BSC CLEAN ROOM PROCEDURES

Riccardo DeSalvo

- These notes are based in part on Input and experience from LMA-Lyon
- The lesson learned are applied to the LIGO BSC chambers that house by far the most sensitive mirrors

Cleaner mirror installation for Ad-LIGO

- The ITM and BS of the 2k have been contaminated, showed anomalous absorption and thermal lensing.

- This contaminant was easy to remove (drag-wipe)

- The contaminant turned out being particles, possibly soot, that entered the BSC during maintenance.

- Ad-LIGO will be >>10 times more sensitive to thermal lensing effects

- Need to establish better defense against contaminants
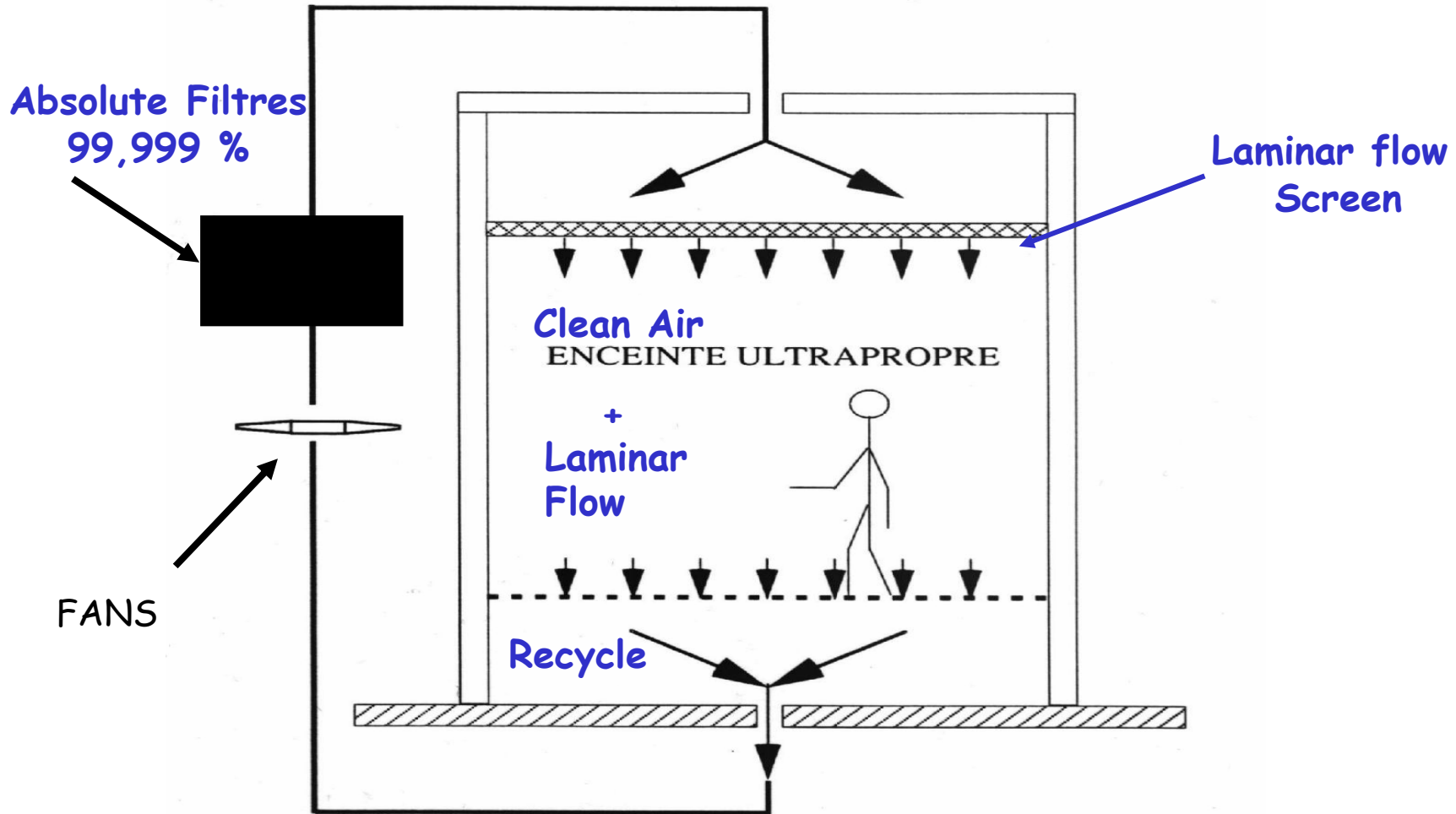
See also T050068-00-R

Cleaner mirror installation for Ad-LIGO

- Strippable paints, suggesting by Helena are a good start
- The main contaminant though, may be the operator that strips the paint and later performs the alignment
- Need an additional defense line
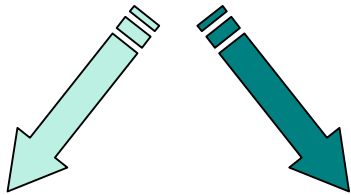- Laminar flow clean chamber is the answer

LIGO

Absolute Filtres
99,999 %

Laminar flow
Screen

Clean Air
ENCEINTE ULTRAPROPRE

+
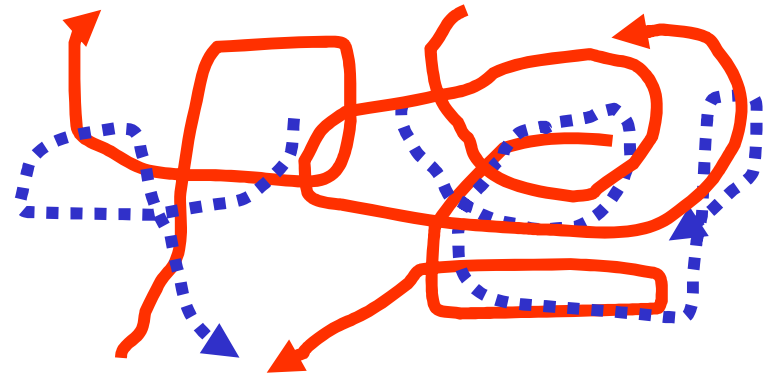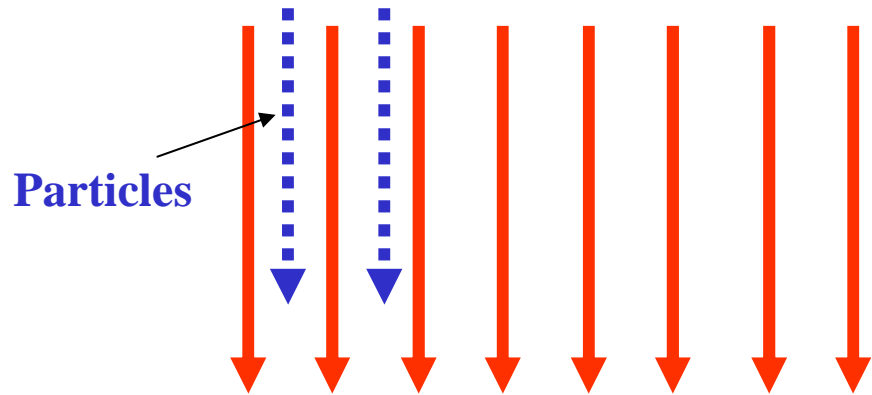Laminar
Flow

FANS

Recycle

Importance of air flow regime

Laminar Flow

Particles

The particles, are dragged away by the flow before they can diffuse on the optics.
Low polluting probability

Turbulent Flow

The turbulent flow actually helps diffusing the particles from the source to the optics
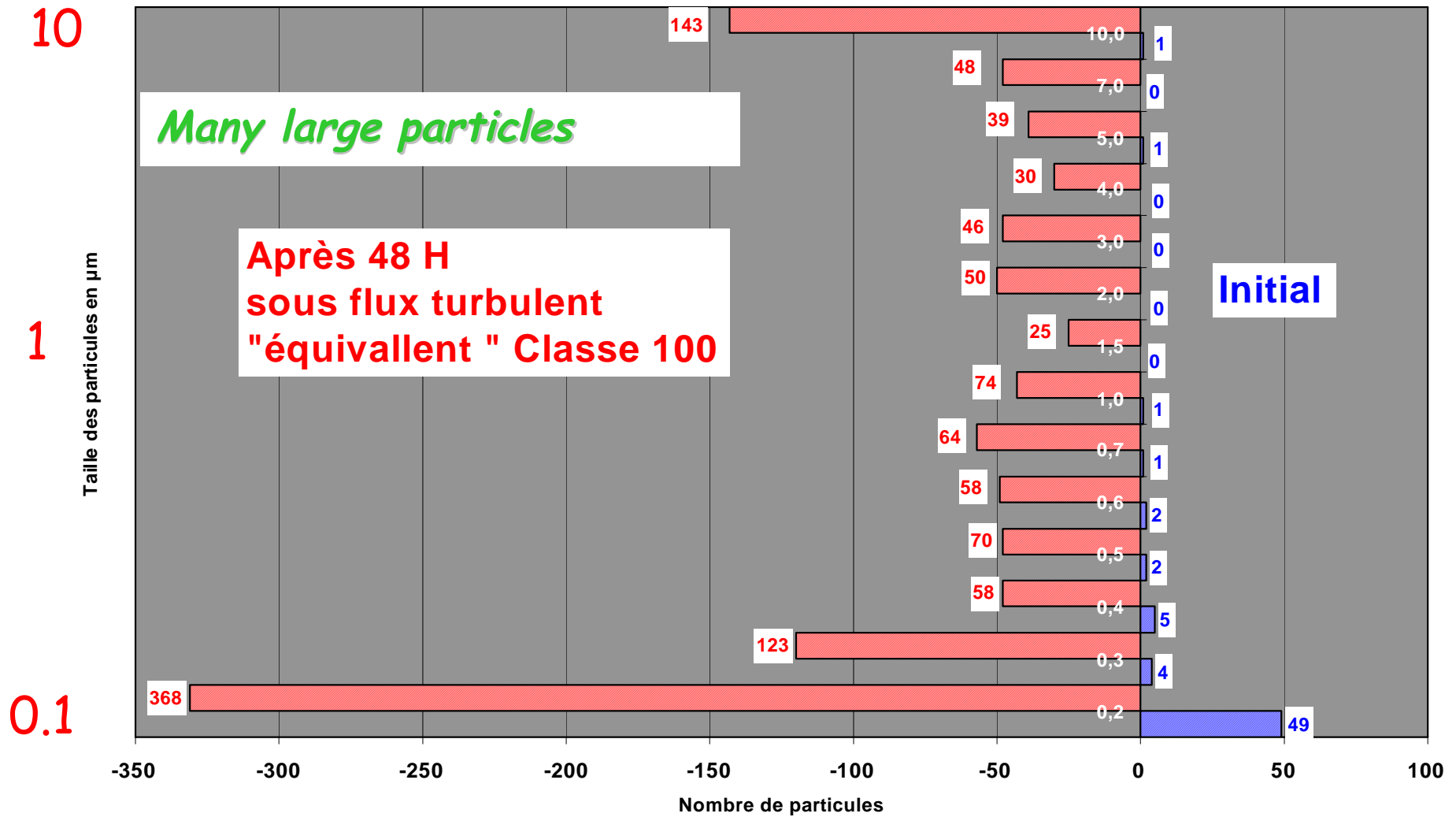High polluting probability.

LIGO-G060130-00-R

LIGO-G060130-00-R

Particle count on silicium wafer

Flux Turbulent « équivalant » Classe 100

Taille des particules en µm

Many large particles

**Après 48 H
sous flux turbulent
"équivallent " Classe 100**

Initial

Nombre de particules

Particle count on silicium wafer

Flux Laminaire Classe 10

small significative change

Après 48 H sous flux laminaire Classe 10

Initial

Taille des particules en µm

Nombre de particules

LIGO

Absolute Filtres
99,999 %

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Laminar
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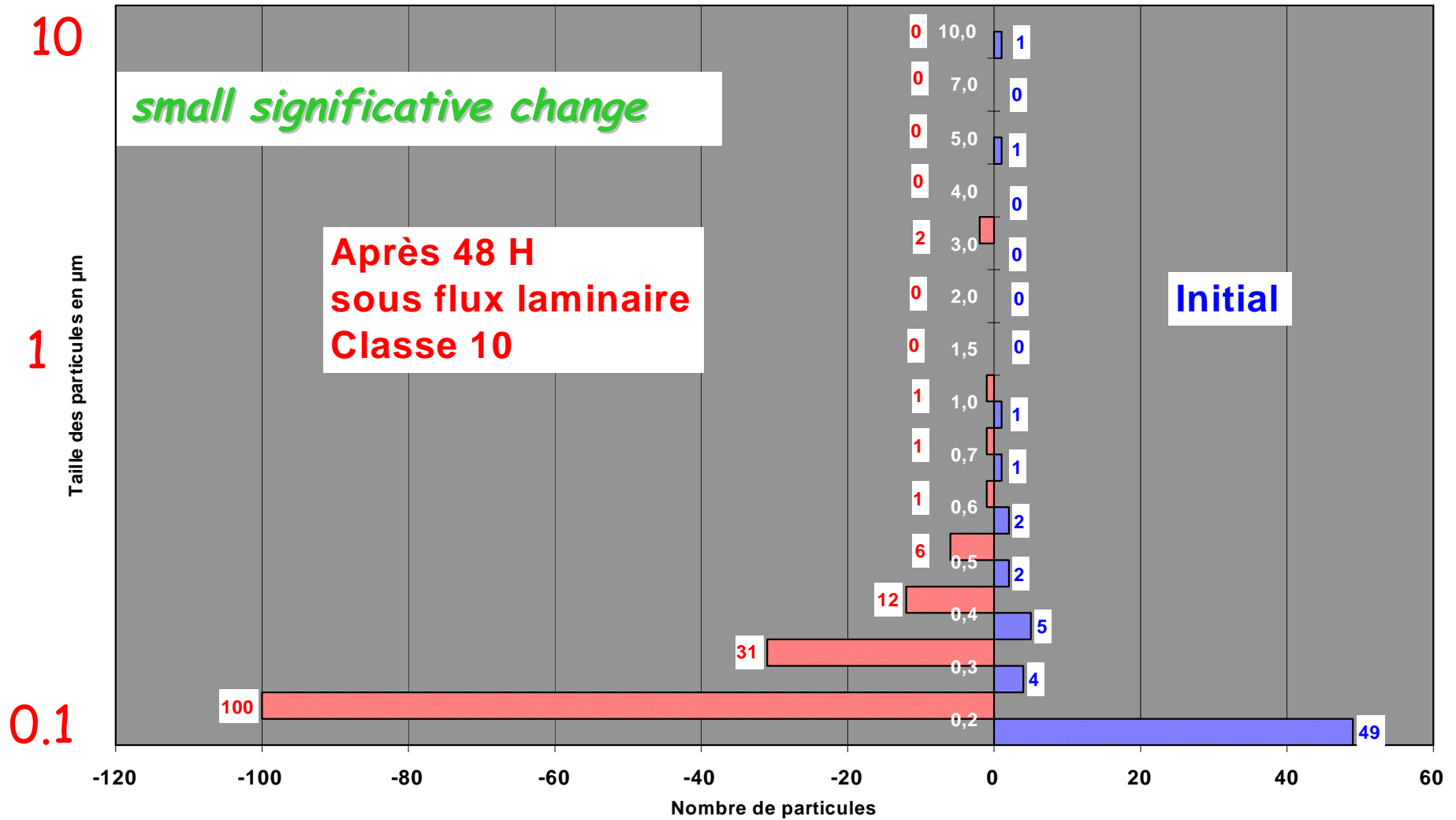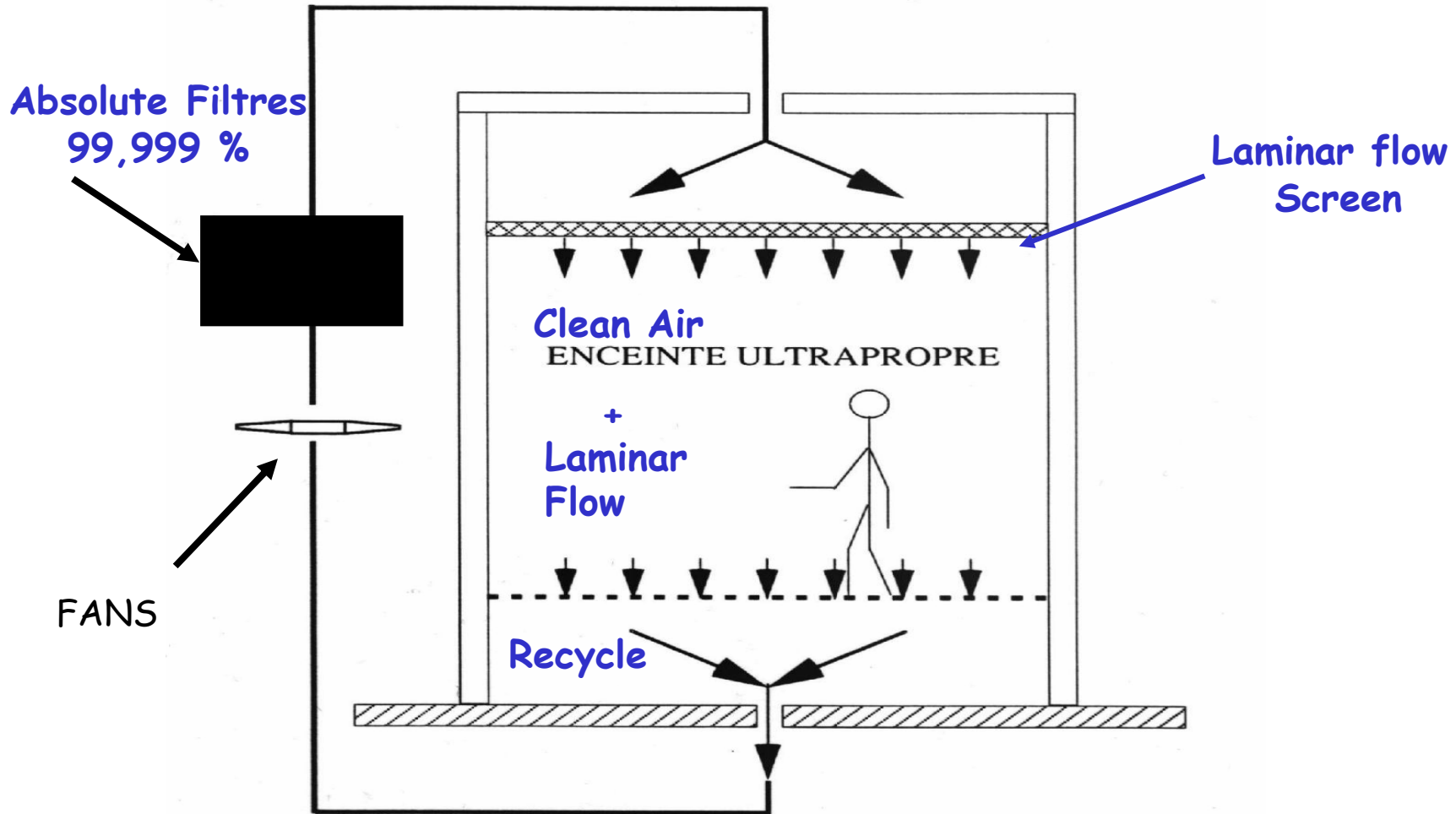
LIGO

	BSC Volume and flow parameters	
BSC cross section	Maximum Laminar air speed	Flow
6 m^2	0,45 m/s	~ 3 m^3/s
BSC height	Replacement time	Replacement rate
~3 m	~1.5 s	2400 vol/hour

How to implement laminar flow
Clean room facilities
In the BSC chambers

Pressurize optical bench
Use threaded and additional holes as
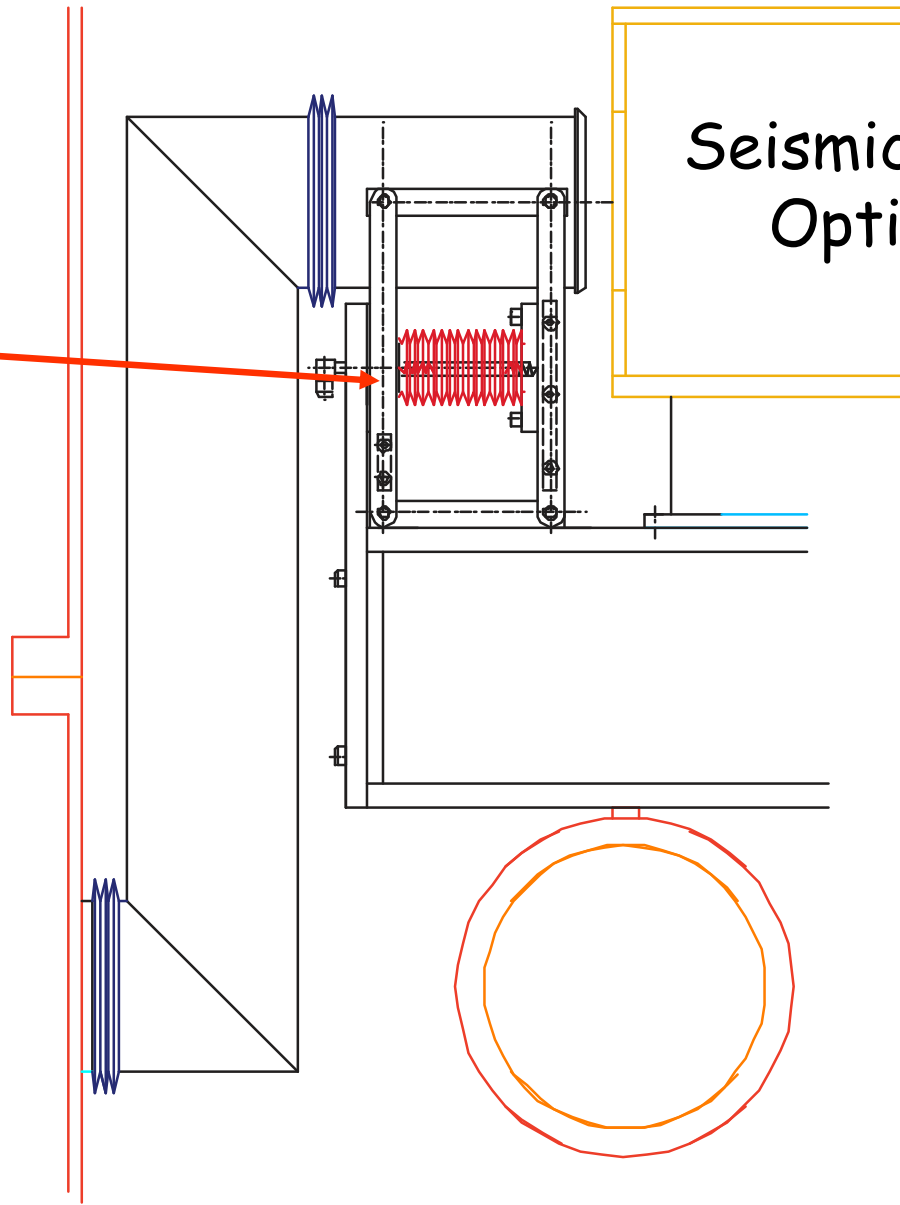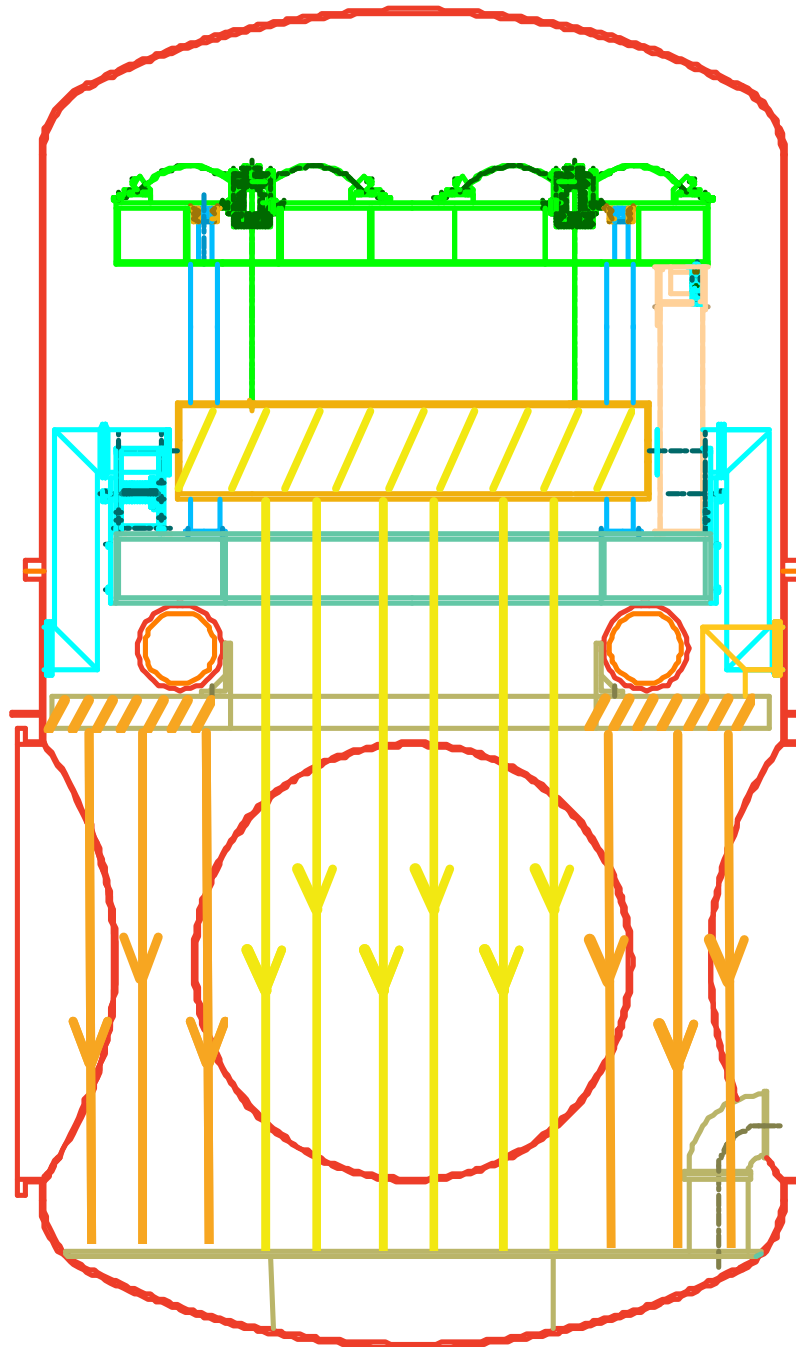laminar flow diffusers
Collect the clean air with a sieved floor

LIGO

Drive
bellow

Seismically isolated
Optical bench

Air inlet
Gate valve

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LIGO

1.0 m³/s
For core
~laminar
flow

2.0 m³/s
For annular
Laminar
Flow
Curtain

2.8m³/s
Suction

7-8% outflow

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Laminar Flow curtains

Particles
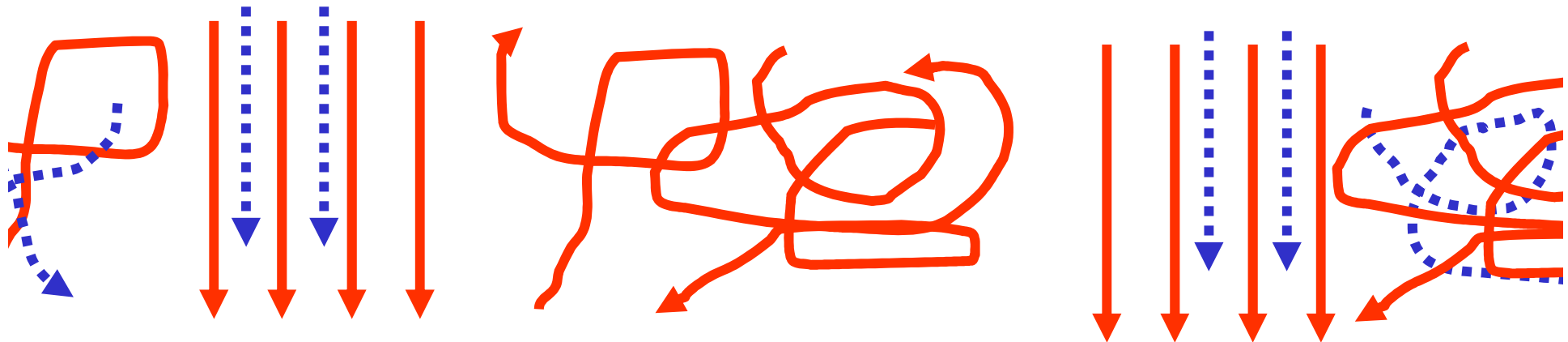
The particles, are dragged away by the flow before
they can diffuse in the turbulent flow volume.
But high turbulence induced in the optics region can
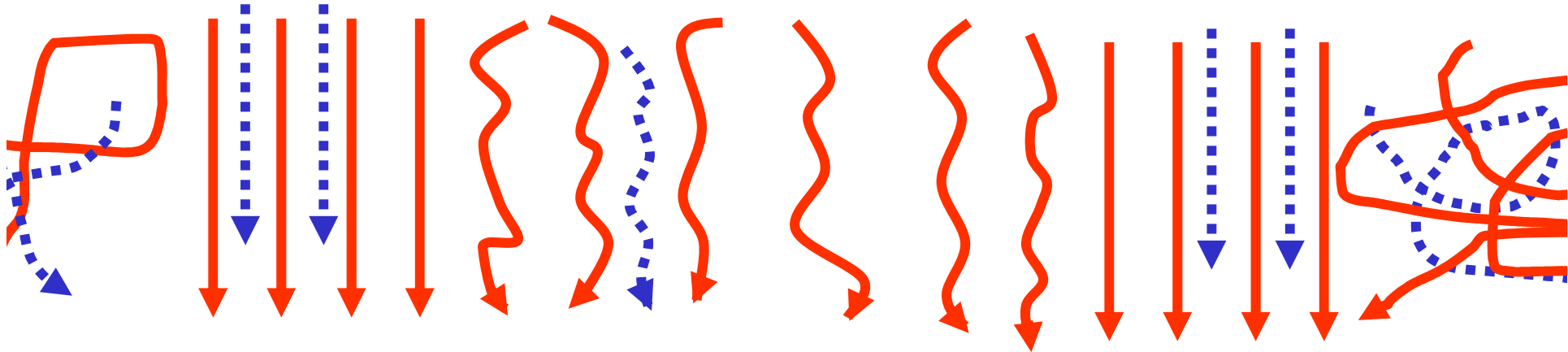still generate particulate contamination
Diminished but not negligible polluting probability

Laminar Flow curtains plus semi-laminar flow core

Particles

The suspension mechanics disturbs the otherwise laminar flow. Particles from outside are screened off by the laminar flow curtain. Particles injected **by the operator** in the semi-laminar volume are still dragged away by the flow although less effectively.
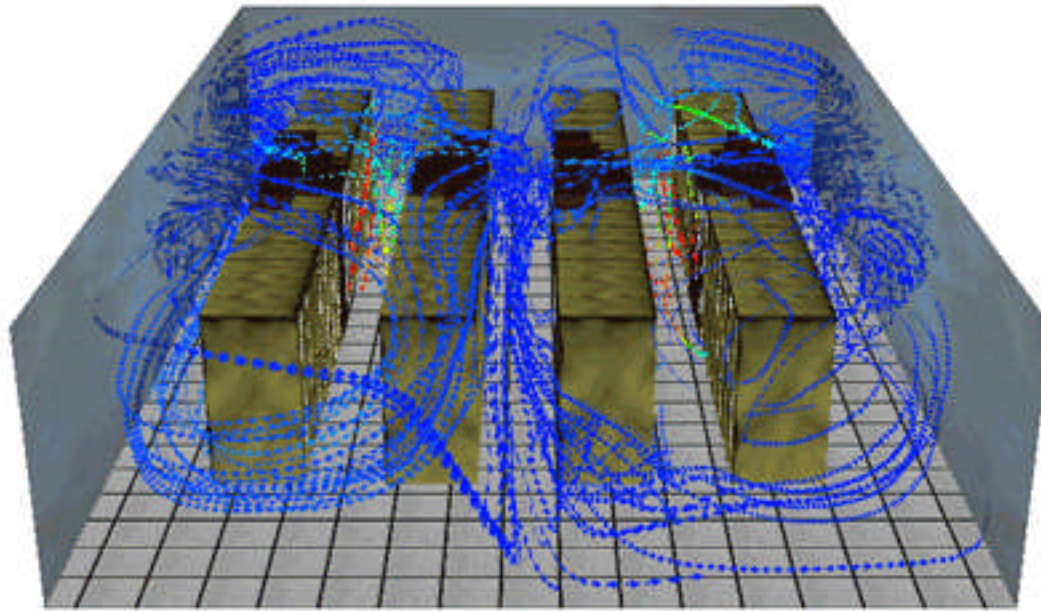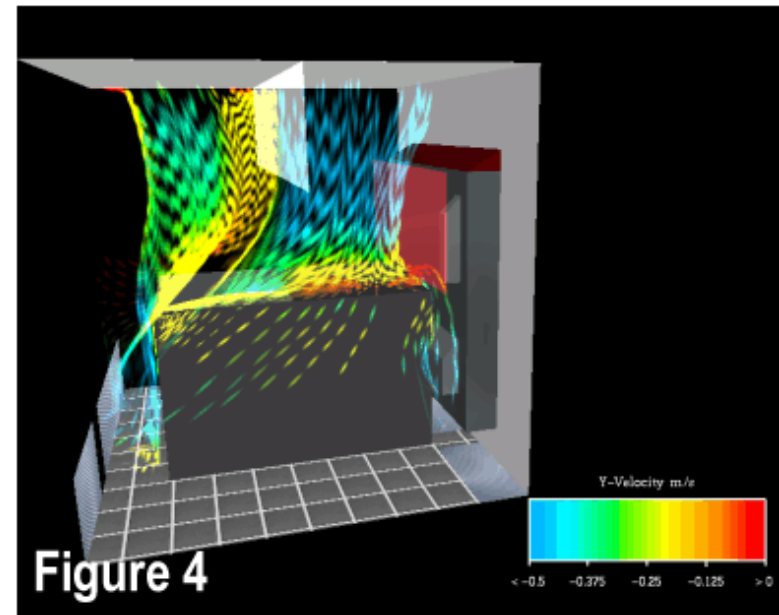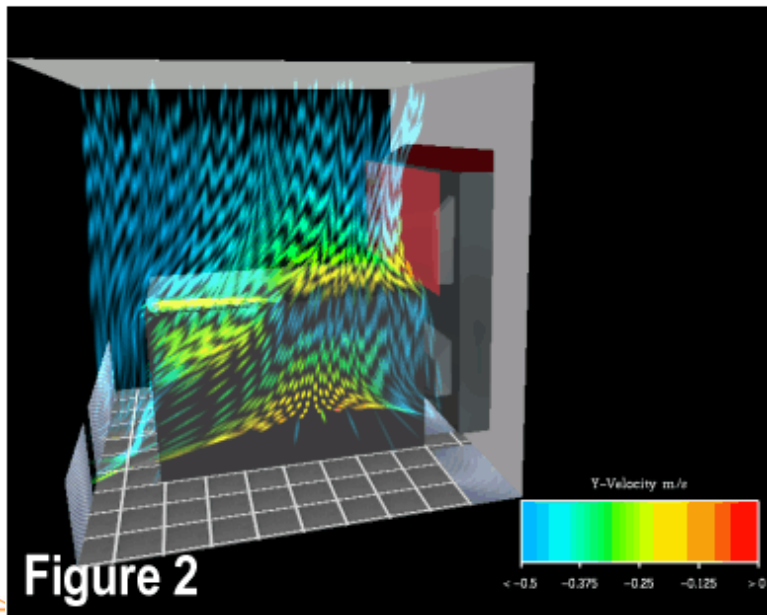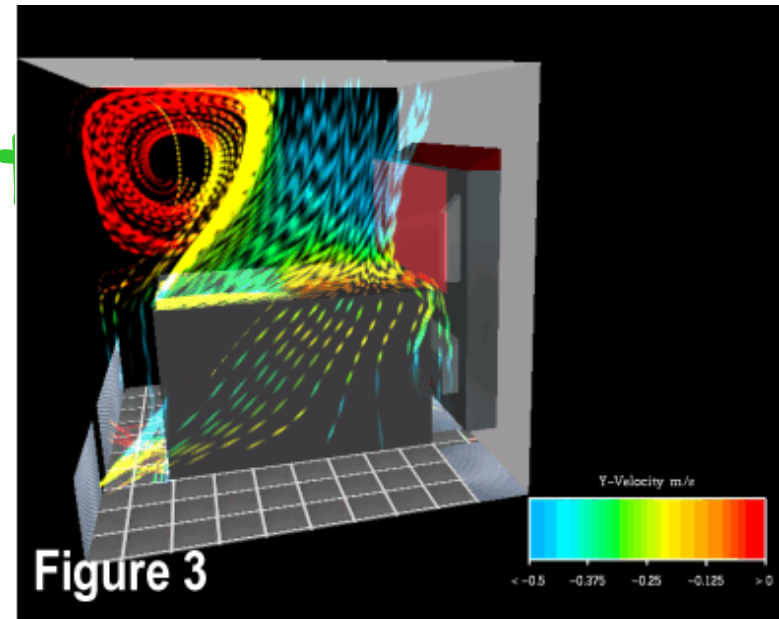
Minimized polluting probability

LIGO-G060130-00-R

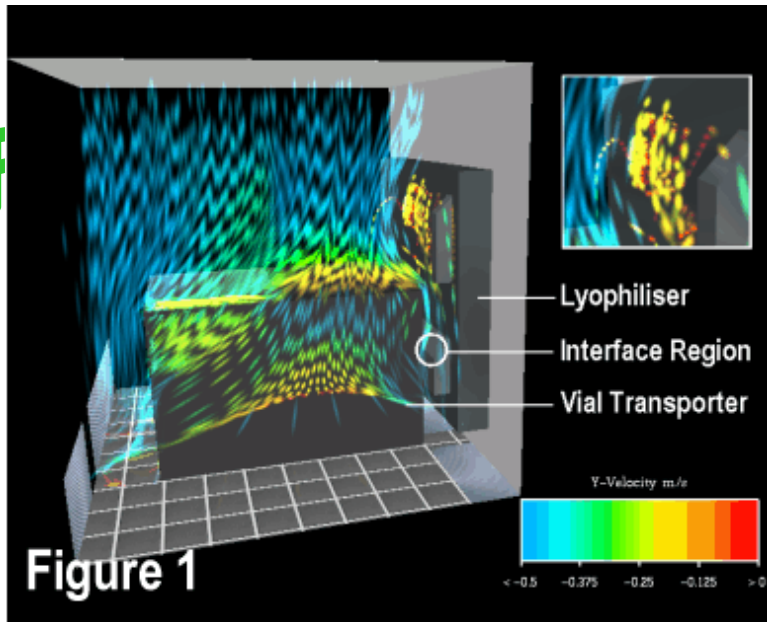**LIGO**

Due to the quad suspension
Structures it is impossible to
Establish pure Laminar Flow
in the test mass region

Detailed Flow conditions
To be simulated
Example: Flomerics.com

Temperature (degC)

Examples of clean room air flow simutation

Figure 1

Lyophiliser
Interface Region
Vial Transporter

Y-Velocity m/s

Figure 3

Figure 2

Figure 4

LIGO

The Laminar Flow curtains plus semi-laminar flow core seem to be the best solution for the BSC chambers and Guarantee a reasonable Protection against contaminants