

AR Electric Field — Marker Encoding

This lab tracks printed 3×3 matrix-code (barcode) markers with AR.js — no marker training needed. There are **two independent schemes**: a **Plane** scheme (flat stickers on a desk — each point charge **floats above** its sticker, and plate stickers raise a charged board) and a **Cube** scheme (markers on a box, charge at the cube centre). Because you only ever run **one scheme at a time**, the two schemes deliberately **reuse the same barcode values**. Print at 100% (actual size) and keep the white quiet-zone border around every code.

Plane scheme — flat stickers; charges float above the desk

Code	Marker	Role	What / where
0		Positive charge (+)	A + point charge floats 2× the sticker edge above this sticker (?lift=).
1		Negative charge (-)	A – point charge, floating above its sticker.
2		Positive electron gun (fires e ⁺)	On the desk; fires e ⁺ along the printed arrow .
3		Negative electron gun (fires e ⁻)	Fires e ⁻ along the printed arrow .
4		Positive charged plate (2×)	A square board standing on the desk, side = 4× edge, perpendicular to the desk, uniform charge = 2× a point charge.
5		Negative charged plate (2×)	Same, with a uniform –2× charge (?plateside=, ?plateq=).

Cube scheme — markers on a box; charge at the cube centre

Each cube uses **five** distinct face markers (top + four sides). Every visible face is stepped inward by ½ the **cube edge** and the faces are averaged, so the charge sits dead-centre and never jumps as you circle the cube.

Code	Marker	Role	What / where
0–4		Positive cube — 5 faces	Positive charge at the centre of this box.
5–9		Negative cube — 5 faces	Negative charge at the centre of a second box.
10		Positive electron gun (e ⁺)	Lay flat by the cubes; fires e ⁺ along its arrow.
11		Negative electron gun (e ⁻)	Fires e ⁻ along its arrow.

Firing direction, plates & tips

Every electron gun fires along the **printed arrow** on its card (the app fires along the marker's local +X axis); add **?gundir=1** (0–3 quarter-turns) if a beam comes out rotated. Both signs of test charge are available: e⁺ and e⁻. A

charged plate is a square board standing on the desk, 4× the marker edge on a side, carrying a uniform charge of 2× a point charge; its field leaves both faces. In the live apps the layout **auto-locks** once the markers are seen steadily, freezing the field; the camera pose is then recovered from the **average of all visible markers**, so the scene stays glued to the desk without jitter. Print at 100%, keep the white quiet-zone border, and use even lighting on a matte surface.