RF heat load compensation with electrical heaters for XFEL accelerator – measurements at CMTB, AMTF and FLASH

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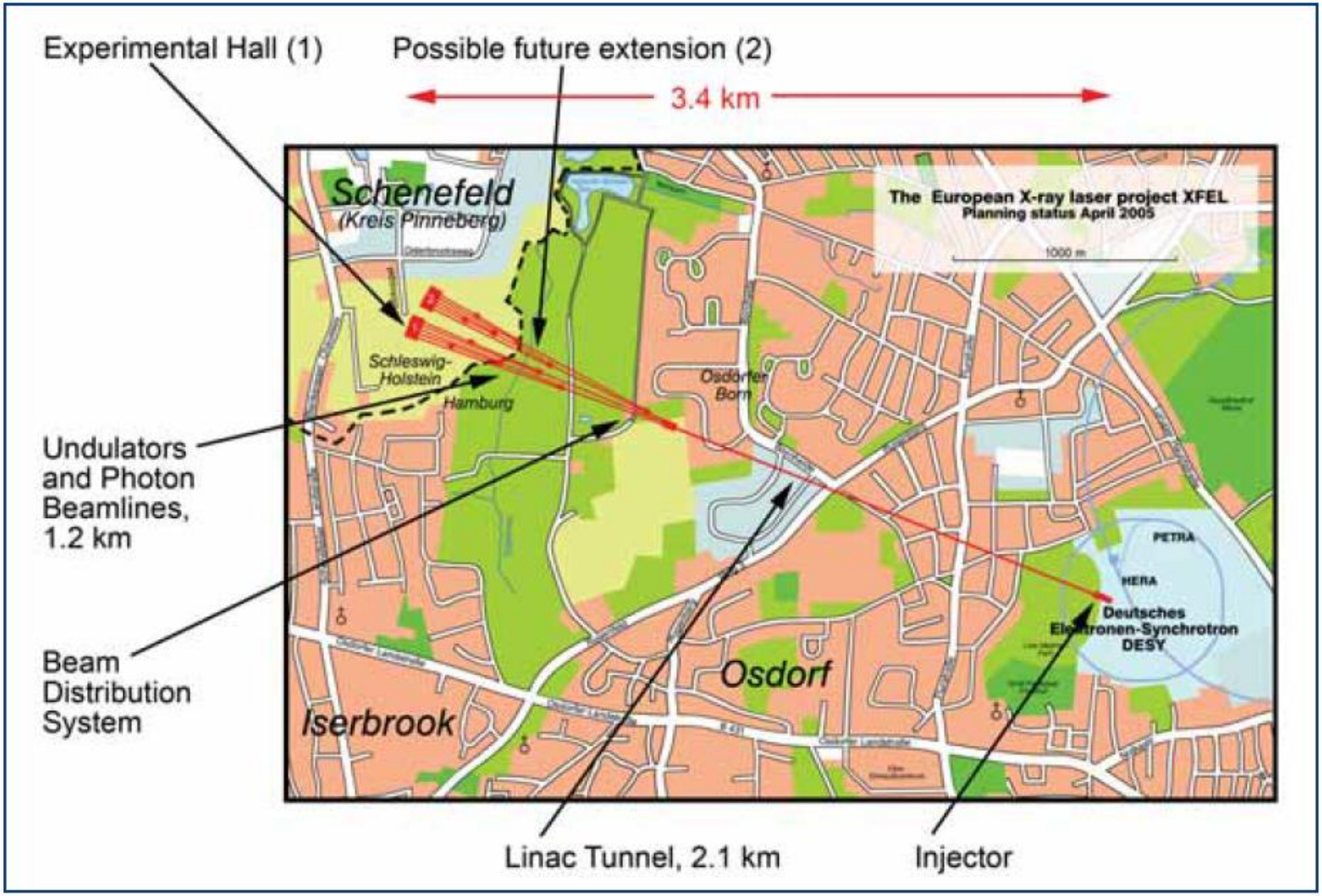
Content

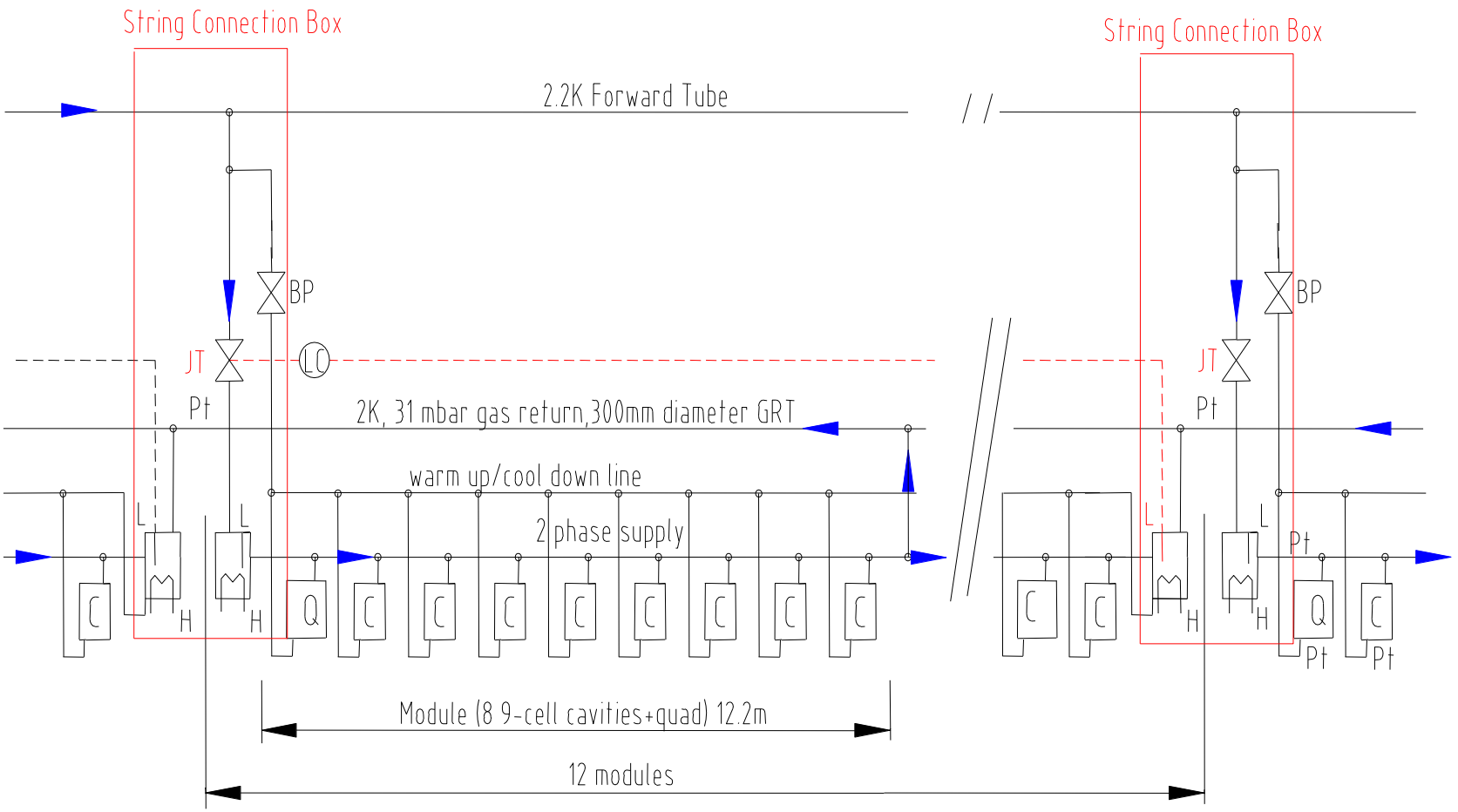
- Cryogenics at XFEL
- Stability requirement on pressure
- Measurements at CMTB, AMTF and Flash accelerator
- Future plans

European XFEL

XFEL Location



Simplified flow diagram of cryomodule string



String connection box contains all cryogenic instrumentation.

Stability requirements on pressure and mass flow rates (steady-state operation)

RF change of TESLA cavities versus pressure change : ca. 50 Hz / mbar

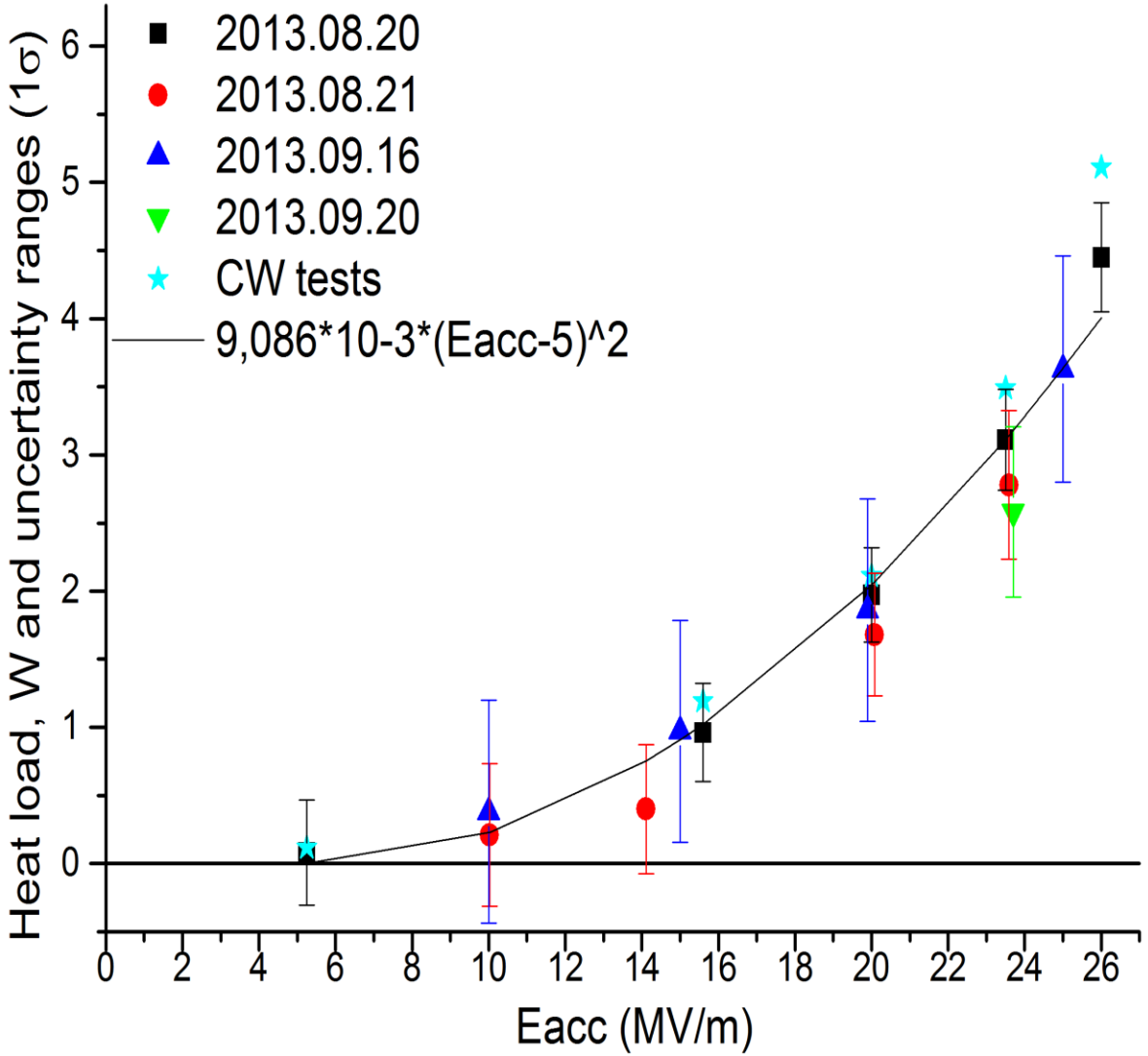
Note from DESY RF experts: fluctuations should be limited to +/- 35 Hz to avoid RF phase shifts

-> pressure stability better than **+/- 0.7 mbar** required -> specification **+/- 1.0 %** relative, i.e. **+/- 0.3 mbar**

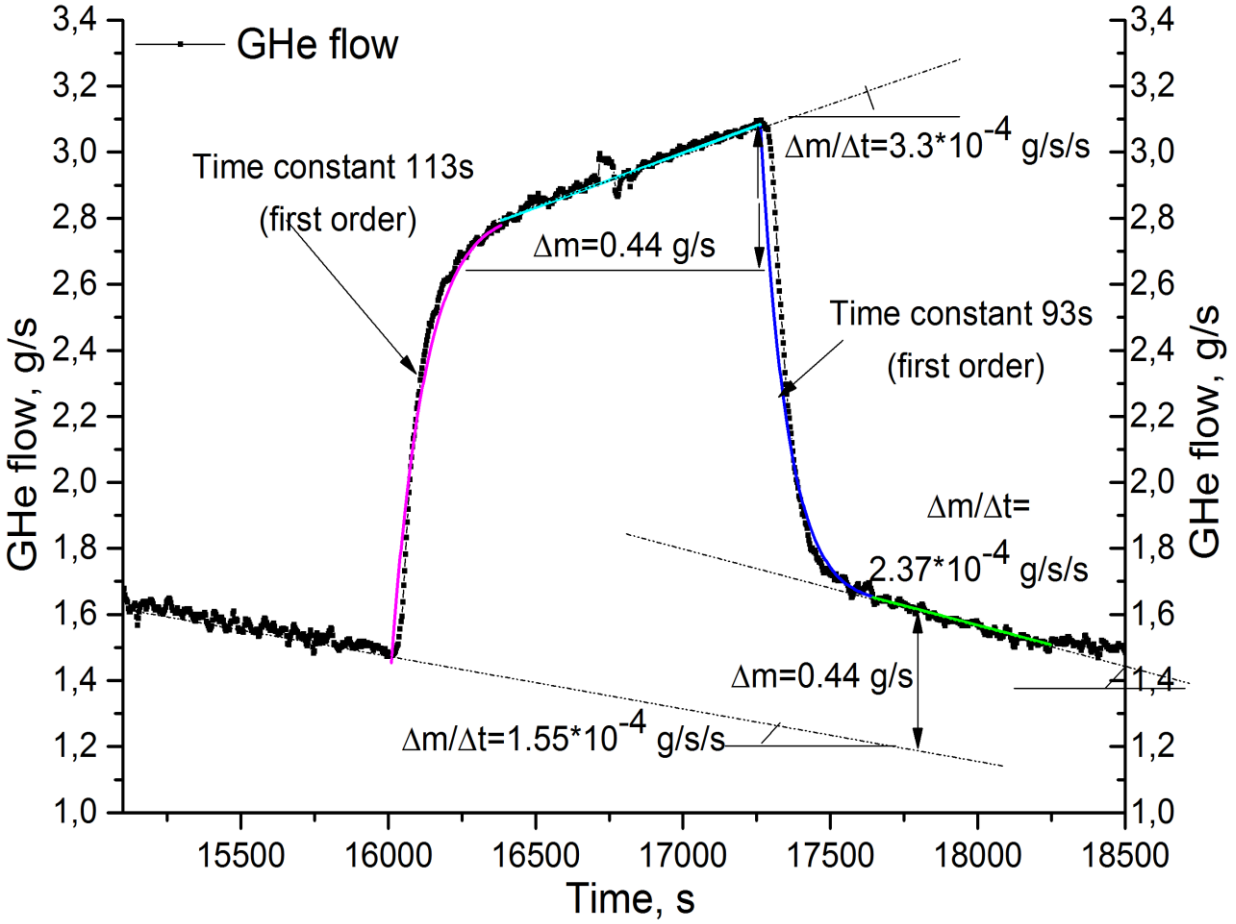
RF heat load compensation with electrical heaters at steady-state operation mode (I)

Three steps:

1. Read acceleration field (Eacc)
2. Recalculate to the cryogenic heat load
3. To compensate cryogenic heat load with electrical heater.



RF heat load compensation with electrical heaters at steady-state operation mode (II)



Parameter of RF operation (FLASH accelerator):

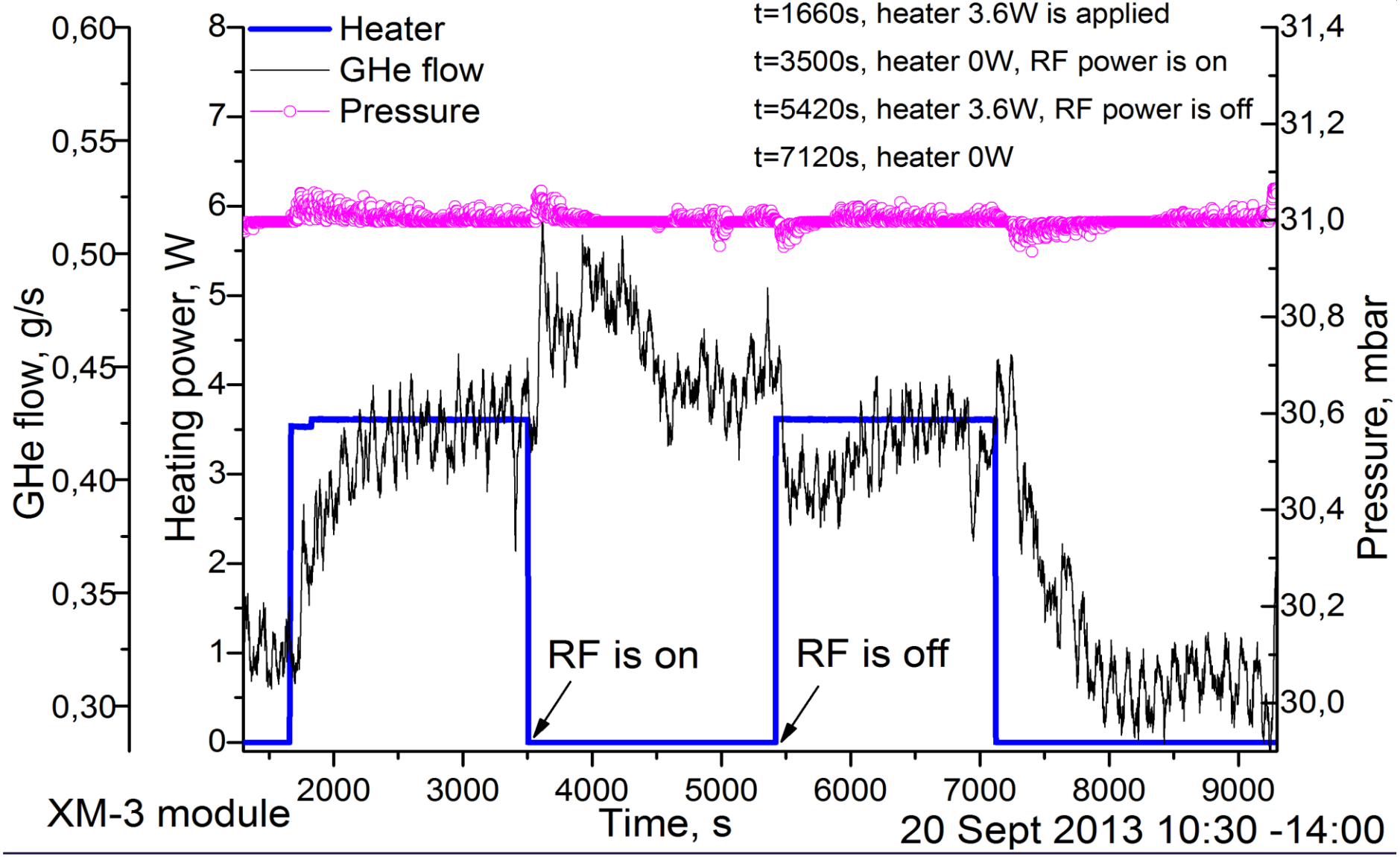
Absolute value of heating power

Time constant for increase/decrease

Long-time drift of GHe flow due to residual heating

Quite similar considerations are applicable to the electrical heaters!

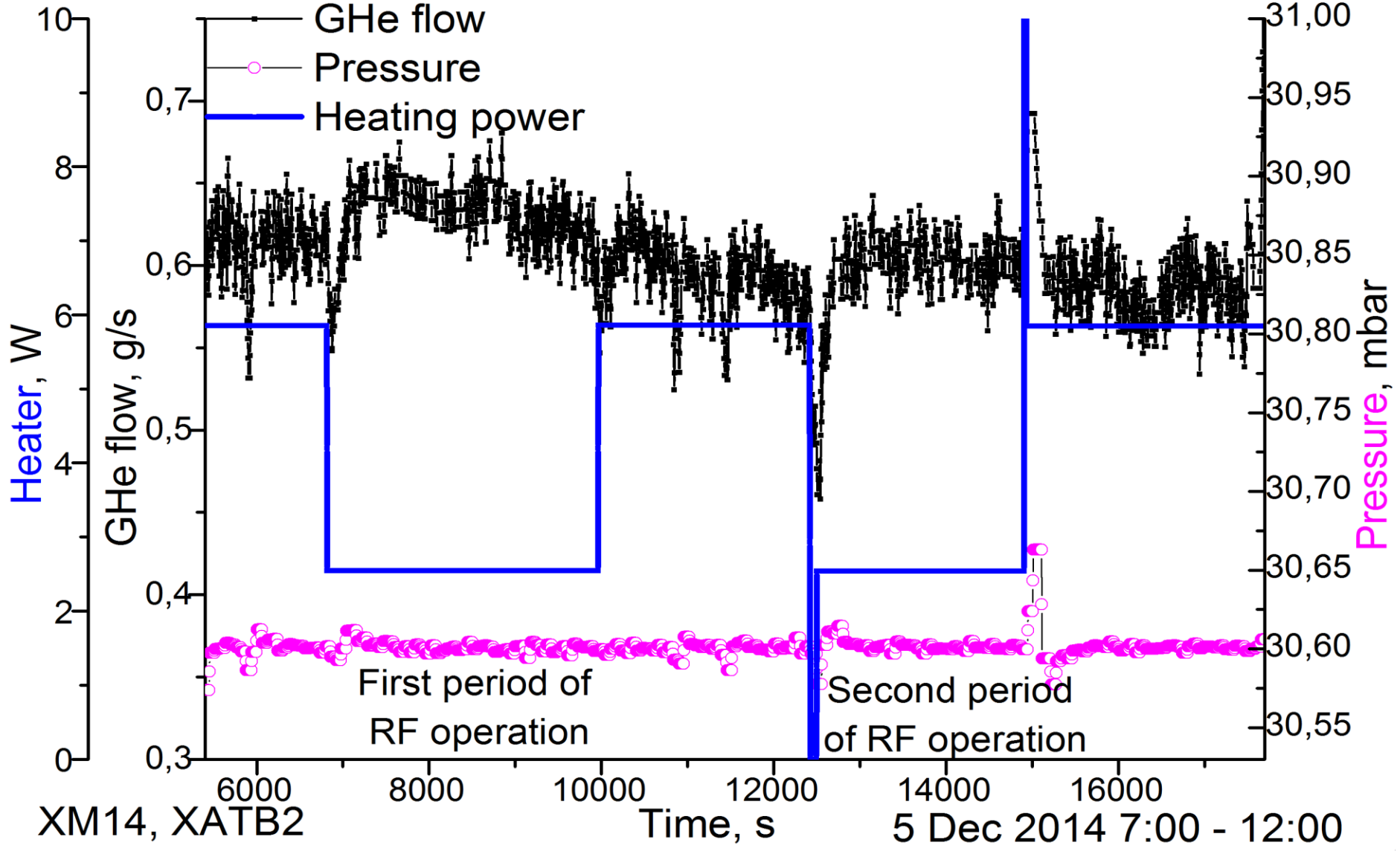
RF heat load compensation with electrical heaters at steady-state operation mode (III)



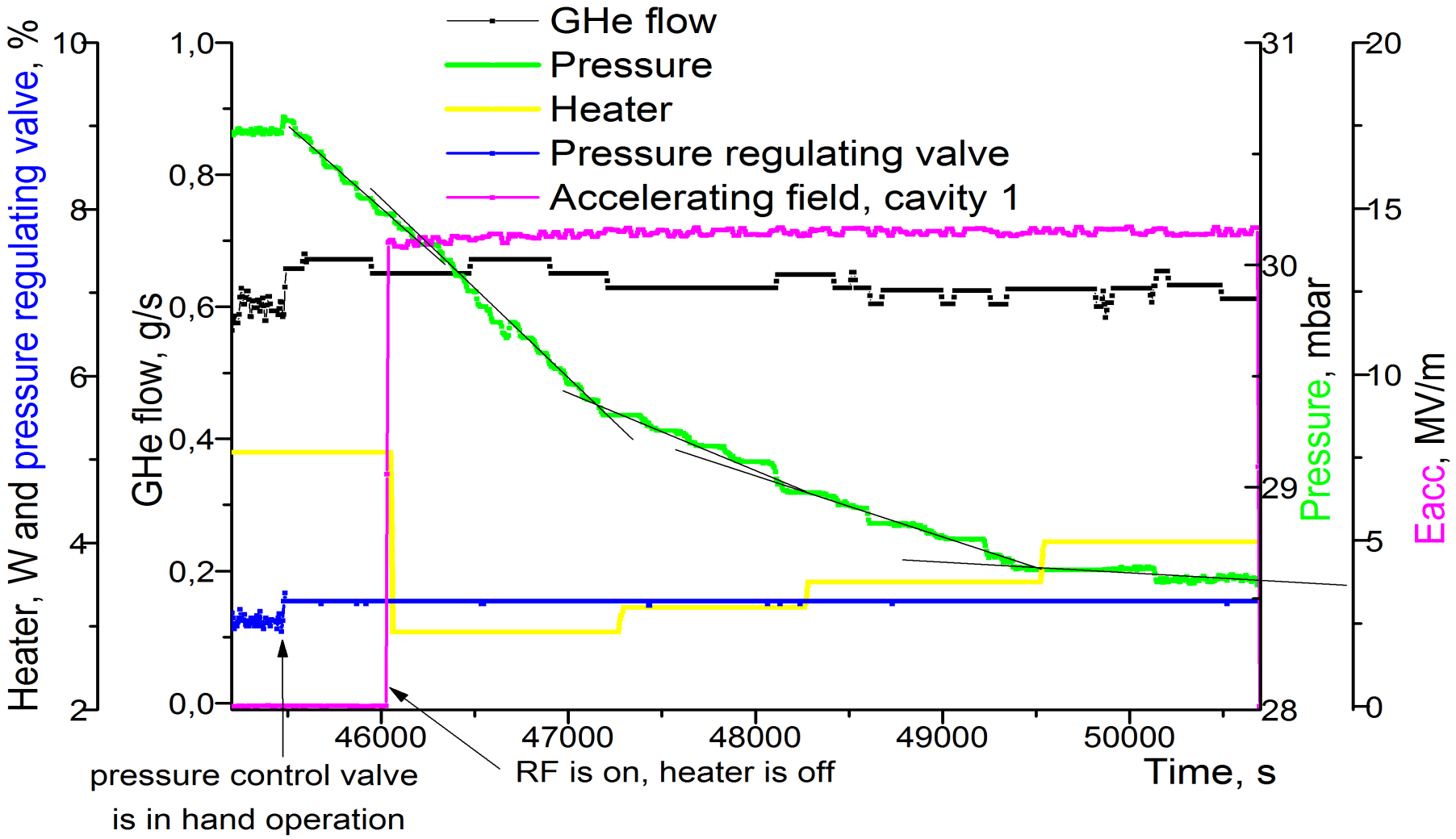
XM-3 module

20 Sept 2013 10:30 -14:00

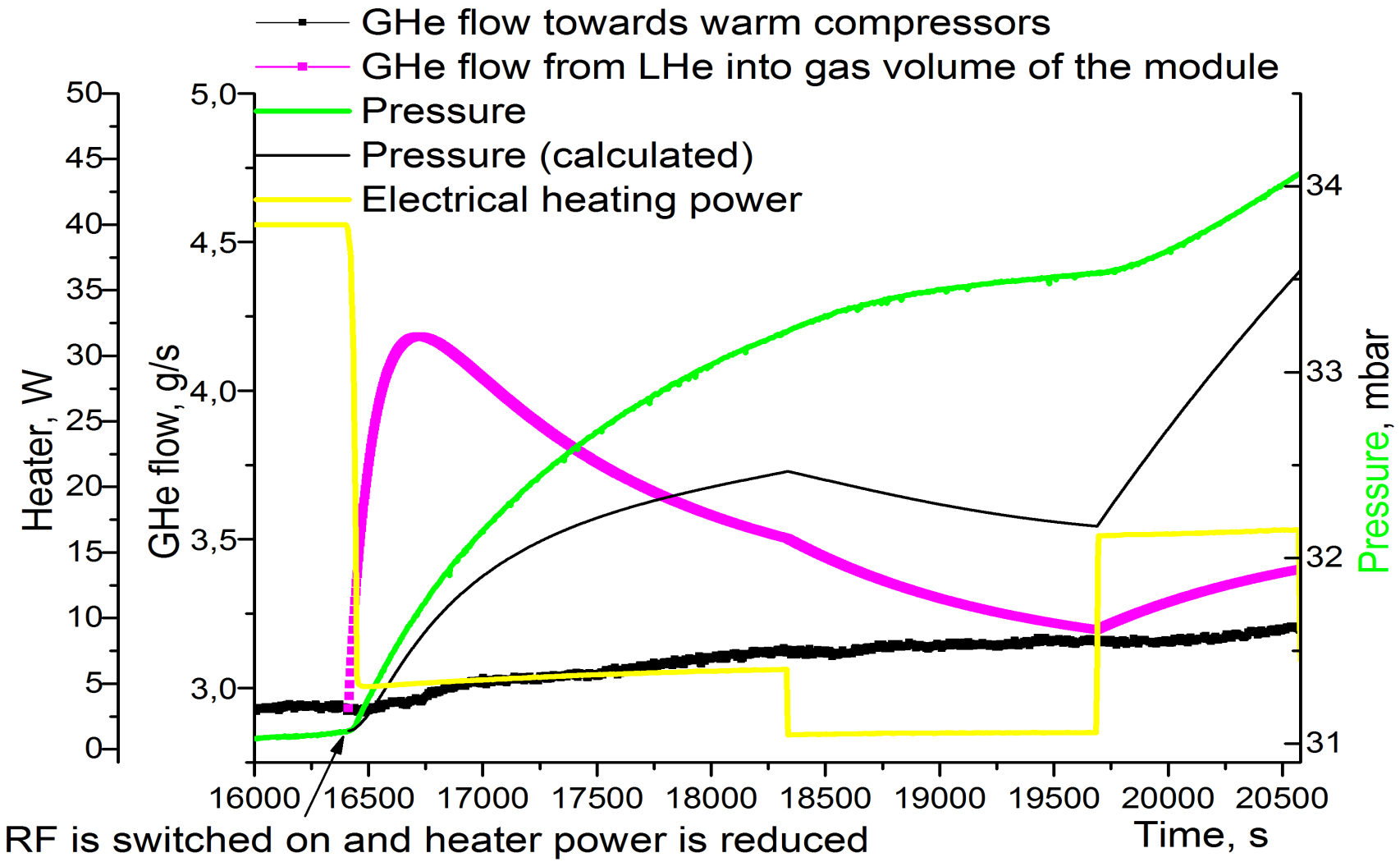
RF heat load compensation with electrical heaters at steady-state operation mode (IV)



RF heat load compensation with electrical heaters at steady-state operation mode (V)



RF heat load compensation with electrical heaters at steady-state operation mode (VI)



Future plans

Experiments at CMTB, AMTF and FLASH accelerator showed that the heat load compensation scheme is feasible.

- To develop the automatic programs for smooth operation between cryogenic and Low Level RF groups
- To perform further measurements at CMTB with different operation parameters

And to be prepared for XFEL commissioning !