Laser-Wire at PETRA III

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DESY / EuroteV

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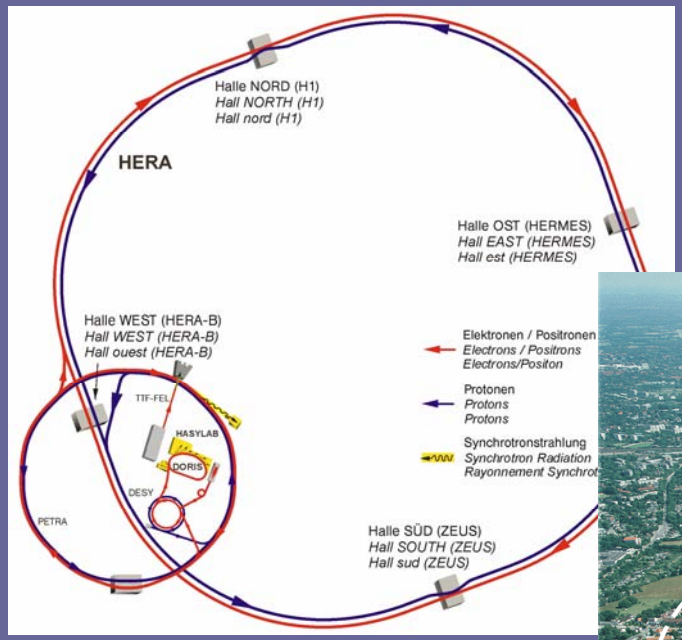
And Welcome to V. Gharibyan (DESY) who will work on LW.

DESY



PETRA II machine:

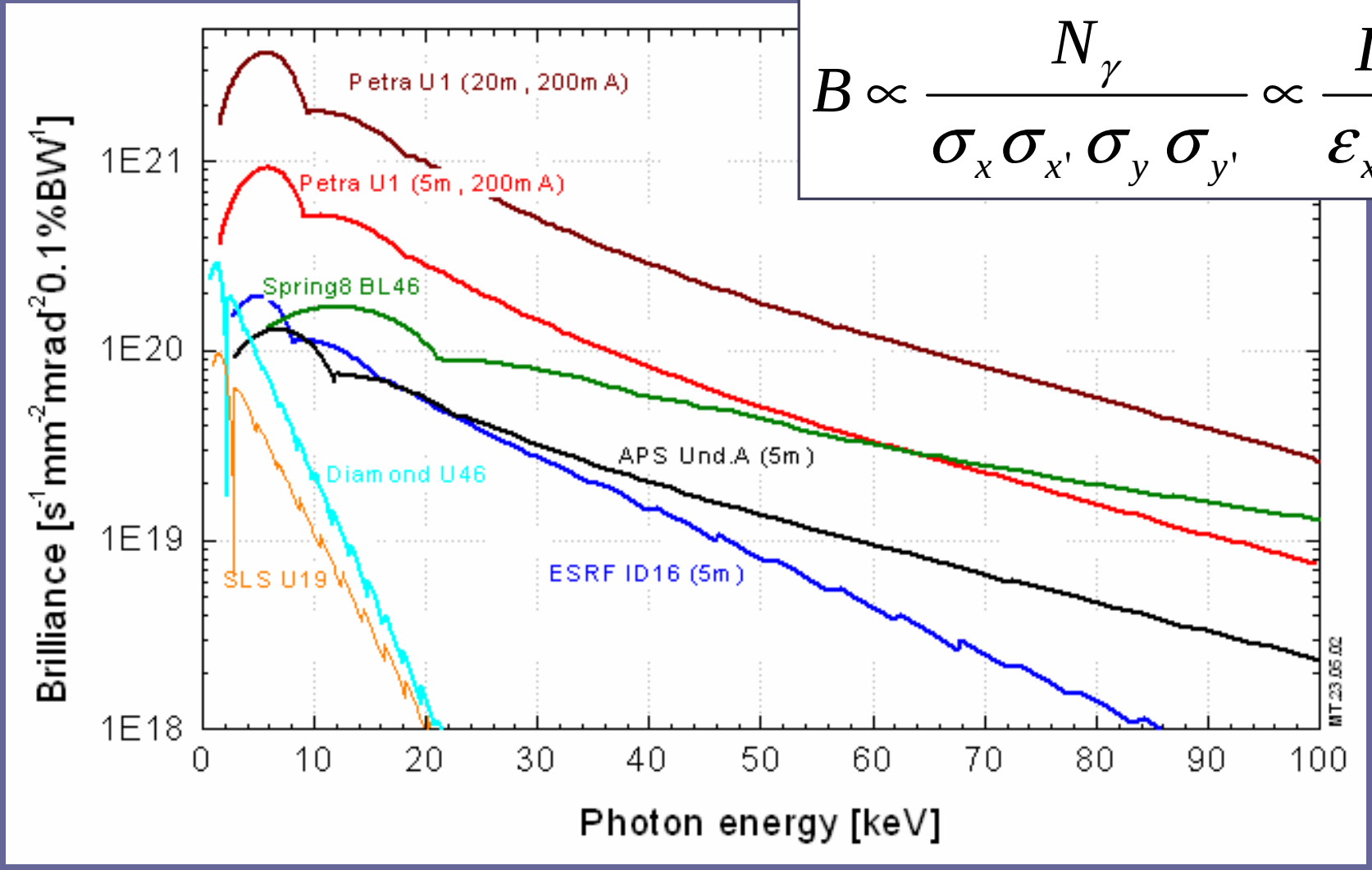
- Injector for Hera
- 2304 m of circumference
- Energy: 4.5, 7, 12 GeV

PETRA II

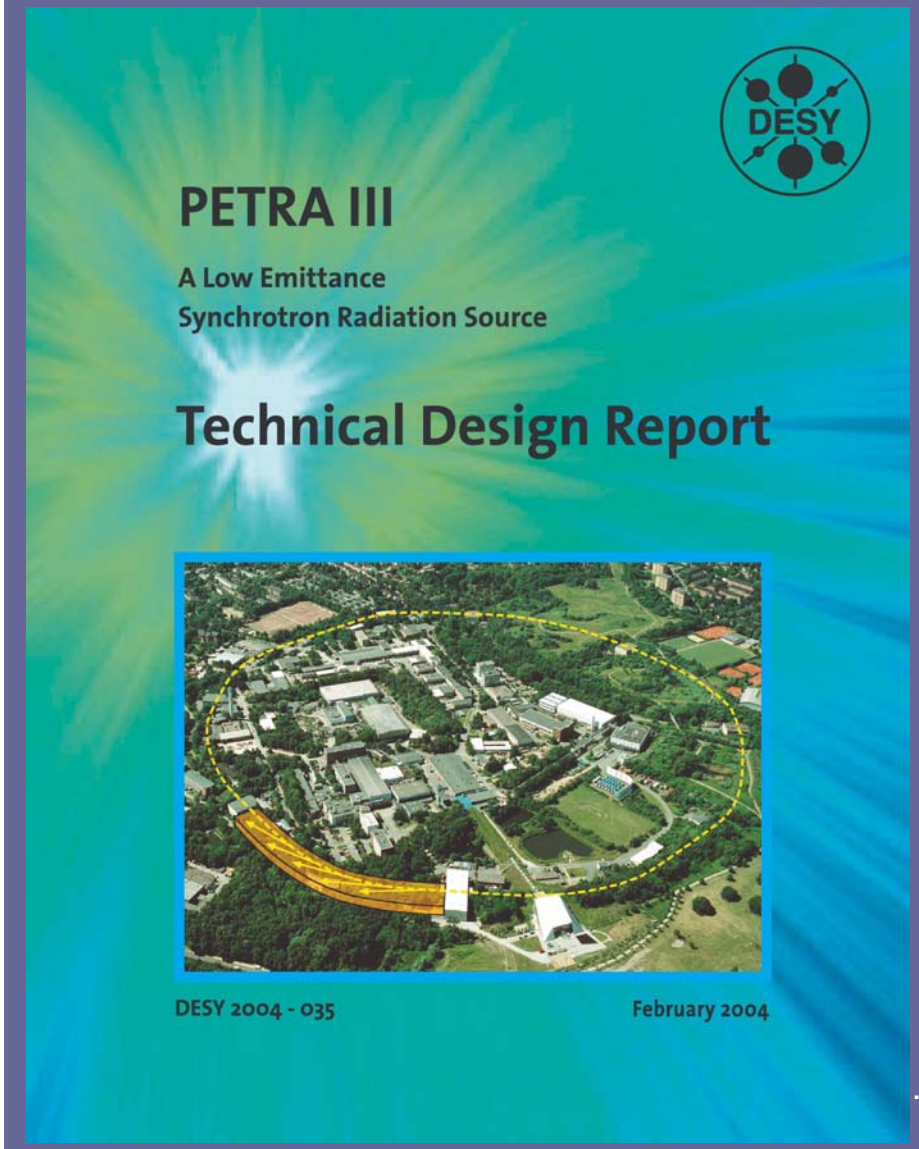
Actual Laser-Wire position

2009 ➔ PETRA III: High Brilliance Machine

$$B \propto \frac{N_\gamma}{\sigma_x \sigma_{x'} \sigma_y \sigma_{y'}} \propto \frac{I_{tot}}{\varepsilon_x \varepsilon_y}$$



PETRA III



Parameters:

- energy: **6 GeV**
- current: **100 mA** (upgrade 200mA)

- straight sections: **9**
- undulators: **14**
- undulator length: **2, 5, 20 m**

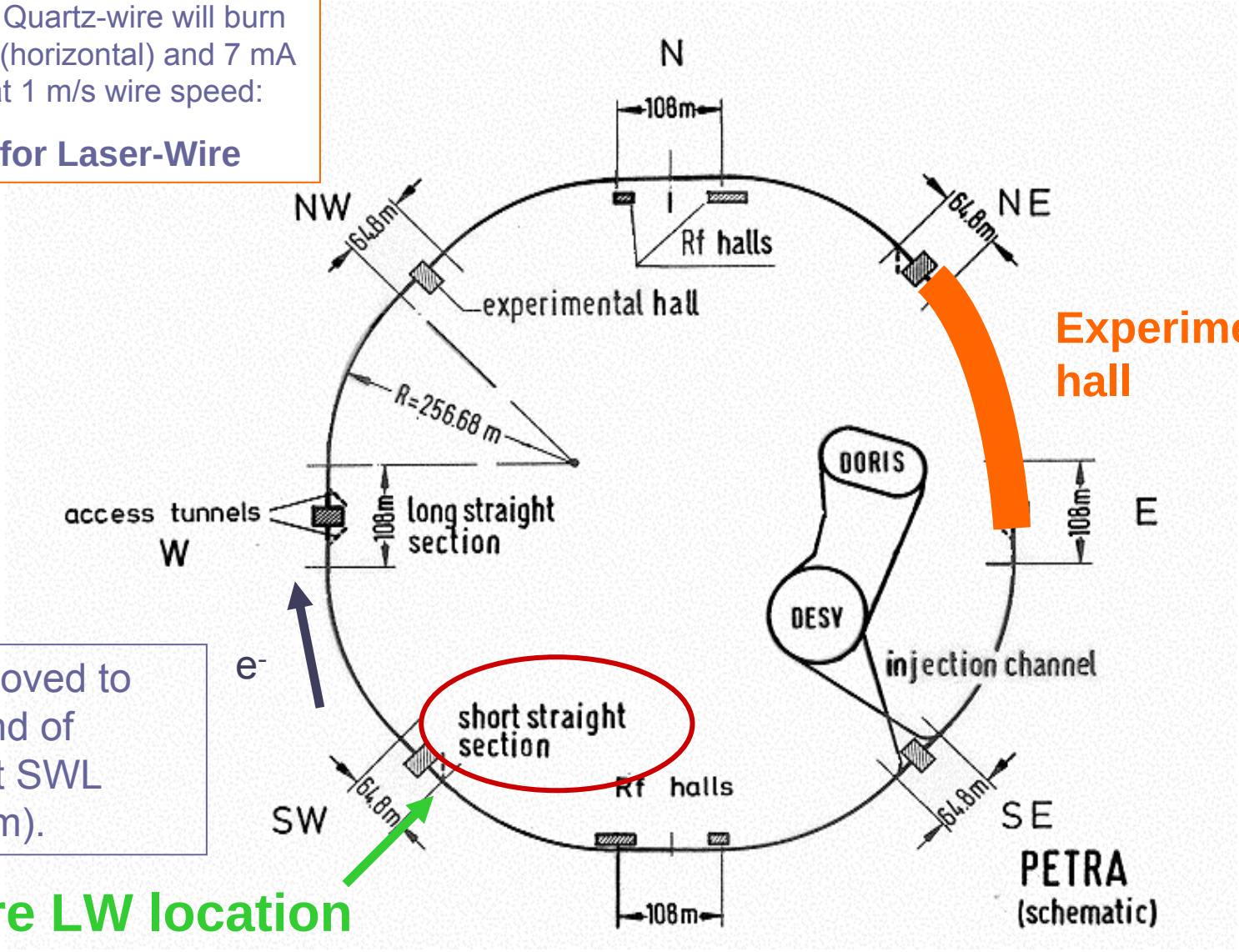
- emittance: **1 nmrad**
- emittance coup.: **1%**

-40 to 960 bunches circulating.
-Top-up strategy when 40 bunches (injection every 5 secs)

PETRA III

15 micron Quartz-wire will burn at 0.7 mA (horizontal) and 7 mA (vertical) at 1 m/s wire speed:

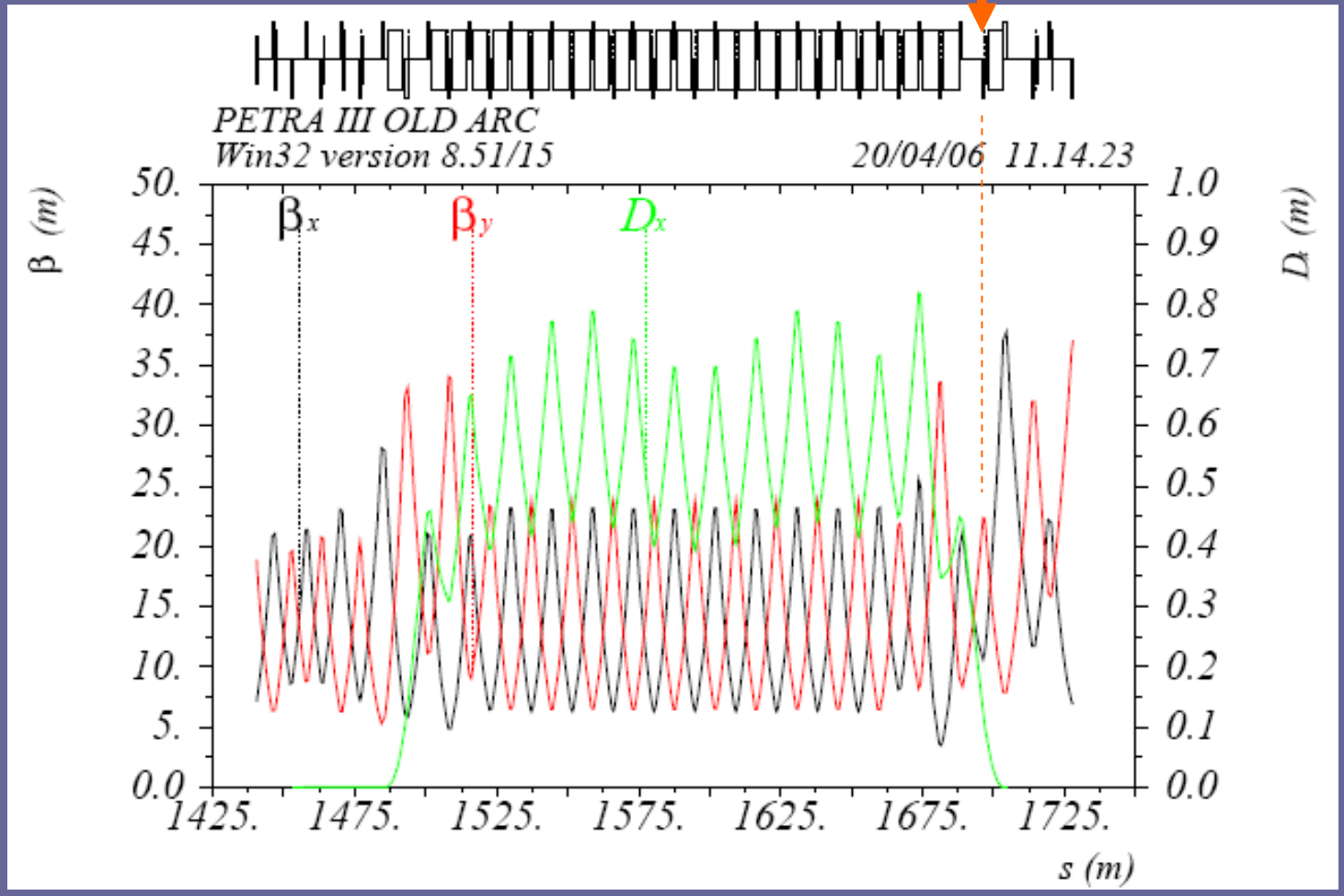
→ **Need for Laser-Wire**



LW moved to the end of octant SWL (~35 m).

Future LW location

Beta Functions



Provided by Li Yongjun (THPLS021)

Location of laser:

β_x= ~10 m

β_y= ~20 m

Dispersion minimum

σ_x= ~100 µm

σ_y= ~14 µm

Orbit stability requirements (with feedback):

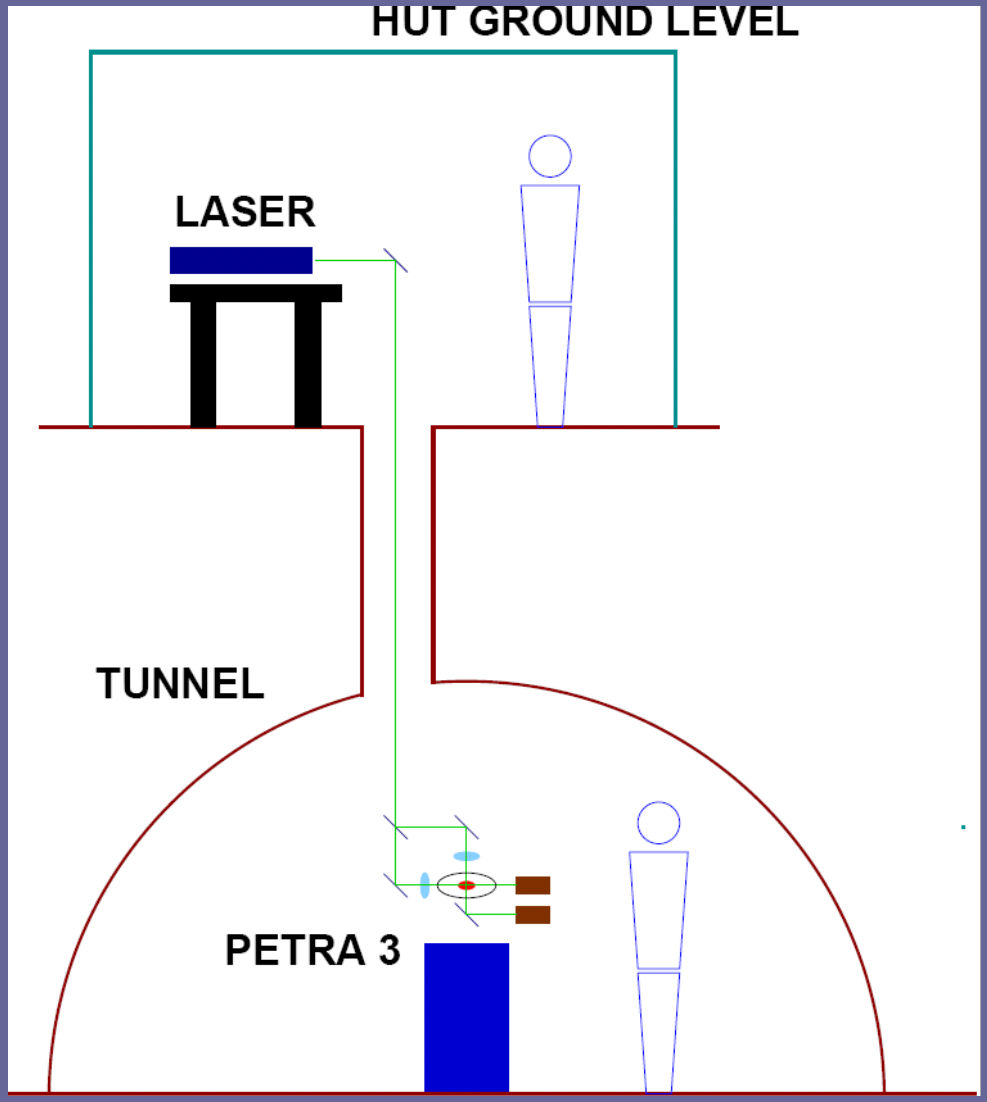
10% σ

Laser-wire at PETRA3

The laser itself located in a hut on the Petra-rampart.

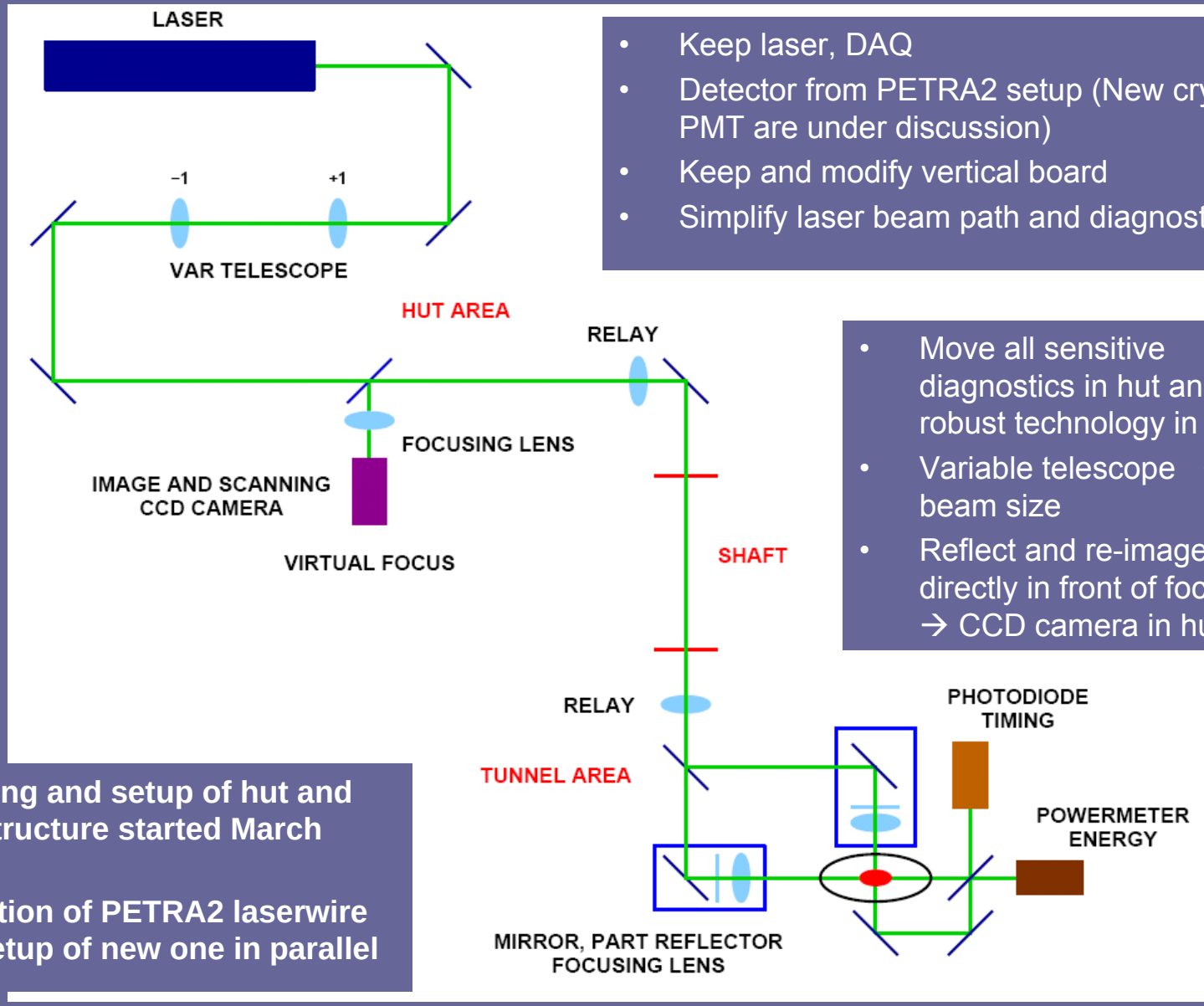
The laser light will be directly lead through a hole in the ceiling of the tunnel into the cross chamber.

Robust optics and technology placed on a table - same as in Petra 2.



Re-cycle laser and vertical board from upgrade
New optical beam path and focusing lens

Laser-wire at PETRA3



- Keep laser, DAQ
- Detector from PETRA2 setup (New crystals + PMT are under discussion)
- Keep and modify vertical board
- Simplify laser beam path and diagnostics

- Move all sensitive diagnostics in hut and only robust technology in tunnel
- Variable telescope → input beam size
- Reflect and re-image beam directly in front of focus lens → CCD camera in hut

- **Planning and setup of hut and infrastructure started March 2005**
- **Operation of PETRA2 laserwire and setup of new one in parallel**

Schedules

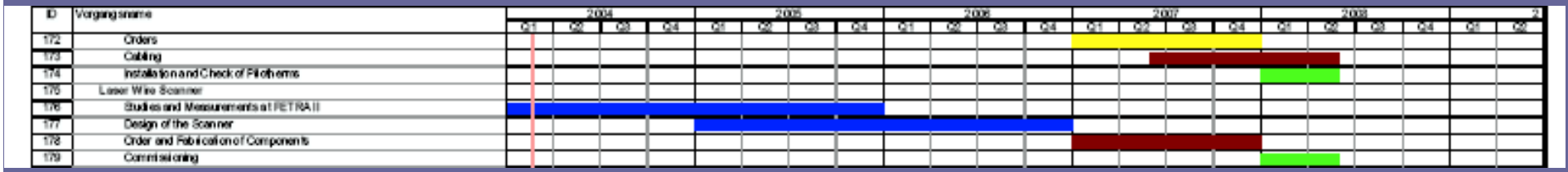
PETRA III

- 2006
  - Start of component ordering / production
- 2007
  - Mid 07: Start of storage ring reconstruction
- 2008
  - Mid 08: Installation of the first beamlines
- 2009
  - First beam + vacuum commissioning
  - Mid 09: First user experiments

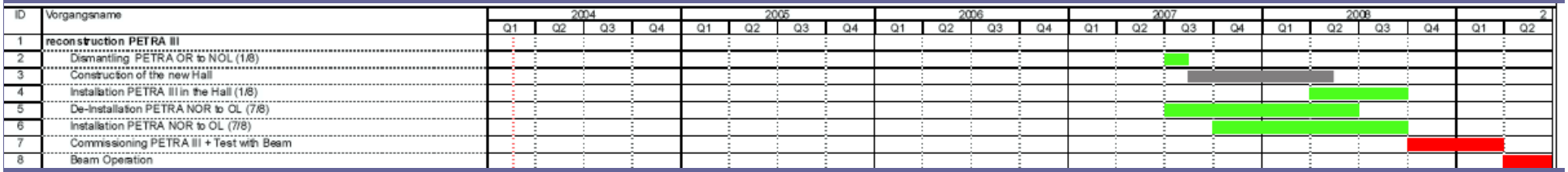
Laser-Wire at PIII

- 2006
  - 05/06: mechanical drawing for light path
- 2007
  - 01/07: Detailed light path from hut to IP
  - 09/07: Room installation (air-con,...)
- 2008
  - 02/08: Optical transport installation, alignment with low power
  - 07/08: H.P. laser up to IP

Schedule – TDR like



ID	Vorgangsname
172	Orders
173	Cabling
174	Installation and Check of Pilotherms
175	Laser Wire Scanner
176	Studies and Measurements at PETRA II
177	Design of the Scanner
178	Order and Fabrication of Components
179	Commissioning



ID	Vorgangsname
1	reconstruction PETRA III
2	Dismantling PETRA OR to NOL (1/8)
3	Construction of the new Hall
4	Installation PETRA III in the Hall (1/8)
5	De-Installation PETRA NOR to OL (7/8)
6	Installation PETRA NOR to OL (7/8)
7	Commissioning PETRA III + Test with Beam
8	Beam Operation

PIII vs PII

- Beam size at LW location:
  - $\sigma_y \approx 14$ um (εy=1nmrad)
  - $\varepsilon_x = 100\ \varepsilon_y \rightarrow \sigma_x \approx 100$ um
- Position jitter:
  - ~10% σ_y (fast feedback goal)
- Topping up bunches (when 40 bunches in ring)
  - Bunch injection (to keep high stable current)

PETRA II (now):

$\sigma_y \approx 70$um

εy=6nmrad @ 6 GeV

PETRA III
Lifetime – Topping up

User demand 12 h run time → total lifetime ≈ 24 h
→ Touschek lifetime ≈ 50 h

Way out

- increase the number of bunches (960) → new feedback system
- Top up (time resolved measurements with a small number of bunches)

➢ More precise: injection at a Hertz rate (constants of I_{tot} **≈ 1 ‰)**

Also attractive in case of many bunches

1. Fill appr. every minute (constants of Itot **≈ 1 ‰)**
2. → thermal equillibrium → relaxes burden of orbit stabilisation (SLS)