

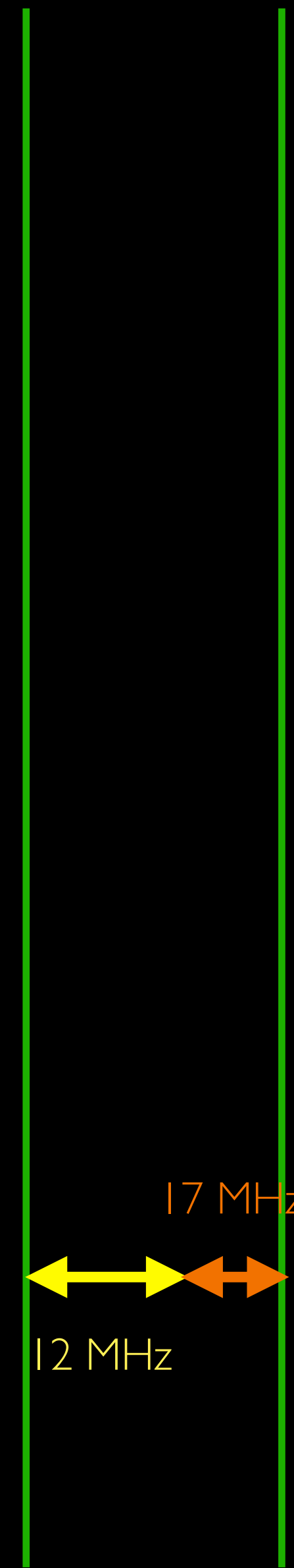


DEFENSIE



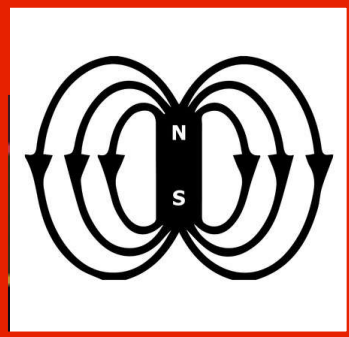
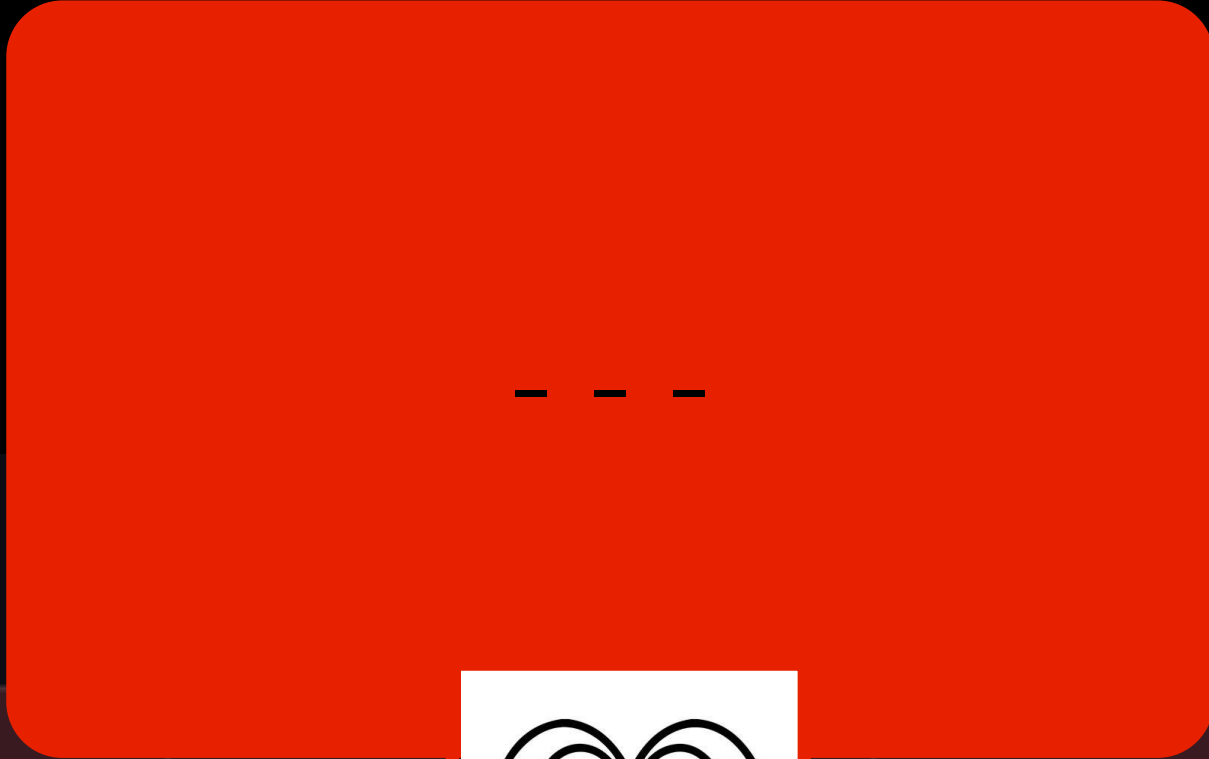
DEFENSIE

May 15, 2024

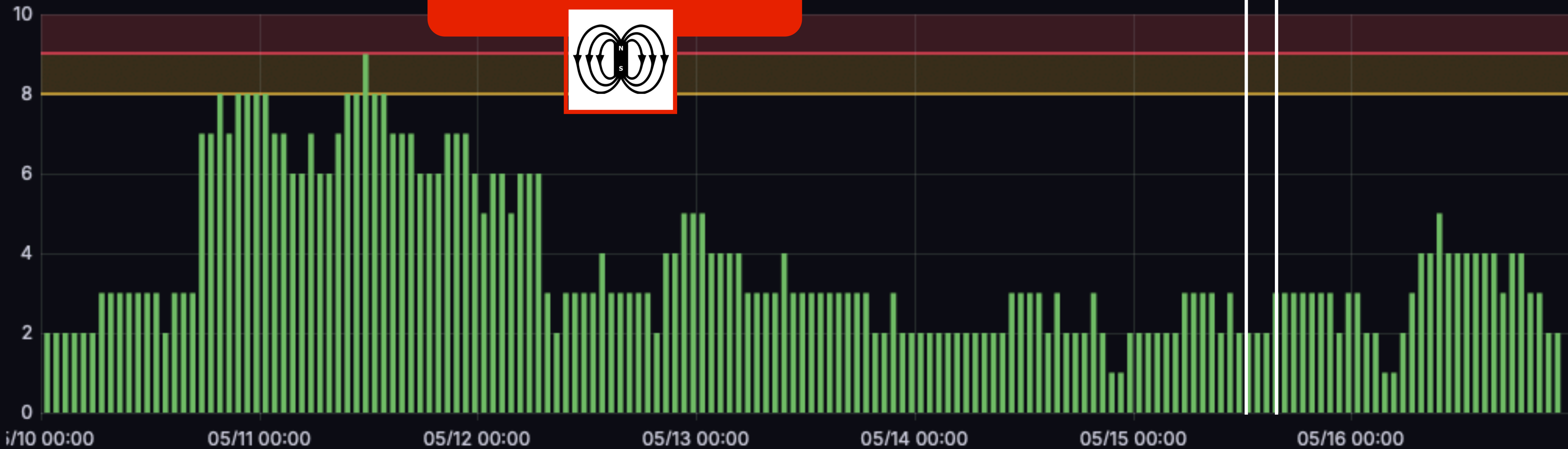


00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

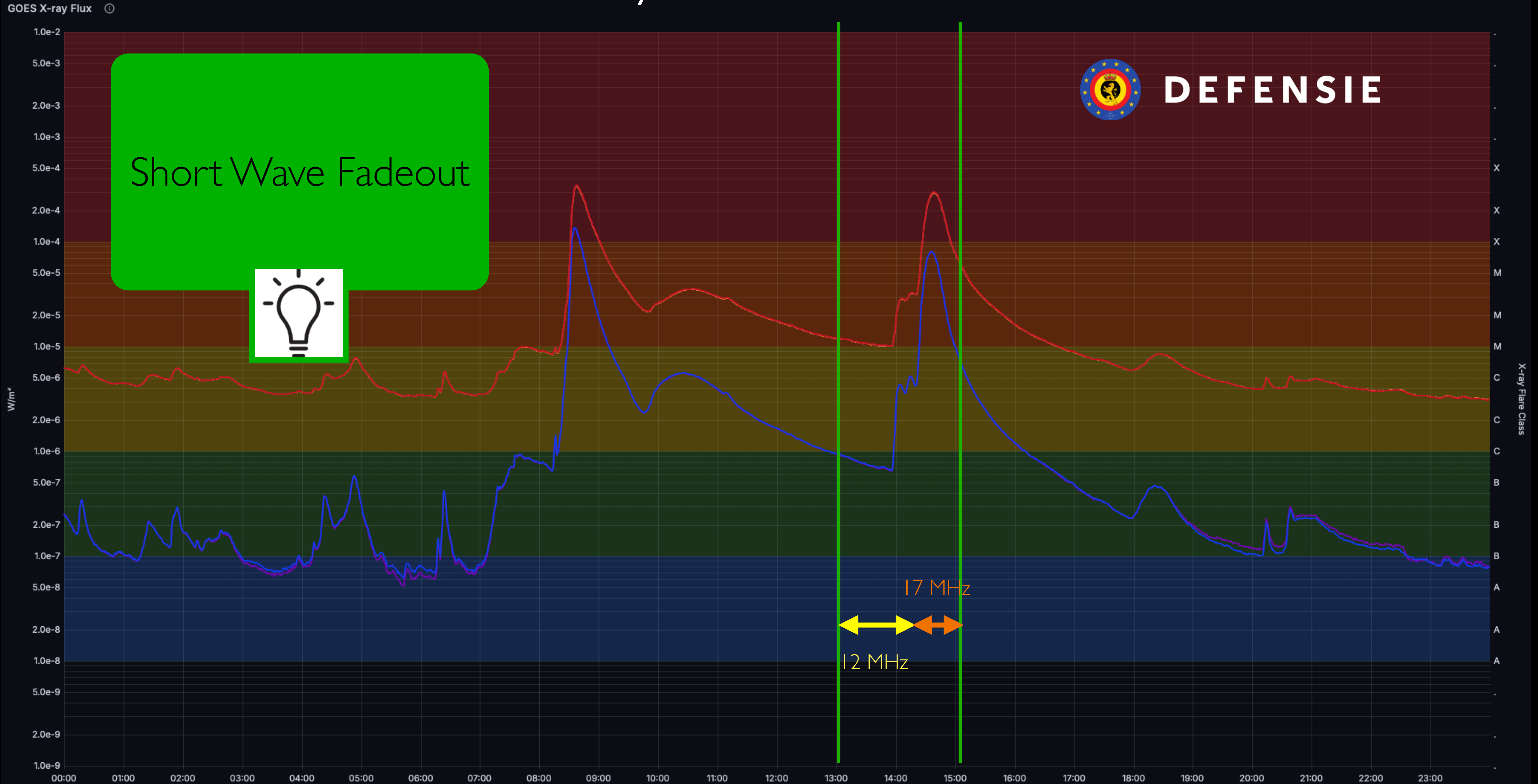
May 15, 2024



K Belgium ⓘ

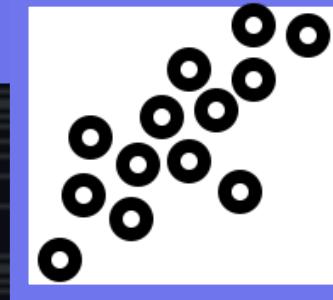


May 15, 2024

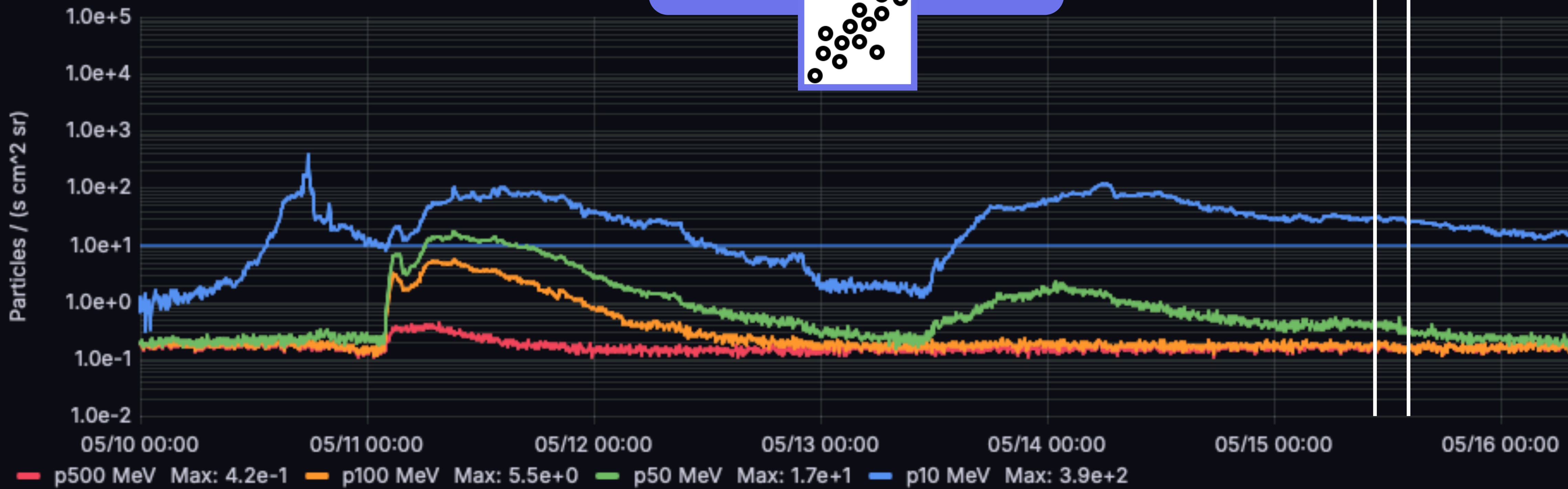


May 15, 2024

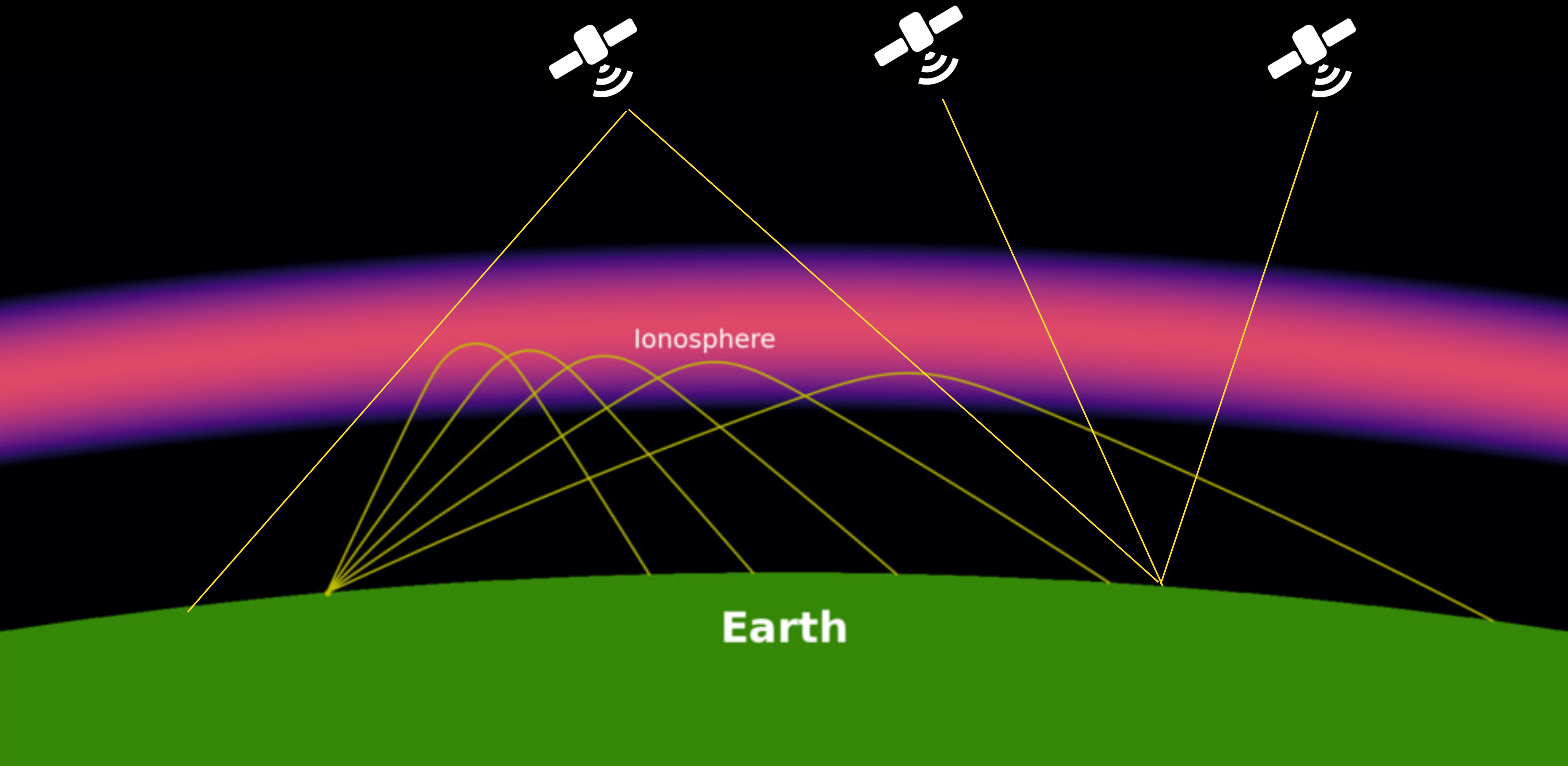
Polar Cap Absorption

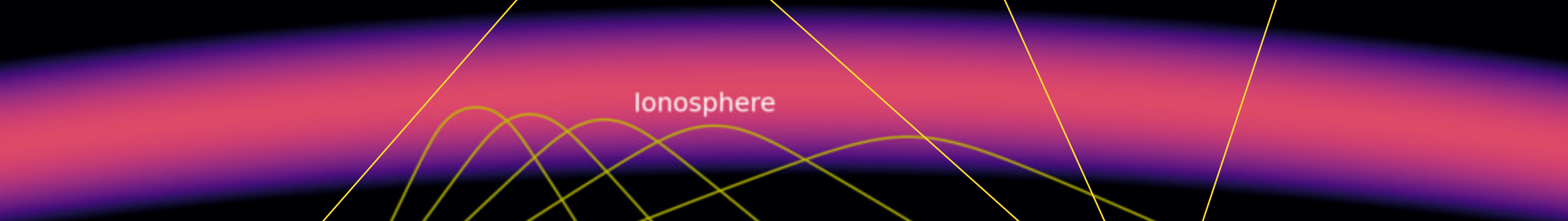
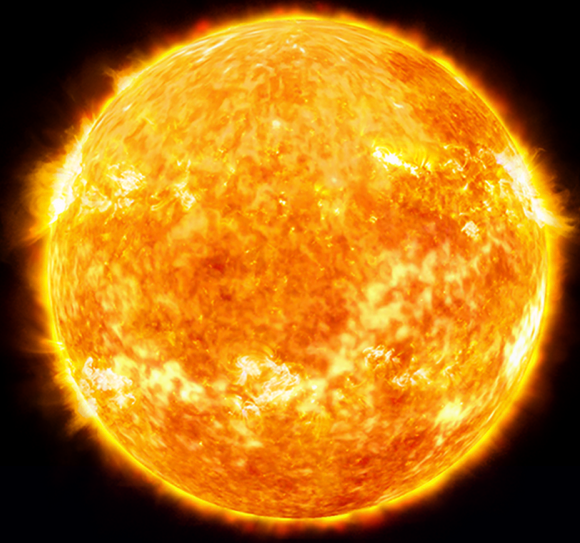


GOES-16 Proton Flux ⓘ



HFcom 2.8 - 35 MHz ; GNSS 1100 - 1600 MHz

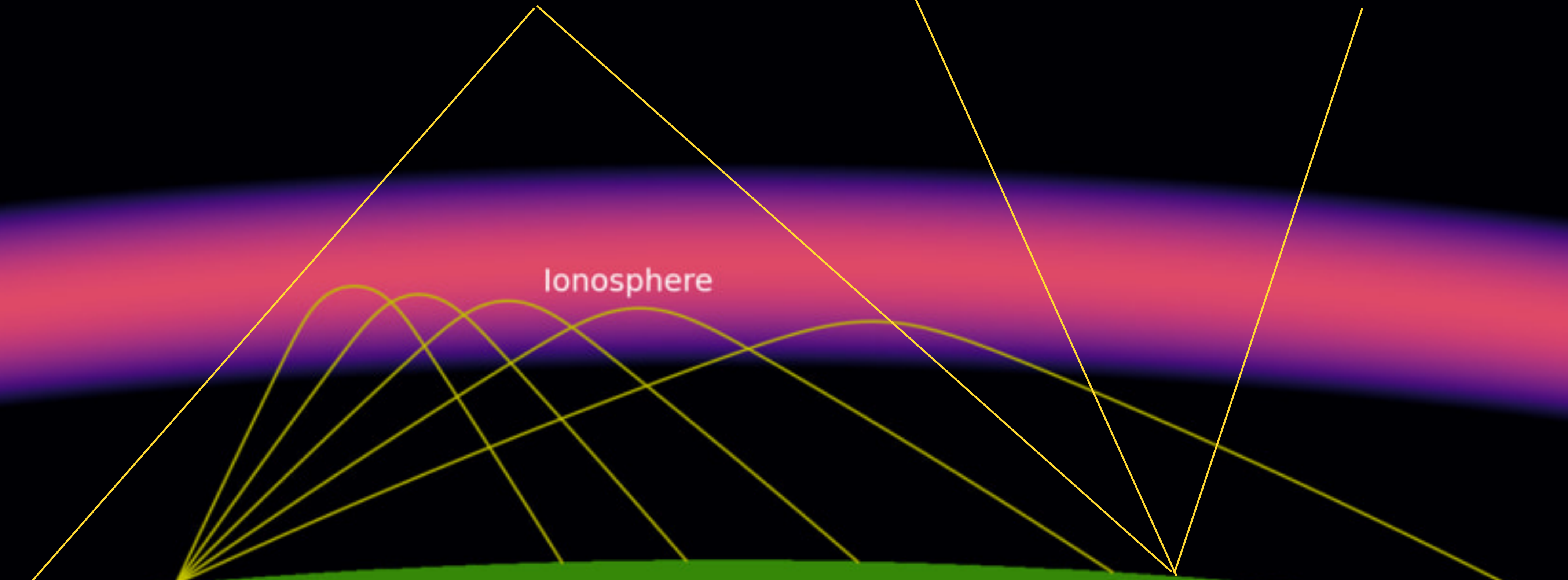


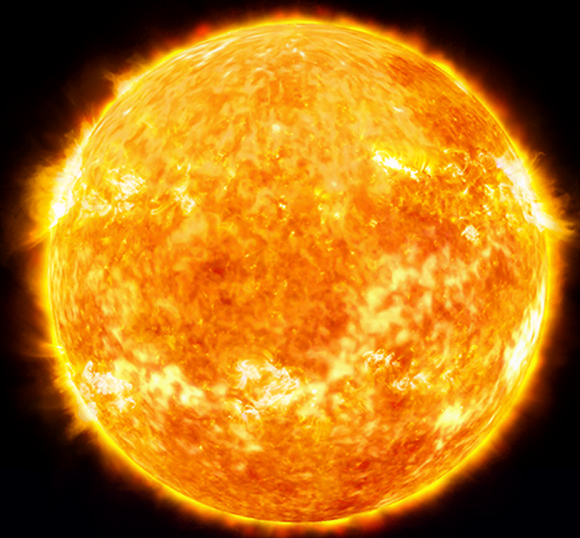


Ionosphere



Earth

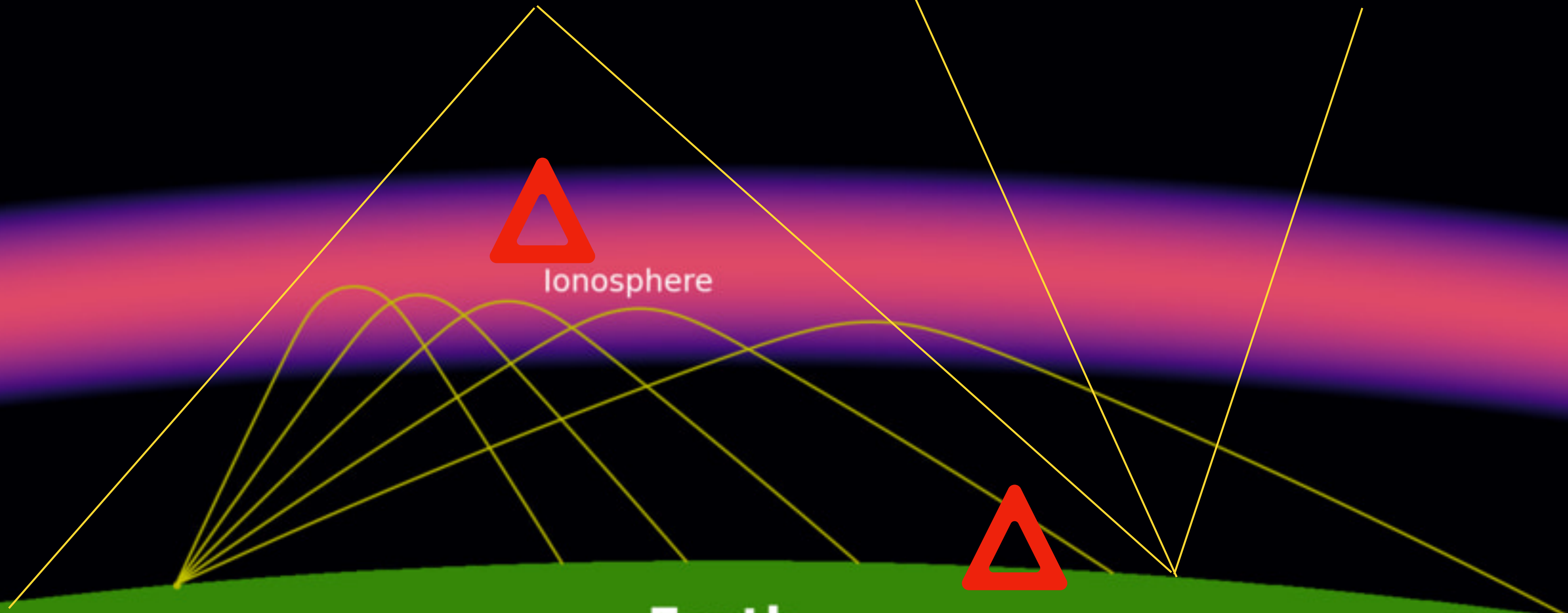


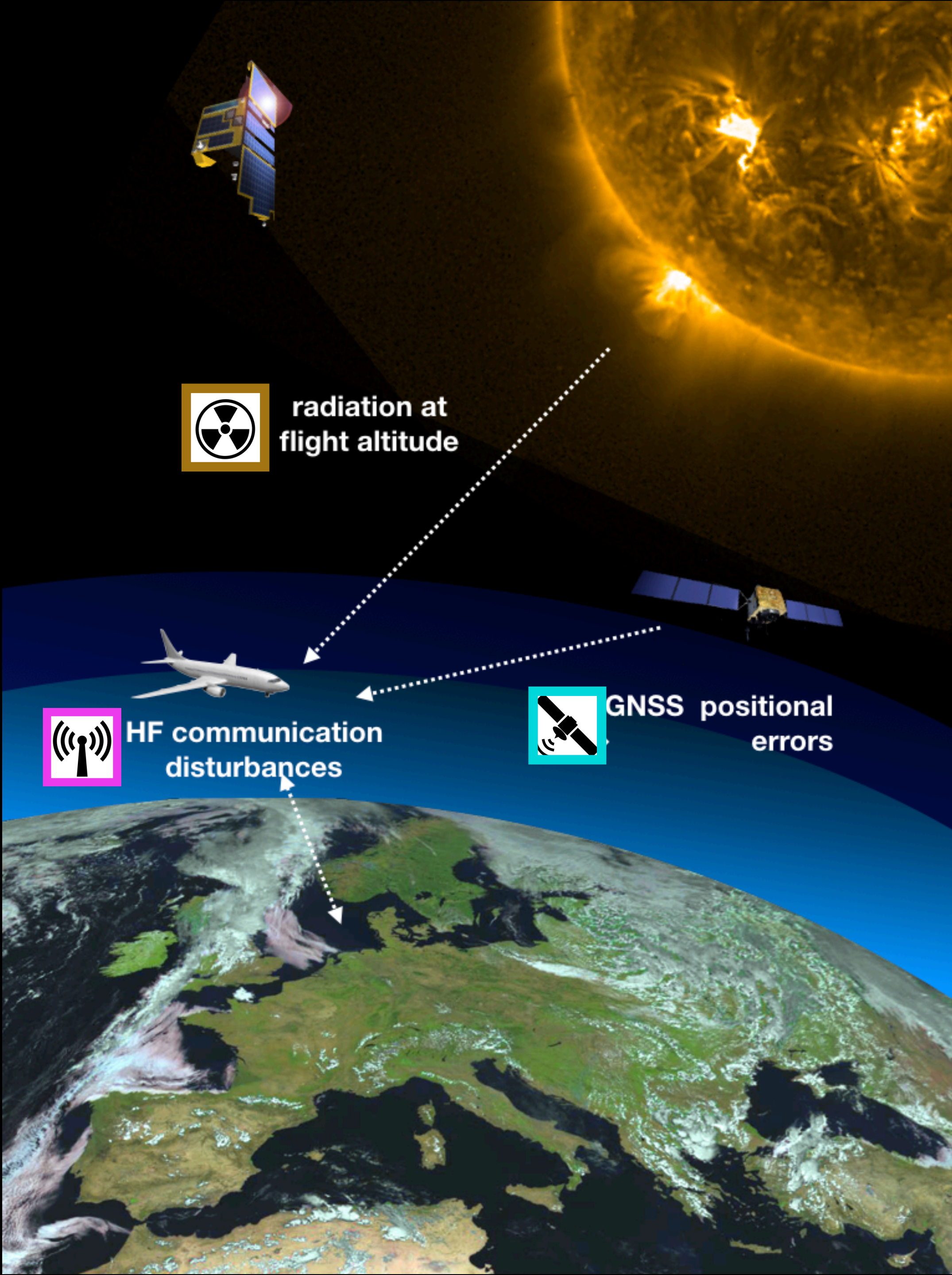


Ionosphere



Earth





PECASUS

Partnership of Excellence for Civil Aviation SWx User Services

Space weather can impact navigation and radio communication systems and can cause an increase of radiation levels at flight altitude.

HF Advisory:

0000057501

FNXX02 EFKL 020814

SWX ADVISORY

DTG: 20260202/0814Z

SWXC: PECASUS

SWX EFFECT: HF COM

ADVISORY NR: 2026/63

OBS SWX: 02/0808Z MOD DAYSIDE

FCST SWX +6 HR: 02/1500Z NOT AVBL

FCST SWX +12 HR: 02/2100Z NOT AVBL

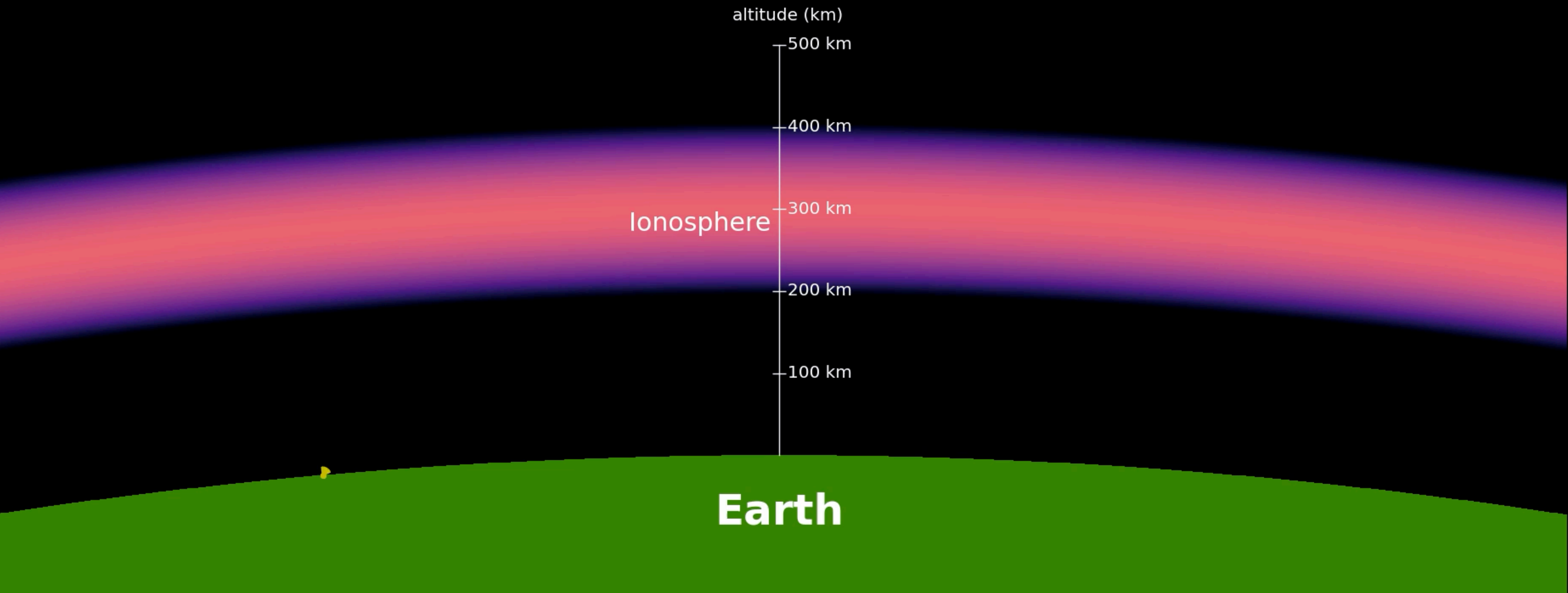
FCST SWX +18 HR: 03/0300Z NOT AVBL

FCST SWX +24 HR: 03/0900Z NOT AVBL

RMK: SPACE WEATHER EVENT (SOLAR FLARE) IN
PROGRESS. IMPACT ON LOWER HF COM FREQUENCY
BANDS EXPECTED

ON THE DAYLIGHT SIDE. HIGHER FREQUENCY BANDS
MAY BE LESS
IMPACTED.

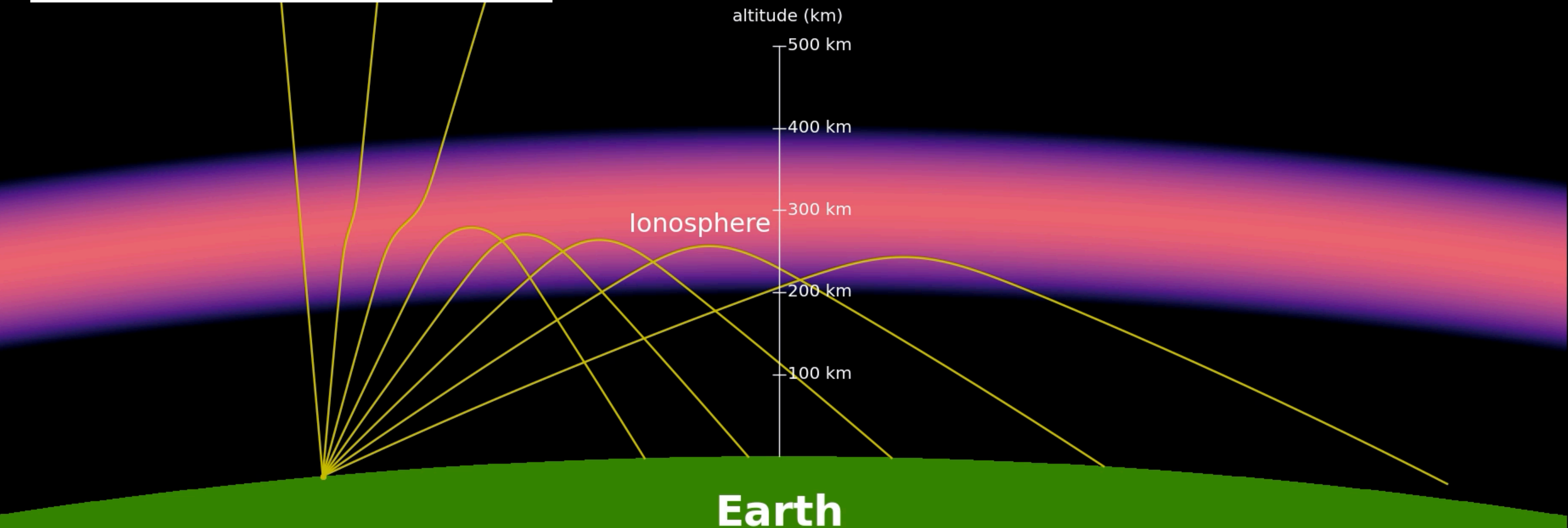
NXT ADVISORY: WILL BE ISSUED BY 20260202/1408Z=



The plasma frequency affects the refractive index of the medium

$$f_p \propto \sqrt{n_o} \quad \left| \quad n = \sqrt{1 - \frac{f_p^2}{f^2}}\right.$$

Each layer will **reflect**, **absorb** or **let pass** radio waves depending on their frequencies and on the characteristic frequency.

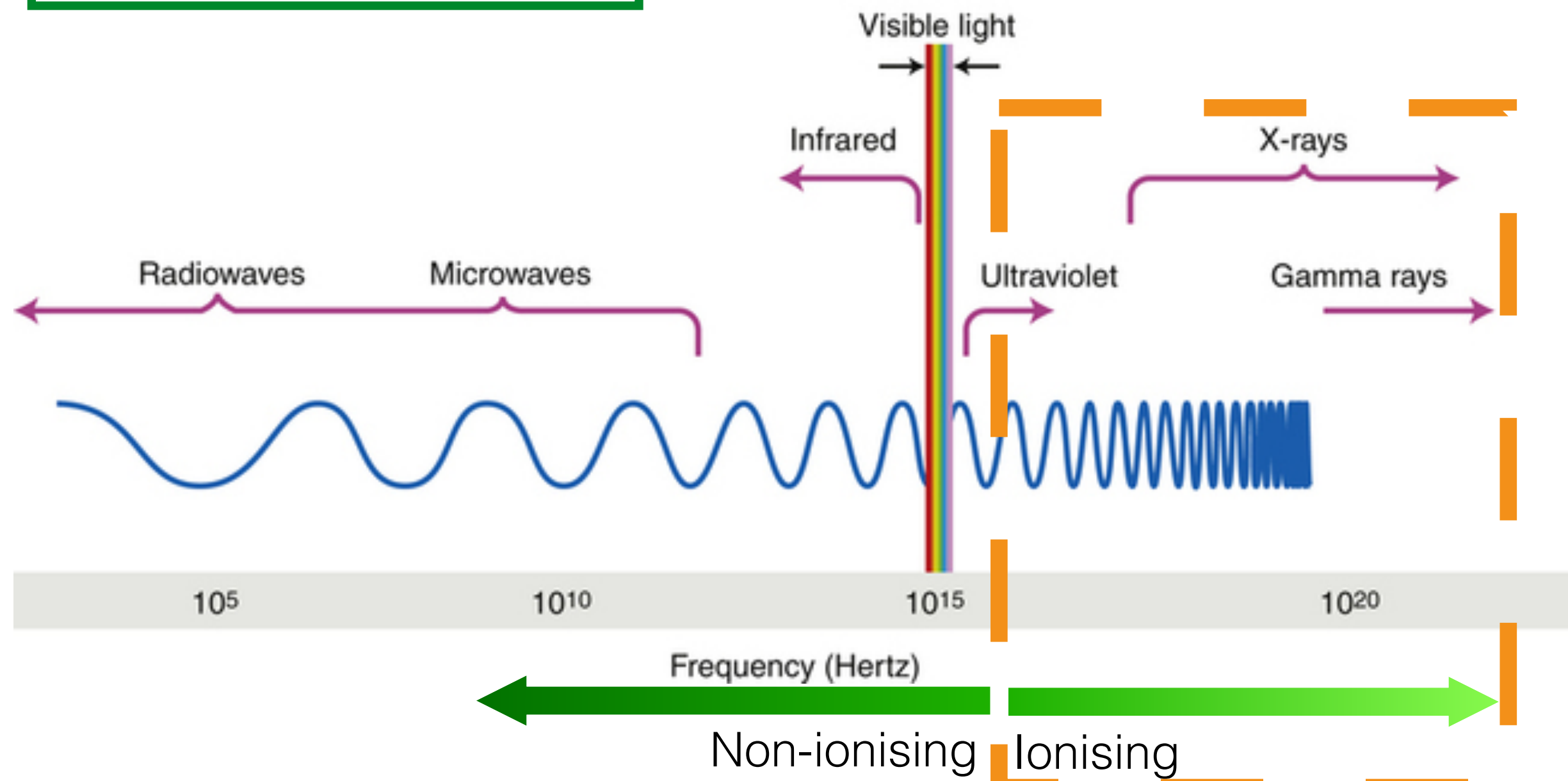


**What can ionise and define the
electron density?**

Electromagnetic radiation

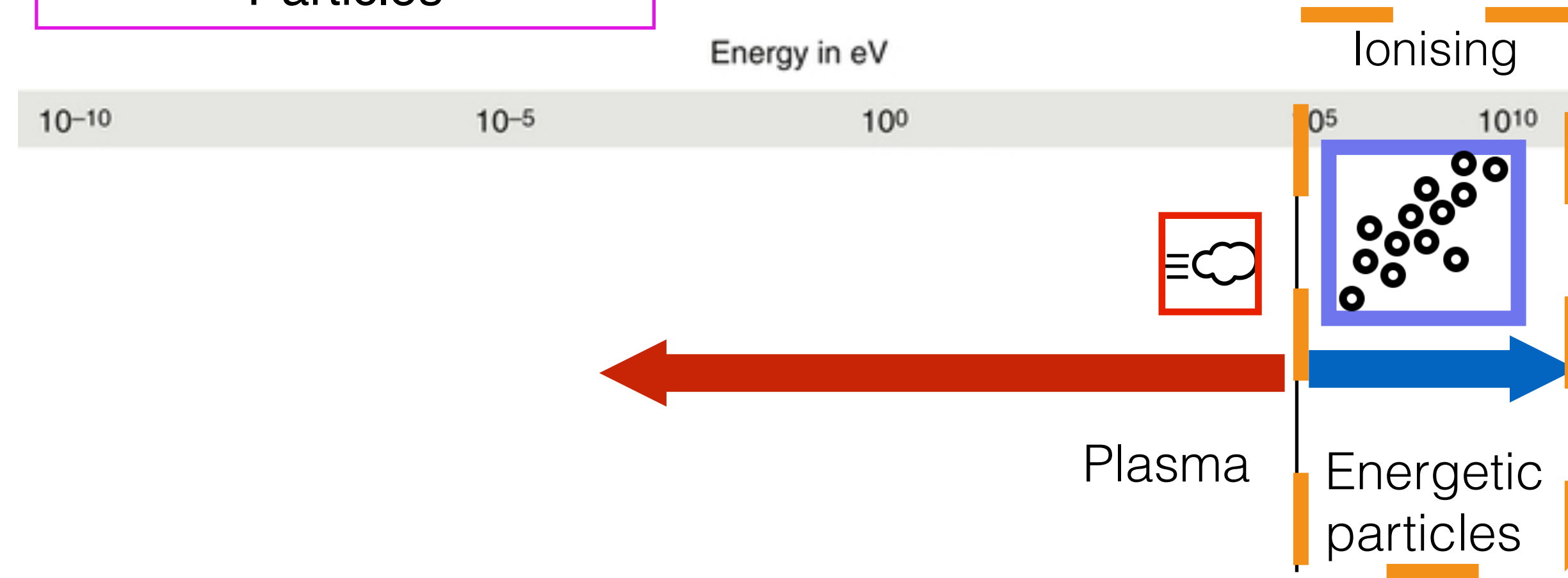


- Photons / electromagnetic waves
- Speed of light

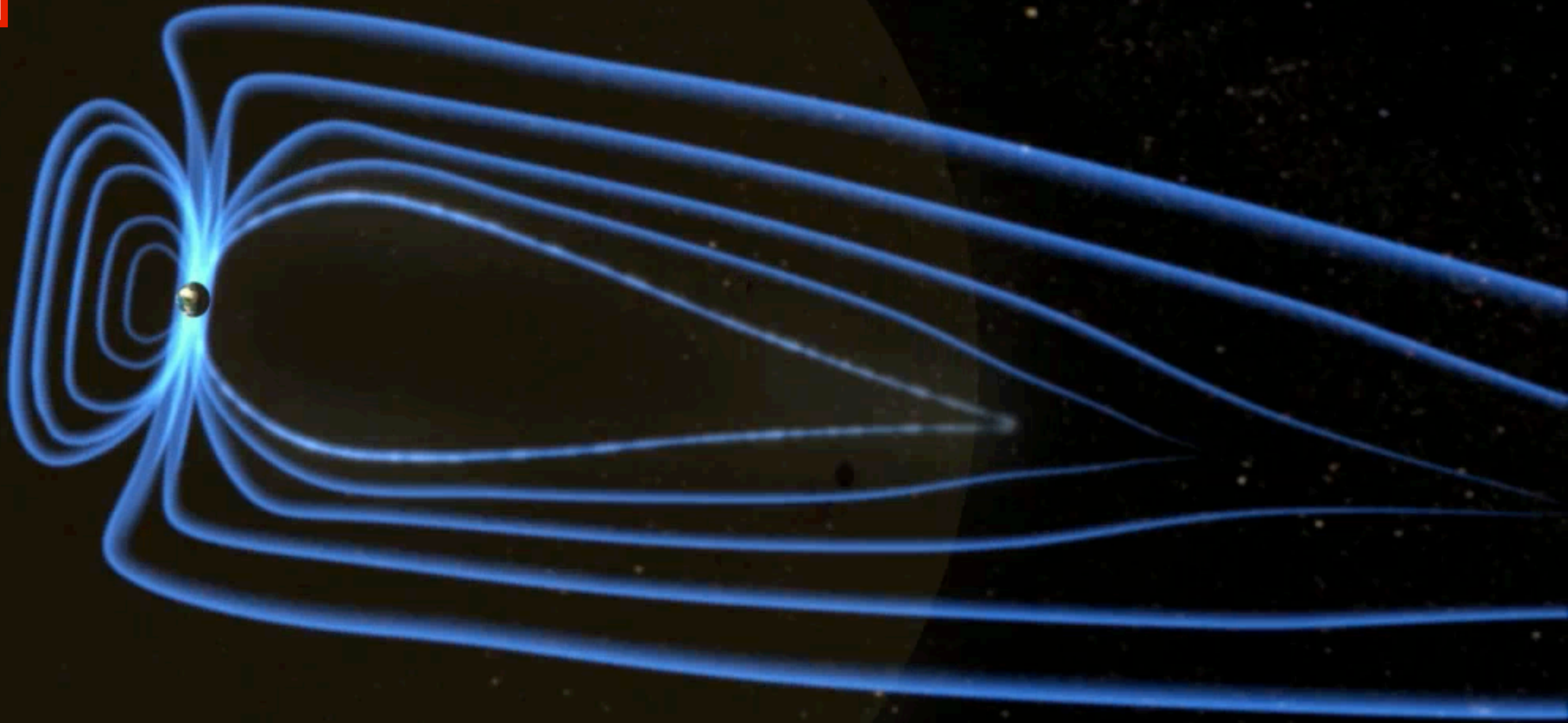
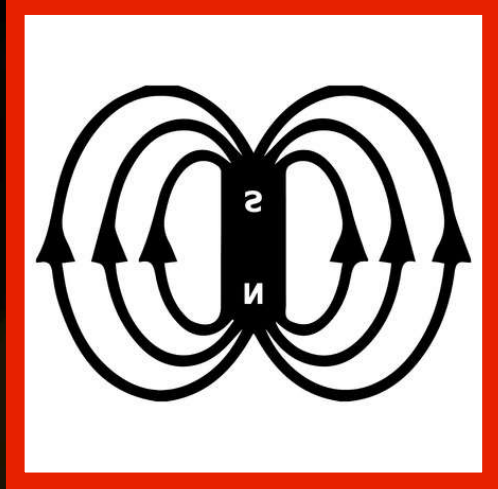
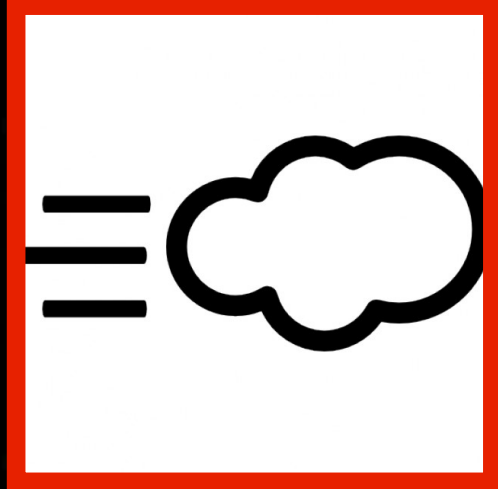


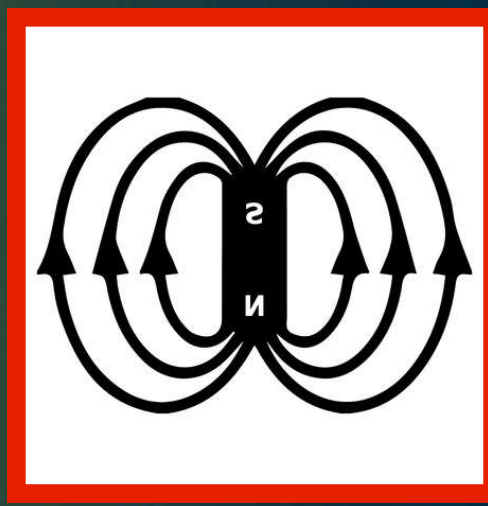
Particles

- Atomic & sub-atomic particles
- m/s to fractions of speed of light



Can the solar wind impact the ionosphere and change the electron density?





Primary Medium

Magnetopause

Plasma mantle

Polar Cusp

North Lobe

Magnetotail

Solar Wind

Neutral point

Plasma sheet

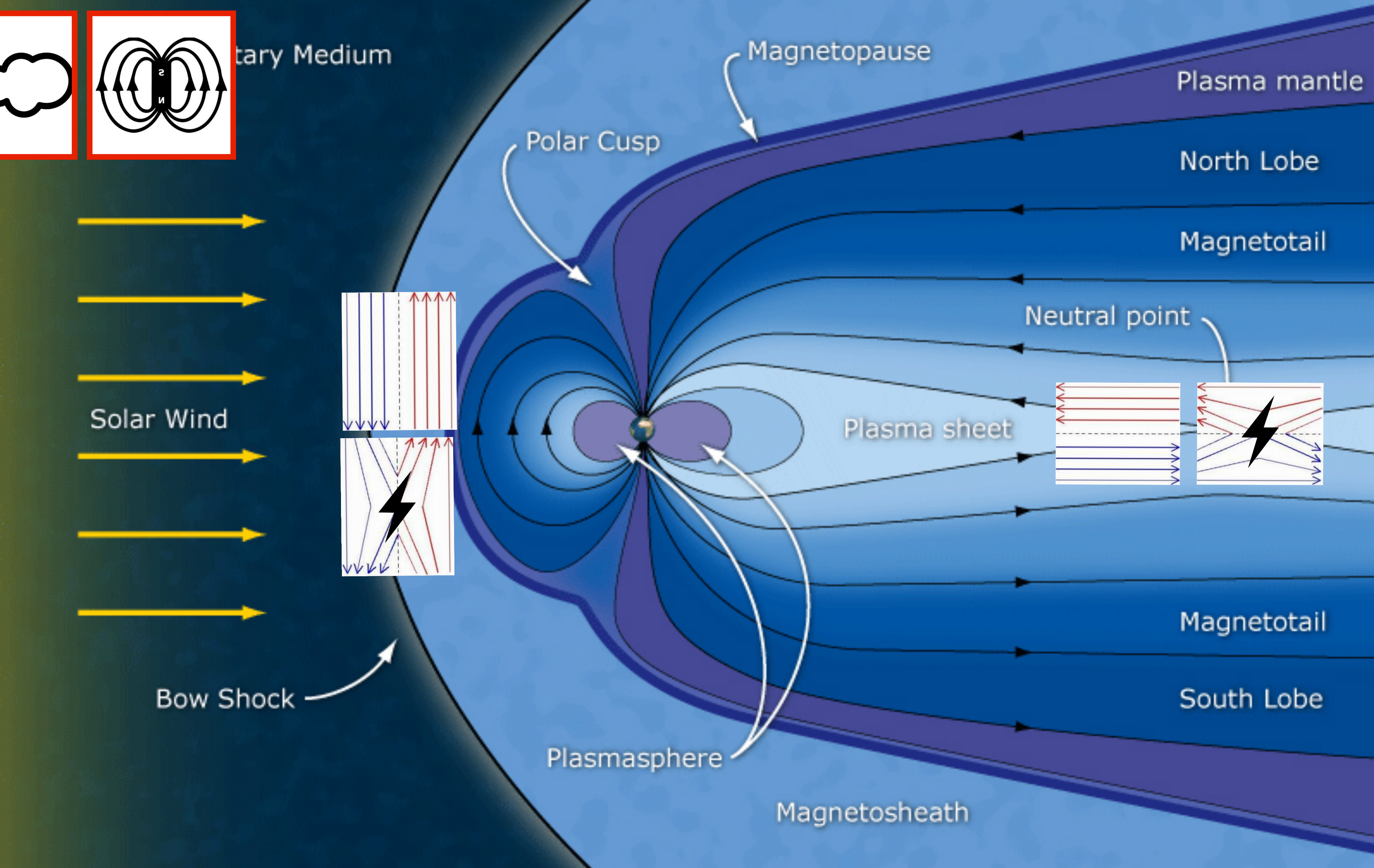
Bow Shock

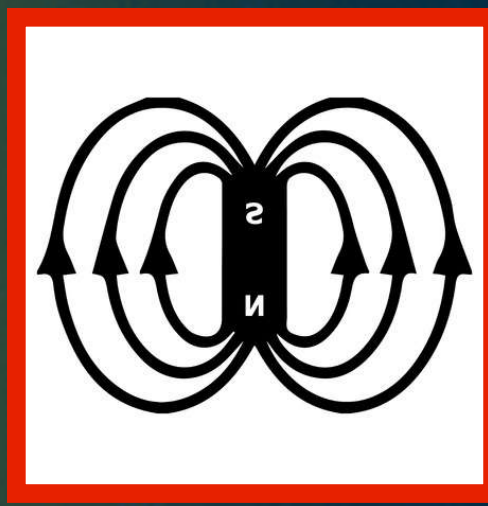
Magnetotail

South Lobe

Plasmasphere

Magnetosheath





Interplanetary Medium

Magnetopause

Plasma mantle

Polar Cusp

North Lobe

Magnetotail

Neutral point

Solar Wind

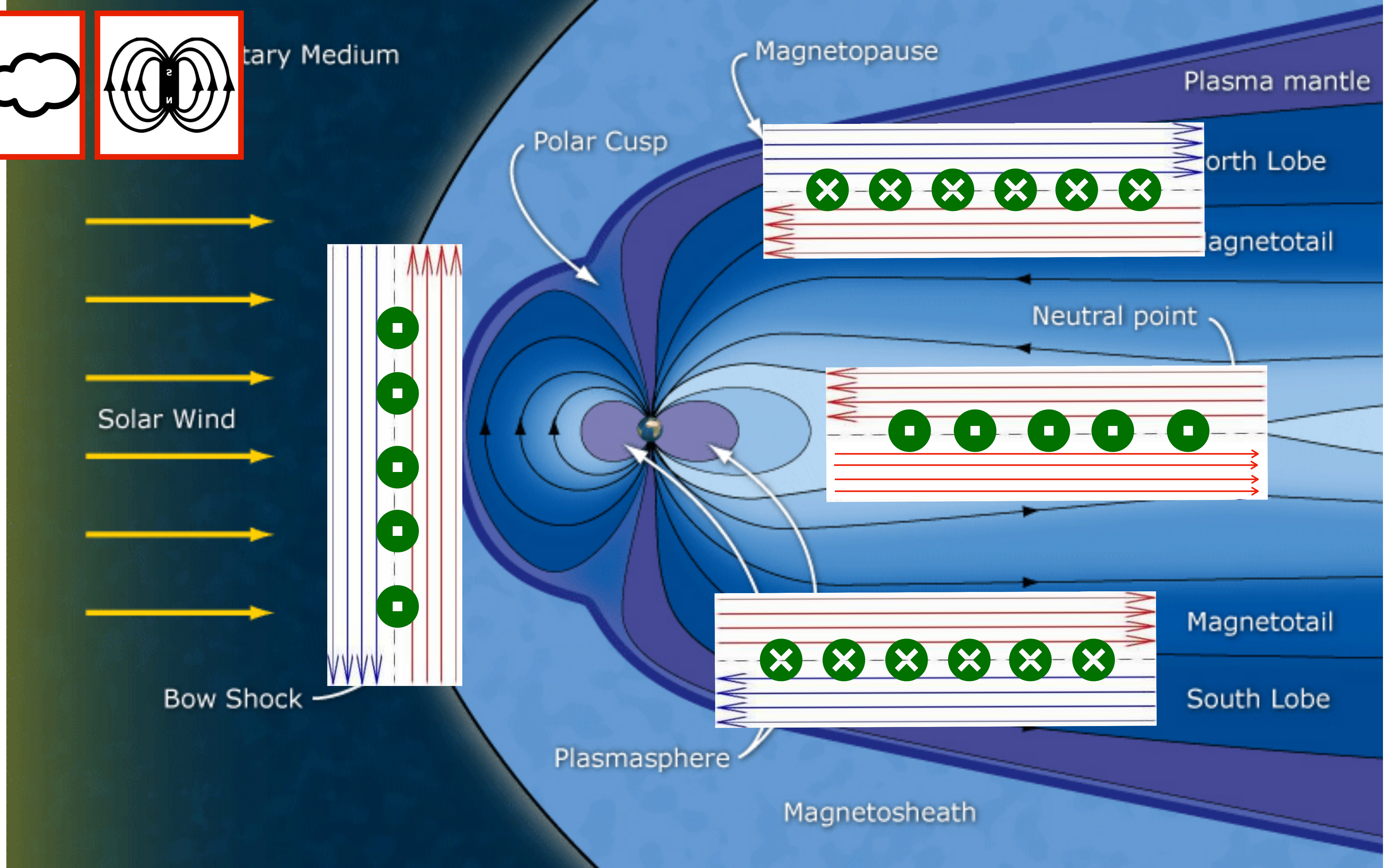
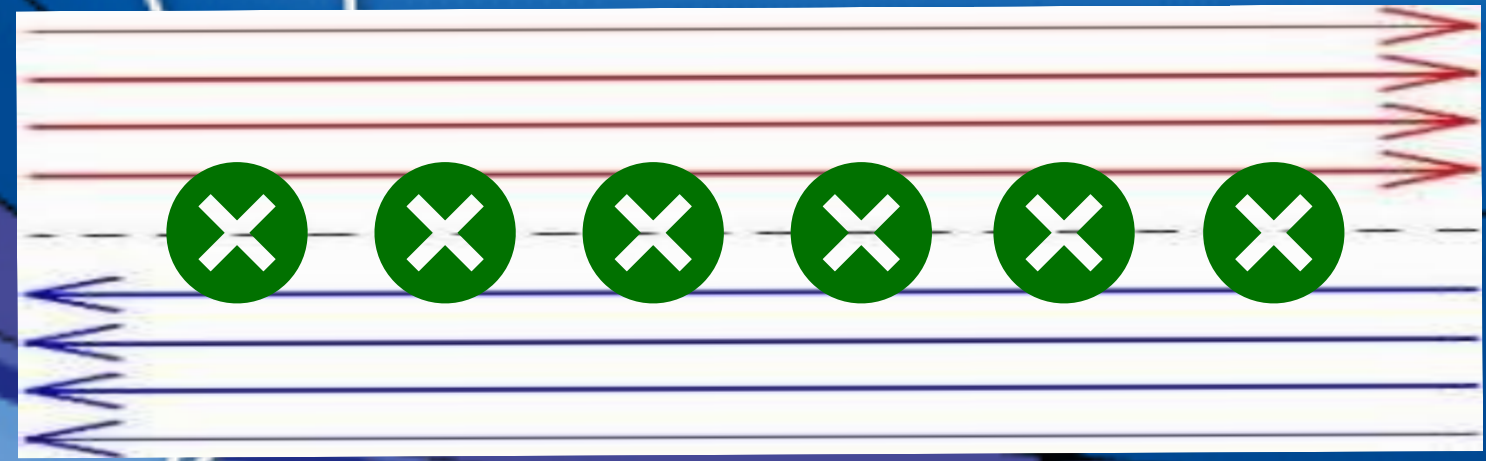
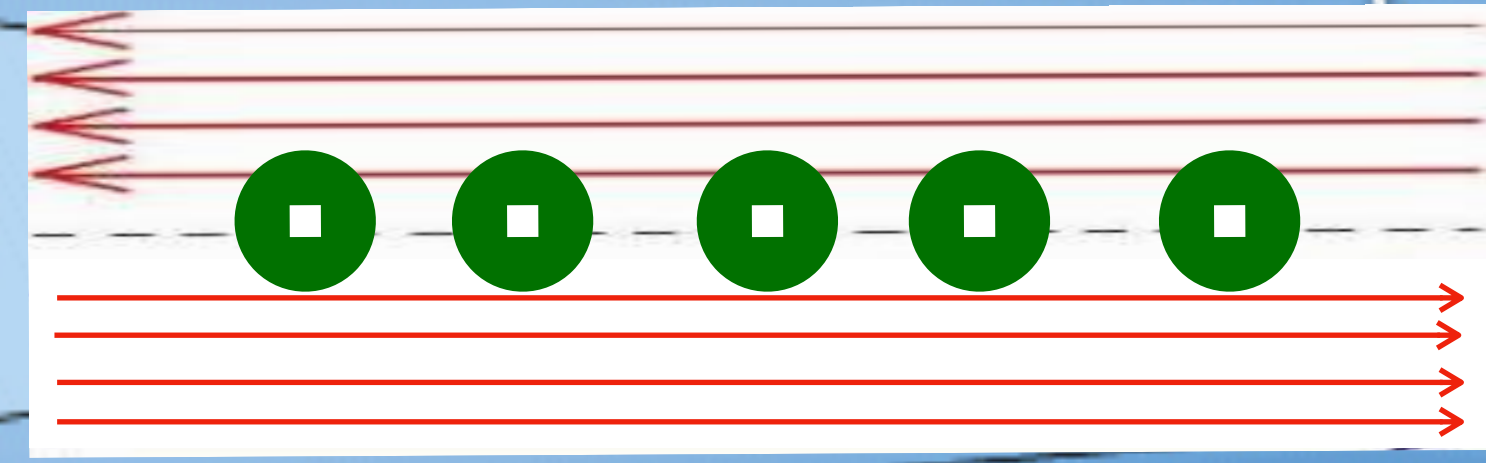
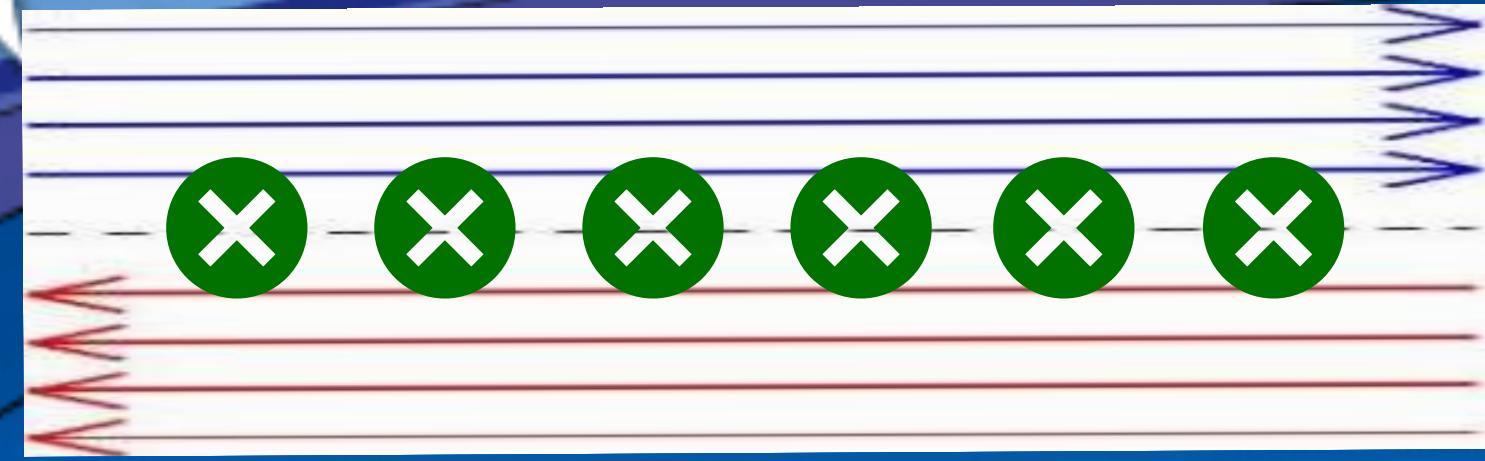
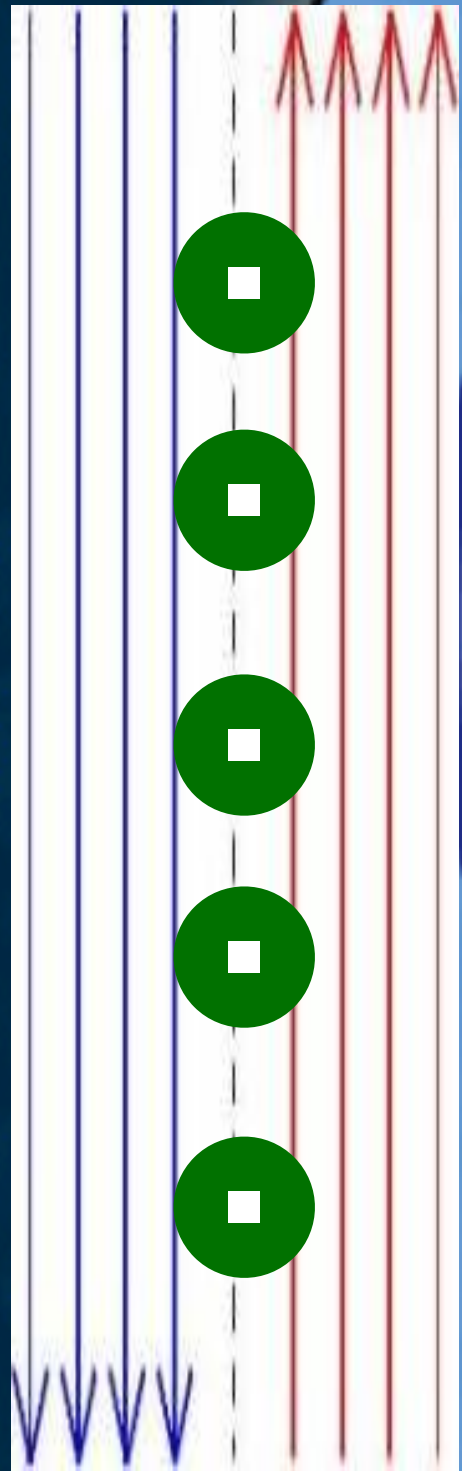
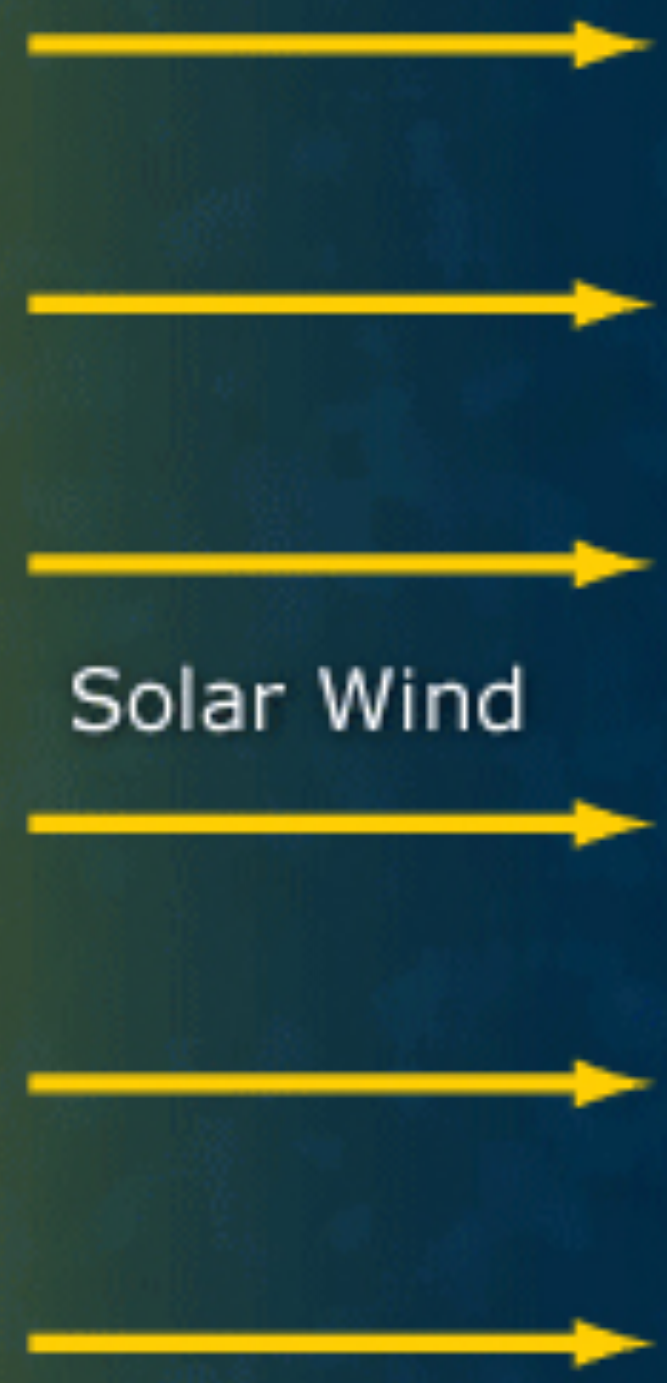
Bow Shock

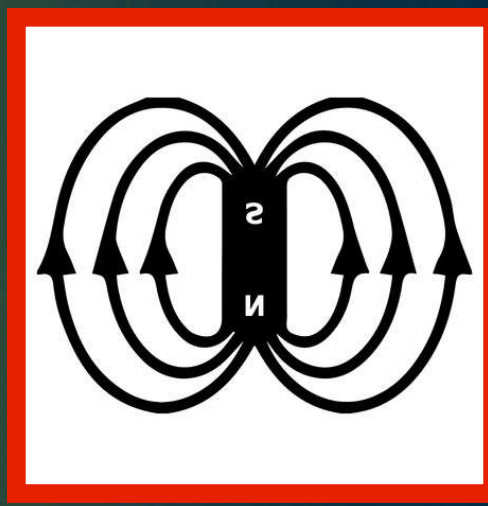
Plasmasphere

Magnetosheath

Magnetotail

South Lobe





Interplanetary Medium

Magnetopause

Plasma mantle

Polar Cusp

North Lobe

Magnetotail

Neutral point

Solar Wind

Plasma sheet

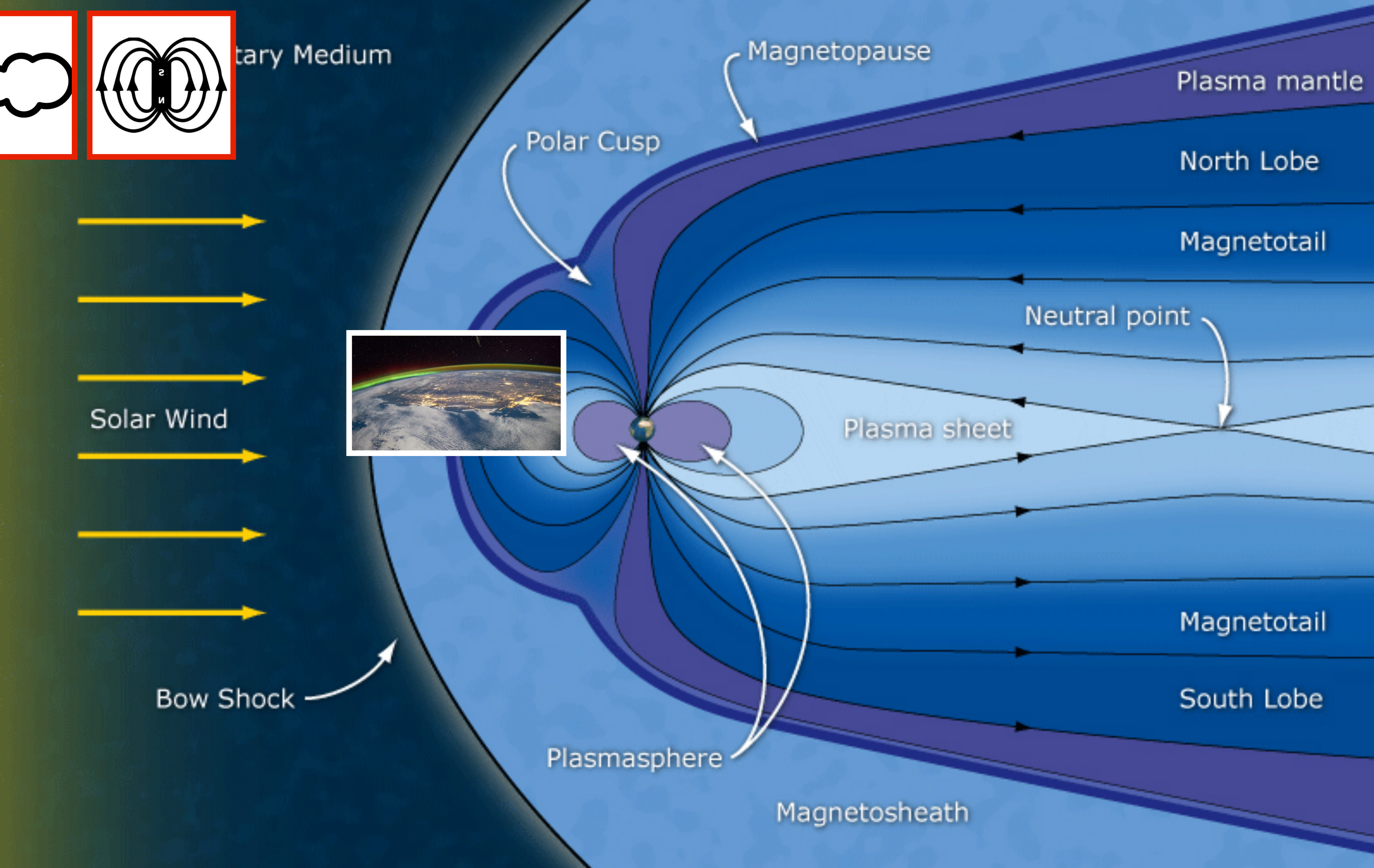
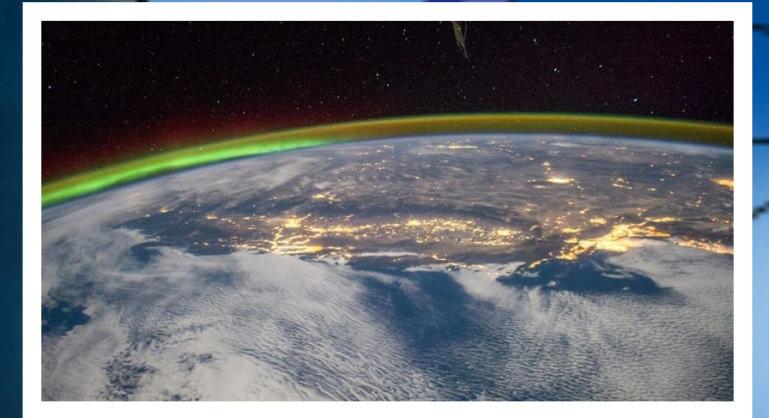
Magnetotail

South Lobe

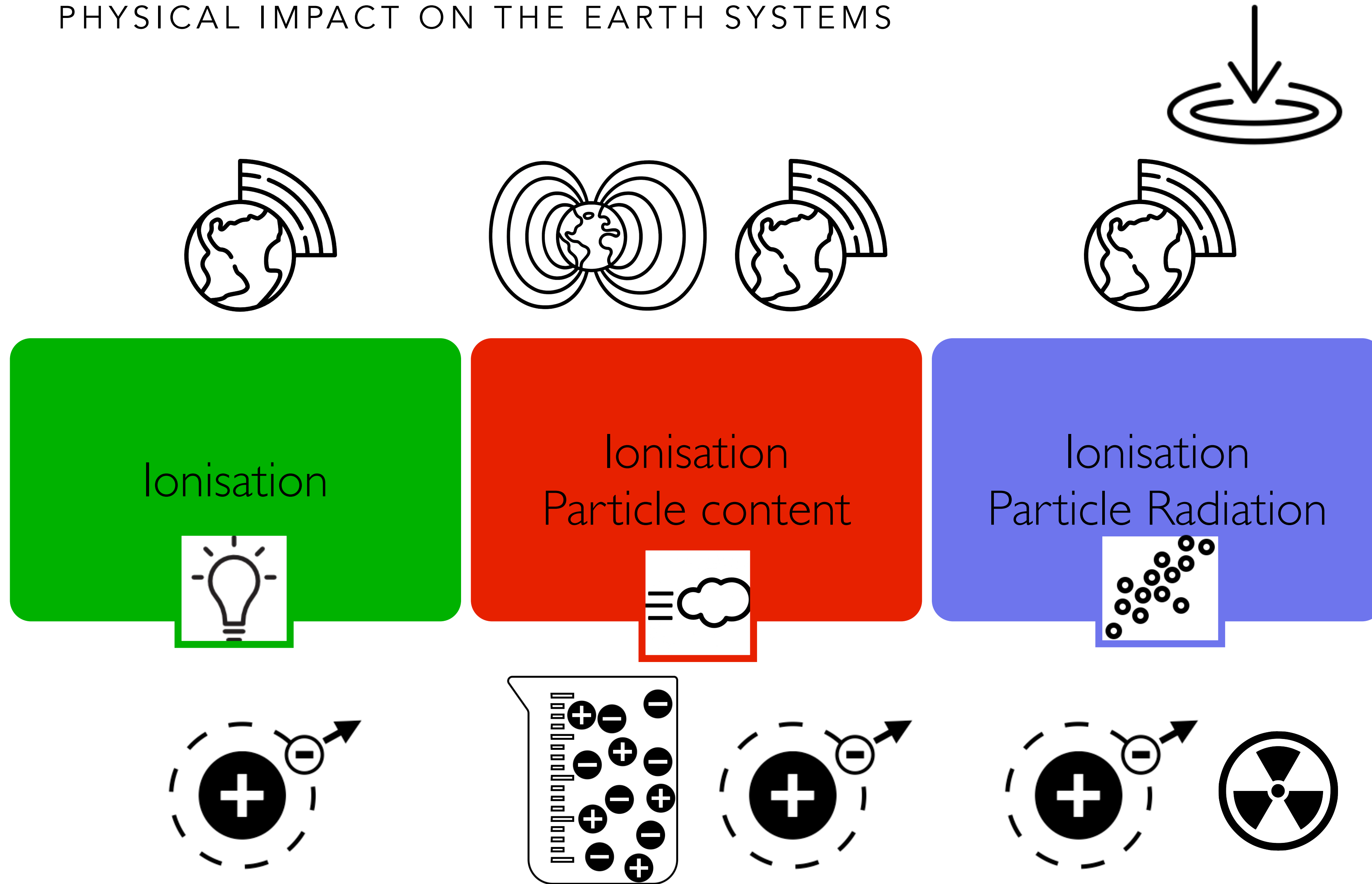
Bow Shock

Plasmasphere

Magnetosheath



PHYSICAL IMPACT ON THE EARTH SYSTEMS



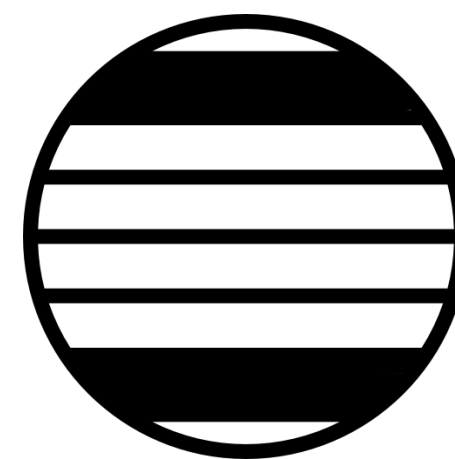
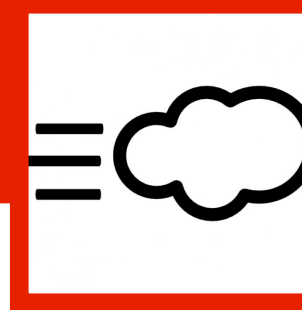
AREA OF IMPACT



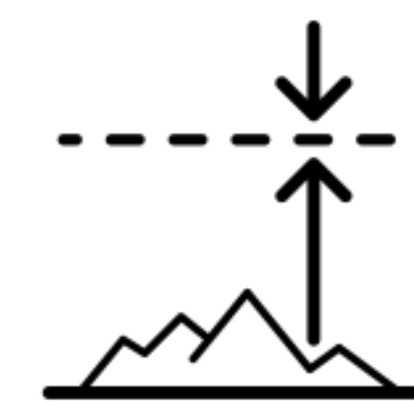
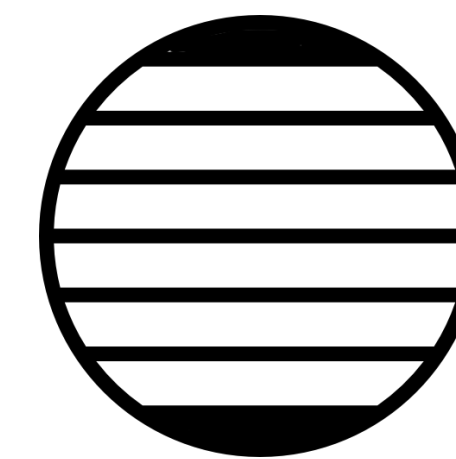
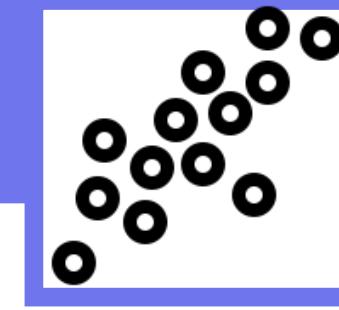
Illuminated area



Auroral Oval & more Latitude



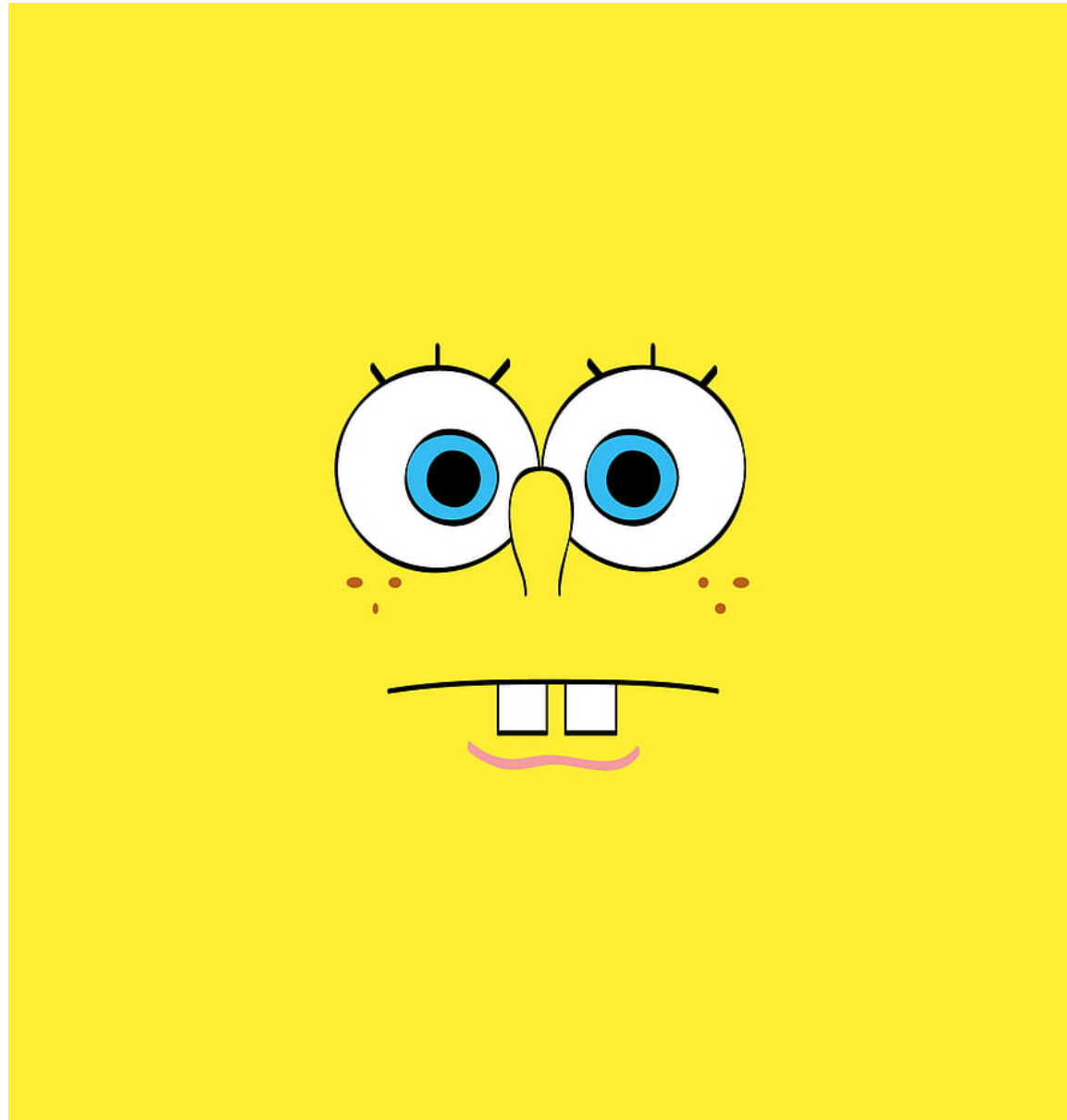
Polar Cap
High Altitude



Impact on radio waves

Impact on radio waves

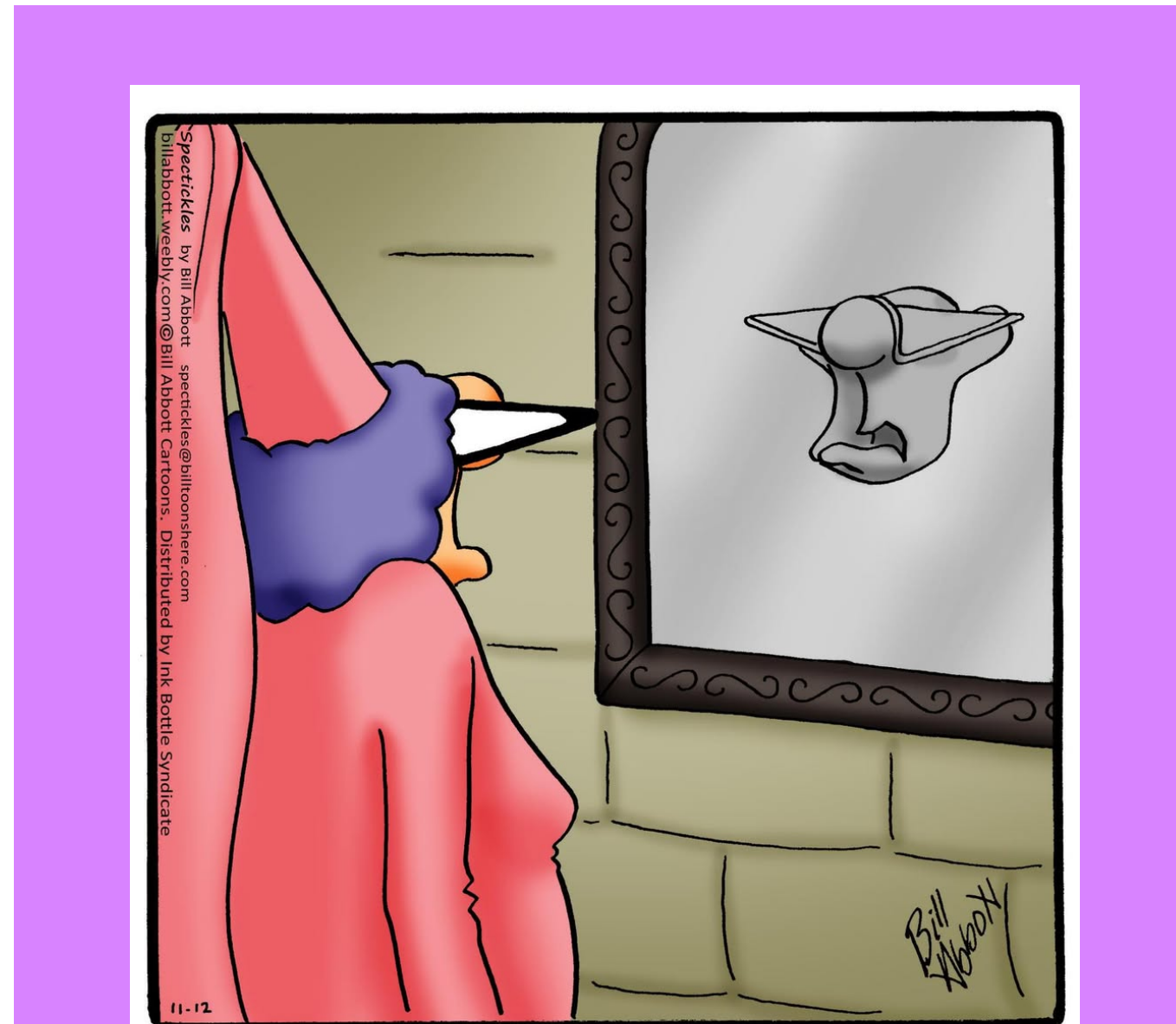
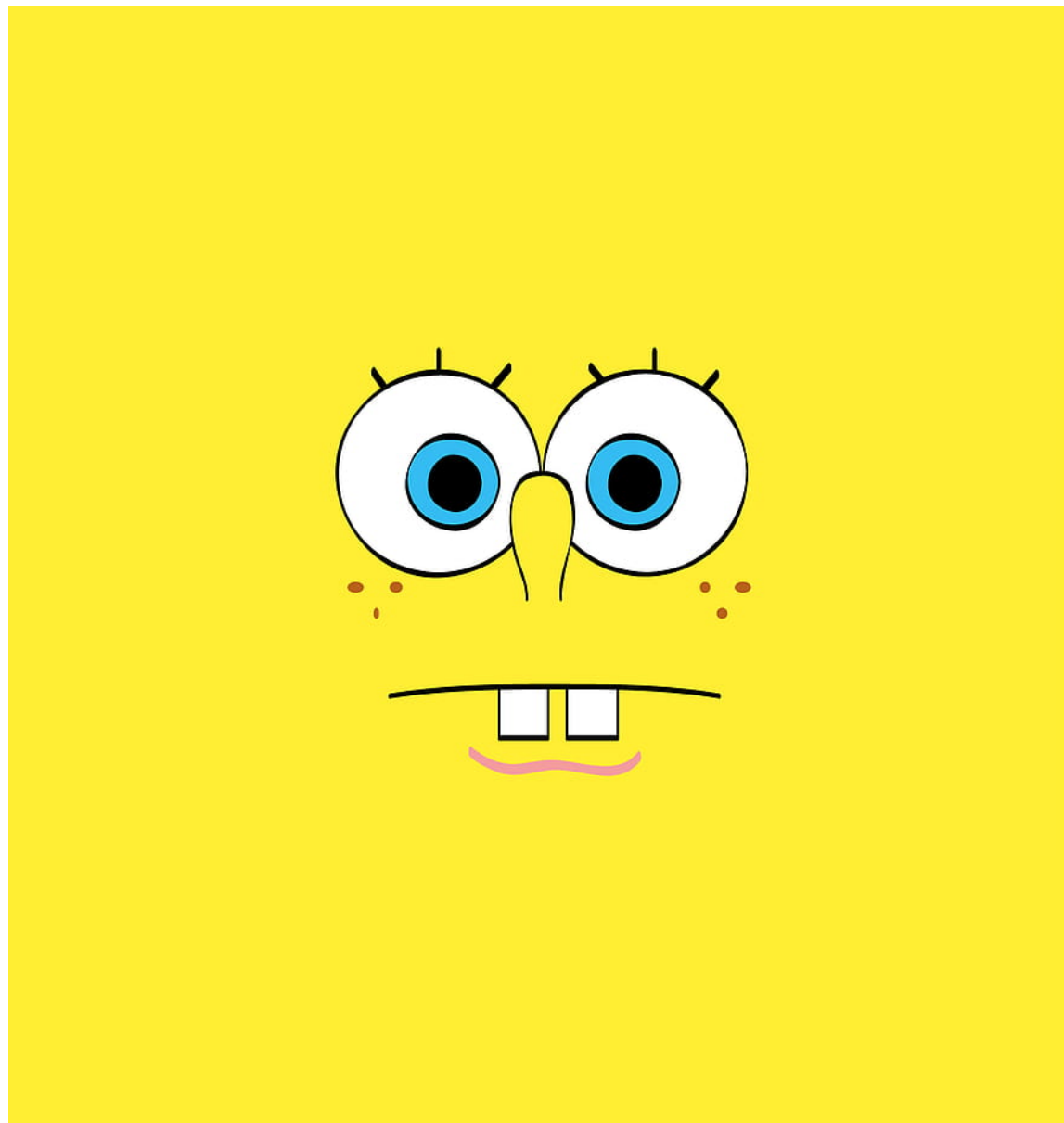
Absorption



Impact on radio waves

Absorption

Decrease of MUF

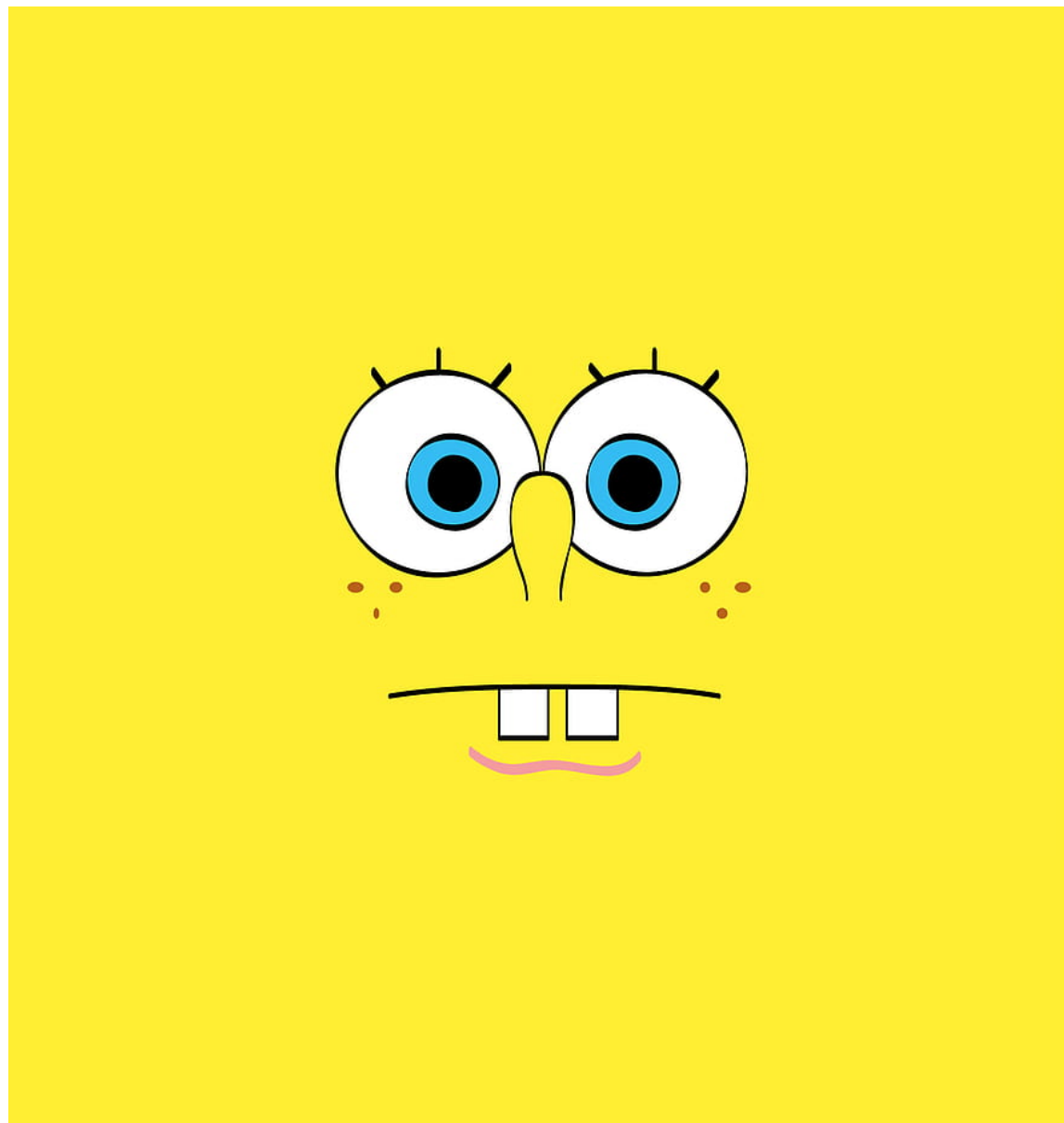


“Before I answer that, may I remind you that it’s seven years of bad luck to break a mirror?”



Impact on radio waves

Absorption



Decrease of MUF



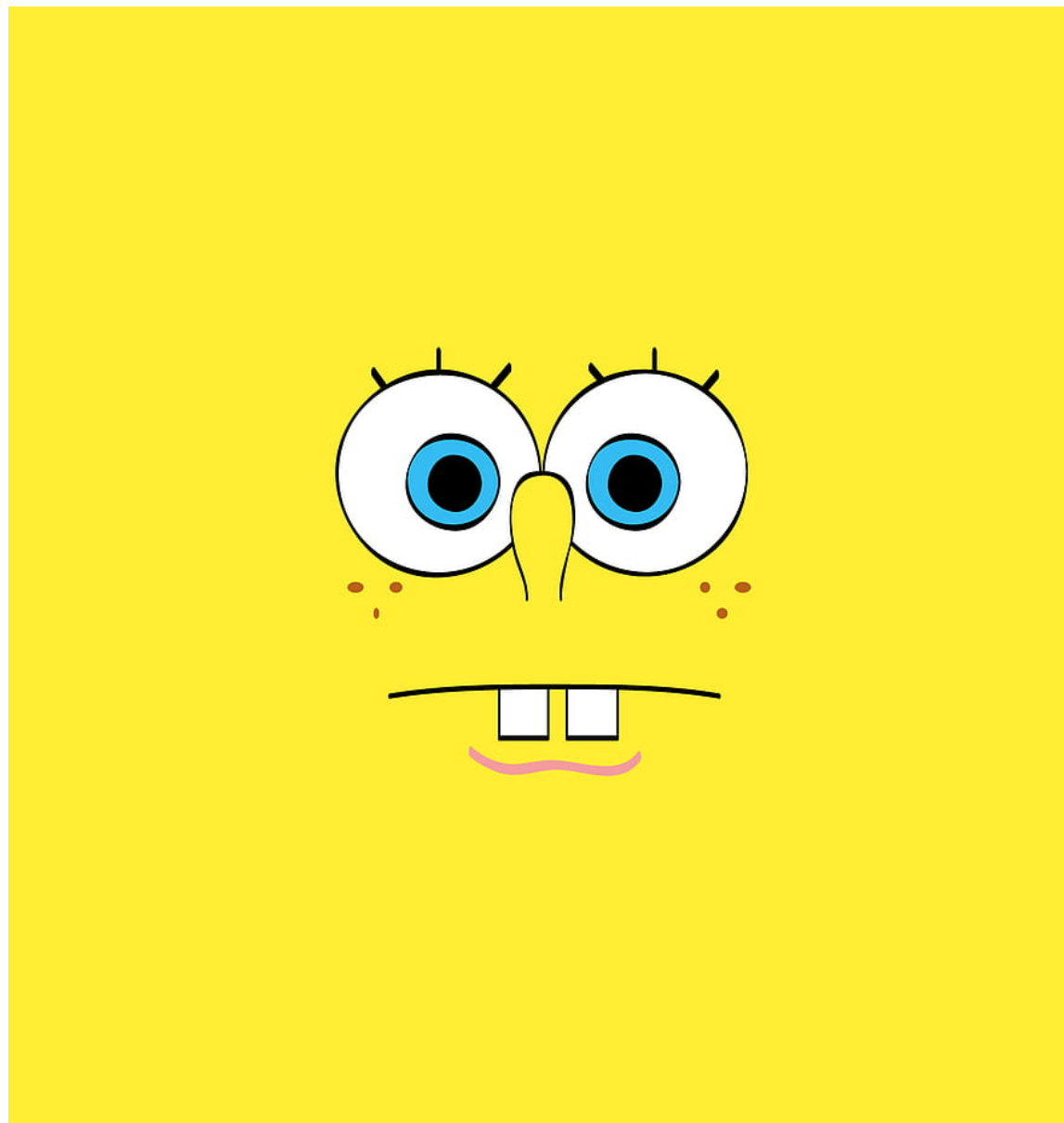
“Before I answer that, may I remind you that it’s seven years of bad luck to break a mirror?”

Scintillation



Impact on radio waves

Absorption



Decrease of MUF



“Before I answer that, may I remind you that it’s seven years of bad luck to break a mirror?”

Scintillation



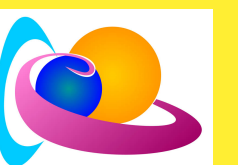
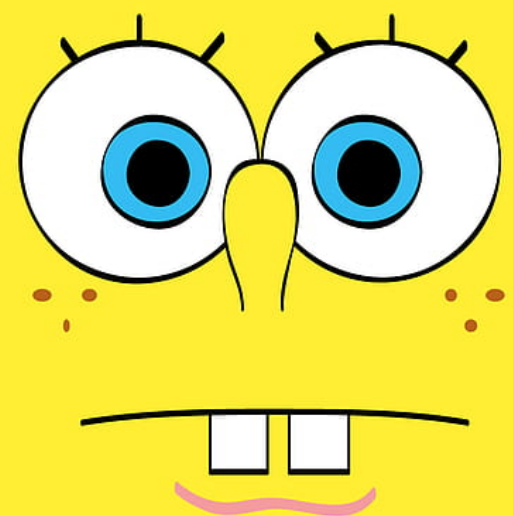
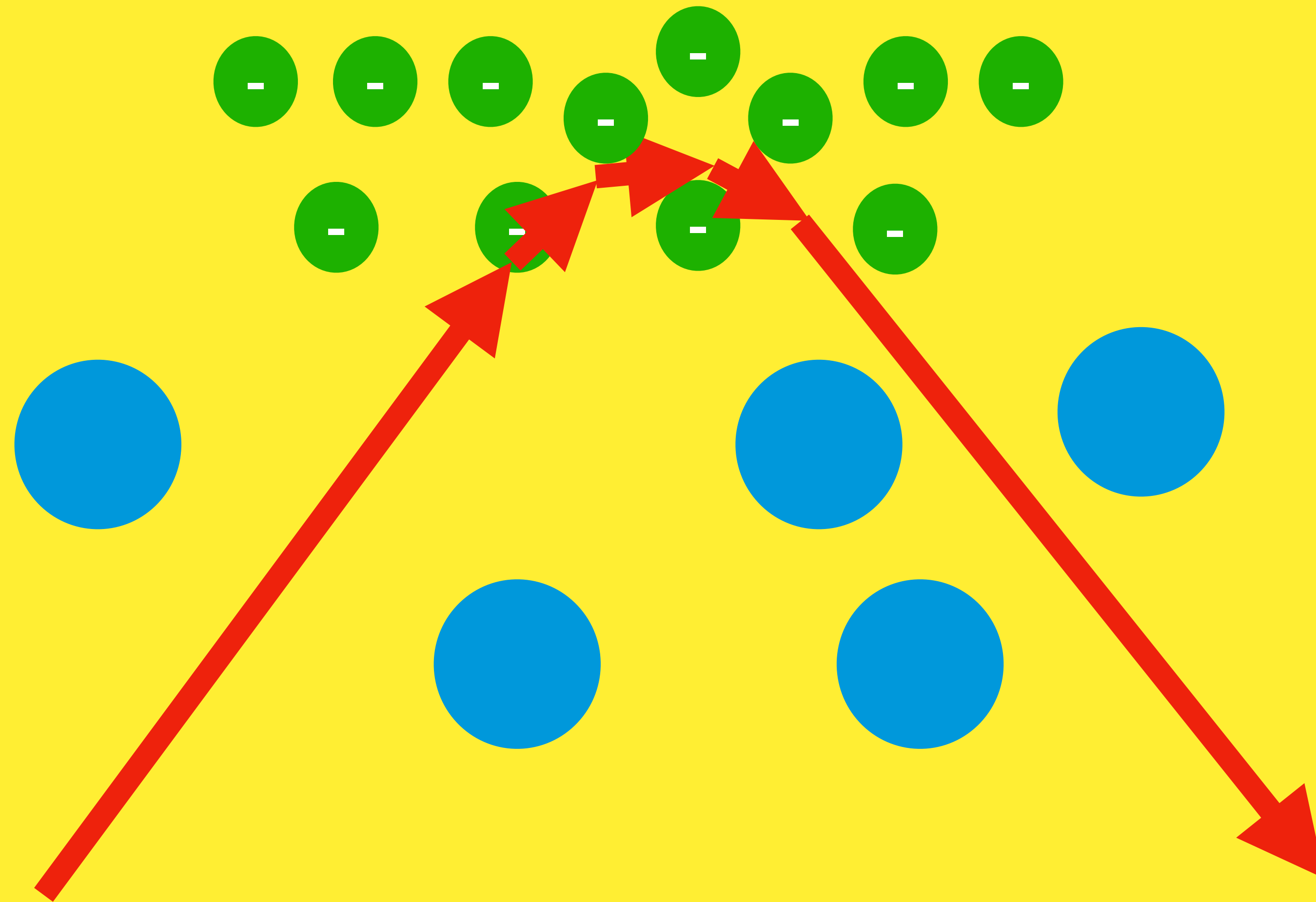
Delay



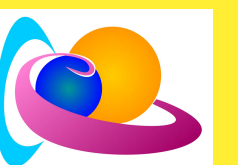
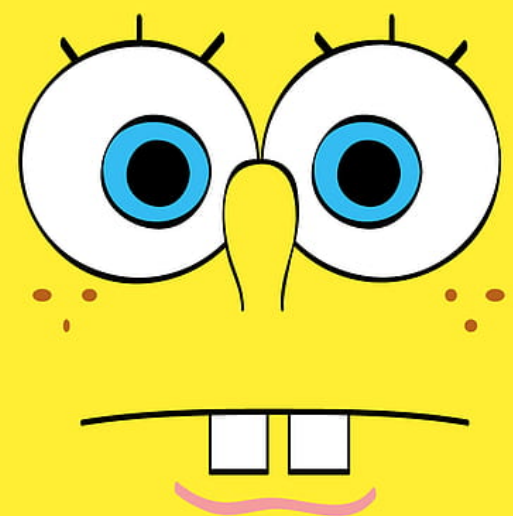
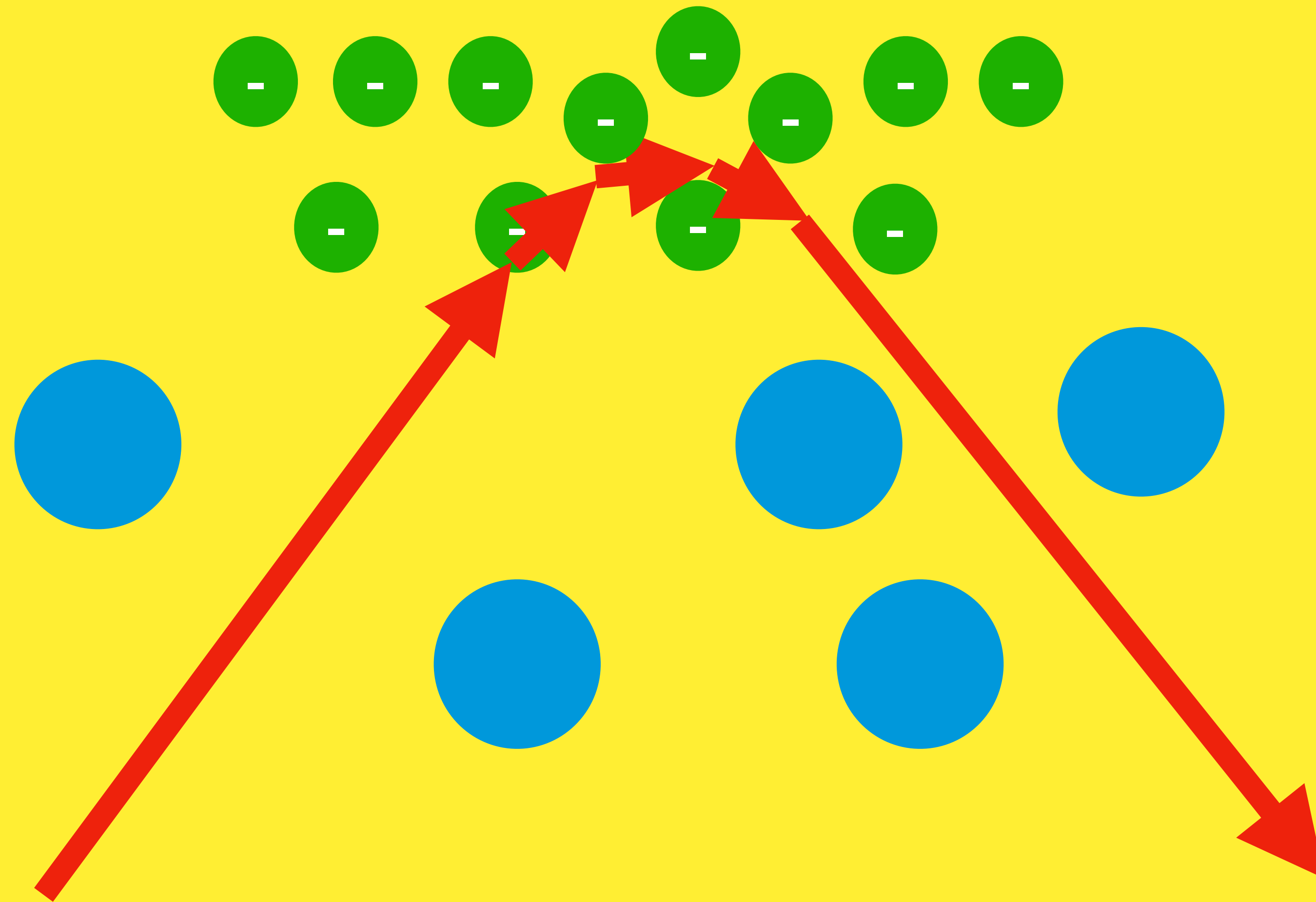
Impact: Absorption of HF waves



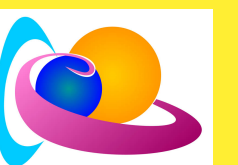
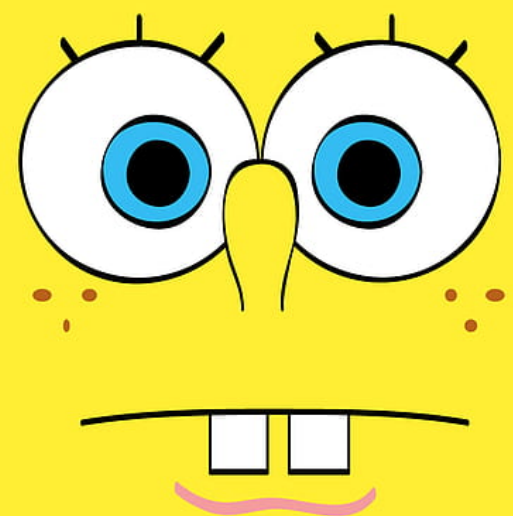
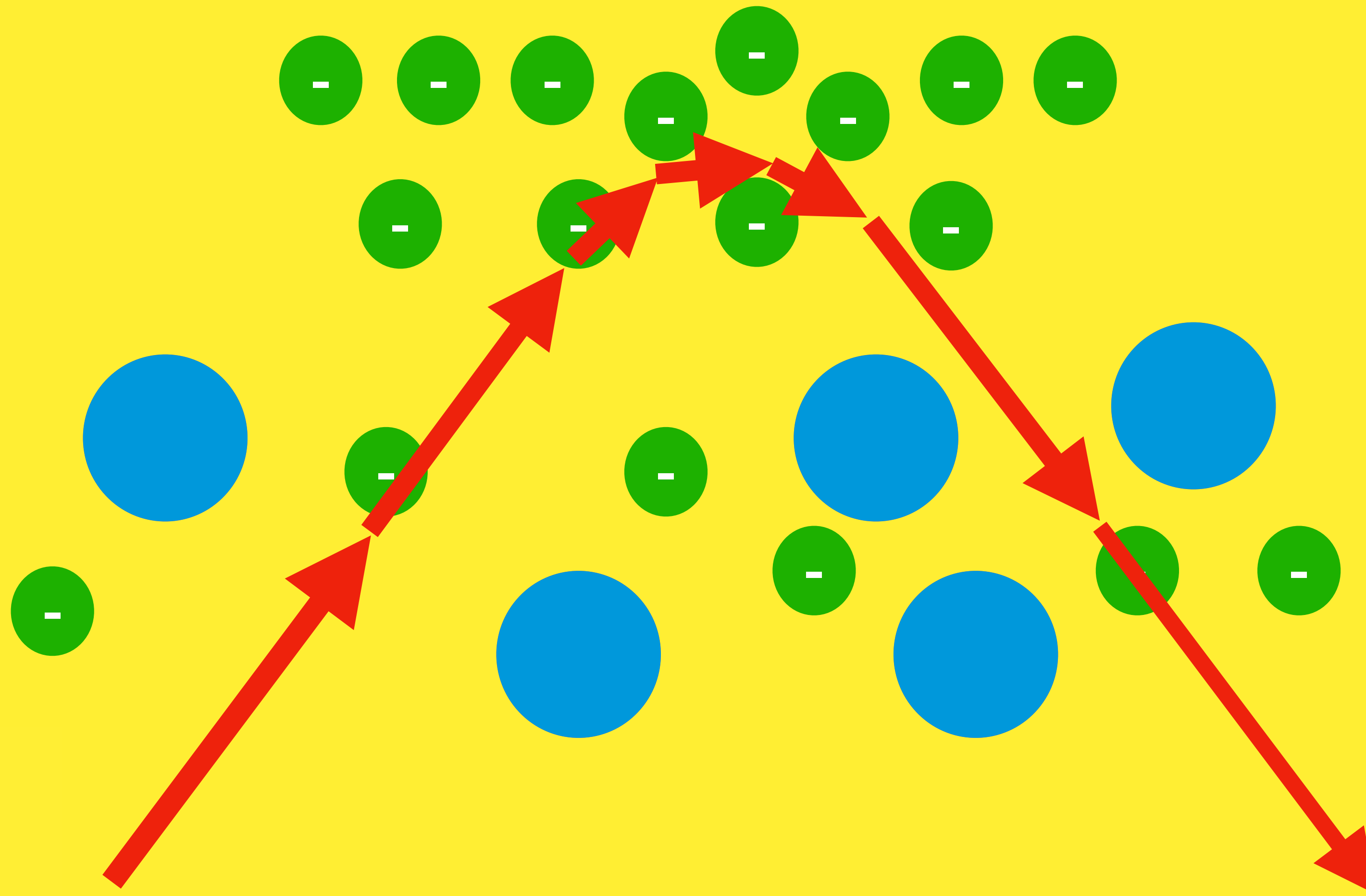
Reflection of waves



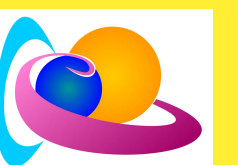
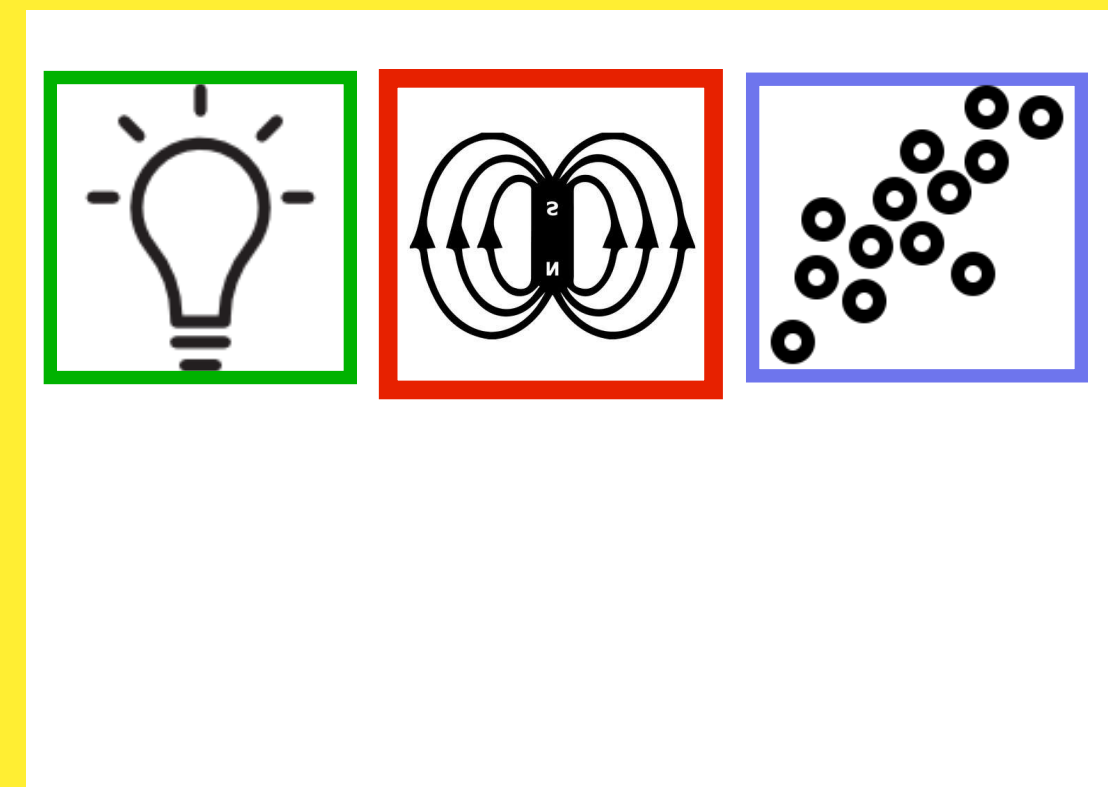
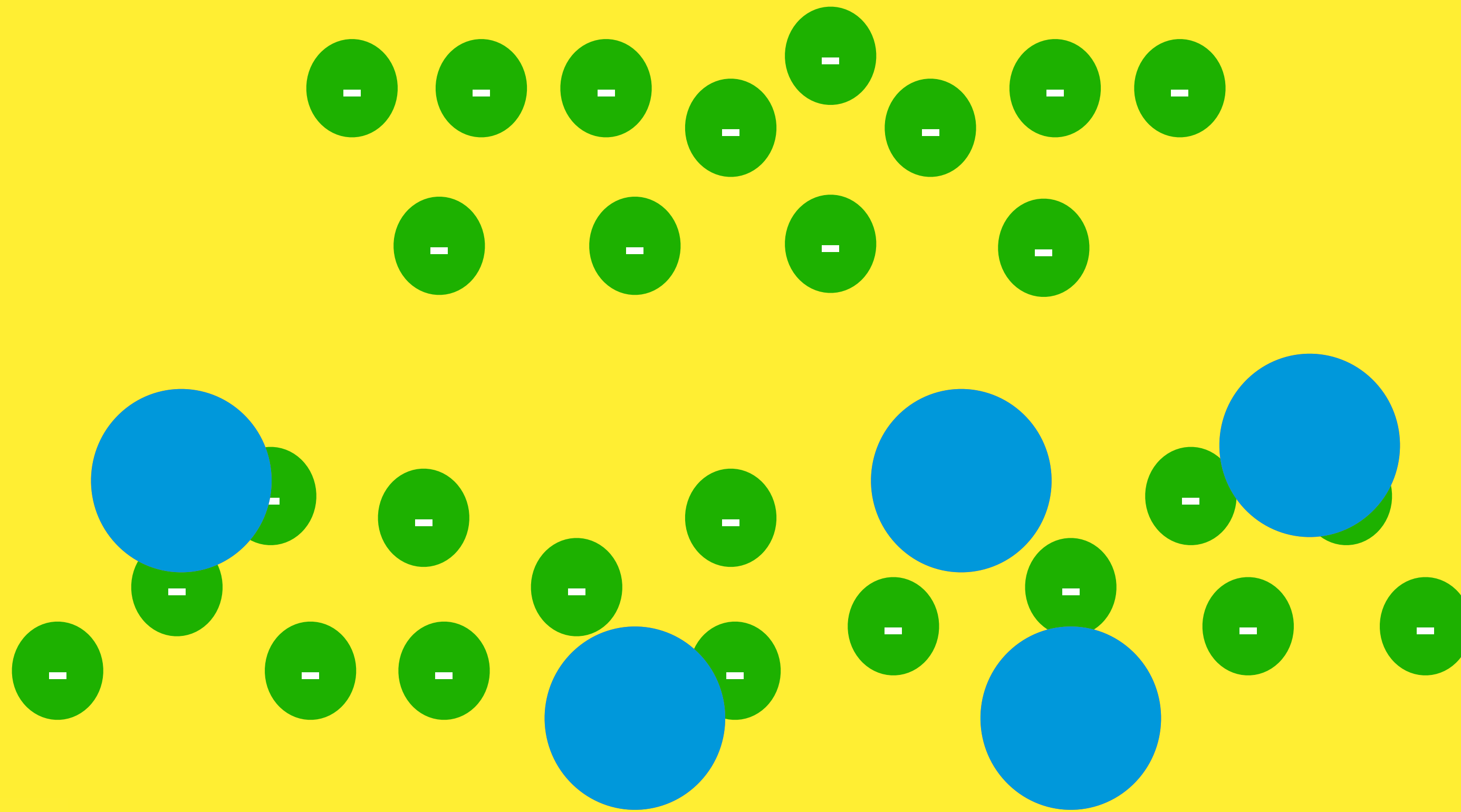
During the night



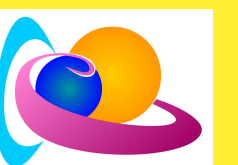
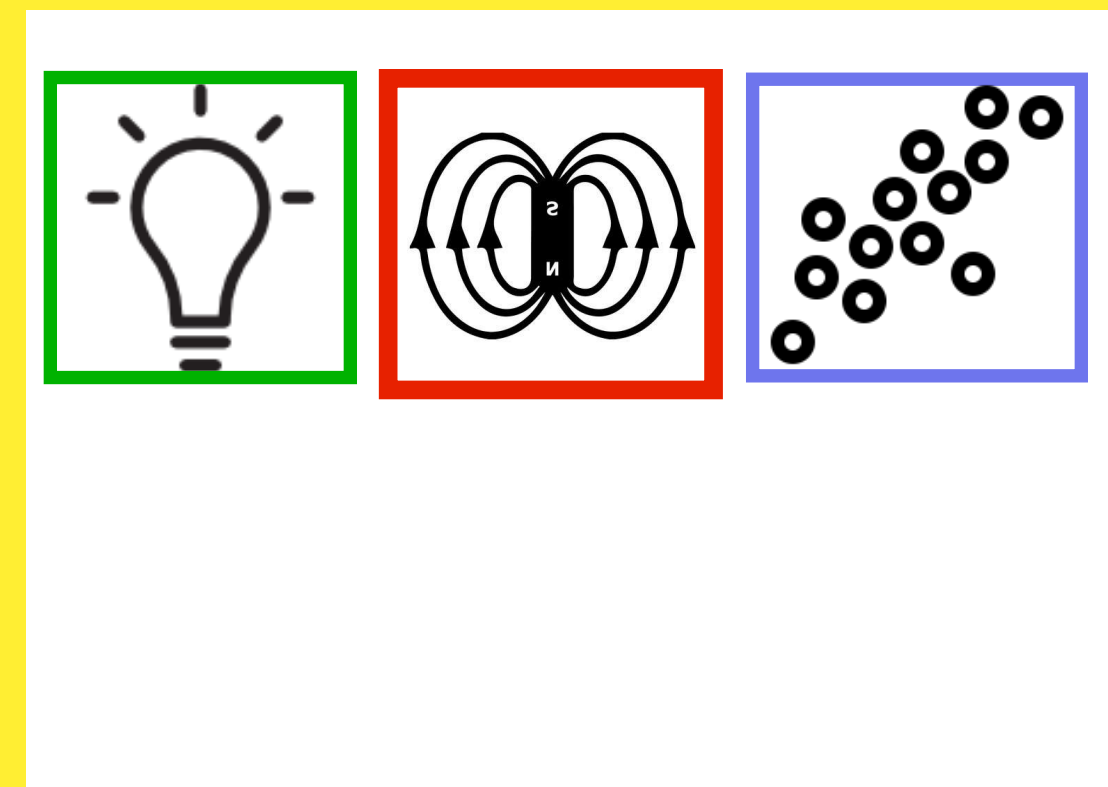
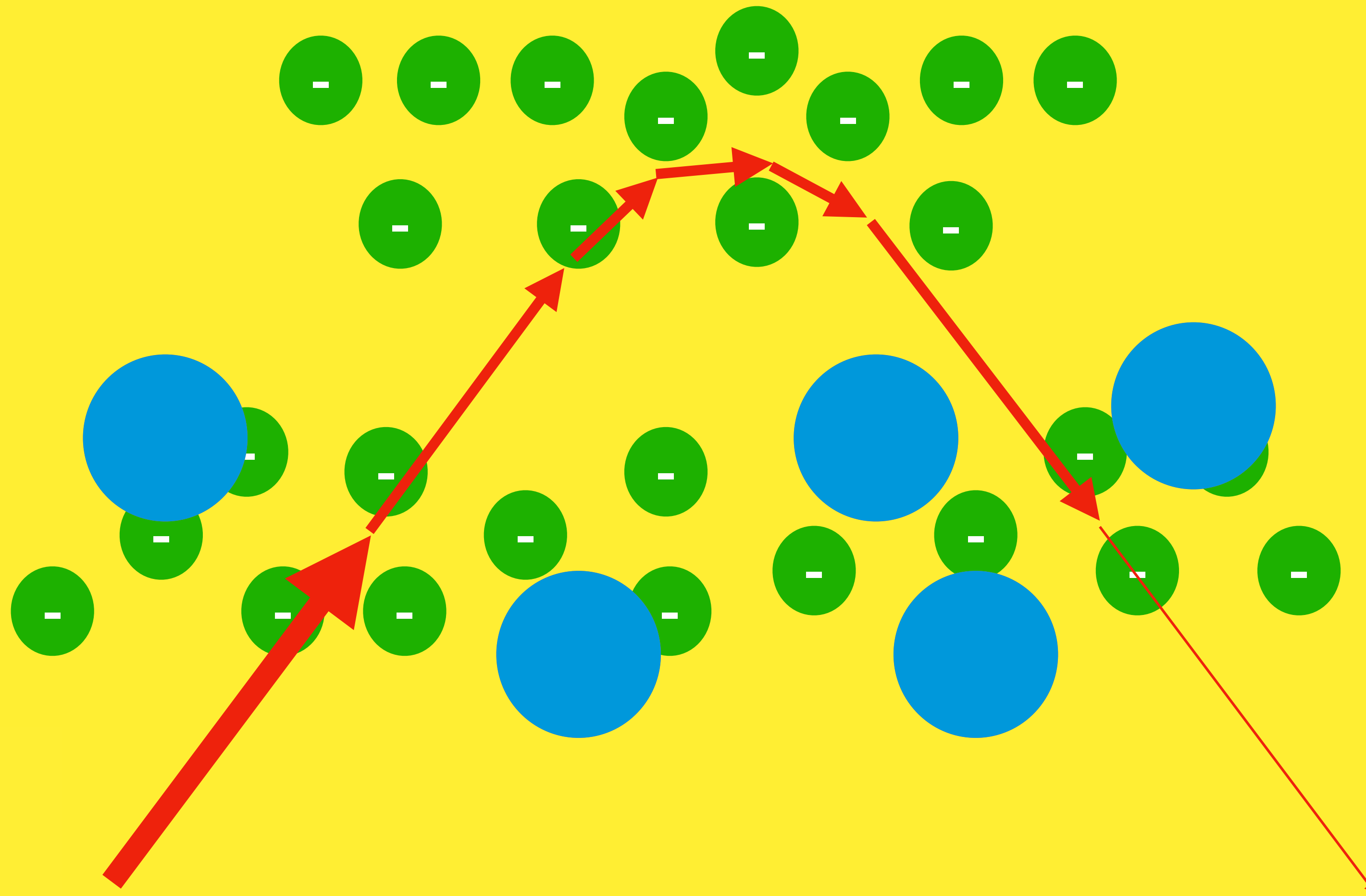
During the day



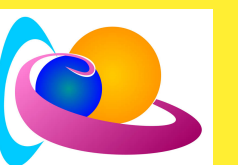
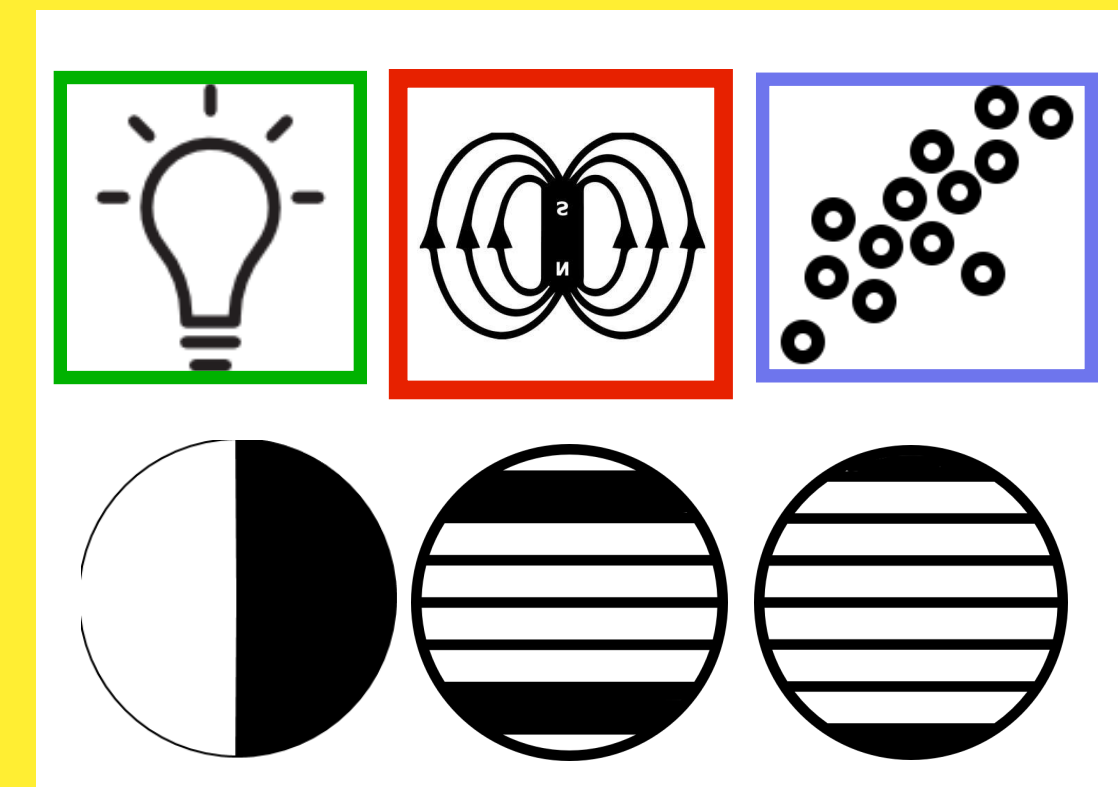
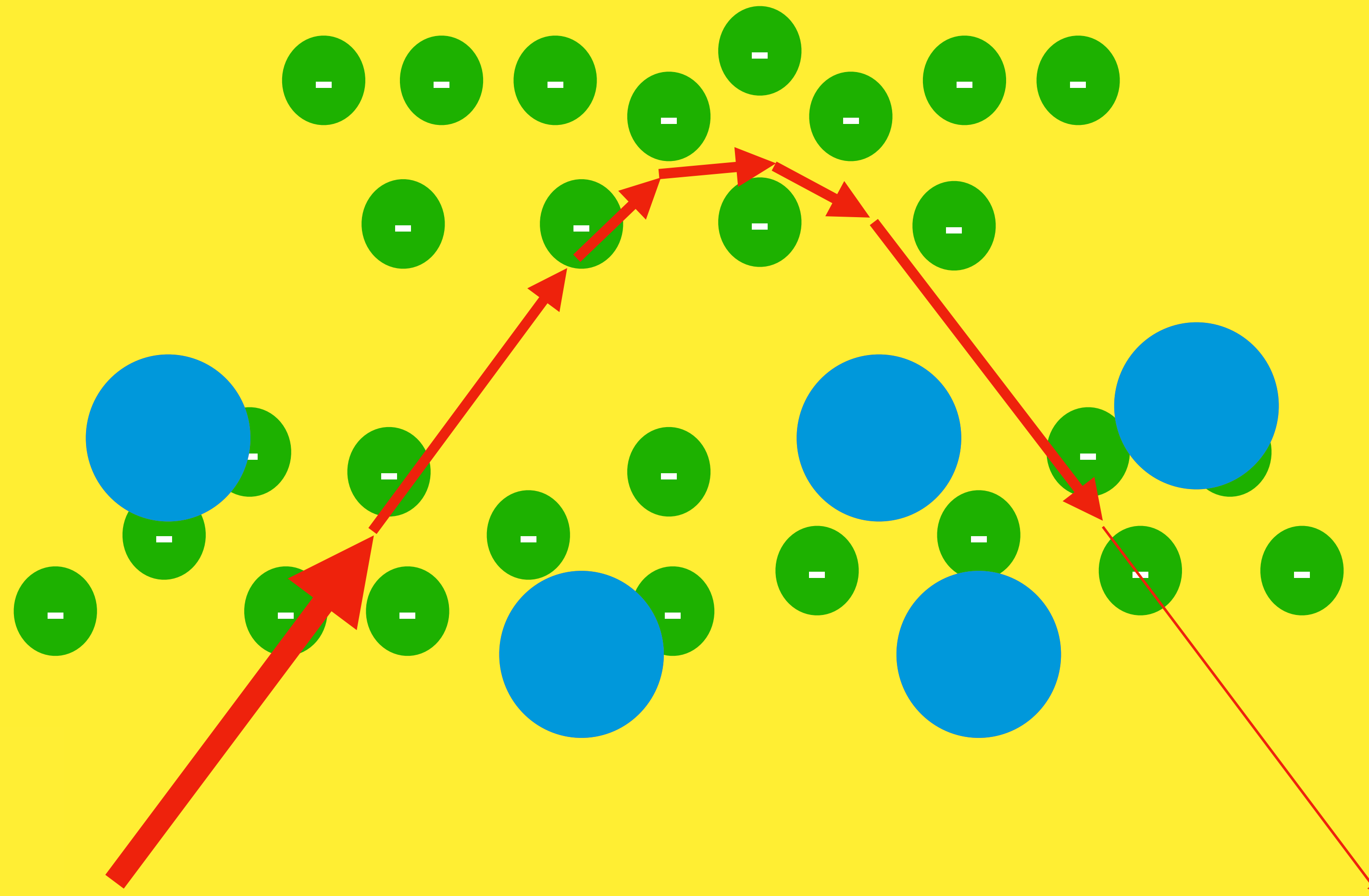
Extra ionisation due to a solar event



Extra ionisation due to a solar event



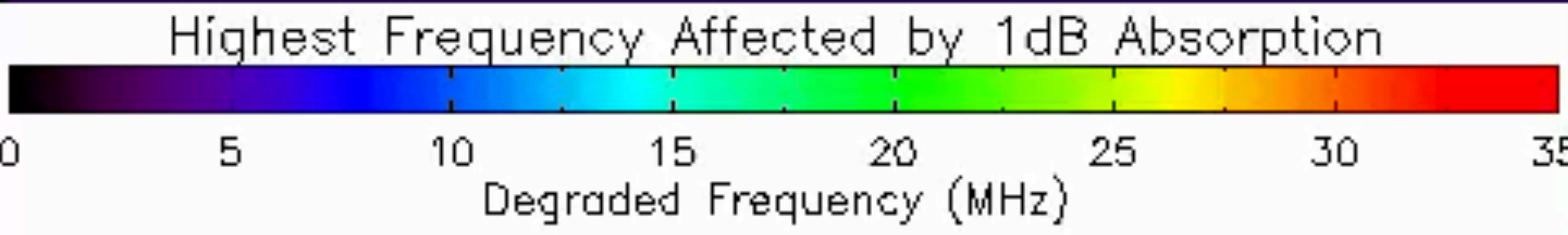
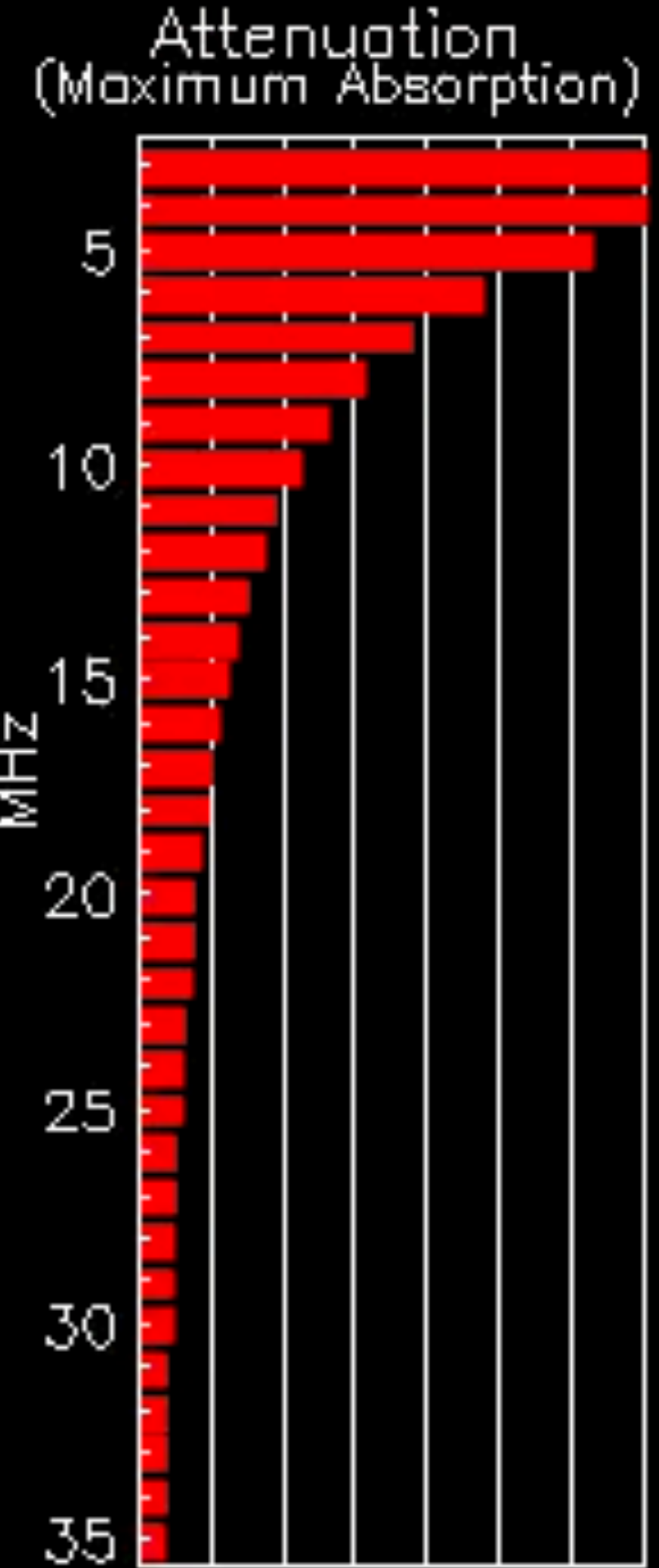
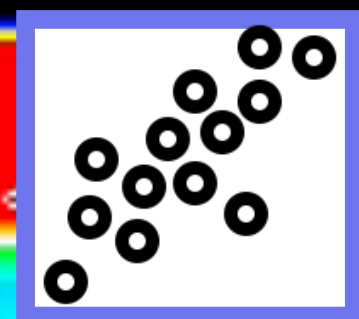
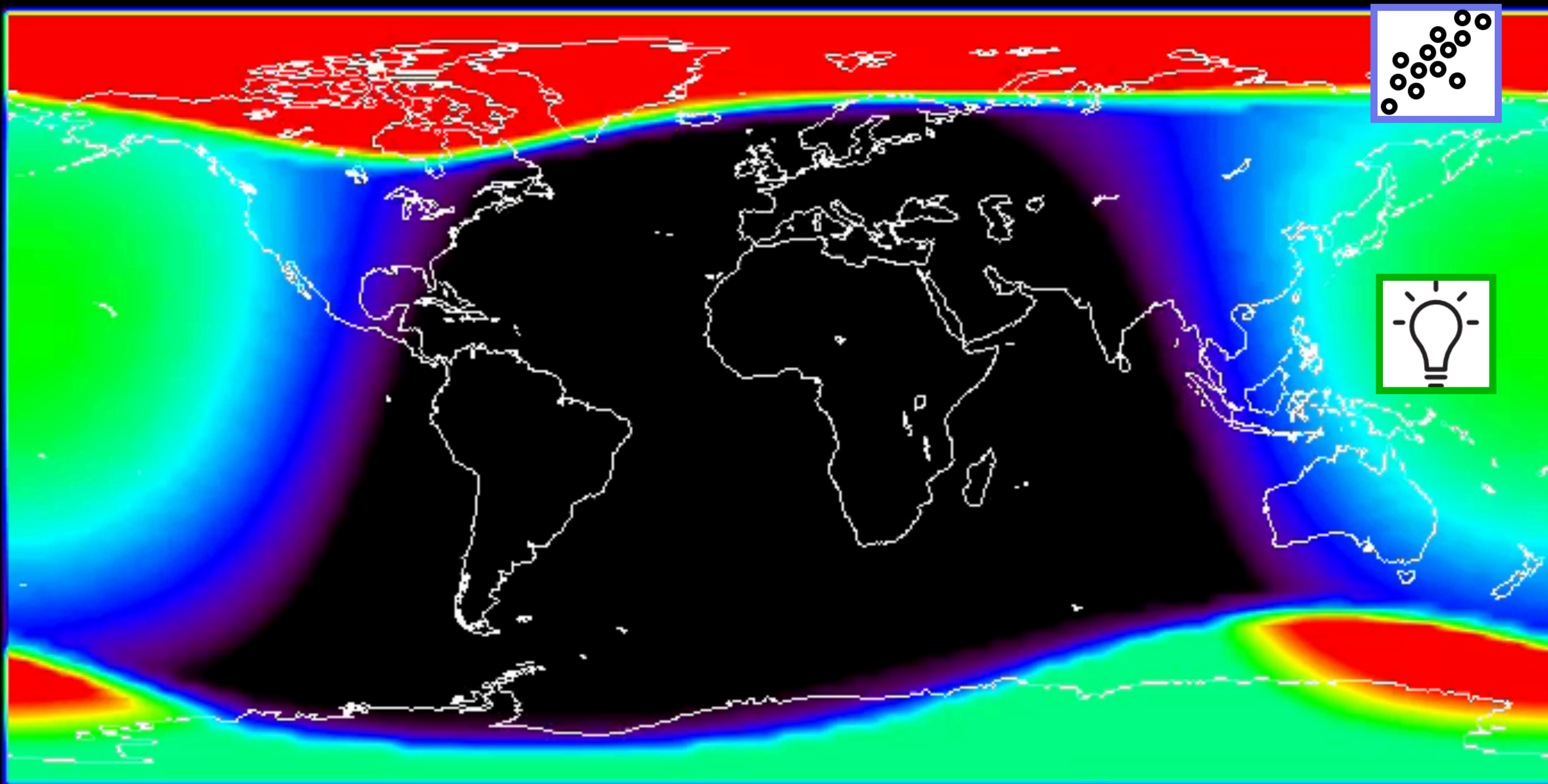
Extra ionisation due to a solar event



After Mother's day storm - May 15, 2024



DEFENSIE



Estimated Recovery Time
 High Latitude Protons :
 5 HRS 47 MINS
 Mid/Low Latitude X-rays :
 No Estimate

Elevated X-ray flux
 Product Valid At : 2024-05-15 00:00 UTC

Minor Proton Flux
 NOAA/SWPC Boulder, CO USA

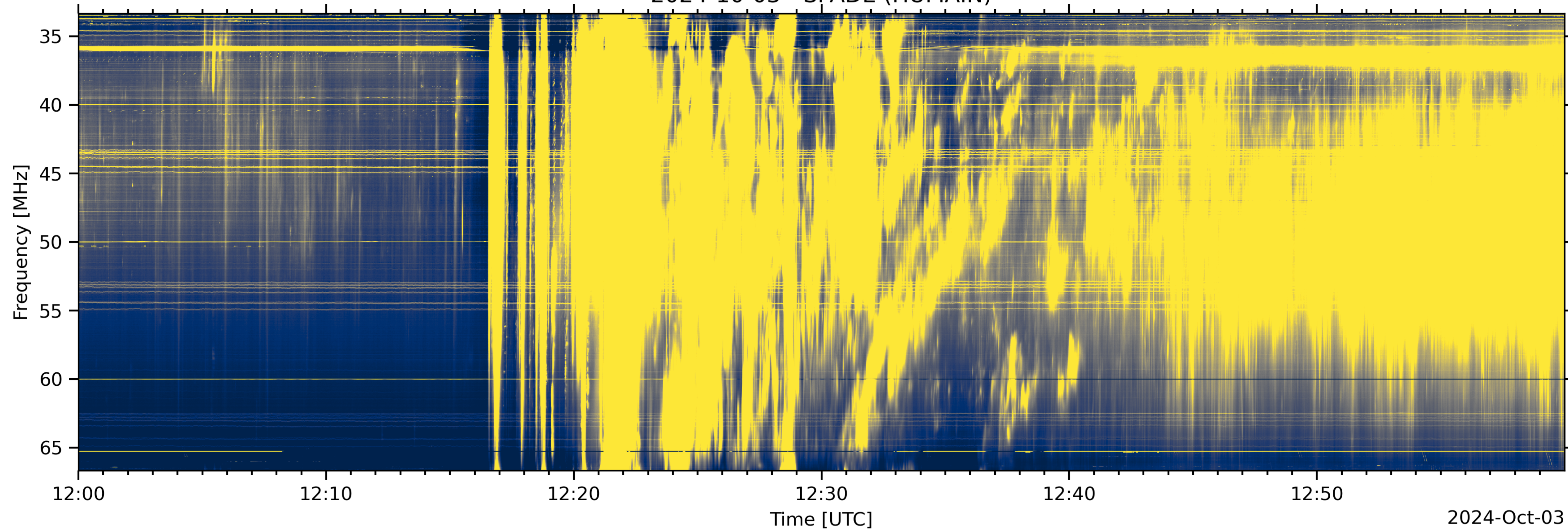
SPADE

- 25 - 75 MHz
- 8 antennas - phased array
- 20 x 20 m square grid
- Solar spectrograph





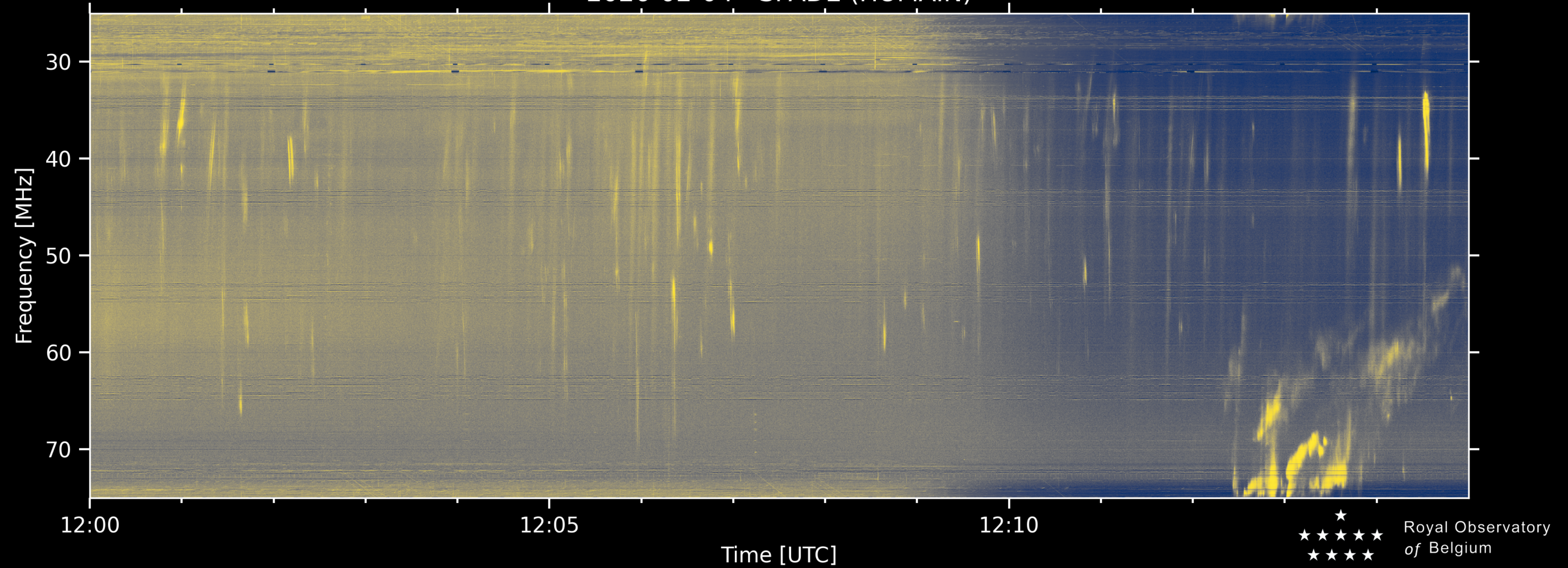
2024-10-03 - SPADE (HUMAIN)

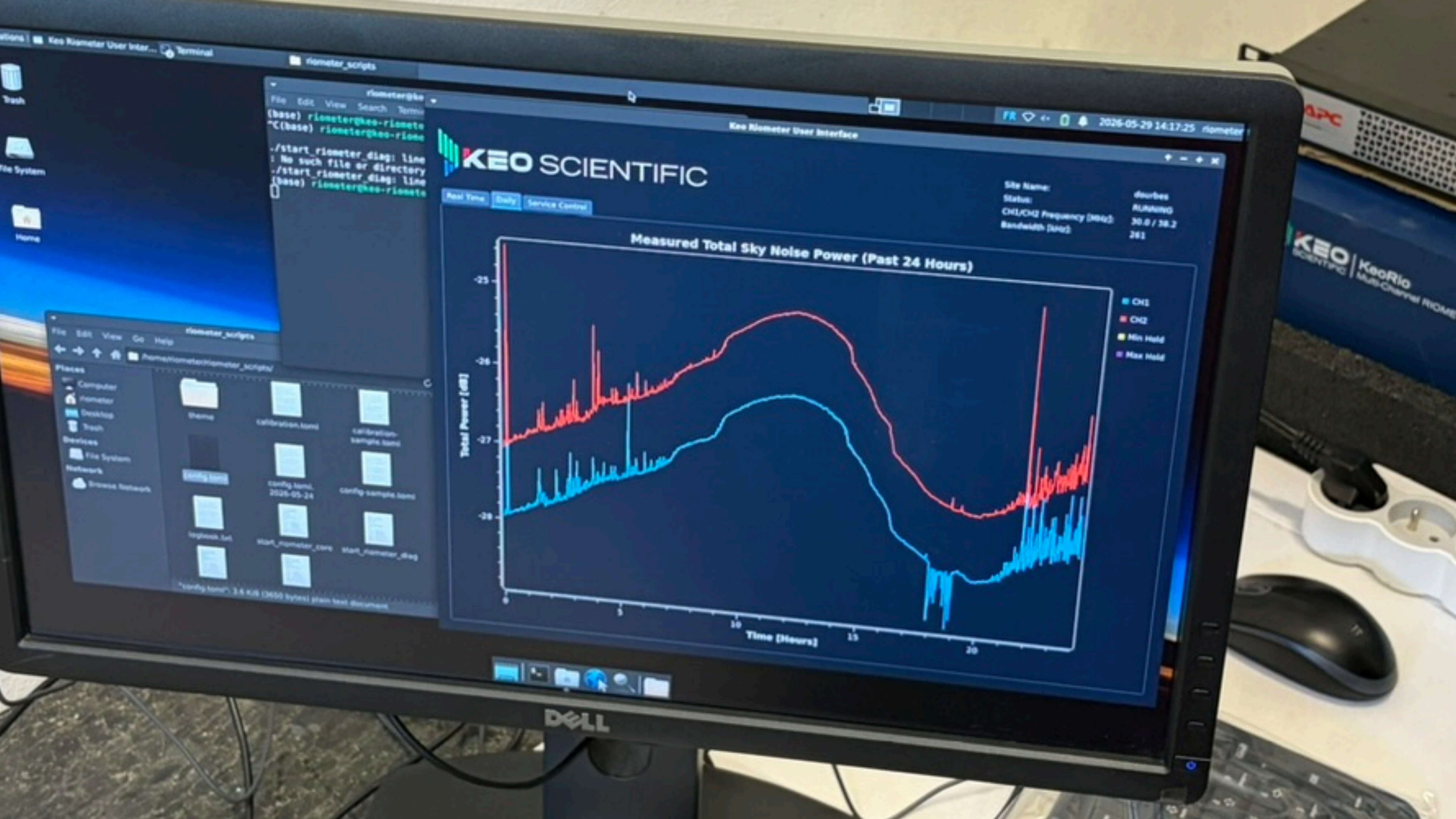


2024-Oct-03



2026-02-04 - SPADE (HUMAIN)





```
riometer@keo
File Edit View Search Termin
(base) riometer@keo-riomete
~(base) riometer@keo-riomete
~/start_riometer_diag: line
: No such file or directory
~/start_riometer_diag: line
(base) riometer@keo-riomete
```

Site Name: dourbes
Status: RUNNING
CH1/CH2 Frequency [MHz]: 30.0 / 30.2
Bandwidth [MHz]: 201



riometer_scripts

~/home/riometer/riometer_scripts/

Places

- Computer
- riometer
- Desktop
- Trash
- Devices
- File System
- Network
- Browse Network

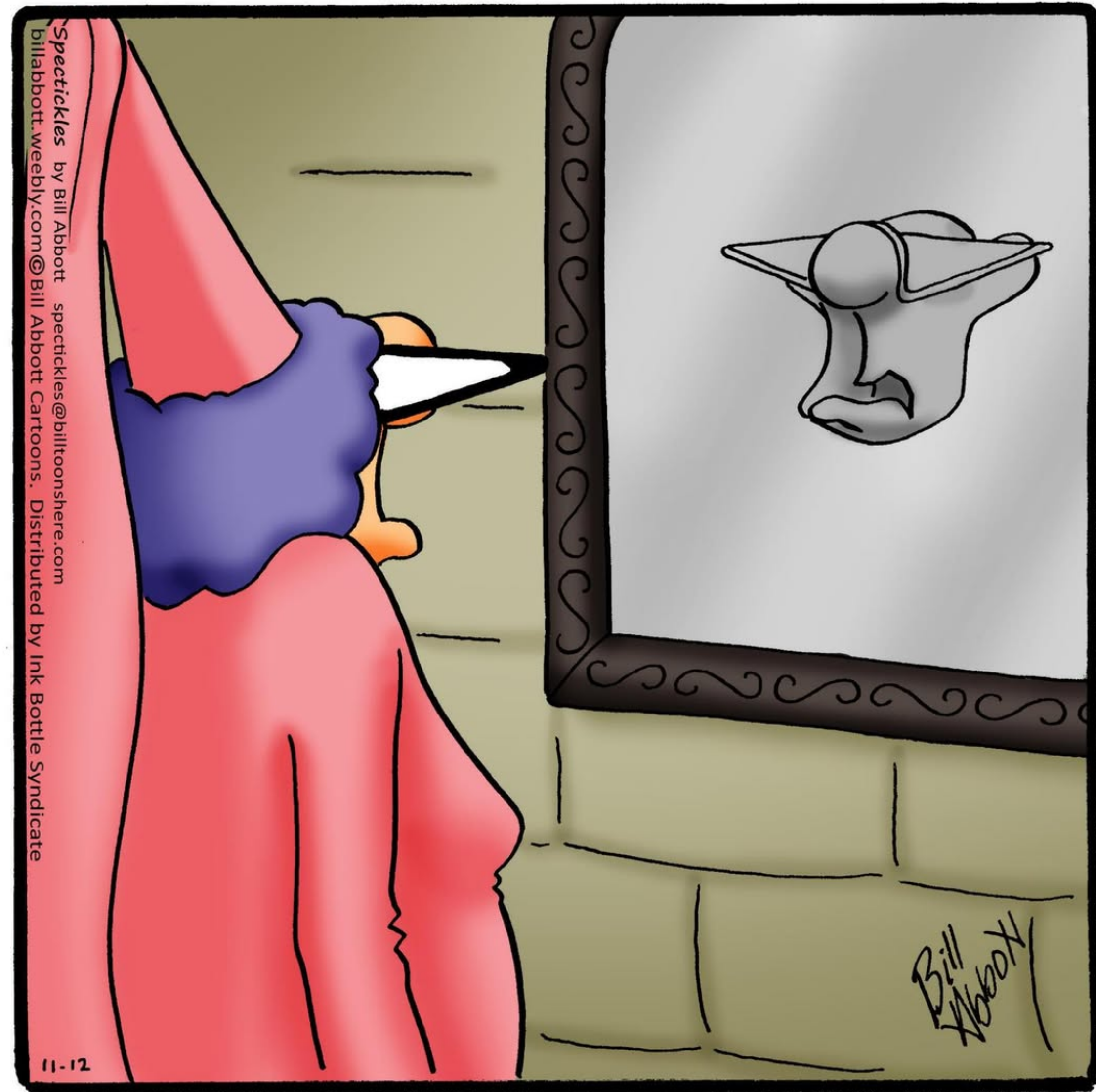
theme
calibration.toml
calibration-sample.toml
config.toml
config-sample.toml
config.toml, 2026-05-24
config-sample.toml
logbook.txt
start_riometer_core
start_riometer_diag

"config.toml" 3.4 KiB (3456 bytes) plain text document

DELL

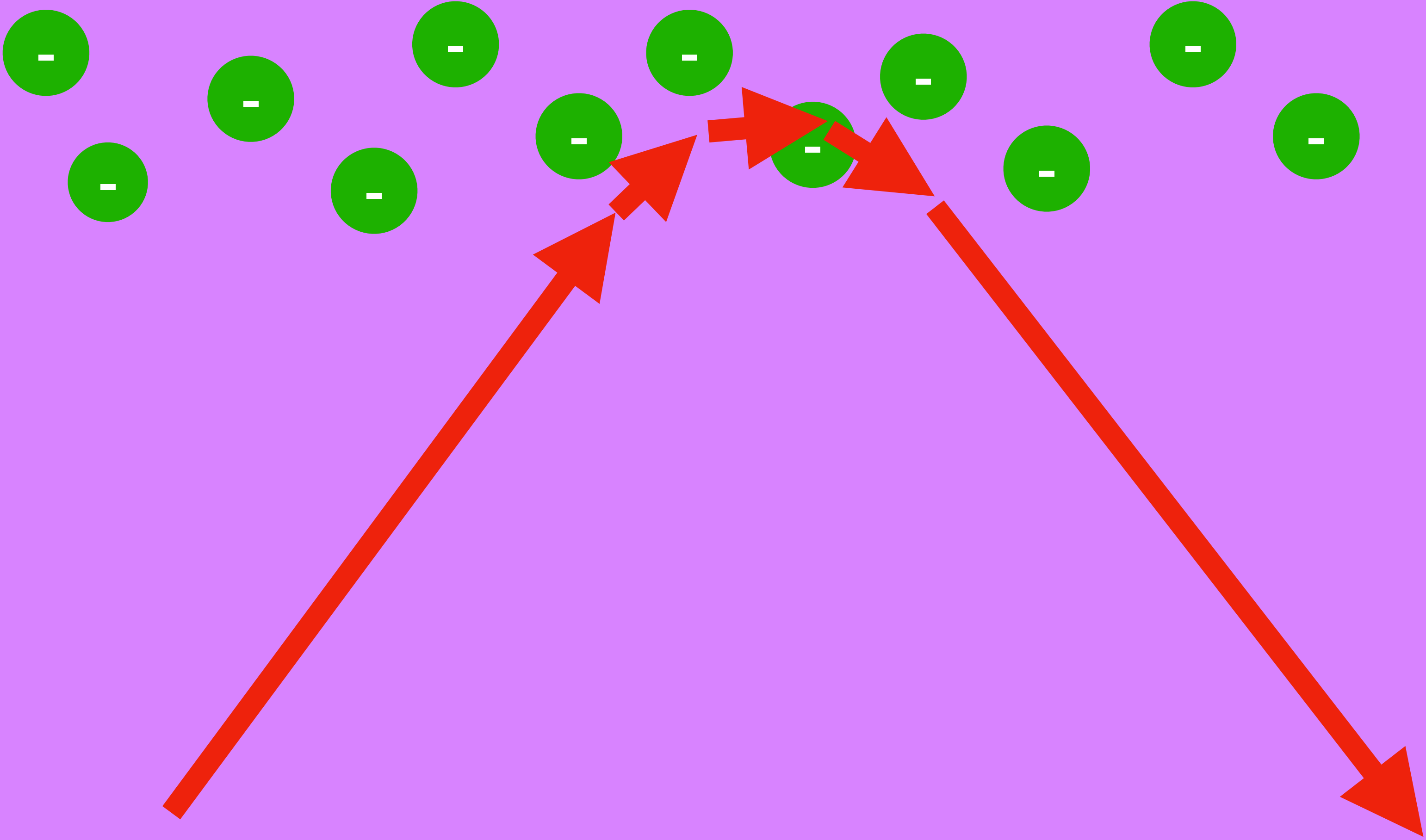


Impact: decrease of MUF
Post storm depression

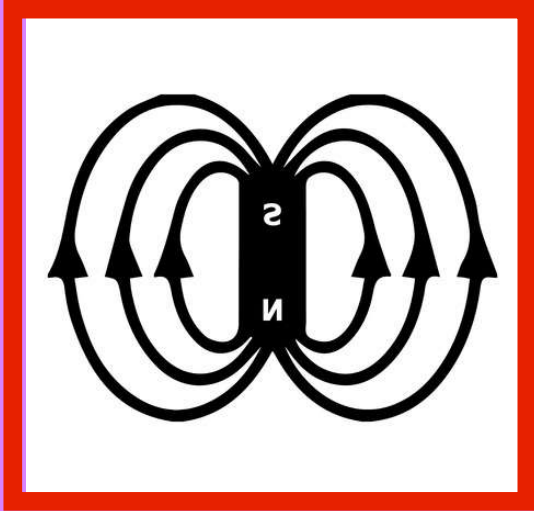
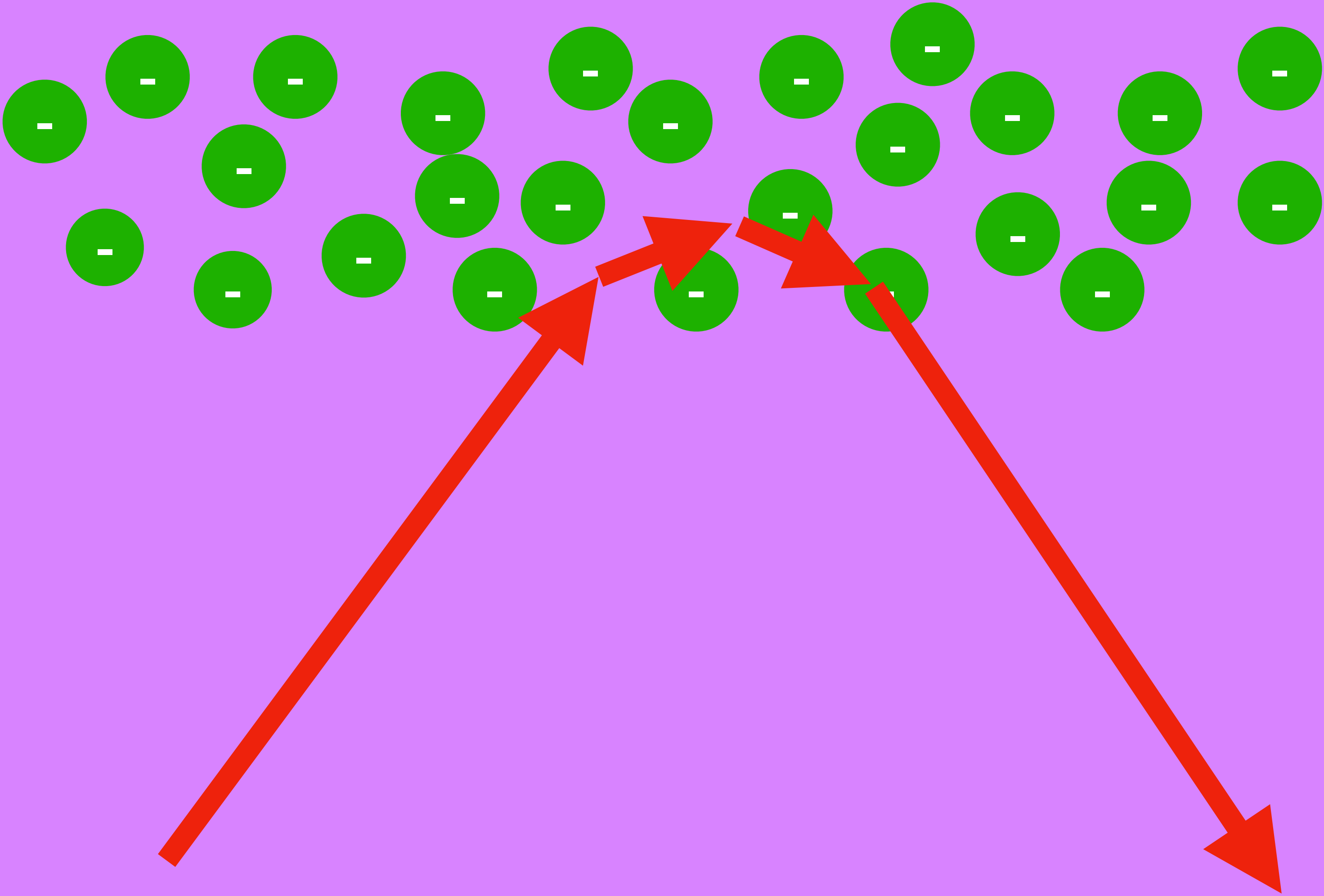


“Before I answer that, may I remind you that it’s seven years of bad luck to break a mirror?”

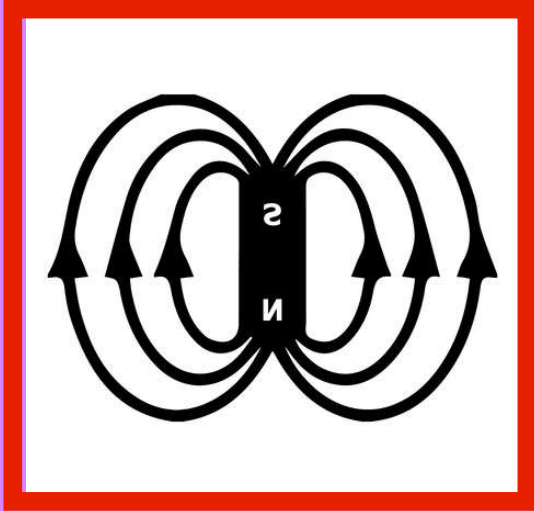
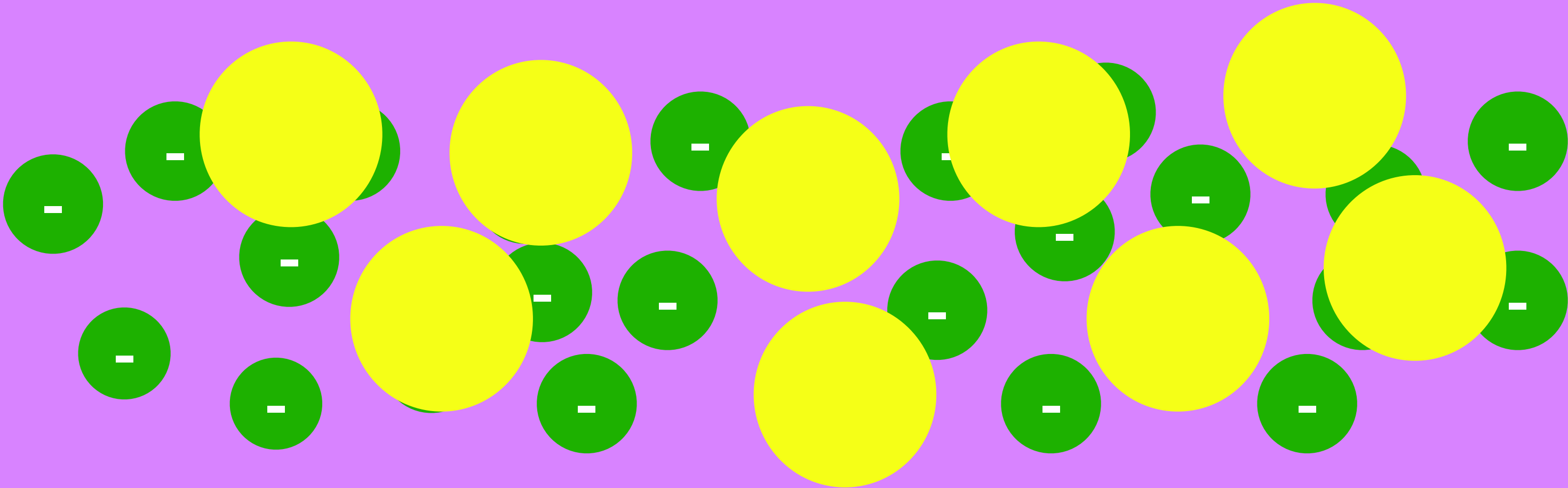
Reflection of HF waves - MUF



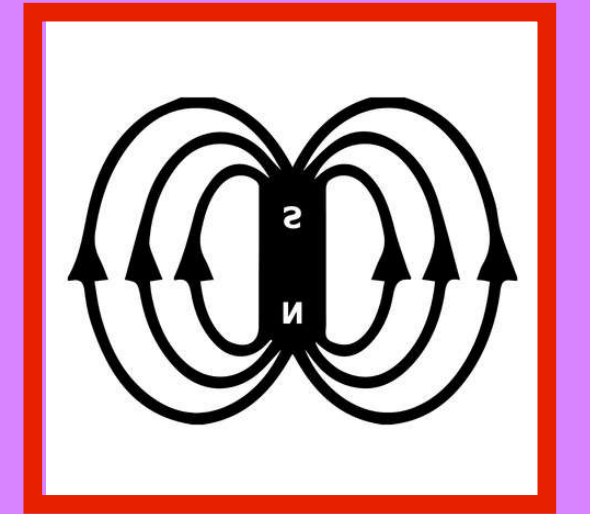
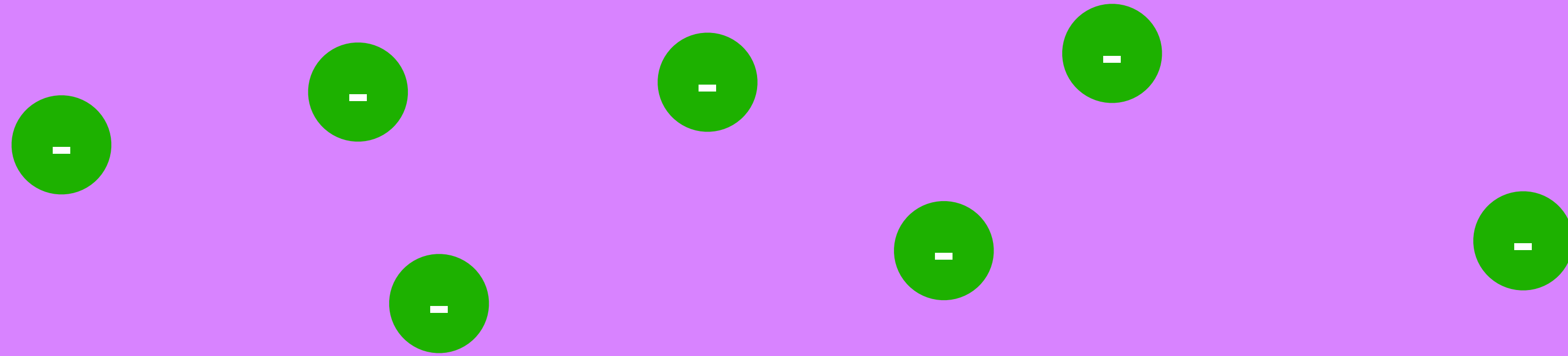
First phase: better reflection



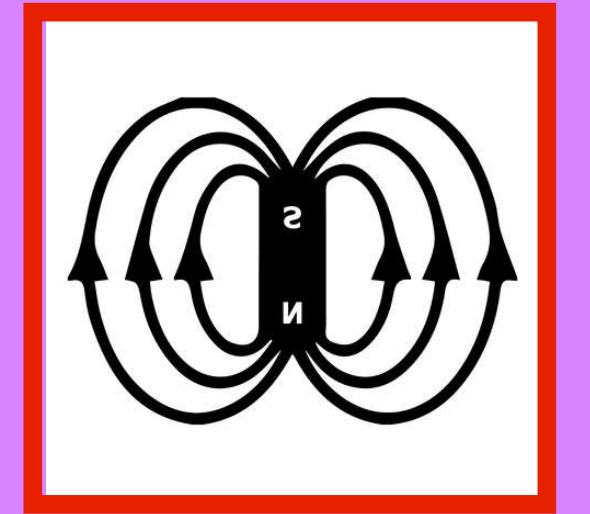
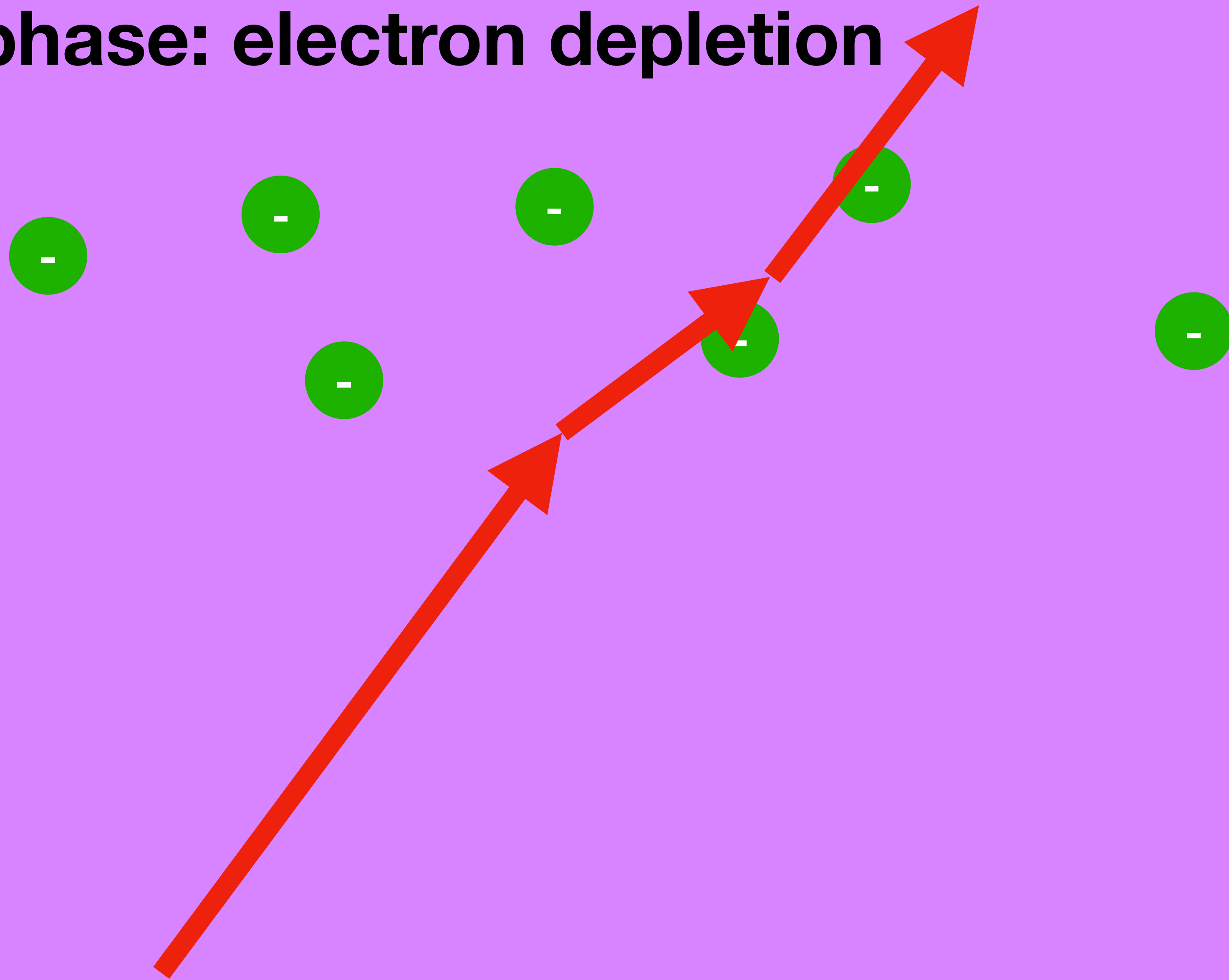
Second phase: Slower neutrals arrive



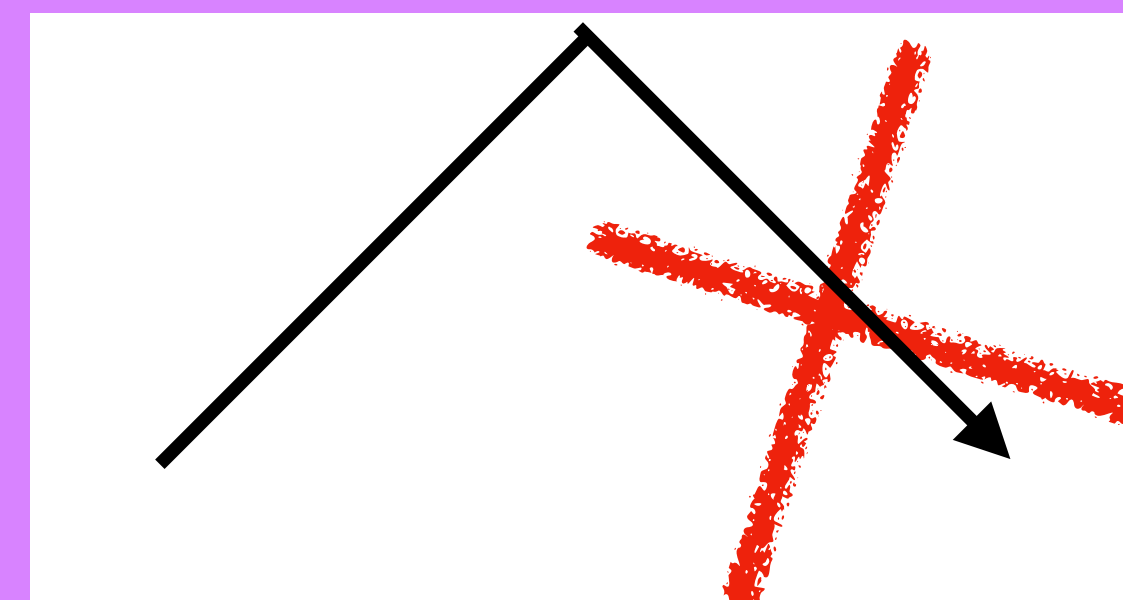
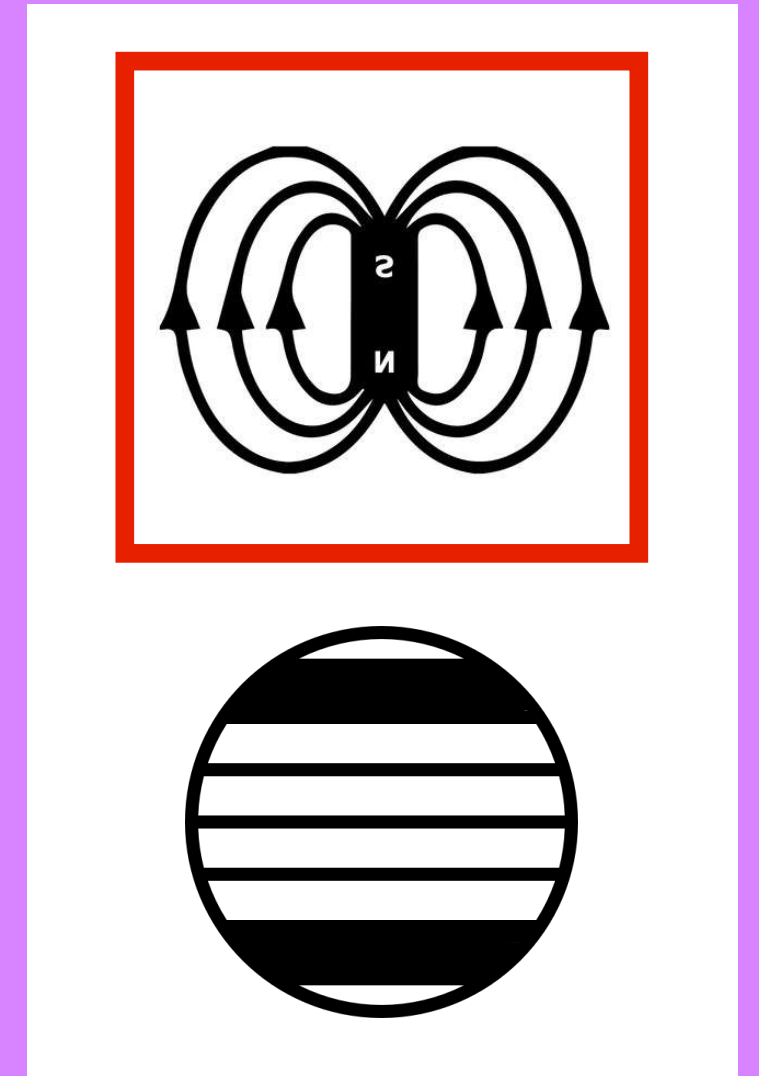
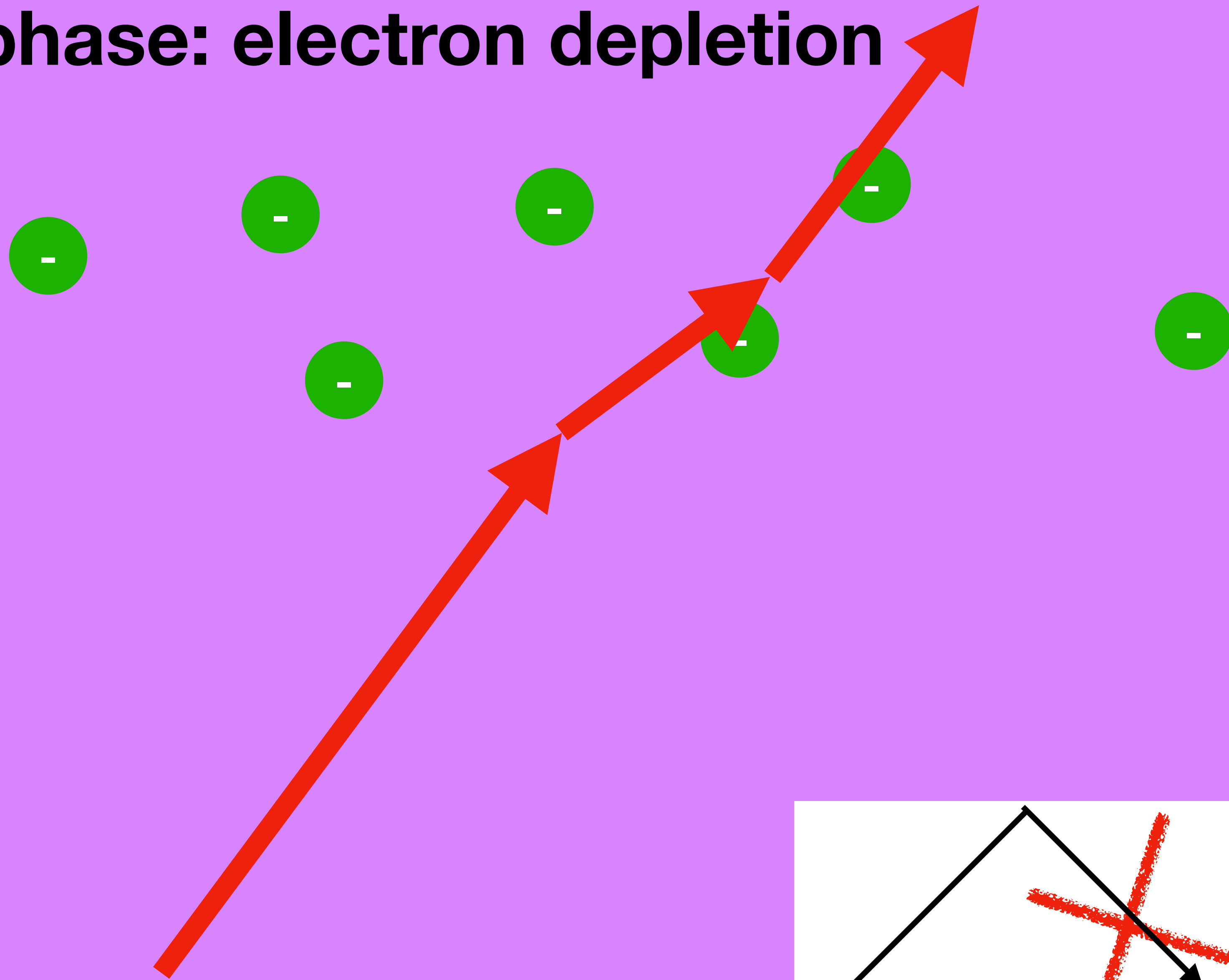
Second phase: electron depletion



Second phase: electron depletion



Second phase: electron depletion



Impact: Scintillation

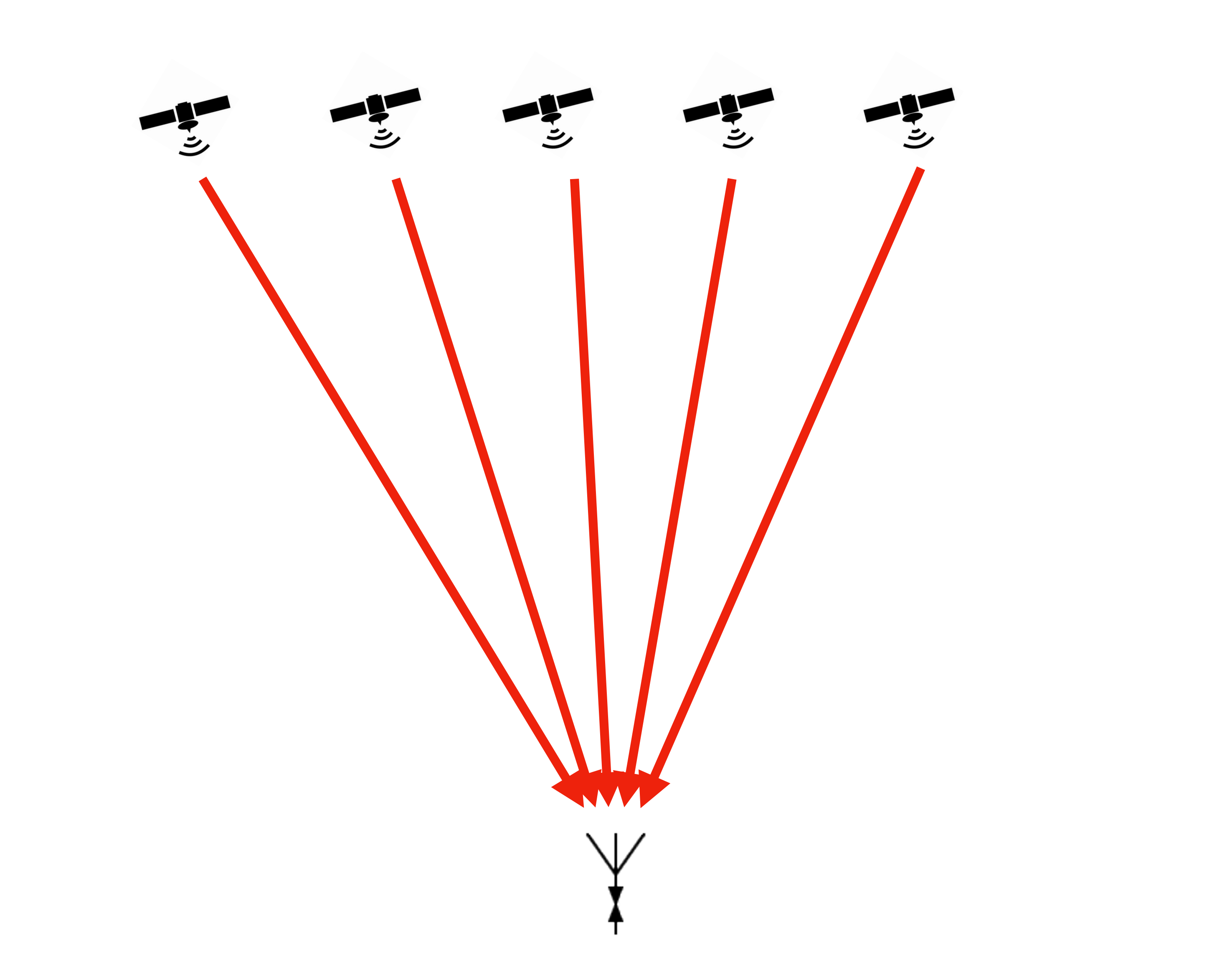


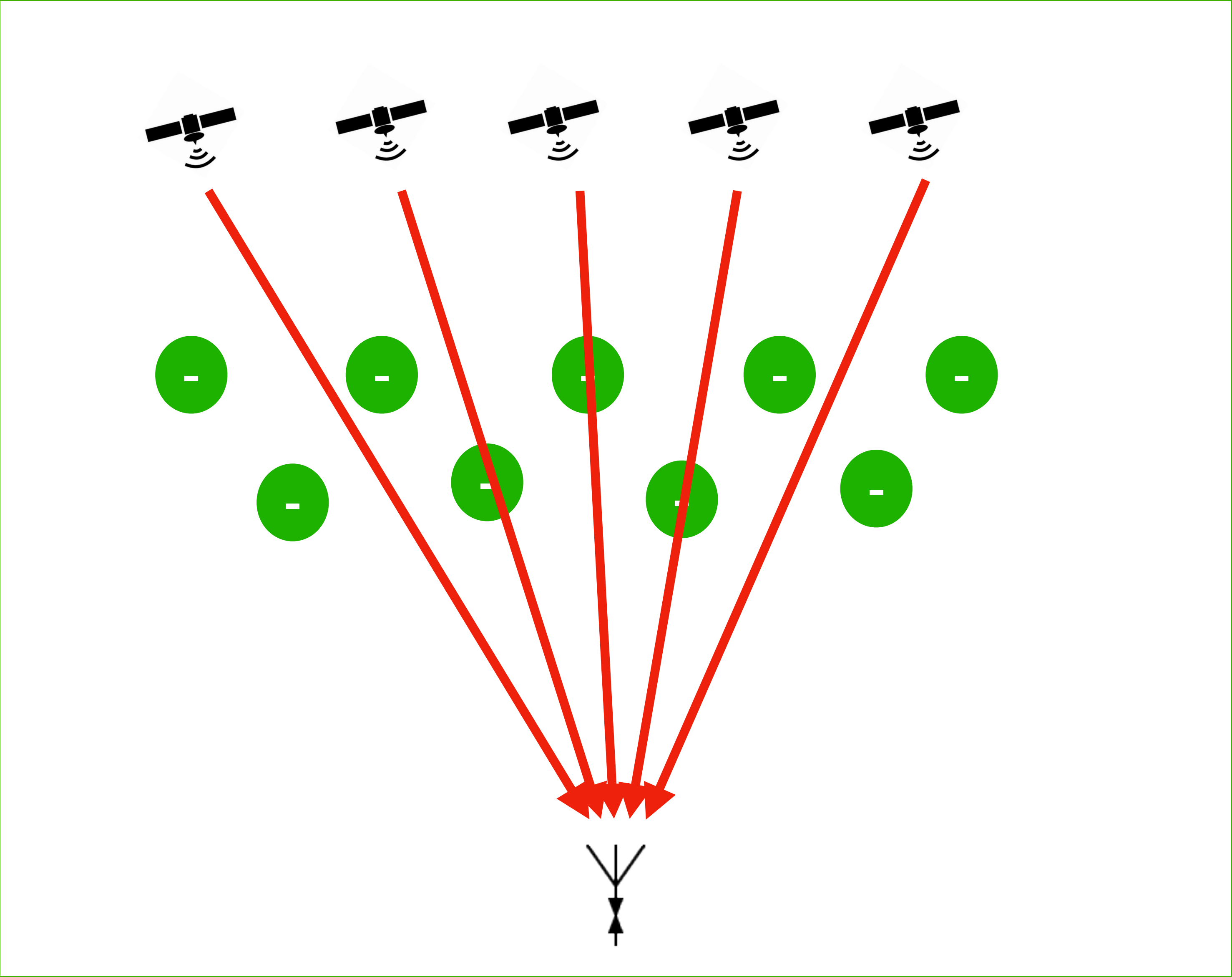
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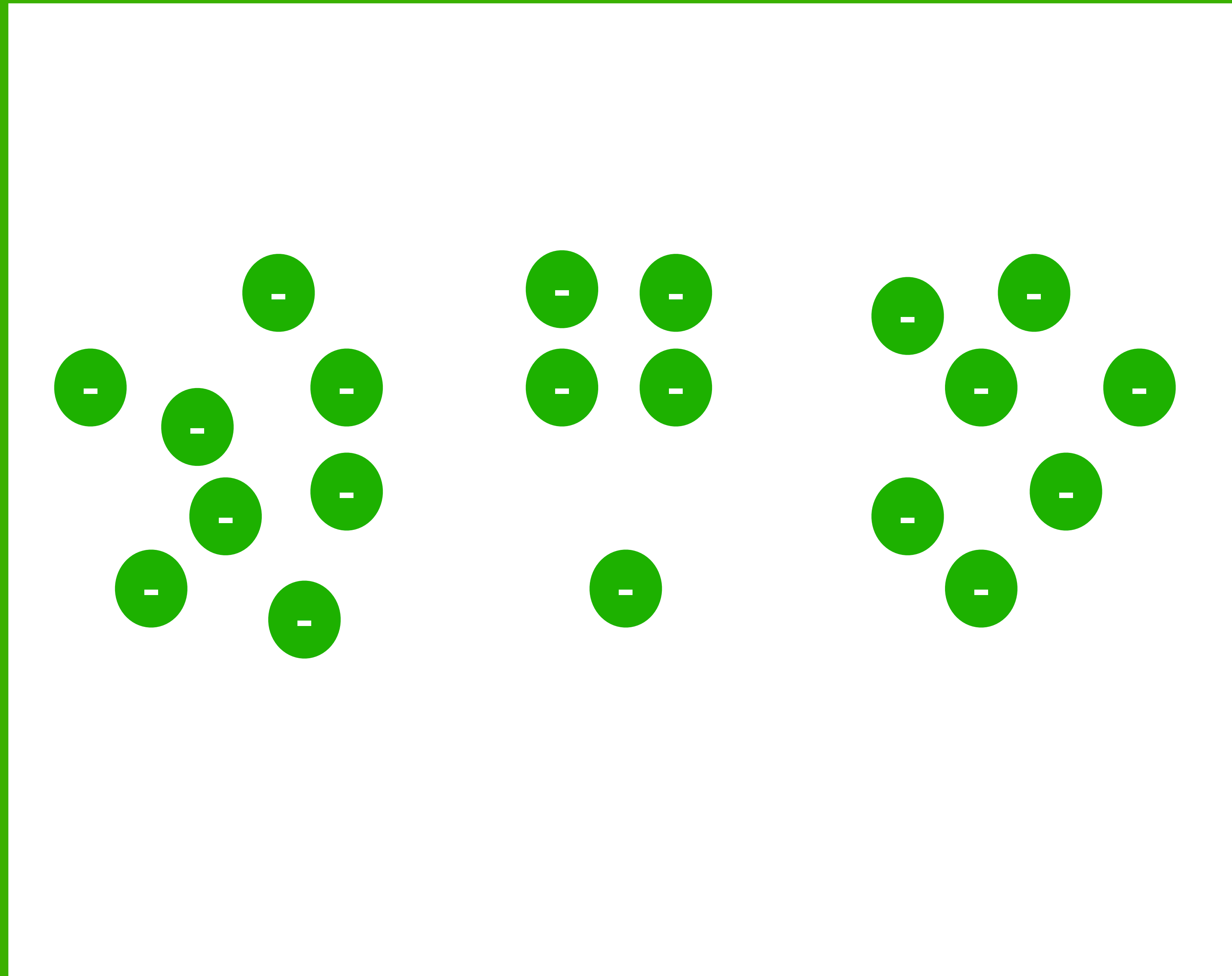
"Gary, the other astrophysicists have asked me to talk to you about your constant humming of 'Twinkle Twinkle Little Star.'"

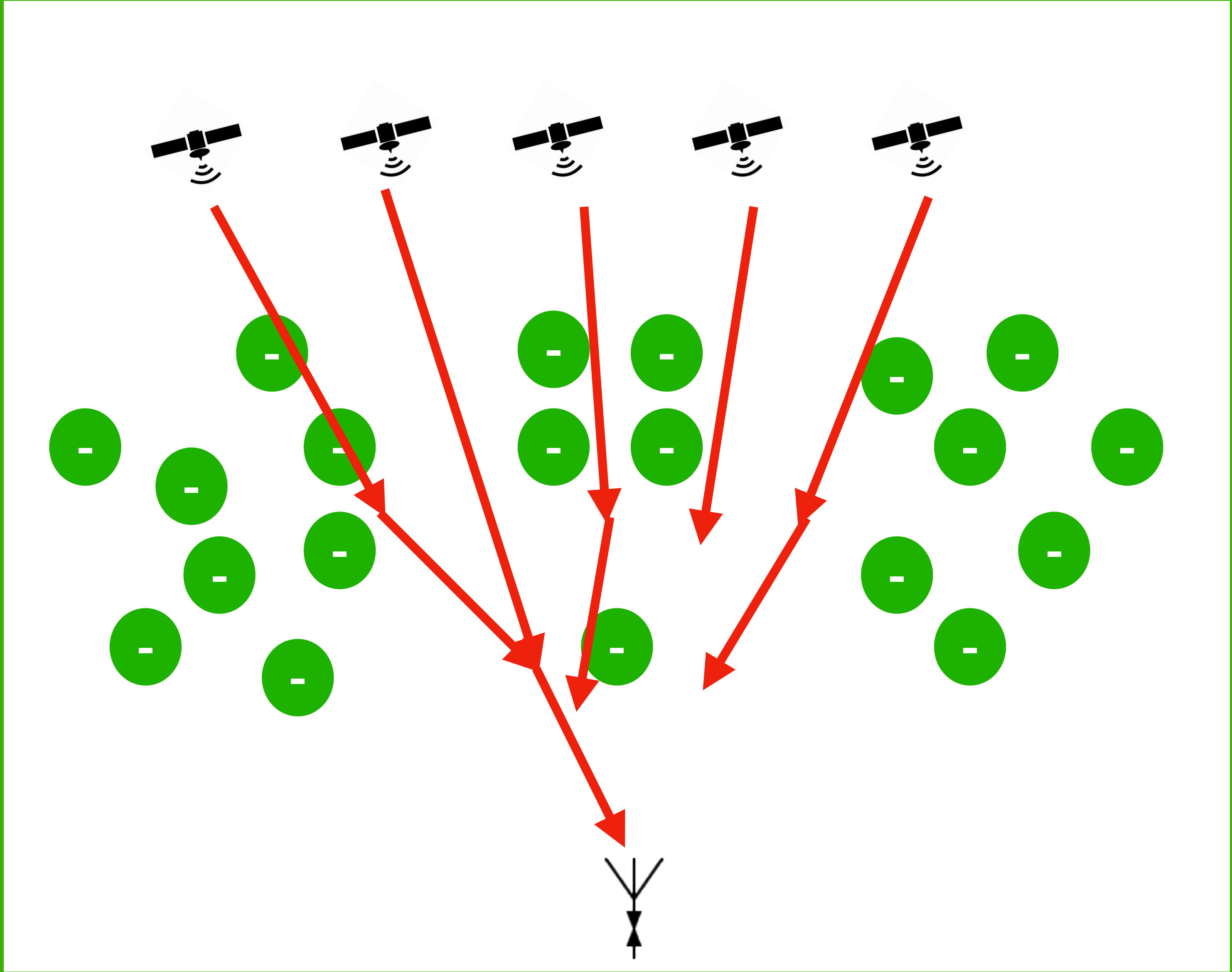






Strong gradients





SCINTILLATION MECHANISMS



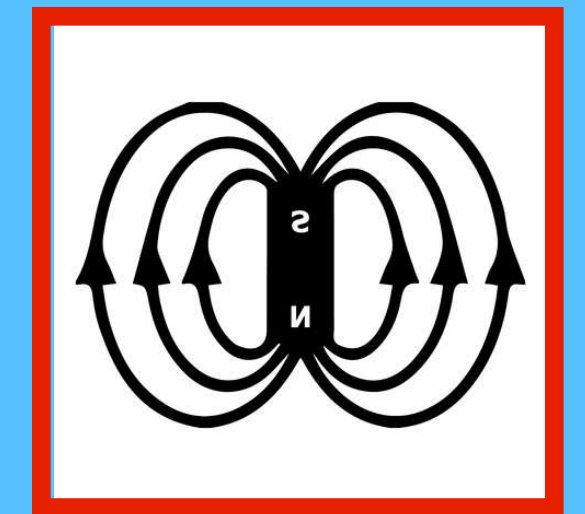
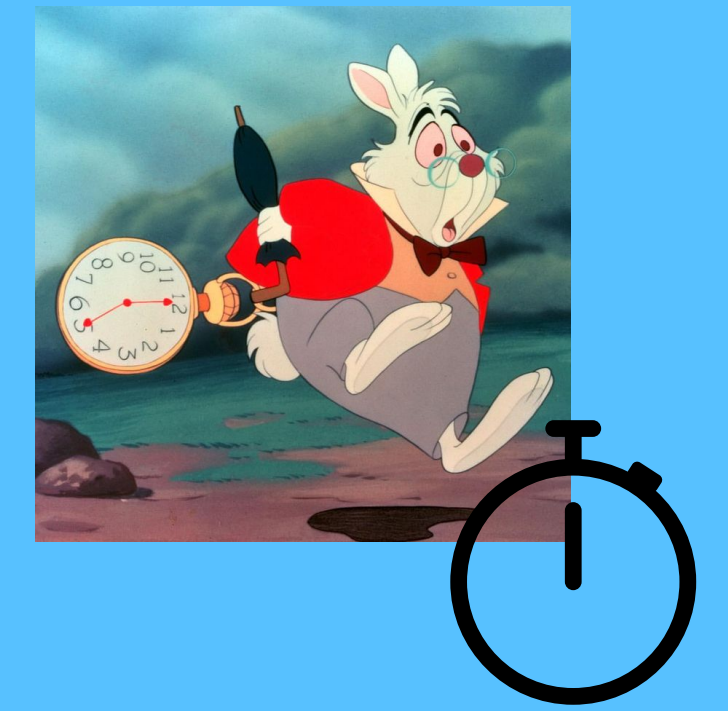
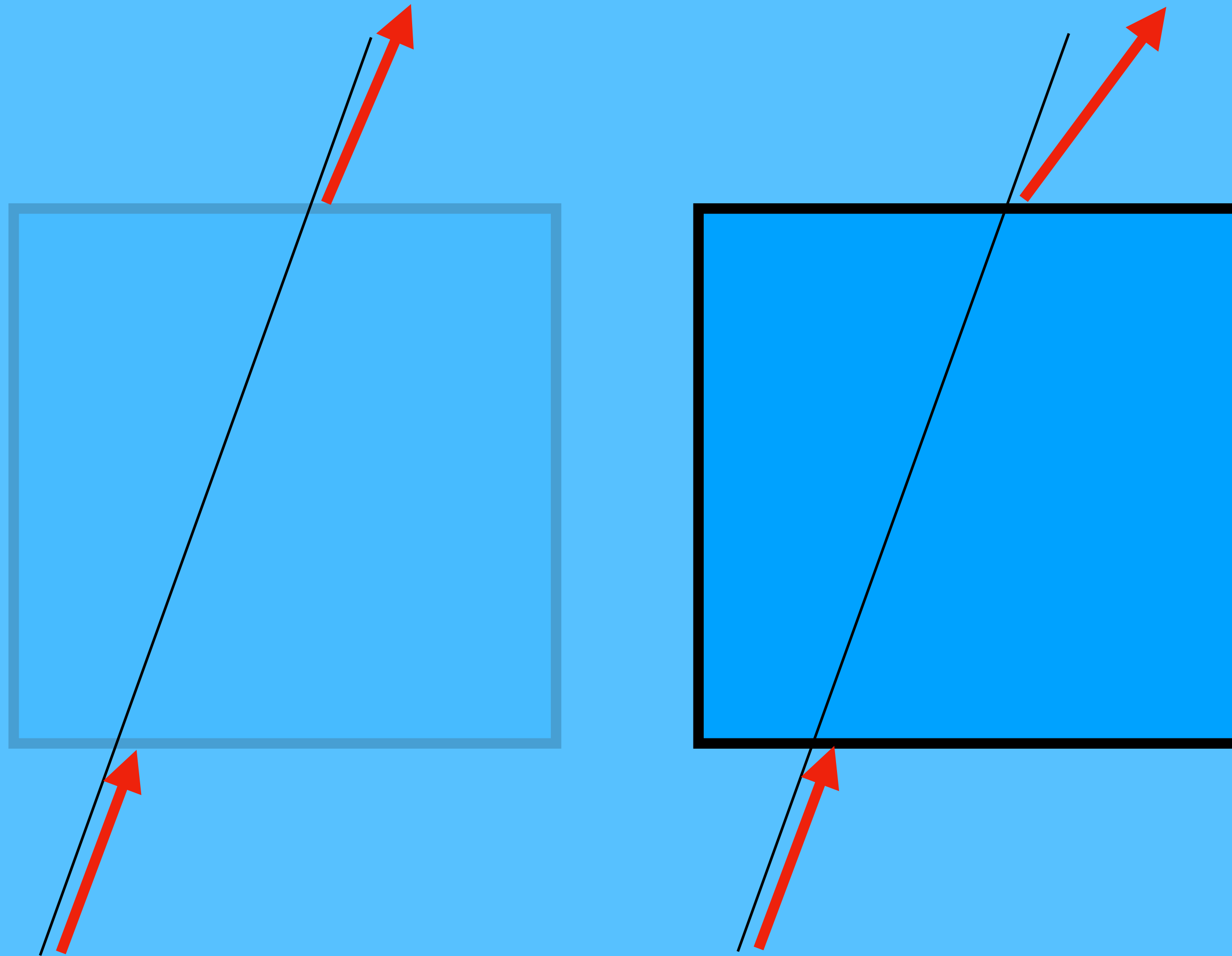
Post-sunset at the Equator

Auroral oval

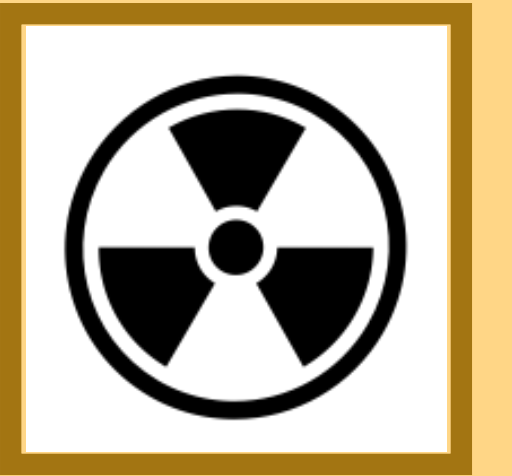
Polar caps

Travelling ionospheric disturbances

Impact: Delay



Radiation



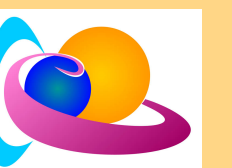
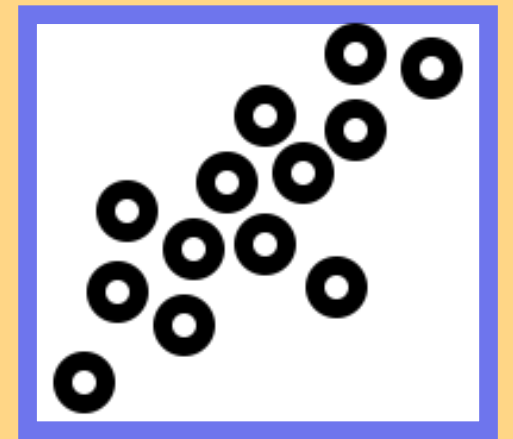
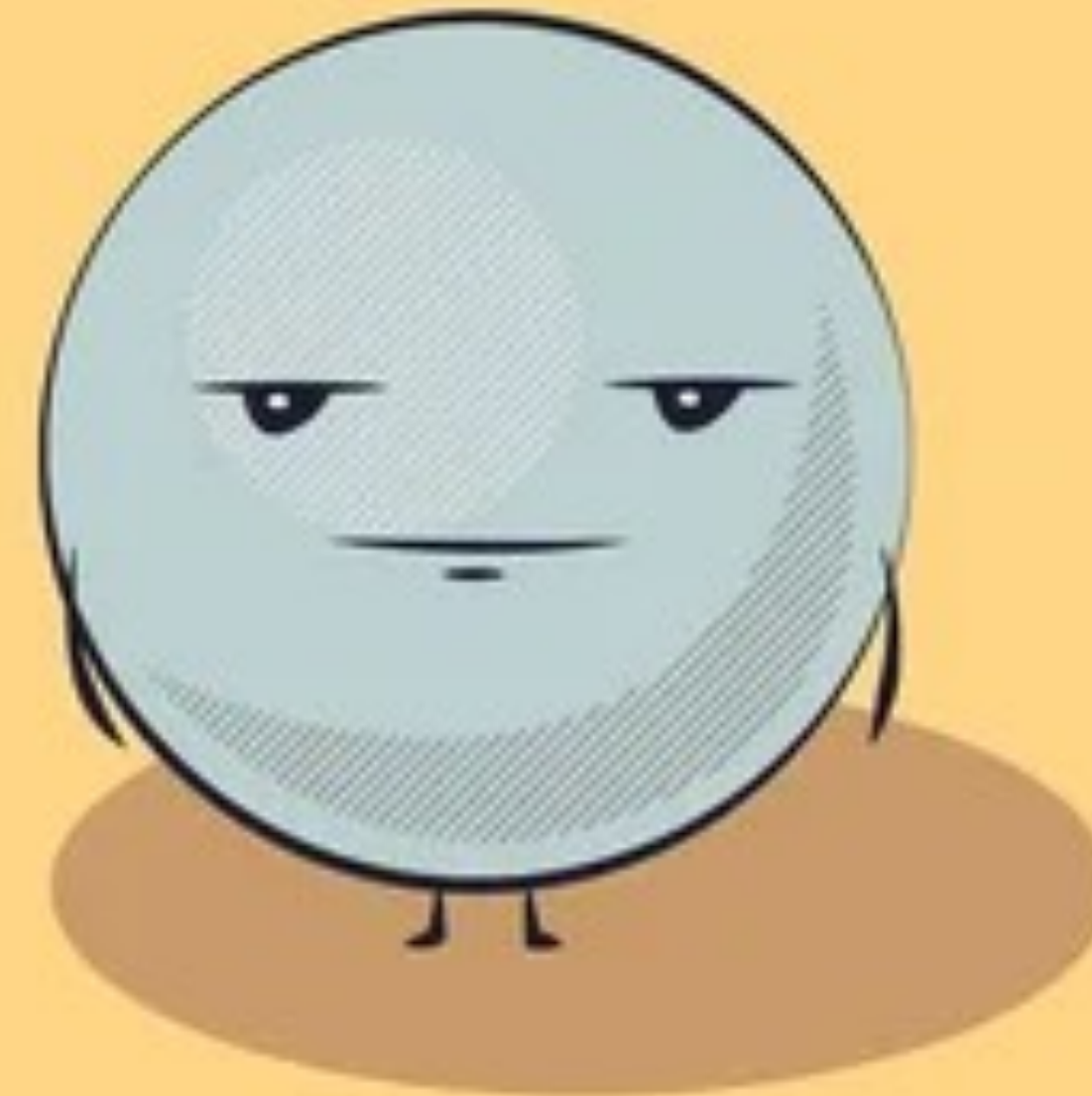
proton



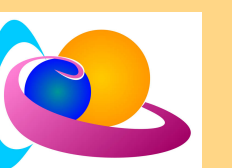
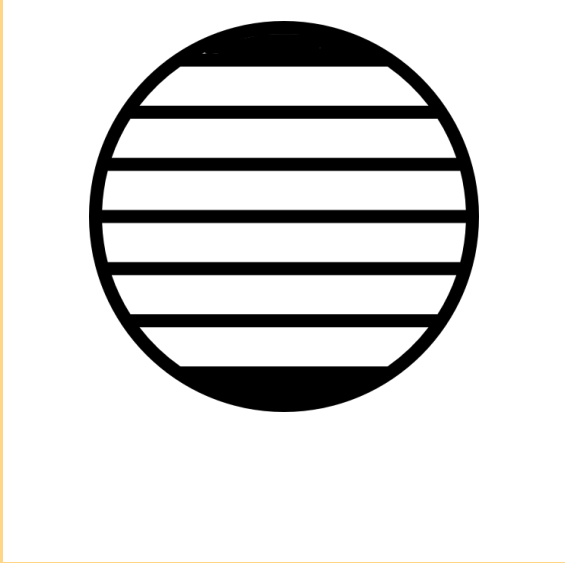
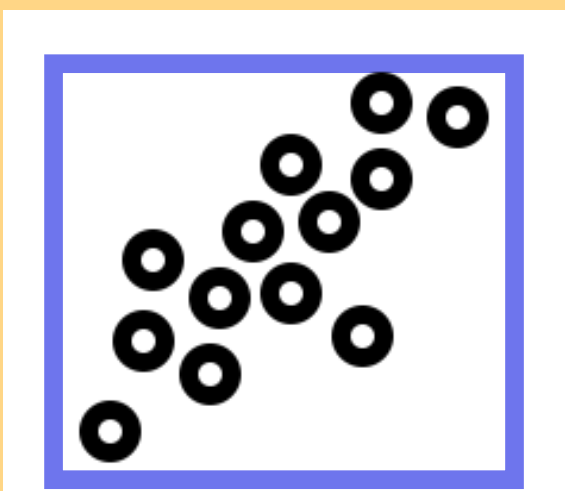
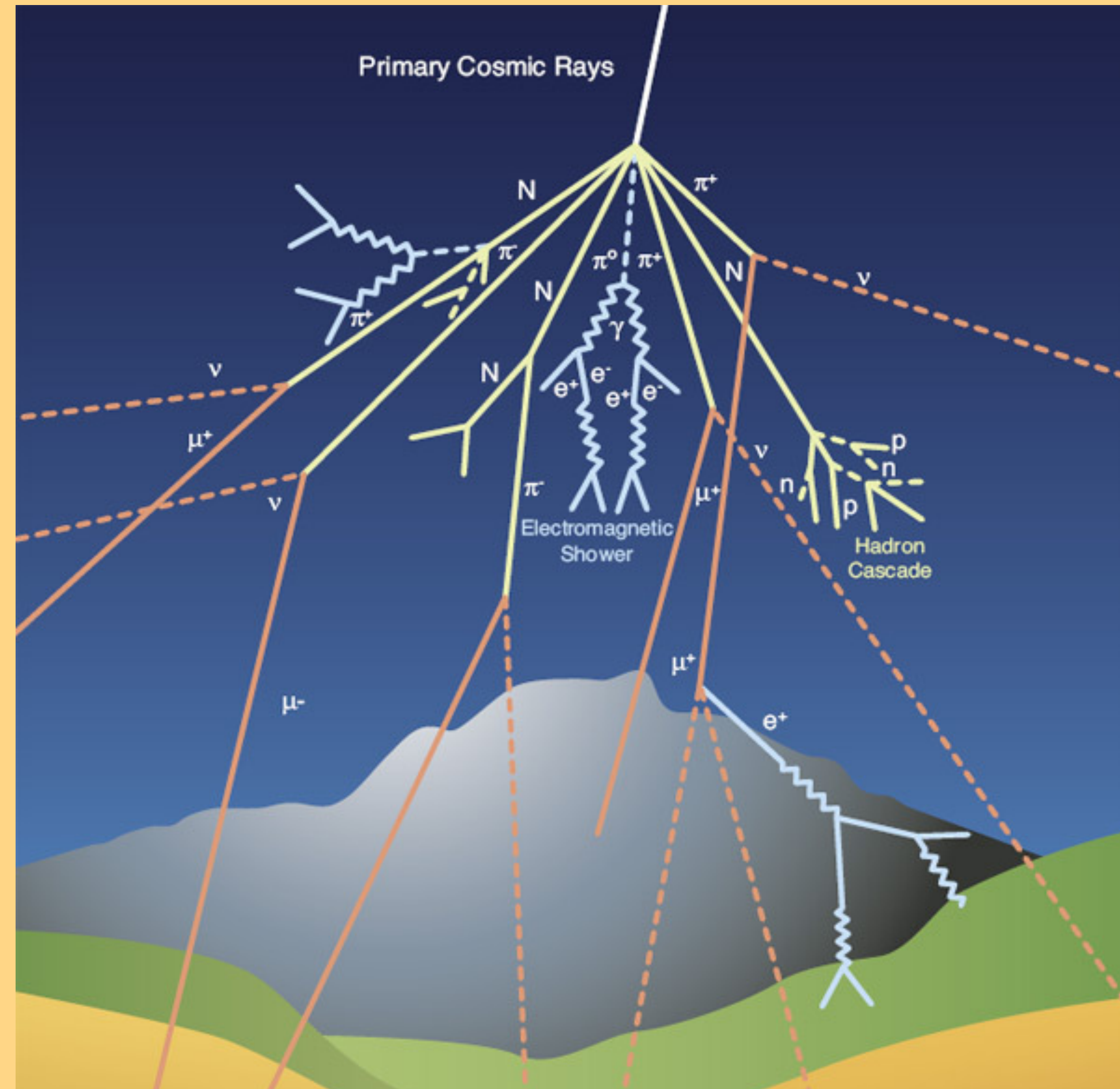
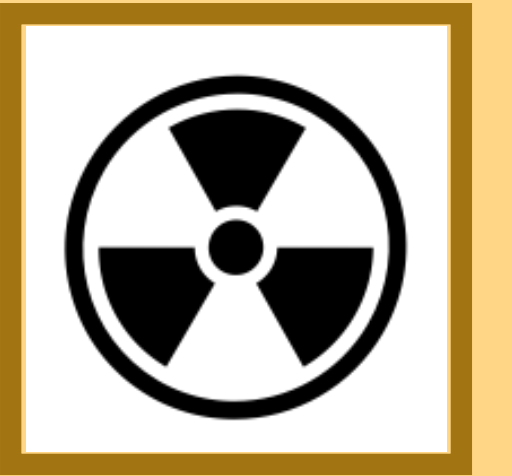
electron








neutron







Radiation



GNSS	Moderate	Severe	Time UTC	Values	Status	Alert	Max-3h values	Max-3h status
<u>Amplitude Scintillation</u>	0.5	0.8	2020-10-12 14:15	0.25	QUIET		0.35	QUIET
<u>Phase Scintillation</u>	0.4	0.7	2020-10-12 14:15	0.13	QUIET		0.14	QUIET
<u>Vertical TEC</u>	125	175	2020-10-12 14:15	61.92	QUIET		61.93	QUIET

RADIATION	Moderate	Severe	Time UTC	Flags	Status	Alert	Max-3h flags	Max-3h status
<u>Effective Dose FL≤460</u>	30	80	2020-10-12 14:20	0	QUIET		0	QUIET
<u>Effective Dose FL > 460</u>	/	80	2020-10-12 14:20	0	QUIET		0	QUIET

HF COM	Moderate	Severe	Time UTC	Values/Flags	Status	Alert	Max-3h values	Max-3h status
<u>Auroral Absorption (AA)</u>	8	9	2020-10-12 14:16	3.0	QUIET		3.0	QUIET
<u>Polar Cap Absorption (PCA)</u>	2	5	2020-10-12 14:20	0.00	QUIET		0.00	QUIET
<u>Shortwave Fadeout (SWF)</u>	x1.0	x10.0	2020-10-12 14:17	< M.5-flare	QUIET		< M.5-flare	QUIET
<u>Post-Storm Depression (PSD)</u>	30%	50%	2020-10-12 14:15	0	QUIET		0	QUIET