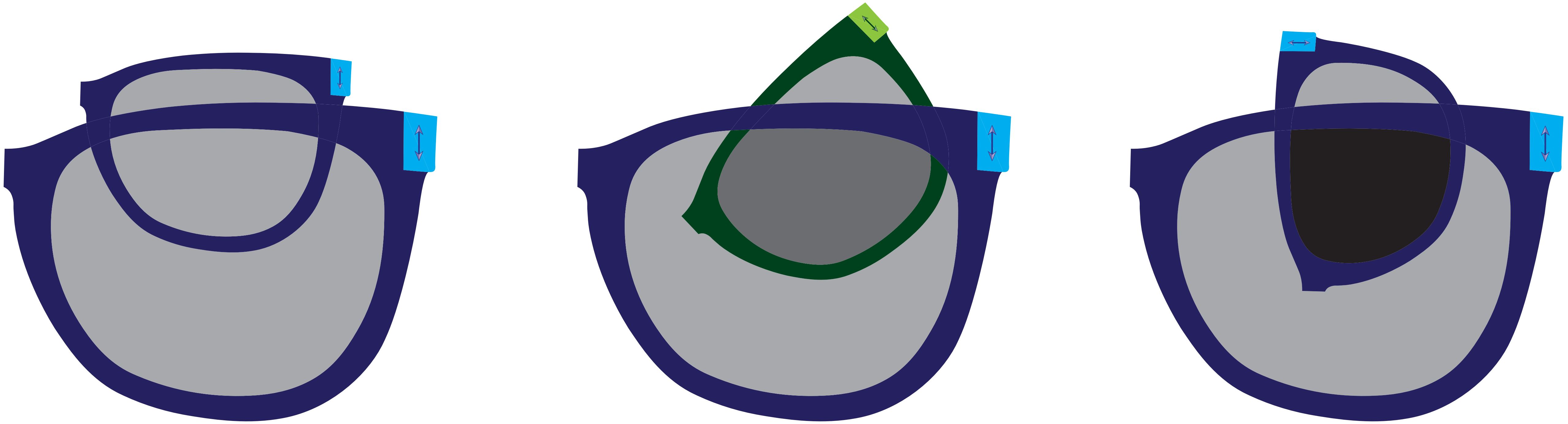
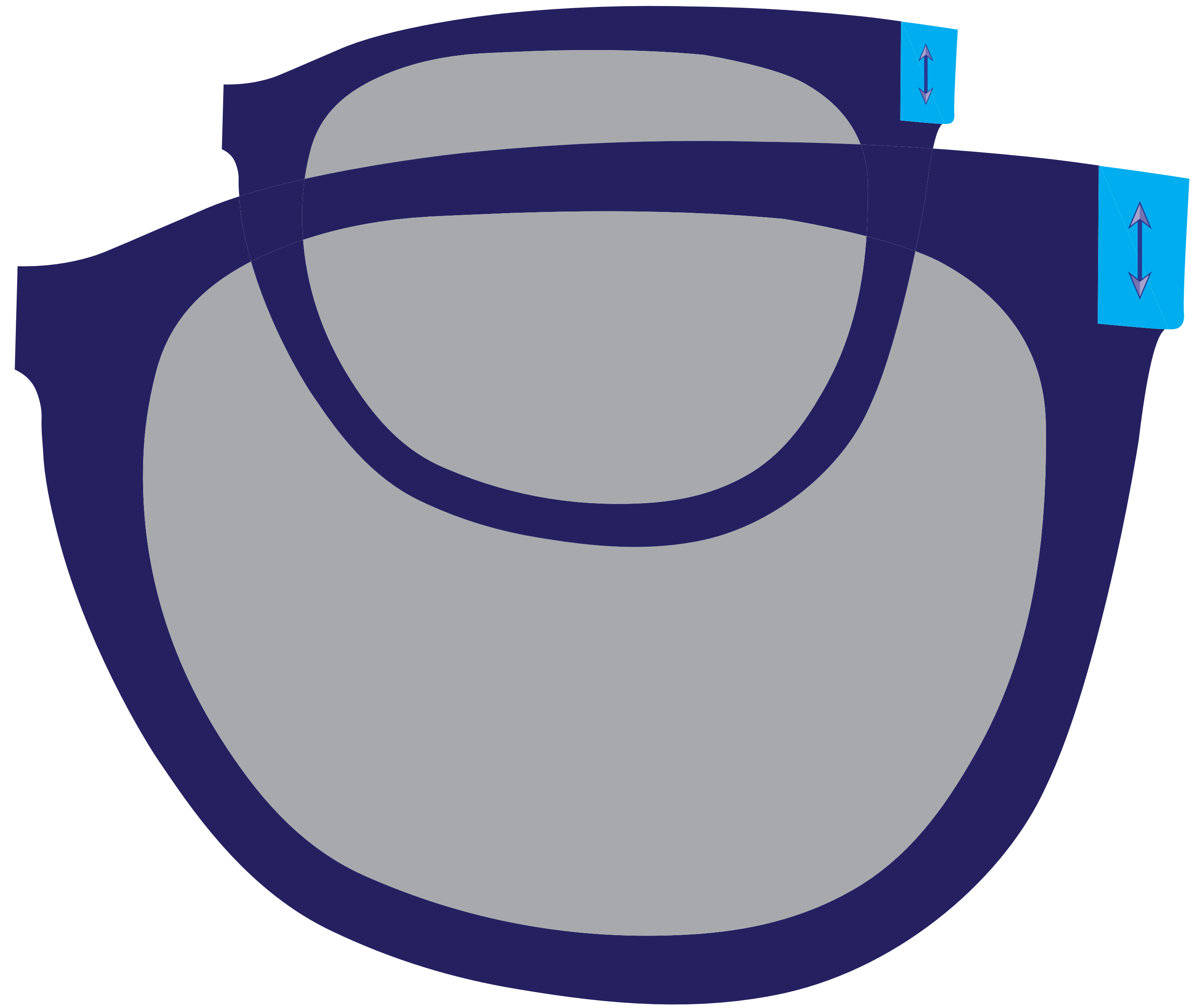
# Quantum spooks

# Sunglasses



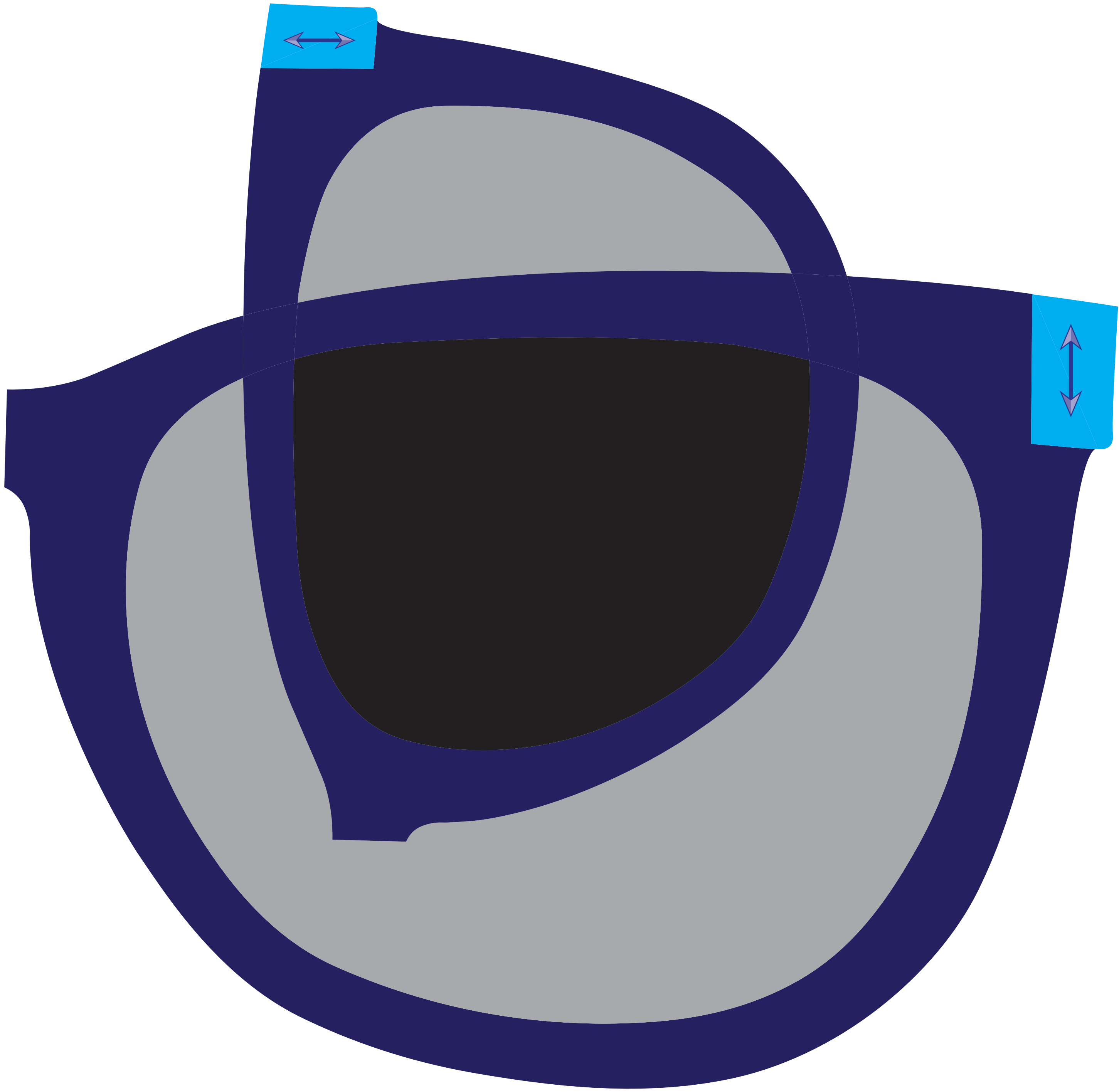
# Two glasses

- Half of the unpolarized light (background) makes it through the rearmost glasses. Only vertically polarized light makes it through.
- Since forward glasses only let vertical polarization through, all the light that got through the first pair make it through the second.

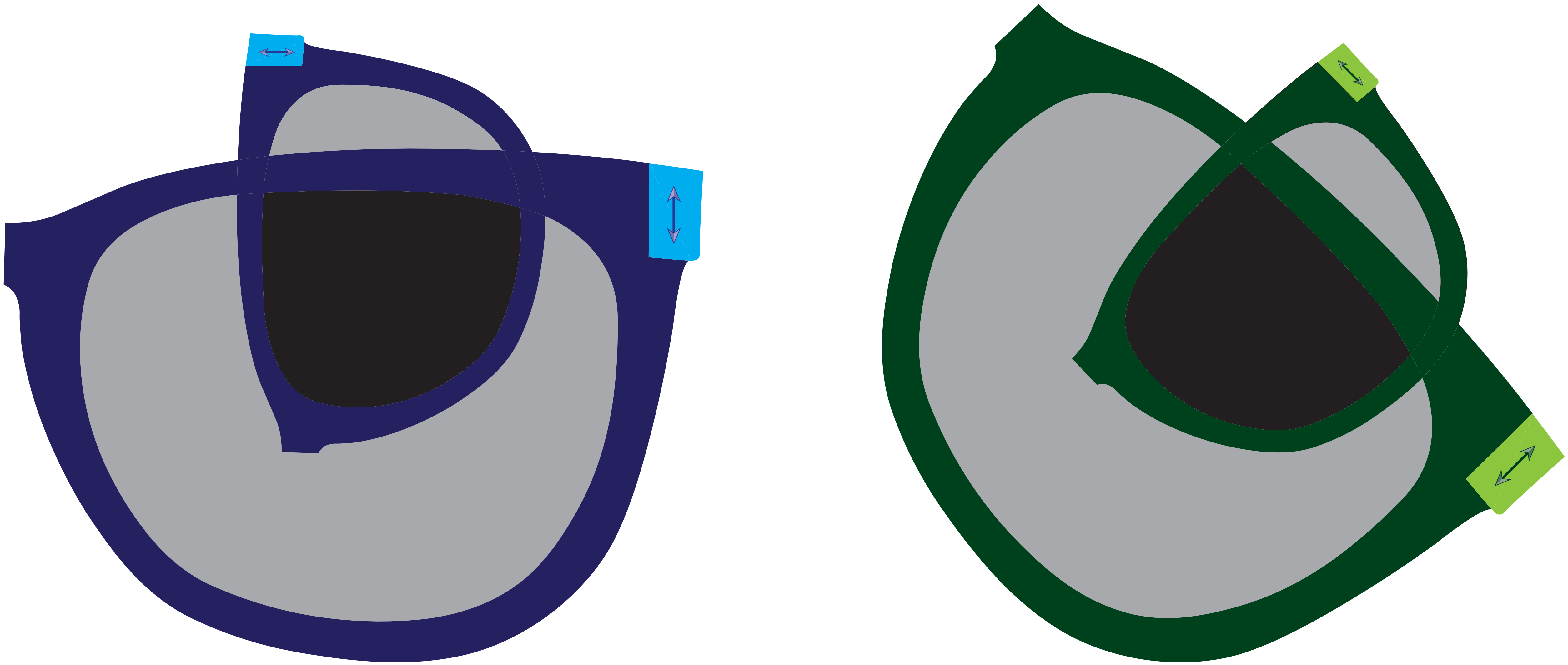


# Two glasses

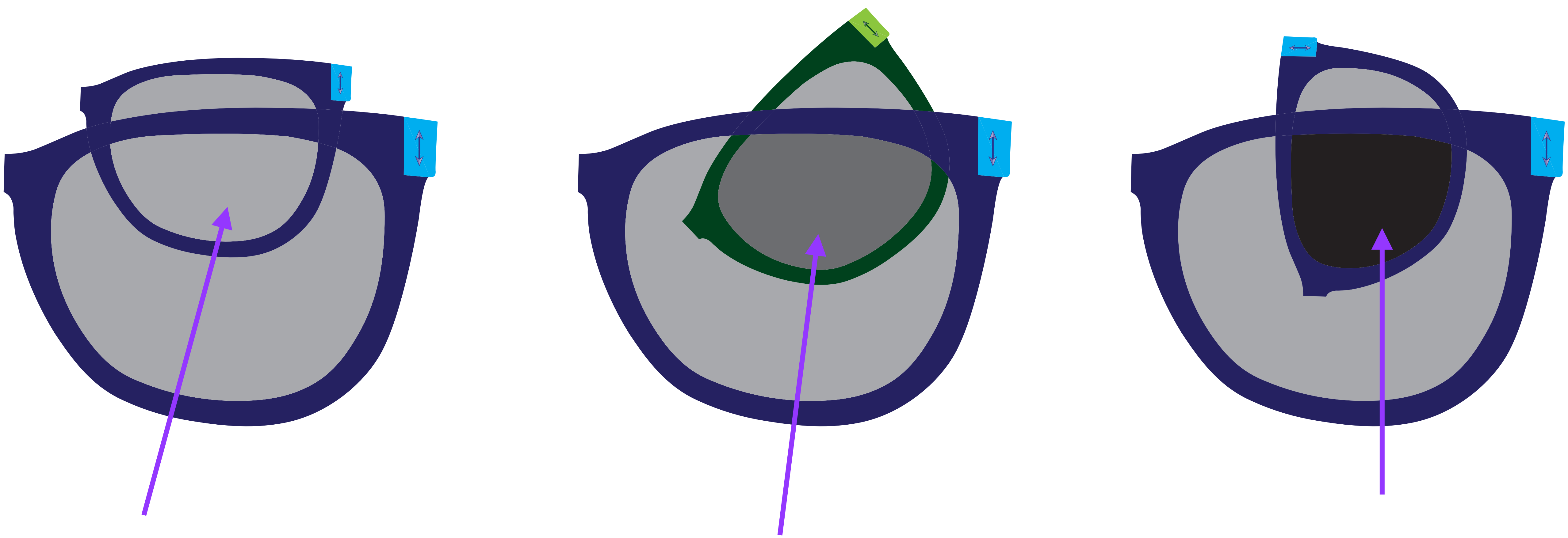
- Half of the unpolarized light (background) makes it through the rearmost glasses. Only horizontally polarized light makes it through.
- Since forward glasses only let vertical polarization through, all the light that got through the first pair is blocked by the second pair.



# Only relative orientation matters



# Mixing sets



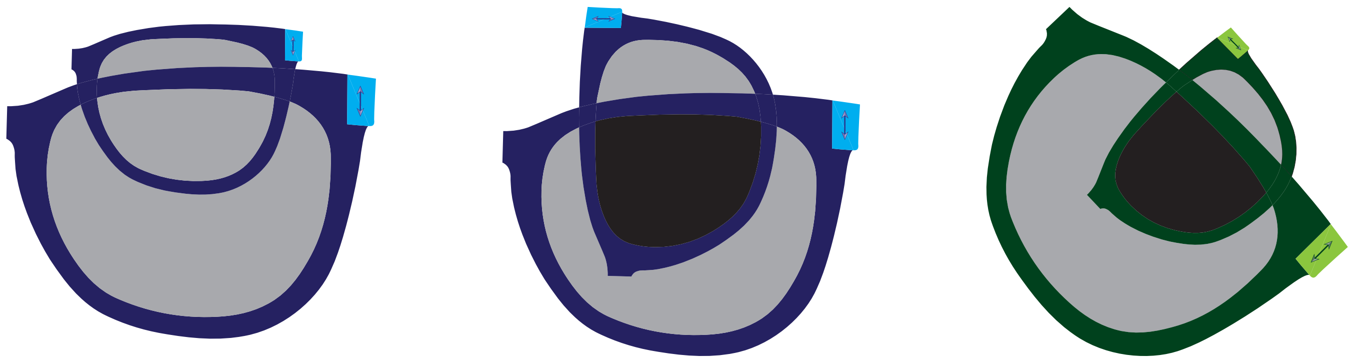
1/2 * all = 1/2

1/2 * 1/2 = 1/4

1/2 * none = 0

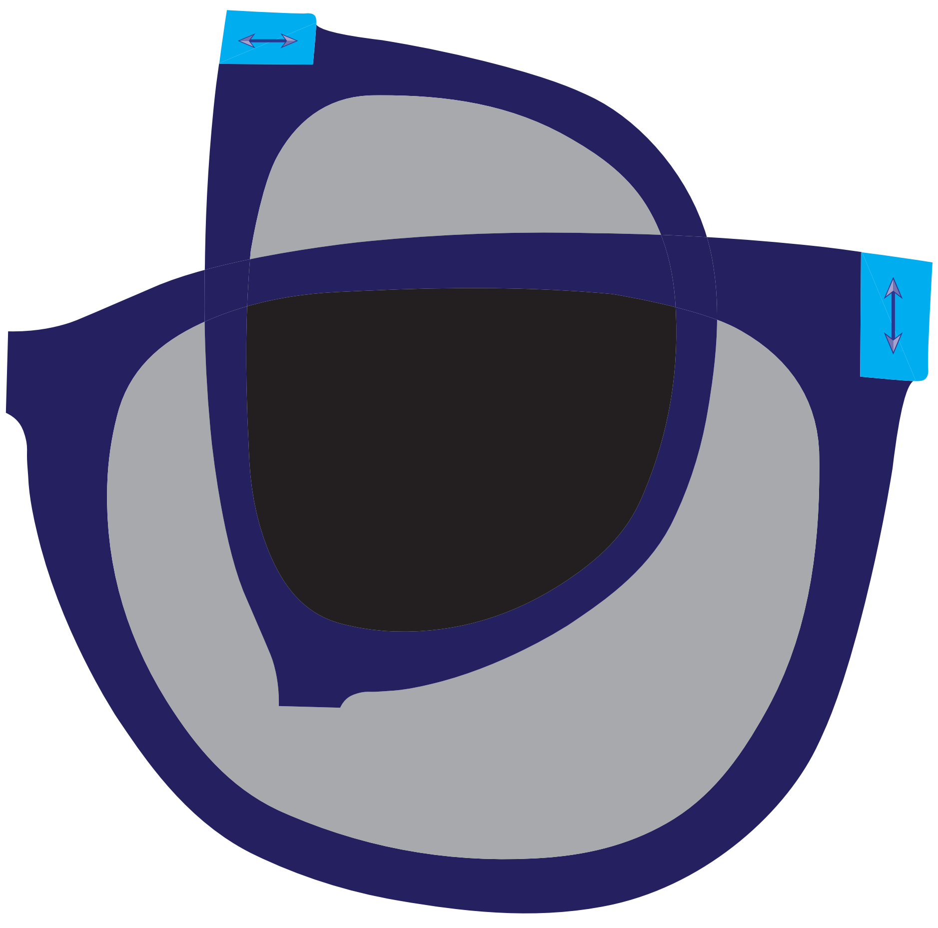
# Mixing sets

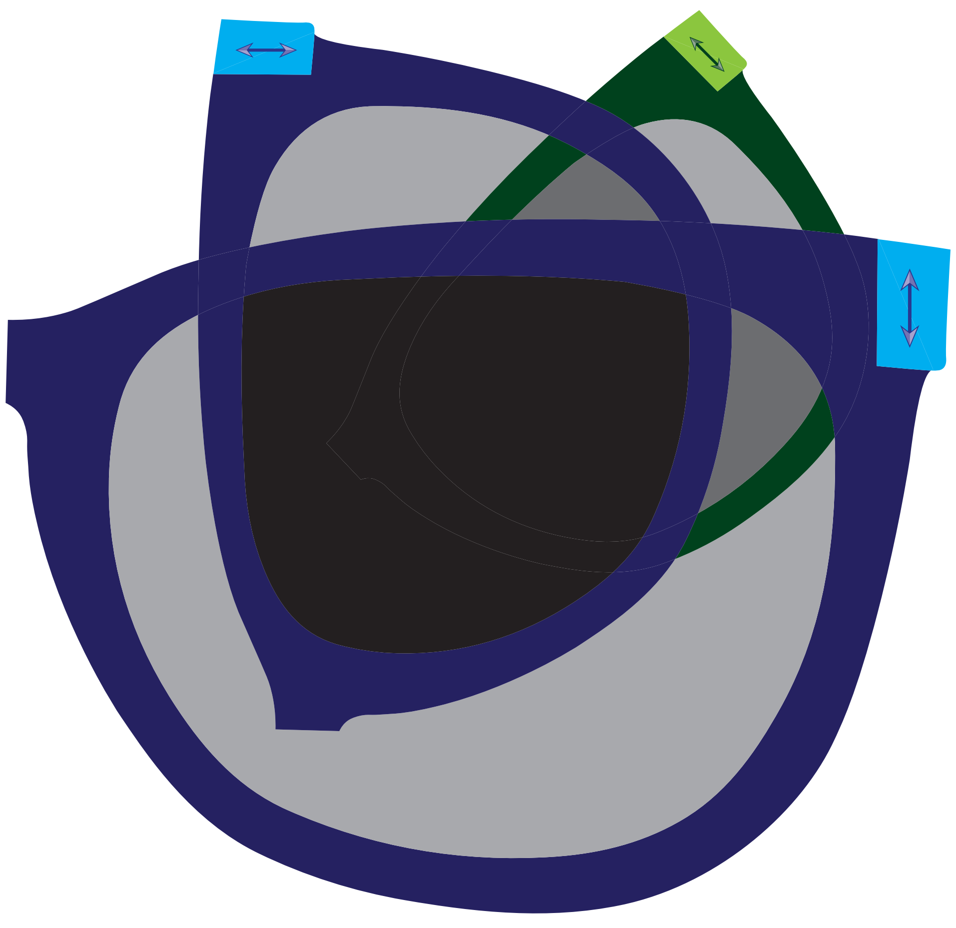
- Two glasses of the same ‘set’ (frame color) gives either all of light through the first or none.



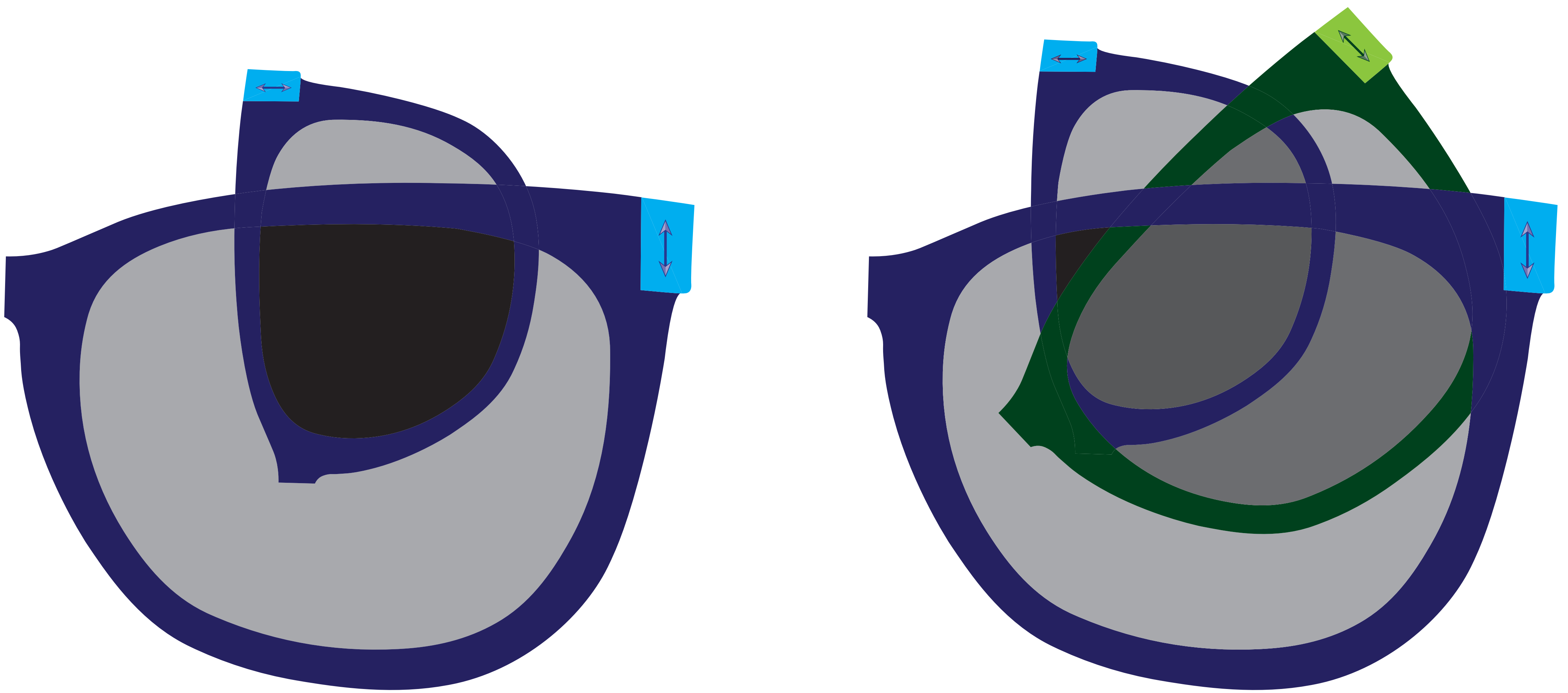
- Two glasses from different sets always gives 1/2 of light through the first pair.

# Adding a third pair of glasses

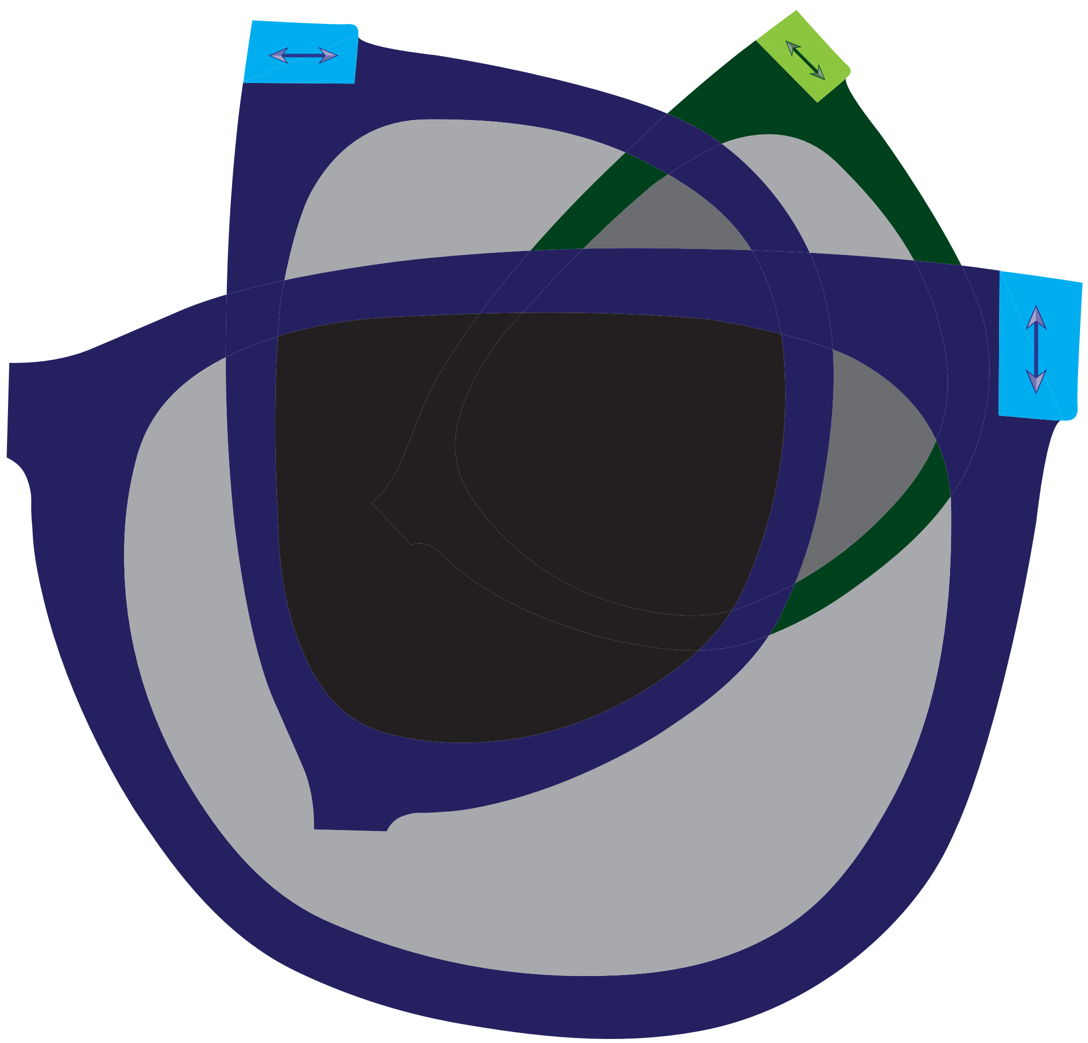


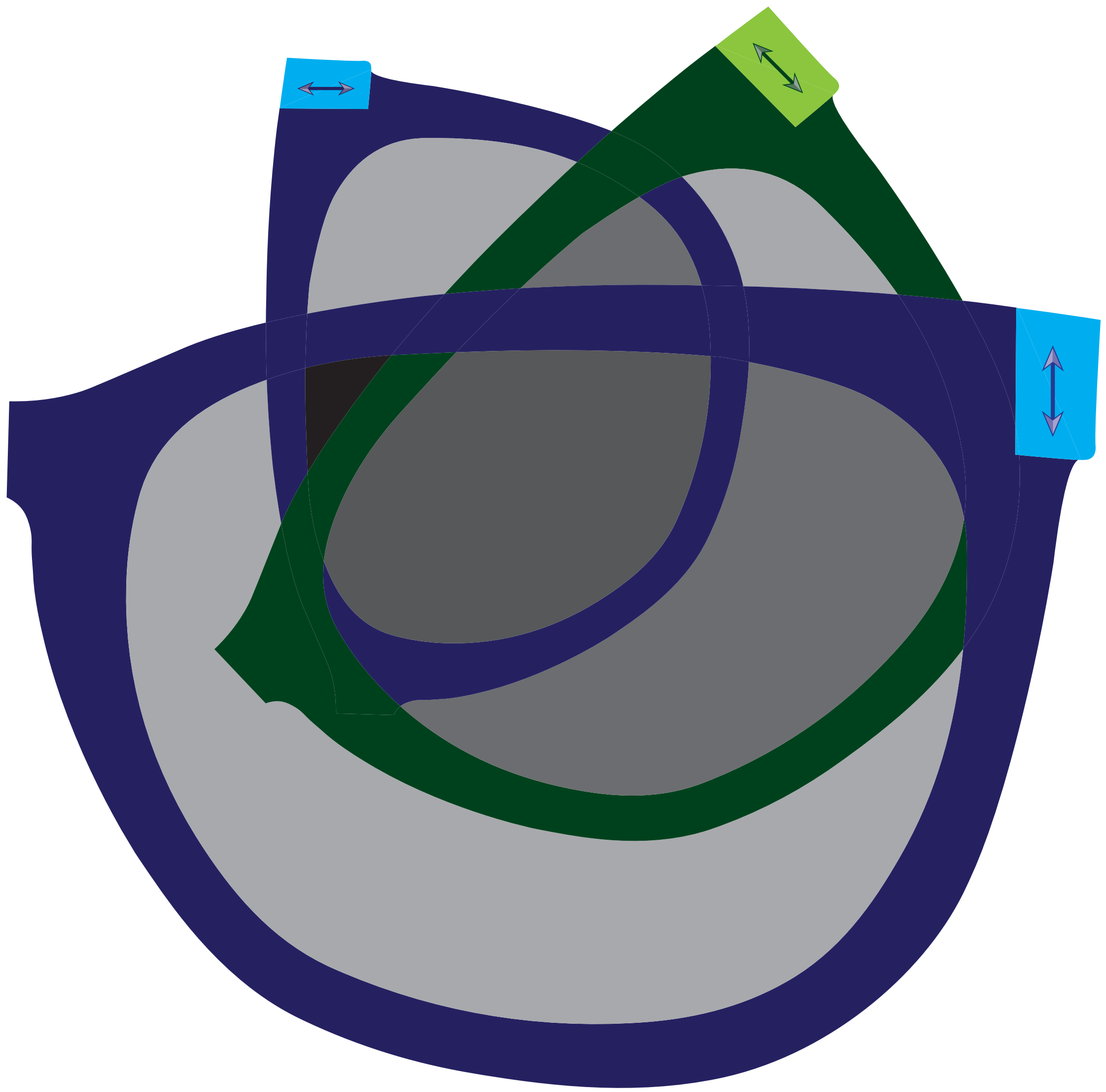


# Adding a third pair of glasses



# Order matters!

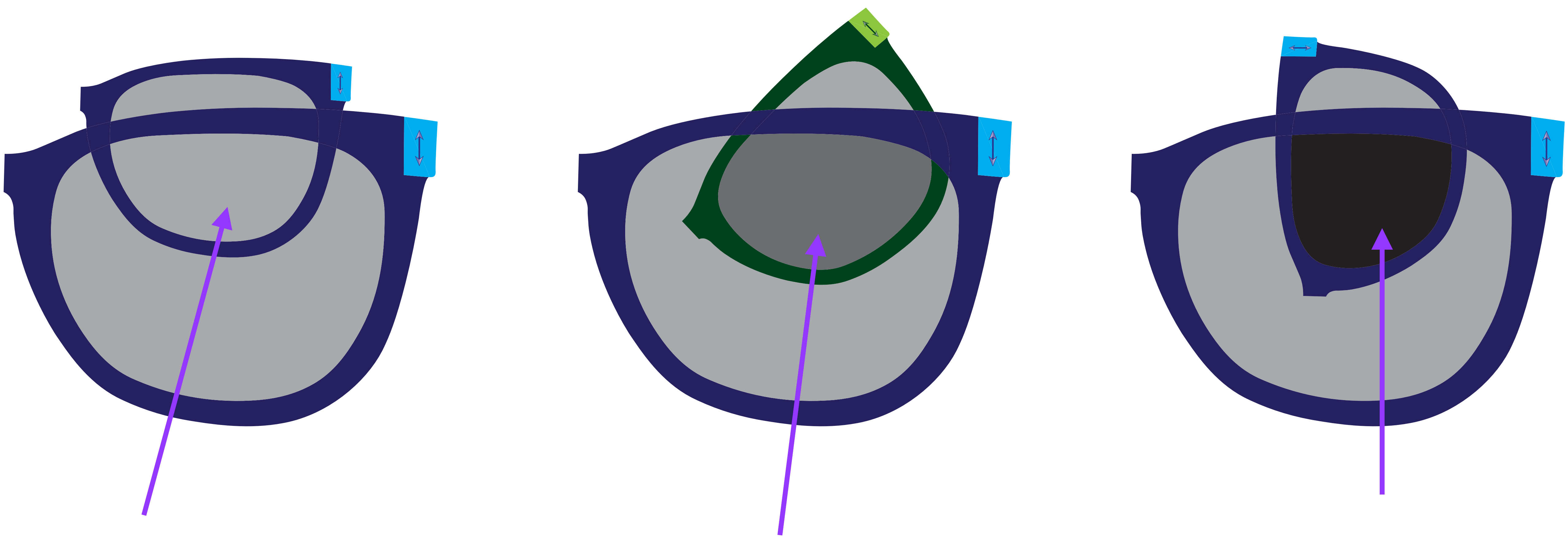




# Wearing sunglasses at night

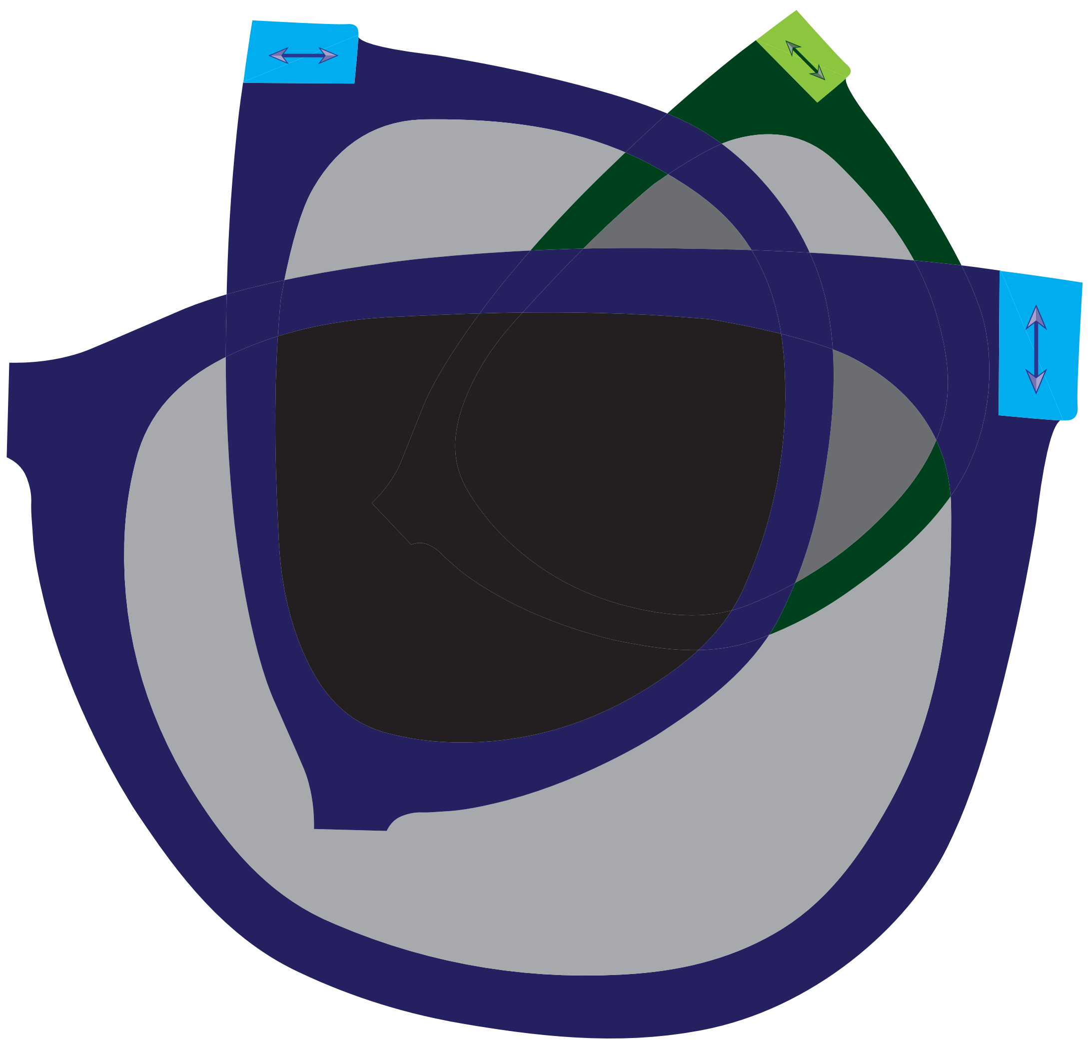
Diane Knutson,
International Dark-Sky
Association

# Fraction of photons making it through

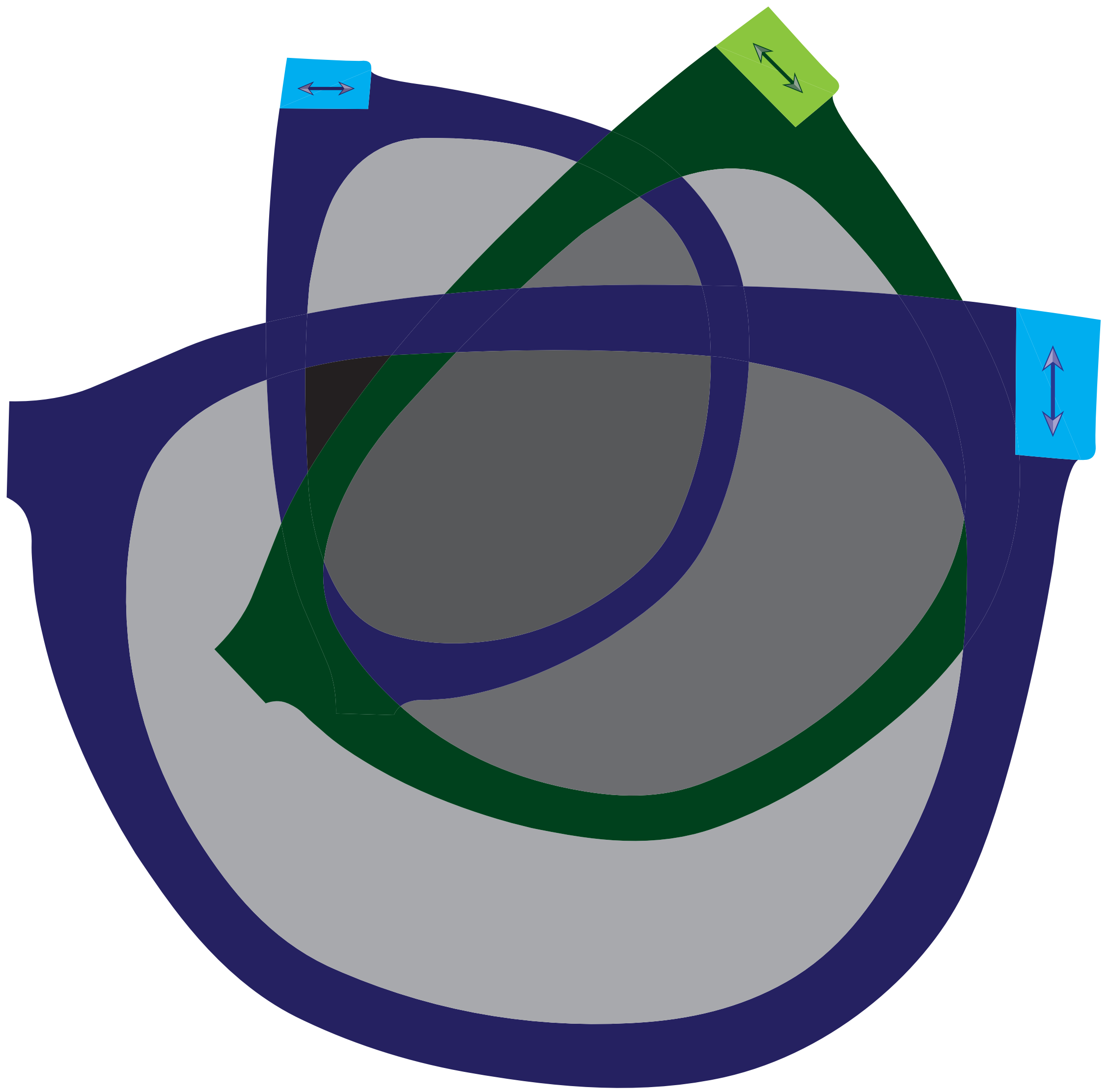


1/2 * all = 1/2          1/2 * 1/2 = 1/4          1/2 * none = 0

# Fraction of photons making it through



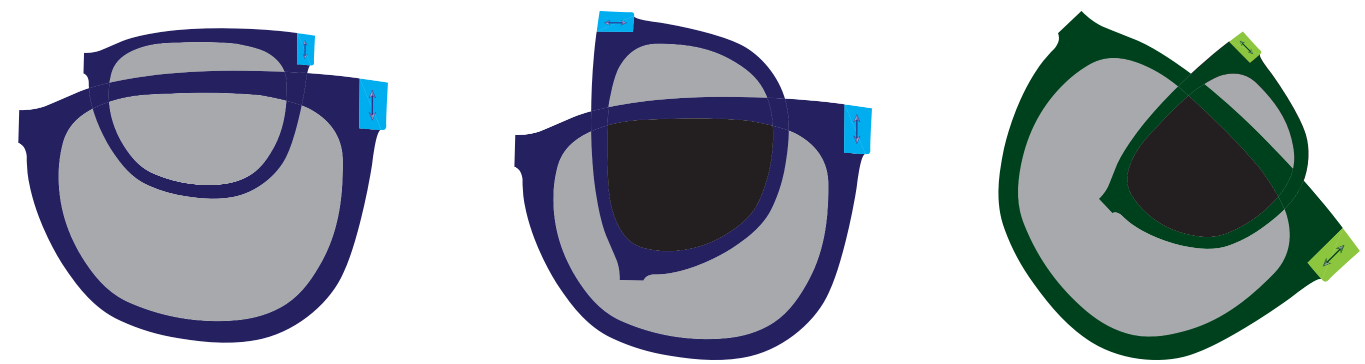
1/2 * 1/2 * none = 0



1/2 * 1/2 * 1/2 = 1/8

# Deterministic or Random

- If two glasses from the same set (frame color), whether a photon makes it through the next pair is deterministic (all or none)



- If two glasses from different sets, probability of photon making it through the second pair is *random* (always 50-50)

# Deterministic and random

- We've made two sets of glasses (green or blue frame color) that are internally deterministic but mutually random.

- A ***deep*** feature of quantum mechanics