Progress report :
Non-linear MHD simulations of pellet triggered ELM in JT-60SA

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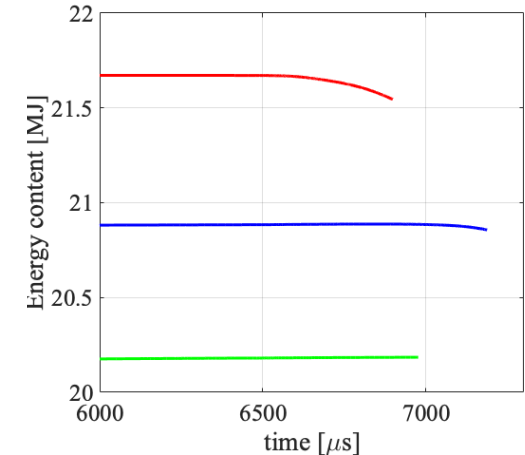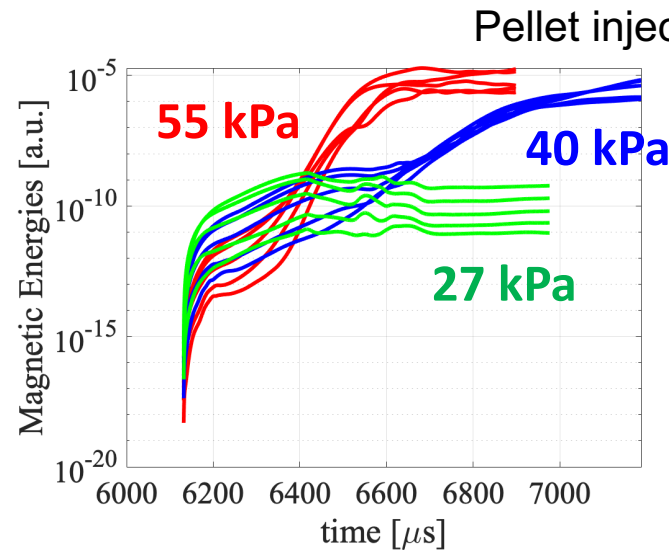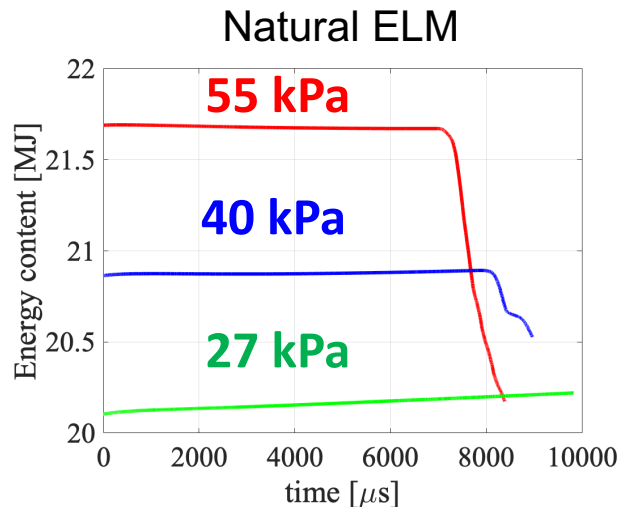
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Summary 2021

Status 2021

- Three pedestal top pressure equilibriums are prepared; P_{ped}=55 kPa, 40 kPa, 27 kPa.
- The pellet size, 0.8×10^{21}D, which is the reference size of pellet ELM triggering for JT-60SA;
  - **55 kPa** case shows strong growth of high-n modes → ELM triggering.
  - **40 kPa** case shows very weak growth of high-n modes → ELM triggering…? Anyway, very small.
  - **27 kPa** case does not show the growth of high-n mode. ELM is not triggered.

Natural ELM

Pellet injected cases

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Plan 2022

- It may be nice to know if 0.8×10^{20} D pellet triggers an ELM in a 40 kPa pedestal pressure plasma.

- It would be nice if the realistic plasma flow (diamagnetic term, neoclassical term, etc) can evolves the pedestal profile. [Cathey, Hoelzl, NF 2020]

- The pellets will be injected inter-ELM phase (same approach with [Futatani et al., NF 2021]).
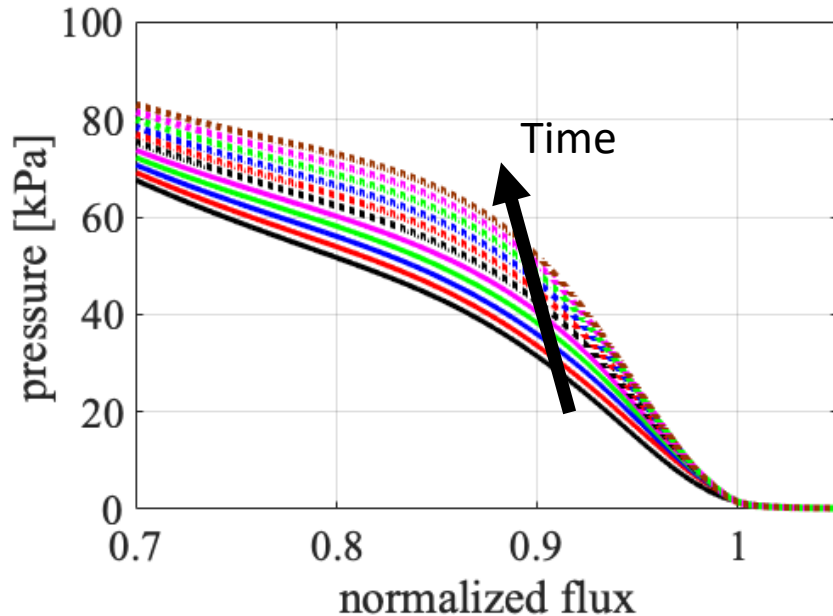
[Cathey NF (2020)]

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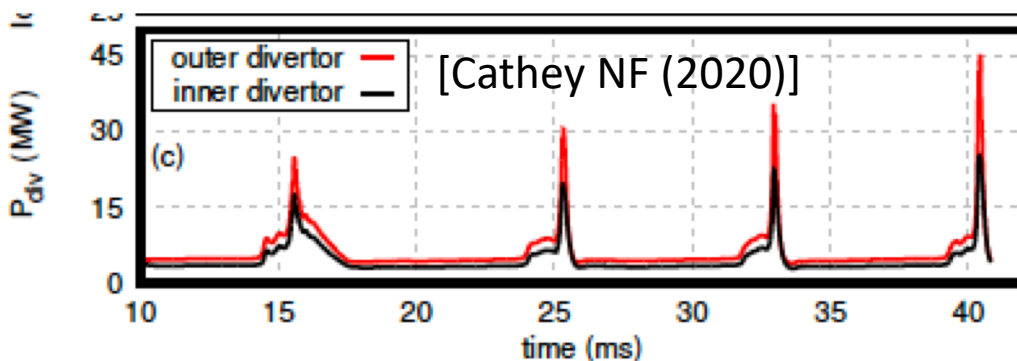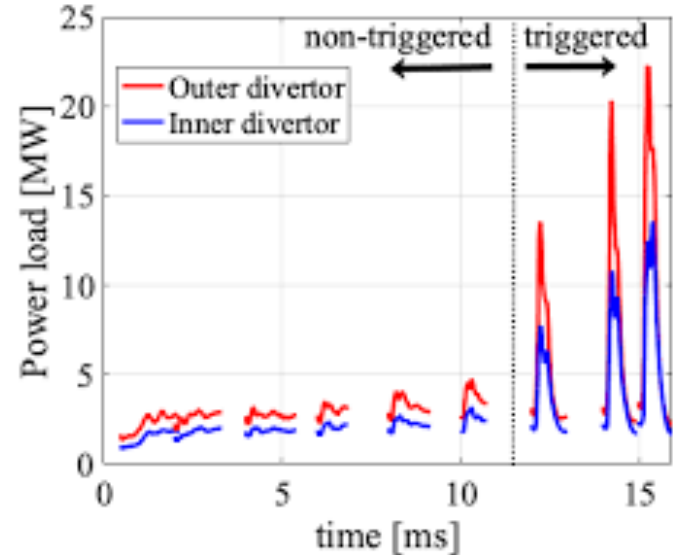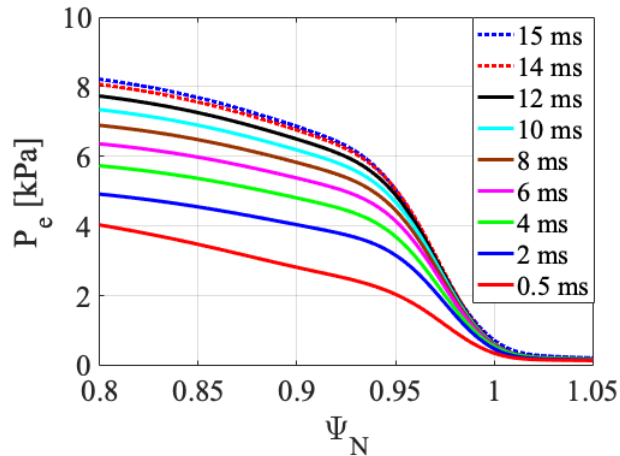
Status 2022 (Up to now)

- The preparation of simulation set-up for multi-ELM events.

- This is very difficult to find appropriate parameters which reproduce reasonable build-up of pedestal profile. → Still more work needed

For now, the evolution of the pedestal can be reproduced. However, the position shifts to the core direction...

More investigation (trials and fails) of diffusion coefficient profile and source profile should be carried out.

Plan 2022

- (If the set-up becomes ready), pellets will be injected inter-ELM phase (same approach with [Futatani et al., NF 2021]).

- Deliverable 2022 would be, Pellet injections in at least 2 time slices (post and pre-ELM event) in the self-consistently evolving pedestal profile.

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Possible proposal

- MIPS [Todo Y et al 2010 Plasma Fusion Res. 5 S2062] (i.e. extraction of MHD module from MEGA code) is being developed.

Pellet cloud propagation in LHD stellarator plasma.
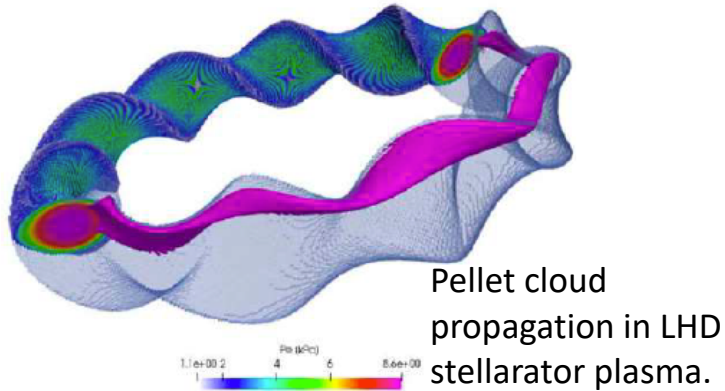
This year, I (Futatani) have two master students who are contributing the MIPS code development.

-Futatani and Suzuki, PPCF 2019
-Suzuki, Futatani, Geiger, PPCF 2021

- Japanese team(s) is working on the simulations of JT-60SA using MIPS code.
  - The effects of RMP field on the ELM in JT-60SA → ELM mitigation with RMP field was demonstrated.

Particle flux on the outboard divertor

Heat flux on the outboard divertor

Splitting
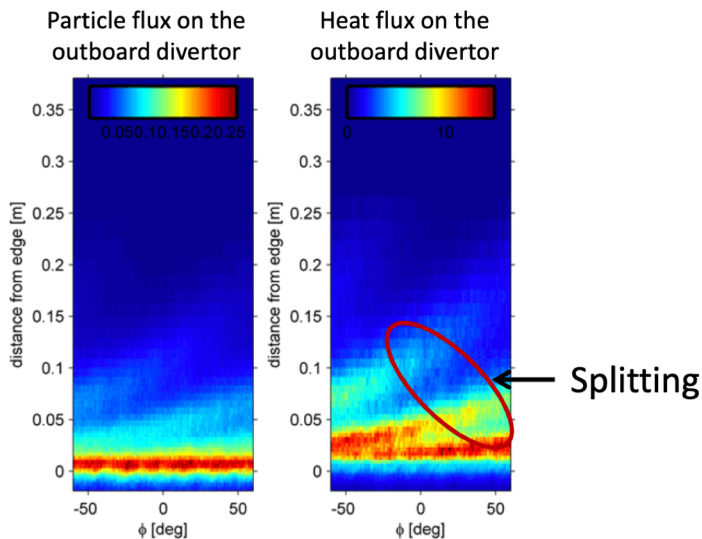
Suzuki-san (Hiroshima Univ., former NIFS) is working on RMP-ELM mitigation in JT-60SA.
Unless research topic does not interfere this work, it is possible to work on 'something' using MIPS code from EUROfusion (or me, UPC) side in collaboration with Japan.

What do you think? (Topic, manpower, input data, etc.)

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