

Design of Beam Transfer Lines

LA³NET Workshop Aachen, 05.11.2013

Andreas R. Maier

Junior Research Group for Laser-Plasma Driven Light Sources (LUX)



LAOLA. is a collaboration of



What is this session about?

> Transfer Beamline Design

	LIDAR sources	
ibility ge)	A. Design of beam transfer lines / imaging optics	B. High power enhancement cavit
	Andreas R. Maier, CFEL	Ioachim Pupez MPQ, München

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- > Transfer Beamline Design
- > very special parameter set
(200 TW, 5J in 25 fs, 80 mm beam)

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- > very special parameter set
(200 TW, 5J in 25 fs, 80 mm beam)
- > equations free talk...
- > this is not a lecture

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Outline

- > Laser-Plasma Project in Hamburg: CFEL and LAOLA
- > Design Aspects: Laser Transport Beamline

LUX - Junior Research Group

- > „Laser-Plasma Driven Light Sources“
- > group leader A. Maier
- > established September 2013
- > context: CFEL/Univ. Hamburg and LAOLA
- > setup and operate (a) ANGUS, a 200 TW laser system, and (b) a laser-plasma beamline

CFEL Lab

> we are part of CFEL



> shared office spaces and 100 m² laser lab
w/ group Florian Grüner



image: cfel.de

LAOLA Collaboration



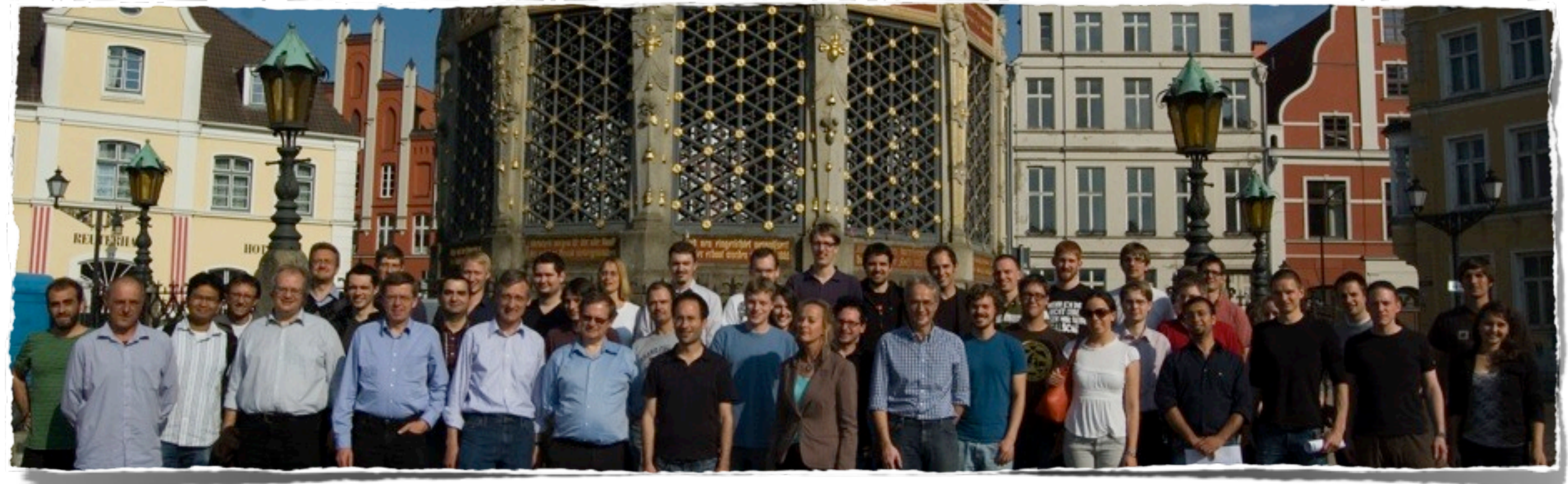
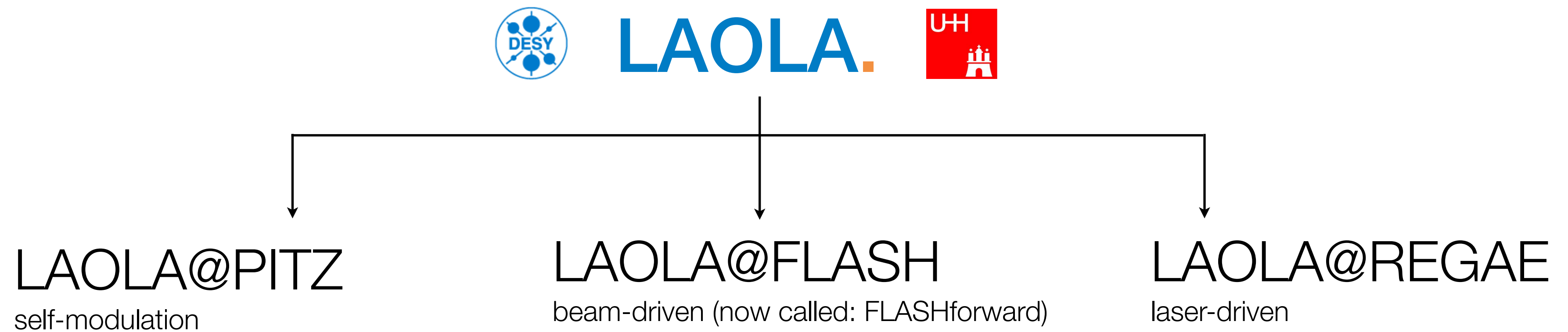
Reinhard Brinkmann
Klaus Flöttmann
Ralph Aßmann
Holger Schlarb
Bernhard Schmidt
Frank Stephan
Matthias Gross
Brian Foster
Eckhard Elsen
Jens Osterhoff

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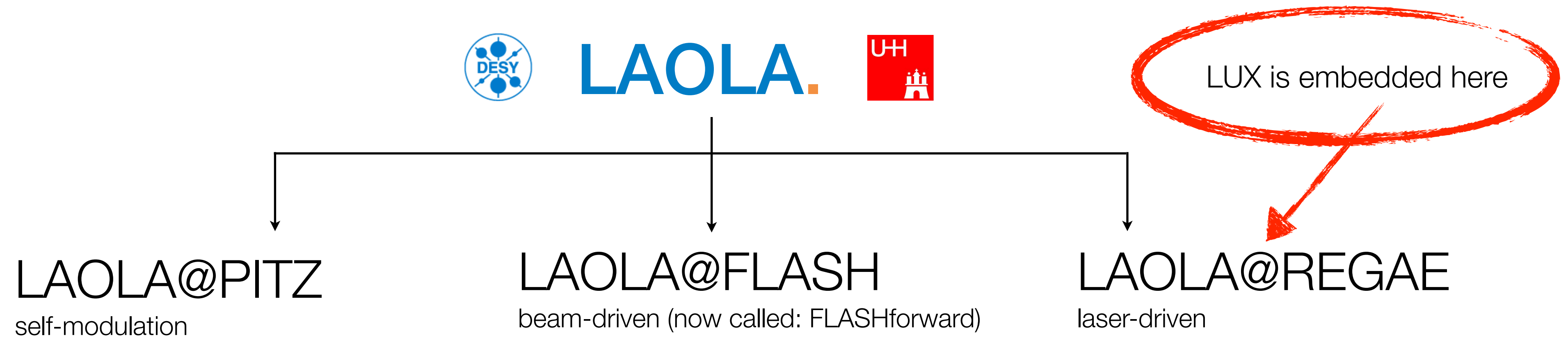
Florian Grüner
Andreas Maier
Benno Zeitler
Bernhard Hidding

...

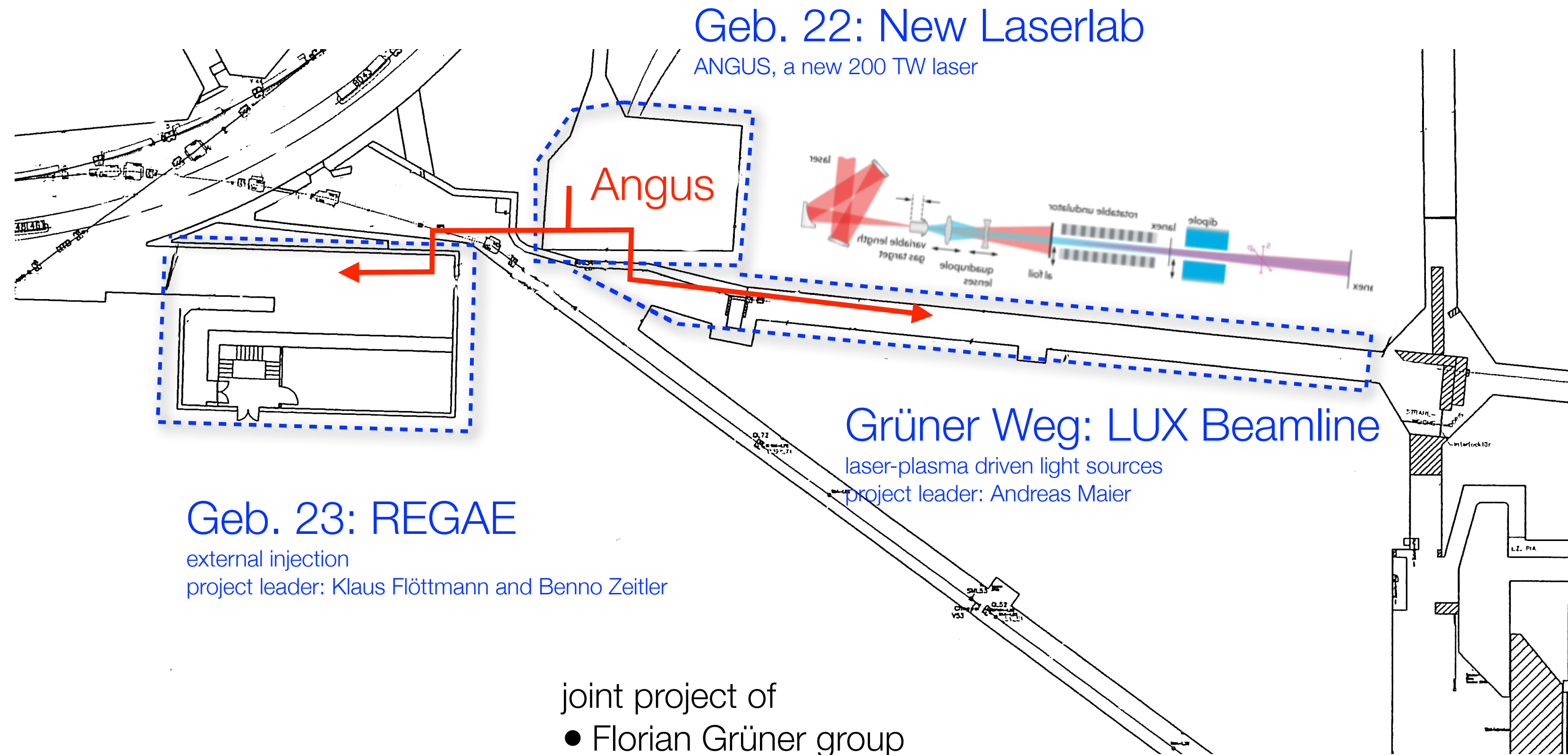
LAOLA Collaboration in Hamburg



LAOLA Collaboration in Hamburg

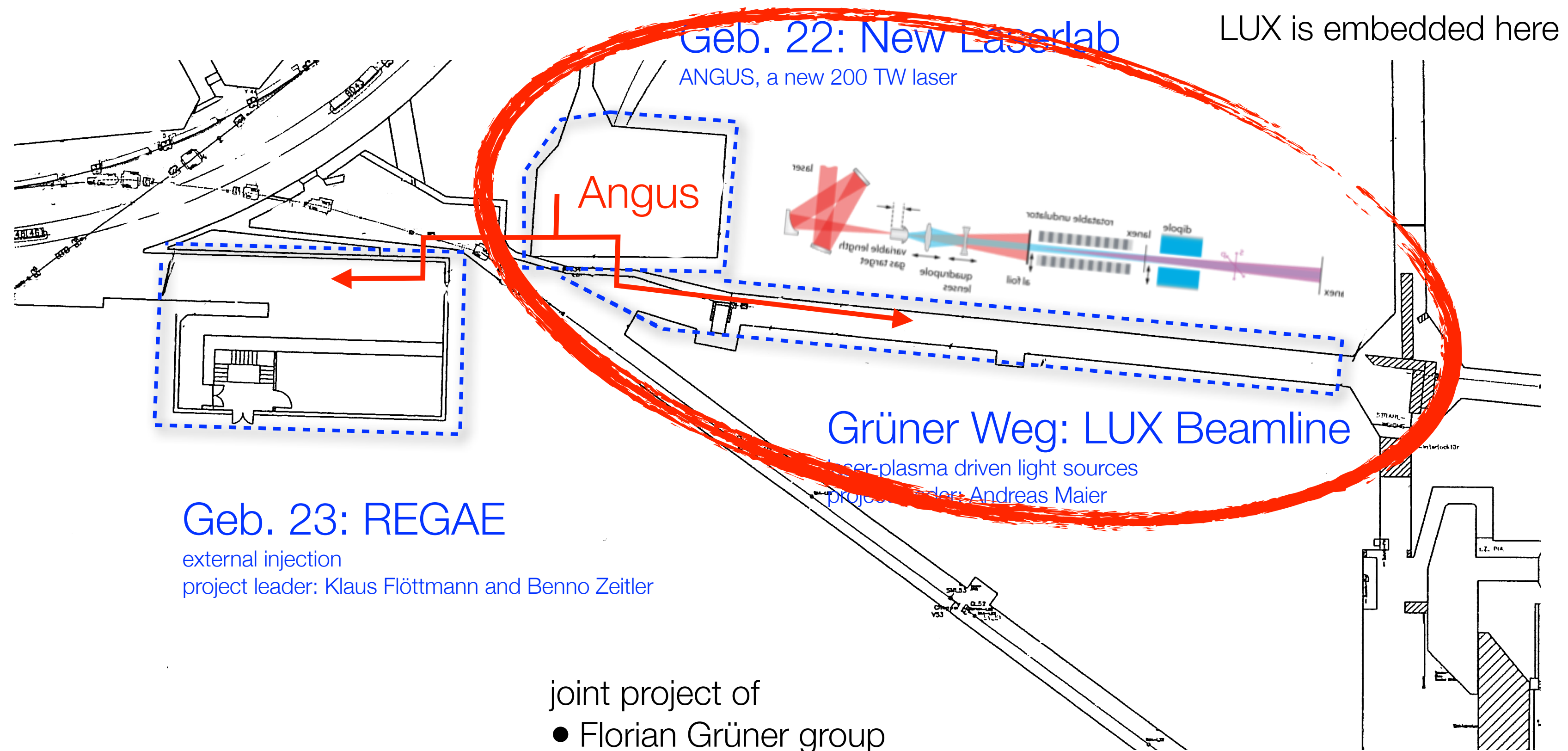


LAOLA@REGAE



- joint project of
- Florian Grüner group
 - Andreas Maier group
 - DESY Machine division

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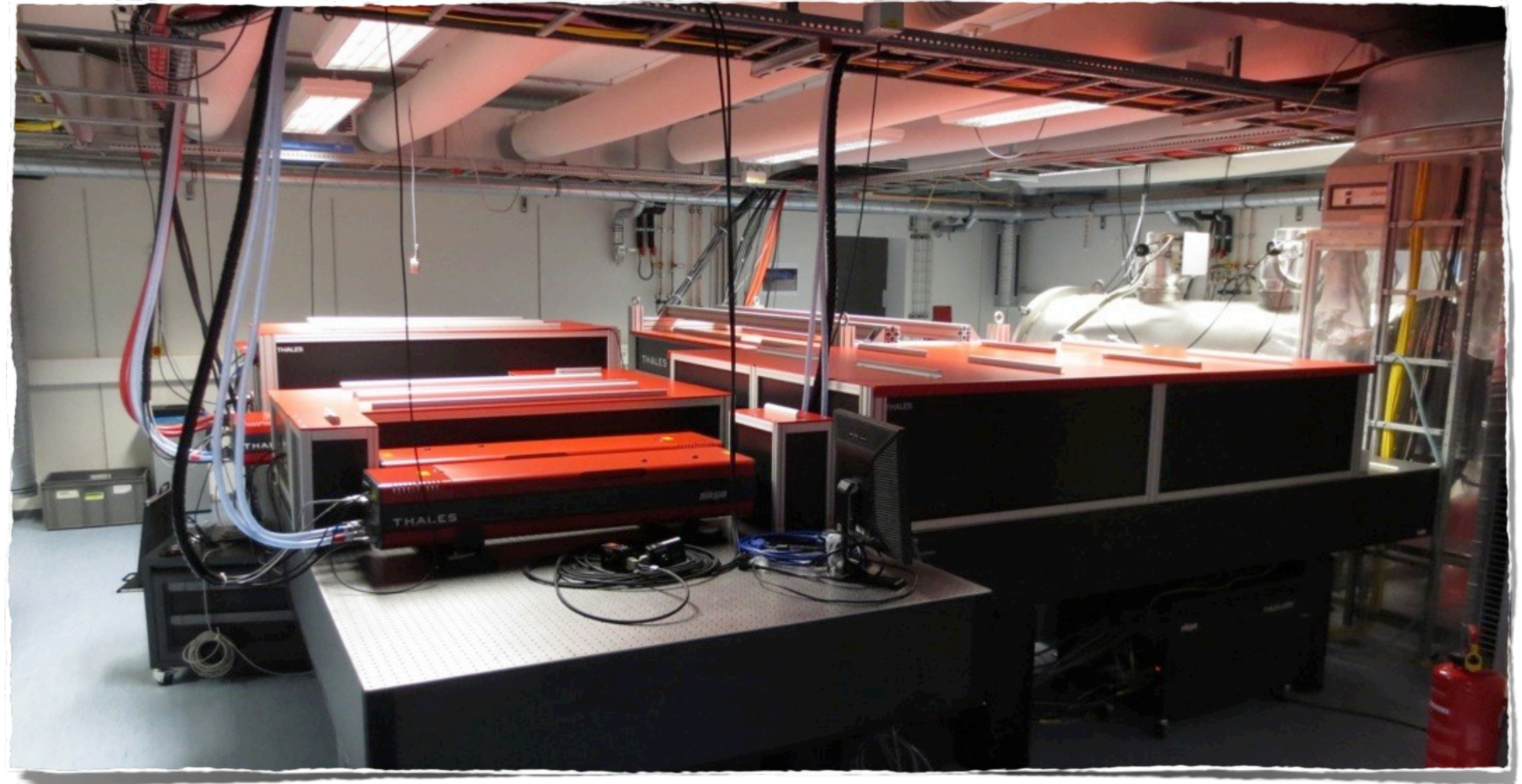
Laser Lab

Laser parameters:

- > 5 J in 25 fs @ 5 Hz
- > commercial THALES system
- > 80 mm beam diameter
- > currently doing site-acceptance

Lab

- > 0.1 °C temperature stability



Laser Transport Beamline

enough chit-chat...

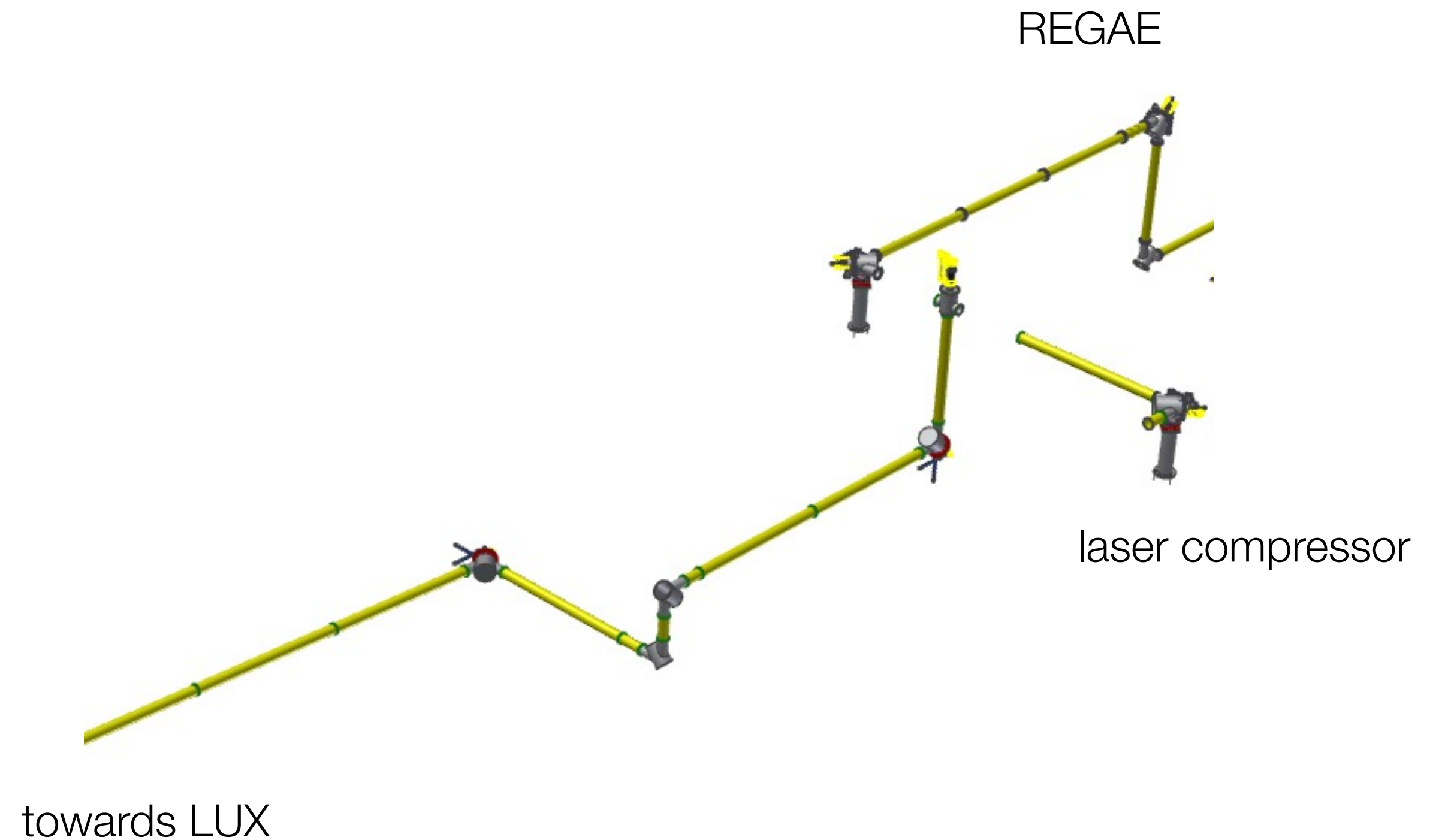
Most important lesson: Know your boundary conditions

Laser parameters:

> 5 J in 25 fs @ 5 Hz

> 80 mm beam diameter

> flat-top profile



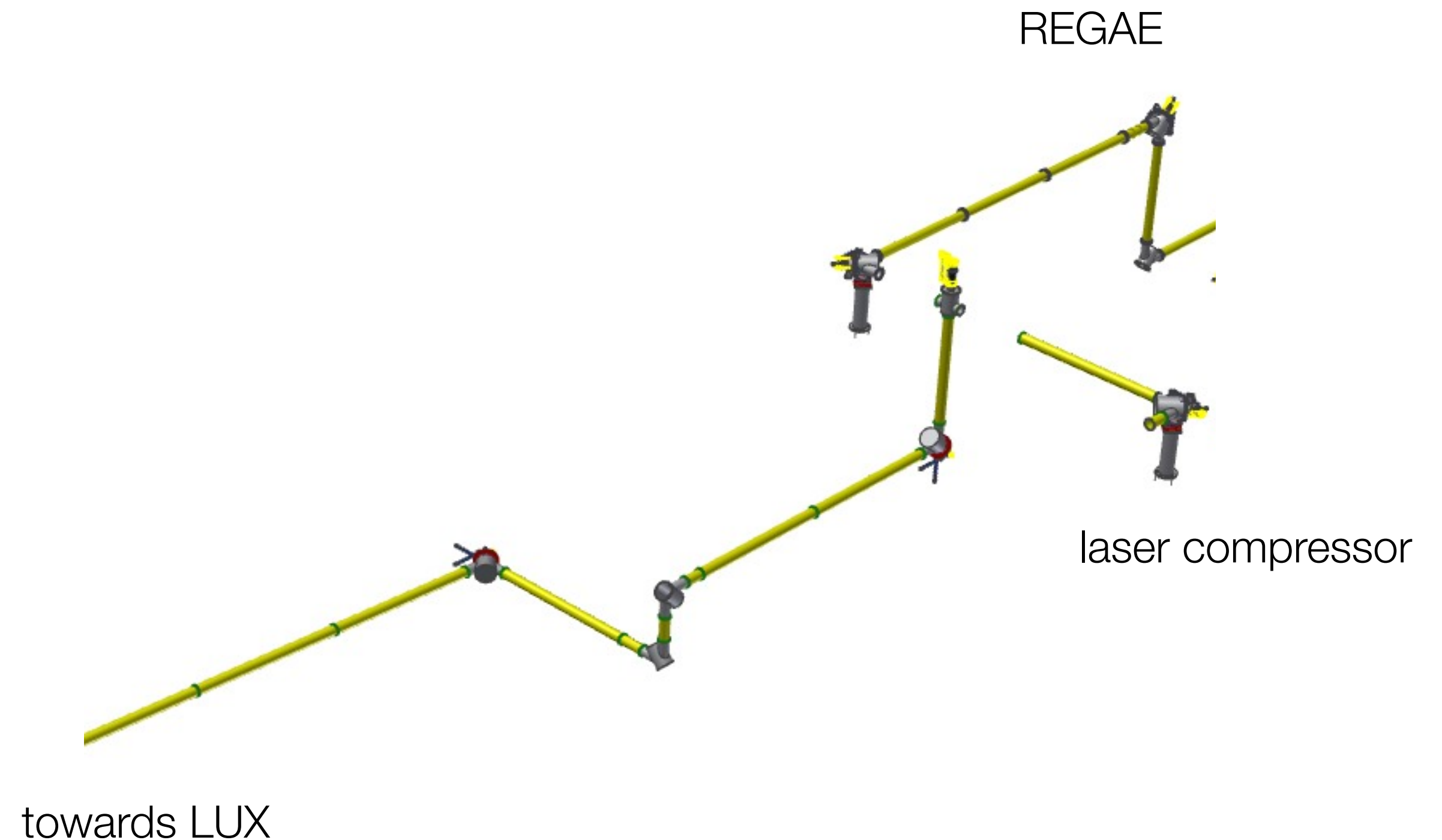
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Laser parameters:

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Vacuum

- > machine vacuum
- > particle-free
- > free of carbon-hydrats
- > no fluoride



Most important lesson: Know your boundary conditions

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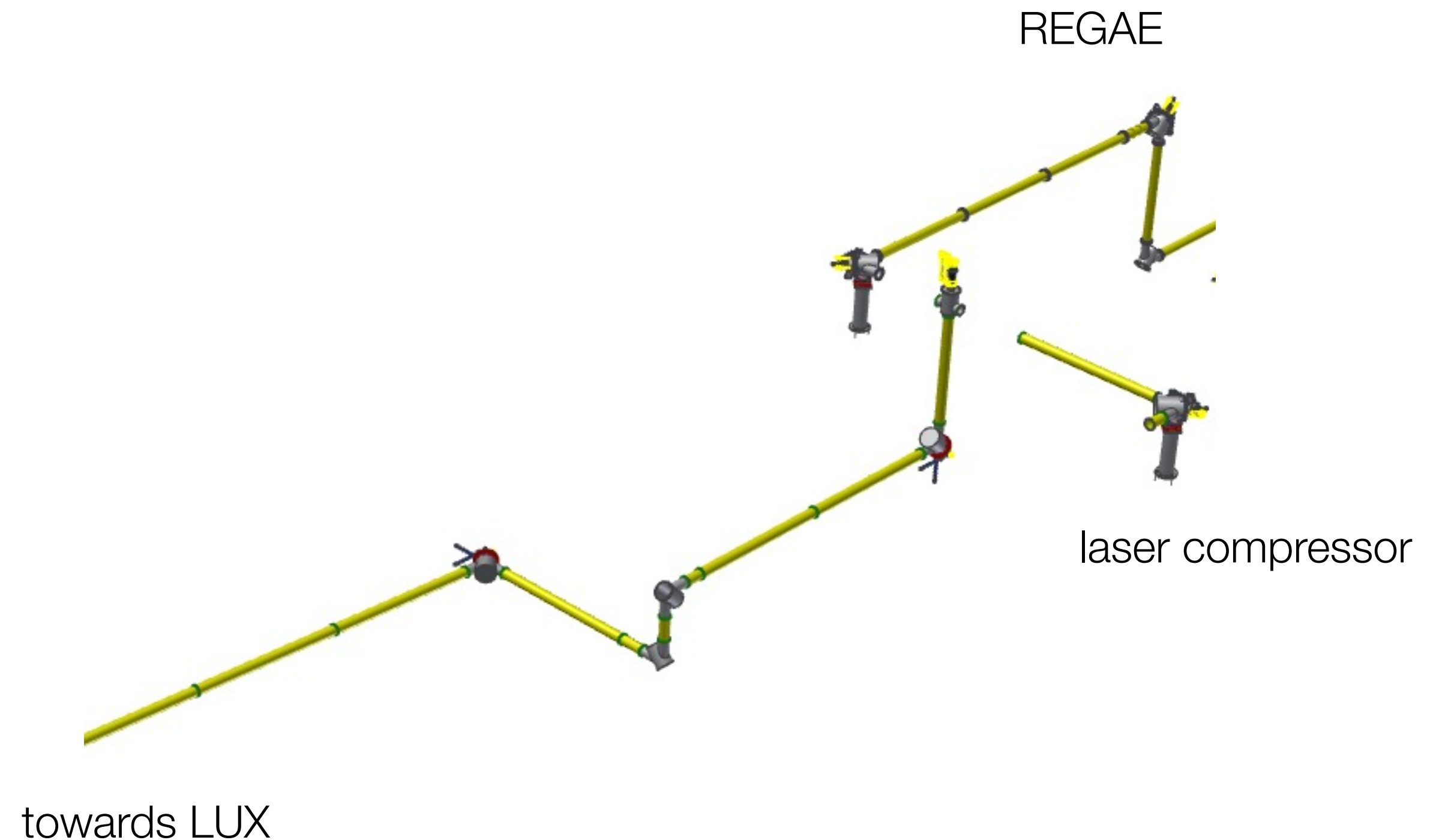
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Environment

- > vibrations of building?
- > temperature stability
0.1° C for Angus, 1° C for beamline



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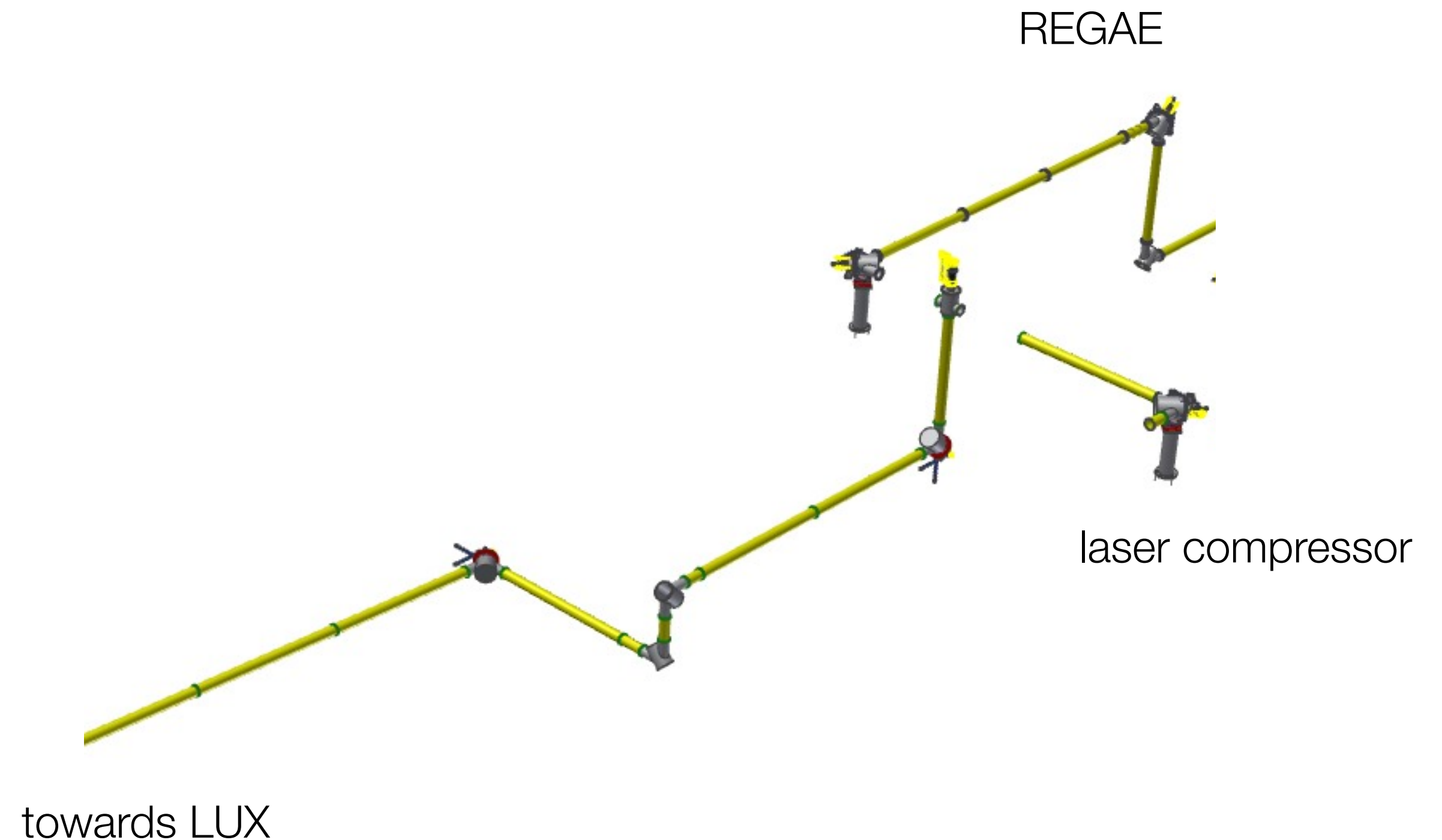
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> Target

- > few 100 μm channel transverse size
- > more than 10 m distance from compressor



Lesson 2: The clash of cultures

laser guys

laser PhD:

- 1) wait for „typical“ lucky record shot
- 2) write paper
- 3) run away

accelerator guys

accelerator PhDs have to:

- > build a machine for users
- > stability
- > reliability

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what they believe in...

> we even hide pizza in the chamber...

> UHV vacuum

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what they believe in...

- > we even hide pizza in the chamber...
- > we never actually close it
- > we motorize each and every mirror

- > UHV vacuum
- > we never open the vacuum system
- > we just couple in and out of the beamline - nothing else

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- > we even hide pizza in the chamber...
- > we never actually close it
- > we motorize each and every mirror
- > the laser is the center of our universe

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what they believe in...

- > UHV vacuum
- > we never open the vacuum system
- > we just couple in and out of the beamline - nothing else
- > the electron beam is the center of our universe

More details...

... in no specific order

Laser Parameters

Laser parameters:

> 5 J in 25 fs @ 5 Hz

> 80 mm beam diameter

> flat-top profile

Laser Parameters

no curved optics
only flat mirrors
-> pointing translates into offset

Laser parameters:
> 5 J in 25 fs @ 5 Hz
> 80 mm beam diameter
> flat-top profile

> absolutely no windows
(B-integral)
> no transmissive optics

focus is not a Gaussian

Vacuum Specs

Vacuum

> machine vacuum

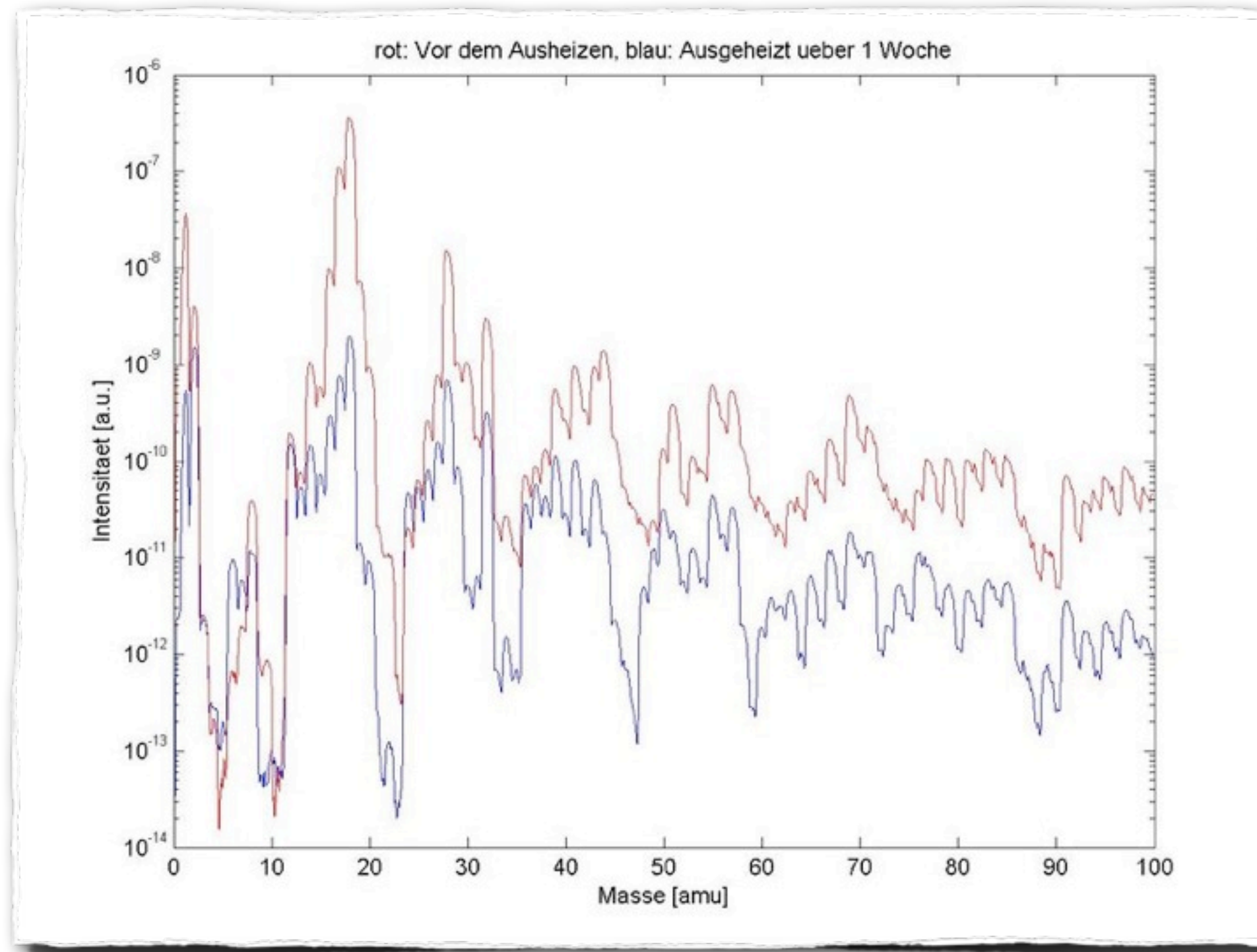
> vacuum is not defined by pressure, but:

> particle-free

> free of hydrocarbons

> no fluoride

Vacuum Specs

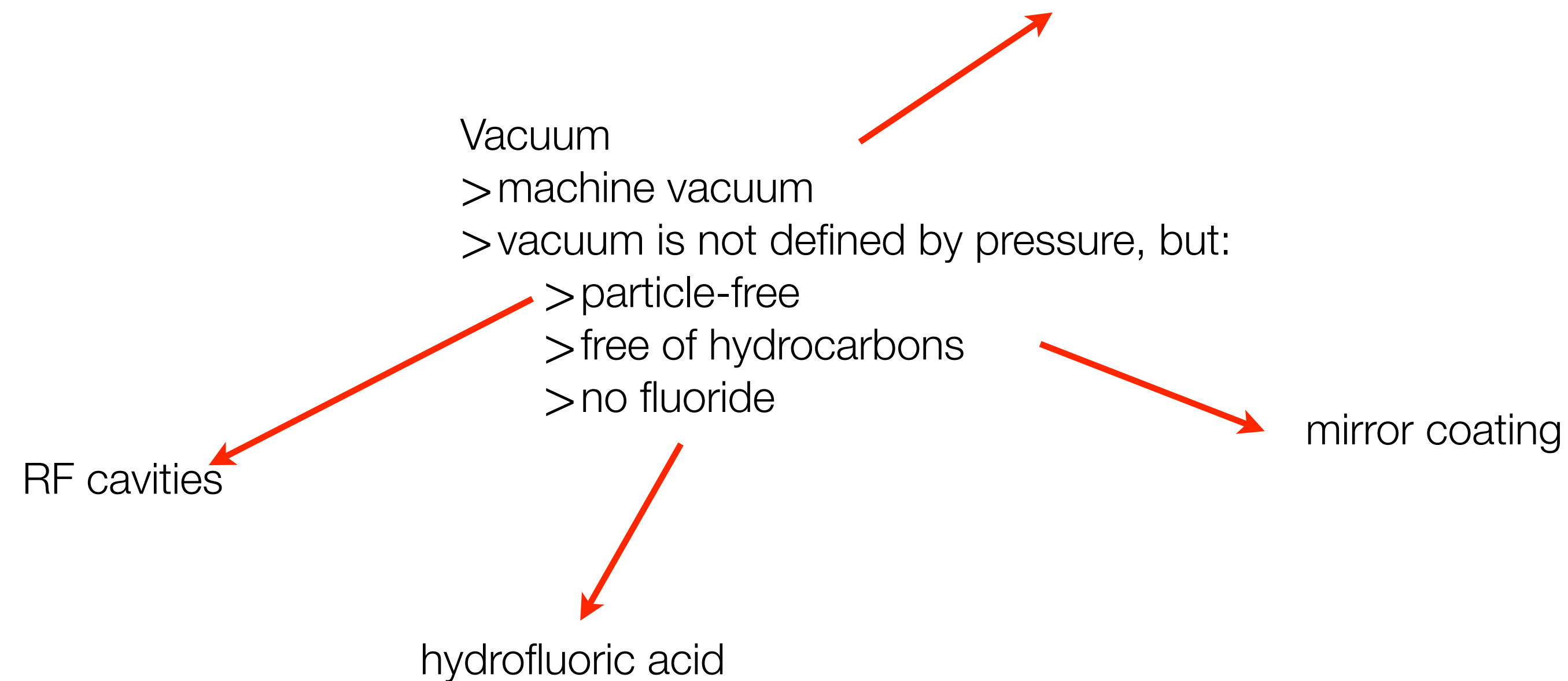


vacuum
not defined by pressure, but:
-free
hydrocarbons
oxide

**vacuum is not defined by pressure:
example of mass spectrum before and after baking the a test chamber**

Vacuum Specs

Why machine vacuum? -> Connection to REGAE gun.
No window, because of power and pulselength.



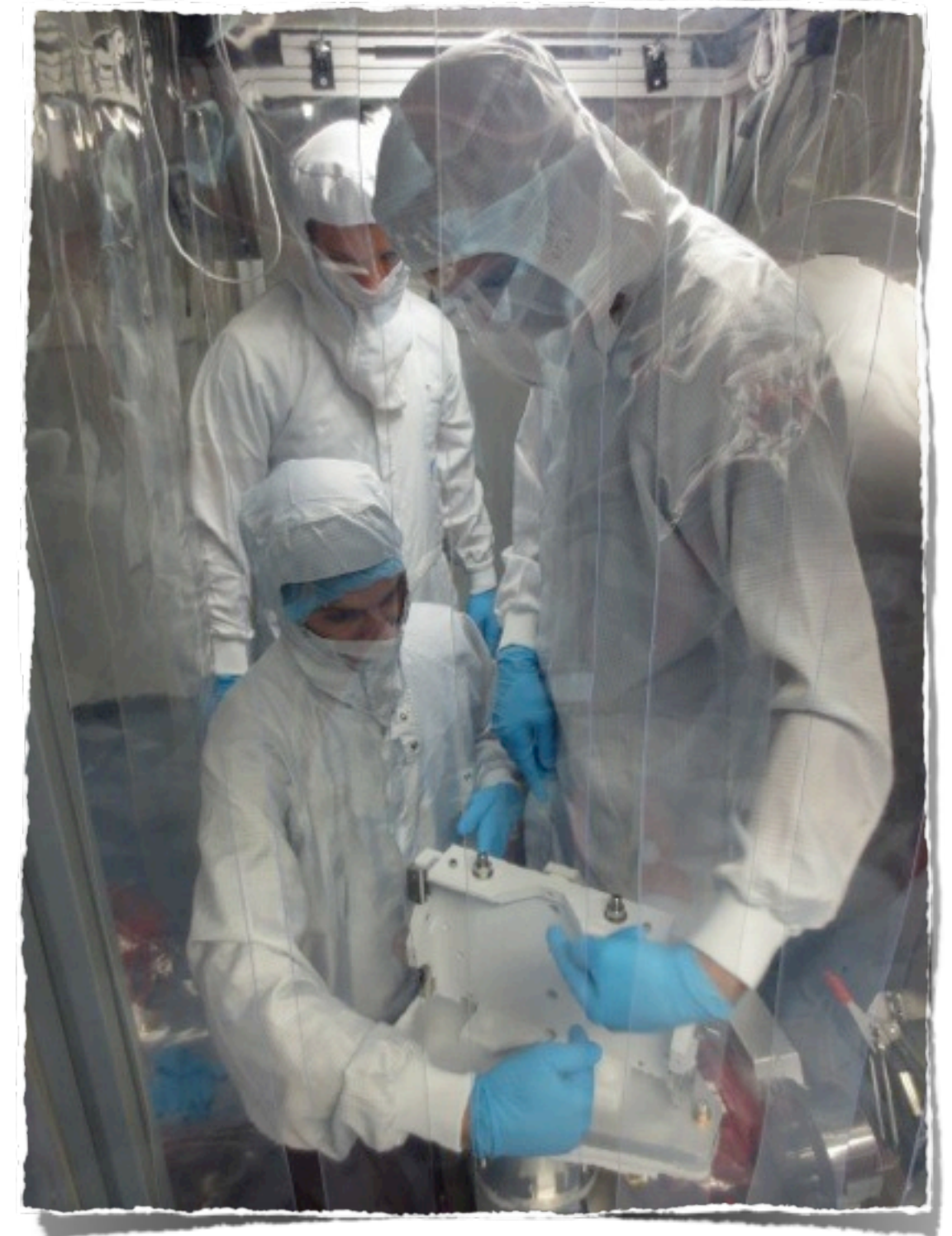
Vacuum Specs - Consequences

- > Get all motors out of the vacuum
- > Design own mirror mounts

- > assemble everything under clean room conditions, w/ 25 particles per cubic foot

Vacuum

- > machine vacuum
- > vacuum is not defined by pressure, but:
 - > particle-free
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Design philosophy

- > use two mirrors to couple in
- > two mirrors to couple out
- > leave rest untouched

- > no panic mirrors
- > save money on mirror mounts and motors

Environment

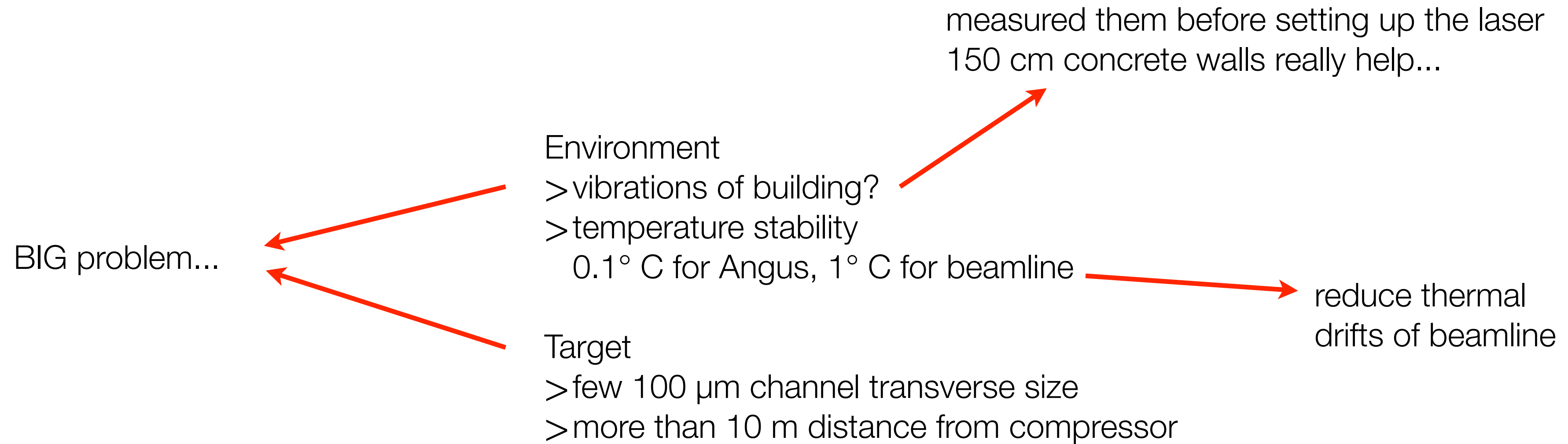
Environment

- > vibrations of building?
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Target

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- > more than 10 m distance from compressor

Environment



What should I do different?

> Everything!

What should I do different?

> Everything!

> Use windows (if you can)

> Use lenses (if you can)

> ...

Lessons learned... ?

- 1) Know your boundary conditions.
- 2) Know your design philosophy.
- 3) Questions? Write me an email: andreas.maier@cfel.de

Thanks

funding contributed by



acknowledgement

