

Salamanca experience on the high repetition rate experiments challenges:

Intensity measurement on spot

Luis Roso

On behalf of
the CLPU Team



BLIN4: Beam Line and INstrumentation:

Fourth Workshop

June 29th, 2020





We are at
Salamanca,
Spain!





CLPU is a user facility
open to domestic and
international users

50% Spanish Central Government
(Ministerio de Ciencia)
45% Regional Government
(Junta de Castilla y León)
5% University of Salamanca

MAP OF
**UNIQUE
SCIENTIFIC
AND TECHNICAL
INFRASTRUCTURES
(ICTS)**

The CLPU main laser: VEGA



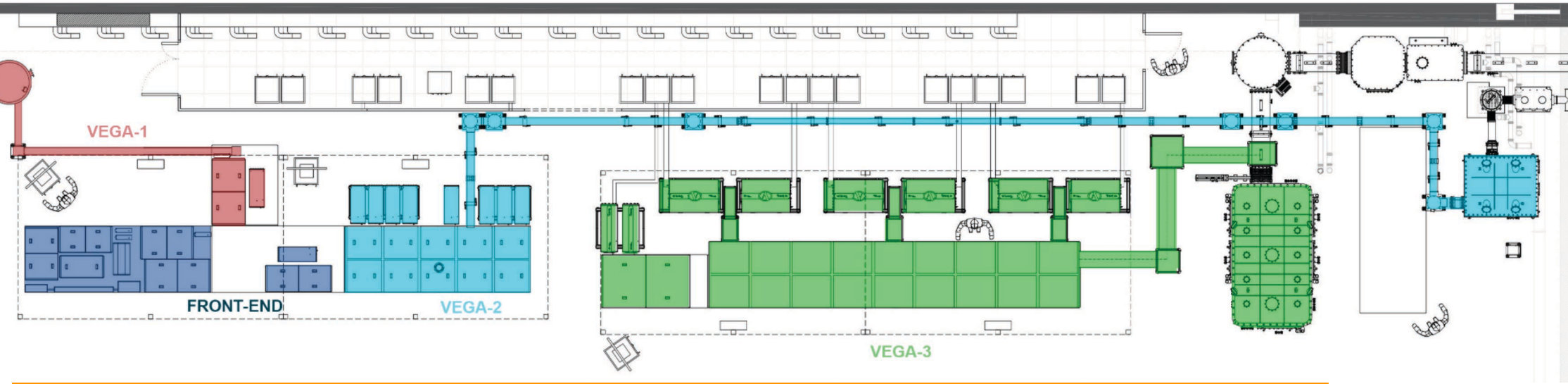


VEGA laser system

Ti:sapphire 800 nm



30 m



VEGA	peak power	energy	duration	rep rate
VEGA-1	20 TW	600 mJ	30 fs	10 / seg
VEGA-2	200 TW	6 J	30 fs	10 / seg
VEGA-3	1 PW	30 J	30 fs	1 /seg



High Power Laser Science and Engineering, (2019), Vol. 7, e25, 6 pages.

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doi:10.1017/hpl.2019.10

Generation of high energy laser-driven electron and proton sources with the 200 TW system VEGA 2 at the Centro de Laseres Pulsados

L. Volpe^{1,2}, R. Fedosejevs³, G. Gatti¹, J. A. Pérez-Hernández¹, C. Méndez¹, J. Apiñaniz¹, X. Vaisseau¹, C. Salgado^{1,4}, M. Huault^{1,4}, S. Malko^{1,4}, G. Zeraouli^{1,4}, V. Ospina^{1,4}, A. Longman³, D. De Luis¹, K. Li¹, O. Varela¹, E. García¹, I. Hernández¹, J. D. Pisonero¹, J. García Ajates¹, J. M. Alvarez¹, C. García¹, M. Rico¹, D. Arana¹, J. Hernández-Toro¹, and L. Roso^{1,4}

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(Received 21 December 2018; revised 17 January 2019; accepted 30 January 2019)

Loooooooooooooong way



From a PW laser at 1 Hz installed

Gratings heating
Target debris

...

Targetry ... underdense and overdense

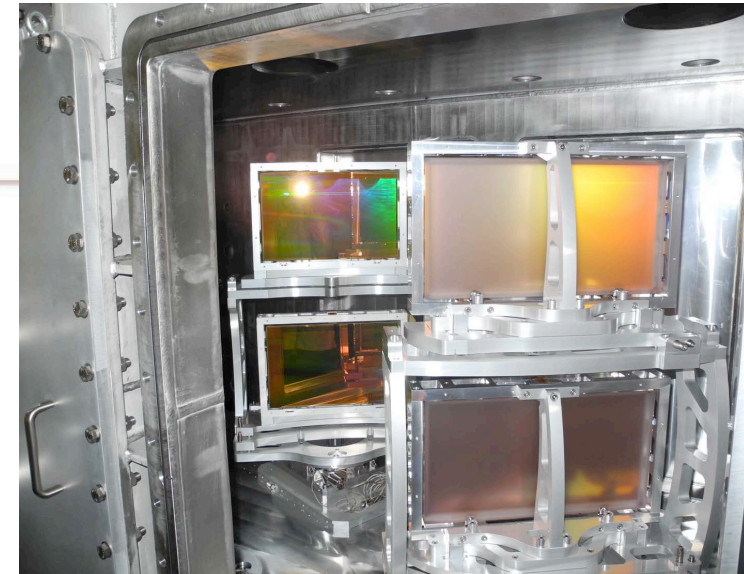
Detection ... shot by shot, not integrated

EMP at high repetition rate

...

Intensity measurement, in situ

To a useful PW laser at 1 Hz



Marine Huault, CLPU

Massimo De Marco, CLPU

in this talk



Intensity Gauge

Need of a detector able to measure directly the intensity in the relativistic domain

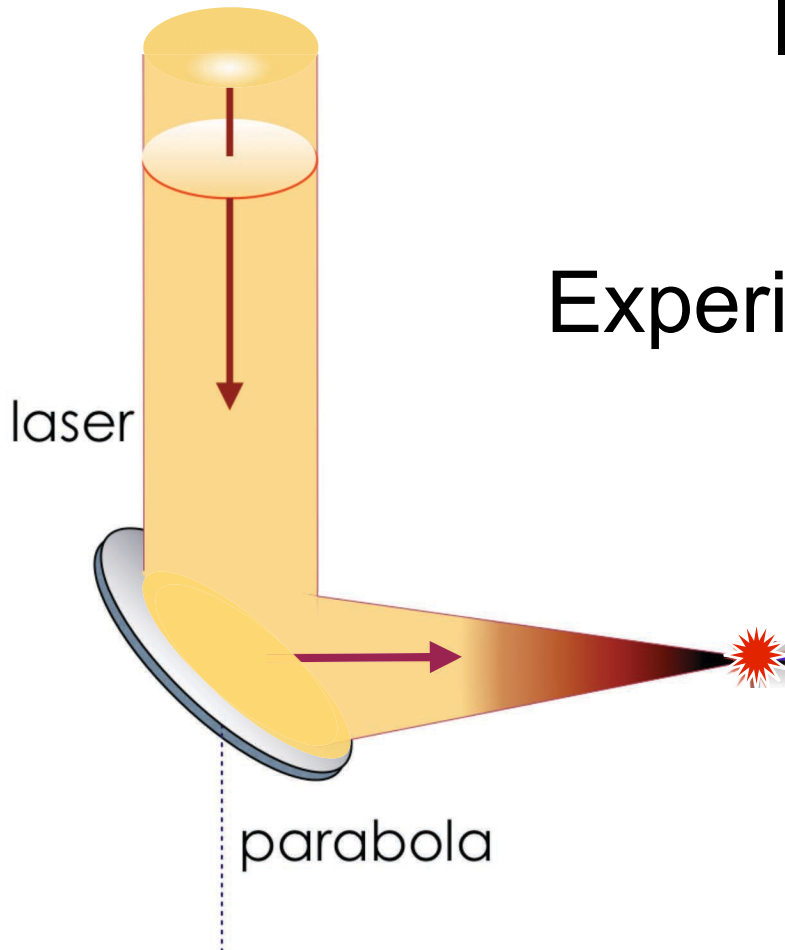
Possibility of direct measurement

Intensity W/cm^2

Pulse energy J
Pulse duration fs
Focal spot cm^2

Experiments at vacuum 10^{-6} mb

Residual gas
or inject some gas $<10^{-4}$ mb





Beyond 10^{16} W/cm² there are no neutral atoms
ions + free electrons

Beyond 10^{18} W/cm² electrons move relativistically

Key point: Use radiation from ionized driven
electrons to have a direct measurement of the
intensity

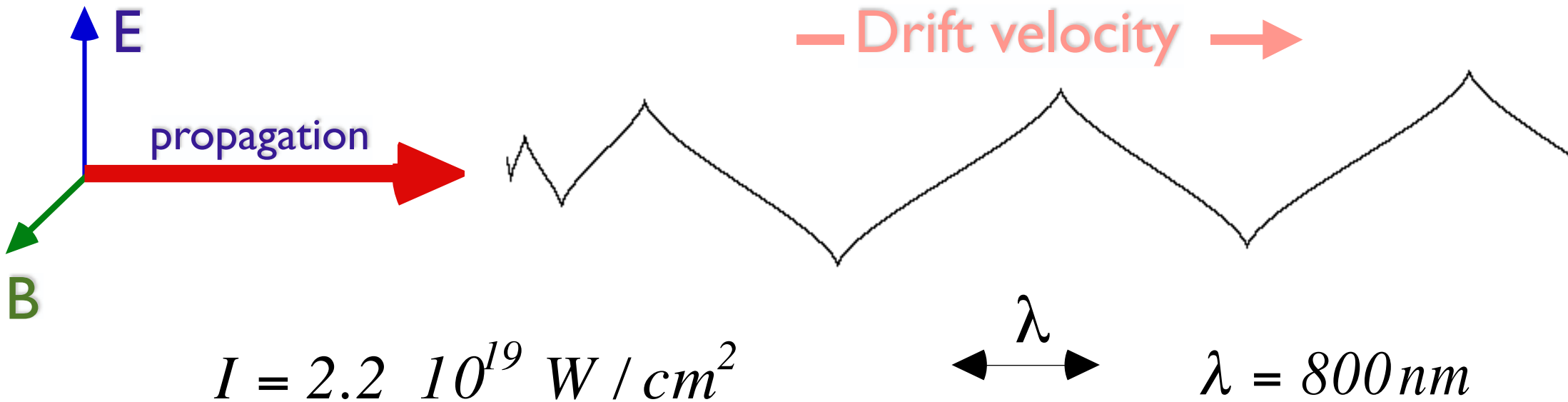
E S Sarachik and G T Schappert, Phys. Rev. D 1, 2378 (1970)



Classical theory of the scattering of intense laser radiation by free electrons



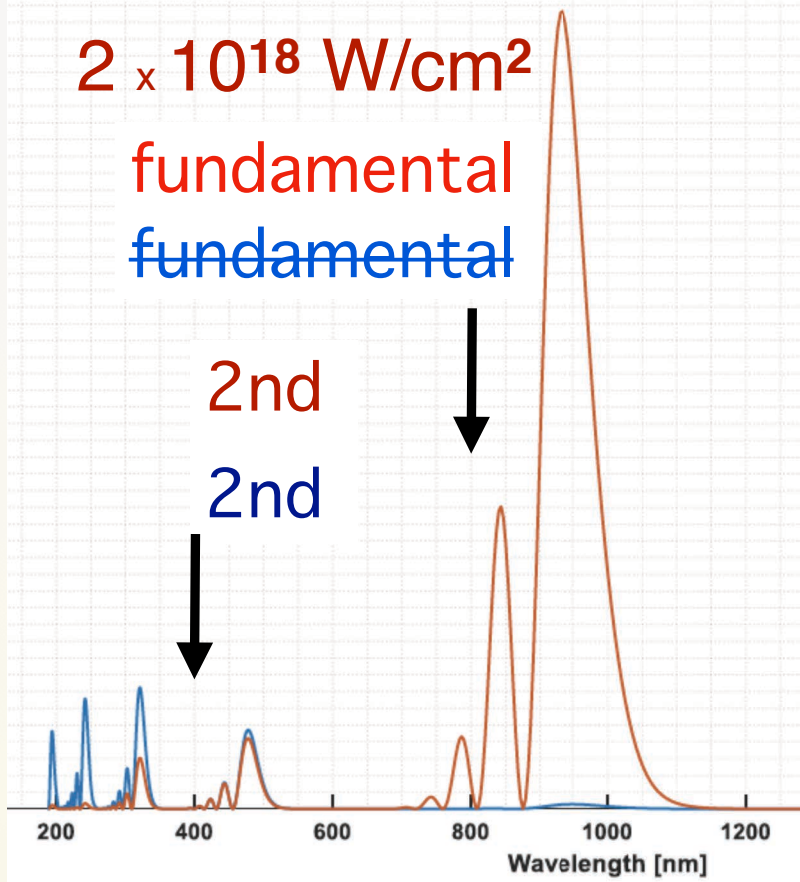
Linear polarization



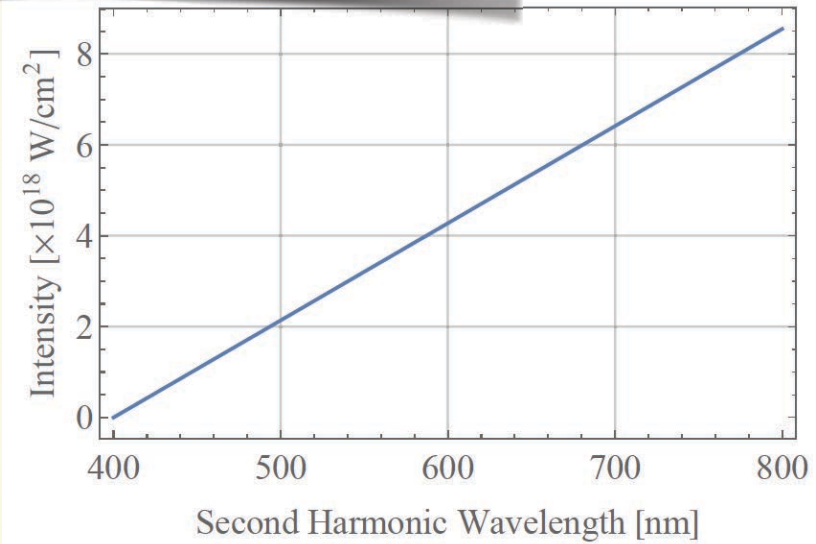
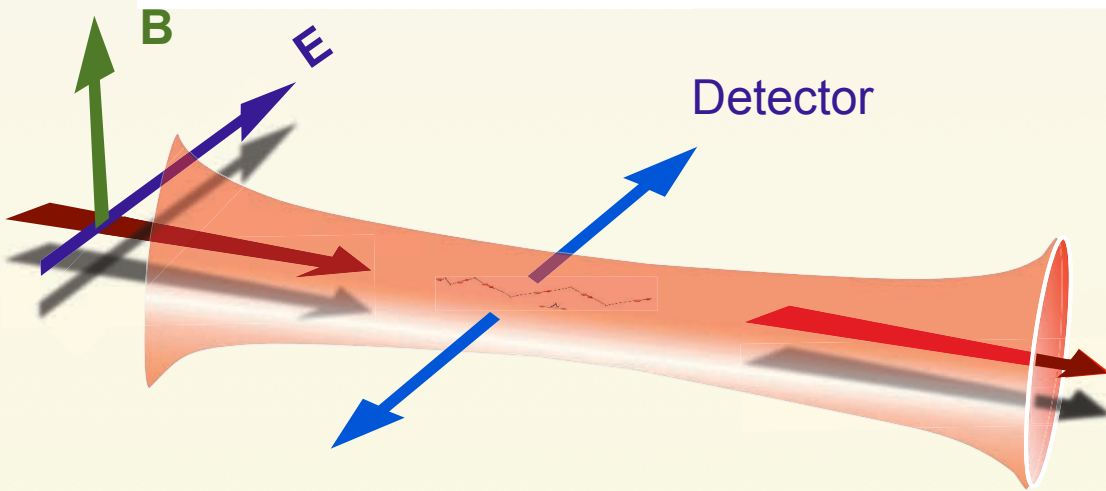
Where is the figure of eight?

$2 \times 10^{18} \text{ W/cm}^2$
fundamental
fundamental

2nd
2nd

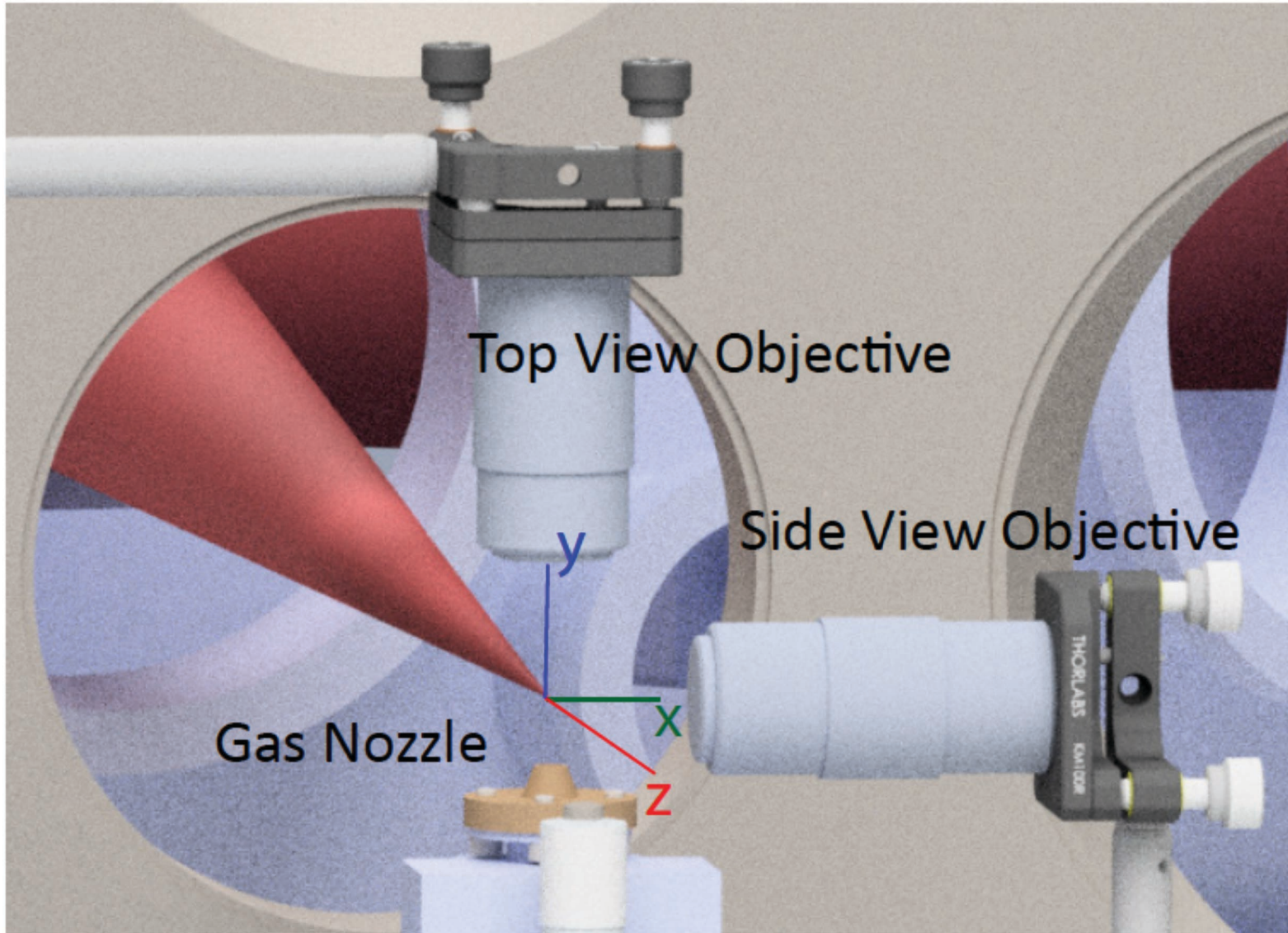


Thomson scattering
shows large red shift



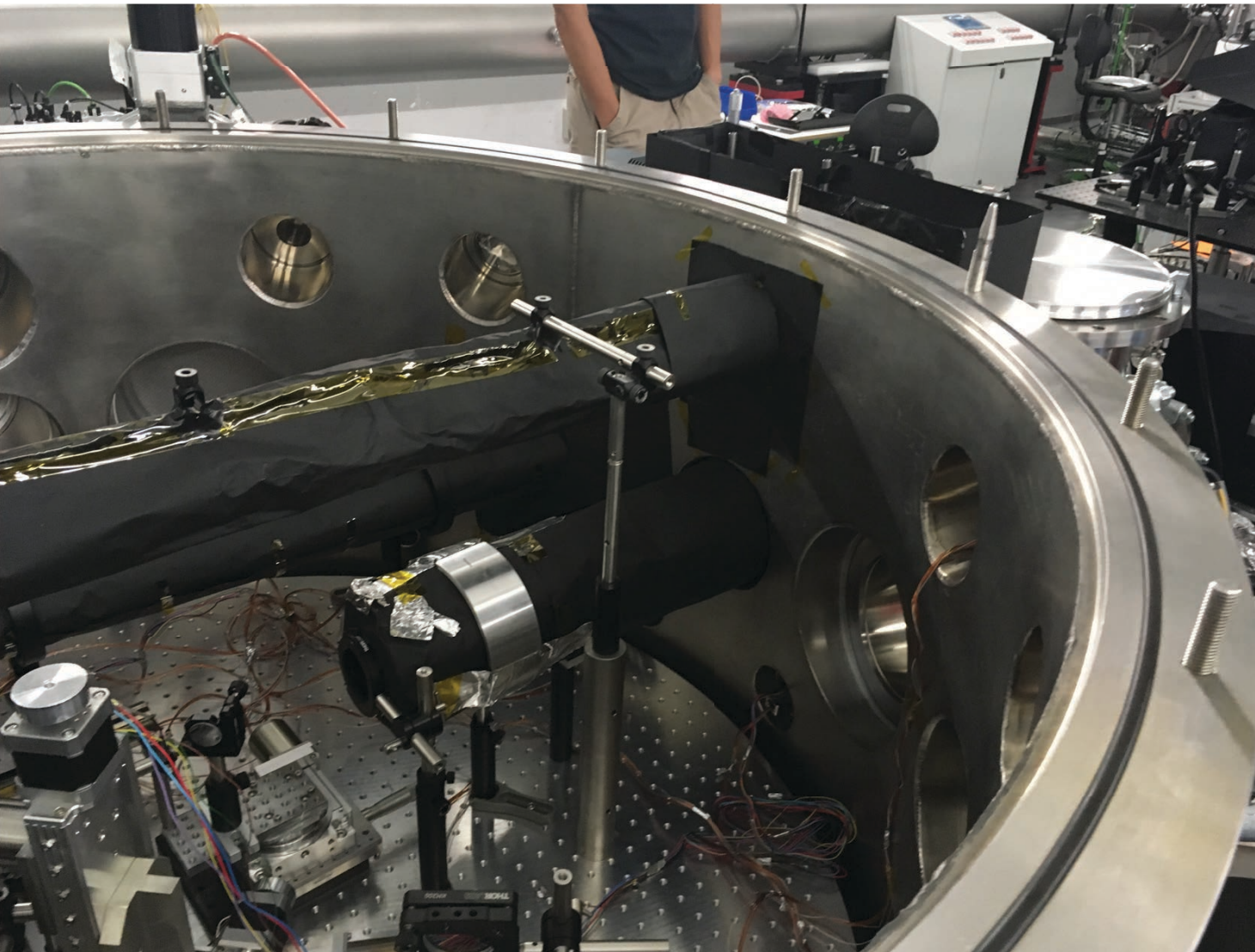


Experimental setup



Thomson Scattering at CLPU

avoid 800 nm scattering



Robert Fedosejevs
Andrew Longman

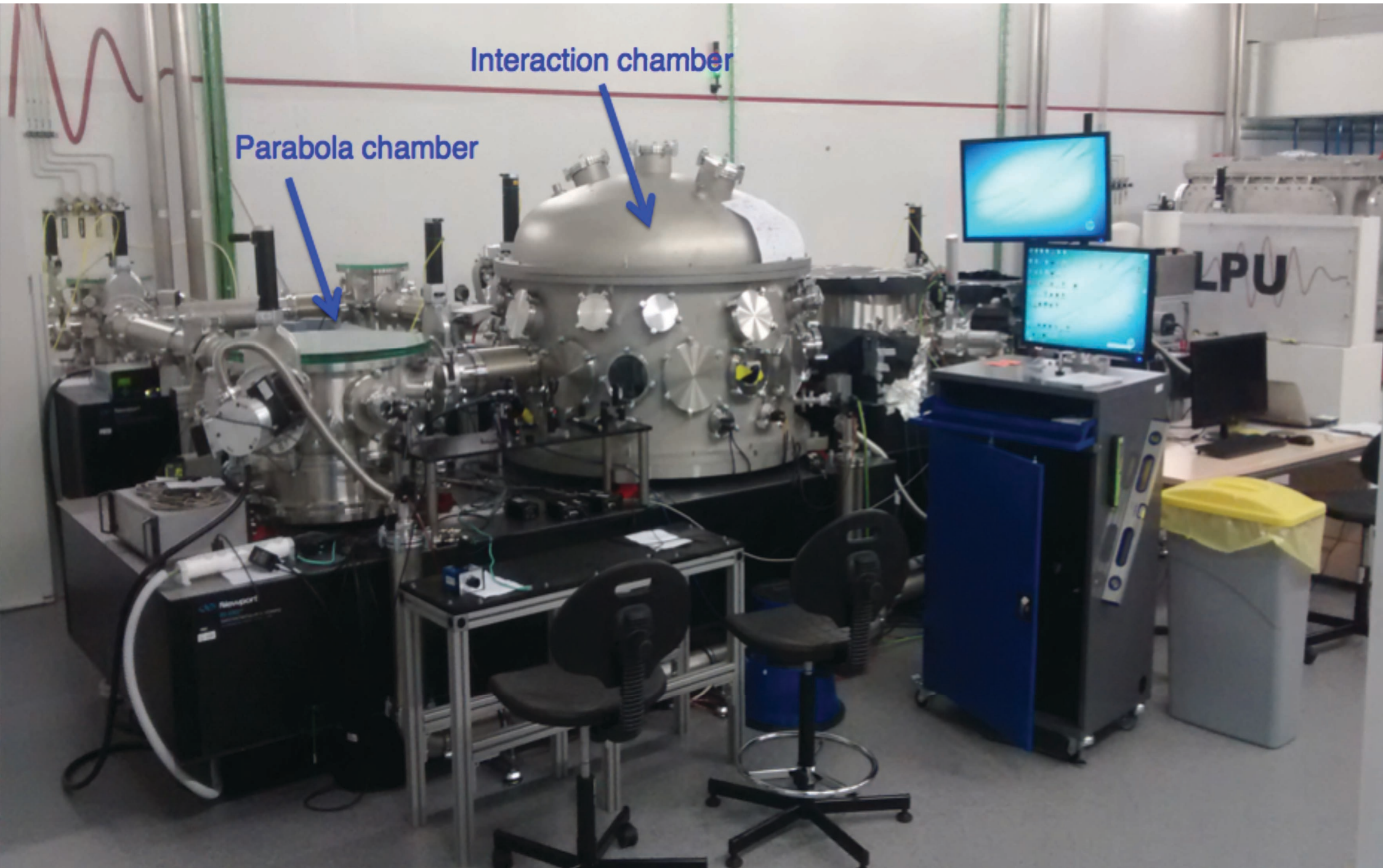


Wendell T Hill
Calvin He



Luis Roso
Giancarlo Gatti
J A Pérez-Hernández





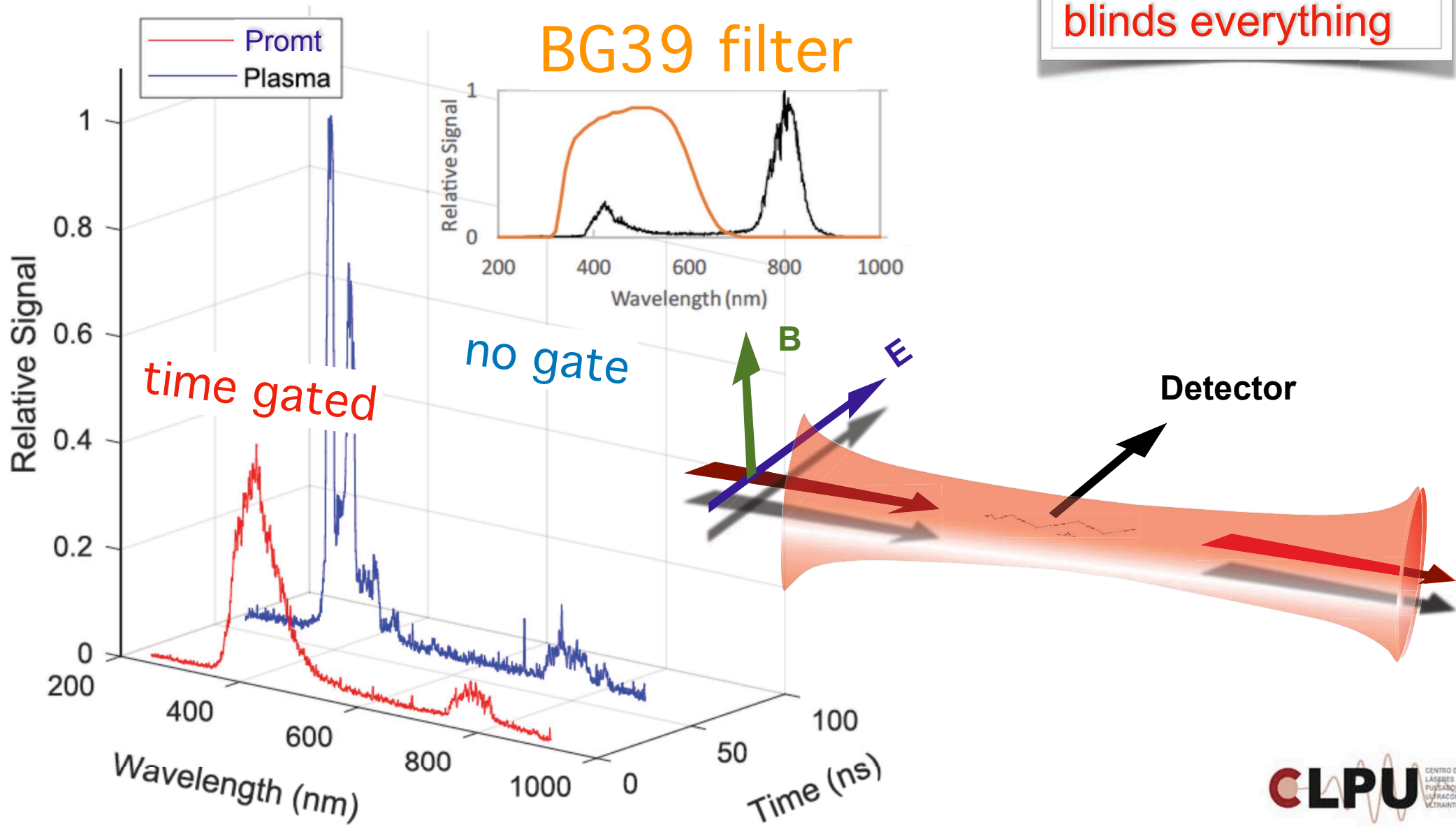
Interaction chamber

Parabola chamber

LPU

Experimental set up

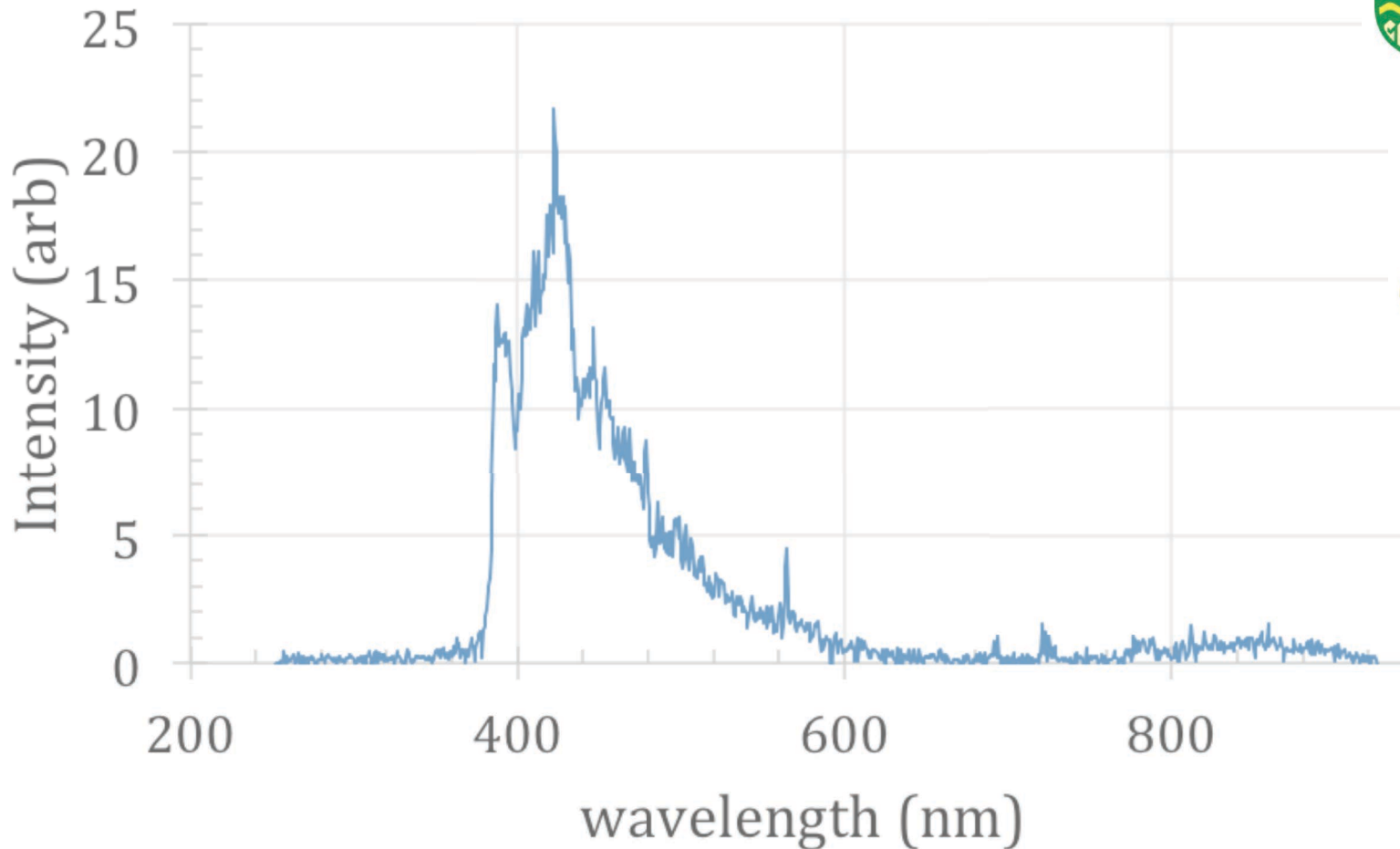
Residual 800 nm scattering at walls blinds everything



Thomson Scattering at CLPU



Second harmonic doppler shift



Robert Fedosejevs
Andrew Longman



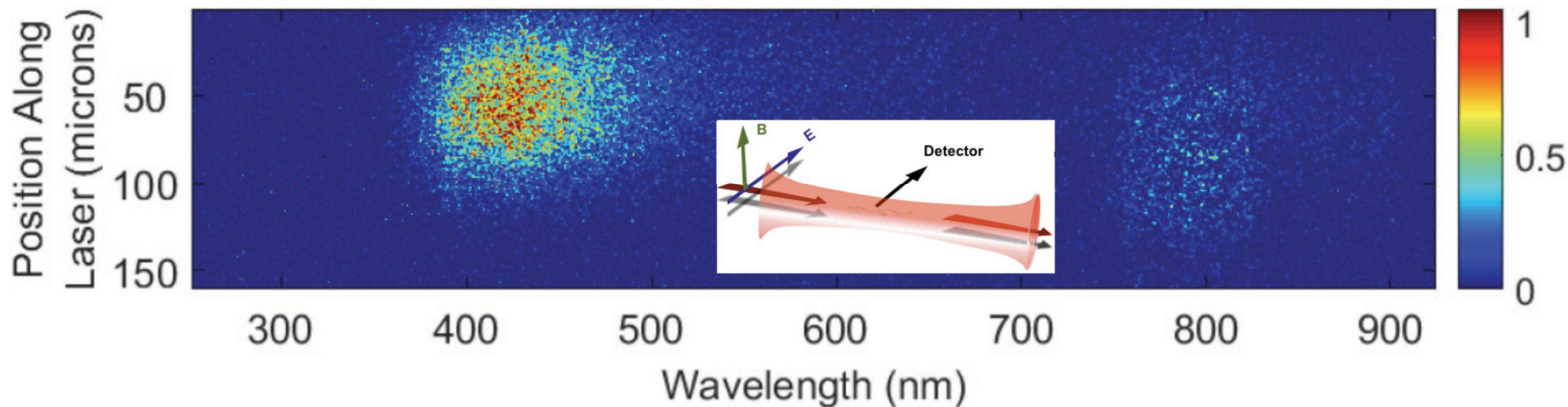
Wendell T Hill
Calvin He



Luis Roso
G Gatti
J A Pérez-Hernández

Optics Express, 2019





Towards an *in situ*, full-power gauge of the focal-volume intensity of petawatt-class lasers

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Conclusions

- Its a long way to achieve a useful high power laser
- Many points where we need to push the thecnology beyond today's limits.
- One of them is a direct measure of the focus profile at high intensity
- At Salamanca we have a PW laser at 1 Hz and a 200 TW at 10Hz open for competitive access and we are looking for users/collaborators !!!



Robert Fedosejevs
Andrew Longman



Wendell T Hill
Calvin He

Giancarlo Gatti
Luca Volpe

José Antonio Pérez
Jon Apiñaniz
Carlos Salgado
Ghassan Zeraouli
Michael Touati
Marine Huault
Diego de Luis
Mauricio Rico
Massimo di Marco
Sophia Malko
Ainhoa Mantaut
Roberto Lera
José Luis Henares
Juan Hernández

Engineers ... and Co

Cruz Mendez

Enrique García
Oscar Varela
Irene Hernández
Jose David Pisonero
Javier García
Jose Luis Sagredo
Marta Olivar
Carlos Albarrán

José M Alvarez

We thank also our users !!!

We are looking for scientists

