ET Optical Layouts:
Flexibilities update April '25

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with inputs from numerous ISB WPs & individuals

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TELESCOPE

Reminder: *Envelope* and *Demands*

Envelope:

Flexibilities given to the engineers to optimize the design that is constructed

Demands:

Flexibilities we want to keep within the final facility, for adjusting and/or upgrading the design over the facility lifetime

Note: We take a strictly **optical** perspective.
This work is another input for detector layout and beyond, for further development into the overall facility design.

Envelope

Implemented more-or-less as in 2024:

- Included in [main layout output table (3B)](#)
- Provided for lengths, positions and/or footprints (only?*)
- "Traffic Light" system:

some additional information is available, but in different sets of completeness for different subsystems/categories (e.g. masses). We will focus on the core information above for the taskforce documents.

*Parameter (auto-generated)	e Value	*Unit	Tolerence	Readiness	Flexibility Envelope
ZX1HR position	82	m		analytical or n... ▼	major redesign ▼
ETMXHR position	15000	m		analytical or n... ▼	major redesign ▼
ETMXHR orientation	0	deg		experimental v... ▼	none ▼
IMC2-INJ footprint		sqm		back-of-the-en... ▼	major redesign ▼
IMC2-INJ position	8	m	-2, +42	assumption ▼	minor redesign ▼
IMC2-INJ orientation	(any)	deg	360	assumption ▼	free ▼

EXAMPLES

3.3.1 Flexibility Envelope of the Optical Layout

We broadly define four categories, following a 'traffic light' - style rating:

- **Free** (green): unconstrained.
  A parameter that can be freely chosen to optimize the design for cost, geography, accessibility, and other factors.
  For example: the orientation of the IMCs with respect to the main interferometer.

- **Minor redesign** (yellow): likely possible.
  Changing this parameter will have some moderate impact on the local optical layout with limited impact on the global configuration.
  For example: distance between vessels in the input path from PSL to PRM.

- **Major redesign** (orange): some limited flexibility.
  Changing this parameter is likely to have significant knock-on impacts for the global optical layout that will need careful study, depending on the magnitude of the requested change.
  For example: lengths within the recycling cavities.

- **None** (red): completely constrained.
  A parameter that can *not* be altered by teams other than optical layout. The value of the parameter may be altered as a result of an optical layout redesign, but may not be considered independently.
  For example: angles of ZMs in the recycling cavities.

It is essential that *any* exploitation of the flexibility envelope, including alterations within the tolerance values where stated, is done in consultation with the optical layout team. This is both to ensure that the alteration is compatible with the performance requirements of the optical design, and so that continued studies to evaluate and further complete the optical design (e.g. control scheme design) are based on consistent numbers. The flexibility envelope categorisations are provided as part of [TAB3B].

10

Demands

New, resulting from work presented in previous workshops

- Overleaf with longer description of the thought process will serve as an ancillary document
- 4 categories: Large, Medium, Small, Facility Redesign
  - 'Facility Redesign' is considered beyond the scope of the taskforce
    - Includes more broad-sweeping conceptual changes
    - Also includes important topics to study now, e.g. beamsplitter AoI, that must be resolved *before* a facility is built, as it would not be feasible to build a facility compatible with all of them.
    - Therefore these aren't 'flexibilities' to our baseline, but new designs.
- Currently collected in Table 3D of the output tables →
  - Feedback appreciated!

A taster:

UID	#	Motivation	# in Overleaf	System (HFI/LFI)	Location (eg Xarm)	Optic(s)	Scale	Direction	Likely impact on layout	Comments
	1	recycling telescope beam sh	2.1.1 (2.2.	HFI	RCX	ZX2, ZX1	tens of meters	position alon	Large	
	1		2.1.1 (2.2.	HFI	RCY	ZY2, ZY1	tens of meters	position alon	Large	