HELMHOLTZ

ROCK-IT

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Controls and Acquisition GUI Strategies Satellite Workshop
NOBUGS | 23 September 2024

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Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Introduction

- Beamline operation: working during a wide range of hours demanding extreme on-screen focus.

- Physical fatigue, mental exhaustion, ocular health issues – eye strain, eye dryness, discomfort due to screen exposure.

- Creating a user-centered GUI design: enhance usability, increase efficiency, improve user satisfaction, attract more industrial users, address inclusivity, help to reduce screen-related ocular problems and stress. Adaptability to various working environments is a plus.

Photo credit: DESY

Fundamentals of Screen Design:
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Introduction

- Incorporating basic screen design principles, addressing UI/UX design needs, following the **Web Content Accessibility Guidelines 2.2 (WCAG 2.2) (**https://www.w3.org/TR/WCAG22/**)** (latest version as of Sept 15, 2024. WCAG 3 on the way) by the **World Wide Web Consortium (W3C) (w3c.org)**.

- "Web Content Accessibility Guidelines (WCAG) 2.0 covers a wide range of recommendations for making Web content more accessible."

- Making content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these.

- This presentation will focus on beamline GUIs' accessibility for users with color vision deficiency, as well as how to reduce ocular stress and help to reduce screen-related ocular health problems.

Photo credit: DESY

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Is Your Color Scheme Accessible?

- **Color accessibility:** Choosing the correct hues, saturation, and tint for ideal contrast increases **inclusivity** towards users with **color vision deficiency**.

Image by Sketchepedia on Freepik
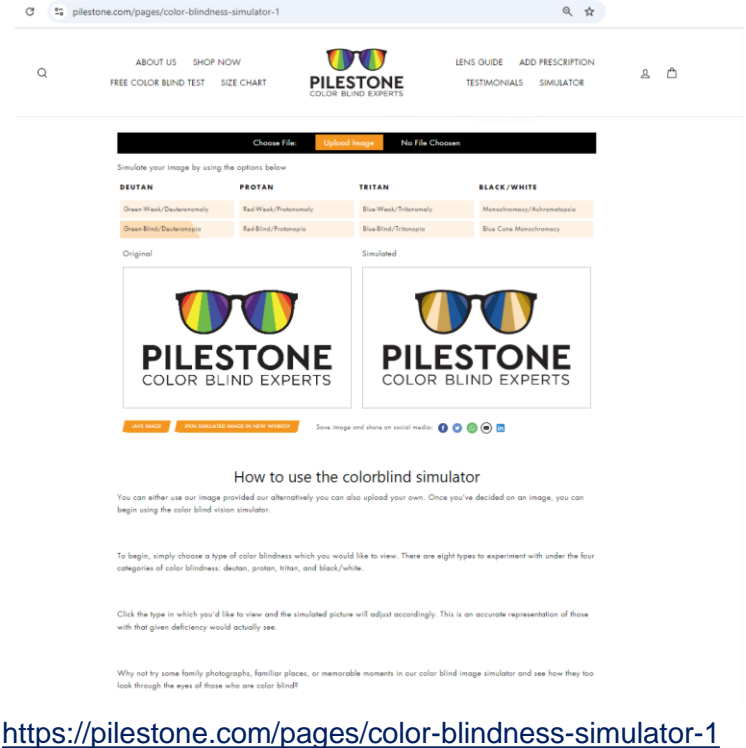
Fundamentals of Screen Design:
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Is Your Color Scheme Accessible?

- **Color accessibility:** Choosing the correct hues, saturation, and tint for ideal contrast increases **inclusivity** towards users with **color vision deficiency**.

- **Most common type** of color vision deficiency: telling the difference between **red and green**. Worldwide, **8% of men and 0.5% of women** have a red/green type of **color vision deficiency**.

- These figures rise in areas where there is a greater number of Caucasian people per head of population, so in **Northern Europe** the figures increase to **~10-11% of men**.

- Other types of color vision deficiencies: blue-yellow color vision deficiency (~1/10.000), complete color vision deficiency (monochromacy, ~1/33.000).

Sources: National Eye Institute (nei.nih.gov), colourblindawareness.org.

Original   Green blind / Deuteranopia

Red blind / Protanopia   Blue blind / Tritanopia

Image by Sketchepedia on Freepik
Color vision simulator: https://pilestone.com/pages/color-blindness-simulator-1
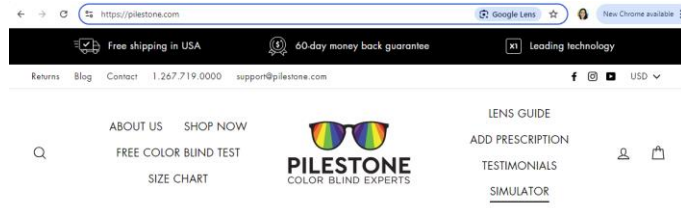
Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Is Your Color Scheme Accessible?

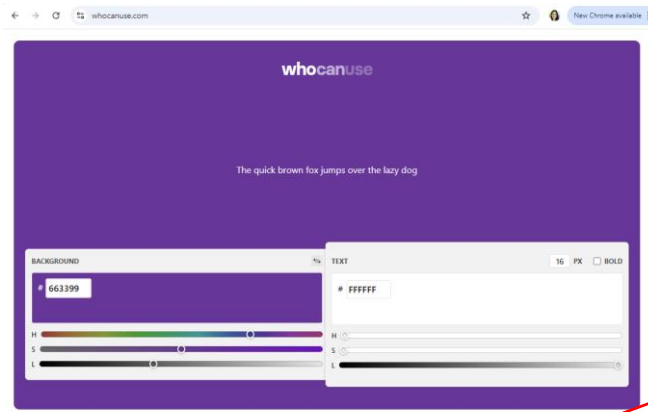- **"1.4.1 Use of Color:** Color […] (**should not** be) used as the **only visual means** of conveying information, indicating an action, prompting a response, or distinguishing a visual element.**" Web Content Accessibility Guidelines 2.2 (WCAG 2.2).**

- **Besides color vision deficiency;**
  - Users with partial sight often experience limited color vision.
  - Some older users may not be able to see color well.
  - Users who have color-blindness benefit when information conveyed by color is available in other visual ways.
  - People using limited color or monochrome displays may be unable to access color-dependent information.

Original

Green blind / Deuteranopia

Red blind / Protanopia

Blue blind / Tritanopia

Image by Sketchepedia on Freepik
Color vision simulator: https://pilestone.com/pages/color-blindness-simulator-1

Fundamentals of Screen Design:
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Is Your Color Scheme Accessible?

Online color blind vision simulator: https://pilestone.com/ → SIMULATOR

https://pilestone.com/pages/color-blindness-simulator-1

Fundamentals of Screen Design:
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Is Your Color Scheme Accessible?

Creating a color scheme:

https://color.adobe.com/create/color-accessibility

Red and green can work together as separate indicators with the right contrast ratio.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Is Your Color Scheme Accessible?
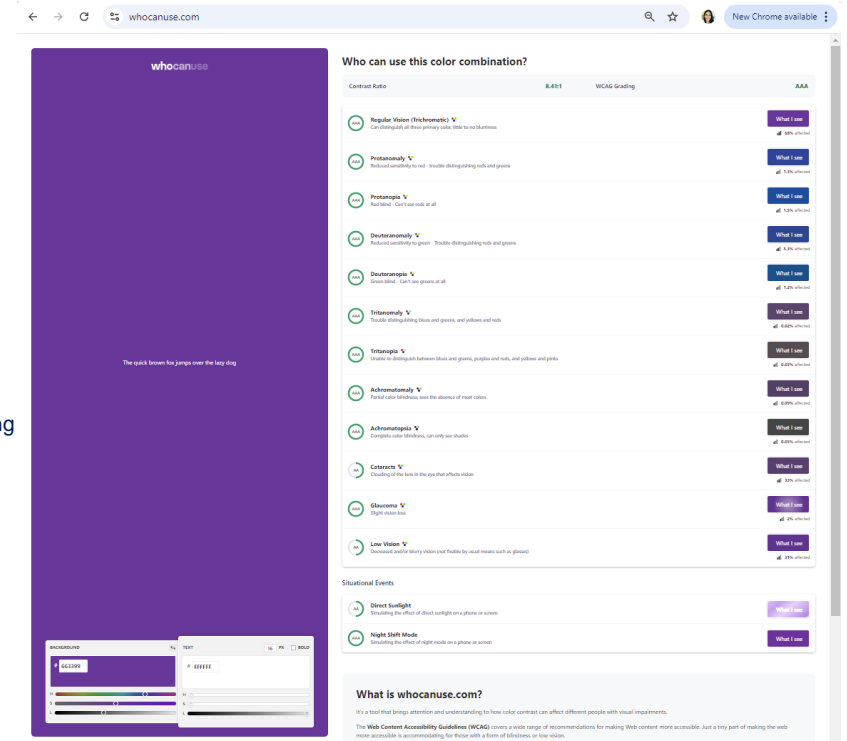

Large texts: Contrast Ratio > 3:1

Regular texts:
Contrast Ratio > 4,5:1
(unless inactive components)
(WCAG 2.2 – 1.4.3)

Contrast Ratio > 4,5:1

WCAG Grading
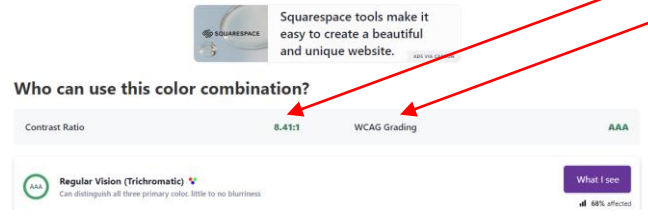
https://www.whocanuse.com/

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes

- Avoid using pure white (#FFFFFF) and pure black (#000000) on screen (both as background colors and text colors).

- Using softer colors, creating good contrast (meeting the 1:4,5 WCAG standard), and light & dark mode options will help reduce eye strain due to long screen exposures.

- Search "shades of white", "shades of black" for inspiration.

WHITE #FFFFFF	IVORY #FFFFF0	BEIGE #F5F5DC	CREAM #FFFDD0
EGGSHELL #F0EAD6	SEASHELL #FFF5EE	GHOST WHITE #F8F8FF	VANILLA #F3E5AB
LINEN #FAF0E6	OFF WHITE #FAF9F6	PEARL WHITE #F8F6F0	WHITE DOVE #F0EFE7
ANTIQUE WHITE #FAEBD7	BABY POWDER #FEFEFA	BONE #E3DAC9	CORNSILK #FFF8DC

Image source: https://creativebooster.net/blogs/colors/shades-of-white-color
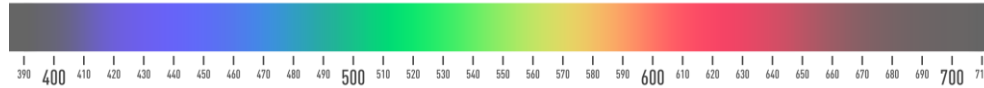

Nature Black #111810	Winter Black #20211A	Bitter Black #1D1615	Galaxy Black #2A292B
Black Mist #484547	Black Bronze #1F1D1B	Blackened Pearl #4E4B51	Old Black #292827
Cold Black #121214	Arctic Black #2E3135	Intense Black #1A1819	Aurora Black #202020
Blackboard #1C1C1C	Black Purple #0F0616	Anthracite Black #252729	Ash Black #383B39

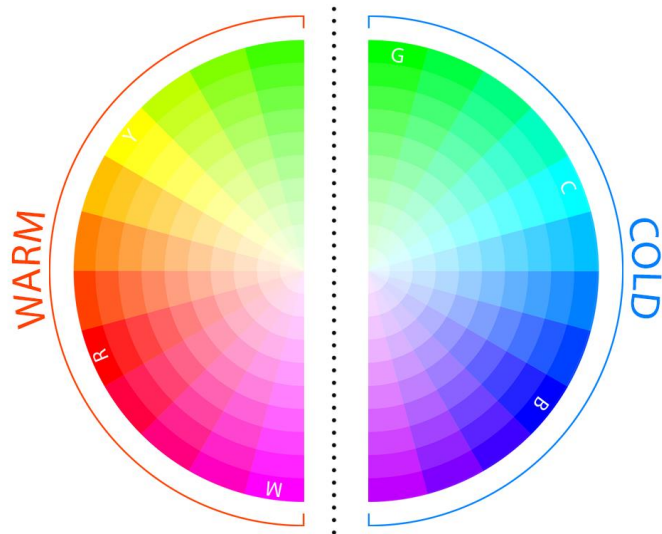**Image source:** https://kbmd3signs.com/what-is-color-theory/what-is-the-color-black/

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes

The human-visible spectrum perceived from 390 to 710 nm wavelength.

Visual by Bhutajata - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=59589865

Image source: https://www.serenaarchetti.com/blog/how-to-effectively-use-warm-and-cool-colors-in-art

"Warm" gray   "Cool" gray

Mixed with 6% yellow Mixed with 6% blue

Image source: https://en.wikipedia.org/wiki/Color_temperature

The terms 'warm' and 'cool' colors in this presentation do not refer to the color temperature of the electromagnetic radiation emitted by an ideal black body.

Color temperatures and example sources	
Temperature	Source
1700 K	Match flame, low pressure sodium lamps (LPS/SOX)
1850 K	Candle flame, sunset/sunrise
2400 K	Standard incandescent lamps
2550 K	Soft white incandescent lamps
2700 K	"Soft white" compact fluorescent and LED lamps
3000 K	Warm white compact fluorescent and LED lamps
3200 K	Studio lamps, photofloods, etc.
3350 K	Studio "CP" light
5000 K	Horizon daylight, Tubular fluorescent lamps or cool white/daylight compact fluorescent lamps (CFL)
5500–6000 K	Vertical daylight, electronic flash
6200 K	Xenon short-arc lamp[10]
6500 K	Daylight, overcast
6500–9500 K	LCD or CRT screen
15,000–27,000 K	Clear blue poleward sky

Image source: https://en.wikipedia.org/wiki/Color_temperature

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

This text is written on pure black background (#000000) in pure white (#FFFFFF) with the Arial typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

Ullaccu Iparitatur a nis mo con conem quunt, as eatur? Xeriore hendes se num que num quosam-usam illaccu llacepe ipsape conecta que omnim

This text is written on a softer black background (#1F1E1C) in a warm white tone (#FAF9F6) with the Arial typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

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Fundamentals of Screen Design:
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Fundamentals of Screen Design:
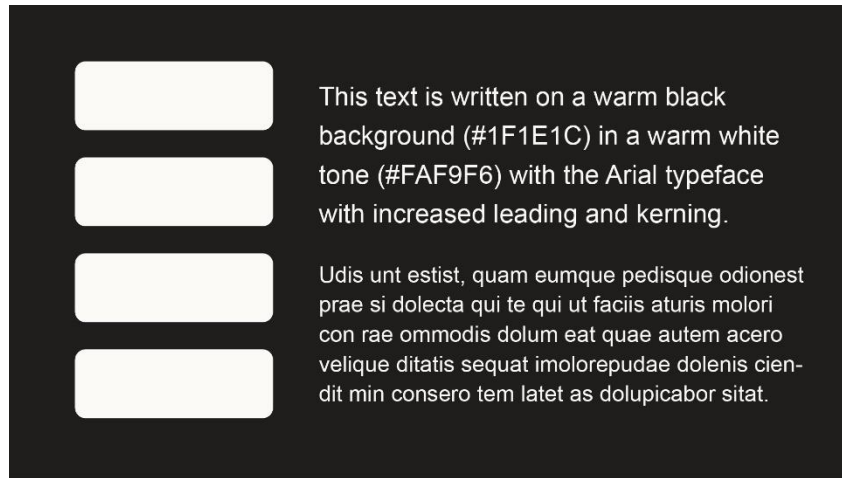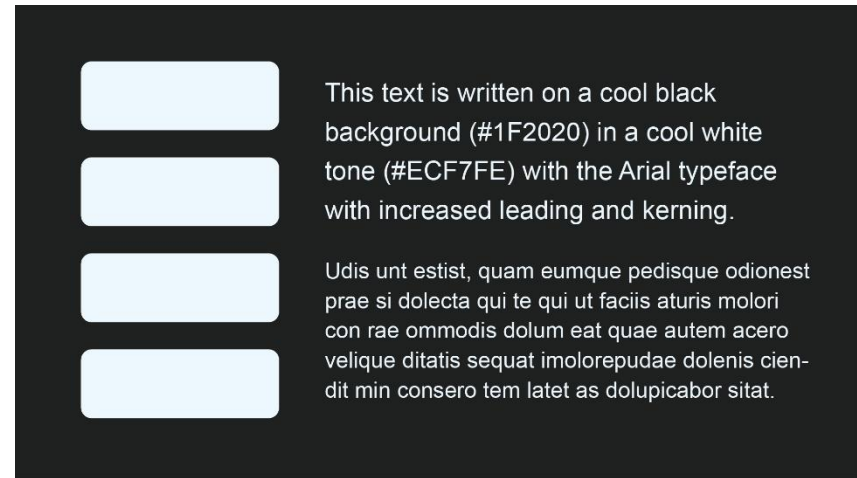# Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

This text is written on a softer black background (#1F1E1C) in a warm white tone (#FAF9F6) with the Arial typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

Ullaccu Iparitatur a nis mo con conem quunt, as eatur? Xeriore hendes se num que num quosam-usam illaccu Ilacepe ipsape conecta que omnim

This text is written on a warm black background (#1F1E1C) in a warm white tone (#FAF9F6) with the Arial typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

This text is written on a warm black background (#1F1E1C) in a warm white tone (#FAF9F6) with the Arial typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

This text is written on a cool black background (#1F2020) in a cool white tone (#ECF7FE) with the Arial typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

Warm tones are ideal for reducing eye stress.
Reducing the amount of blue light is better for the eyes.

Ideal for environments with bright light.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

This text is written on pure white background (#FFFFFF) in pure black (#000000) using the Verdana typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as dolupicabor sitat.

Ullaccu Iparitatur a nis mo con conem quunt, as eatur? Xeriore hendes se num

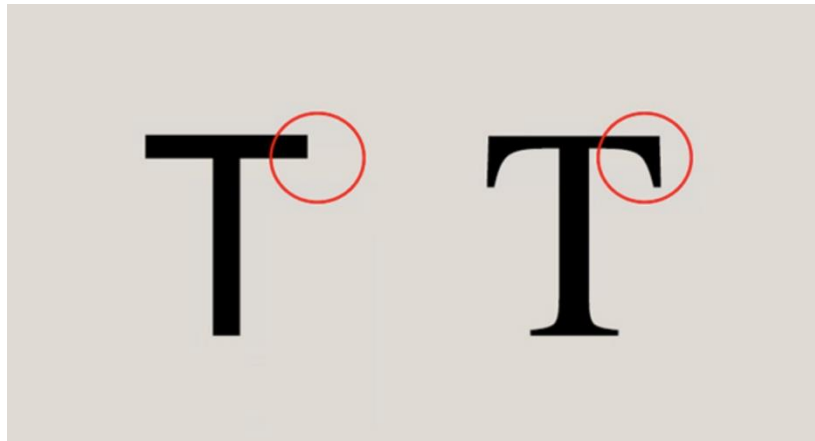This text is written on a warm white background (#FAF9F6) in a softer black tone (# 1F1E1C) using the Verdana typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as dolupicabor sitat.

Ullaccu Iparitatur a nis mo con conem

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

This text is written on a warm white background (#FAF9F6) in a softer black tone (# 1F1E1C) using the Verdana typeface.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as dolupicabor sitat.

Ullaccu lparitatur a nis mo con conem

% 40
% 60
% 80
% 100

This text is written on a warm white background (#F5F5F5) in a warm black tone (#413839) using the Verdana typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Selecting Eye-Friendly Color Schemes – Screen Typography

% 40

% 60

% 80

% 100

This text is written on a warm white background (#F5F5F5) in a warm black tone (#413839) using the Verdana typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as

% 40

% 60

% 80

% 100

This text is written on a cool white background (#F8F8FF) in a cool charcoal tone (#36454F) using the Arial typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis ciendit min consero tem latet as dolupicabor sitat.

Ideal especially environments that are not too bright.
Reducing the amount of blue light reduces eye stress.

Works better in brightly lit environments.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Screen Typography

Setting aside the exceptions and focusing on basic rules;

- **Serif typeface** – classical, ideal for long texts, books; enables a continuous horizontal movement of the eye.

- **Sans serif typeface –** modern, clean and simple, no bulk - **ideal for screens**. Needs extra leading for long texts.

Sans serif typeface vs Serif typeface

Image source: https://www.adobe.com/uk/creativecloud/design/discover/serif-vs-sans-serif.html

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Screen Typography

- Using sans-serif, clean typefaces designed for screens increase readability and legibility.
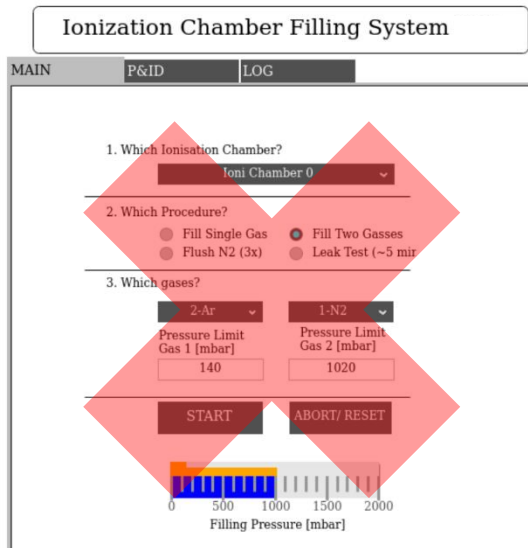
Web safe sans-serif typefaces:
Arial
Verdana
Tahoma
Trebuchet MS

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Screen Typography

WCAG 2.2 – 1.4.8 Visual Presentation
- Width is no more than 80 characters or glyphs (40 if CJK).
- Text is not justified (*i.e.* not aligned to both the left and the right margins).
- Line spacing (leading) is at least space-and-a-half within paragraphs, and paragraph spacing is at least 1.5 times larger than the line spacing.

WCAG 2.2 - 1.4.12 Text Spacing
- Line height (line spacing) to at least 1.5 times the font size;
- Spacing following paragraphs to at least 2 times the font size;
- Letter spacing (kerning) to at least 0.12 times the font size;
- Word spacing to at least 0.16 times the font size.

% 40

% 60

% 80

% 100

This text is written on a warm white background (#F5F5F5) in a warm black tone (#413839) using the Verdana typeface with increased leading and kerning.

Udis unt estist, quam eumque pedisque odi-onest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepu-dae dolenis ciendit min consero tem latet as

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Creating a Color Scheme

WCAG 2.2 1.4.11, Non-text Contrast

The visual presentation of the following have a contrast ratio of at least 3:1 against adjacent color(s):

•**User Interface Components:** Visual information required to identify user interface components and states, except for inactive components or where the appearance of the component is determined by the user agent and not modified by the author;

•**Graphical Objects:** Parts of graphics required to understand the content, except when a particular presentation of graphics is essential to the information being conveyed.

Source: www.color.adobe.com

Fundamentals of Screen Design: Creating a User-Centered GUI Design for Beamlines
Creating a Color Scheme

#8cb5d0

#fde24f

#3d64ff

#d04b3c

This text is written on a dark blue background (#000747) in a cool white tone (#ECF7FE) with the Arial typeface with ideal leading and kerning.

Udis unt estist, quam eumque pedisque odionest prae si dolecta qui te qui ut faciis aturis molori con rae ommodis dolum eat quae autem acero velique ditatis sequat imolorepudae dolenis cien-dit min consero tem latet as dolupicabor sitat.

Green blind/Deuteranopia

Red blind/Protanopia

Blue blind/Tritanopia

Monochromacy/Achromatopsia

Color vision deficiency simulations: https://pilestone.com/pages/color-blindness-simulator-1

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Distinguishing Colors: Patterns
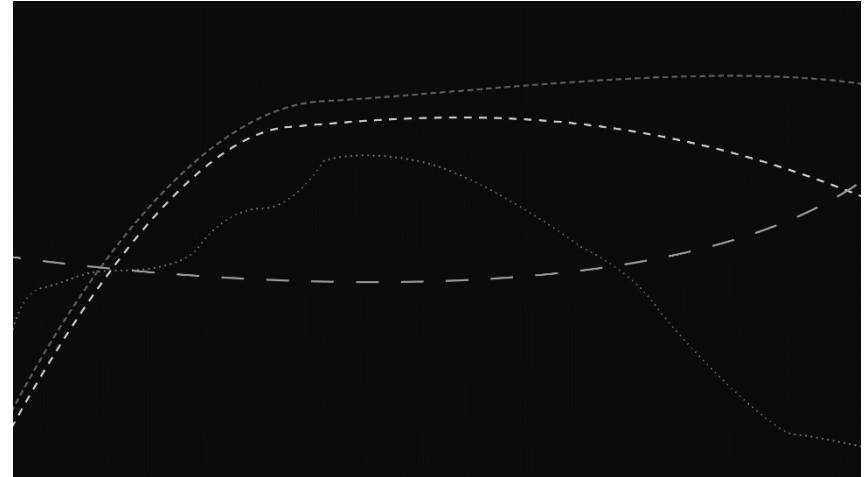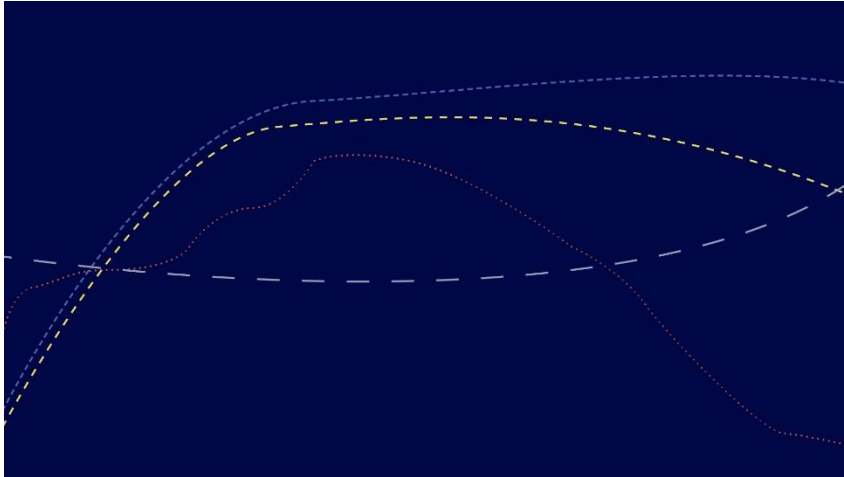
Monochromacy/Achromatopsia

Color vision deficiency simulation: https://pilestone.com/pages/color-blindness-simulator-1

Fundamentals of Screen Design:
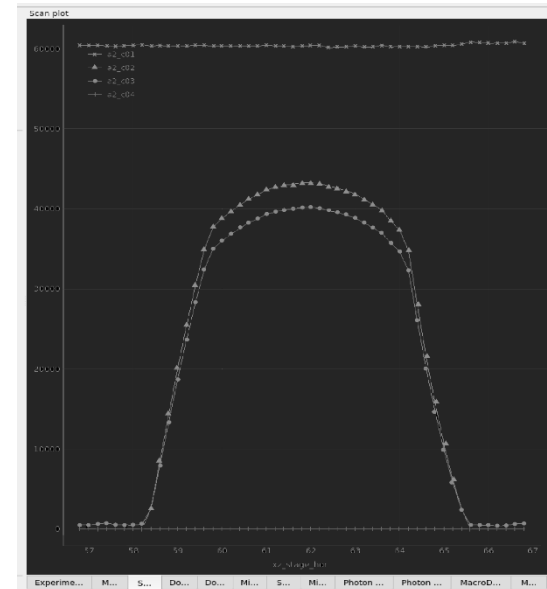# Creating a User-Centered GUI Design for Beamlines
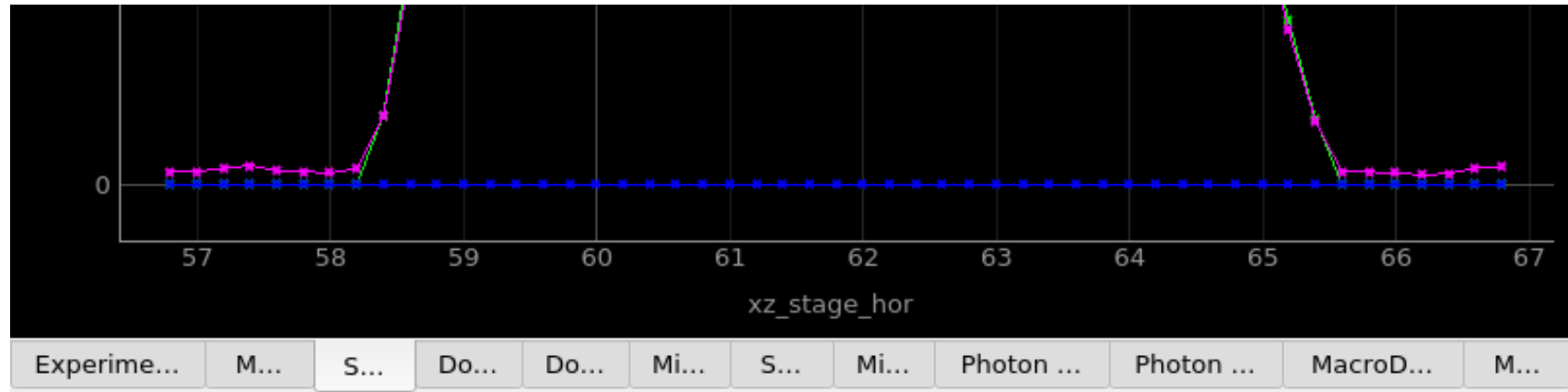## Distinguishing Colors: Shapes and Icons
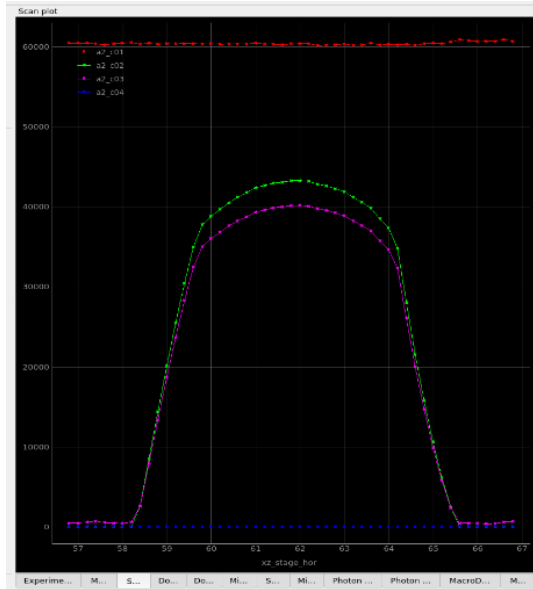
Current state.
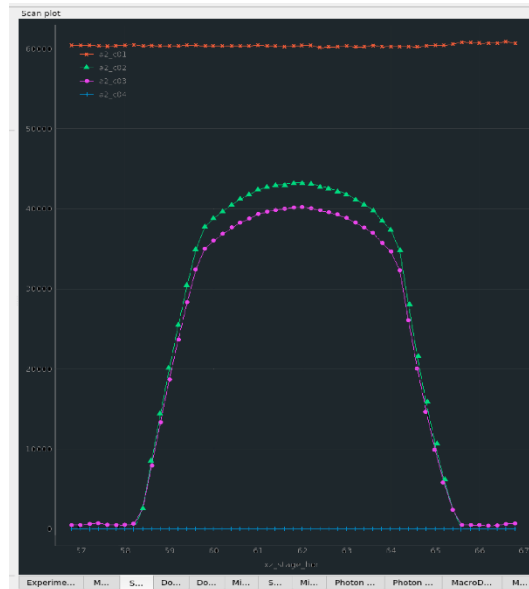
#000000 background changed with #1E272C. Softer and lighter tones are used for better contrast and to reduce eye strain.

Specialized icons make it easier to distinguish lines regarding color vision deficiency.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Iconography

Tabs not readable and create confusion:
this can be solved by basic iconography.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Readability and Legibility + Distinguishing with Iconography

"1.4.1 Use of Color: Color […] (**should not** be) used as the **only visual means** of conveying information, indicating an action, prompting a response, or distinguishing a visual element.**"** **Web Content Accessibility Guidelines 2.2 (WCAG 2.2)**
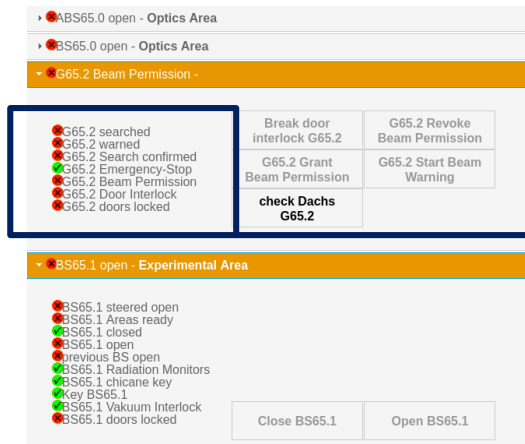
Key elements of a user-friendly screen design include

- choosing a readable font at an appropriate size,
- ensuring sufficient contrast between text and background meeting the **minimum 4,5:1** (WCAG 2.2 - 1.4.3), **enhanced: 7:1** (WCAG 2.2 1.4.6) standard,
- adjusting kerning and leading for optimal spacing,
- using clear iconography when necessary.

A particular presentation of text is essential to the information being conveyed (1.4.5 WCAG 2.2).

⊗	G65.2	Searched
⊗	G65.2	Warned
⊗	G65.2	Search confirmed
⊕	G65.2	Emergency stop
⊗	G65.2	Beam permission
⊗	G65.2	Door interlock
⊗	G65.2	Doors locked

Improved legibility through kerning, leading, and distinguished background color. More legible icons added for different types of color perceptions.

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines

Iconography
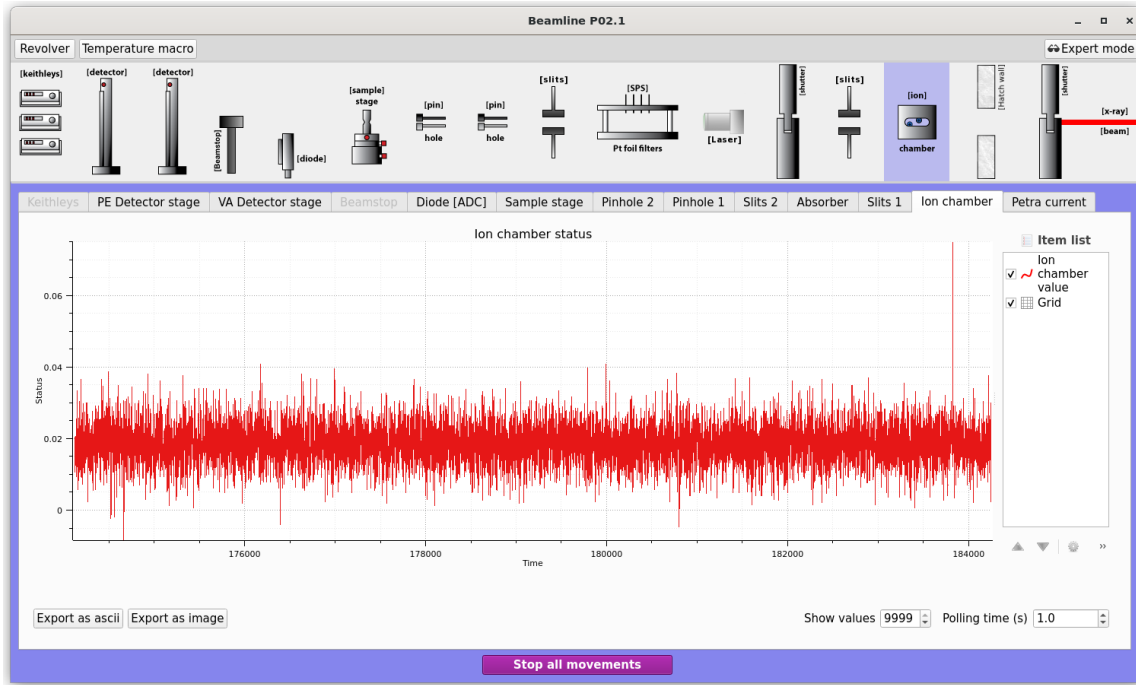
Enhanced user experience by the visualization of beamline components.

Thank you for your attention!

Zeynep Isil ISIK DURSUN | DESY
zeynep.isik.dursun@desy.de

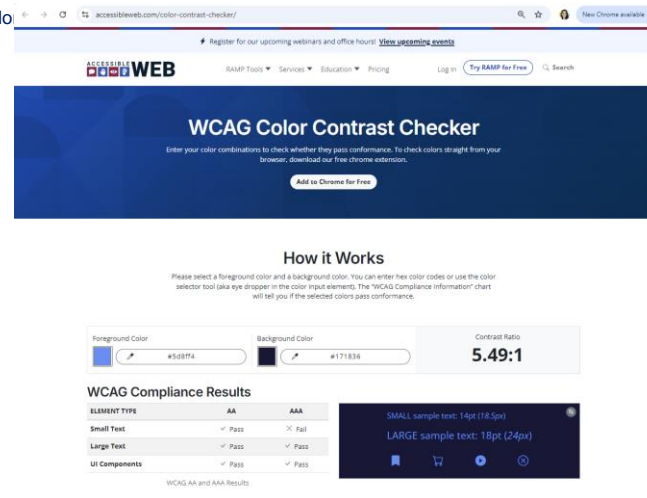**More information on ROCK-IT:**
www.rock-it-project.de

Thank you for your attention!

Zeynep Isil ISIK DURSUN | DESY
zeynep.isik.dursun@desy.de

Fundamentals of Screen Design:
Creating a User-Centered GUI Design for Beamlines
Working Environment: Dark hub or office with sunlight?

- Dark and light modes.

- Light mode – more color options. Watch out for background color – no pure white; #ffffff , to reduce eye strain.

- Dark mode – can get tricky. No pure black #000000, but shades of black, depending on your color scheme. Dark mode uses less energy on screens.

  - Blue – reduces tension, green gives positive messages – suggested to include in the color scheme (blue color
  - Make sure to have enough contrast between the colors (örnekle).
  - How to measure contrast: "color contrast checker" https://accessibleweb.com/color-contrast-checker/

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Is Your Color Scheme Accessible?

https://www.whocanuse.com/

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Screenshot: https://x.com/martinleblanc/status/466638260195041280