Meeting Report

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Contents

Scaling analysis

Previously on...

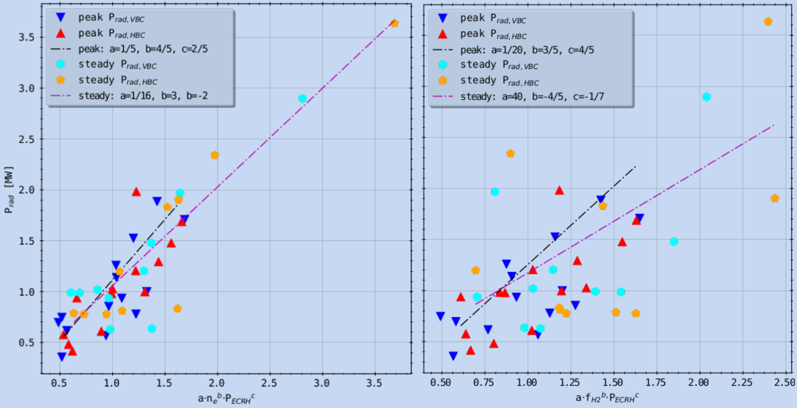
- trying to find possible scaling between input power, density, gas fueling and radiated power loss, e.g. for plasma control
- making simple 3 parameter $\{a, b, c\}$ intereference assumption like:

$$P_{rad}[\mathsf{MW}] \propto a\{n_e[10^{19}\mathsf{m}^{-3}]\}^b\{P_{ECRH}[\mathsf{MW}]\}^c$$

or

$$\propto a\{f_{H2}[\mathsf{mbar\,s/l}]\}^b\{P_{ECRH}[\mathsf{MW}]\}^c$$

Results, manual selection on DCH



Attempt of finding a possible scaling between input power, density/main gas fueling in H_2 and radiation loss in arbitrary magnetic configurations. Seperated however are the stages after the fueling, i.e. right at the peak of P_{rad} and when equilibriated (steady).

New agenda

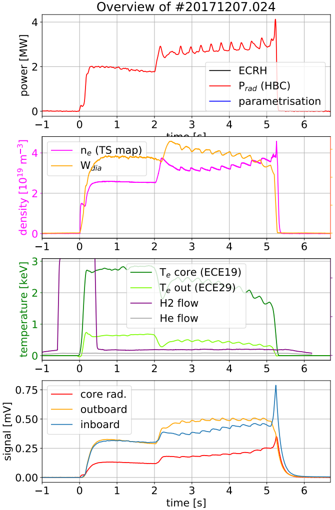
High priority: correlation analysis

- find best/most relevant channel combination to predict P_{rad}, i.e. the most relevant channels for divertor gas insertion experiments
- localisation and sensitivity of channels in response to thermal gas divertor valves, maybe $\mathrm{n}_e(\mathrm{P}_{rad})$, $\mathrm{P}_{rad}(\mathrm{n}_e)$
  $\Rightarrow$ spatial sensitivity for tomography?
- prediction:

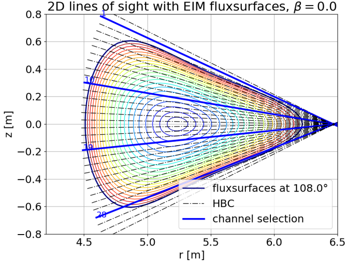
$$P_{prediction} = \frac{V_{P,tor}}{V_S} \cdot \sum_s^{selection} \frac{V_s}{K_s} \cdot \frac{P_s}{53\%}$$

with: $V_S = \sum_s^{selection} V_s$

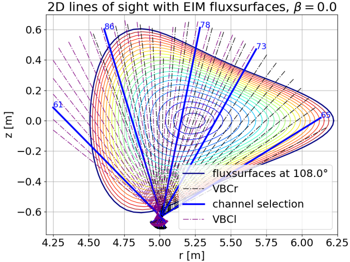
New agenda



Overview of #20171207.024
power [MW]
ECRH
P_{rad} (HBC)
parametrisation
n_e (TS map)
W_{dia}
density [10^{19} m^{-3}]
energy [kJ]
T_e core (ECE19)
T_e out (ECE29)
H2 flow
He flow
temperature [keV]
flow [10^{-3} bar s l^{-1}]
core rad.
outboard
inboard
signal [mV]
time [s]



2D lines of sight with EIM fluxsurfaces, $\beta = 0.0$
fluxsurfaces at 108.0°
HBC
channel selection
z [m]
r [m]



2D lines of sight with EIM fluxsurfaces, $\beta = 0.0$
fluxsurfaces at 108.0°
VBCr
channel selection
VBCl
z [m]
r [m]

Correlation: “Standard deviation”

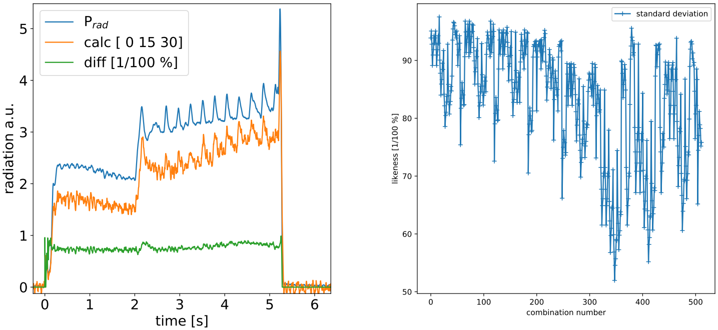
“Standard deviation”-method

$$d_{diff}(t) = \|P_{rad}(t) - P_{prediction}(t)\|$$

$$\varepsilon(t) = \left\{ \begin{array}{ll} 1 - \frac{d_{diff}(t)}{P_{rad}(t)} & , d_{diff} < P_{rad} \\ 0 & , \text{else} \end{array} \right\}$$

$$\vartheta = \overline{\varepsilon(t)}$$

Example: testing against P_{rad}(HBCm)



Correlation: Cross correlation

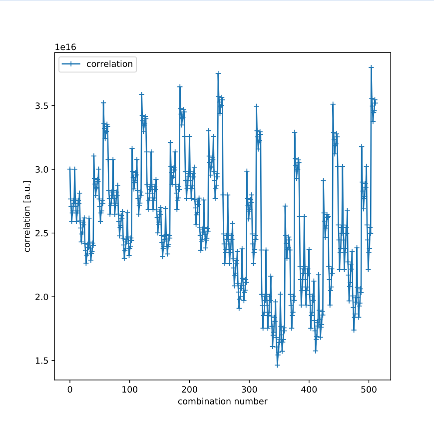
Cross correlation-method

$$C_{corr} = \int (P_{rad} * P_{prediction})(\tau)\mathrm{d}\tau$$

$$= \iint P_{rad}(t)P_{prediction}(t+\tau)\mathrm{d}t\mathrm{d}\tau$$

Correlation: Cross correlation

Example: testing against P_{rad}(HBCm)



Correlation: Coherence

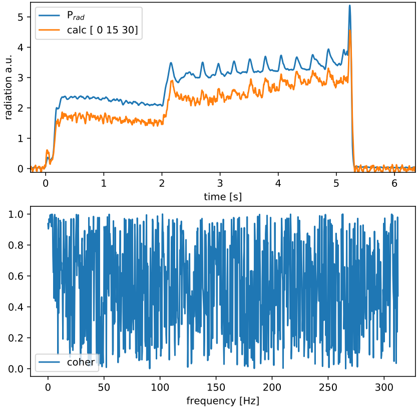
Coherence

$$C_{x,y} = \frac{\|(P_{x,y}\|^2}{P_{x,x} \cdot P_{y,y}}$$

$P_{x,x}$ and $P_{y,y}$ are power spectral density estimates of $X = P_{rad}$ and $Y = P_{prediction}$,
and $P_{x,y}$ is the cross spectral density estimate of X,Y

Correlation: Coherence

Example: testing against P_{rad}(HBCm)



Protocoll of meeting

Protocoll

- wavelet transformation instead of FFT/coherence analysis since FFT tend to smear and over-amplify the contribution of noise to the results since the evaluation window is small/placed inconveniently
  $\Rightarrow$ ask T.Windisch about cross wavelet anylsis
- the previously discussed differentiation between intrinsic (H2, He, C, 0, Fe, ...) and extrinsic (N, Ne, CH4, ...) might rather be down to the configuration, scenario, transport, profles etc.
  ...

Protocoll of meeting

Protocoll

- because of that, the localisation/sensitivity is possibly subject to changes according to the temperature profiles, especially separatrix/SOL temperatures (hot/cold)
- need seperatrix/SOL/sheath profiles from midplane manipulator/He-box of n_e/T_e
  $\Rightarrow$ might be asking for complementary/fundamentaly different profiles to prove-check the sensitivity analysis
  $\Rightarrow$ Victoria Winters did CH4 experiments at different pressures, densities, temperatures

Protocoll of meeting

Protocoll

- calibrate single LOFs against the P_{rad} to check if its a special channel or combination
- extend anlysis definitely to experiments with actual radiation feedback (20181010.032)

Protocoll of meeting

Protocoll

To summarize:

1. calculate sensitivity for channels – localistaion
2. check whether this is generally applicable or a function of different system variables
3. if necessary, focus on detachment experiments where feedback is applied and hence the channel selection does matter
4. why is that the case? differences in radiation locals
5. applicable conclusions for feedback system