Infrared Beamline to Experimental Hall (IBTEH?)

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H. Delshemi, P. Schmüser, B. Schmidt (FLA)

H. W Hübers (DLR)

U. Schade (BESSY)

A. Winter, W. Seidel (FZ Rossendorf)

P. Dumas (Soleil)

O. Kozlov

G. Geloni, O. Grimm, E. Schneidmiller, M. Yurkov, E. Saldin (DESY)

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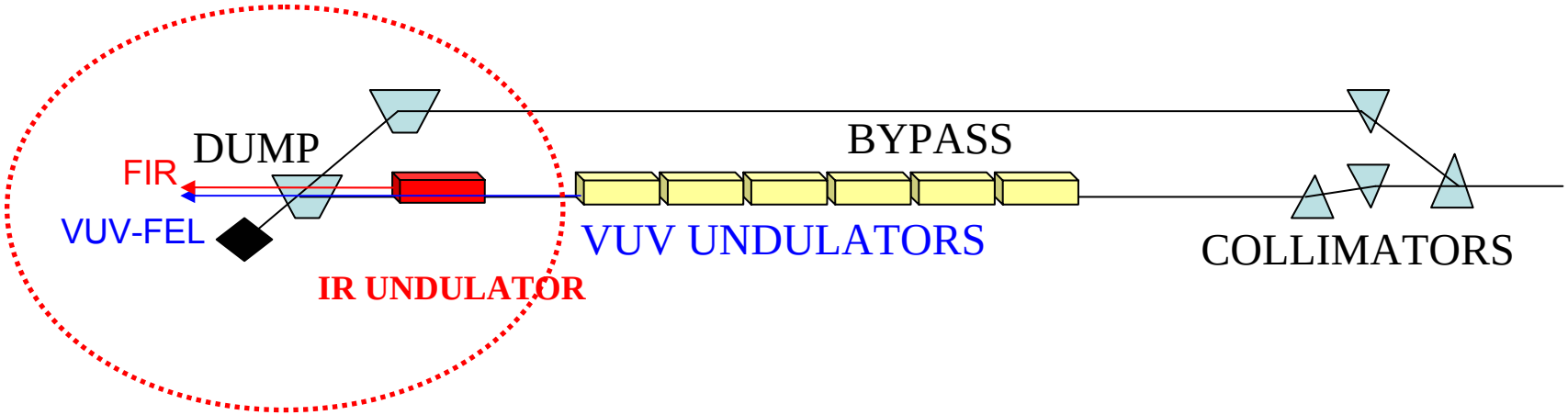
Layout

Commissioning

Motivation



Electrondiagnostics

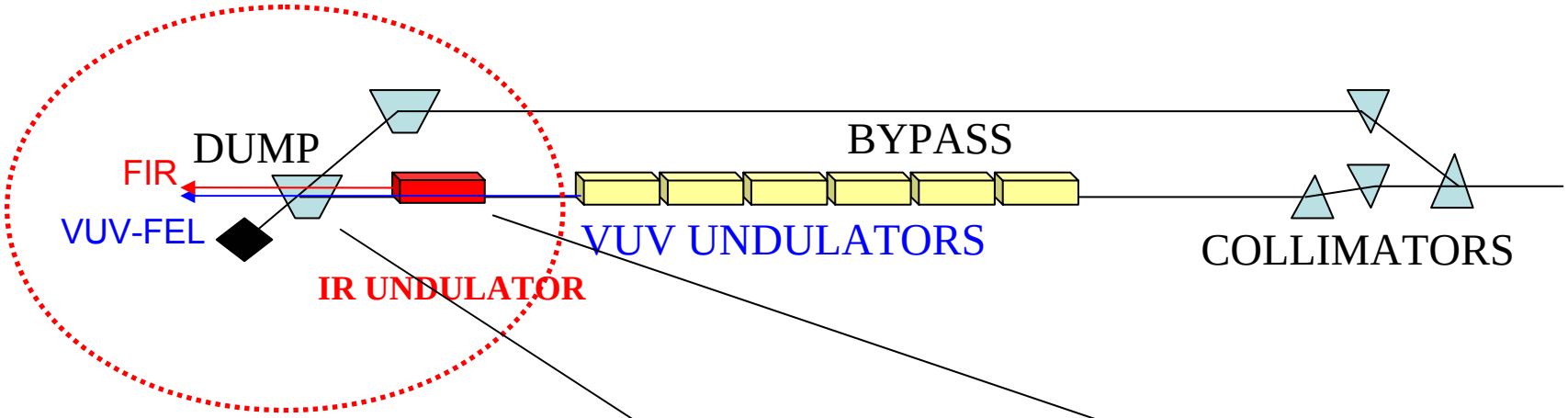
-> determination of the longitudinal electron density

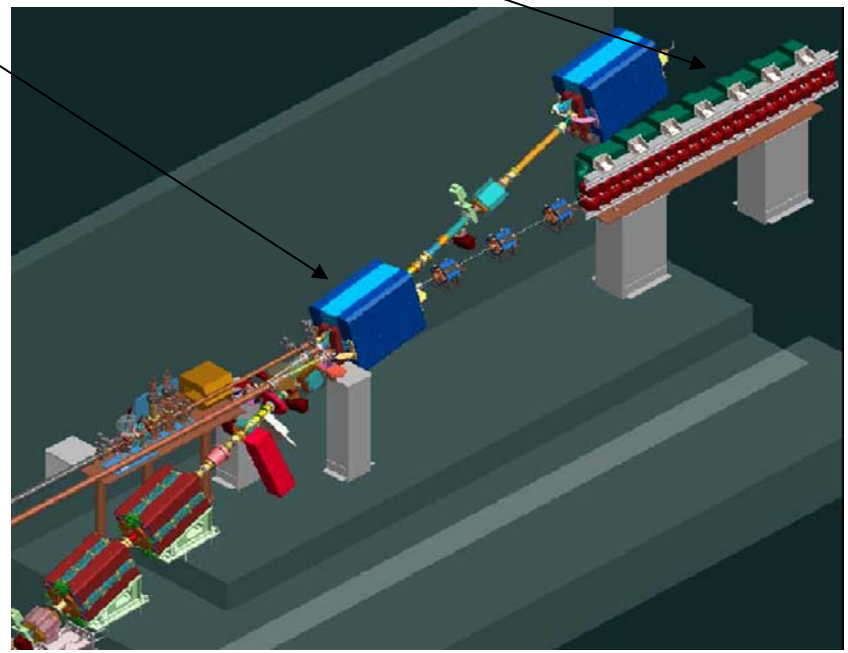
Photondiagnostics

- **intrinsic synchronization of FIR to VUV (< 20 fs, *priv. comm. M. Yurkov*)**

-> single shot determination of the timestructure of FLASH (AG Drescher/HASYLAB)

Motivation

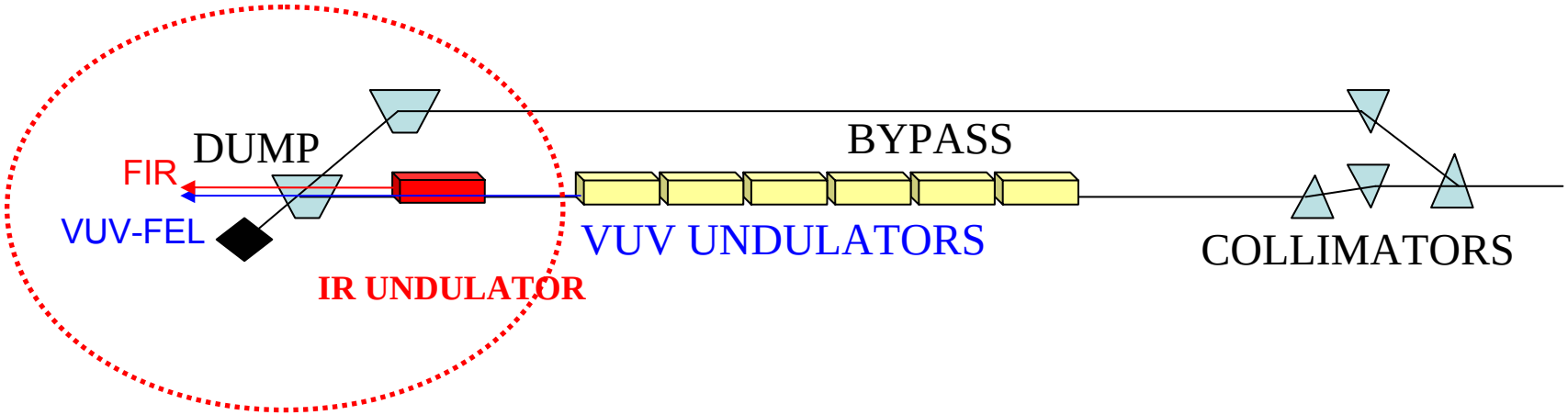




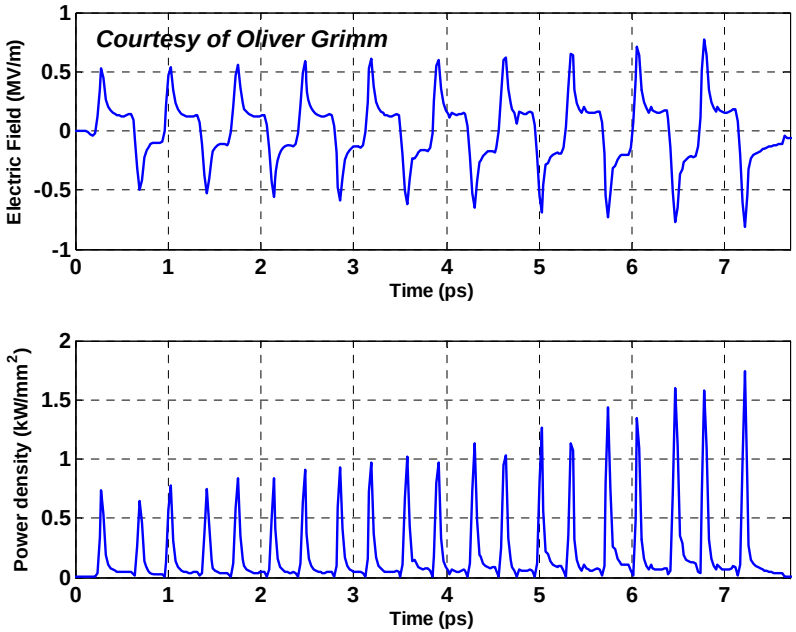
IR UNDULATOR – parameters:

- Generates radiation (1-200) μm (at 500 MeV)
- Gap: 40 mm
- Period length: 400 mm
- Number of periods: 9
- K-value3 –49

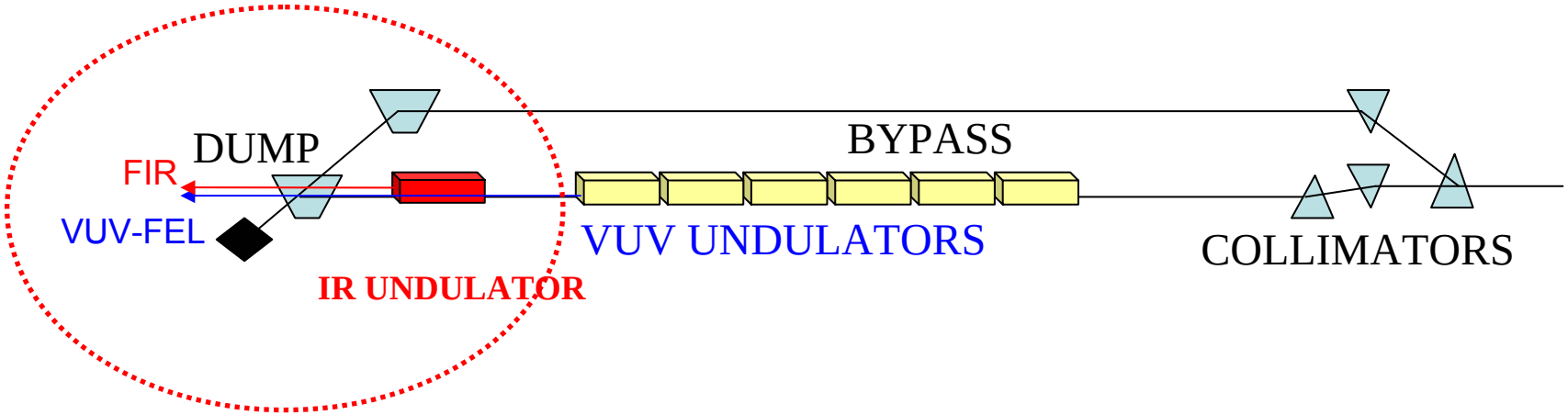
Motivation



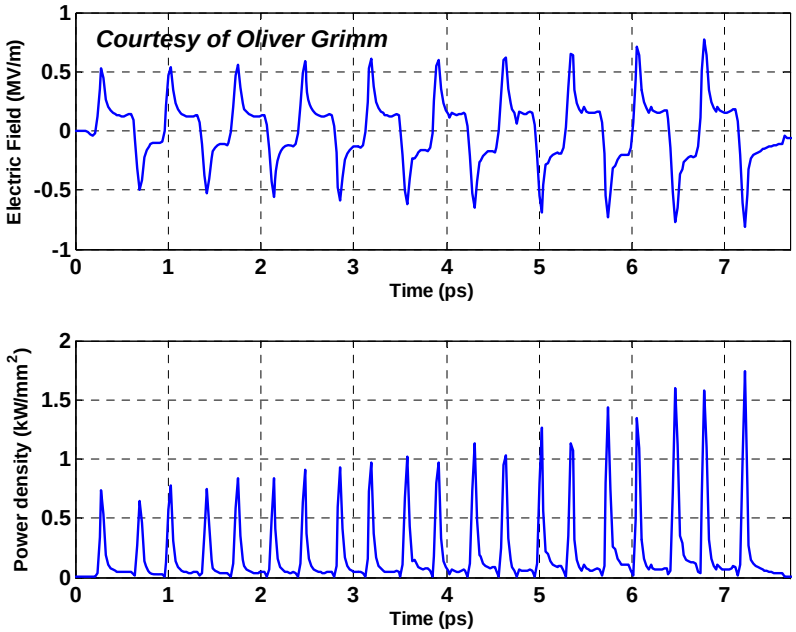
Electric field and power density on axis for 1nC bunch



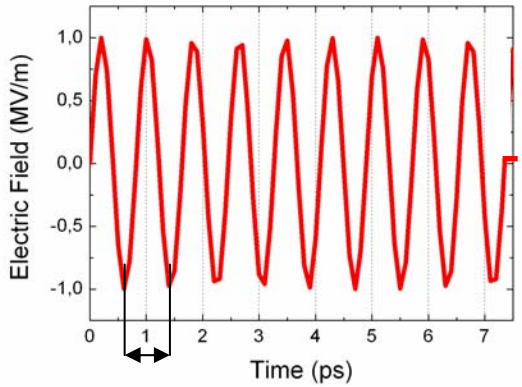
Motivation



Electric field and power density on axis for 1nC bunch



Electric field after spectral filter (e.g. band pass)



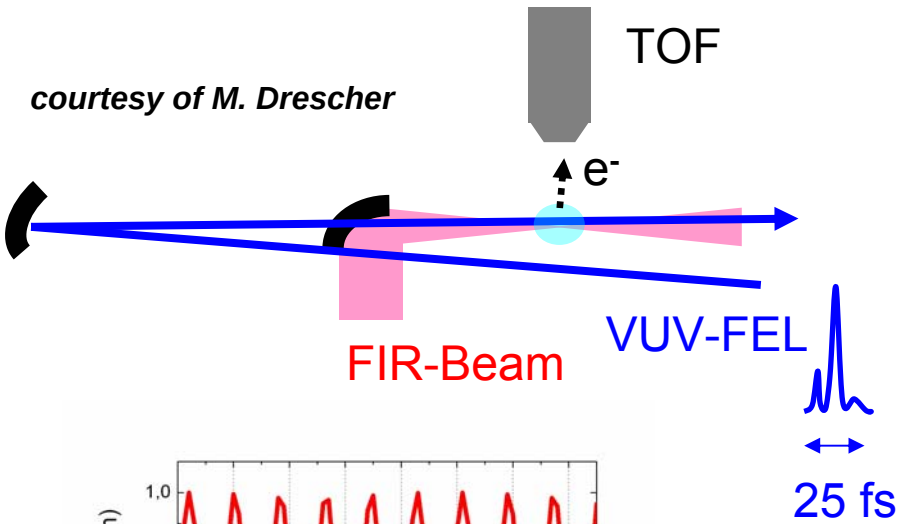
T ~ 800 fs → f ~ 1.25 THz → λ~ 240 μm

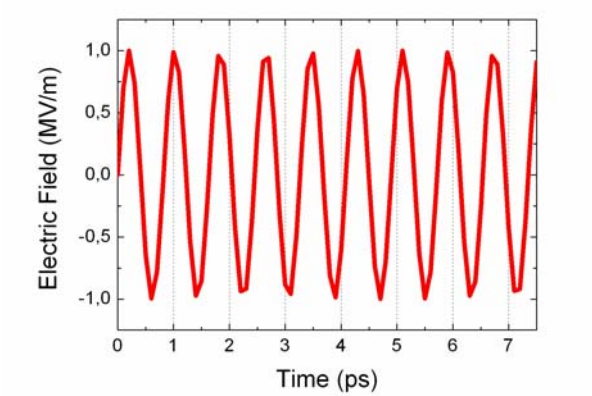
Synchronized STREAK field!!

Motivation

AC – field Streak Camera for the VUV FEL (AG Drescher/HASYLAB)

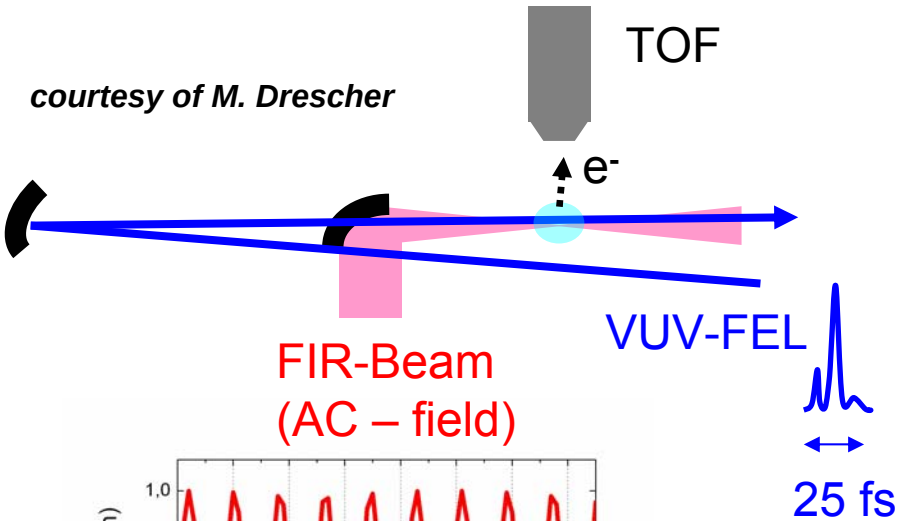
courtesy of M. Drescher

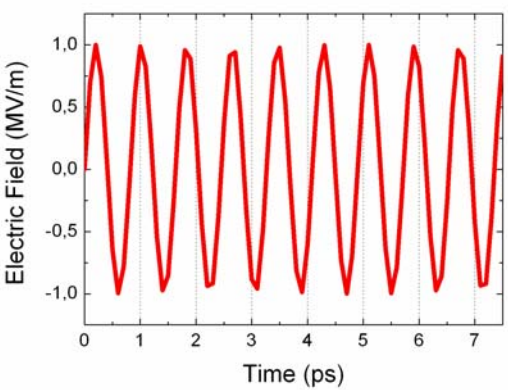


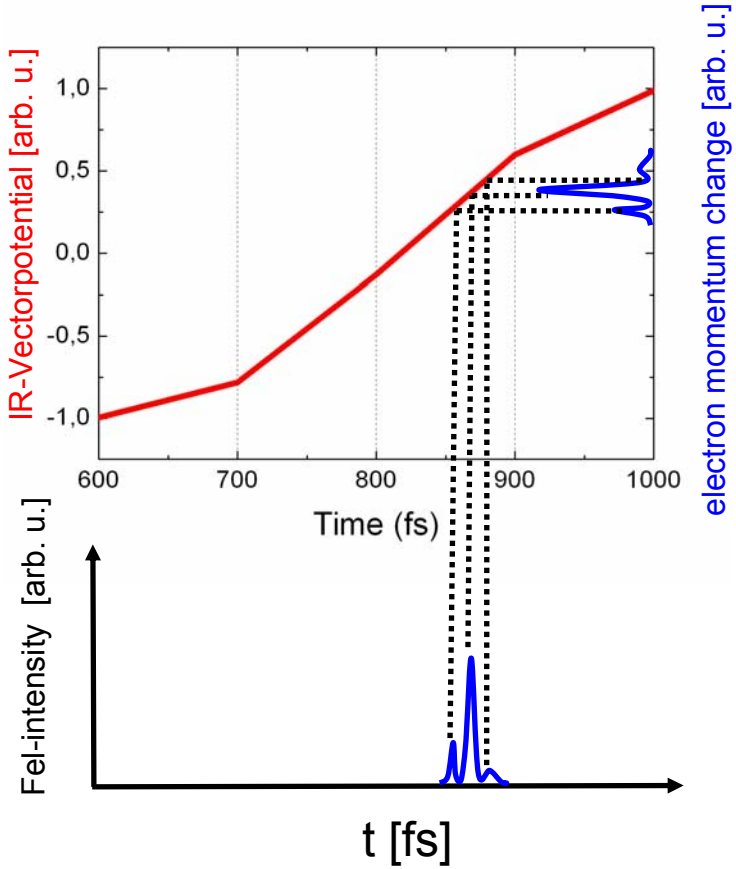


Motivation

AC – field Streak Camera for the VUV FEL (AG Drescher/HASYLAB)



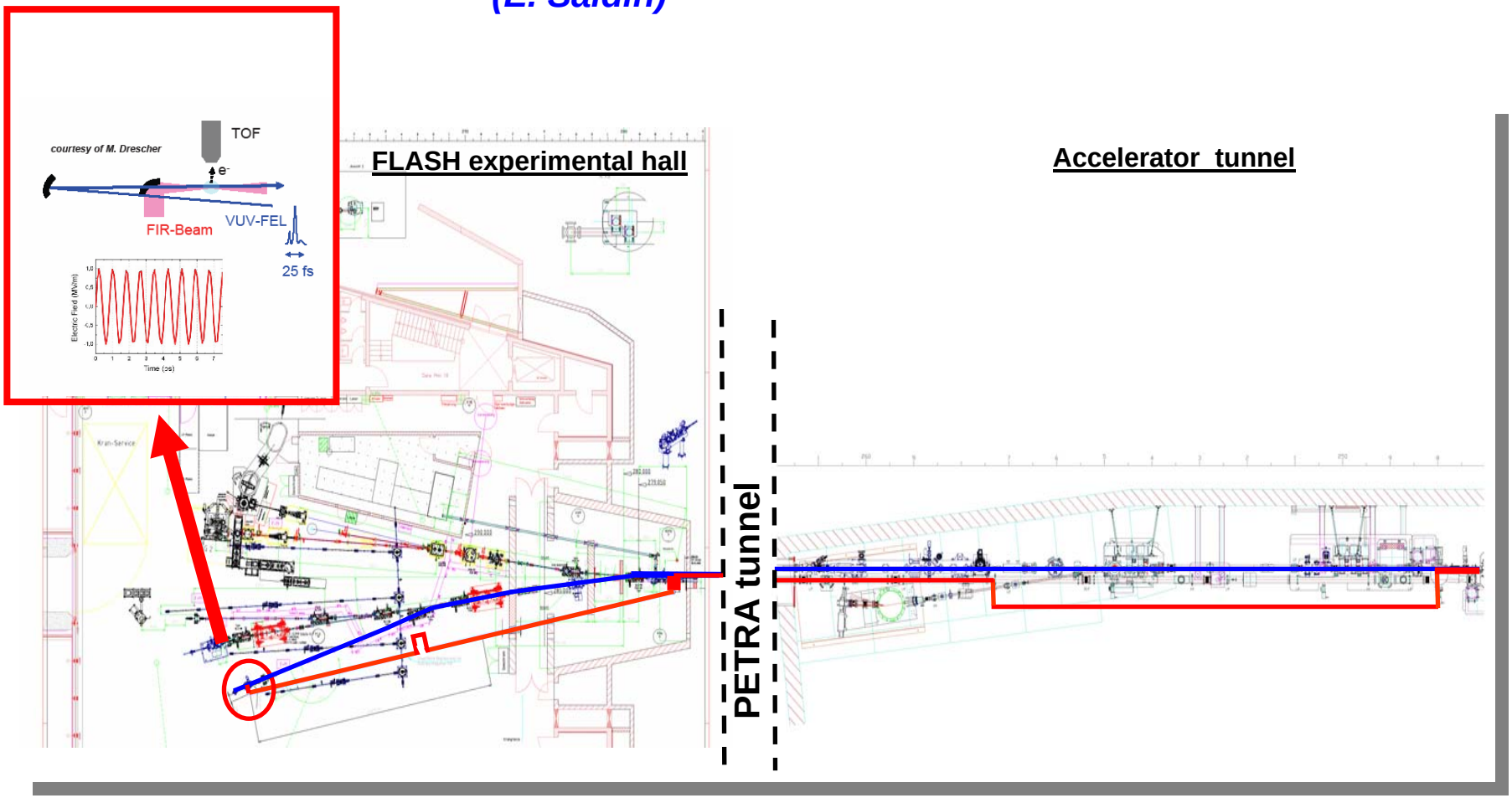




Motivation

AC – field Streak Camera for the VUV FEL (AG Drescher/HASYLAB)

100 – 200 μm at BL3! → ***We need copper-coated vacuum pipe in FIR Undulator!! (E. Saldin)***



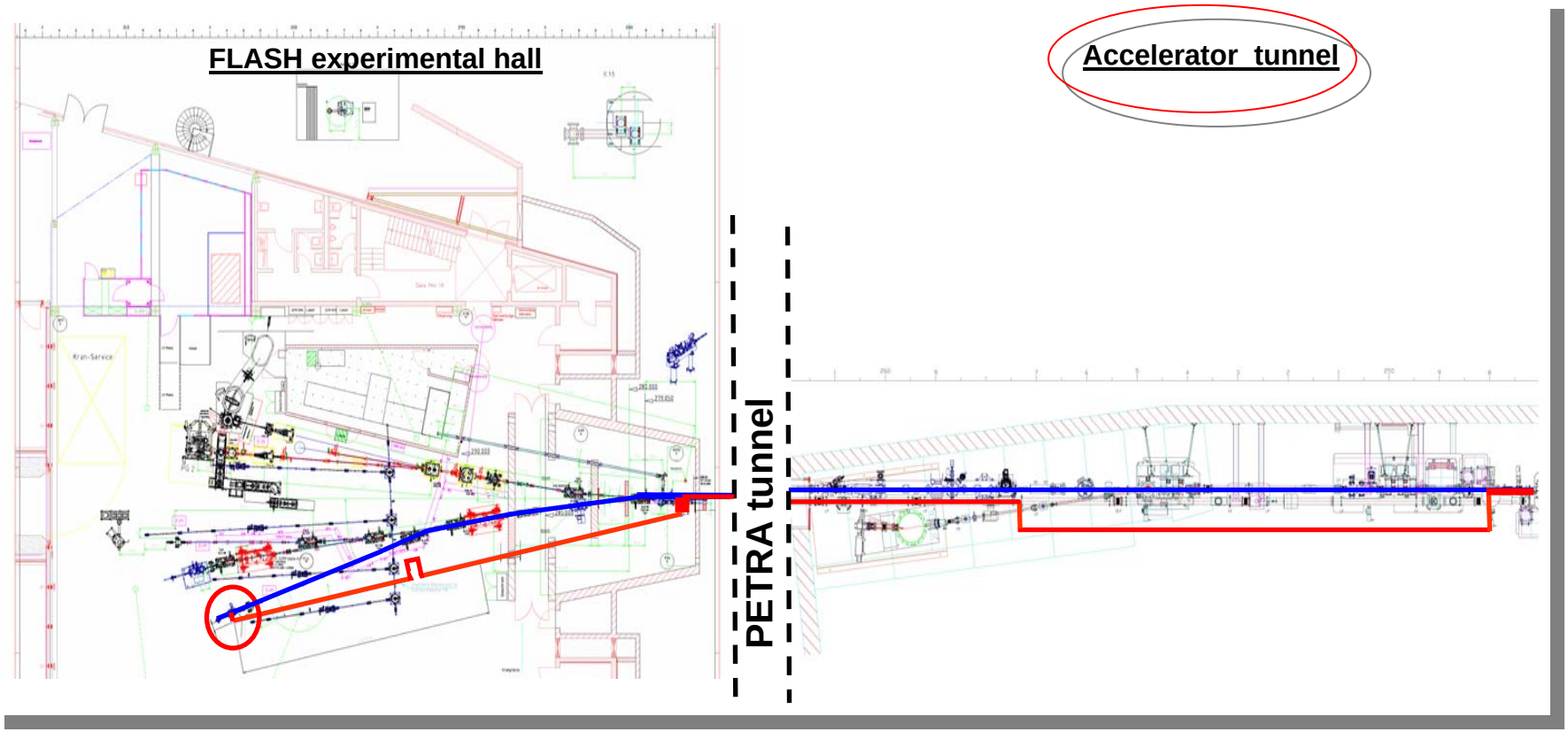
Layout

Commissioning

Layout

requirements:

- **spectral range: 1! – 200 μm („dispersionfree“)**
- **timestructure/wavefront needs to be transported**

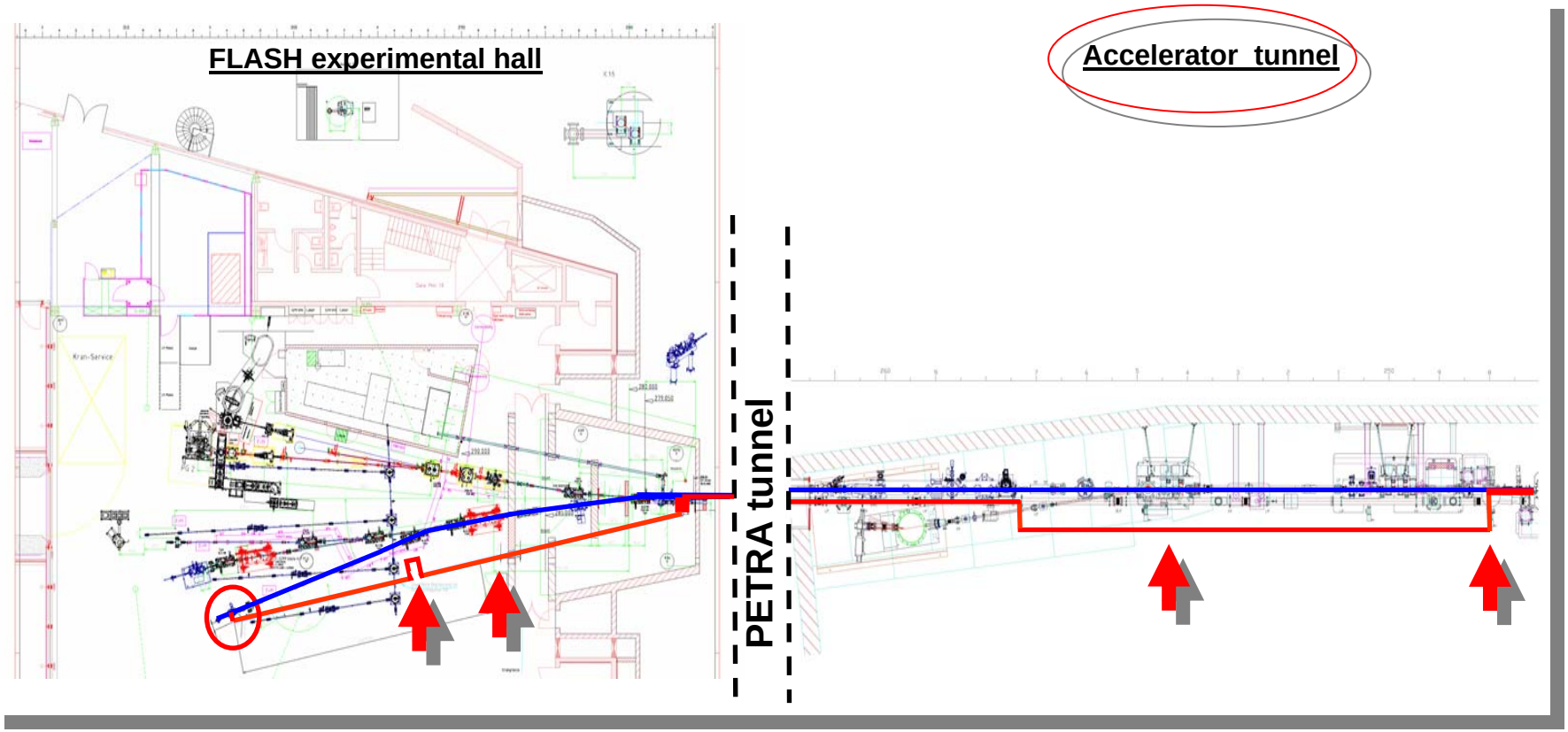


Layout

requirements:

- **spectral range: 1! – 200 μm („dispersionfree“)**
- **timestructure/wavefront needs to be transported**

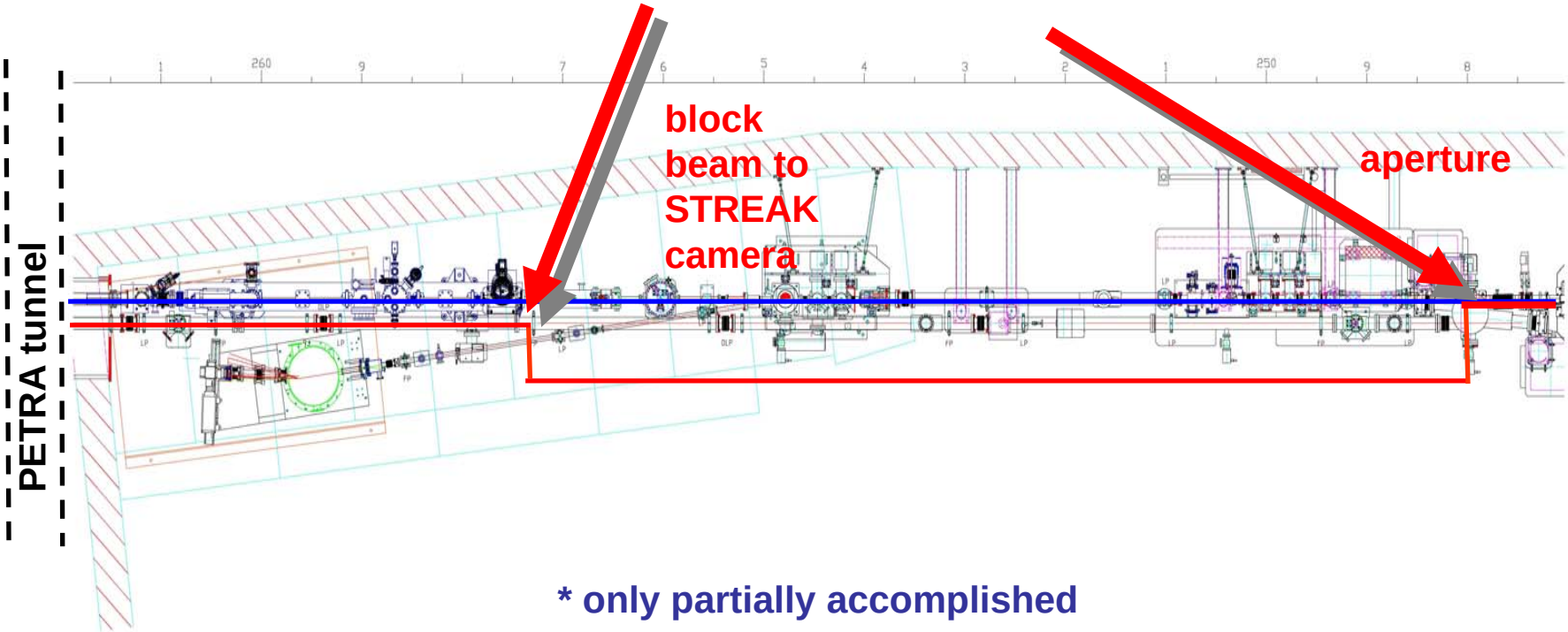
+ photondiagnostics



Layout: Accelerator tunnel

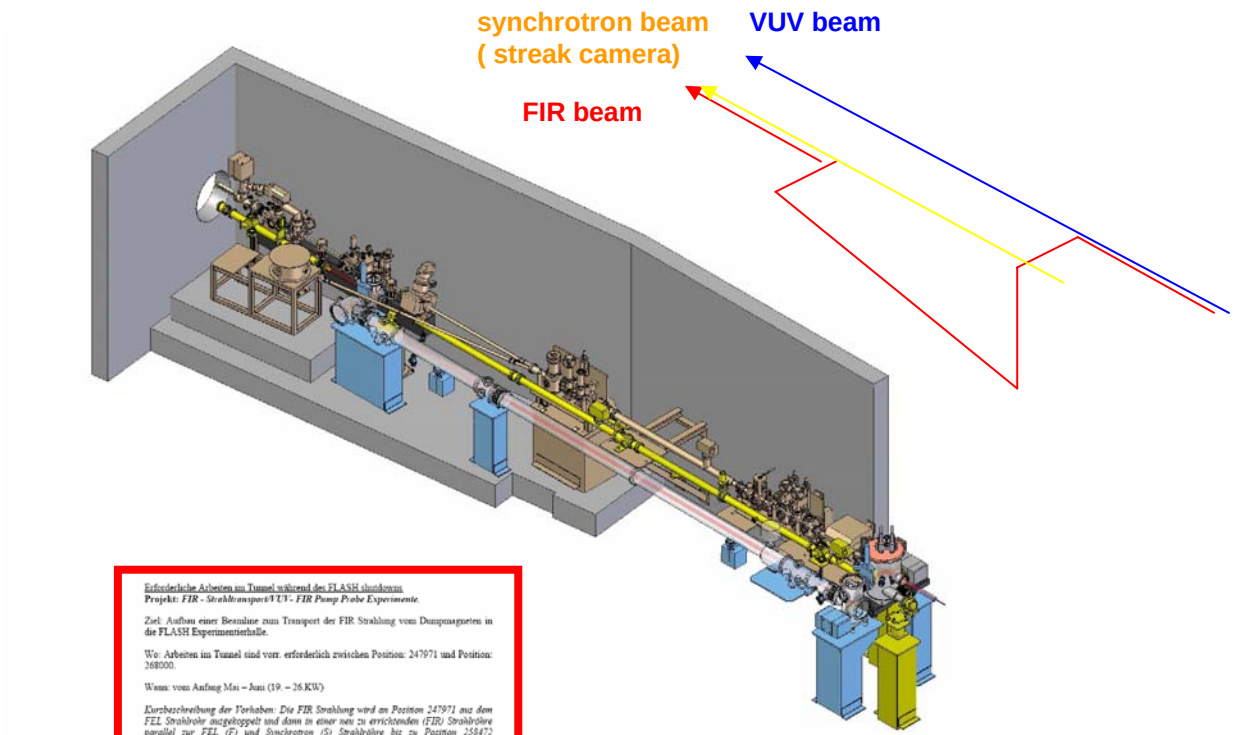
specific requirements:

- **as close as possible to particle free UHV specs**
- **avoid conflicts with normal FLASH run when necessary**
- **robust incoupling of large beam diameters into beam pipe**
- ***allow parasitic use of FIR beam****



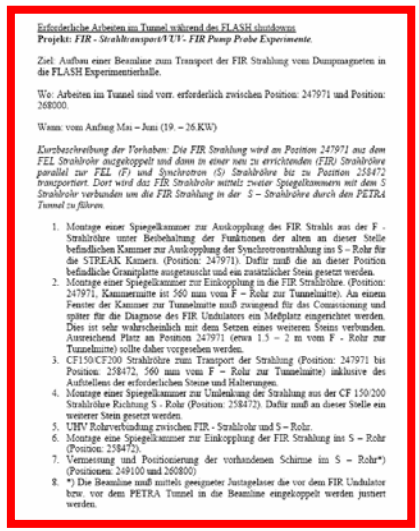
*** only partially accomplished**

Layout: Accelerator tunnel



Extensive building work, KW 19 – 26

for details see shutdown plan 11/2006



Erforderliche Arbeiten im Tunnel während des FLASH shutdowns
Projekt: *FIR - Strahltransport/VUV- FIR Pump Probe Experimente.*

Ziel: Aufbau einer Beamline zum Transport der FIR Strahlung vom Dumpmagneten in die FLASH Experimentierhalle.

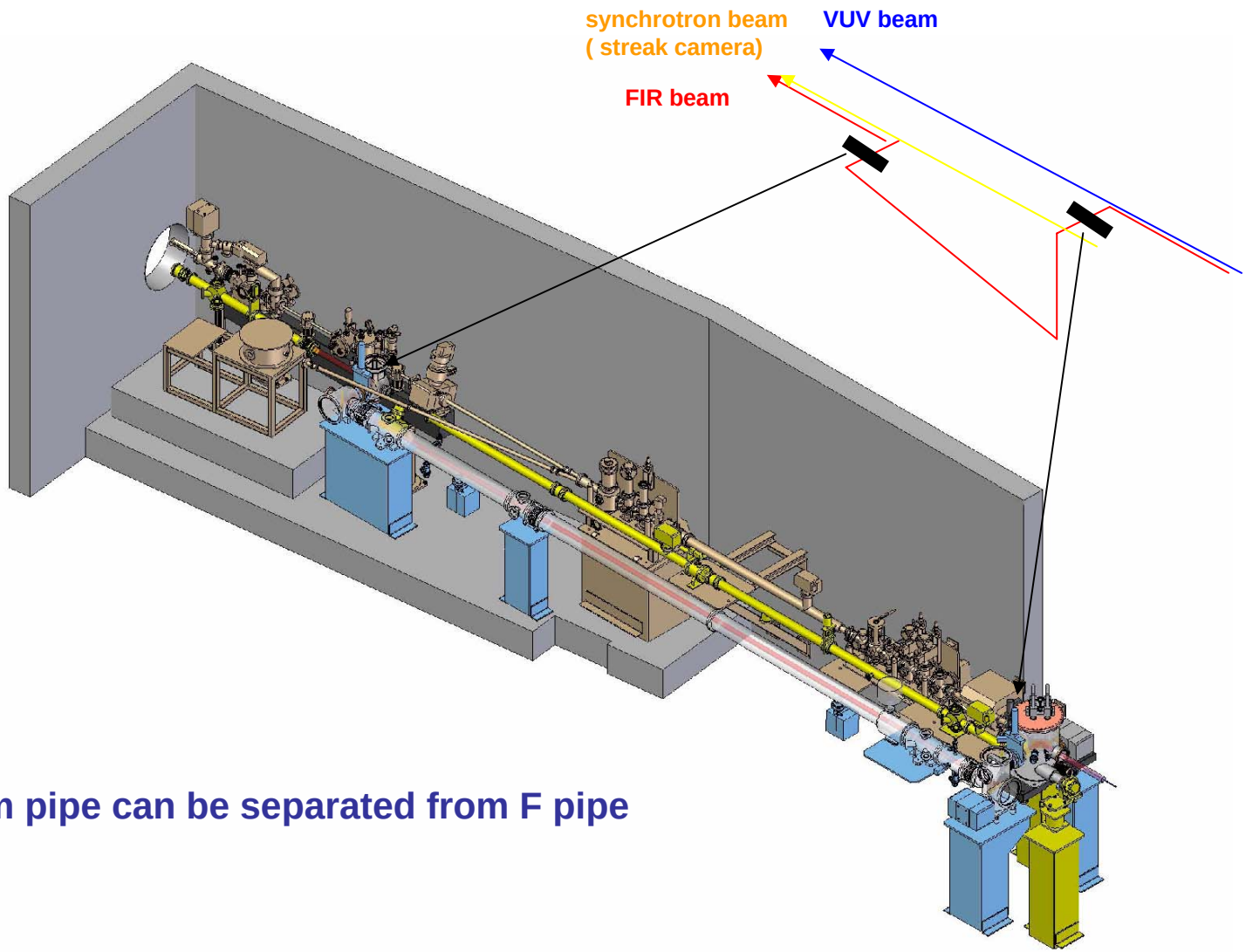
Wo: Arbeiten im Tunnel sind vorr. erforderlich zwischen Position: 247971 und Position: 268000.

Wann: vom Anfang Mai – Juni (19. – 26.KW)

Kurzbeschreibung der Vorhaben: Die FIR Strahlung wird an Position 247971 aus dem FEL Strahlrohr ausgekoppelt und dann in einer neu zu errichtenden (FIR) Strahlröhre parallel zur FEL (F) und Synchrotron (S) Strahlröhre bis zu Position 258472 transportiert. Dort wird das FIR Strahlrohr mittels zweier Spiegelkammern mit dem S Strahlrohr verbunden um die FIR Strahlung in der S – Strahlröhre durch den PETRA Tunnel zu führen.

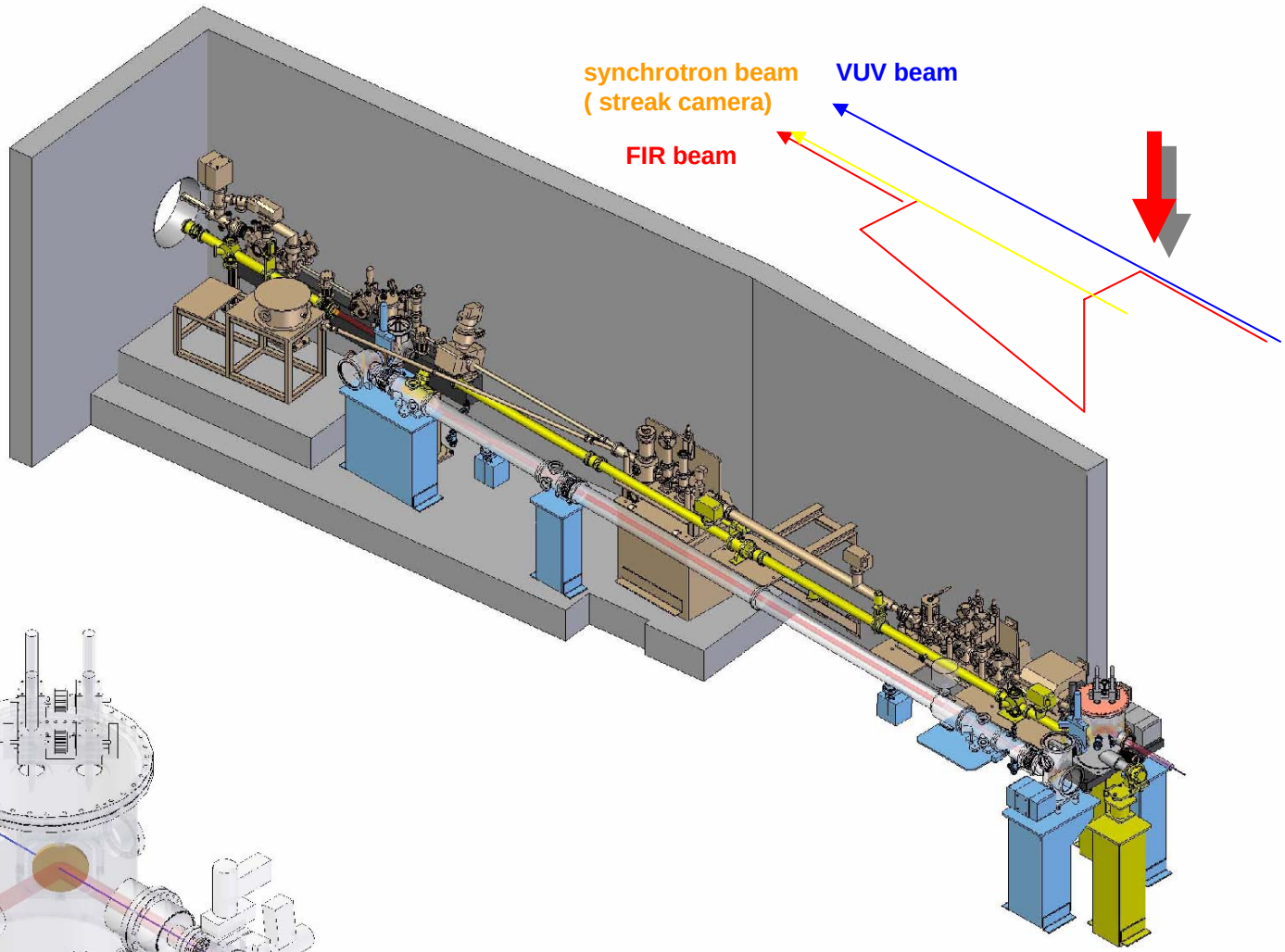
1. Montage einer Spiegelkammer zur Auskopplung des FIR Strahls aus der F - Strahlröhre unter Beibehaltung der Funktionen der alten an dieser Stelle befindlichen Kammer zur Auskopplung der Synchrotronstrahlung ins S – Rohr für die STREAK Kamera. (Position: 247971). Dafür muß die an dieser Position befindliche Granitplatte ausgetauscht und ein zusätzlicher Stein gesetzt werden.
2. Montage einer Spiegelkammer zur Einkopplung in die FIR Strahlröhre. (Position: 247971, Kammermitte ist 560 mm vom F – Rohr zur Tunnelmitte). An einem Fenster der Kammer zur Tunnelmitte muß zwangsläufig für das Consistoscop und später für die Diagnose des FIR Undulators ein Meßplatz eingerichtet werden. Dies ist sehr wahrscheinlich mit dem Setzen eines weiteren Steins verbunden. Ausreichend Platz an Position 247971 (etwa 1.5 – 2 m vom F - Rohr zur Tunnelmitte) sollte daher vorgesehen werden.
3. CF150/CF200 Strahlröhre zum Transport der Strahlung (Position: 247971 bis Position: 258472, 560 mm vom F – Rohr zur Tunnelmitte) inklusive des Aufstellens der erforderlichen Steine und Halterungen.
4. Montage einer Spiegelkammer zur Umlenkung der Strahlung aus der CF 150/200 Strahlröhre Richtung S - Rohr (Position: 258472). Dafür muß an dieser Stelle ein weiterer Stein gesetzt werden.
5. UHV Rohrverbindung zwischen FIR - Strahlrohr und S – Rohr.
6. Montage eine Spiegelkammer zur Einkopplung der FIR Strahlung ins S – Rohr (Position: 258472).
7. Vermessung und Positionierung der vorhandenen Schirme im S – Rohr*) (Positionen: 249100 und 260800)
8. *) Die Beamline muß mittels geeigneter Justagelaser die vor dem FIR Undulator bzw. vor dem PETRA Tunnel in die Beamline eingekoppelt werden justiert werden.

Layout: Accelerator tunnel

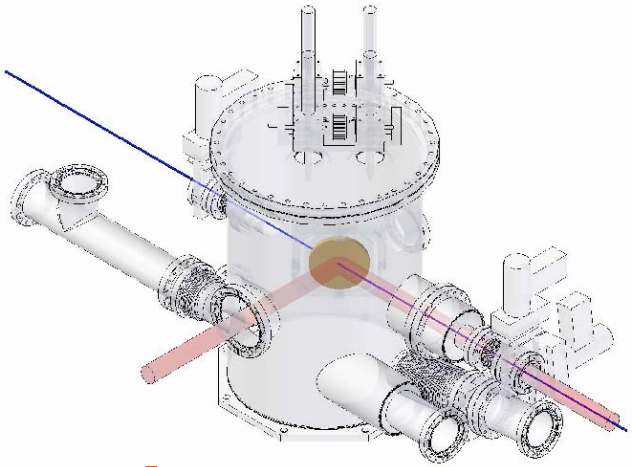


FIR beam pipe can be separated from F pipe vacuum!

Layout: outcoupling chamber



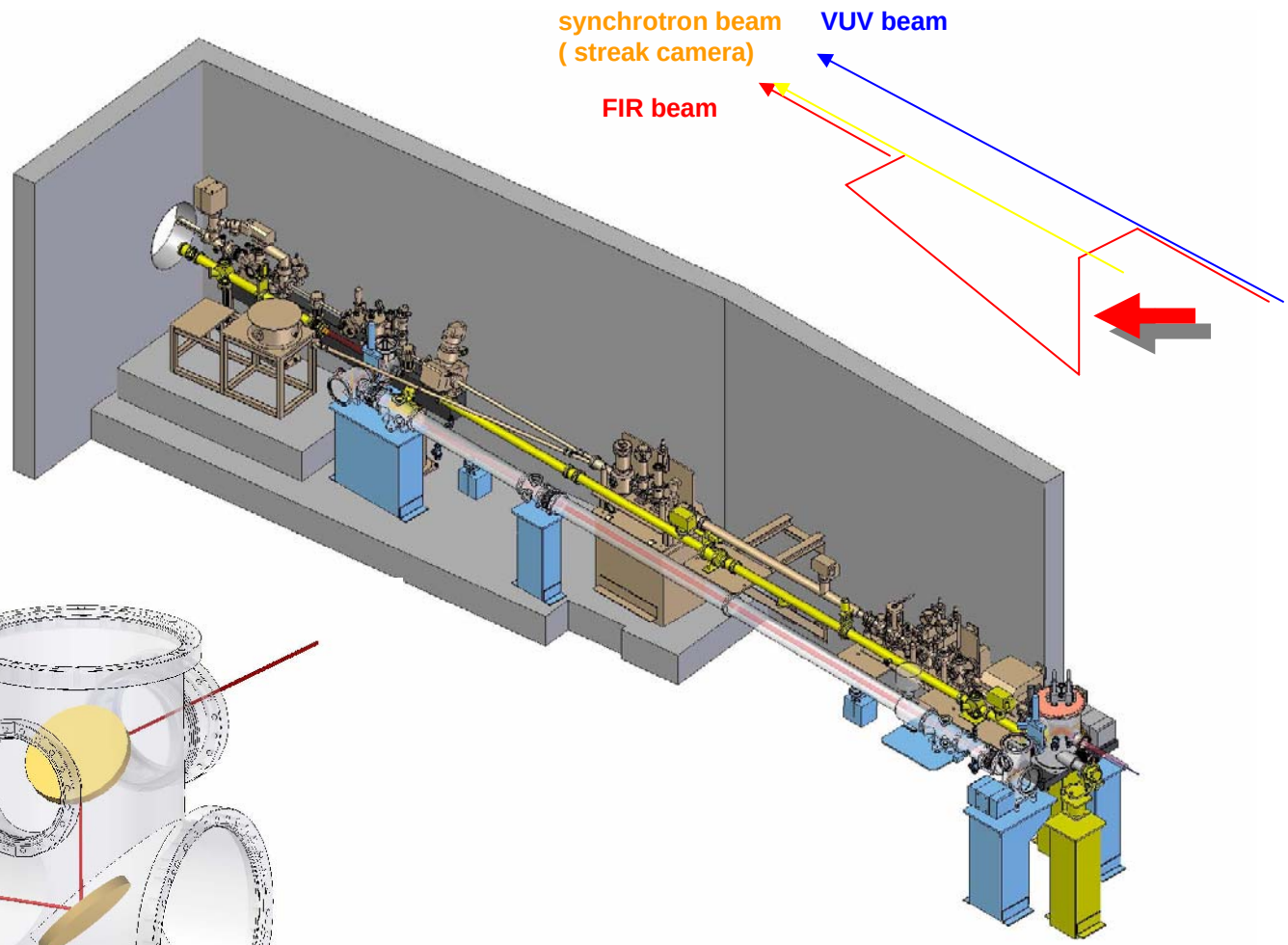
VUV beam

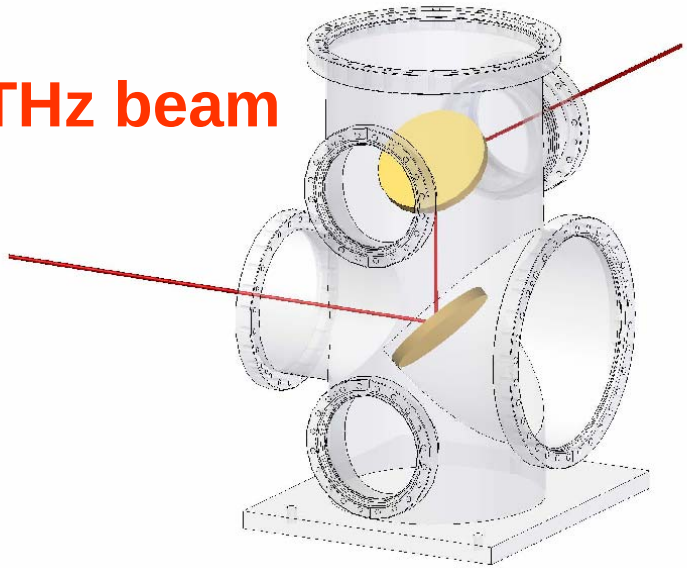


THz beam

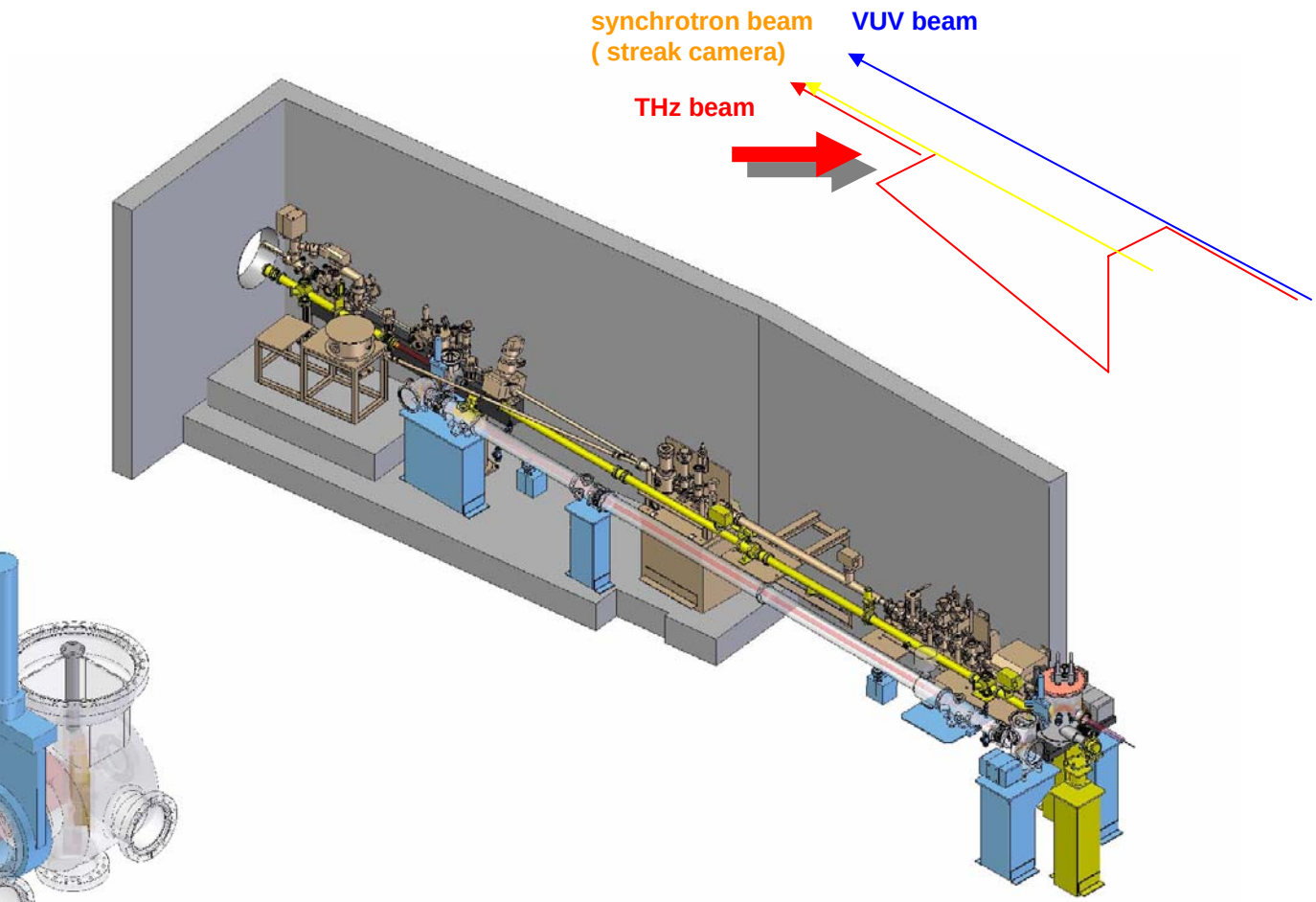
only additional chamber in F pipe
Can be separated from F pipe by valves!!!

Layout: into FIR pipe

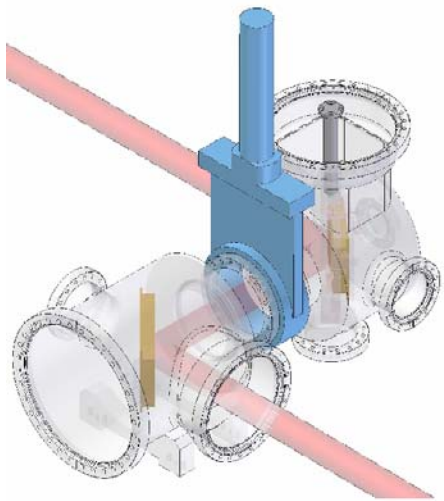




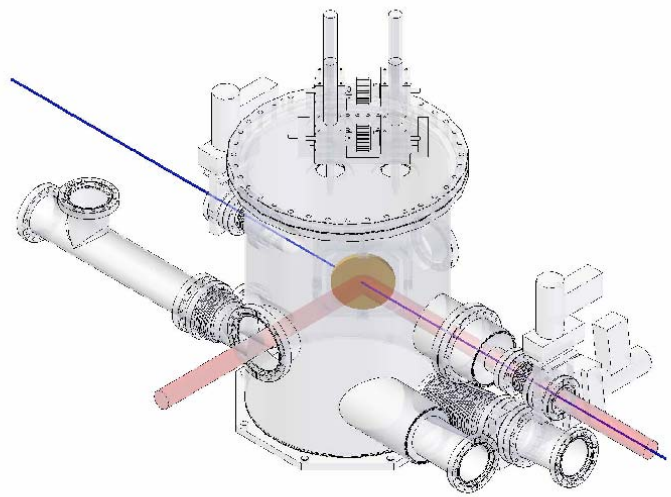
Layout: into S Pipe

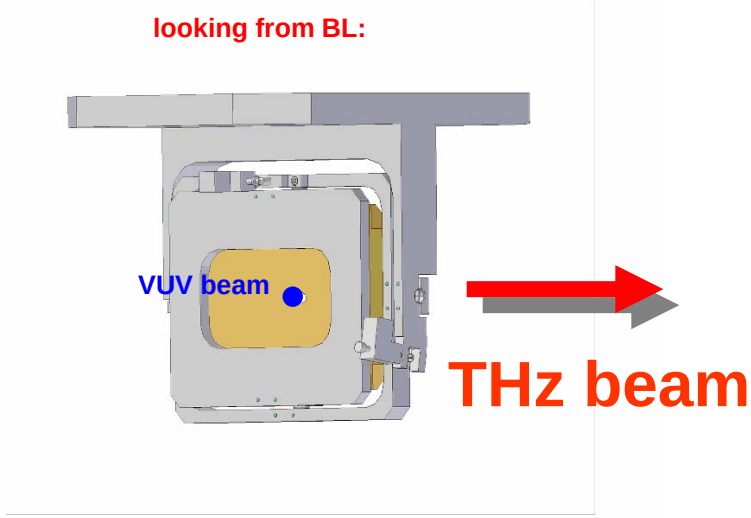


THz beam

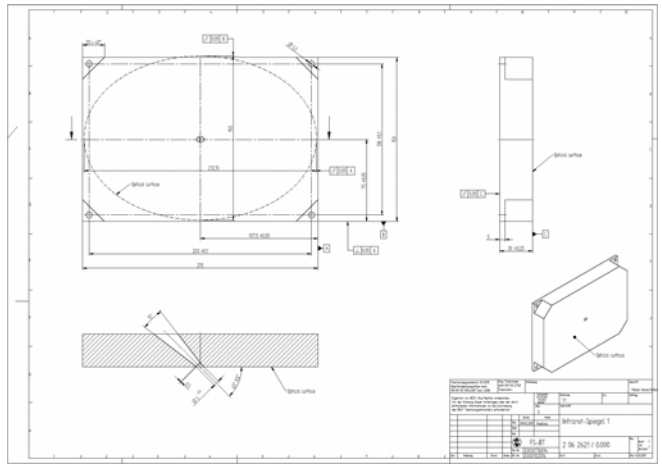


Layout: outcoupling I





Design for planar Mirror 1



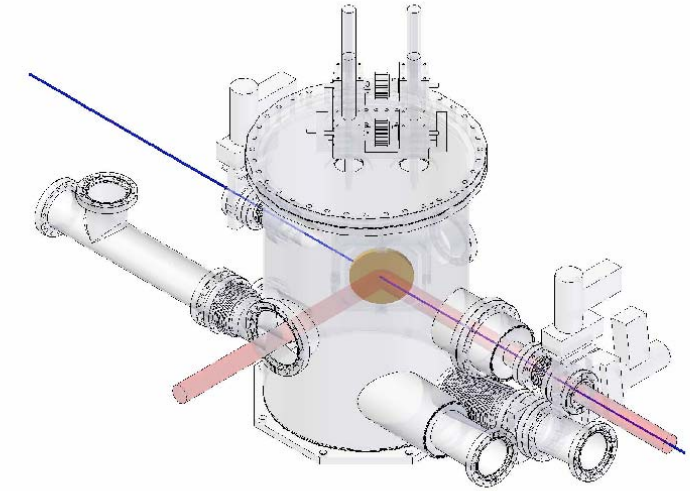
- Mirror can be completely withdrawn (within seconds)

- cardanianholder for angular alignment +/- 1 °, res.: 0.01 °

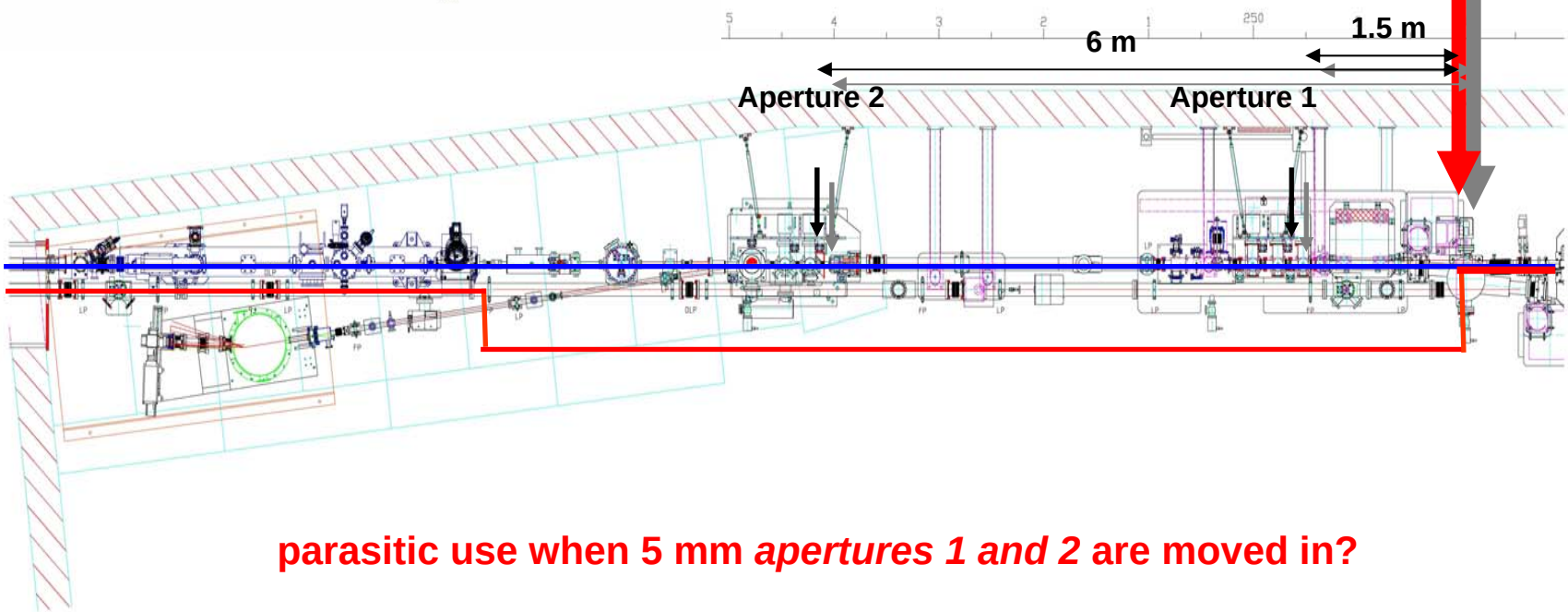
- alignment of aperture to beam
  z: +/- 20 mm, res.: 0.1 mm
  x: +/- 10 mm, res.: 0.1 mm

parasitic use when 5 mm *apertures 1 and 2* are moved in?

Layout: outcoupling II



add. Aperture: 5mm
Position: 248 m

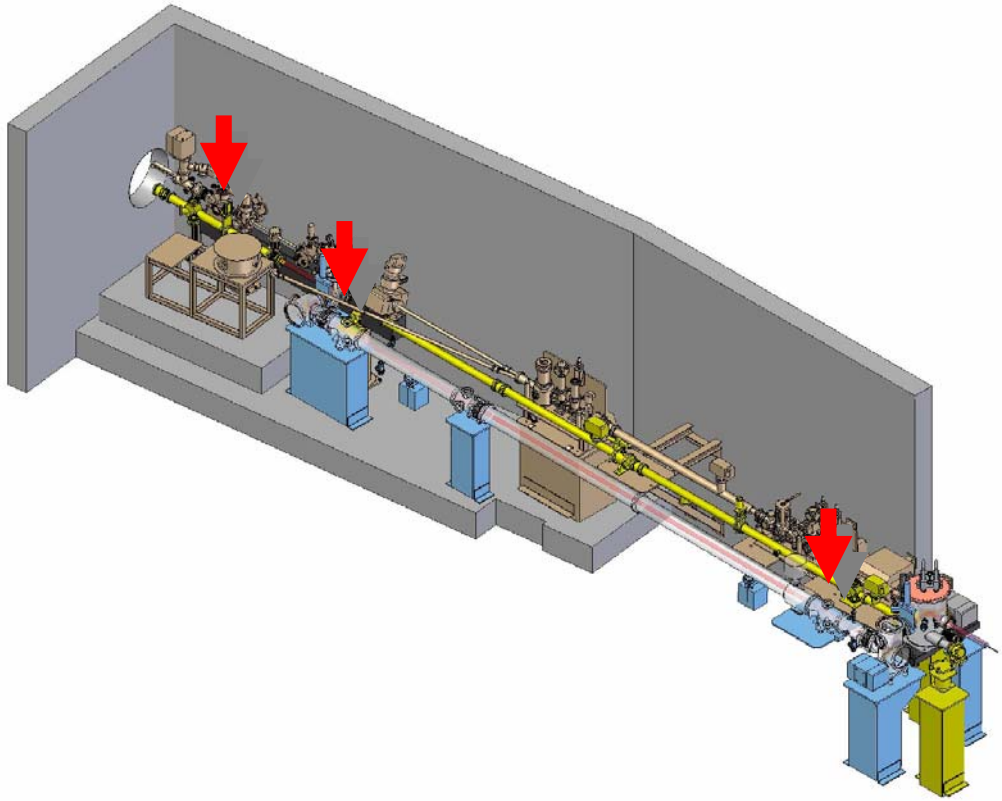


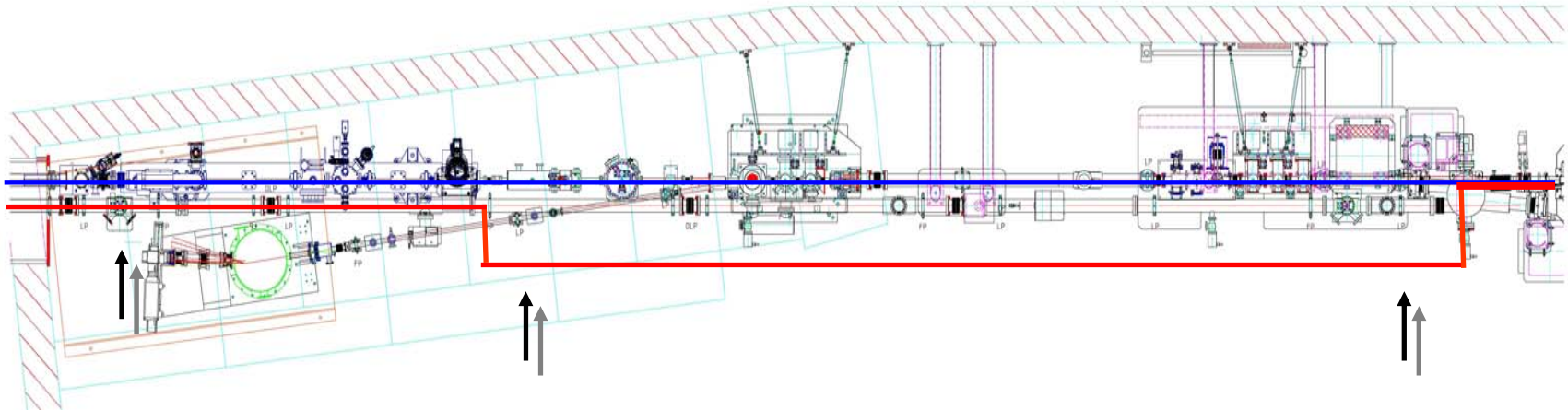
parasitic use when 5 mm *apertures 1 and 2* are moved in?

Layout

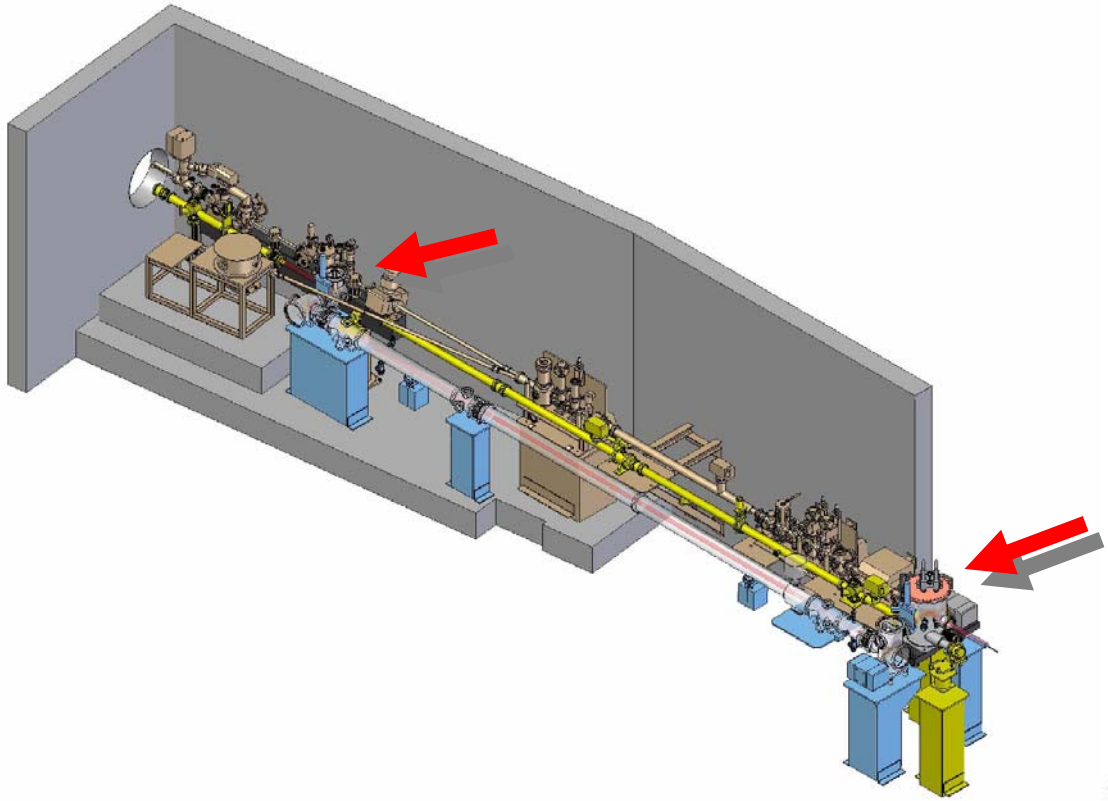
Commissioning

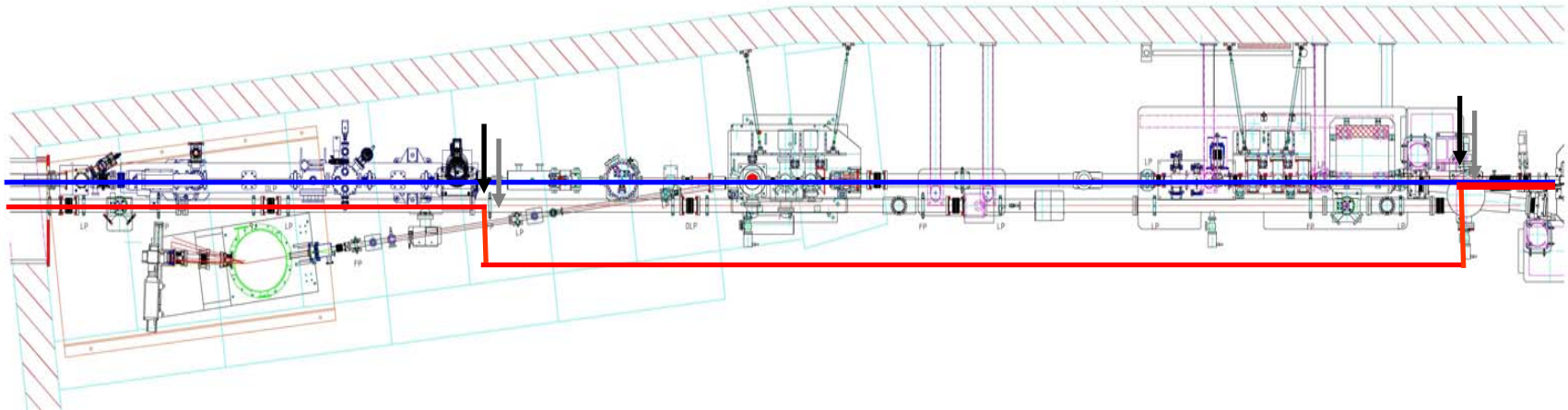
Comissioning: screens



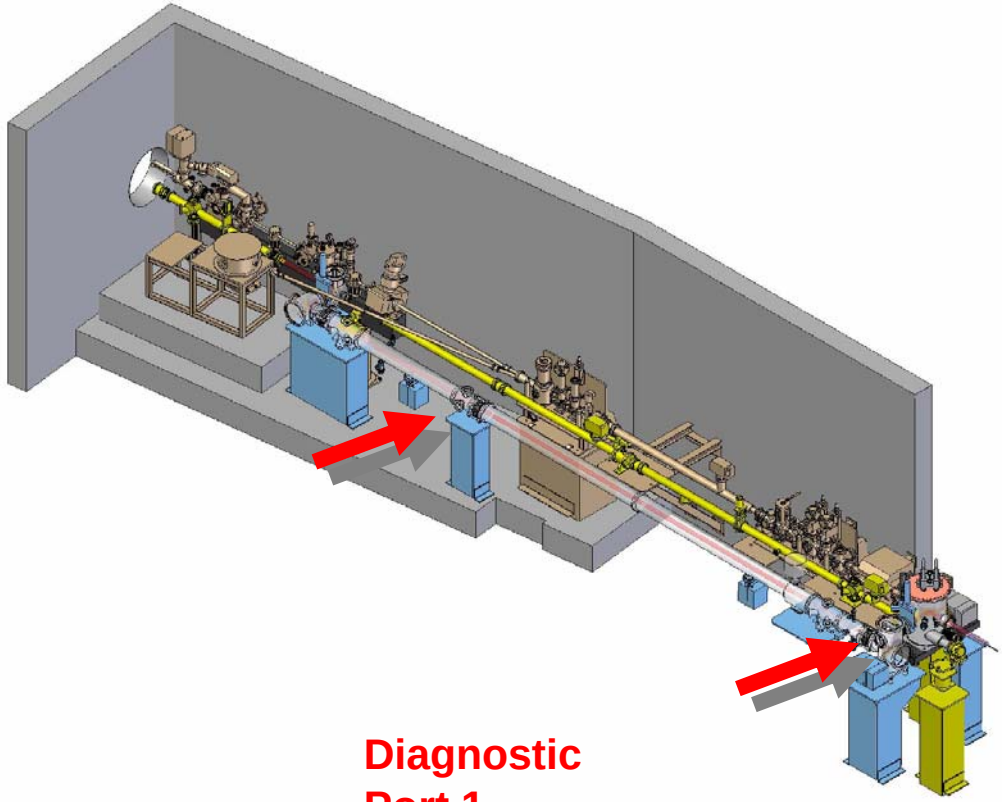


Comissioning: viewports



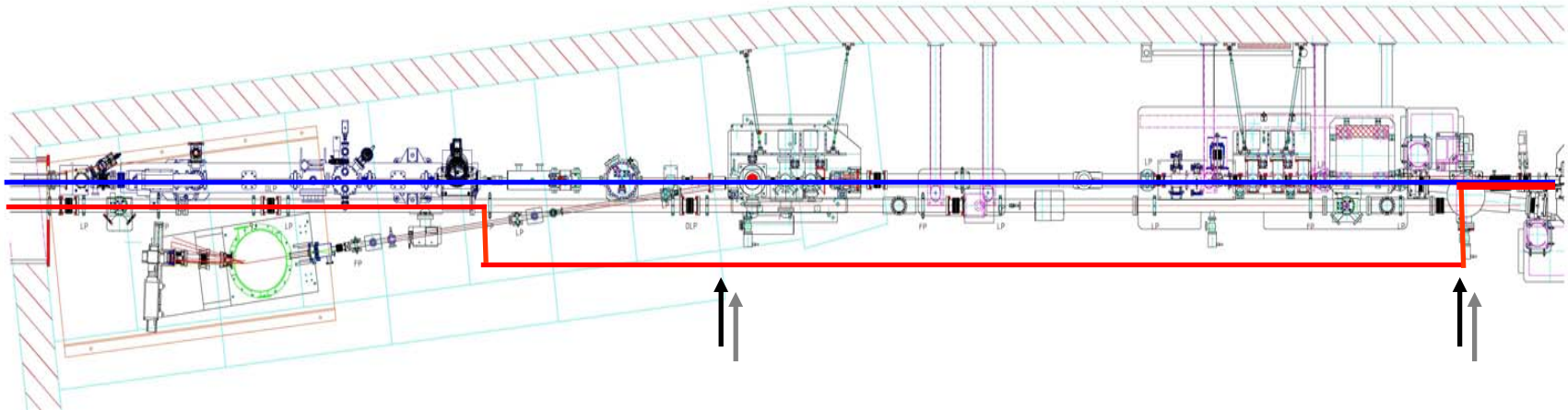


Comissioning: diagnostic ports



Diagnostic
Port 2

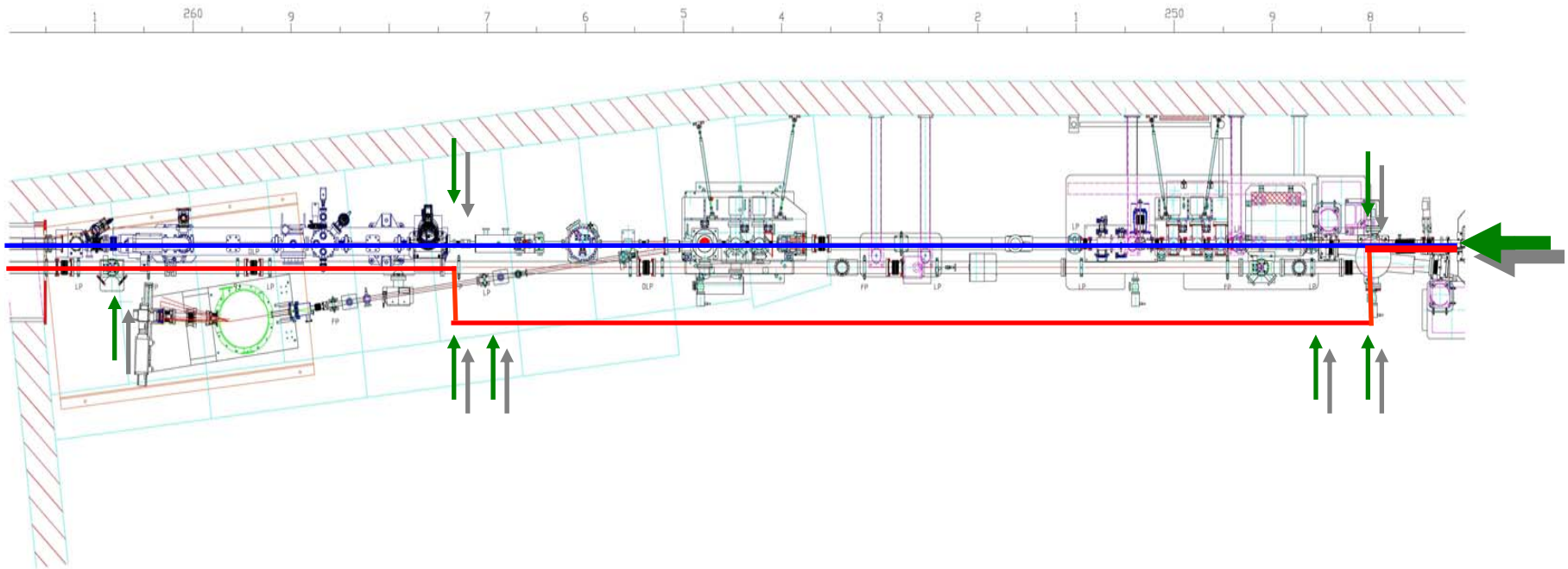
Diagnostic
Port 1



Comissioning: phase 1
Beamline alignment

Utilizing alignment laser coupled in before FIR undulator

Viewports, screens and dioagnostic ports are used



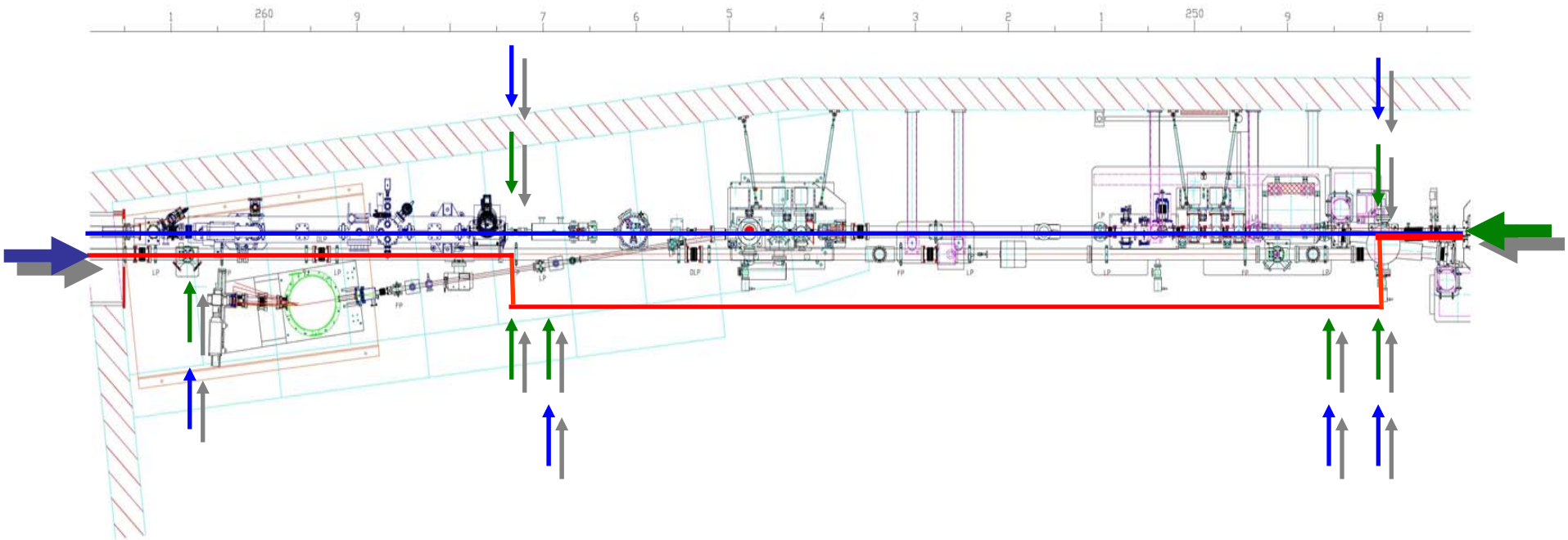
No electrons!!

Comissioning: phase 1
Beamline alignment

Utilizing alignment laser coupled in before FIR undulator

Utilizing alignment laser coupled in in experimental hall

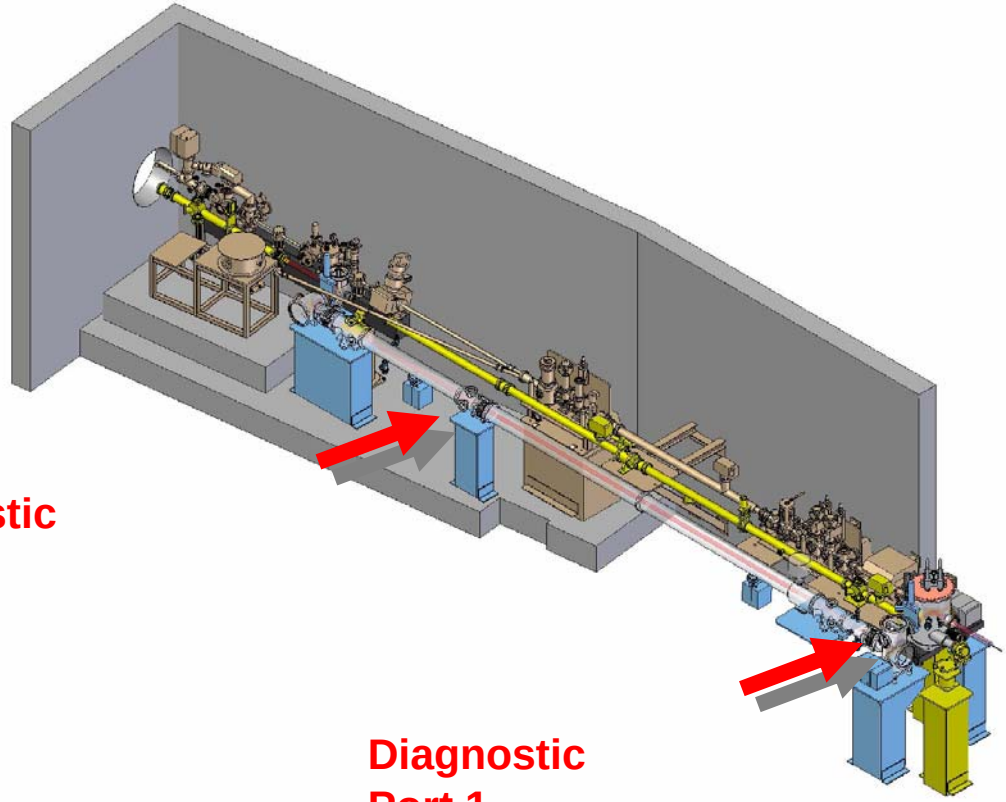
Viewports, screens and diagnostic ports are used



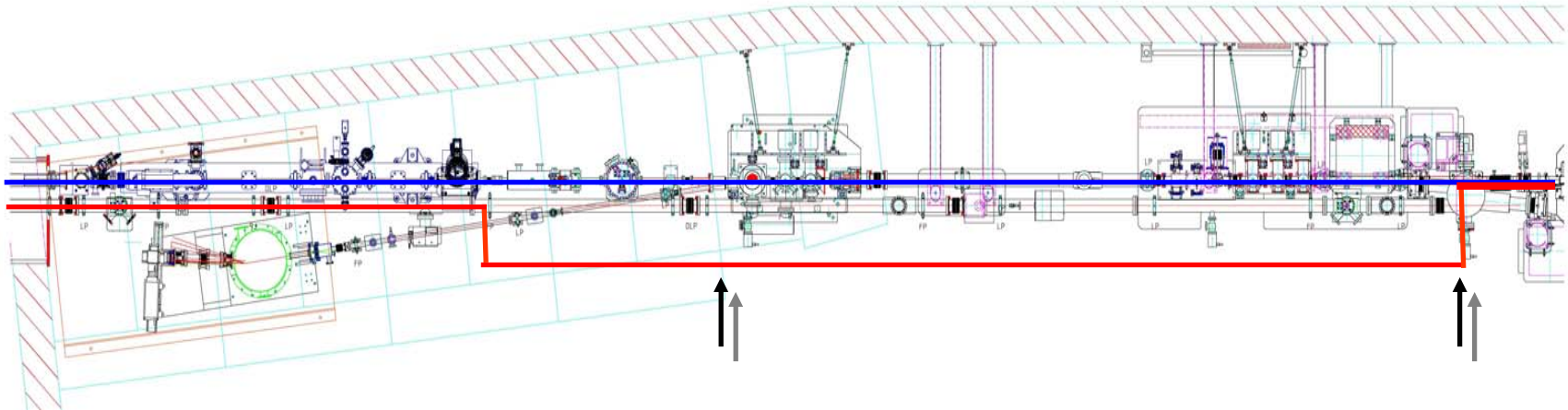
No electrons!!

parasitic!! (but no streak camera)

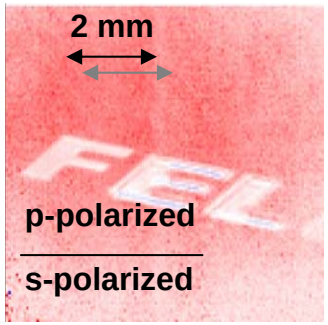
Comissioning: diagnostic ports



Diagnostic
Port 1



Comissioning: phase 1
„Source diagnostics“ 8 m and 17 m behind the undulator



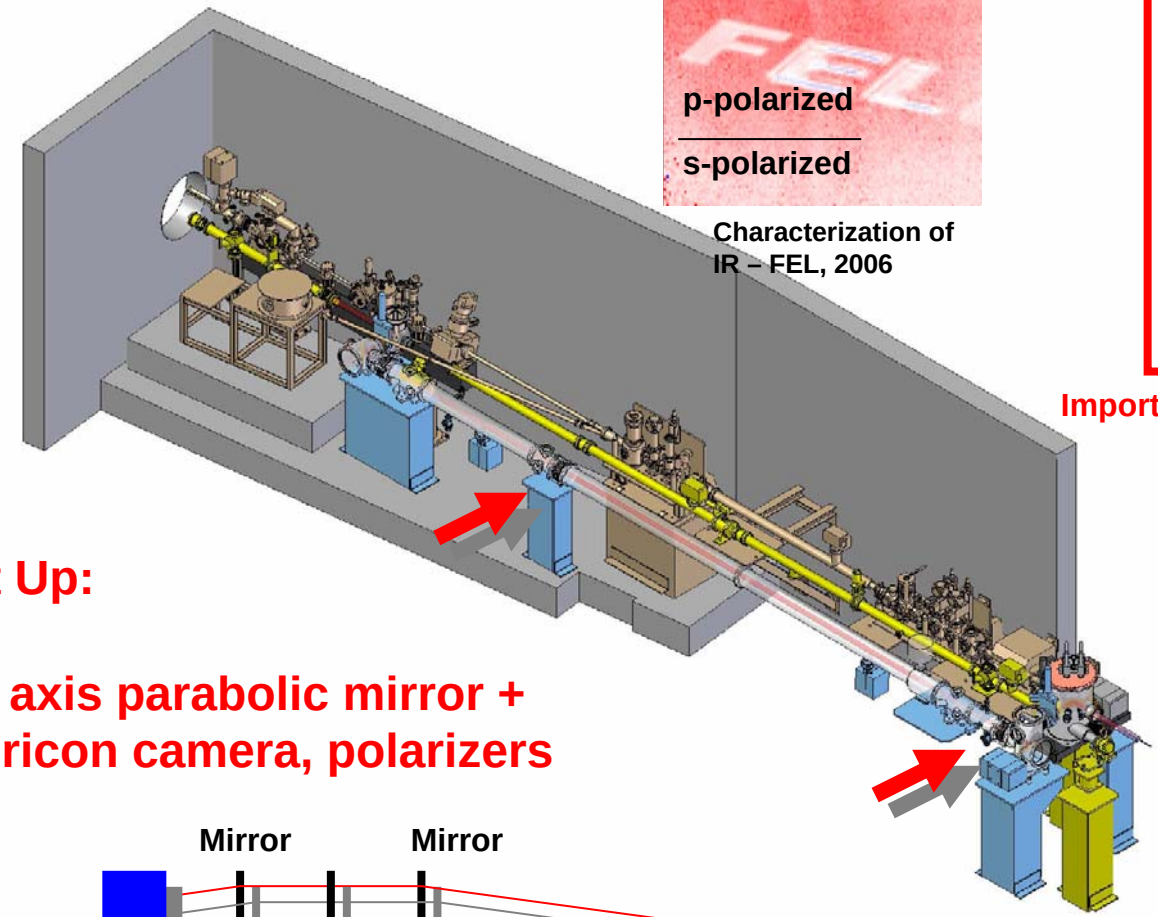
Characterization of
IR – FEL, 2006

Undulator Radiation in a Waveguide

Gianluca Geloni, Evgeni Saldin, Evgeni Schneidmiller and Mikhail Yurkov

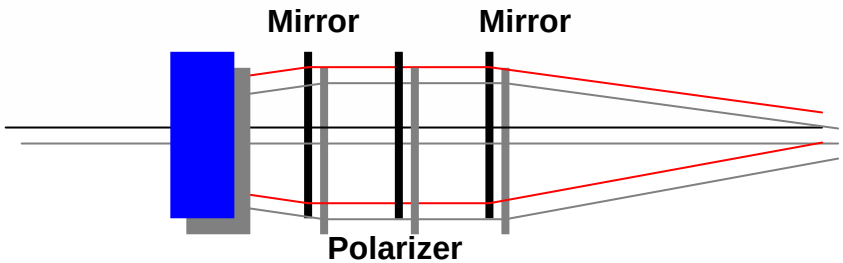
Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

Important for transport of the radiation!!



Set Up:

Off axis parabolic mirror +
Spiricon camera, polarizers



?

Comissioning: phase 1
source alignment

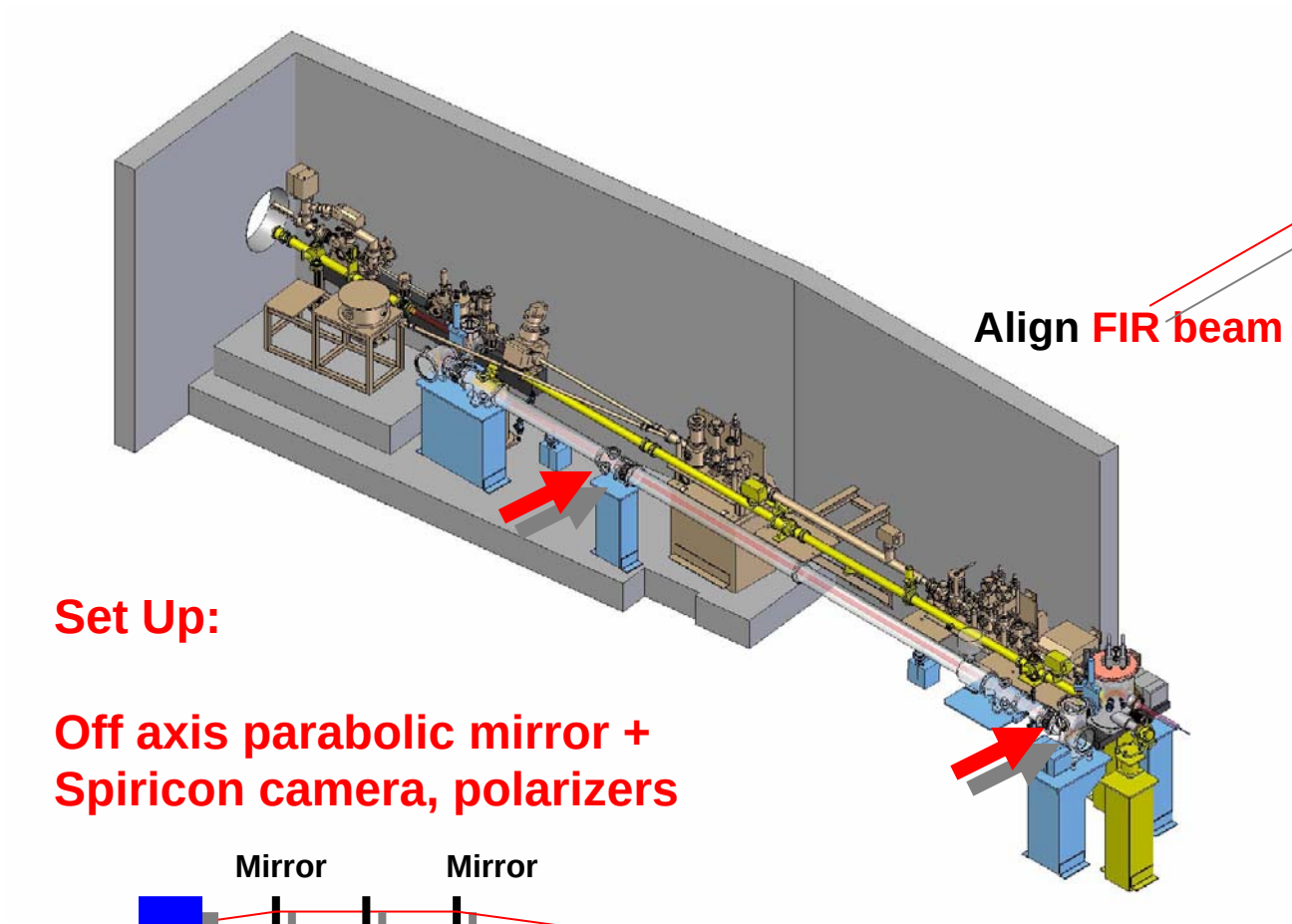
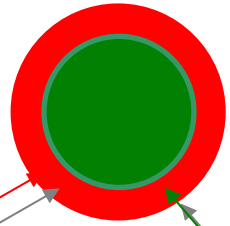


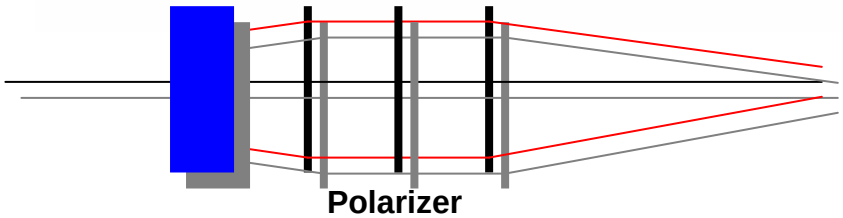
Image on detector



Align FIR beam to tunnel alignment laser

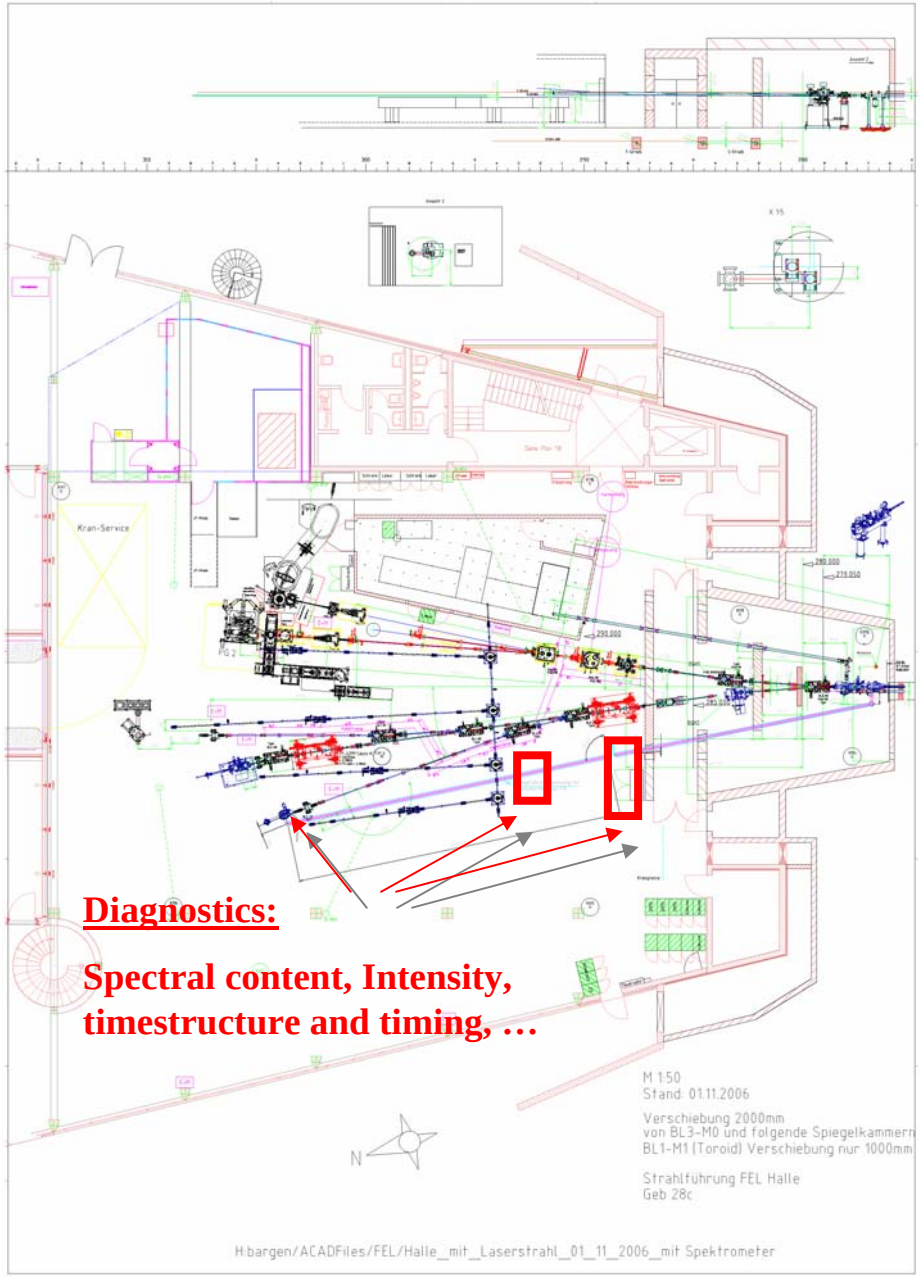
Set Up:

Off axis parabolic mirror + Spiricon camera, polarizers



permanent installation at port 1…. port2?!

Comissioning: phase 2



Diagnostics:

Spectral content, Intensity, timestructure and timing, …

Spectral content and intensity:

- Martin Puplett Spectrometer

(collab. with U. Schade/BESSY)

- Single shot dispersive spectrometers

(collab. with H. Delshemi, B. Schmidt/FLA; W. Seidel/FZ Rossendorf?)

- Intensity

(collab. with O. Grimm/U Hamburg)

Timestructure/Timing:

-Direct measurement with Hot Electron Bolometer

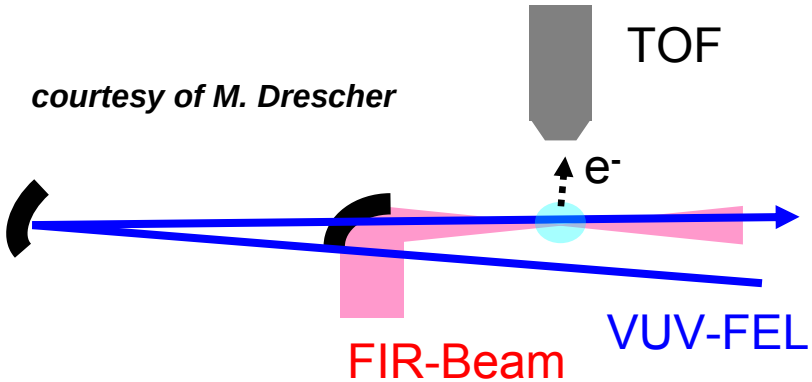
(collab. with H.W. Hübers/DLR)

-E/O measurements (spatial and/or spectral decoding)

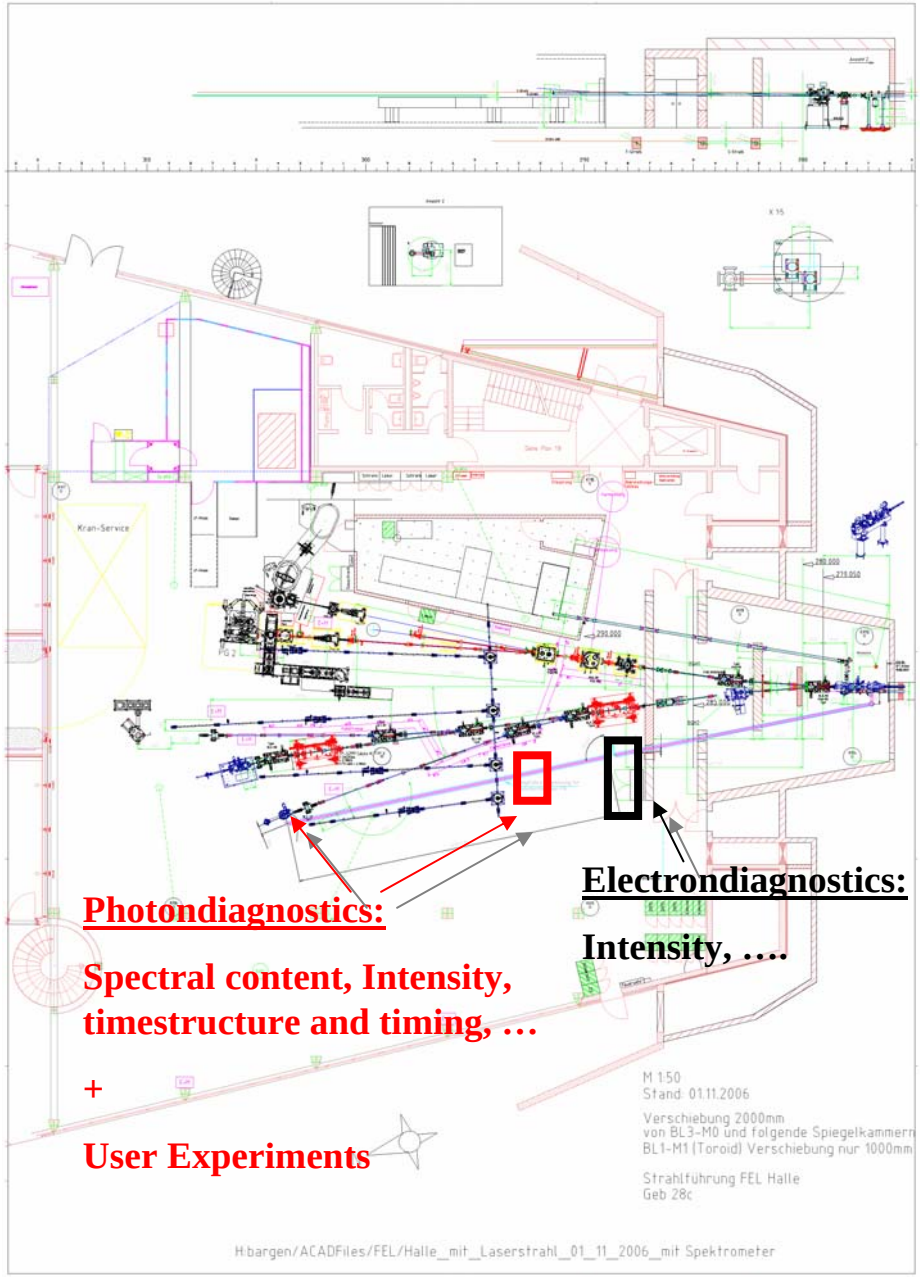
(collab. S. Duesterer, A. Azima + FLA)

Spatial and temporal Overlapp with VUV at BL3

courtesy of M. Drescher



„Routine“ running? in 2008 ….



Photondiagnostic:

Spectral content:

- Single shot dispersive spectrometers

(collab. with H. Delshemi, B. Schmidt/FLA; W. Seidel/FZ Rossendorf?)

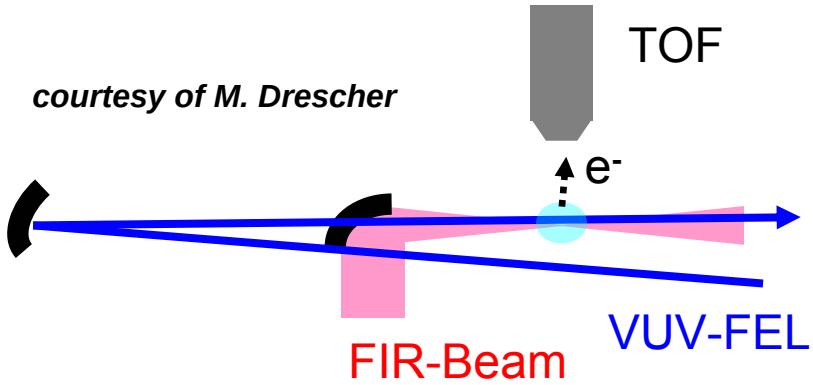
Timestructure/Timing:

-E/O measurements (spatial and/or spectral decoding)

(collab. S. Duesterer, A. Azima + FLA)

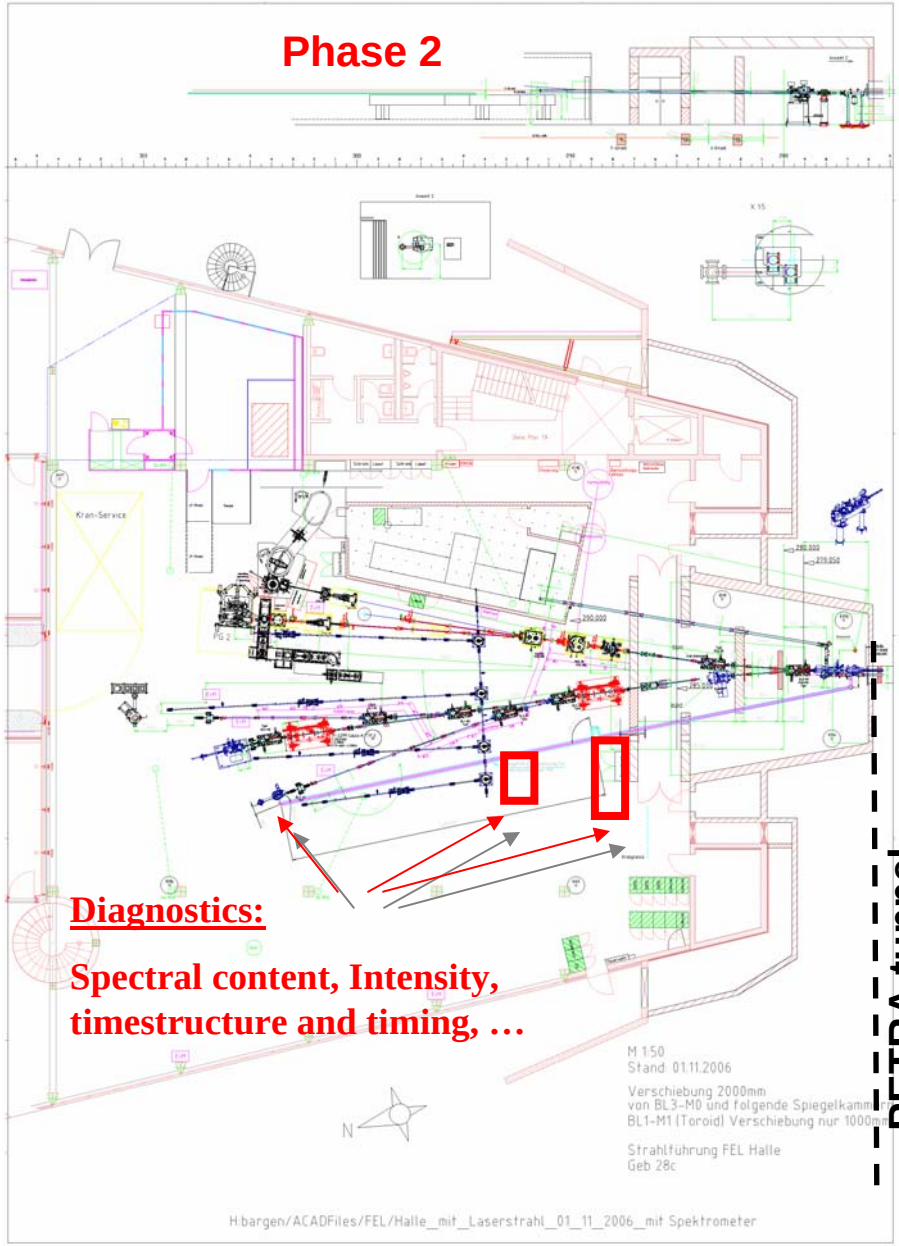
Spatial and temporal Overlapp with VUV at BL3

courtesy of M. Drescher



“User” experiments??

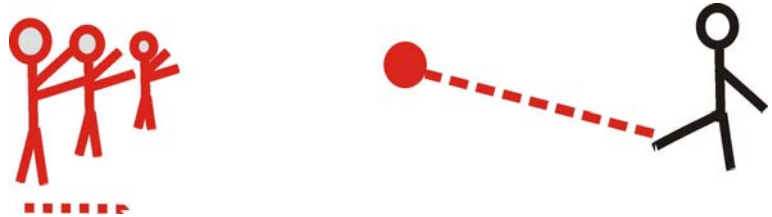
Summary



Diagnostics:

Spectral content, Intensity, timestructure and timing, …

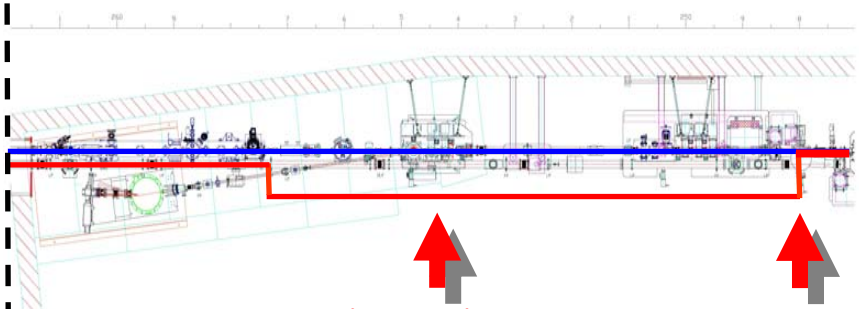
Alot of work…..



Are we sufficciently „parasitic“ ??

PETRA tunnel

Phase 1



Diagnostics:

Alignment, source properties (size, pointintg, reproducibility….)