FLASH 2 beamlines - concepts and discussion.

Elke Plönjes, Bart Faatz, Josef Feldhaus, Kai Tiedtke, Rolf Treusch

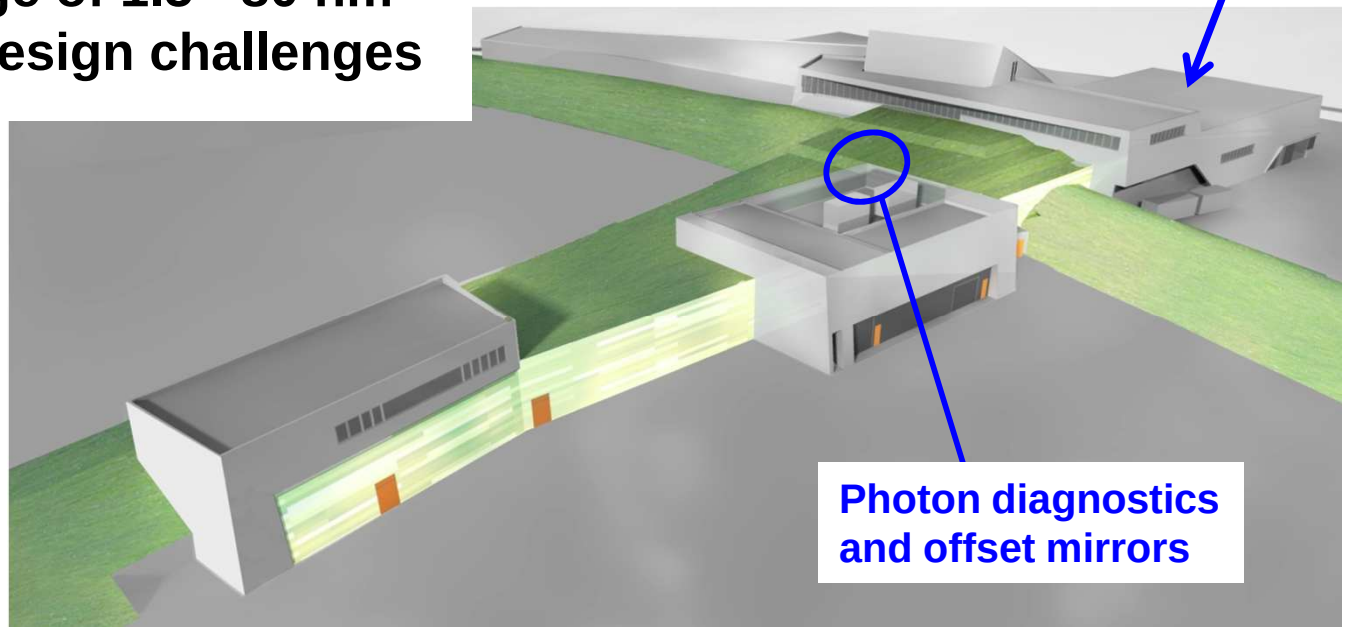
New Science Opportunities with FLASH, 12 Oct. 2011

HELMHOLTZ GEMEINSCHAFT

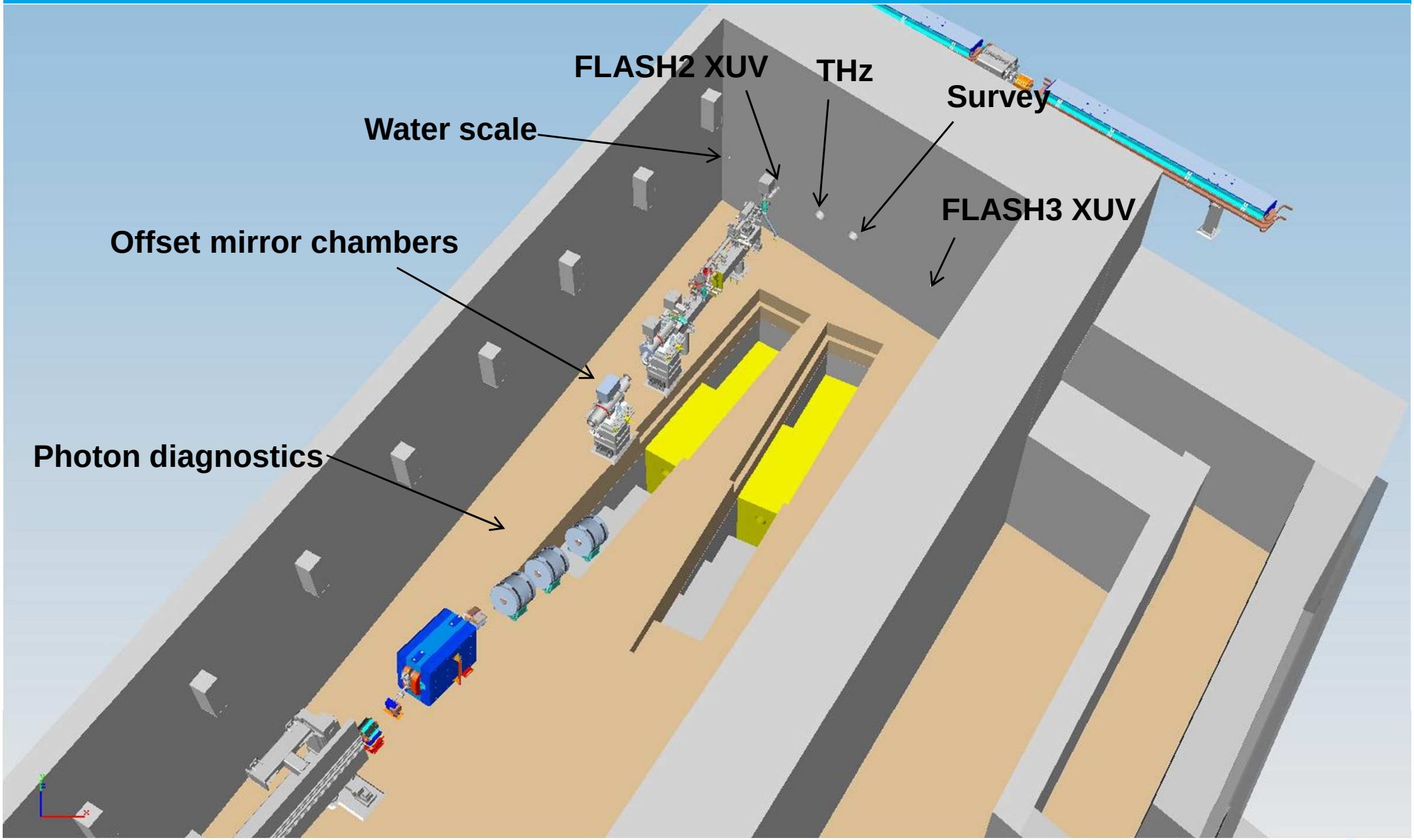
DESY

Overview.

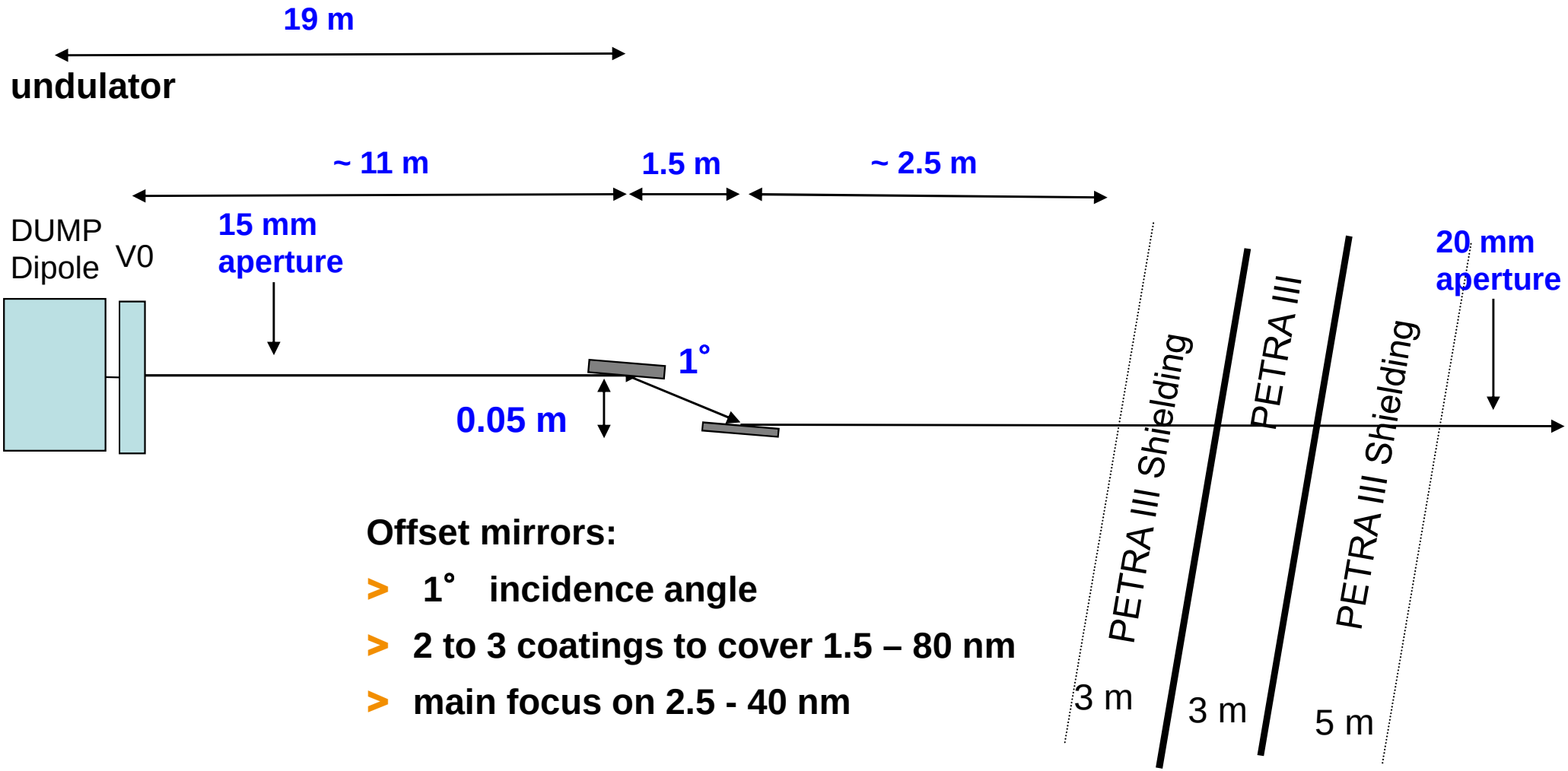
- Basic photon diagnostics and one beamline are in the budget
- Concept for entire beamline system and experimental hall is being developed now
- Wavelength range of 1.5 - 80 nm poses specific design challenges



FLASH 2 tunnel photon diagnostics area.



FLASH 2 tunnel photon beamline.

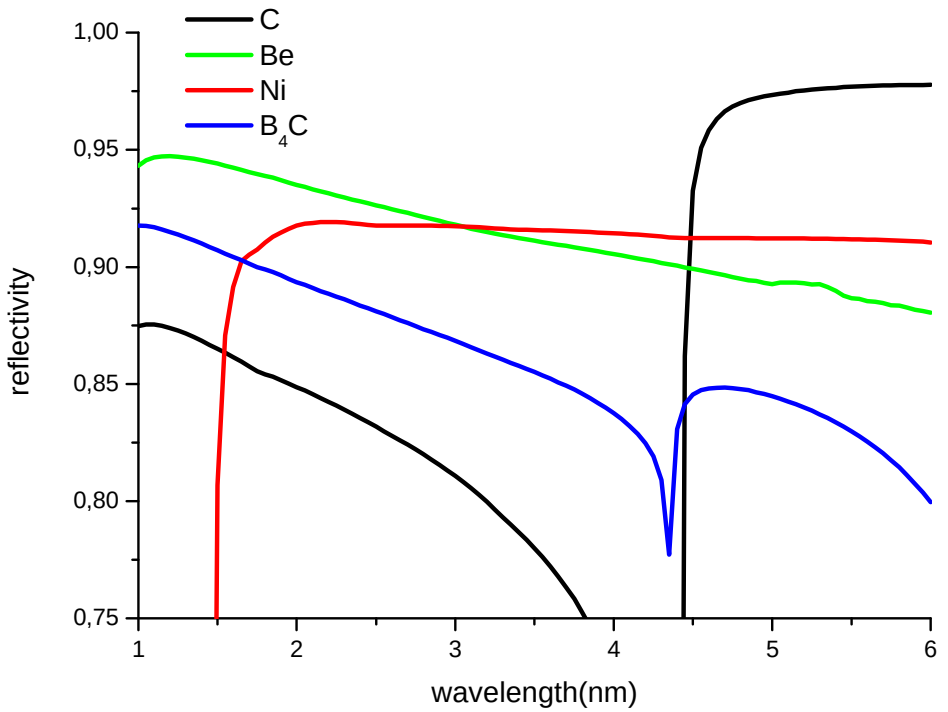


Offset mirrors:

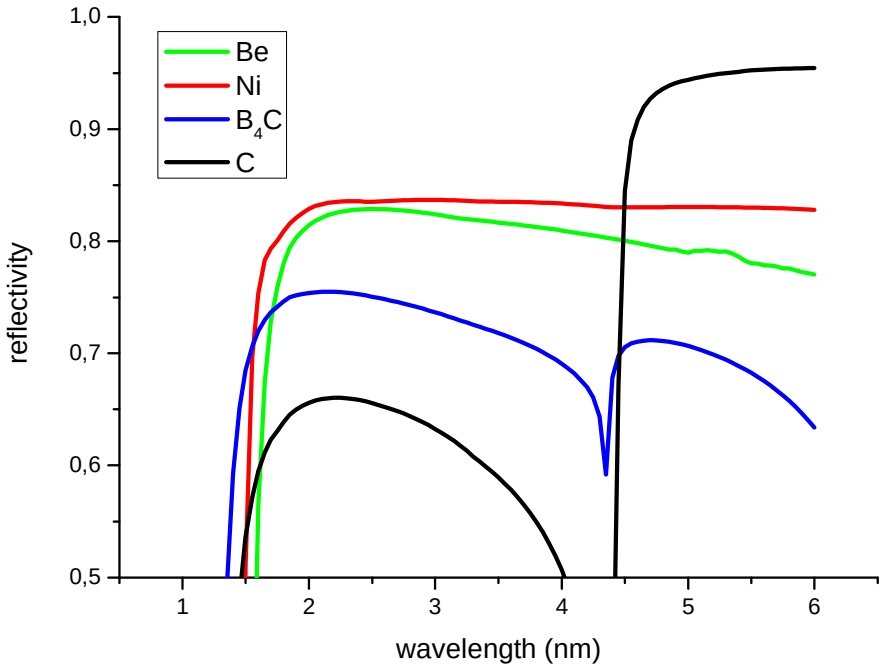
- **1° incidence angle**
- **2 to 3 coatings to cover 1.5 – 80 nm**
- **main focus on 2.5 - 40 nm**

Mirror coatings - Short wavelengths.

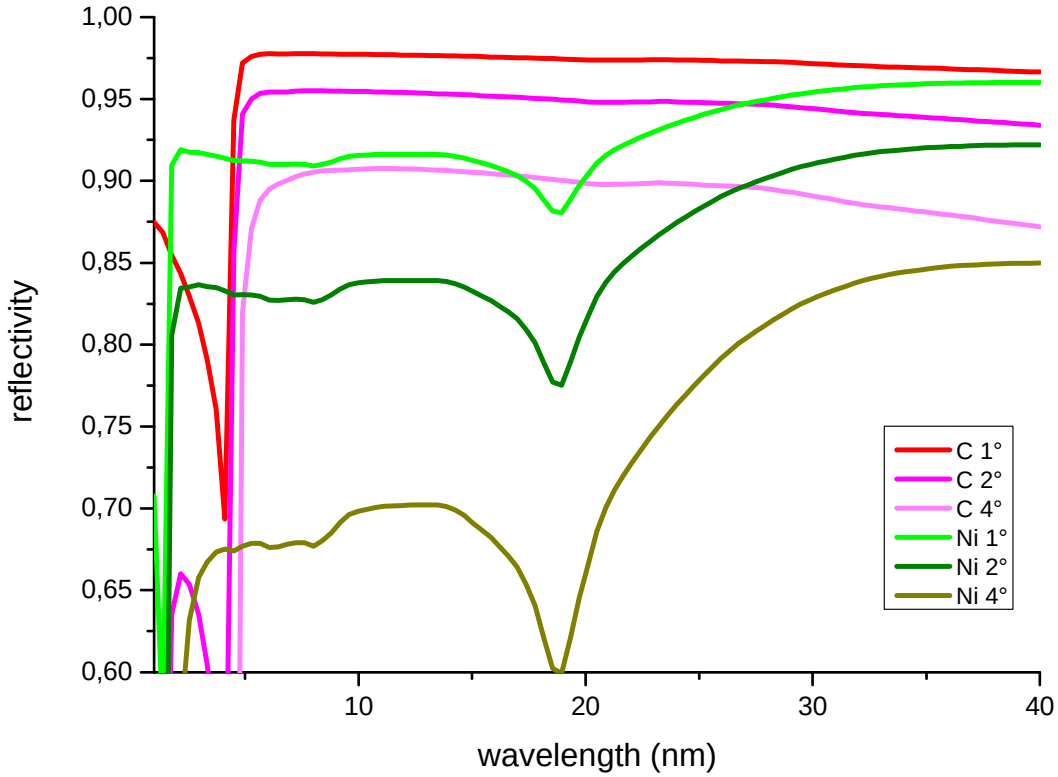
1 ° incidence angle



2 ° incidence angle

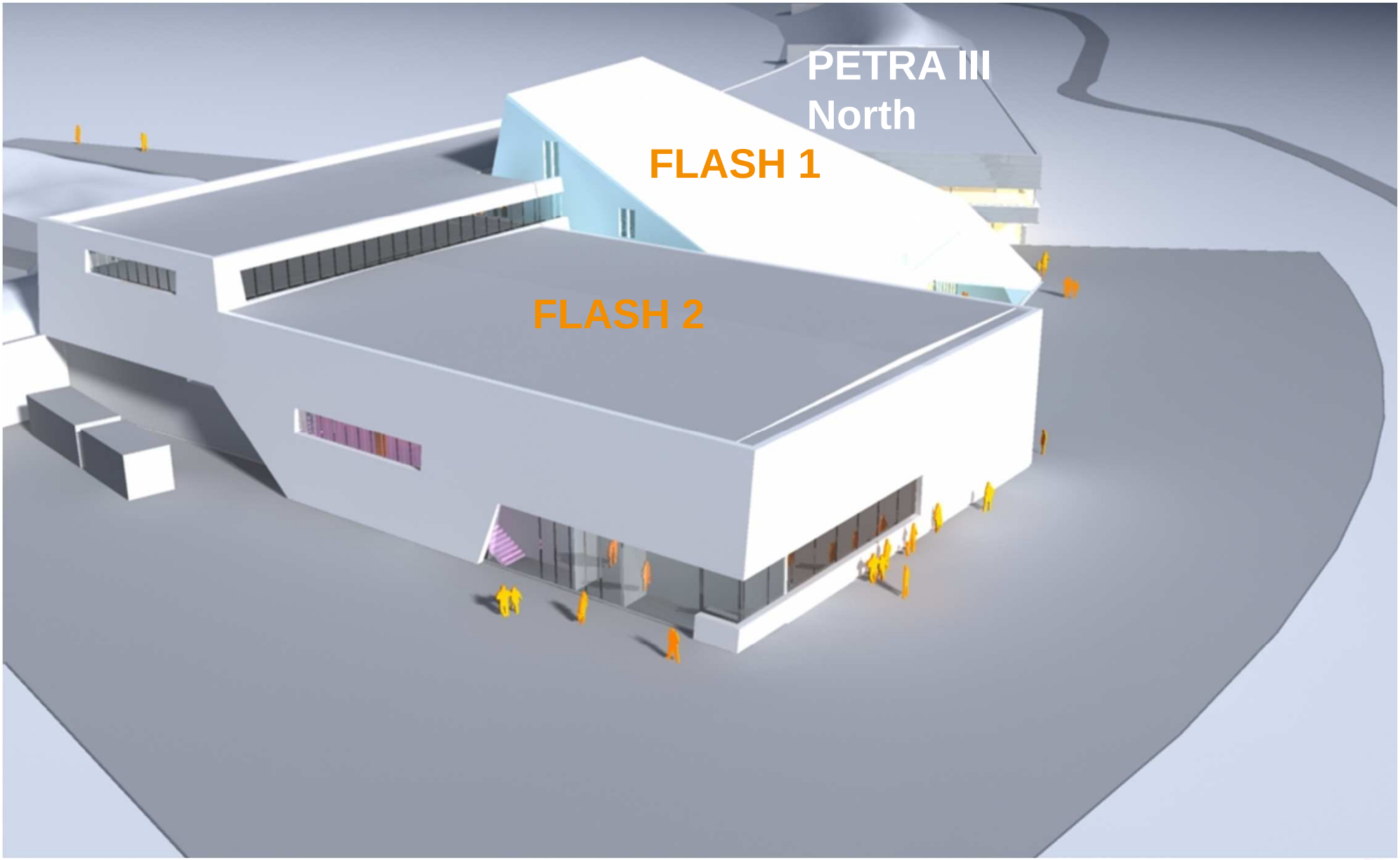


Mirror coatings for FLASH 2.



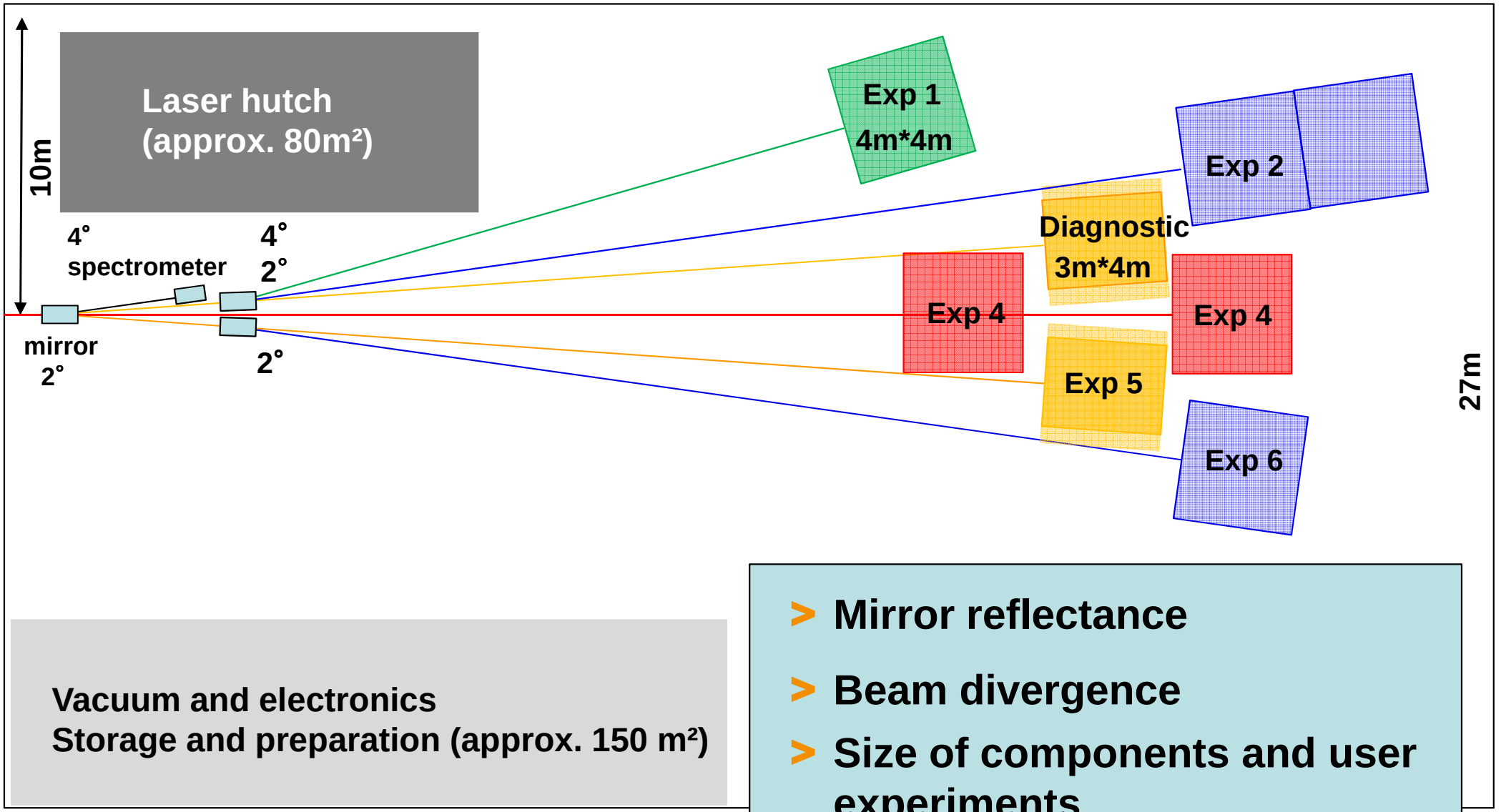
- **High efficiency (small geometric losses, high reflectivities)**
- **Mirror damage due to high FLASH powers**
- **Main focus on 2.5 to 40 nm**
- **Silicon mirrors with C coating**
- **For λ ≤ 4.3nm (C1s) additional Ni coating for plane mirrors**
- **Focussing optics pose special issues**

FLASH hall 3D view – outside.



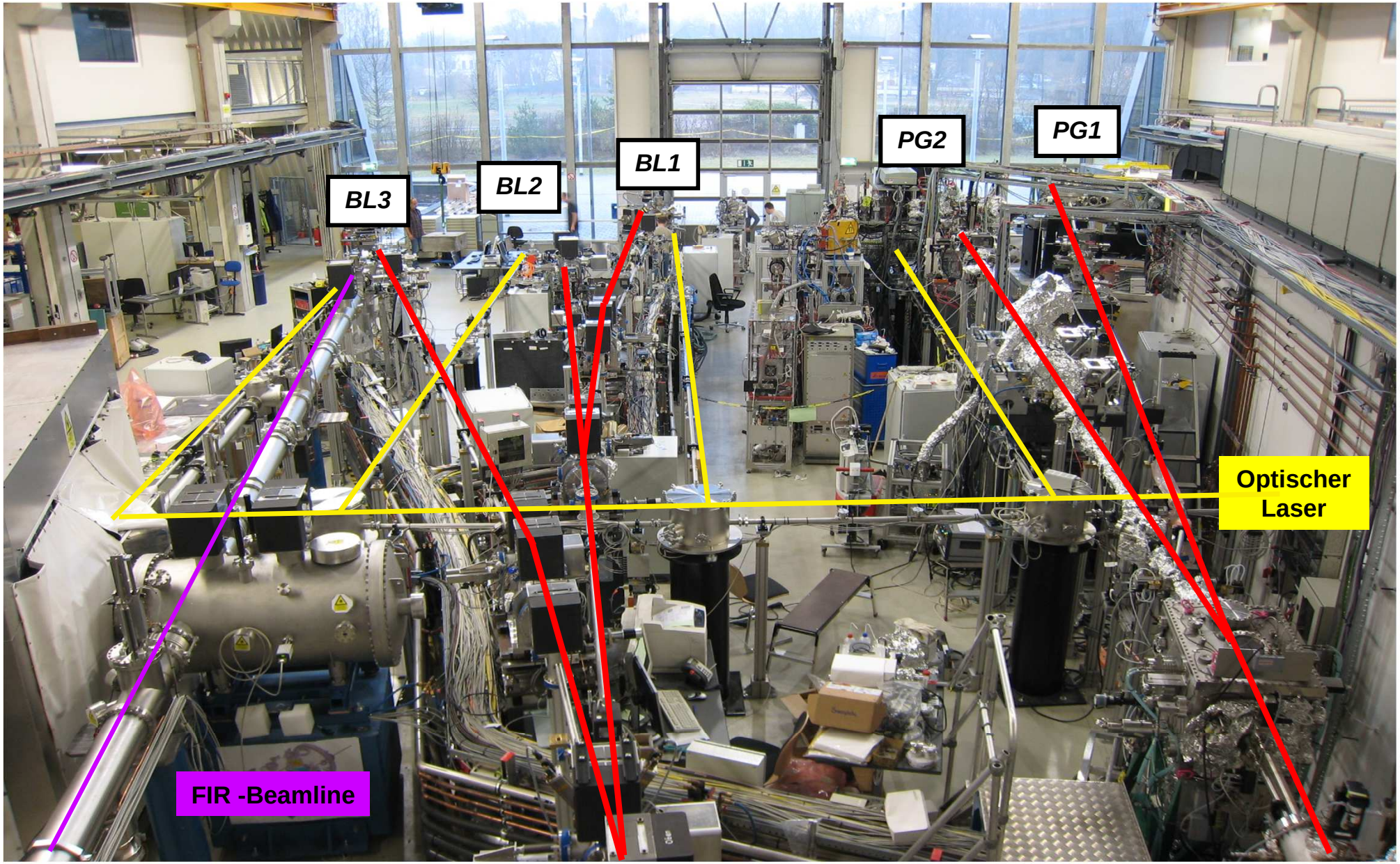
FLASH hall 3D view – inside.

Draft layout of FLASH 2 experimental hall.

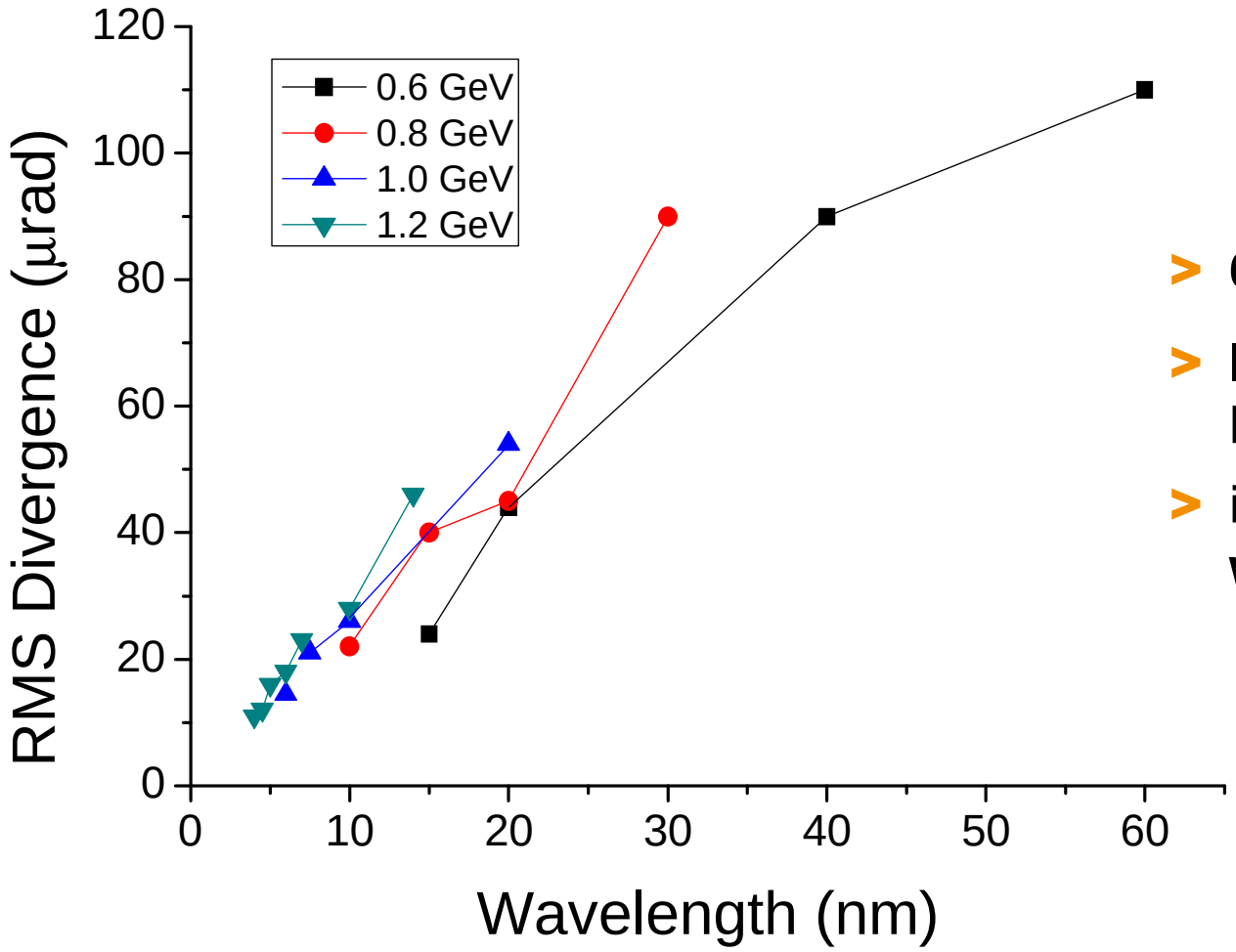


- Mirror reflectance
- Beam divergence
- Size of components and user experiments

FLASH(1) experimental hall.



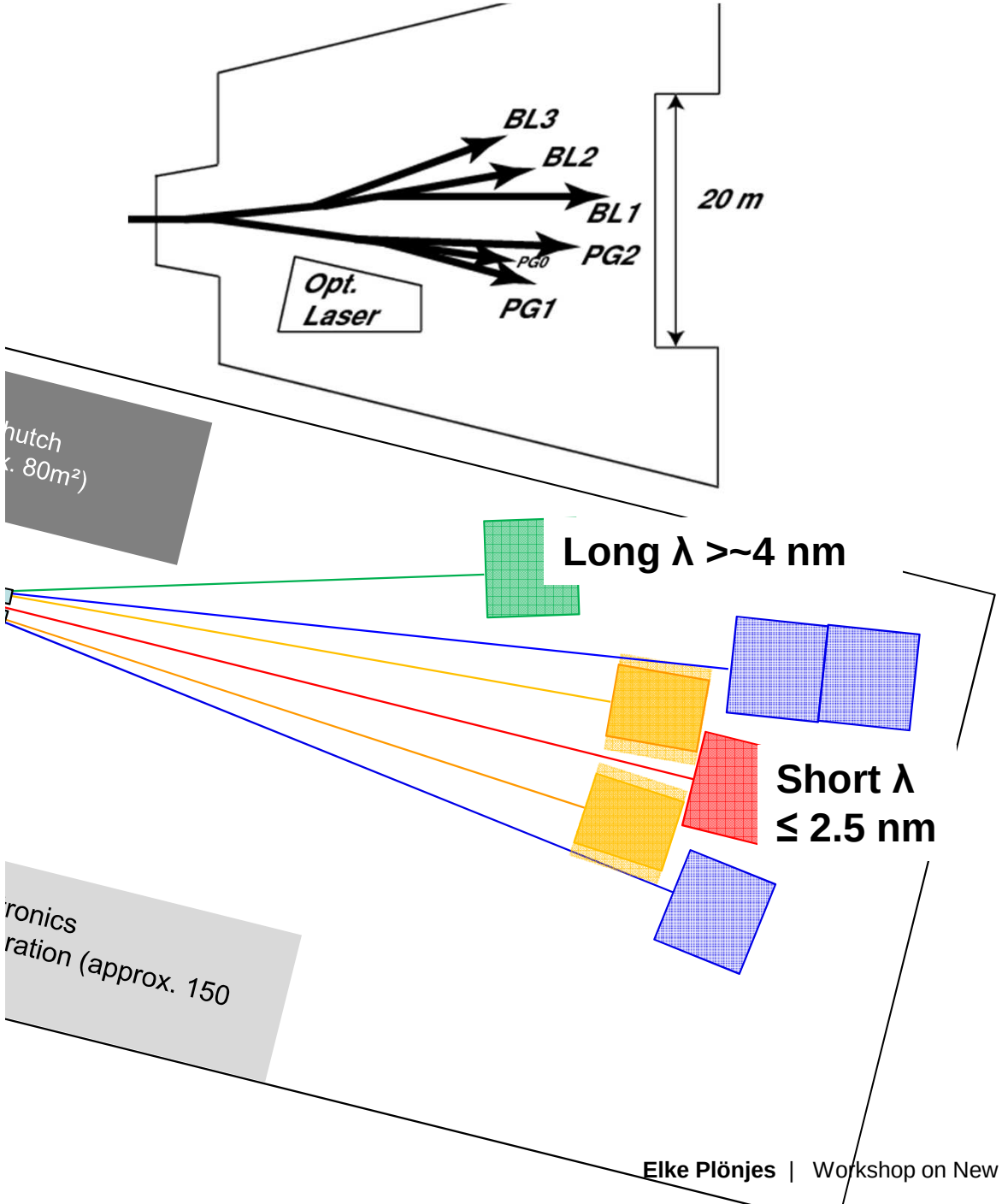
Divergence for different wavelengths.



- **6σ acceptance is the goal**
- **limited by far-field in the hall**
- **in tunnel at least 100 μrad with 6σ**

Divergence for all wavelengths depends on beam energy and (slightly) on beam emittance

Draft layout of beamlines.



FLASH 1:

- At least one beamline will be rebuilt to accommodate shortest wavelengths

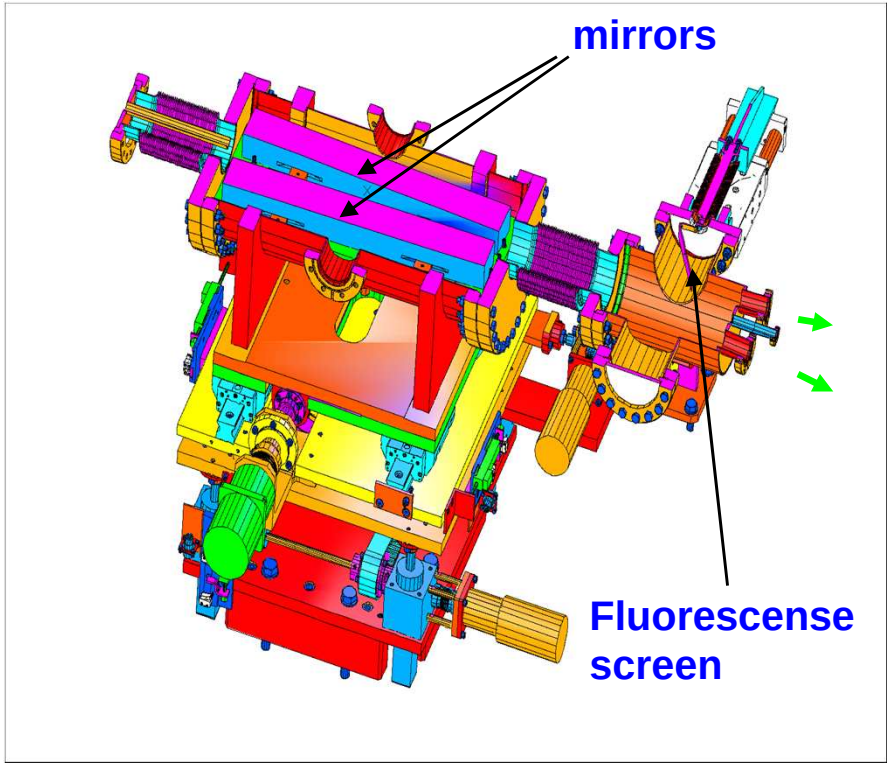
FLASH 2:

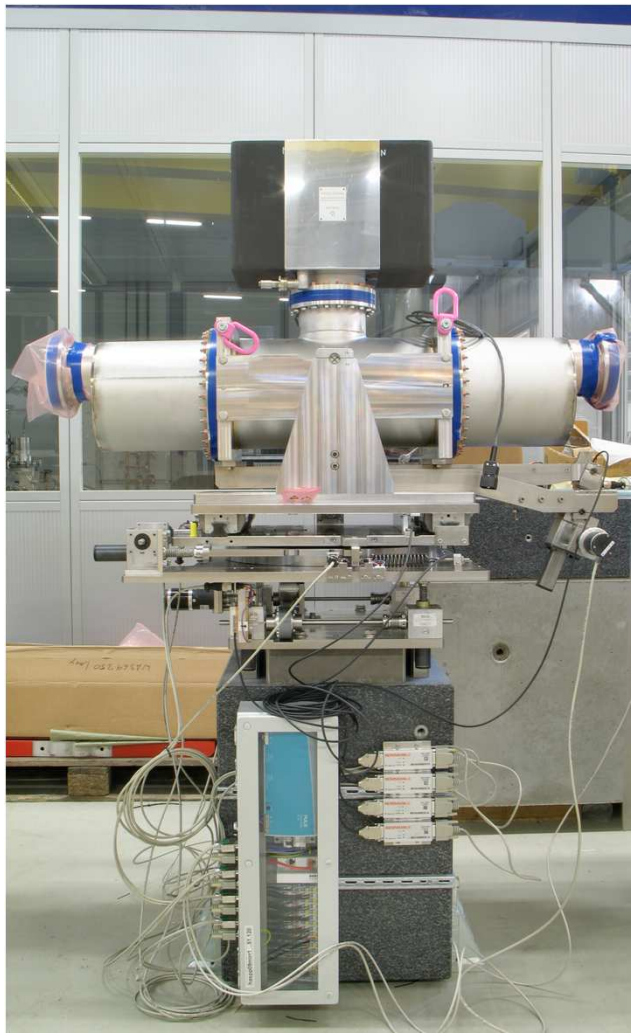
- Main range 2.5 - 40 nm (at most beamlines with 2°)
- Plane mirrors with C and Ni
- Focussing optics only for selected range

What do you need?

Beamline components - mirror chambers.

- One type of chamber minimizes construction time and cost
- Option to install one or two mirrors
- Outside movements – improved PETRA III design
- PETRA III design - up to 1m long mirrors with 3 coatings

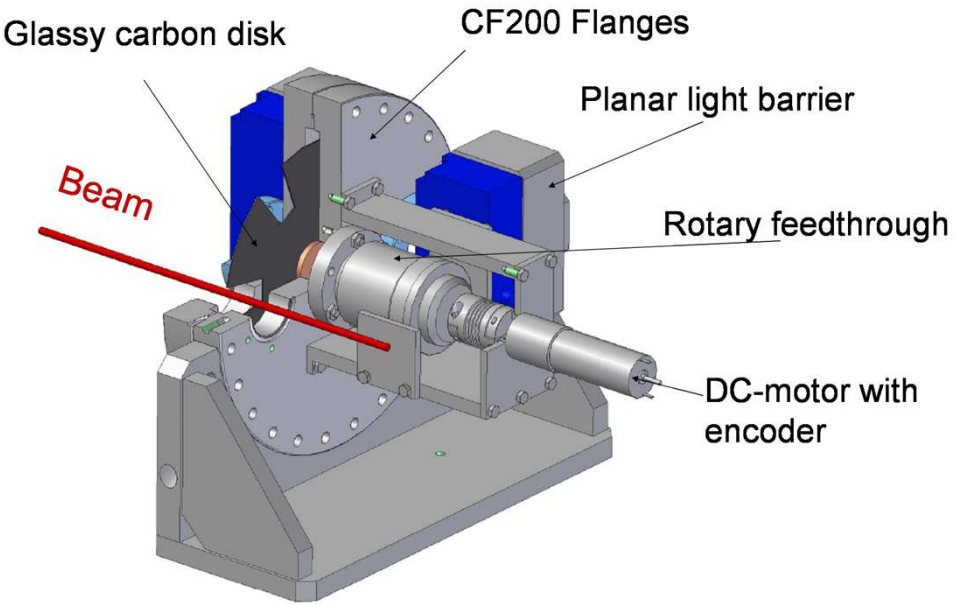




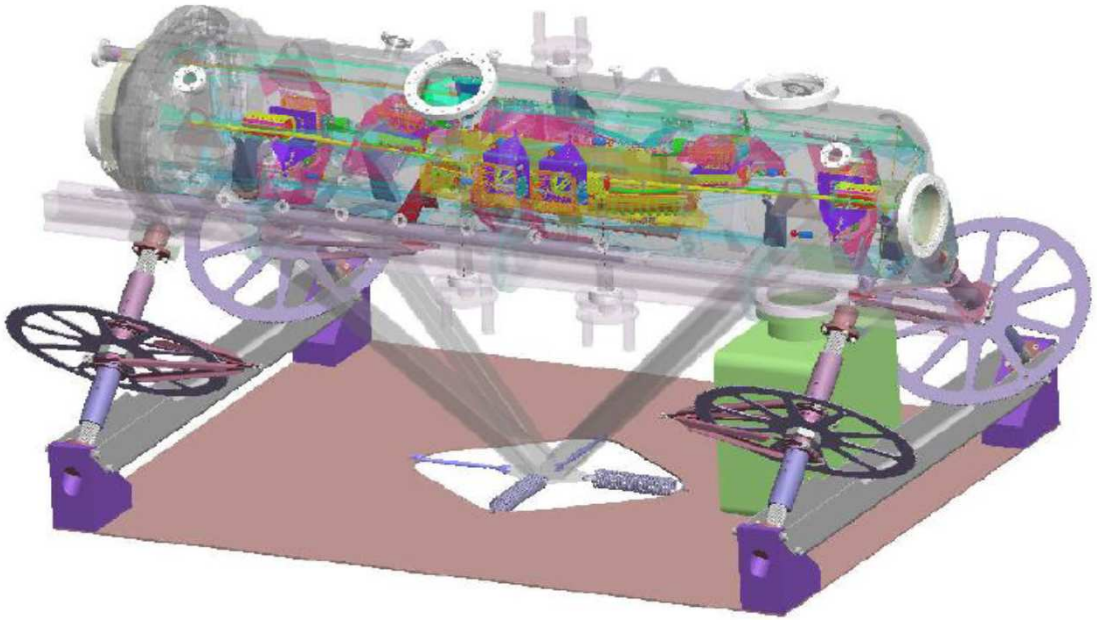
PETRA III mirror chamber

Beamline components.

- Fast (bunch train) shutter
- Alignment lasers for all beamlines
- Fast switching mirror (2.5 Hz)?



Beamline components - split and delay units.

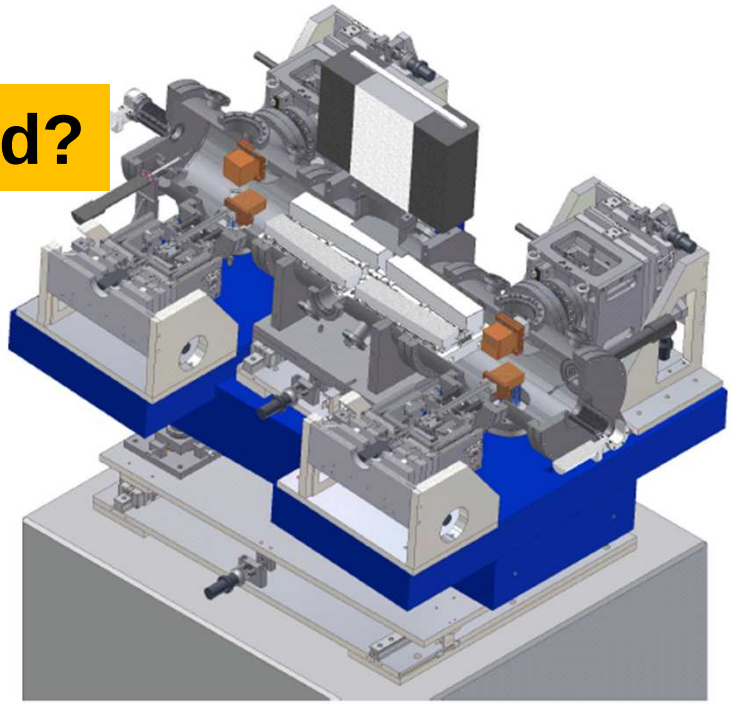


- Installed at BL2
- Design for 6 – 40 nm
- C coated mirrors with up to 6° incidence angle
- Delay range – 3 ps to +20 ps

R. Mitzner et al, Opt. Exp. 16, 19909 (2008)

What do you need?

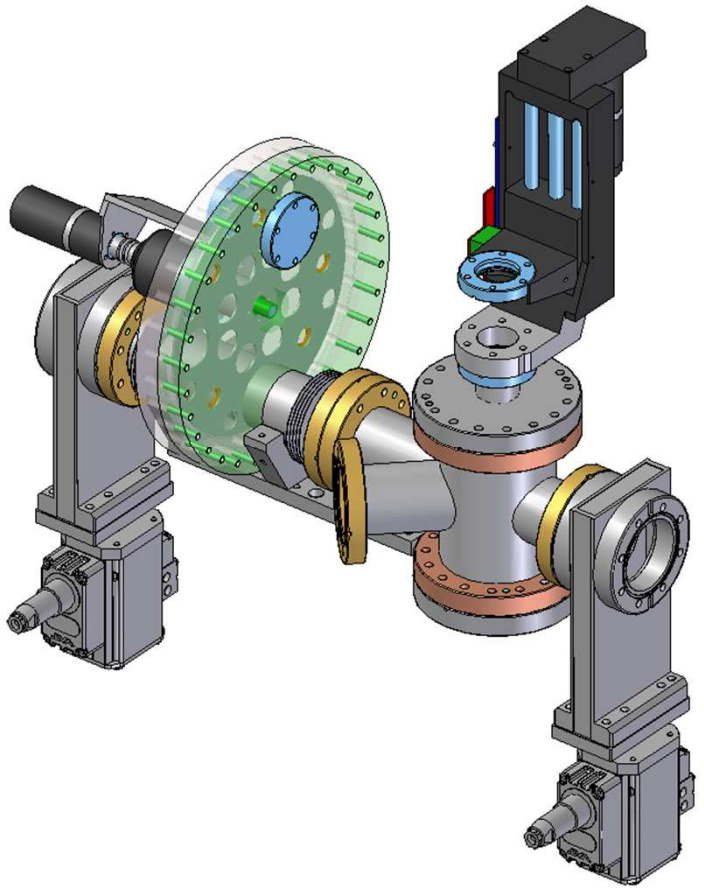
- Installed at PG2
- Design for 4.3 – 35 nm with up to 5 ° incidence angle
- Delay Range ± 6 ps
- Time resolution < 1 fs



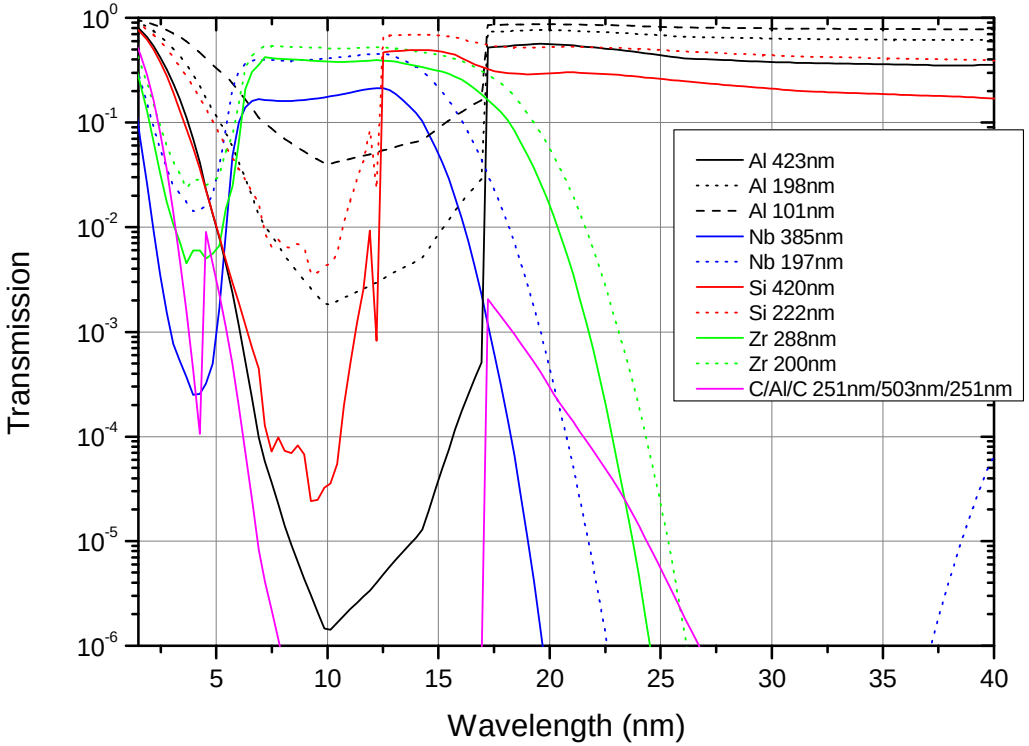
W.F. Schlotter et al, Opt. Lett. 35, 372 (2010)

Beamline components - suppression of harmonics.

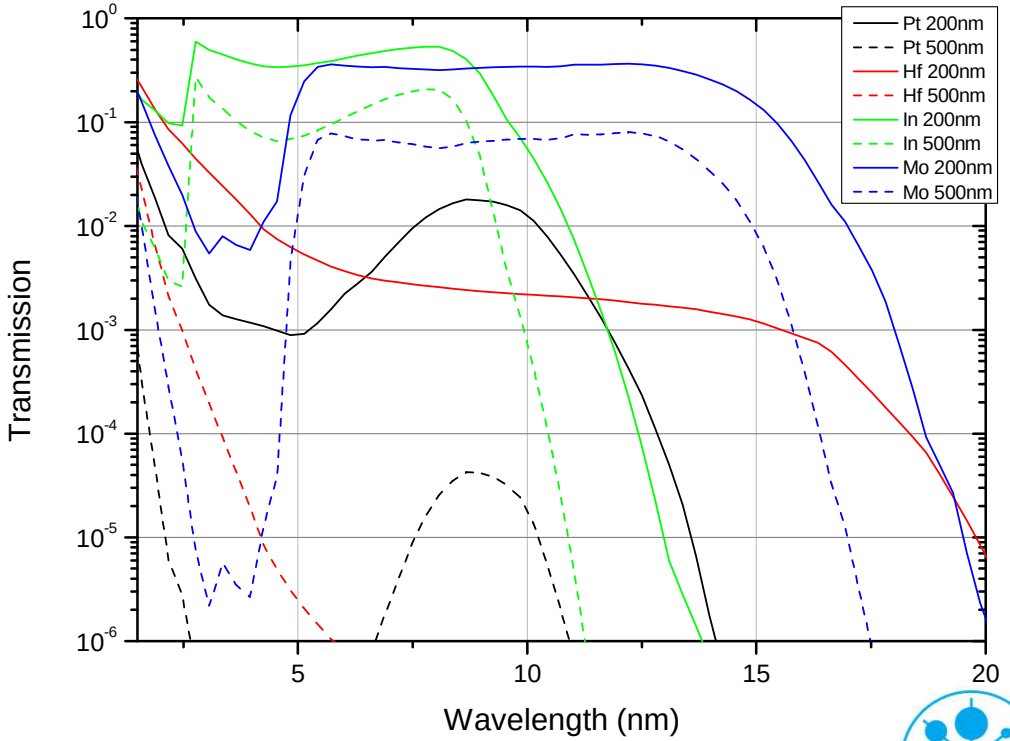
- Set of solid filters on filter wheel
- Gas attenuator
- Spectral filtering using multilayer mirrors
- Advanced optical designs
  - Time-compensated broad-band monochromator (Luca Poletto, Padua)



Transmission filters for FLASH 2.

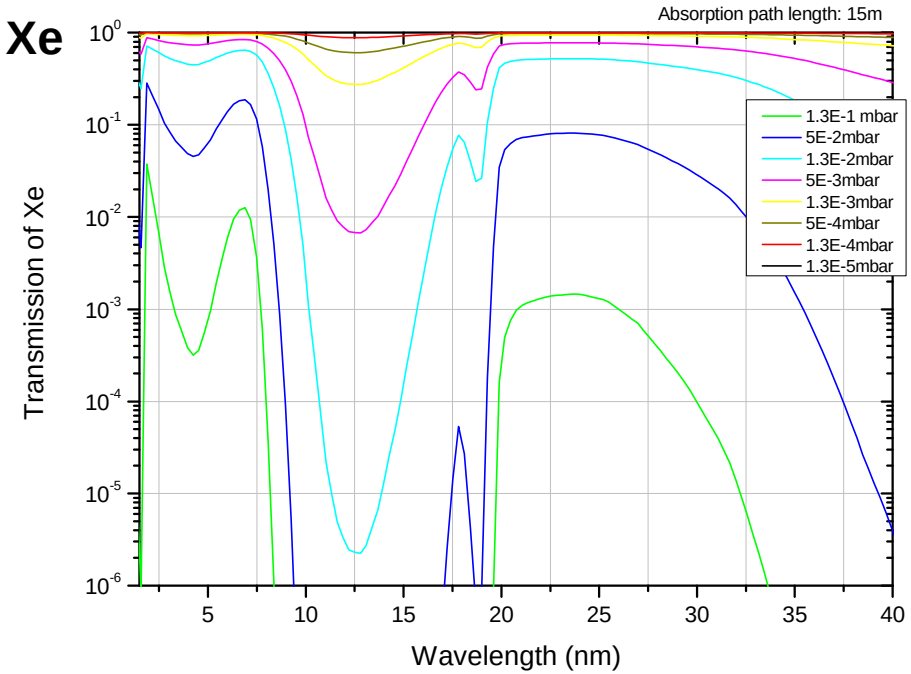


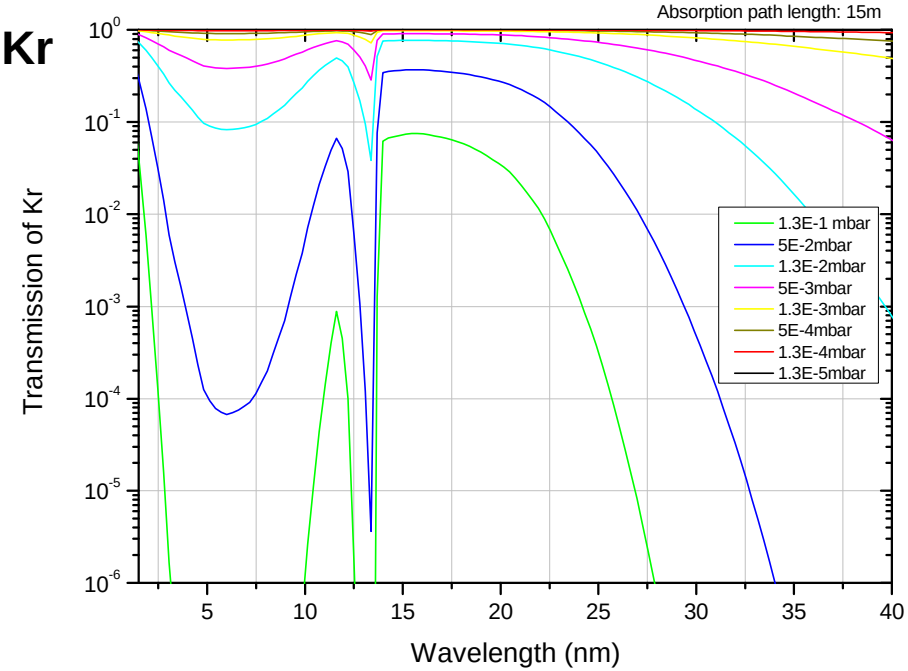
- above 4nm sufficient suppression
- take care of beam intensities and use gas attenuator in combination

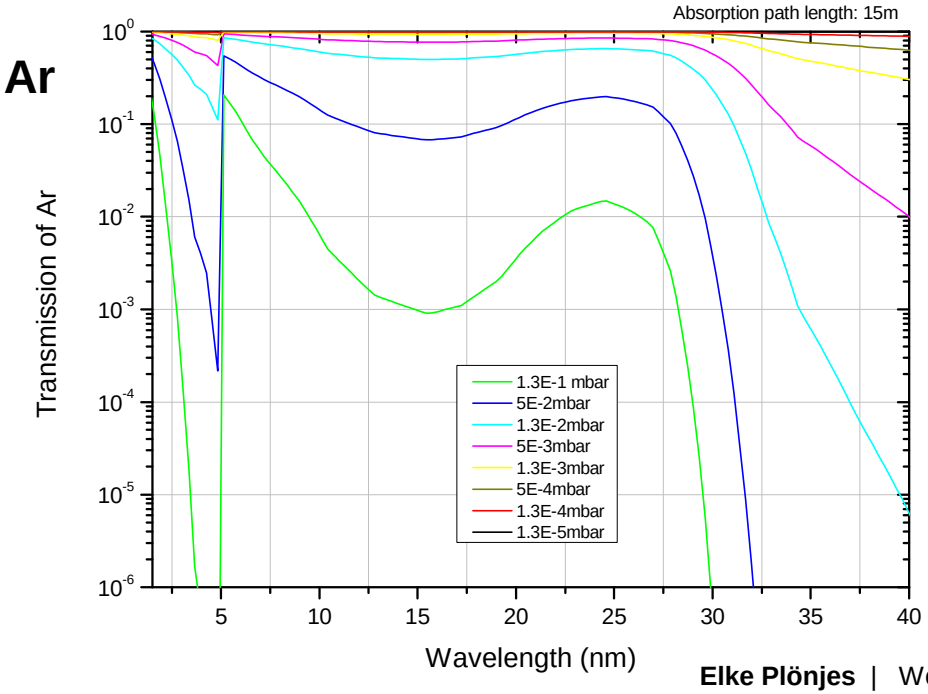


- below 4nm suppression only possible using thick, fragile and unusual filter materials
- ~ 1.5nm suppression is an issue

Gas attenuator transmission down to 1.5nm.







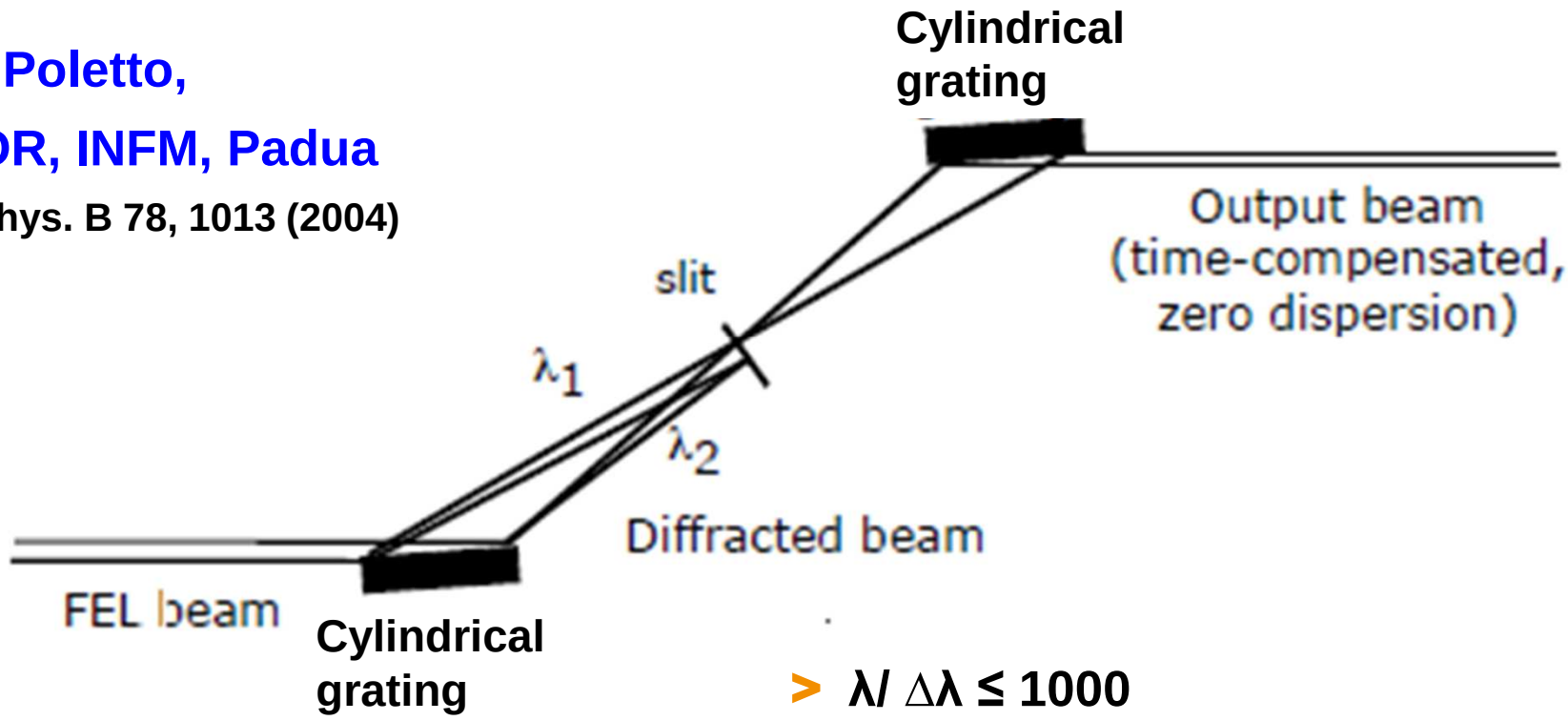
- **gas attenuator will have larger pressure range up to 0.1 mbar**
- **partial suppression below 4nm is possible with Xe, Kr and Ar**
- **Ne and N not below 4nm**
- **~ 1.5nm suppression is still an issue**

Time-compensated broad-band monochromator.

Luca Poletto,

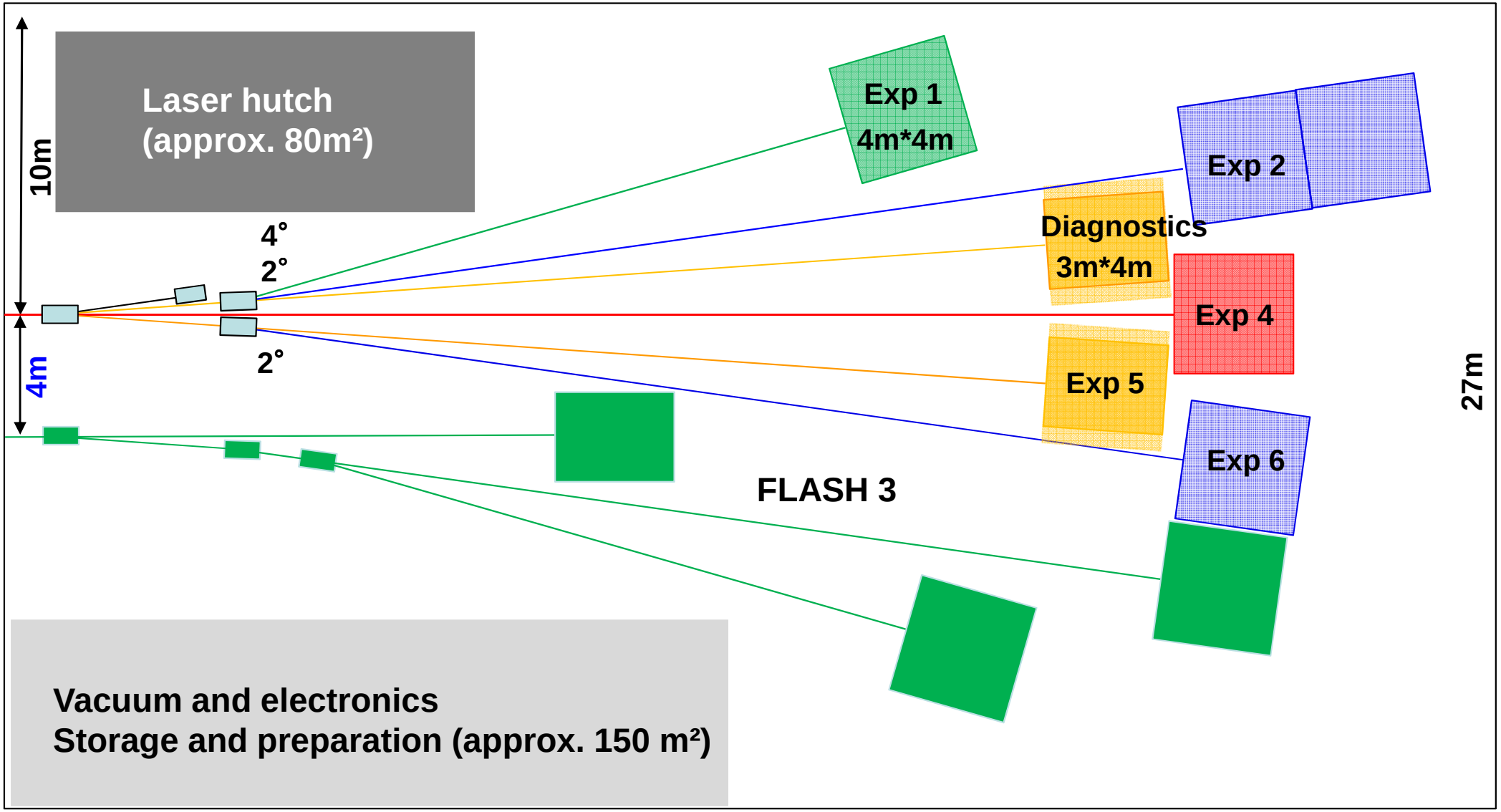
LUXOR, INFM, Padua

Appl.Phys. B 78, 1013 (2004)

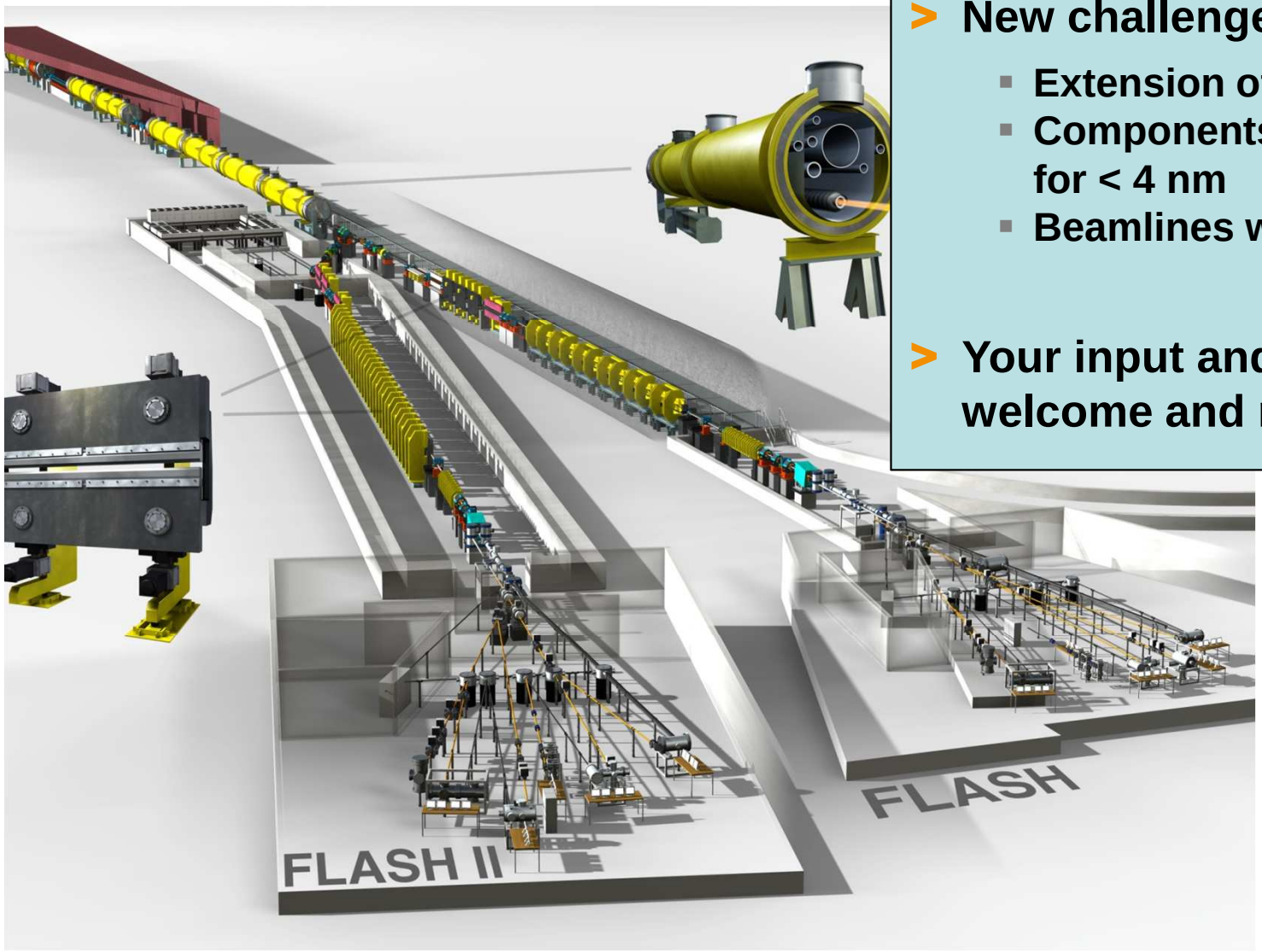


- **$\lambda / \Delta\lambda \leq 1000$**
- **Design for > 5 nm**
- **Dedicated beamline for a certain wavelength range**
- **Complementary to high resolution monochromator at FLASH**

FLASH 3.


Laser hutch
(approx. 80m²)
10m
4m
4°
2°
2°
Exp 1
4m*4m
Exp 2
Diagnostics
3m*4m
Exp 4
Exp 5
Exp 6
FLASH 3
27m
Vacuum and electronics
Storage and preparation (approx. 150 m²)
50m

Summary.



- Many ideas and components can be used from FLASH
- New challenges
  - Extension of wavelength range
  - Components have to be developed for < 4 nm
  - Beamlines will be more specialized
- Your input and contributions are welcome and needed

Thank you to the FLASH team!

W. Ackermann, G. Asova, V. Ayvazyan, A. Azima, N. Baboi, J. Bähr, V. Balandin, B. Beutner, A. Brandt, A. Bolzmann, R. Brinkmann, O.I. Brovko, M. Castellano, P. Castro, L. Catani, E. Chiadroni, S. Choroba, A. Cianchi, J.T. Costello, D. Cubaynes, J. Dardis, W. Decking, H. Delsim-Hashemi, A. Delserieys, G. Di Pirro, M. Dohlus, S. Düsterer, A. Eckhardt, H.T. Edwards, B. Faatz, J. Feldhaus, K. Flöttmann, J. Frisch, L. Fröhlich, T. Garvey, U. Gensch, Ch. Gerth, M. Görler, N. Golubeva, H.-J. Grabosch, M. Grecki, O. Grimm, K. Hacker, U. Hahn, J.H. Han, K. Honkavaara, T. Hott, M. Hüning, Y. Ivanisenko, E. Jaeschke, W. Jalmuzna, T. Jezynski, R. Kammering, V. Katalev, K. Kavanagh, E.T. Kennedy, S. Khodyachykh, K. Klose, V. Kocharyan, M. Körfer, M. Kollewe, W. Koprek, S. Korepanov, D. Kostin, M. Krassilnikov, G. Kube, M. Kuhlmann, C.L.S. Lewis, L. Lilje, T. Limberg, D. Lipka, F. Löhl, H. Luna, M. Luong, M. Martins, M. Meyer, P. Michelato, V. Miltchev, W.D. Möller, L. Monaco, W.F.O. Müller, O. Napieralski, O. Napoly, P. Nicolosi, D. Nölle, T. Nunez, A. Oppelt, C. Pagani, R. Paparella, N. Pchalek, J. Pedregosa-Gutierrez, B. Petersen, B. Petrosyan, G. Petrosyan, L. Petrosyan, J. Pflüger, E. Plönjes, L. Poletto, K. Pozniak, E. Prat, D. Proch, P. Pucyk, P. Radcliffe, H. Redlin, K. Rehlich, M. Richter, M. Roehrs, J. Roensch, R. Romaniuk, M. Ross, J. Rossbach, V. Rybnikov, M. Sachwitz, E.L. Saldin, W. Sandner, H. Schlarb, B. Schmidt, M. Schmitz, P. Schmüser, J.R. Schneider, E.A. Schneidmiller, S. Schnepp, S. Schreiber, M. Seidel, D. Sertore, A.V. Shabunov, C. Simon, S. Simrock, E. Sombrowski, A.A. Sorokin, P. Spanknebel, R. Spesyvtsev, L. Staykov, B. Steffen, F. Stephan, F. Stulle, H. Thom, K. Tiedtke, M. Tischer, S. Toleikis, R. Treusch, D. Trines, I. Tsakov, E. Vogel, T. Weiland, H. Weise, M. Wellhöfer, M. Wendt, I. Will, A. Winter, K. Wittenburg, W. Wurth, P. Yeates, M.V. Yurkov, I. Zagorodnov, K. Zapfe

Thanks to all our partners:

PTB, Berlin
IOFFE Institute, St. Petersburg
CLRC, Daresbury
University of Hamburg
BESSY, Berlin
University of Münster
CNR-INFM, Padova
LASER Lab Göttingen
JINR Dubna