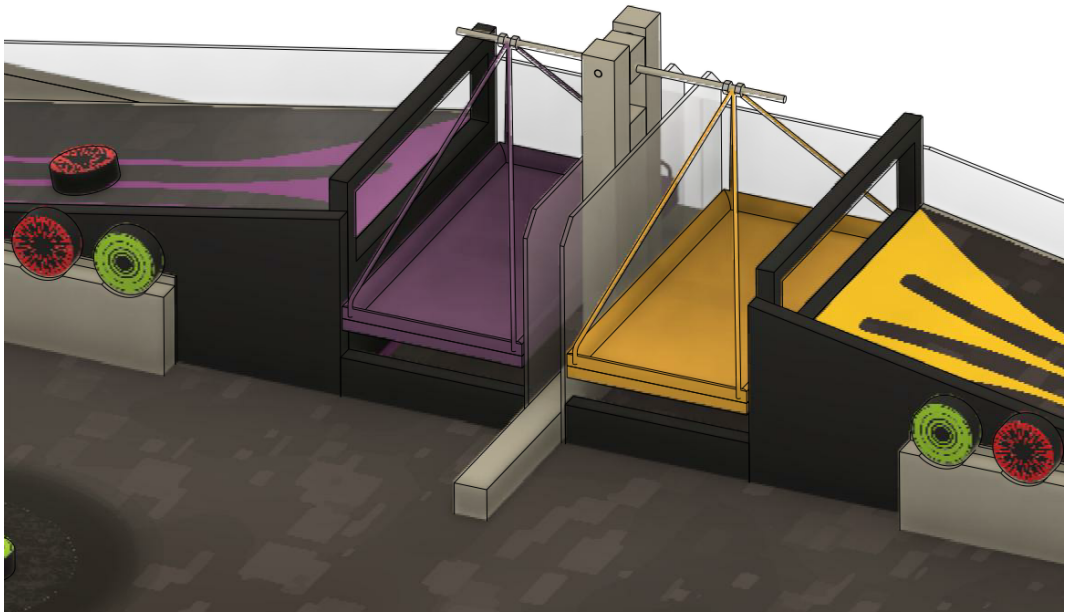


Figure 8 – Overview of the weighing scale

The weighing scale: In front of the playing area, are placed two **weighing trays** (one for each team). Each weighing tray can move up and down and remains horizontal as an weighing scale of type "Double-Pan Balance Scale".

The weighing tray is composed of a flat surface and a border around it. Its movements are limited in amplitude, the altitude of the top of the border compared to the surface of the playing area can vary from 80mm to 150mm.

The ramps Each team has at its disposal a **ramp** at the front of the playing area, which can help robots to place the atoms into the scale.

D.6.b. ACTIONS AND CONSTRAINTS

Actions: Robots have to pick atoms and place them on the weighing scale. The heavier atoms will bring more points to a team than the lighter ones!

Constraints:

- To be valid:
  - the vertical projection of an atom must be located at least partially on the weighing tray
  - An atom must be either in contact with the weighing tray of the weighing tray or in contact with another valid atom.
- Each tray may contain up to 6 atoms.
- In the event that a team dispose more than 6 atoms on the weighing scale, only the 6 lightest atoms will be considered. Consequently, the removed heavier atoms will not be taken into account.

- It is strictly forbidden to place or remove atoms on the tray dedicated to the opponent.
- When climbing the slope, robots are no longer subject to the height constraints of the regulation.
- Any element or robot hindering the proper functioning of the scale after the end of the match (blocked atom, robot that lingers over...) can be (re)moved by the referee in order to count correctly the points on the scale. A team can be disqualified if it tries to influence the opposing team's score.

D.7. PARTICLE ACCELERATOR

Usually particle accelerators impart an enormous source of energy to atoms, which has the effect of accelerating them to a speed very close to the speed of light. At this speed, a collision between several atoms can potentially create a new element, until then unknown.

Let's see if our robots are able to create new elements!

D.7.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

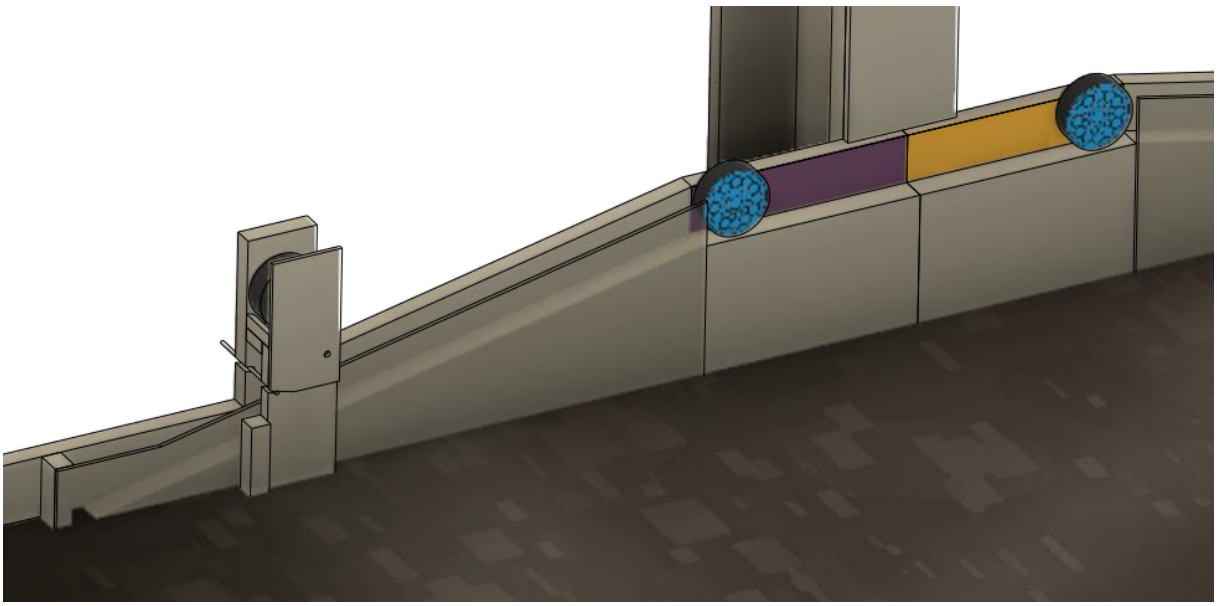


Figure 9 – Particle accelerator

The particle accelerator: it's a linear ramp where it's possible, on its top surface, to put a atom on its edge. So it's possible for the atom to accelerate freely towards the bottom of the ramp. Each team has at its disposal its own particle accelerator.

The particle detector: located on top of the particle accelerator. When an atom crosses it, it opens a trapdoor which liberates a new atom, the "Goldenium".

At the beginning of the match, an atom of "Blueium" is pre-positioned at the top of the accelerator, ready to be launched. The atom of "Goldenium" is positioned in the closed particle detector.

D.7.b. ACTIONS AND CONSTRAINTS

Actions:

- Robots can collect standard atoms by placing them into the particle accelerator.
- A standard atom must pass through the detector to unlock access to the "Goldenium".
- Robots can collect the "Goldenium" in their detector, once it's open, to use it on other actions on the playing area.

Constraints:

- Only the atoms present in the particle accelerator will be taken into account for the counting of the points. The atoms must be in contact with the slope of the particle accelerator, the flat area of the team color at the top of the slope is not part of it.
- It's strictly forbidden to unlock the mechanism other than by passing an atom through the particle accelerator detector.
- It is strictly forbidden to remove the "Goldenium" without having unlocked the particle accelerator detector.
- It is strictly forbidden to put atoms in the particle accelerator of the opposing team. It is also forbidden to recover the "Goldenium" stored in the opponent's particle accelerator, as well as the pre-positionned atom at the top of the opposing particle accelerator.

D.8. PERFORM AN EXPERIMENT

D.8.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

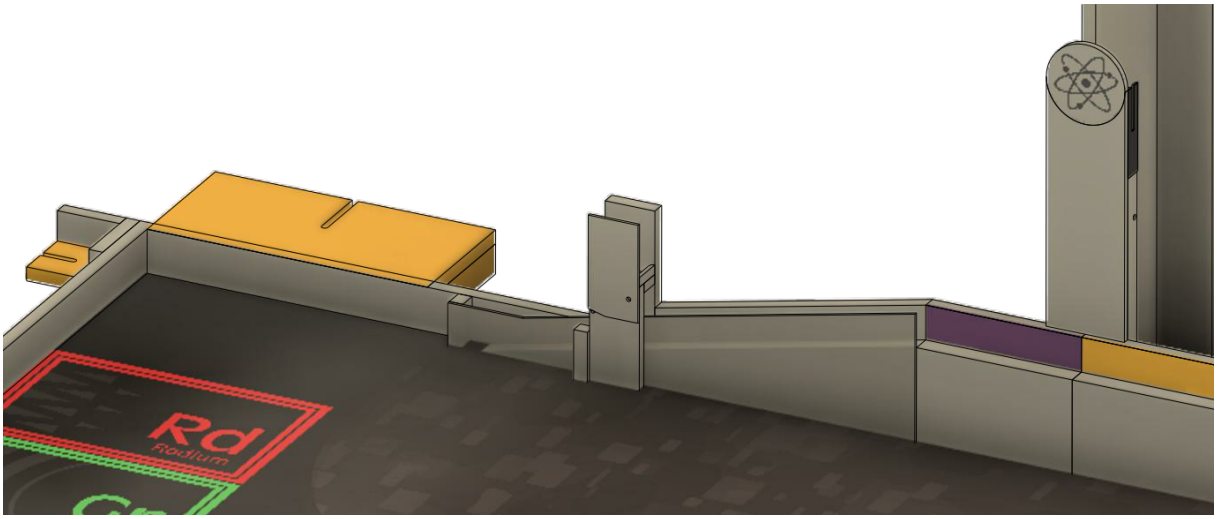


Figure 10 – The experiment area and oxygen atom example

The experiment area: located at the back of the playing area, on the same side of the starting area of the team. The horizontal plane of the experiment area is on the same level as the top of the playing area border.

Oxygen atom: It is a decorative part whose design will be left free to the organizers of each contest. It located on the top of masts near the center at the back of the playing area.

Ionic bonding: is represented by a cord, going from the oxygen atom and tight towards the experiment area and fixed to the experiment itself. It is up to the team to provide this cord.

The electron: it's an element, designed by the team, which is to be moved from the experiment area to the oxygen atom.

D.8.b. ACTIONS AND CONSTRAINTS

Actions:

- The teams must drop off their experiment on the dedicated area during the preparation time.
- During the match the experiment must be activated by any system of the team's choice.
- When the experiment has been activated, an electron, made by the team, must follow the cord until it join the oxygen atom in the middle of the playing area.

Constraints:

- The experience can not be activated by an element external to the playing area (team member, remote control from the public, etc.).
- At any time the vertical projection of the experiment must be inside the limits of the experiment area.
- Consequently, the experiment will have the following maximum dimensions:
  - Depth: 222 mm;
  - Length: 450 mm;
  - Height: 200 mm.
- The weight of the experiment must not exceed 2.5 kg.
- The experiment is allowed to be deployed towards the top during the match. The height, after deployment, is 500mm maximum. This deployment can only happen only after the experiment has been activated.
- The horizontal plane of the experiment area has to be pierced with a 10mm wide groove, going from the center of the support to the middle of the rear side. This groove allows the passage of a threaded rod of 8 mm diameter, fixed vertically on the experiment. A butterfly nut placed on this threaded rod, will help fix the experiment on its support in a fast and reliable way.
- The mast has vertical groove going 70 mm down from the top of the mast, in order to pass the cord. Below, a hole can help you attach the cord.
- The cord must be provided by the team. Its section must not exceed 8 mm.
- The cord must be long enough to go from the experiment to the mast. It must be slipped into the mast groove. On the other side, the team is in charge of achieving fixation with experiment. A mark must be drawn on the cord at 50mm from the end of the side of the mast to allow referees to validate the action.
- The experiment may contain one and only one electrical power supply source. In that case, an emergency stop button directly cutting the power supply must be equipped with the experiment. It must also be clearly visible and easily accessible.
- The activated experiment must be visible from the public. It can be a lighting, a mechanical action or other. The public must be able to easily notice that the experiment is activated or not, even after the end of the match.
- The electron will have the maximum dimensions of: **150x150x150mm.**
- The weight of the electron must not exceed 400 g.
- The electron is an autonomous element so nothing must exceed its perimeter. On the other hand, he may be in contact and/or inside the experience at the beginning of the match.
- The electron must arrive at the oxygen atom (within 50mm of the mast) before the end of the match and remain there, and the experiment must have been activated to consider the action validated.
- No elements of the experiment (cord, electron, etc.) should interfere with the access or use of the particle accelerator of the opponent team.
- The action should not be dangerous for the public, people around the table, the playground or the robots involved.
- The experience can only be activated during the match.
- The experience may include a screen but is only allowed to display information about the current match. It should not display any video, images, photos that are linked to the current match or advertisements.

D.9. PREDICT YOUR OWN SCORE

Just as Dmitri Mendeleev has predicted the existance of unknown elements in the Periodic Table. Also, You will have to predict the unknown. Your own score for example!

D.9.a. DESCRIPTION AND LAYOUT OF THE PLAYING ELEMENTS

The device for displaying the score estimation made during the match must be make by the team:

- It can be static (sheet of paper, slate, Etc.).
- Or dynamic (electronic display); located either on the robot or on the experiment (please make sure that the experiment is activated).

D.9.b. ACTIONS AND CONSTRAINTS

- The team must evaluate the number of points made in the match by its robot(s). For this, two exclusive options:
  - Pre-match evaluation on a static display: the team writes the score it intends to make during the match.
  - Evaluation during a match on a dynamic display device.
- The display area and its sense of reading must be easily visible and identifiable by the referees.
- The estimated score must be expressed in decimal.
- It is allowed for a team with two robots to design a display for each robot. In this case, his score assessment will be the sum of the values of the two displays.
- In the case of dynamic displays, the estimated score must continue to be displayed after the end of the match.
- The score must not change after the match has finished, otherwise the bonus will be lost!

E. PROJECT PRESENTATION

Both Eurobot^{Open} and Eurobot^{Open} Junior encourage participants to practice science in a funny and original way. Our main objective is to assist and value your projects conceived during the year. To achieve this, participants are asked to create a technical presentation and a technical poster of their robots.

We expect to see attractive, innovative robots that respect this edition's technical contraints and rules. Being creative and original will add value to your efforts as much as the performance of your robot(s) during the matches. By doing this presentation, you will increase the communication value of your project and the visual effect of your robots, for both the public coming to the events as well as for your own satisfaction. Having created something aesthetically and functionally complete, will strenghten your work attitude during and after the competition.

TECHNICAL POSTER

Each team is required to provide a technical poster of their robot. This poster should present information related to the design of the robot (drawings, technical references, design specifications, etc.). It should be at least size A1 (594x841 mm) and ideally it should be printed. This poster is intended to encourage exchange and communication between teams.

Special vulgarization efforts should be made to make the content of the poster accessible to the general public. Ideally, the poster should include pictures and charts to explain the concept.

The poster must also include:

- The name of the team
- The names of team members
- The country of the team
- The country flag of the team

This poster will be posted on the booth of each team during the competition. For the international Finals, an English version is be requested. The chosen resolution must guarantee the legibility of all texts. The resulting PDF file must not exceed 25 MB. The PDF version of the poster may be sent to the organization prior to the meeting via your National Organizing Committee.

In general, the organization encourages teams to communicate around their projects on the Internet, social media, via forums, etc.

F. THE ROBOTS

F.1. FOREWORDS

Each team is allowed to register a maximum of two robots which are referred to as the main robot and the secondary robot. The secondary robot has different dimensional constraints.

For Eurobot^{Open}, both robots are autonomous.

The construction of a secondary robot is optional. The aim is to allow teams with a large number of members to work on a second project. It is recommended for beginning teams to concentrate on building a single functional machine. Having one robot that works well is better than having two that do not move.

A secondary robot can compete only with the main robot with which it was designed and approved. However it can compete alone if the main robot cannot participate. It cannot be re-homologated with another main robot.

A team's main or secondary robot must not block the other team's robots. In the event of a voluntary action of this type indicated by the referee, the team may be penalized.

A robot must not intentionally cause damage to the opposing robots or to the playing area and its elements.

Only two members of the team are allowed to enter the backstage and on stage. They transport all the equipment (robots, experience, etc.). The path to the playground may include stairs, especially when entering the stage. It is therefore recommended to design easily transportable equipment.

The main robot and the secondary robot must be composed of independant complementary elements. Robots cannot deposit parts or elements on the playing area, except for the play elements.

Robots must not attach themselves on the playing area (e.g. with a suction cup).

A robot must not prevent the opponent from scoring points. If the robot remains static (e.g. if it has finished an action), it must move as far as possible to a location that does not disturb the opponent, otherwise it risks getting penalties!

A game element can be moved:

- for the purpose of scoring points with;
- if justified by performing another game action (e.g. if a common game element is located on the robot's path). The number of the displaced elements (especially from their starting position of the match) must remain minimal.

Deliberately vibrating the table or any other irregular action exposes the team to a refusal of homologation. If in doubt, contact the refereeing committee!

Be imaginative! For example, as an innovation but also to offer the public and the media an attractive show, your robot can use sounds, display expressions, etc.!

F.2. DIMENSIONS

Warning: the dimensions of the main robot and the secondary robot of Eurobot^{Open} are identical to those of Eurobot^{Open} Junior. Eurobot^{Open} Junior participants can more easily access the Eurobot^{Open} meetings. The Eurobot^{Open} Junior robot will only need modifications to make it stand-alone.

Dimensions of the main robot and the secondary robot:
The perimeter of a robot is measured by surrounding it as shown in the illustrations below:

Dimensions of the main robot:	Dimensions of the secondary robot:
 Not deployed <= 1200mm Deployed <= 1500mm	 Not deployed <= 850mm Deployed <= 1050mm

The perimeter of the main robot must not exceed 1200 mm at the departure time. The perimeter of the fully deployed main robot shall not exceed 1500 mm during the match.

The perimeter of the secondary robot is independent of the one of the main robot. It must not exceed 850 mm at the time of the start and 1050 mm when it is fully deployed during the match.

At any time during the match the height of the main robot and the secondary robot shall not exceed 350 mm. However, it can be tolerated that the emergency stop button exceeds this limit height to reach 375 mm.

This height excludes the beacon support mast, any sensors and associated electronic circuits integrated under the beacon support mast.

When the robot manipulates an object, the height of this object cannot exceed 350mm in order not to disturb the use of the beacons.
At the beginning of a match, in the start configuration, the vertical projection of both robots on the playing area must fit inside the starting area and must not exceed its limits.

F.3. ENERGY SOURCES

All potential sources of energy stored in the robot are permitted (batteries, springs, compressed air, gravitational energy, etc.), with the exception of sources of energy using chemical reactions such as combustion or processes pyrotechnics, which are prohibited for safety reasons.

In addition, the use of corrosive products is strictly prohibited, whereas liquid splashes are not permitted.

If you have any doubt about unconventional energy sources, ask the arbitration committee as soon as possible, providing the corresponding datasheets.

In order to avoid any risk of fire, attention should be paid to the choice of the conductors, depending on the intensity of the currents passing through them. It is also strongly advised to protect the electrical installation with a fuse, wired close to the batteries.

Battery:
If the team chooses a battery power supply, we recall that only sealed batteries can be used.

Teams must be able to play three games in a row. Note that this includes the time required to set up, during which the robot will be powered and awaiting the start.

As a result, we strongly recommend teams to carry several sets of batteries and provide easy access to the batteries in the robot for their change. The teams are reminded that it is essential to have a set of spare batteries, fully charged and available at all times.

Note on the use of Lithium-based batteries:
Lithium batteries are known for their lack of stability and can easily ignite when certain precautions are not taken.
This type of battery is therefore authorized under the following conditions:

- Charger suitable for presenting approvals
- Batteries kept in certified and unmodified fireproof bags: when in the robot or on the stand, even in storage !
- a system for detecting underloads is highly recommended.
- exception in the case of the following batteries, authorized without the conditions listed above:
  - Lithium batteries for LEGO Mindstorm / laptop / mobile phone, provided that they have not been dismantled and are used for the intended purpose of the manufacturer
  - Lithium-Iron batteries (LifePo4)

F.4. OTHER DESIGN CONSTRAINTS

F.4.a. COMMON TO BOTH EVENTS

Visibility: A rectangular space of 100 x 70 mm per robot must be left free on one of the side faces. As far as possible, this space must be visible from a camera located at the height of the playing field. It must also be visually accessible during the majority of the match. The teams will receive stickers printed by the organization (team number, sponsors etc), which they have to place on these open spaces.

Teams are strongly encouraged to make all element manipulations visible from the outside. By doing this, you allow the audience and the cameras that film the event, to see how the transport of your game elements works.

Starting cord of autonomous robots: Robots must be equipped with a starting device easily accessible. This devicehas to be triggered by pulling the end of a cord at least 500 mm long. This cord must not stay attached to the robot after departure.

No other starting system (remote control, manual rocker switch, etc.) will be approved.

The start of one robot can launch the other robot.

Emergency stop button of autonomous robots Autonomous robots must be equipped with an emergency stop button at least 20 mm in diameter and red in color. It must be placed on the top of the robot in a visible position and in a non-risking area to be immediately accessible by the referee at any time during the match.

The button, in its state of rest, may exceed the robot's regulation height of 25 mm. The emergency stop button must be operated by a simple downward movement (for example, by hitting it with the fist).

Pressing this button must stop all robot actuators immediately !

Automatic shutdown Each robotmust be equipped with a system that stops the movement of the robot and all its actuators, automatically at the end of the 100 seconds (a match's duration). The dynamic displays that are present on the robots, can remain on.

Avoidance system (optional for Eurobot^{Open} Junior) All teams are required to equip their robot(s) with a system for detecting opposing team's robots.

This system is intended to prevent collisions between robots, during a match. This point will be systematically checked during the homologation. Referees will pay special attention to non-fairplay teams that deliberately deactivate their avoidance systems after passing the homologation stage.

Voluntary deactivation of robot avoidance systems may result in complete disqualification of the team !

Warning: As most of the events are filmed, please adapt your avoidance systems so that it is not disturbed by autofocus cameras and filming.

Embedded/ on-board bacon support system In order to facilitate robot identification in the field, robots must integrate an embedded beacon support system to identify the beacon of the opposing team. This support system must respect the following points:

- have a convex hull, in any altitude, with a minimal size a 70 mm diameter circle and with a maximum size a 100 mm square;
- be solid and opaque;
- have its upper surface positioned at a height of 430 mm above the playing area to allow the beacon of the opposing team to be placed in good conditions
- the top of surface of the platform will be fully covered of Velcro^{TM} (face hooks);
- the on-board beacon support must have a vertical projection and be located as centrally as possible with a circle of 20 cm diameter around the center of the robot;
- the embedded beacon support must only accommodate sensor systems. The beacon support must be as hollow as possible. For teams using rotating devices, make sure that the portion of cylinder removed has a height of less than 2 cm (except for the minimum size of the envelope convex).
- the on-board beacon support must be stable and must be able to support a minimum weight of 300 g (the opposing beacon)

However, a team may choose not to equip their robot with a embedded beacon support system. In this case, if the opposing team requires a beacon support, and the use of it (either to detect the mast or to place a beacon), the team or the robot concerned may be revoked for that particular game.

F.5. SECURITY CONTSRAINTS

F.5.a. GENERAL ASPECTS

All systems for robots and beacons must comply with the European standards. This is also mandatory for the countries outside the EU that are organizing national meetings or send independant teams for the European Finals. Among other things, these securty standars must respect safety rules and must not endanger participants, organizers nor public.

Robots must not have protruding or pointed parts that could be dangerous or cause damage.

The use of liquid, corrosive, pyrotechnic and living products is prohibited.

All robots must comply with standard "low voltage" regulations. As a result, **the on-board voltages must not exceed 48 V.**

Potential differences greater than 48 V may exist, but only within closed commercial devices (eg lasers, LCD backlights, etc.) and only if these devices have not been modified and comply with national and European regulations.

In general, any system deemed by the refereeing committee as dangerous will not be homologated, and must be replaced, in order to be accepted in the competition.

F.5.b. LASERS

Are considered valid, only laser systems and classes defined according to the IEC60825 international standards. Teams using lasers must provide the manufacturer's document mentioning **the class of the device** (this information is normally always available on the system itself).

On the basis of this classification, class lasers:

- 1 and 1M are accepted without restriction
- 2 are tolerated only in case the laser beam do not exceed the play area
- 2M, 3R, 3B and 4 are strictly forbidden.

WARNING: Disassembling or modifying devices using laser sources often results in a change of class. Laser devices must not be altered and only be used in the state of their commercialization (laser device = source + optics + electronics).

F.5.c. HIGH POWER LIGHT SOURCES

When using a high intensity light source, the light intensity must not be dangerous to the human eye in case of direct contact. Note that some types of LEDs have warnings. Be responsible, as your machines are evolving in front of a general audience!

In the case of slightest doubt, the organization reserves the right to request the manufacturer's specifications to verify the non-dangerous nature of the lighting system used. If it turns out that the system is potentially dangerous, it may result in revocation of lasers class 2M and more.

F.5.d. COMPRESSED AIR SYSTEMS

Compressed air systems should exceed 4 bar !.

G. BEACON TRACKING SYSTEM

G.1. GENERAL POINTS

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At the opponent's request and only if justified, the robots could be equipped with a flagpole to fix an opponent's beacon above (see E.4.b).

All beacons (fixed beacons, embedded beacons and central tracking device) must remain in place on their supports throughout the duration of the match. All robot safety instructions equally apply to beacons.

Fixed beacons, center marker, beacons, embedded beacons and their respective supports are described below.

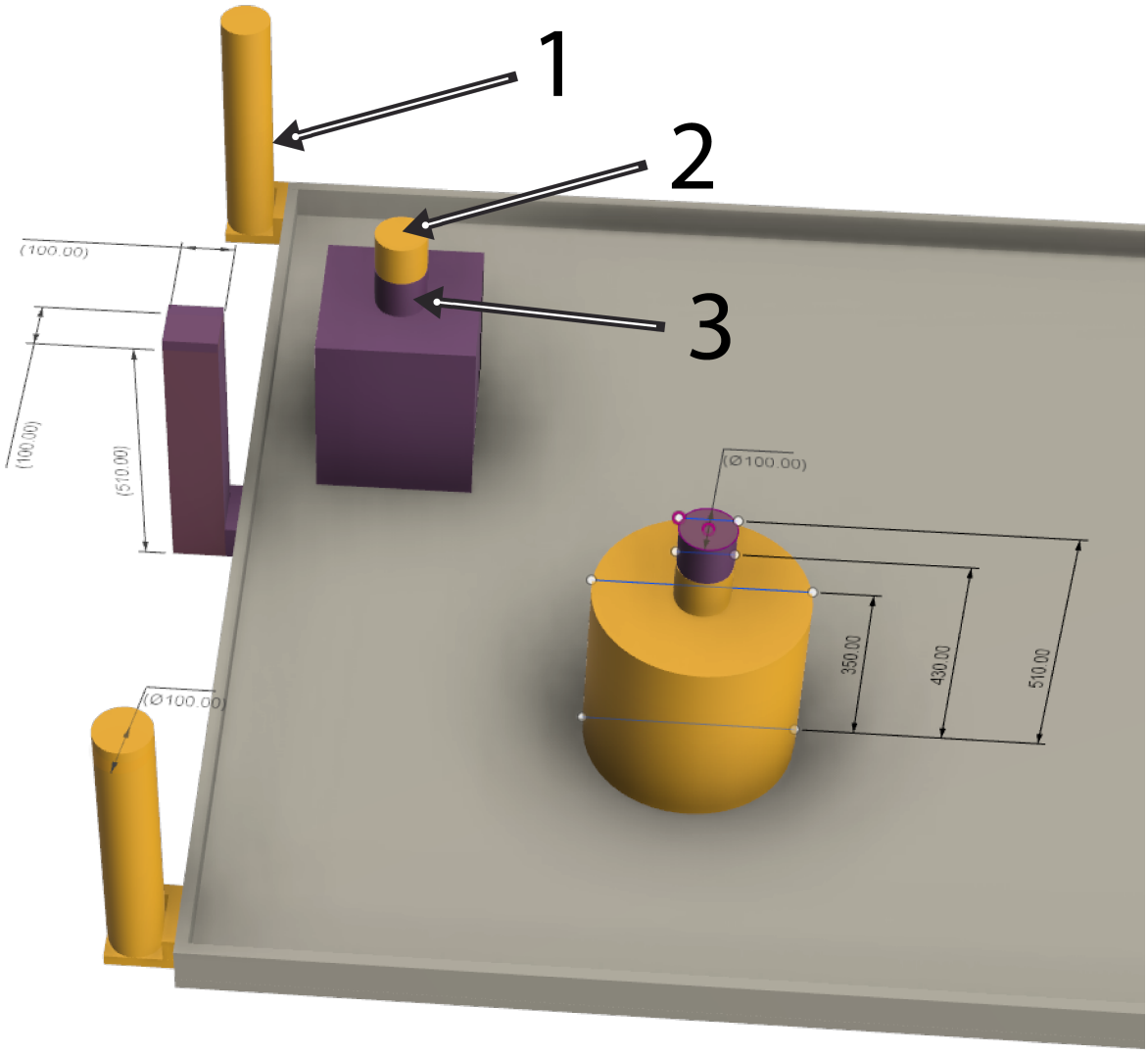

Figure 11 - Example of beacons positioning

Caption:

1. fixed beacons (maximum dimensions W x W x H: 100 x 100 x 510 mm)
2. embedded beacon (maximum dimensions L x W x H: 100 x 100 x 80 mm)

3. mast of the support (cf. G.4.b)

G.2. EMBEDDED/ ON-BOARD BEACONS

A beacon can be placed on each of the adverse robots, in order to locate the latter. It must be placed on a dedicated mast, at an height of 430 mm above the palying area. The maximum size for an on-board location beacon is a square based parallelepiped of 100 mm side and 80 mm height.

The upper side of the on-board beacon must be covered with Velcro^{TM} on the hook side in order to receive the identification mark of the robot, respecting the color of the team.

The underside of the beacons must be covered with velvet Velcro^{TM}.

It is recommended that the color of the beacons be mainly white or very clear, so as to favor their detection on a dark background.

In the name of fair play, the elements used for this beacon must have real utility. Any "useless" or weighted beacon will be refused by the organization.

A localization beacon must not exceed 300 g

G.3. FIXED BEACON

Each team can place up to three fixed beacons on fixed supports. These fixed supports are allocated to the team upon demand and will be placed around the playing area.

Action-cams not useful for the course of the game are prohibited in fixed beacons.

G.3.a. DIMENSIONS

The fixed beacons shall be integrally contained in a square rectangular parallelepiped of 100 mm side and 510 mm height.

A fixed beacon must not exceed 1.5 kg.

G.3.b. FIXATION

Given the potential height of the fixed beacons, they must have a solid fixing system.

The fixed beacon supports must be located at the level of the playing area.

The horizontal plane of the fixed beacon support has to be pierced with a 10 mm wide groove, going from the center of the beacon support to the middle of the rear side. This groove allows the passage of a threaded rod of 8 mm diameter, fixed vertically on the underside of the beacon. A butterfly nut placed on this threaded rod, will help fix the beacon on its support in a fast and reliable way.

The absence of this fixing system will forbid the homologation of fixed beacons.

G.4. CENTRAL TRACKING DEVICE

In order to help identify the robots during the matches, a common platform located on the central symmetrical axis of the ground will be placed 1 m above the surface of the playing area (see plan). This platform can be used to place a robot tracking device with a top view.

The central tracking device should be placed on the area that corresponds to the color of the team. It must not exceed beyond a horizontal plane of 6 cm above the plateform's upper surface. It must also not surpass a horizontal plane of 60mm below the plateform's lower surface. On the sides, an offset of 6 cm is allowed: forward, at the edge not shared with the opponent and at the back. This offset allows: placing sensors above the ground, connecting the parts situated above and underneath the platform and setting up a slid fixing for the central tracking device. Its weight must be less than 2 kg.

It is forbidden to overpass on the opponent's area.

Please note that the central tracking device can be subject to vibrations due to the movements of robots on the playing area .

In appendix, the drawing of a mast supporting the platform are represented. However, only the dimensions and the position of the platform are contractual, the mast itself may be different from one contest to another. Its design is left free to the organizer of the event.

Fixation:

The thickness of the fixing platform for the central tracking device is 22 mm.

The fixing device can surround the fastening platform from above, from below and from all three sides of the supoort so that it can be assembled and positioned quickly and without the risk of falling.

The mounting platform has a 10 mm wide groove from the center of the beacon support to the middle of the side.This groove allows the passage of a threaded rod of 8 mm diameter fixed vertically on the tracking device. A butterfly nut placed on this threaded rod will fix the tracking device in a fast, reliable way.

The absence of this fastening system will prevent the homologation of the tracking system.

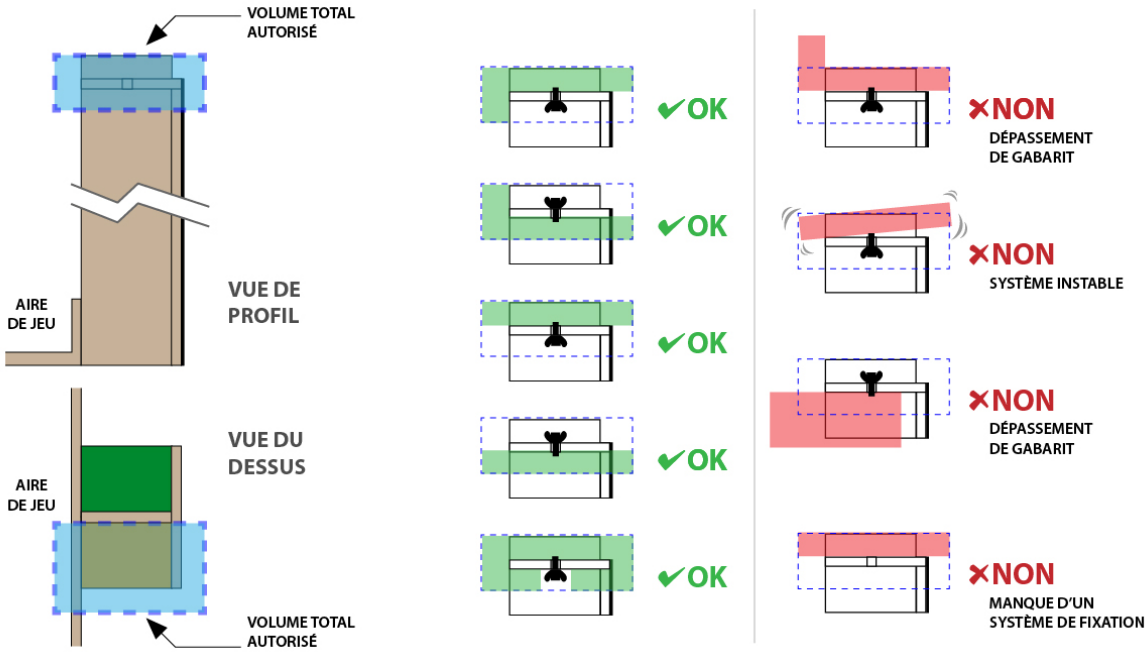

Figure 13 - How to install a central tracking device

G.5. CONNECTIONS

The fixed beacons and the central platform can be connected by a wired link. This connection must not, under any circumstances, disrupt the duration of the match. The installation of the whole system must be carried out

before the match, between the three minutes used for preparations by each team, and it should not disturb the opposing team's preparation.

During the preparation of the match, a temporary wired link may be pulled in between the robot and one or several beacons. This case scenario is accepted only if it doesn't cause any inconvenience for the opposing team

G.6. COMMUNICATION SIGNALS

To avoid interference between teams, it is recommended to encode the communication signals. We strongly recommend teams using infrared devices, to take into account the strong ambient light used during the encounters. In addition, this luminosity may vary in time and according to the emplacement of the playground in the hall.

We also remind teams that the organizing staff uses high-frequency radio devices and under no circumstances can they be held responsible for the malfunctions encountered by the robots.

CAUTION: Beyond the edges of the playing area, there may be elements that may interfere with color detection or communications signals such as:

- décor, lights and objects of the playing area
- people (referees, teams, etc.)
- electronic systems (microphones, cameras, etc.)

It is strictly forbidden to ask people to go away or move away objects/decors around the playing area !.

G.7. ROBOT IDENTIFICATION

During each match, the robots are assigned a color under the form of a small colored module. This marking is intended to help the public recognize which robot belongs to which team at any time.

The mass of the marker module is insignificant. It can be placed on the beacon support of the robot, if it has one, or on the on-board beacon.

H. MATCHES

The matches have a duration of 100 seconds.

Only two people per team are permitted to go backstage and on stage to play the matches.

To ensure that the contest runs smoothly, we ask you to be present on the stand with the robot(s) and ready to go in a match 30 minutes before the start of the series and until that your game is played.

In case of a problem, it is tolerated by the organization to ask for a delay to go to the match but this delay can never exceed the end of the current series. At the end of the series, a package will be applied. In case of abuse, a warning will be applied, and if the problem recurs in a subsequent series, a penalty may be awarded.

In any case, you must be present on your stand when the organization comes to pick you up for a game. In the event of non-compliance with this rule, an official may initially give you a warning, and if the absence is repeated on a subsequent series, a penalty may be awarded.

H.1. PREPARATION PHASE

At the start of a match, the elements of the playing area and the playing area itself are installed as indicated in the diagrams in the appendix.

Upon arrival on the playing area, each team has a maximum of three minutes to proceed with the placement of the robots, experiment and the external beacons.

A robot who is not ready at the end of this period exposes the team to a package for the match.

The other team's robots will still play their own game on the playing field. The team will have to score points to be declared the winner.

When both teams are in place, the referee asks the participants if they are ready. From this moment, teams are no longer allowed to touch their robots. No dispute can be made on the disposition of the elements of play after the beginning of the match.

H.2. THE MATCH

At the signal of the referee, each robot is switched on. In no case may robots, play items and playgrounds be allowed to touch during the match. In case of absolute necessity, the arbitrator may however authorize such action. Any manual intervention on a robot, an element of play or the playing area, without the explicit authorization of the referee, may justify the application of a fixed price for the match.

No elements taken out of the playing area can be handed over before the end of the game and the validation of the scores.

At the end of the match, the robots must stop and turn off all the robot's actuators. It is permissible to keep any dynamic displays giving the rating of the score on.

At the end of the match, **no one except the referee** can touch the robots and the game elements unless expressly indicated by the latter. The referees count the points; they give the result of the match, including the points to the teams. If they both agree, they sign the match sheet, they can then take back their robot (s) and join their stand. If the teams do not agree, they refer calmly to the referees. The robots remain in place until the dispute is resolved. Arbitration decisions are final.

In case of difficulty judges, the referees reserve the decision to replay the game or not.

The referees are allowed to pronounce the end of a game in advance, before the end of the regulation time if

both teams agree (if the robots are blocked for example).

A team is considered to be **forfeit** for the match:

- if none of the robots have completely left the starting area during the match,
- if one of the two robots had the emergency stop button pressed during the match,
- following arbitration decisions.

H.3. COUNTING POINTS

At the end of the match, the referees count the points of each team according to the following scale.

H.3.a. ATOMS CLASSIFYING !

- 1 point for each atom placed on the periodic table;
- 5 additional points for each standard atom correctly placed on cells of periodic table;
- 5 additional points for atom of "Goldenium" if it's correctly placed in its dedicated cell.

H.3.b. ATOMS WEIGHING !

- The atoms present in the weighing scale bring back:
  - 4 points per atom of "Redium";
  - 8 points per atom of "Greenium";
  - 12 points per atom of "Blueium";
  - 24 points for the "Goldenium".

H.3.c. PARTICLE ACCELERATOR !

- 10 points for each atom present into the particule accelerator;
- 10 additional points when the detector has been unlocked (the "Goldenium" has been revealed)
- 20 additional points if the atom of "Goldenium" has been extracted from the detector.

H.3.d. PERFORM AN EXPERIMENT

- 5 points to has put the experiment on the experiment area before the begining of the match;
- 15 additional points to has activated the experiment during the match;
- 20 additional points if the electron reached the oxygen atom before the end of the match.

H.3.e. EVALUATE ITS PERFORMANCE (BONUS POINTS)

The assessment is based on all the previous actions (Atoms classifying, atoms weighing, particle accelerator, perform an experiment).

The estimation bonus is calculated as follows: **Bonus = 0.3 x Score - Delta**

- The score is the one made by the team during the match.
- The delta is the difference between the score made by the team during the match and the score estimated by the team. This one is always positive.
- The bonus is an integer value (rounded up).
- The bonus is added to the points of the team.
- A negative bonus is reduced to 0.
- A score of zero cannot give right to any bonus.

H.3.f. THE PENALTIES

A penalty is a **loss of 40 points** on the result of the match. Several penalties can be applied.

A negative score will be reduced to 0.

An element controlled by a robot, does not yield points. An object is considered to be controlled by a robot, if by moving the robot along its natural axis of movement it is moved.

RECALL:
The penalties are intended to compensate for damage after a possible incident during the course of the game. A penalty situation is considered as non-respect of the rules of the game, this type of situation must remain exceptional!!! A penalty may result in the team's forfeit. The arbitration committee will also be attentive to the penalties distributed between several levels of meeting (region/national/european).

H.3.g. BONUS POINTS

During the final phase, a bonus of 30 points will be given to the team who put the most points in the balance.

10 bonus points are awarded to all teams that are not "forfeit".

H.3.h. FORFEIT CASES

The score of a forfeit team is reduced to zero.

I. THE CONTESTS

I.1. GENERAL

The Eurobot^{Open} events can be organized on three levels:

- regionals: when they exists (e.g. in France for Eurobot^{Open} Junior), qualify a number of teams for the national final,
- nationals: it allows to qualify the teams for the European final,
- european: this last stage brings together, in the same friendly spirit, teams from different countries in Europe and elsewhere.

I.2. APPROVAL

I.2.a. PRE-APPROVAL

Before the start of the matches, the robots are subject to the supervision of an arbitrator who verifies their compliance with the rules. Robots must be able to easily show all their mechanisms.
The ancillary systems (beacons, central tracking device, etc.) will also be subject to static control (size, mass, presence of mandatory elements, etc.).

I.2.b. APPROVAL

The robots must, in 100 seconds, validate at least one action. The robots are put in a game situation but without the presence of the opposing team. Certain specific features provided for in the regulation can also be verified (timer, avoidance of opponents, etc.).
If the assembly consisting of the main robot and the optional secondary robot fulfills these conditions, it is declared homologated. If one of the two robots is not homologated, the other robot can play the match alone.

I.2.c. SIGNIFICANT TECHNICAL MODIFICATION AFTER THE APPROVAL

It is essential to inform the referees of any significant modifications (functionals, structurals, dimensionals ...) brought to the robot(s) or any other element after homologation. The referees will then check the modifications made and re-approve the robot if they deem it necessary. In the event of a breach, the team may be declared disqualified from the contest.

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I.3. QUALIFICATION PHASES

During the qualification phase, the registered teams will have the possibility to play at least three games (often more, depending on the local organizers).
A ranking is established according to the accumulated points in order to select the qualified teams for the final phase.
The tied teams are tied by comparing their scores without taking into account the bonus points. Organizers may also use additional matches. Pairs of teams competing for the same place will be drawn and the resulting matches will be played by knockout. In case of an odd number of teams, an extra match will be drawn at random and played on the same bases.

I.4. THE FINALS

At the end of the qualifying phase, the 4, 8 or 16 first teams (according to the matches) constitute the table of the matches of the final phase.

According to the meetings, only the teams composed of members less than 30 years of age will be able to enter the final stages.

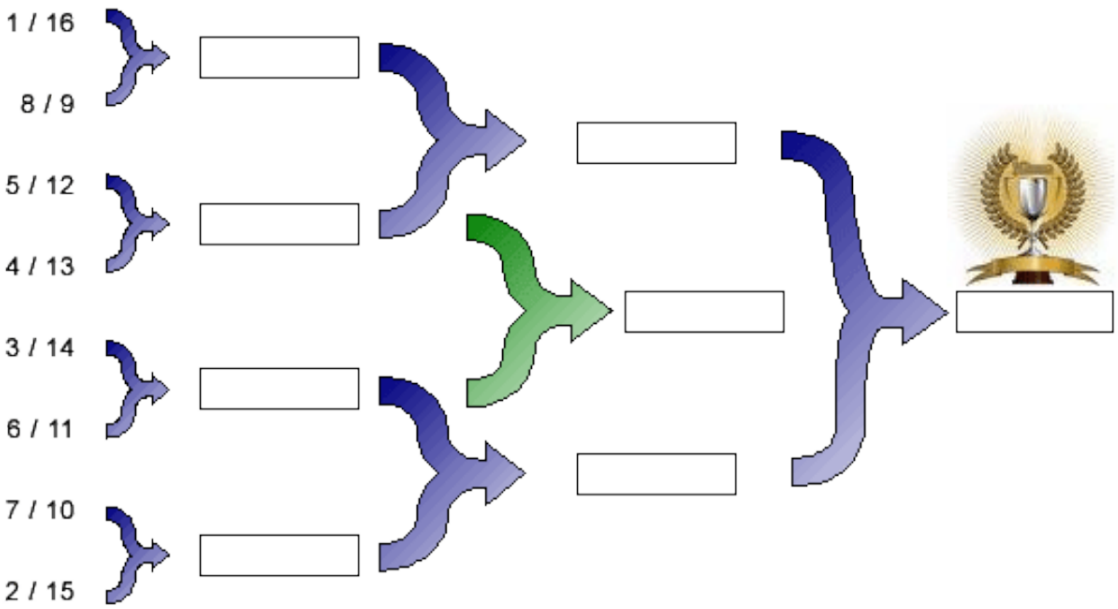

Figure 14 - Exemple de schéma des phases finales

The matches of the final phase are with knockout, unless otherwise organized on some meetings. In the event of double forfeit, double defeat or tie, the match is replayed immediately; if this second match is still a case of double forfeit, double defeat or equality, the winner will be determined according to the points acquired at the end of the qualifying phases.

The final will be played in two winning games. Be careful to provide batteries accordingly for autonomous robots.

I.5. QUALIFICATION FOR THE NATIONAL FINALS

When there are regional meetings (e.g. Eurobot^{Open} Junior France), the number of teams qualified per regional meeting is proportional to the total number of teams registered at the national level.

The best teams in the ranking established at the end of the qualifying phase of each regional meeting, as well as at least one team chosen by the organizers from the special prizes (e.g. creativity, fair play, presentation, etc.).

I.6. QUALIFICATION FOR THE EUROPEAN FINAL

Each country participating in Eurobot^{Open} organizes a national competition to determine the qualified teams for the international contest.

The first two teams in the final rounds (so not the qualification rounds) and a special award will qualify to go to the European final.

For questions and comments, feel free to visit the forum on Planete Sciences Forum.

http://www.planete-sciences.org/forums/

News and more information about Eurobot^{Open} et Eurobot^{Open} Junior are available on our website

www.eurobot.org

(It also contains links to your local organizations)

The whole organization team of Eurobot^{Open} and Eurobot^{Open} Junior whishes you a lot of fun and success in the coming months, and looks forward to seeing you soon around our playing areas!

Robotic Regards,

The Eurobot^{Open} Eurobot^{Open} Junior organization committee.

J. APPENDIX

J.1. GENERAL DRAWINGS

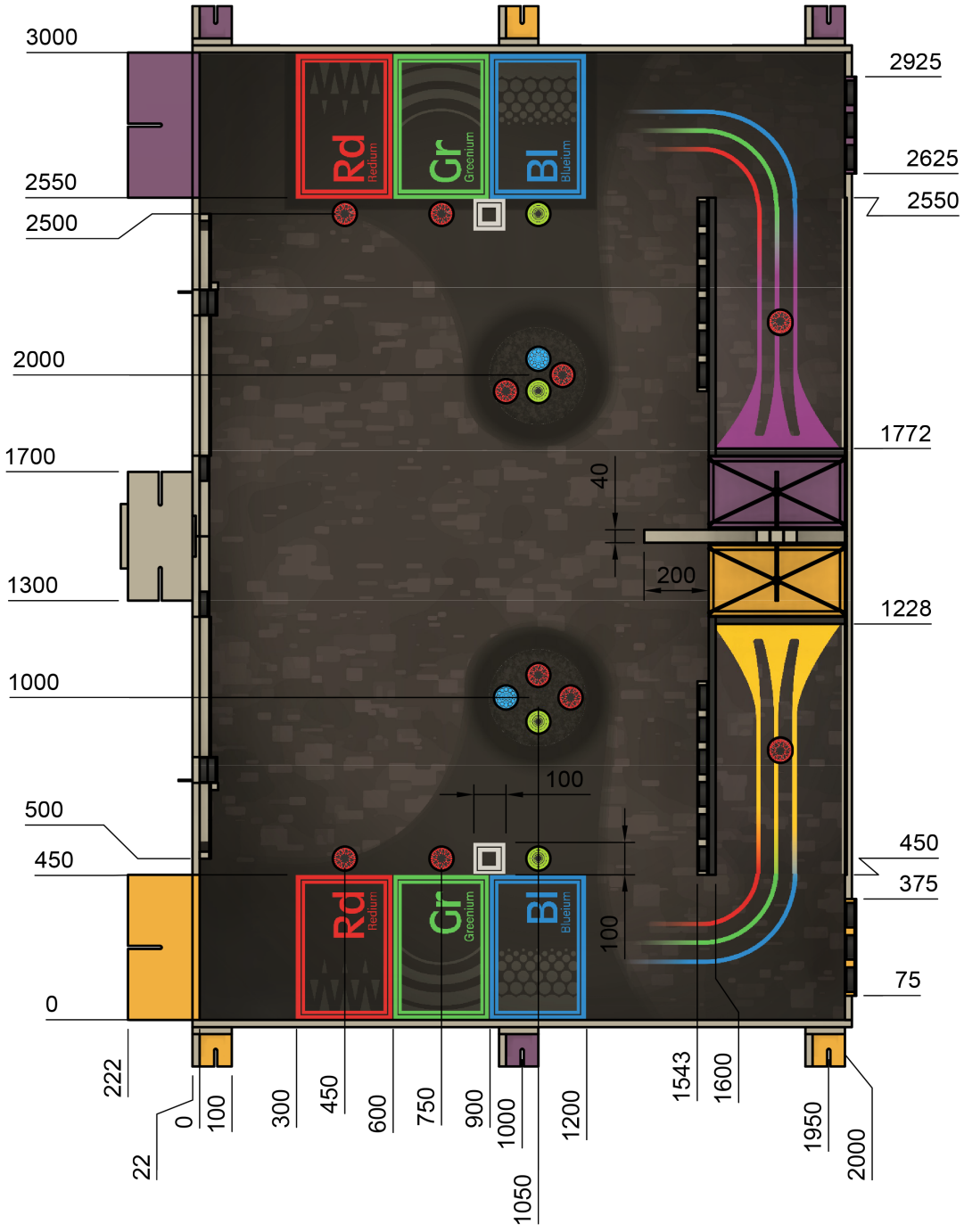

Figure 11 – Top view of the playing area and atoms initial location

J.1.a. ATOMS

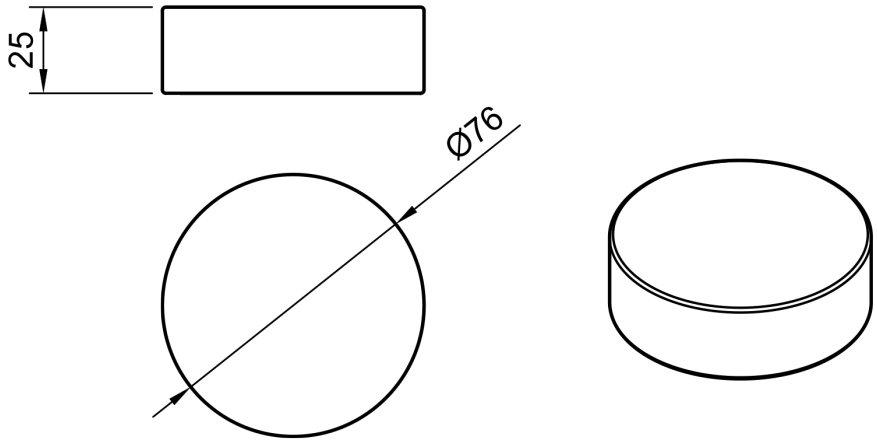

Figure 12 – Standard atom

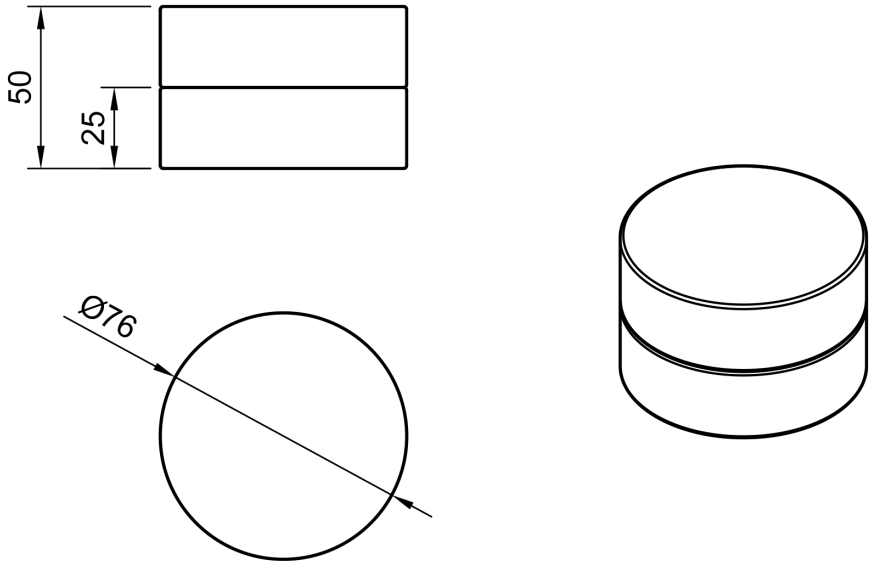

Figure 13 – Special atom

All the atoms are made from rubber hockey pucks, more or less hollowed out according to their mass. When they are hollowed out, the hole can be filled with polyurethane foam plate. All the atoms are covered with a coloured vinyl on their plane surface.

The Redium (Figure 12) 60g, the Greenium (Figure 12) 120g, the Blueium (Figure 12) 170g, and the Goldenium (Figure 13) 340g.

J.1.b. THE SCALES

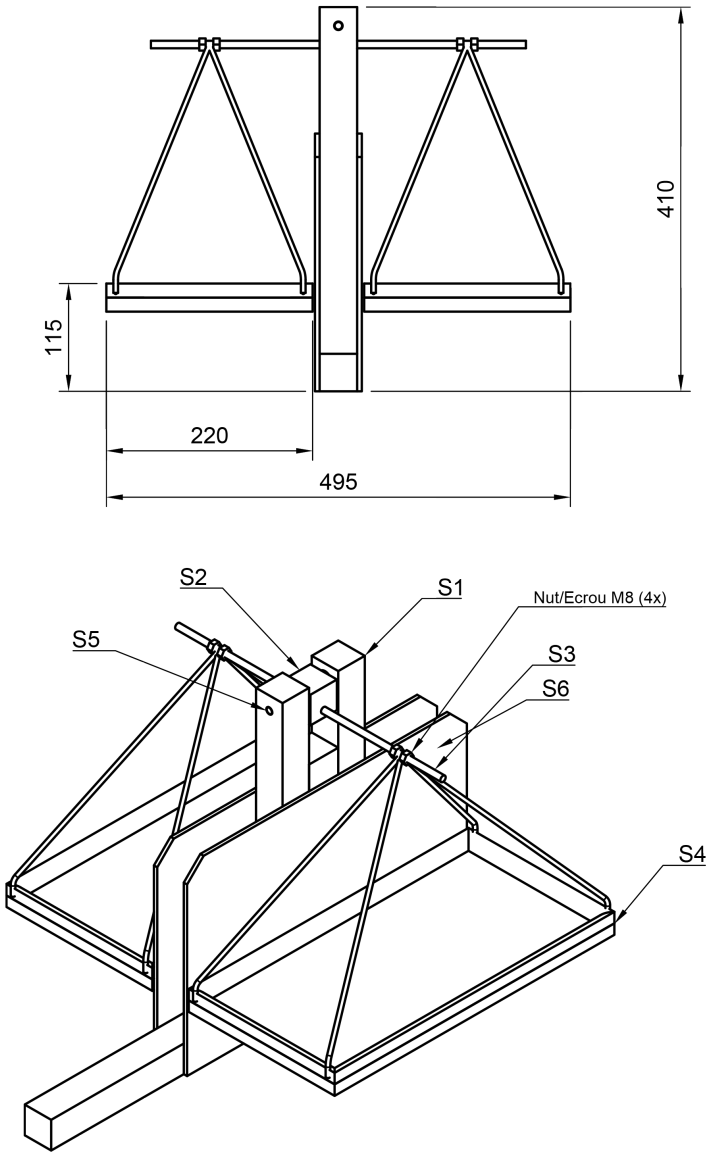

Figure 14 – The scales - Global view

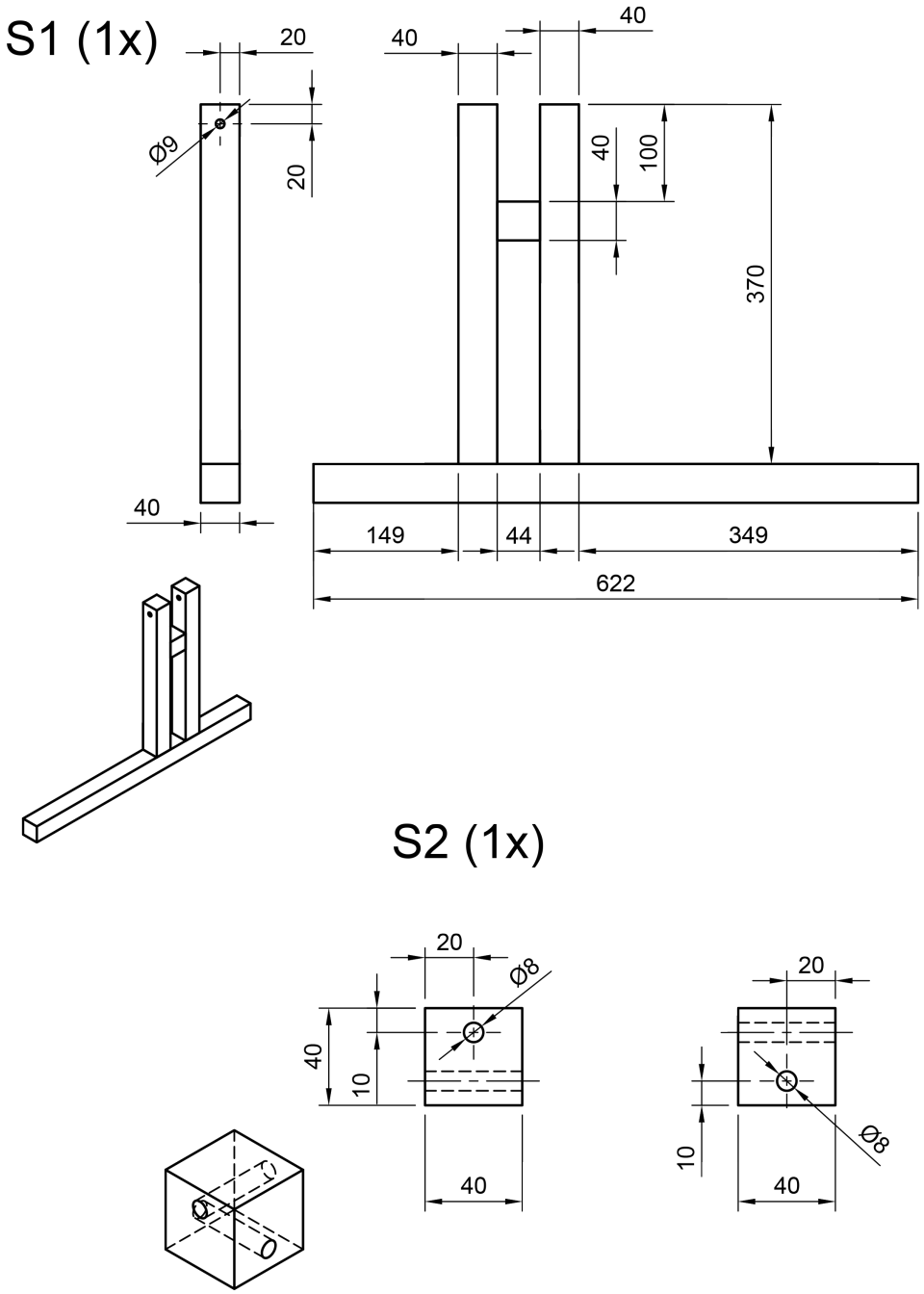

Figure 15 – The scales - Detailled view 1

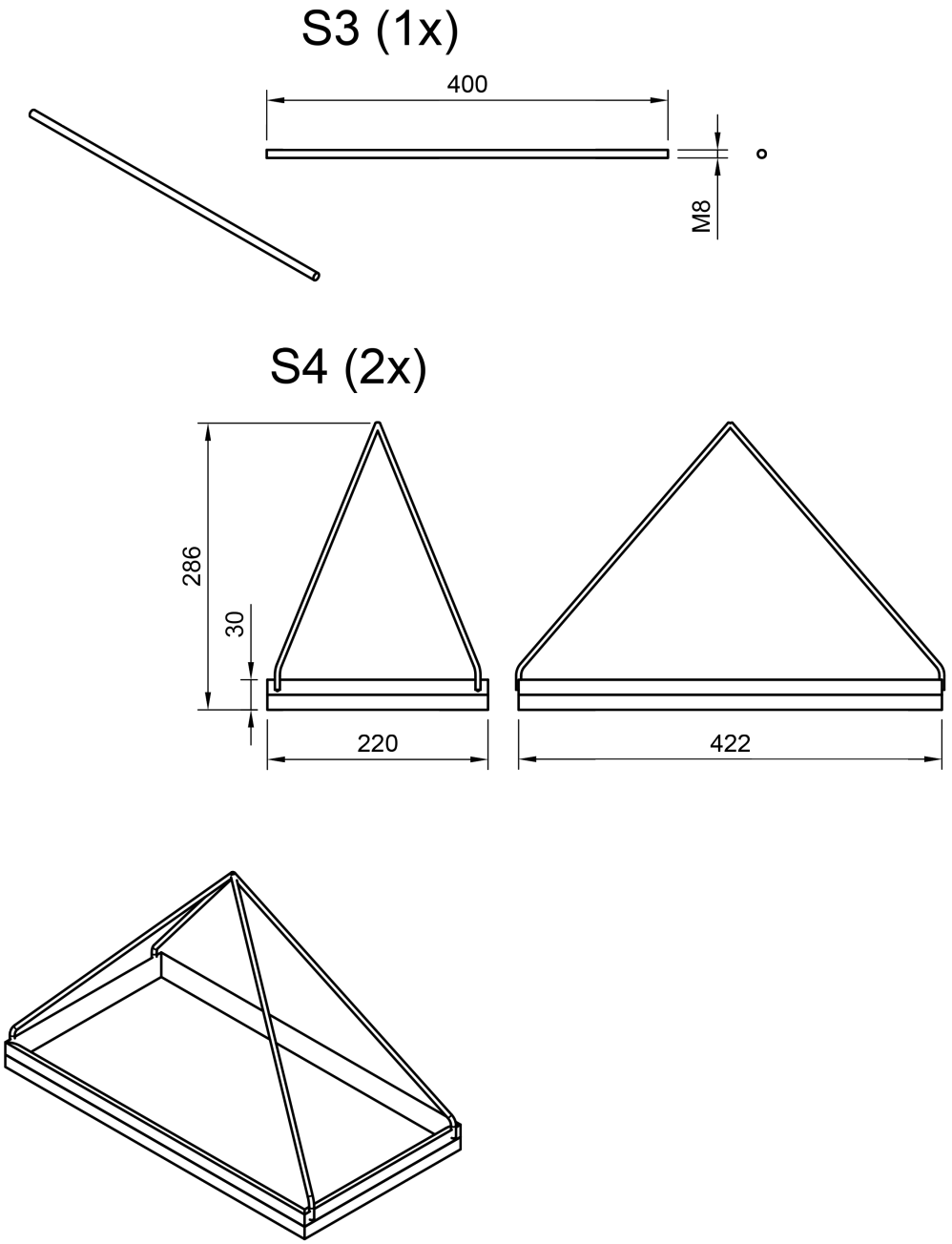

Figure 16 – The scales - Detailled view 2

Subpart S3 is a threaded steel rod.

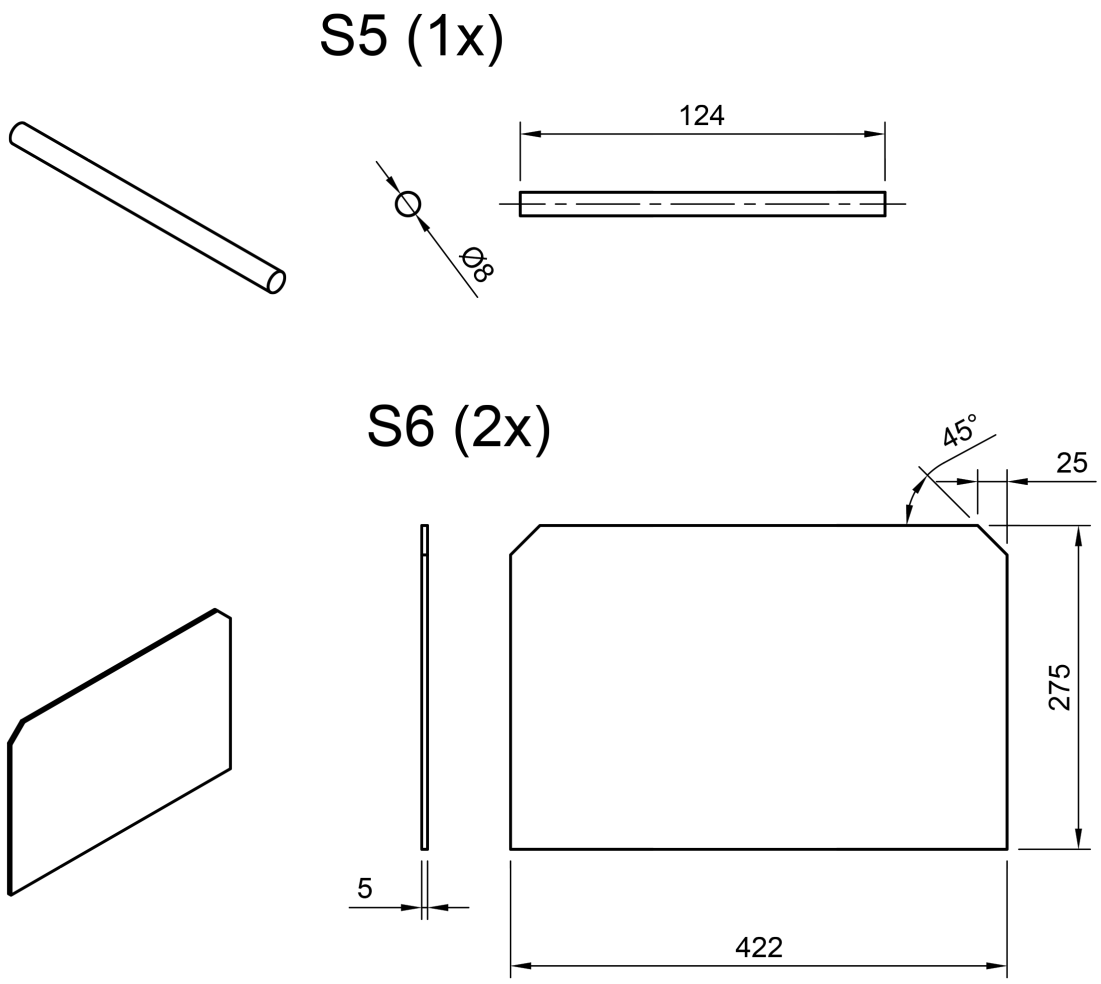

Figure 17 – The scales - Detailled view 3

J.1.c. THE SLOPS

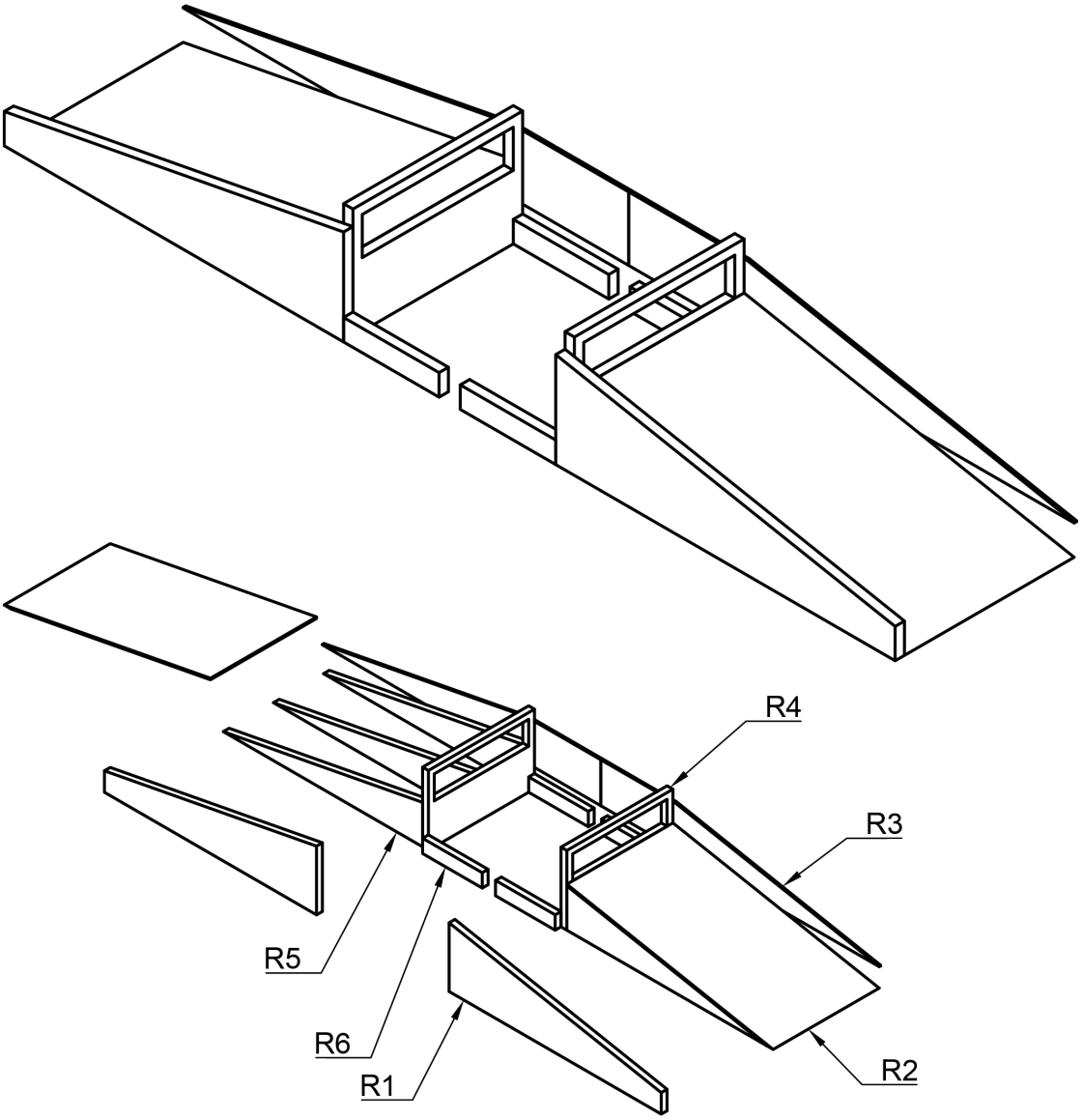

Figure 18 – The slops - Global view

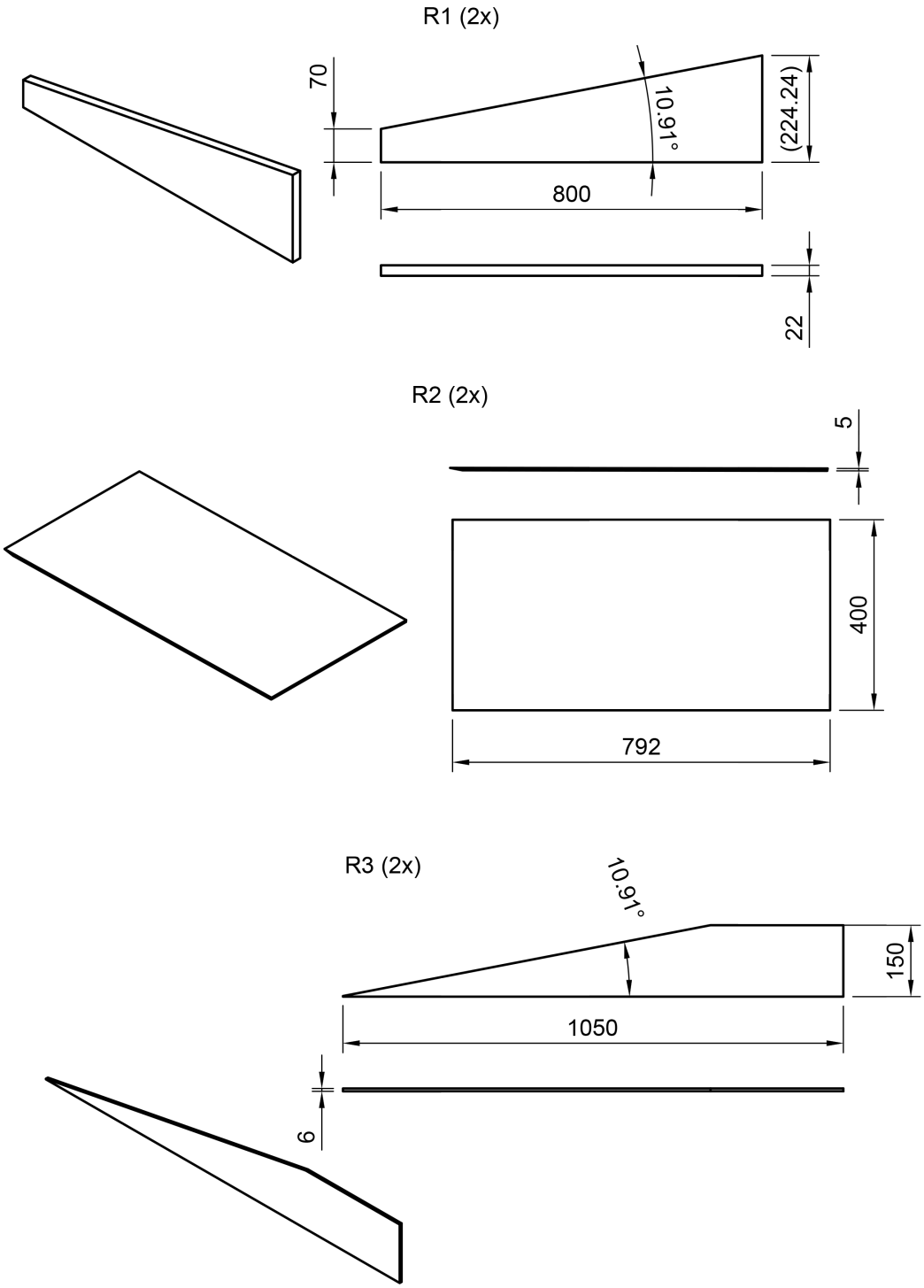

Figure 19 – The slops - Detailled view 1

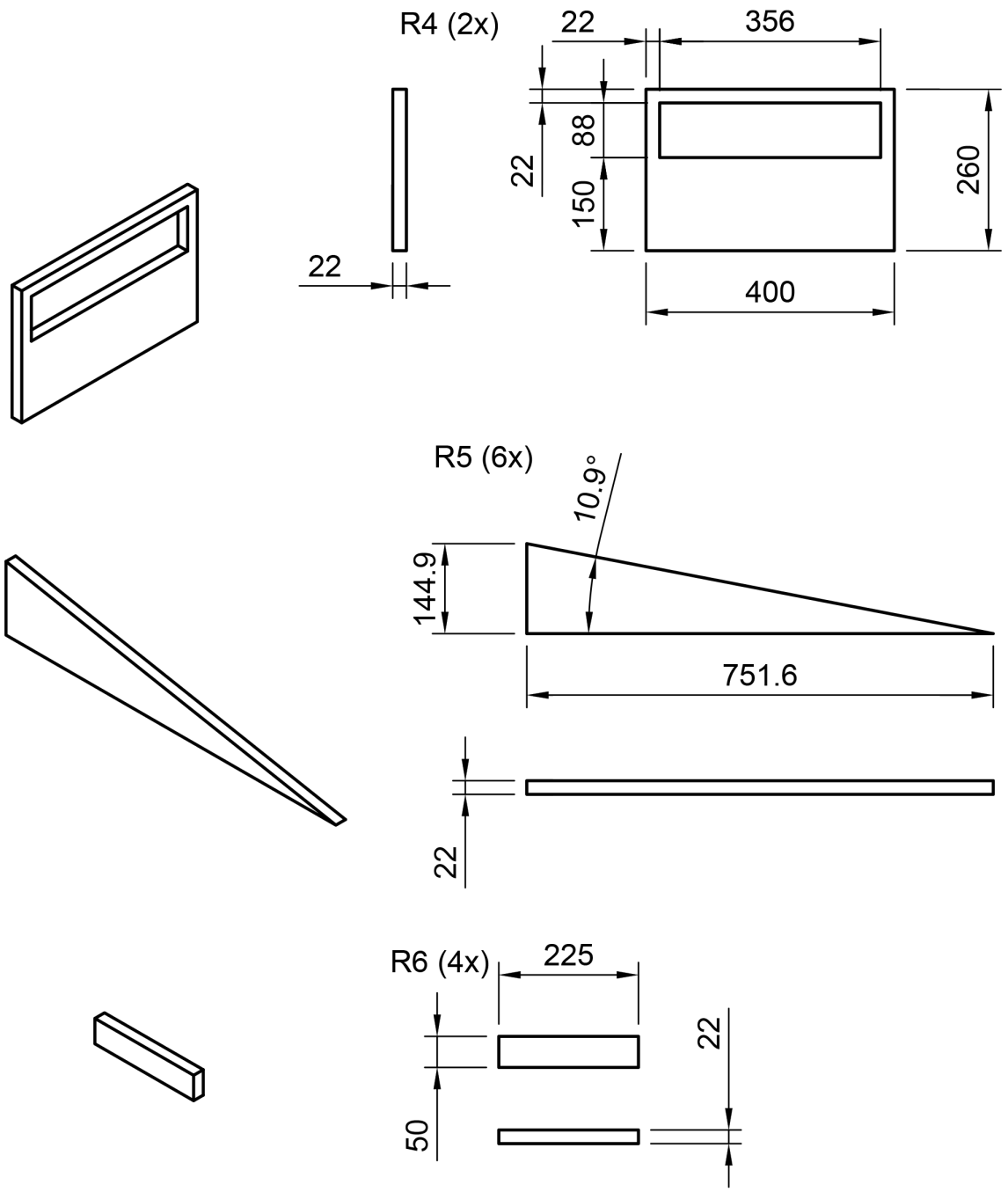

Figure 20 – The slops - Detailled view 2

J.1.d. PARTICLES ACCELERATOR

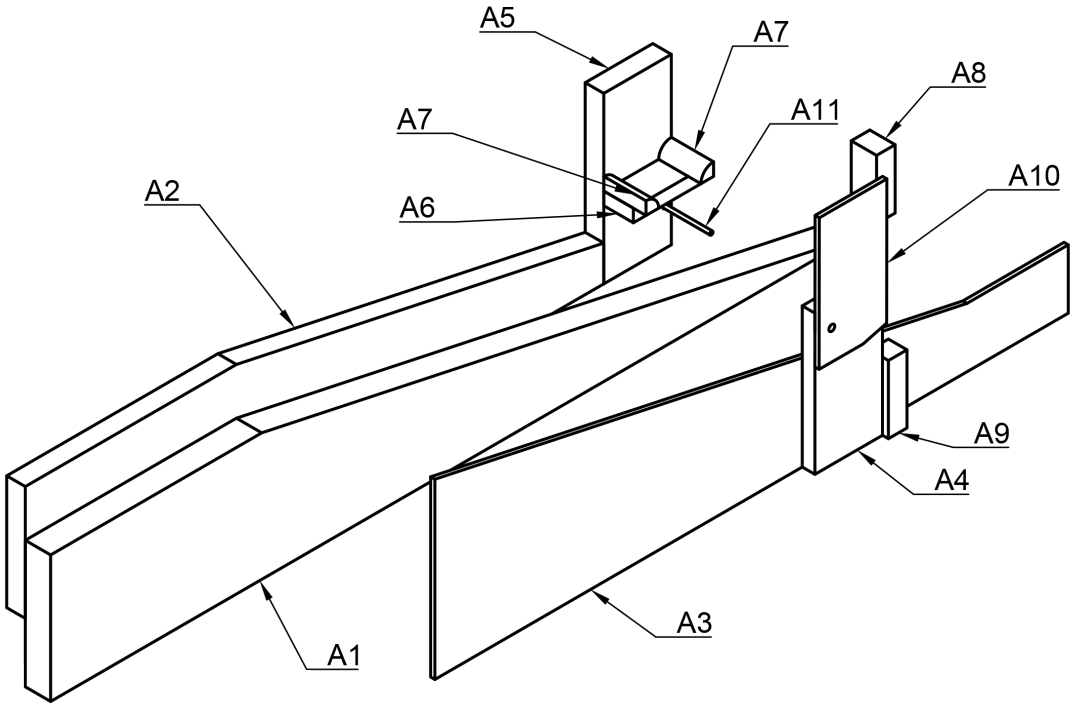

Figure 21 – Particles accelerator - Global view

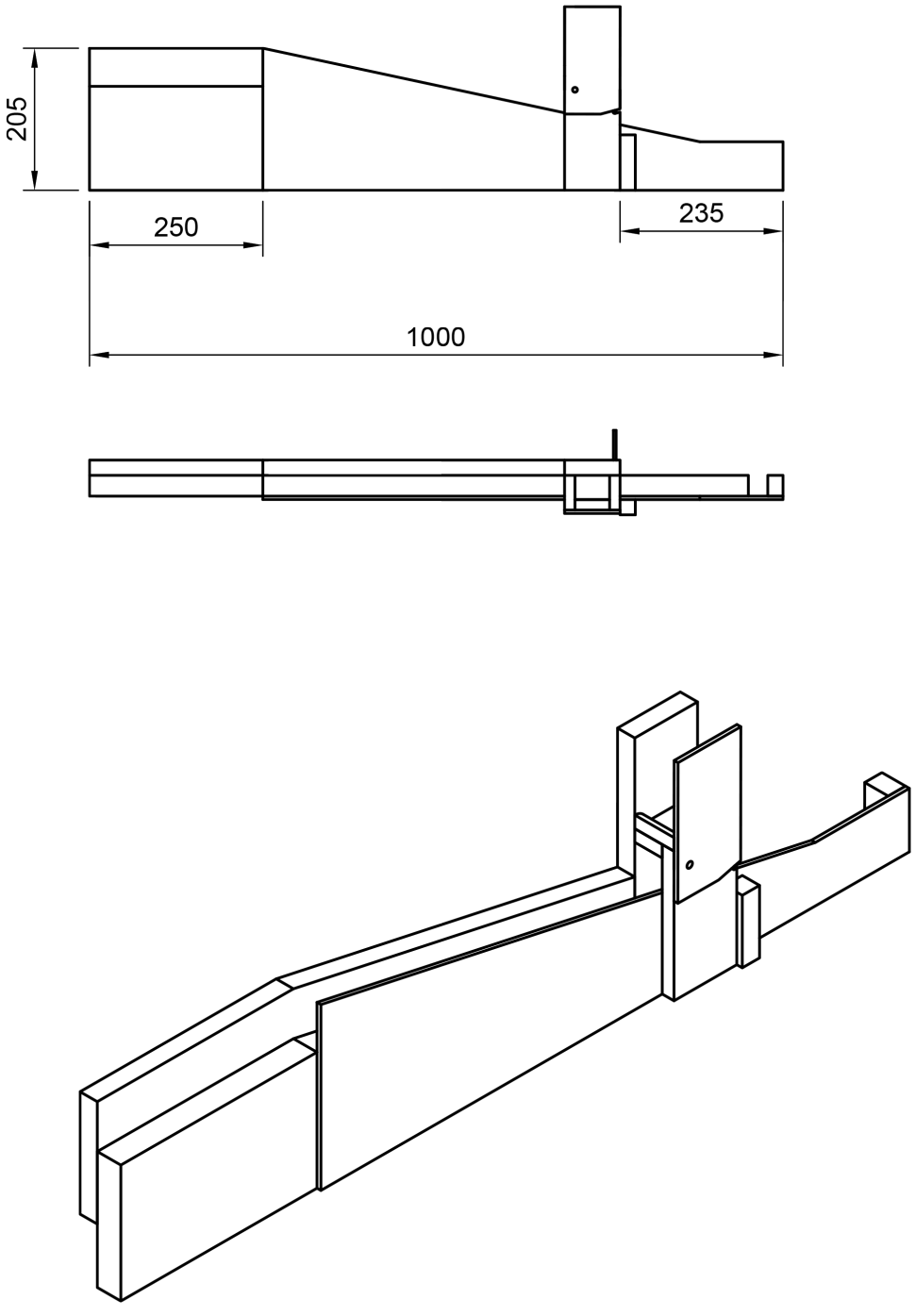

Figure 22 – Particles accelerator - Detailled view 1

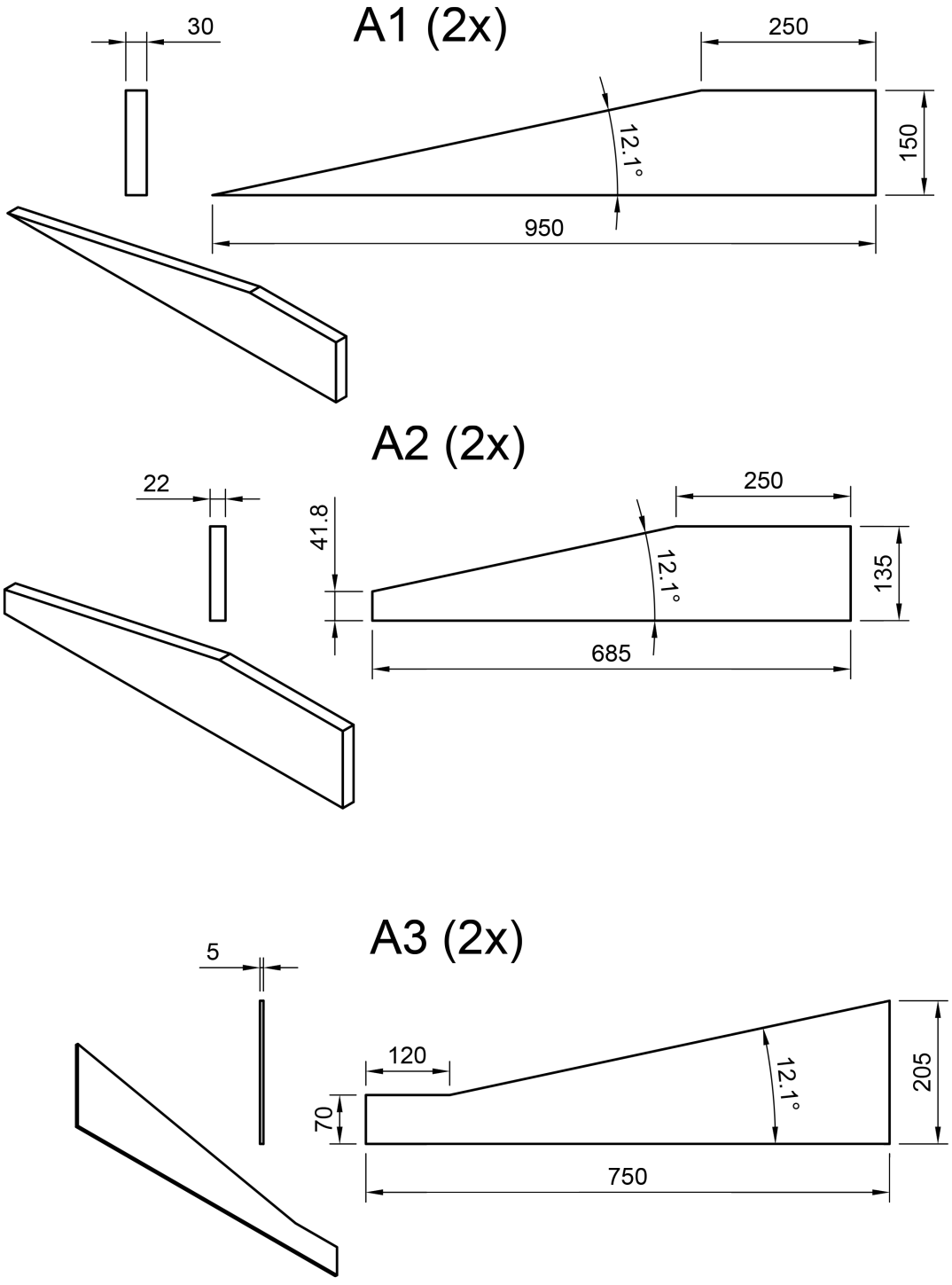

Figure 23 – Particles accelerator - Detailled view 2

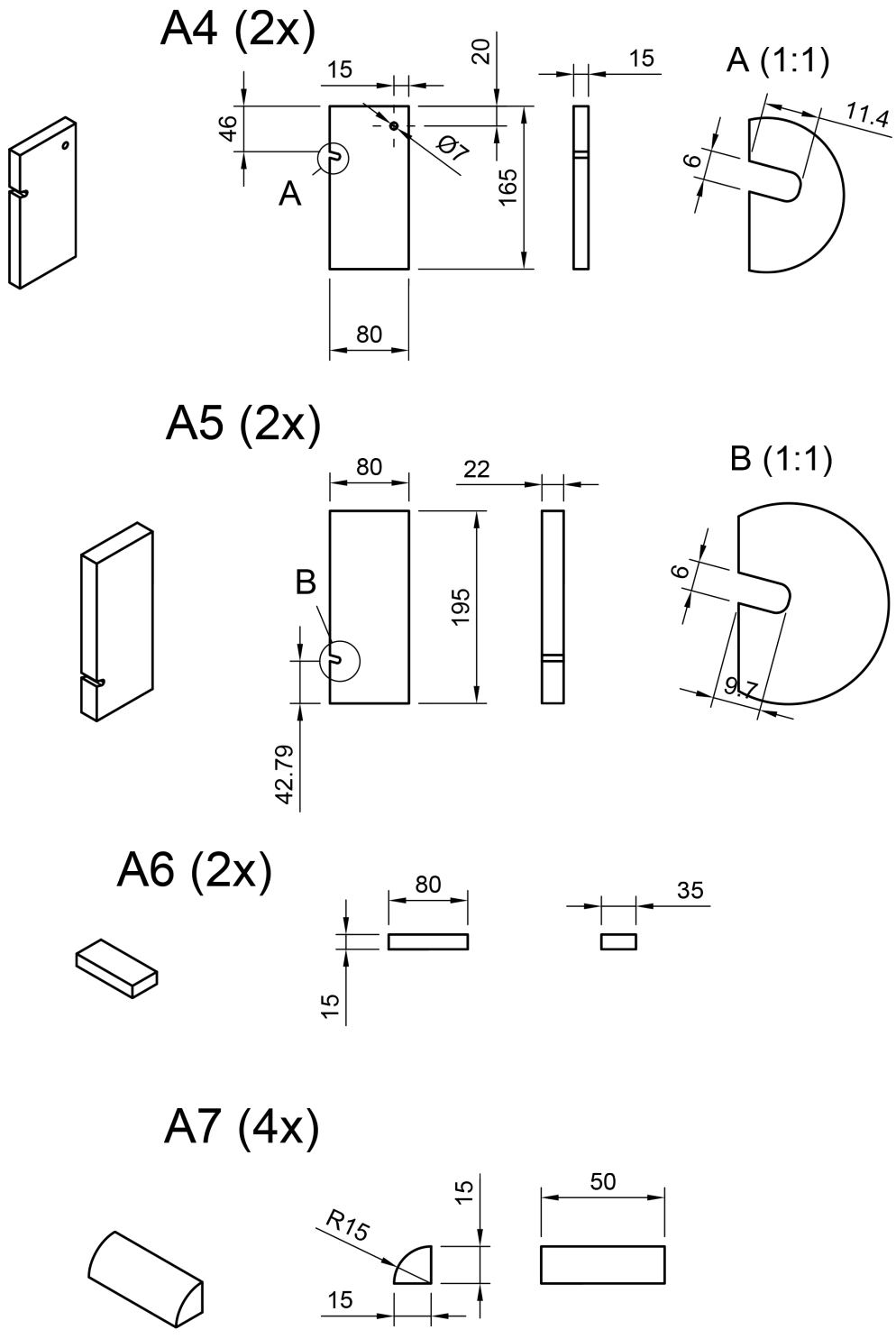

Figure 24 – Particles accelerator - Detailled view 3

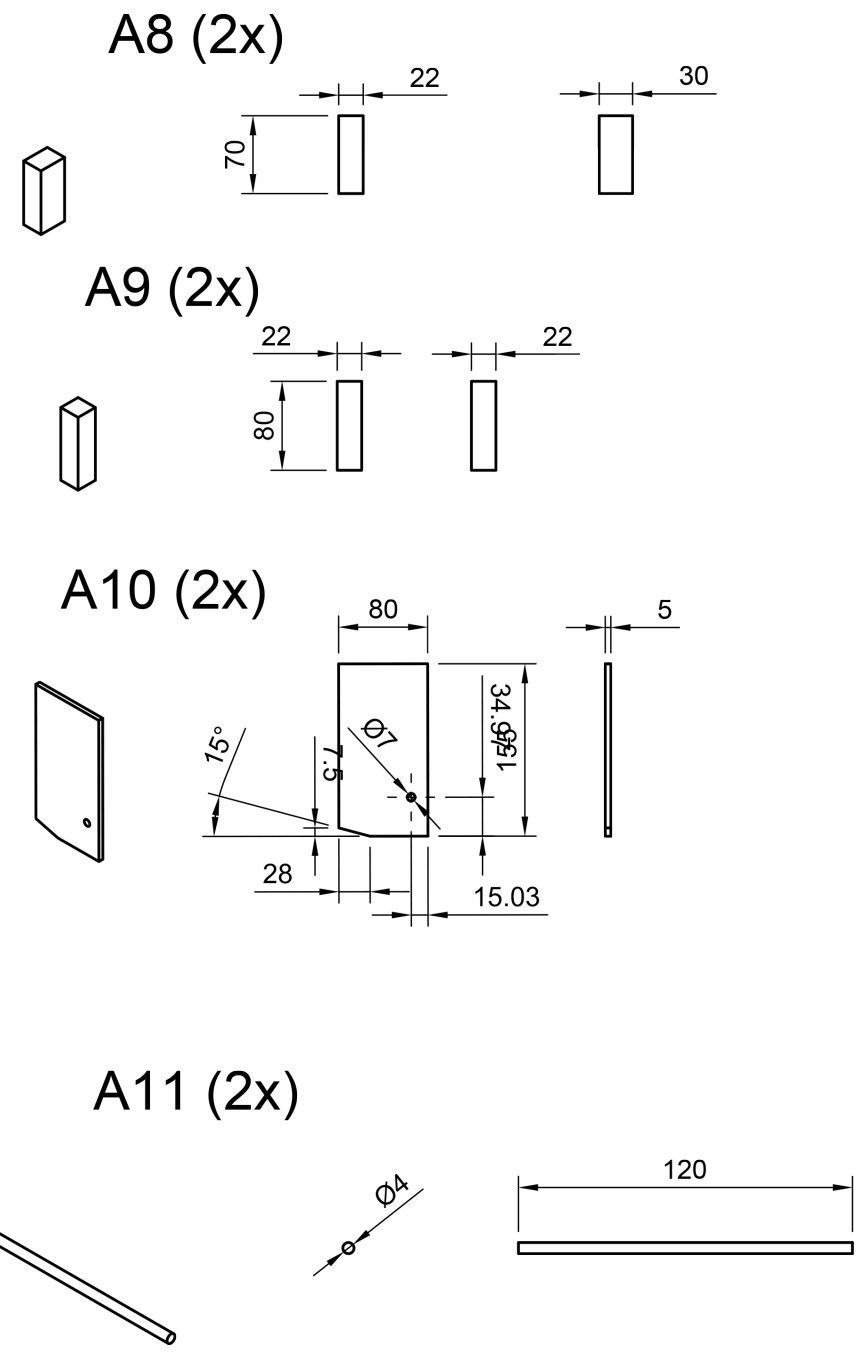

Figure 25 – Particles accelerator - Detailled view 4

The end of pin A11, located outside the field, may be attached to a cord to prevent his fall on the playground.

J.1.e. THE EXPERIMENT

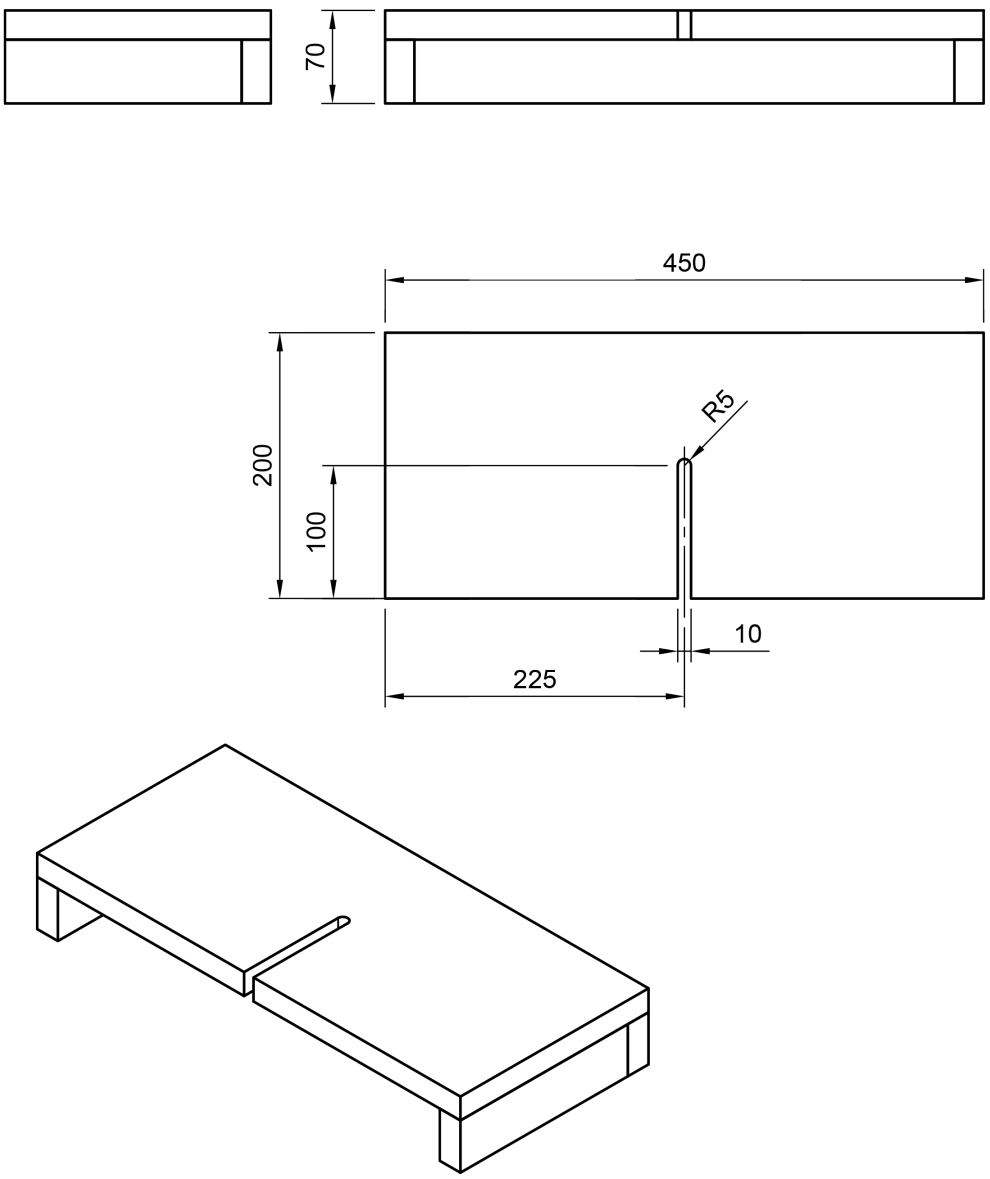

Figure 26 – The experiment area

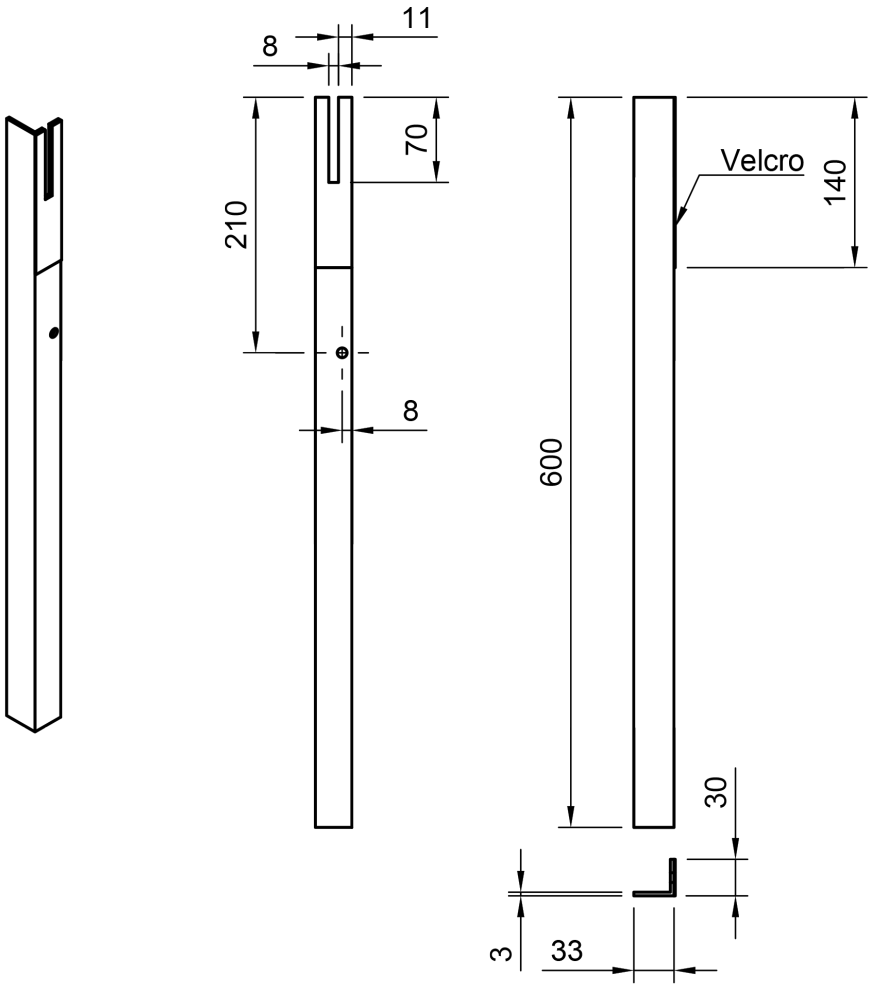

Figure 27 – The experiment mast

J.1.f. THE ATOMS DISPENSERS

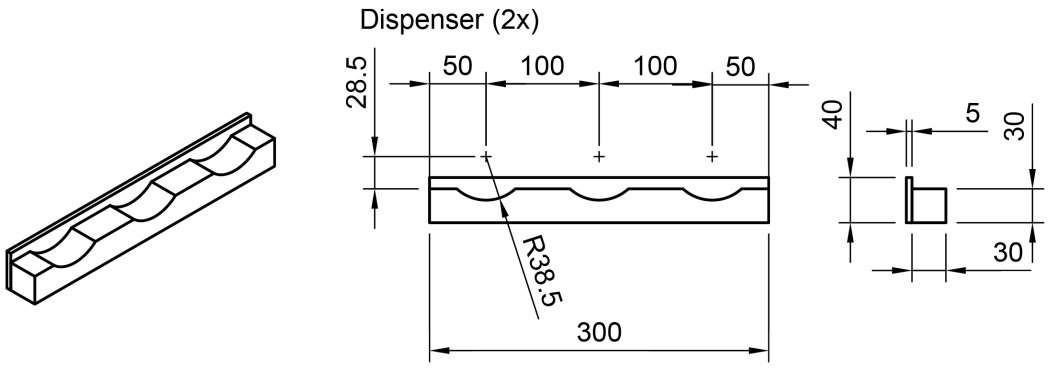

Figure 28 – Tha small atoms dispenser

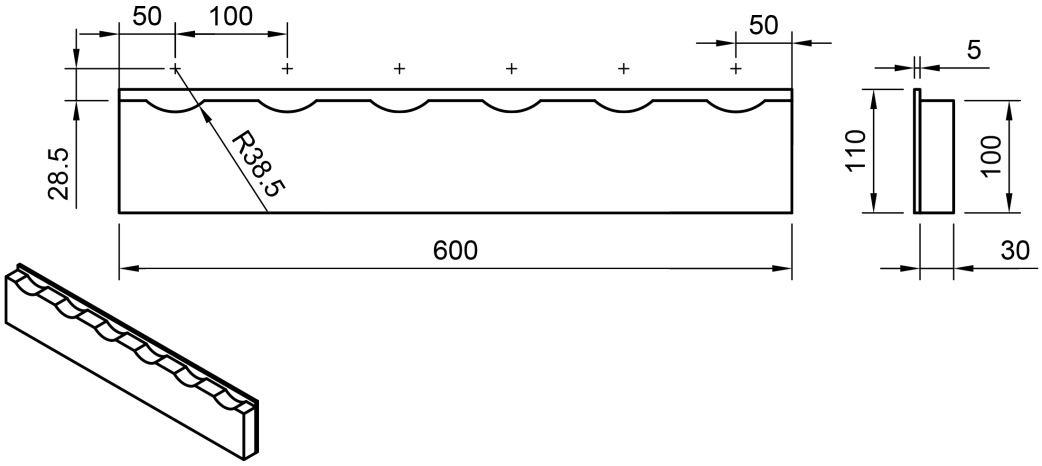

Figure 29 – The large atoms dispenser

J.1.g. BEACONS SUPPORTS

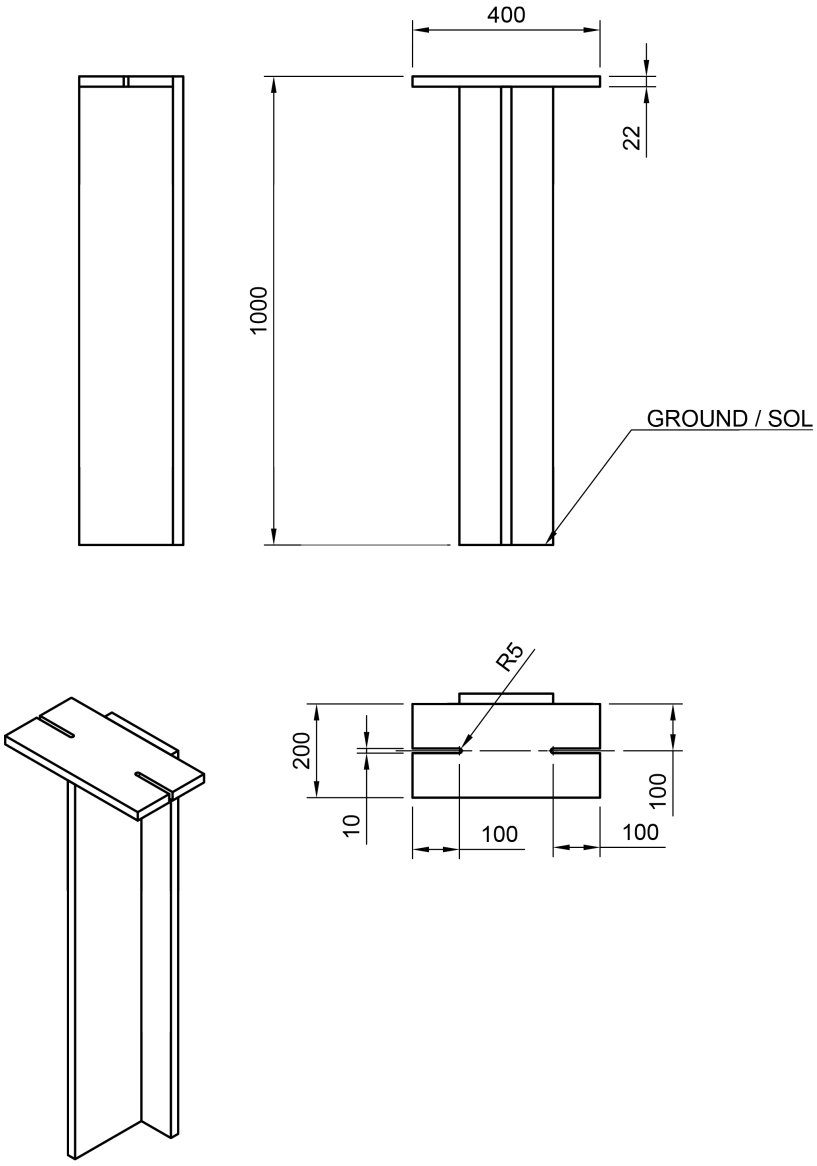

Figure 30 – Central traking device platform

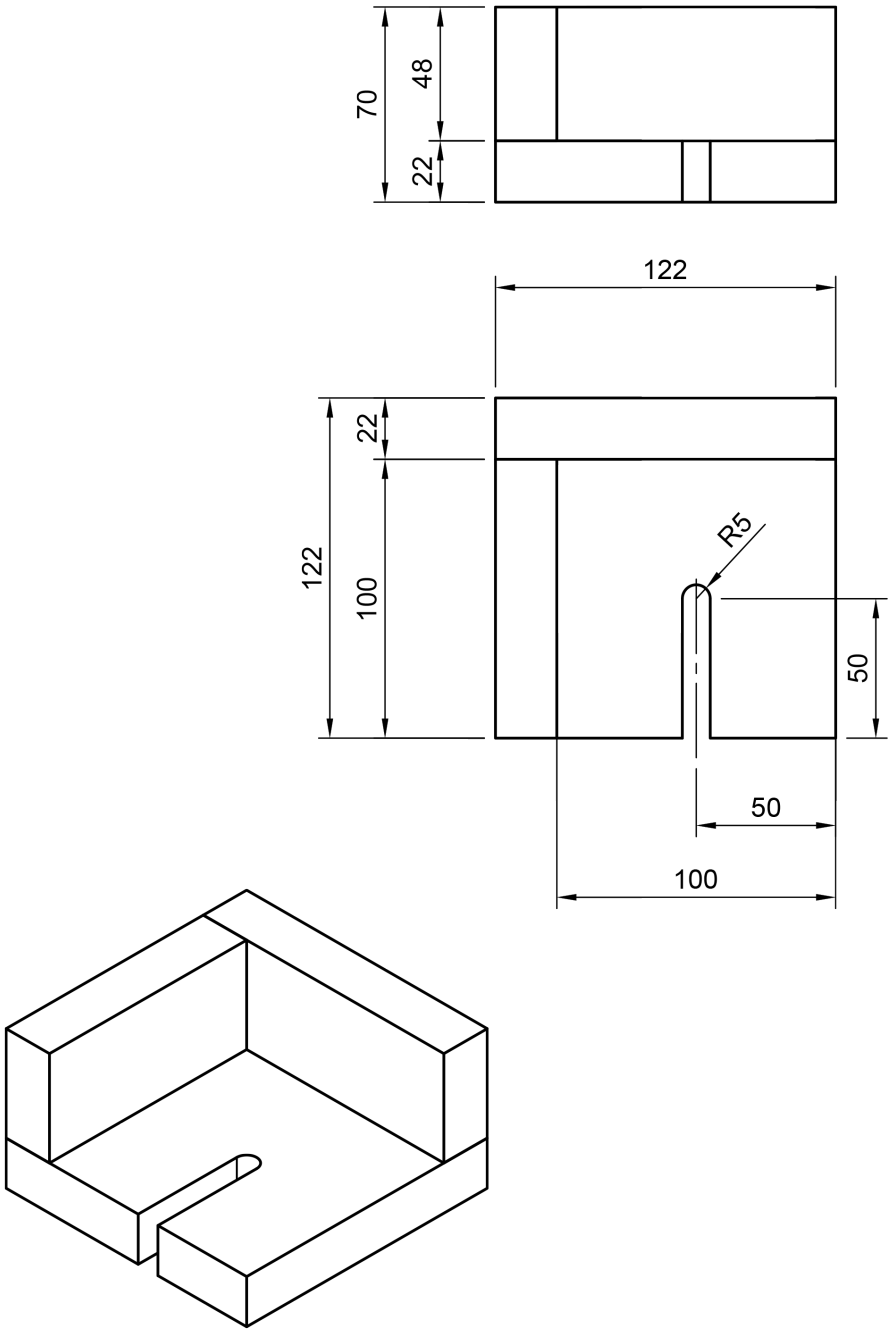

Figure 31 – Fixed beacon support

J.2. MATERIAL REFERENCES

Elements	Material or reference	Comments
Atoms	Vulcanized rubber - Polyurethane foam	Ice hockey puck line with international standards of the IIHF
Game floor	Printed monomeric gripping vinyl	Ordering information will be provided by Planète Sciences
Weighing scale	Wood - Steel - Cord - Plexiglass	
Experiment area	Mast: Steel	
Slops	Wood - Plexiglass	
Particule accelerator	Wood - Steel - Plexiglass	

No objections regarding differences in dimensions will be taken into account.

The material's density can change from one country to another. It is highly recommended that the team tries different types of wood since the weight may differ significantly.

J.3. MANUFACTURING TOLERANCES

All dimensions are in millimeters (or mm). Manufacturing tolerances shall comply with the following rules, unless otherwise specified directly on the drawings.

Dimensions	General Tolerances
≤ 20	± 1.50
> 20 and ≥ 70	± 2.50
> 70 and ≥ 150	± 4.00
> 150	± 5.00

The atom weights can vary from ± 10g.

J.4. PAINTING REFERENCES

	Colors	References	CMYK
Team A	Signal violet	Ral 4008 Mat	50%, 90% , 0% , 5%
Team B	Traffic yellow	Ral 1023 Mat	0%, 25% , 100% , 0%
Borders and non-colored elements	Pebble grey	RAL 7032 Mat	15% , 10% , 25% , 20%
Redium	Traffic red	Ral 3020 Mat	0% , 100% , 100% , 10%
Greenium	Yellow green	Ral 6018 Mat	70% , 0% , 90% , 0%
Blueium	Sky blue	Ral 5015 Mat	90%, 40% , 0% , 0%
Ramps border of the weighing scale	Jet black	Ral 9005 Mat	100%, 40% , 50% , 90%

RAL hues can vary from a printed soil mat to another.