

# Lunar Football Rule Book



ET



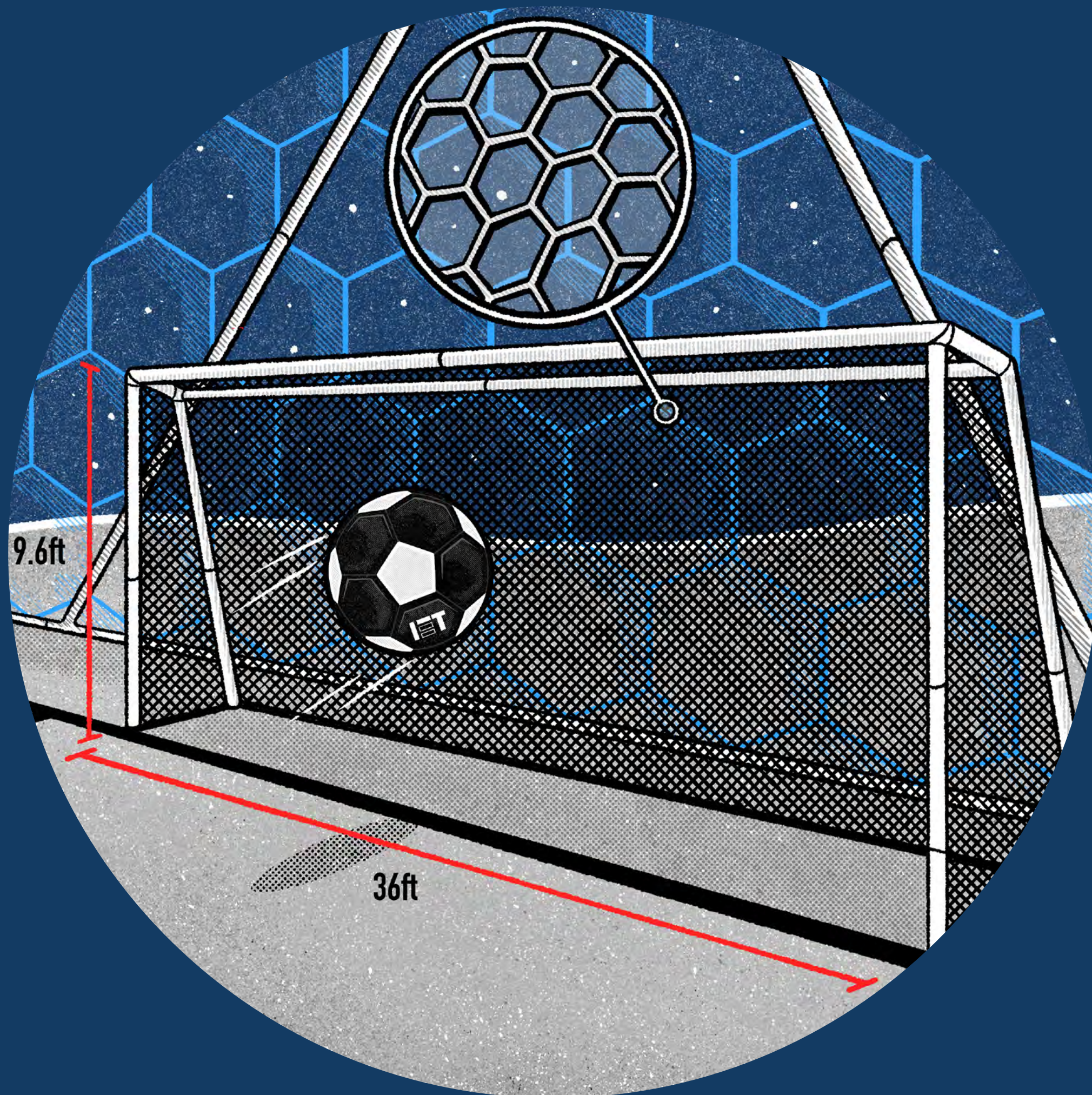
# 01. Preface

Association Football is the most beloved game on Earth, so it's only natural that with the 2025 Lunar mission set to make a Moon settlement one step closer, it will only be a matter of time before we look to take the beautiful game with us to space. And, it just might be sooner than we think!

According to a panel of scientists and engineers brought together by the Institution of Engineering and Technology (IET), we could be playing football on the Moon as early as 2035. But, given the Moon has one-sixth of Earth's gravity, a surface of dusty soil and no breathable atmosphere, the game will look very different.

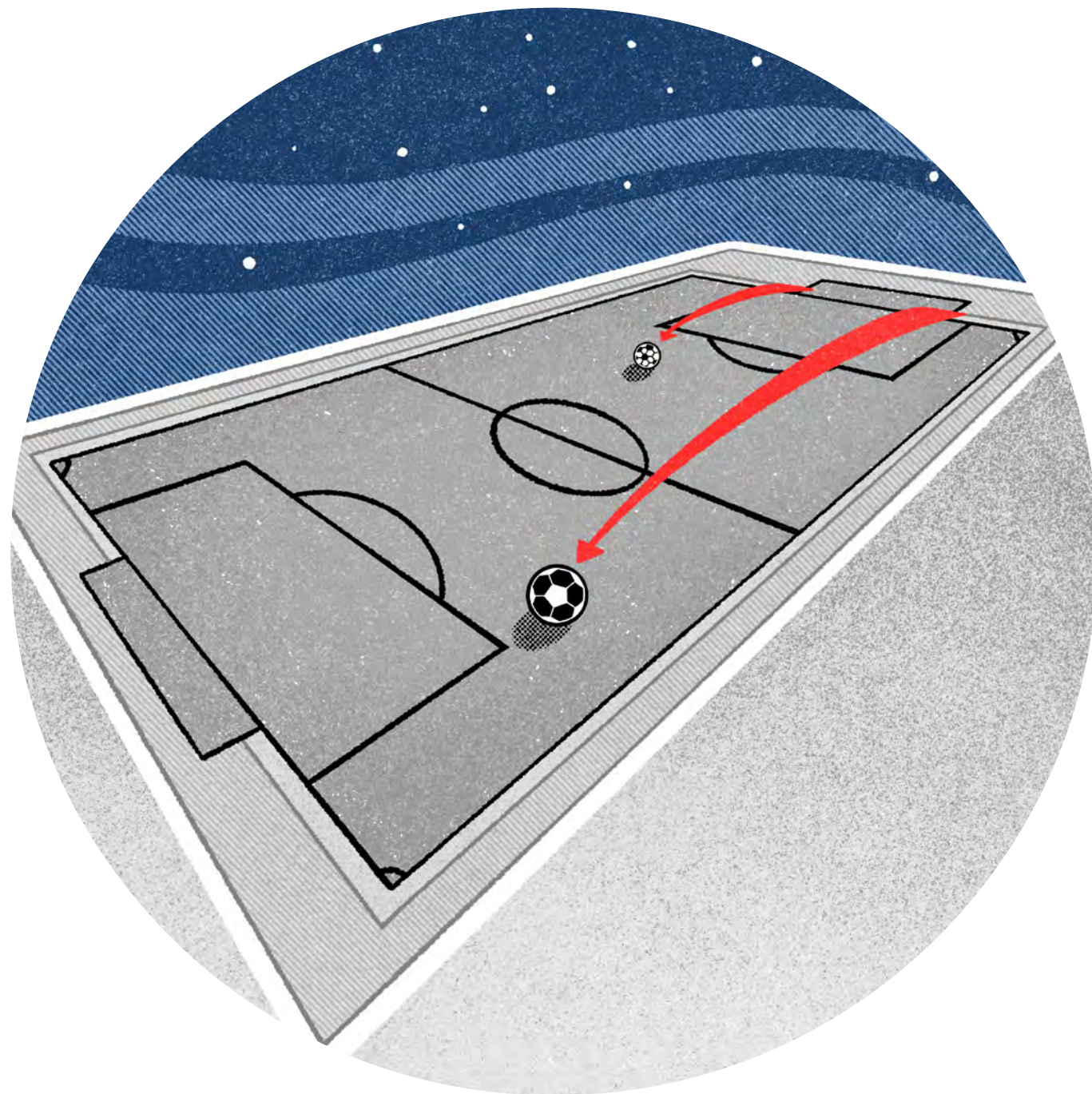
As a result, the IET asked its panel of engineers, technology, and science professionals to create the first-ever Lunar Football Rule Book, determining how the game of football will need to be adapted to play in these harsh conditions and the technological advances we'll need to be able to do so, so that humans can have a kickabout without delay once we establish a lunar base. The core principles of the sport remain unchanged but the way in which a match is played has been fundamentally overhauled to bring football to the Moon, as outlined in this handbook\*.

\*Please note, the Lunar Football Rule Book is based on adult five-a-side football. Rules, ball sizes, goals and pitches will be adapted accordingly for children as per Earth football.





# 02. IET Lunar Football Board



Introducing the IET Lunar Football Board. A team of engineers and technology professionals who have together predicted the future of Lunar Football.



## Eneni Bambara-Abban

Eneni is a multi award-winning Robotics Engineer, Science, Technology, Engineering, and Mathematics Educator, philanthropist, and filmmaker. She has worked in multiple tech sectors, from developing computer vision algorithms for self-driving cars to data analysis and optimisation for some of the biggest gaming apps in the world. She is also the founder of The Techover Foundation, an international Non-Governmental Organisation that focuses on encouraging, educating, and supporting individuals from underserved communities into technology.



## Beth Clarke

Beth is an Astrophysicist turned Software Engineer, currently specialising in quality and DevOps at ROSEN where she leads global compliance initiatives for one of their key software products. She was recognised as an IET Young Woman Engineer (YWE) 2020 finalist and Rising Star of Women in Technology by Computer Weekly in 2021 and by Everywoman In Technology in 2023.



## Ama Frimpong

IET Young Woman Engineer of the Year (2022-23), Ama is Head of Product Development at 52 North Health. Here, she manages the company's engineering teams in the development of Neurocheck® – a low-cost, portable device that helps identify people living with cancer who are at risk of neutropenic sepsis – a life-threatening medical emergency occurring in immunosuppressed chemotherapy patients.



## Sophie Harker

Sophie is Assistant Chief Engineer of Electric Air Vehicles at BAE Systems. As an aerospace engineer, she specialises in aerodynamics and performance engineering on aircraft of the future. Sophie is also an analogue astronaut – testing space conditions in a simulated crewed mission. In 2018, she was named winner of the IET's YWE Award.



## Abbie Hutty

Abbie is a Chief Engineer at ispace Europe SA, where she leads the development of Lunar Rover missions. Prior to this role, she spent 12 years at Airbus space in the UK, working primarily on Mars Rover missions. She is a chartered engineer, and alongside her day job, Abbie promotes engineering careers and studying STEM subjects to the next generation. Abbie won the IET's YWE award in 2013.



## Brian David Johnson

Brian has made the future his business. From 2009 to 2016, Brian was Intel Corporation's first-ever futurist. Currently, he is a professor at Arizona State University's Global Futures Laboratory and the School for the Future of Innovation in Society. He also works in a private practice with a broad range of groups, including governments, militaries, corporations, nonprofits and start-ups, to help them envision their future.



# 03. The rules

## Equipment

### 1. Safety

Each player must carry their own oxygen tank. Before taking to the field the referee based in the space station must verify that each player's oxygen tank is full and not leaking. The referee must also confirm the functionality of each player's master comms system, elbow and knee padding, cooling systems and reserves systems.

### 2. Compulsory equipment

#### A. Suit

Players must be wearing an airtight suit. The suit will be a slimmed down version from the spacesuits used by the Apollo astronauts, with an increased flexibility that will make it easier to move with the ball than the original versions. Suits will have in-built padding around the knees and elbows with a hardened shell. Suits are required to have cooling and heating systems adjustable to the temperature of the lunar climate. The suit also features flannel in the seat for the absorption of sweat. The Lunar Football team or club's strip must be worn over the suit.

#### B. Helmet

Players must be wearing a helmet sufficiently equipped for safety and playability. The helmet must have a visor that has a 180 to 270-degree view. The helmet also has sensors which process and communicate the following on the visor's Augmented Reality (AR) Heads Up Display (HUD): lunar climate conditions, player suit status, scoreboard, match time, pitch markings and other player's positions on the pitch, to help situational awareness and prevent collisions. The helmet also features systems enabling communication with players and coaches, but this can be overridden by the master comms system in order to prioritise refereeing and emergency messages. Helmets will feature a Valsava device to unblock players ears during any pressure changes, as well as an absorbent pad so that players can wipe sweat from their brows, so it doesn't run into their eyes and distract from important play!

### 3. Ball

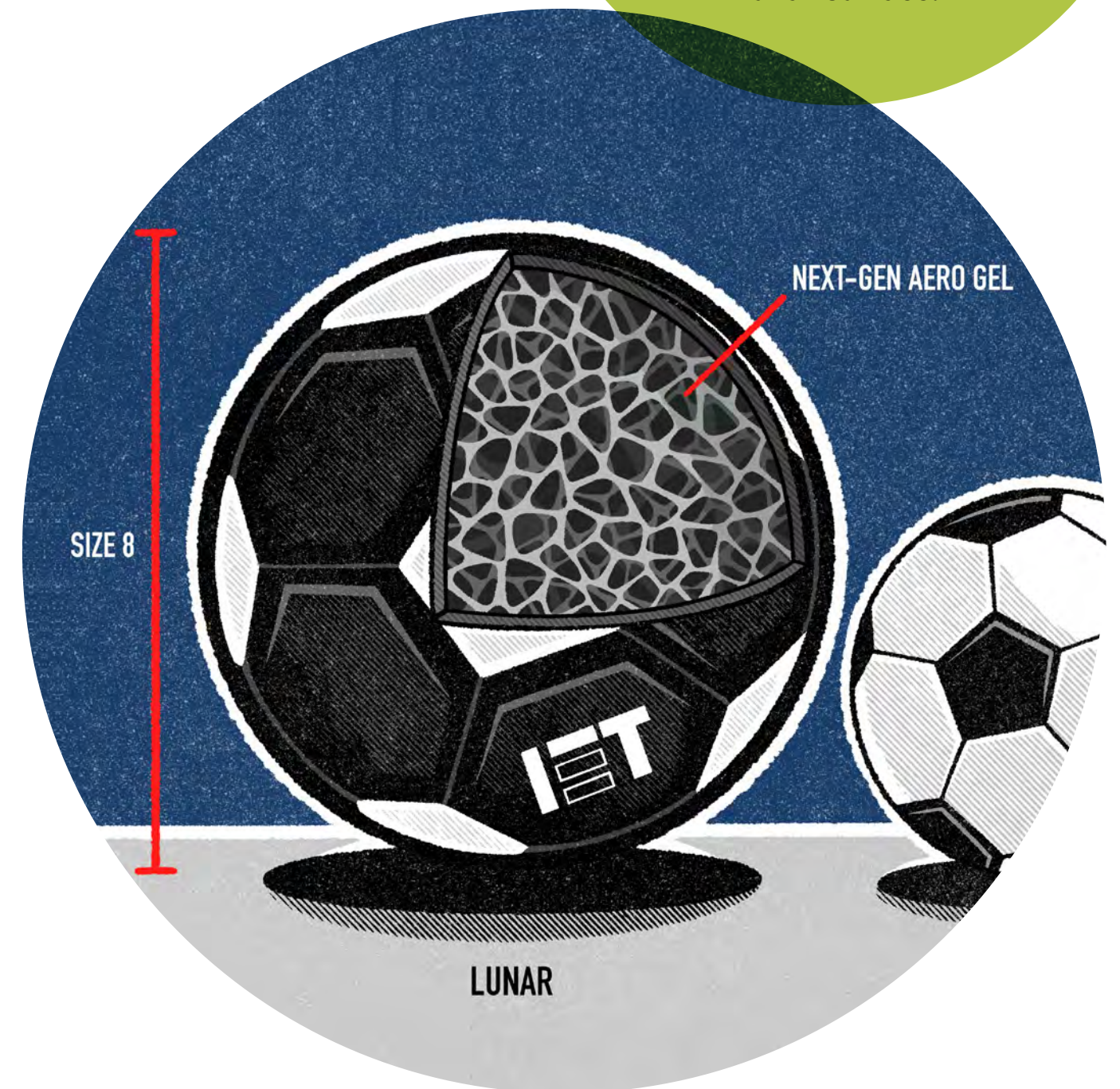
The ball must be 1.5x the size of a terrestrial football – making it a size 8 football. The colour of the ball must be strictly black and white only. Ideally the ball will be mostly black to contrast with the lunar soil. Critically the ball must have a core of Next-Gen Aerogel. Aerogel is a spongy structure which will give the ball a compressibility to allow bouncing while not containing any air. A ball filled with air in space would likely leak or burst due to the pressure difference between the ball and the vacuum of space.

Aerogel is an open celled foam.  
**99.8%**  
of the structure consists of empty pockets which allows it to be squashed or compressed.

Early aerogels were quite rigid – next gen aerogels have more elasticity and spring back to shape after being squashed, which is what we look for in a football.

Aerogel is especially suitable as it is very resistant to high and low temperatures – both of which will be experienced on the lunar surface.

It will be extremely bright on the Moon so the high contrast between the black and the white will be essential for players to see the ball.





# The field of play

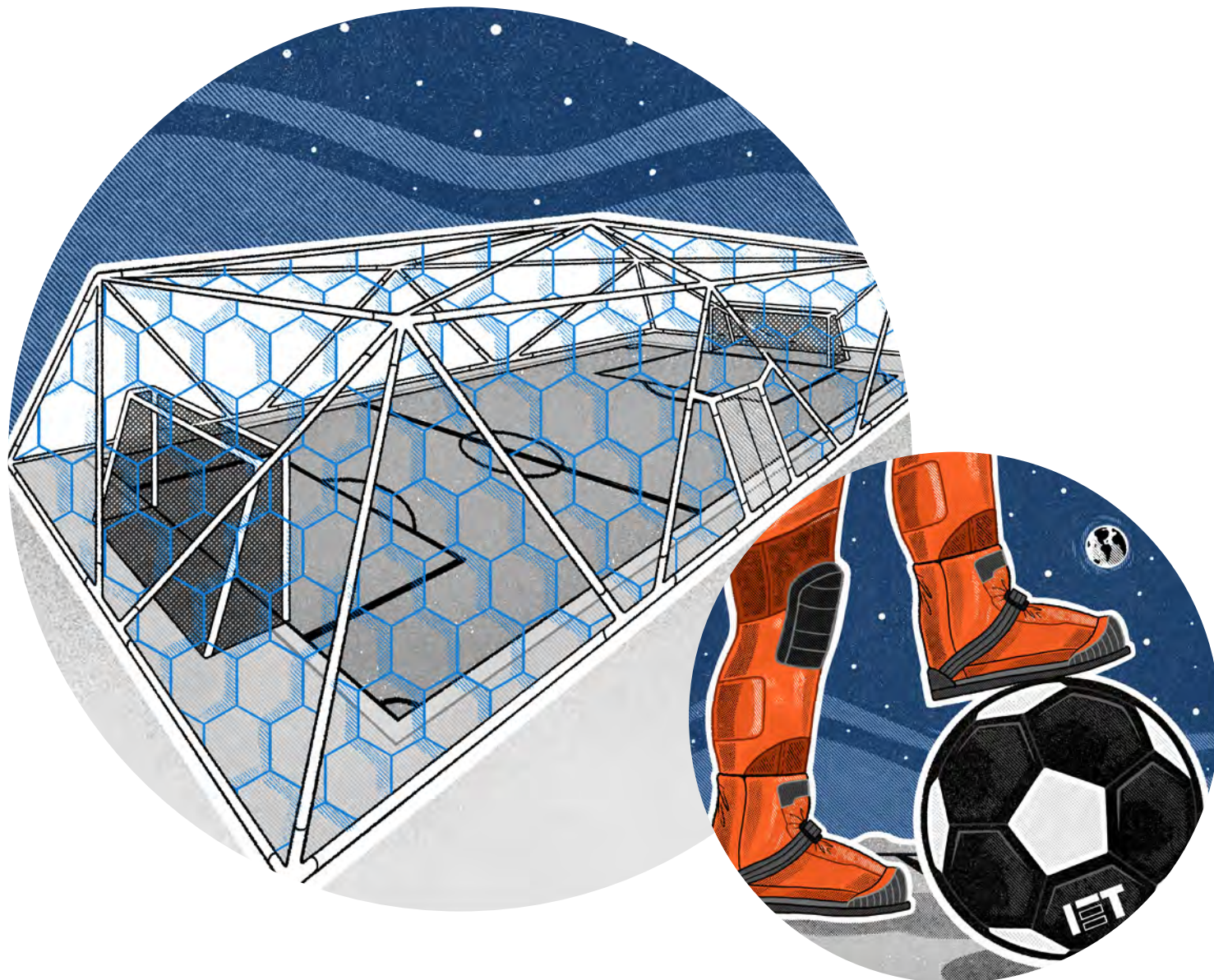
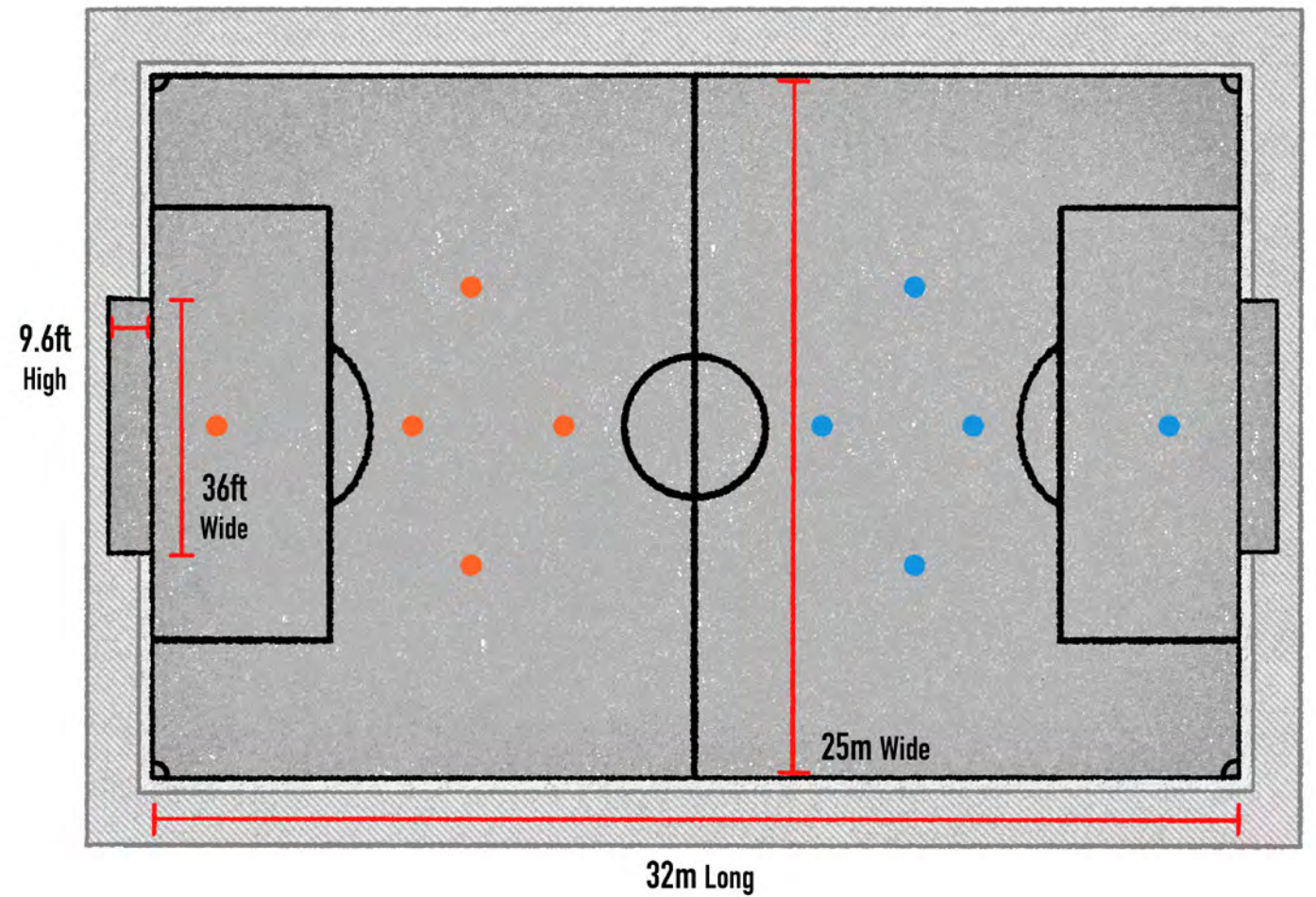
## 1. Field surface

The field of play must be prepared using laser sintering, turning the soil into a glassy compound similar to concrete or cement in order to achieve an even and consistent pitch on the lunar surface. Laser sintering must be used to ensure that the field of play is durable, failing to do so would cause the pitch to erode during the match, endangering players as a result.

## 2. Field markings

The field of play must be marked out with black and white polymer. In the player's Heads Up Display, both the ball and the field markings will show up as fluorescent glowing colours overlaid over the real view, to help the player identify them against the dazzling lunar surface.

Laser sintering is where the lunar soil is treated by firing a laser at the surface, slightly melting the particles so they stick together as a single solid layer.



## 3. Boundaries

The pitch is 32m long and 25m wide, with an area 8 times smaller than that of a terrestrial football pitch – like a five-a-side pitch on Earth. Outside the marked field of play must be a netted boundary covering the sides of the pitch and including a netted roof. The net is required to have a rectangular prism area for play, with a low roof and closed sides, so that the ball can bounce quickly off the net and back down or into the players. The ball can be played off the roof and netted sides without stopping play – within the netting there is no out-of-bounds.

## 4. Goals

The goal must be 1.5 x wider (36ft) and 1.2 x higher (9.6ft) than a terrestrial football goal – it will be a similar structure to an Earth goal but the string for the net would be made from a space grade material like Nomex or Kapton. This size of the goal is to account for the larger, size eight ball, and the fact that jumping is easier on the Moon.



The lunar day is  
**28 Earth days**  
long, so lunar noon can be  
considered to be a 72-hour  
period occurring once every  
lunar day cycle.

## The game

### 1. Timing

Lunar Football is played in four 10-minute quarters with 20-minute breaks between each quarter in order to recover, refuel and repair equipment. The game can be paused or stopped at any time for medical or other emergencies, such as receiving an alert about a solar flare.

### 2. Conditions

Light is high contrast on the Moon therefore Lunar Football must take place at lunar noon to maximise visibility and avoid shadows.

### 3. Teams

Lunar Football is a five-a-side game to provide space for play and for the avoidance of collisions. It therefore requires at least 11 astronauts on the Moon to play – five on each team, and one referee. Much like terrestrial five-a-side there will be no offside.

### 4. Fouls

Lunar Football is a non-contact sport.

Turnovers in possession will be solely through interceptions. Players cannot:

- Approach another player from behind
- Head the ball (to protect the helmet)
- Slide for the ball (to protect the suit)
- Initiate a tackle of any kind (to protect the suit and player welfare, and avoid dust clouds)
- Fail to assist or pick up another player that has fallen to the ground
- Trip or bump another player

### 5. Punishments

Red and yellow cards will be distributed through players' visors. Players handed a yellow card will see a countdown timer appear for the duration of their yellow. Red carded players will be sent to the 'sin bin' for the rest of quarter and re-enter at the next.





# 04. How to play

Now that you understand the rules and requirements of Lunar Football it's time to get stuck in. You're space-suited and booted, helmet on and have a size 8 football at your feet, what next?

## Heads up

Your helmet's Heads Up Display shows you everything you need to know. Pitch markings glow in the periphery and distance, teammates appear highlighted in gold in your visor with opposition players glowing red.

Your Heads Up Display will also have access to important information about the game: the top of your visor will display how long is left in the quarter and the match score – this information will be intermittently replaced with updates on refereeing decisions and messages from coaching staff.



## Formation

Playing football on the Moon is more tiring owing to the bulkiness of the suit – it will take a lot more effort to get about the pitch. The most efficient way for a team to line up is to take inspiration from table football with each member of the team responsible for a horizontal section of the pitch. As the ball travels up and down the field it is up to you to intercept it as it passes you – just be fast enough to get there before your opponent.

5-a-side positions include:

- Goalkeeper • Defender • Mid-fielder • Attack mid-fielder • Striker

## Put yourself about

Putting yourself about the pitch and being agile is going to be a little harder. The suit is bulky which makes it harder to run, and due to the lower gravity, players will bounce higher with each step – think of it as skipping across the Moon. Using this technique, your strides could be much longer than on Earth – though Jill Scott will still out stride us all!

## Tekkers

The ball at your feet will not behave like a football on Earth as the lack of air means there is no drag on the ball – the Moon's atmosphere is a near vacuum. And, given that the Moon's gravity is one-sixth of Earth's and there is no wind or air resistance, if you kicked a ball on the Moon as hard as you do back on Earth, it would travel around six times further before it hits the ground. The ball's ability to travel means players need the speed of Kylian Mbappe and the anticipation of Virgil van Dijk, easy enough, right?

## Top bins

Owing to the much larger goals, players have more space to aim at when they strike the ball. This is due to the goalkeeper's ability to jump higher and further – make sure you're aiming for top bins when you hit it.

## Tactics

You must make use of your surroundings to the best of your ability. The net isn't just there to stop the ball flying away into infinity, it's there to keep the game moving at pace. Play quick one-twos with the ball to gain ground on your opponents. Think of Lunar Football as if it is a mix of football and ice hockey... and on the Moon.

## Respect the (Holo) Ref

Space is at a premium in Lunar Football and as such the Referee will be stationed at the Moon's basecamp. Your match official will still be a visible presence, just in the form of a hologram. Laser range finders will monitor the pitch and give the Ref situational awareness and they'll certainly need it, as they will also be the fixture's Medic/Physio.

## Take a (literal) breather

You are more than likely accustomed to a game of two halves (literally and metaphorically), but Lunar Football is a game of four, 10-minute quarters with 20-minute breaks between each period. Players must use these breaks wisely, recovering from the intense demands of the suit – the shedding of playing boundaries and the moving away from traditional tackling means that the only breaks in play are penalties and goals being scored; the physical demands are immense. Most importantly, rest periods must be used for refilling oxygen reserves – the Holo Ref will be checking your tank is full before resuming play.

## They can't play on!

In the unfortunate event of injury, players will have to leave the field of play, though there's no stretchers on the Moon – instead autonomous vehicles will swoop in to rescue the competitor.

## Sporting behaviour

Lunar Football is a more considerate game.

The Moon is a hazardous place to be playing football, it's a harsh and an unforgiving environment – solar flares could halt play at any moment and any significant damage to a player's suit could be very dangerous.

Considering the hazardous environment, sportsmanship is of paramount importance and crucially, when played on the Moon, football is a non-contact sport – tackling is a thing of the Earth, and all turnovers of possession will be made through interceptions. Players will be obliged to help each other up when they go down and can be punished if they fail to come to a peer's aid.



# 05. Conclusion



As humanity continues to push boundaries, seek new frontiers, and explore further horizons – engineers will help us bring the very best of what Earth has to offer along with us. With the 2025 Lunar expedition fast approaching, and the possibility of inhabiting the Moon ever increasing, it's only inevitable that we'll take the world's most popular sport with us in the not-too-distant future, but we can only do that if we have hardworking, creative engineers and scientists on hand to help us make it happen.

Yes, Lunar Football may look a little different – a non-contact sport, with no out-of-bounds play and flexible suits with AR helmets to deal with the harsh conditions of space. But, it will still remain an exciting game of skill, passion and creativity and we can't wait for kick-off.

Do you think you  
have what it takes to help  
make Lunar Football a reality?  
Or are you interested in finding out  
more about the different careers  
in STEM?

For more information, visit  
[eabw.theiet.org](http://eabw.theiet.org).



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