CHALMERS
UNIVERSITY OF TECHNOLOGY

DREAM

Plans for 2021-2022

M. Hoppe, I. Pusztai, O. Vallhagen and T. Fülöp

MSc student Boel Brandström, BSc students: Ida Ekmark, Christian Rutgersson, Anton Rosenberg, Summer students: Hannes Bergström, Peter Halldestam, Esmée Berger

- ITER SPI simulations, *O. Vallhagen et al*
  - Code optimisation (C1, C4, C6)
  - Workflow to integrate MHD driven transport (C1)
  - Benchmarks (C1)
  - Simulations (A1, A2)
- Spatio-temporal analysis of runaway electrons in a JET disruption with material injection (DREAM+SOFT), *B. Brandström et al* (V1)
- Current relaxation due to fast magnetic reconnection, *I. Pusztai et al*
- SPARC Runaway Electron Mitigation Coil (REMC), *A.Sundström et al*

- Neutral and impurity transport
  - Injection schemes evolving on the transport timescale are appropriately described.
  - Expansion of neutrals after ablation is accounted for.
  - Redistribution of impurities during the TQ included.
- Plasma shaping (elongation, toroidicity).
- Currents in passive structures.

- 3D MHD simulation data will be provided by the ITER Organization (IO).
- Perturbed fields shall be input to ASCOT to determine the energy and time-dependent transport coefficients during TQ.
- Criterion for the TQ onset in accordance to the observations in the 3D MHD results.

- Material deposition
  - Fragment penetration and ablation, as well as overall material deposition compared to INDEX results (provided by IO).
- Background plasma evolution during the TQ.
  - Temperature, density, impurity and electric field profiles compared to 3D MHD data.
  - Sensitivity tests.
- CQ dynamics
  - DREAM CQ dynamics compared to 2D equation evolution codes such as DINA, TSC, JOREK (provided by IO).

- Mitigated disruptions
  - Multiple injection scenarios (neon/hydrogen), staggered injection
  - Aim: establish the parameter space for the ITER DMS for which RE formation is
- Unmitigated disruptions
  - Unmitigated TQ followed by mitigated CQ.
  - Fully unmitigated TQ.

Spatio-temporal analysis of REs in a JET disruption

- MSc thesis by Boel Brandström (seminar planned 11 June).
- Discharge 95135 (also studied by C Reux et al).
- Simulates the CQ using peaked and hollow seed profiles.
- Couple DREAM RE distribution to SOFT, compute synthetic synchrotron signals.
- Runaway population is radially redistributed during the disruption.
- Investigates also MSE data.

Goal: Explore the effect of current relaxation on RE dynamics.
Use helicity transport model of Boozer, recently implemented in DREAM.

$$\frac{\partial \psi_p}{\partial t} = -V_{\text{loop}} + \frac{\partial}{\partial \psi}\left(\psi \Lambda \frac{\partial}{\partial \psi}\frac{j_\|}{B}\right), \tag{1}$$

where Λ is the *helicity transport coefficient*, and ψ_p and ψ denote the poloidal and toroidal flux.

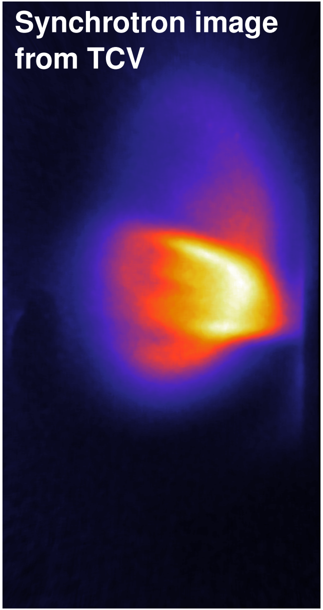
- Λ term acts to flatten $j_\|$ profile, emulating fast magnetic reconnection event without the need to resolve 3D dynamics.
- Allows current relaxation and related I_p spike to be modeled.
- At boundaries of regions with intact flux surfaces ($\Lambda = 0$) large skin currents can develop.

We would like to establish...

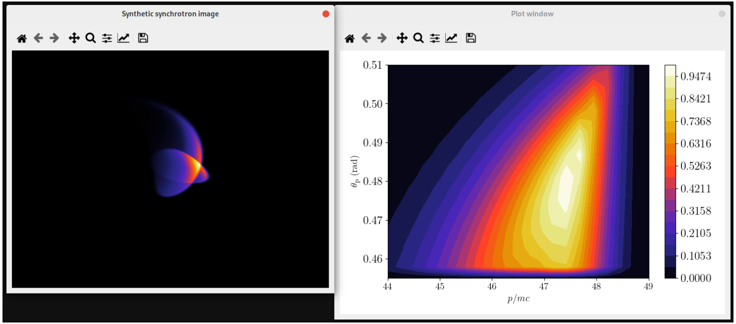
- the role of skin currents in runaway generation.
  - Compare RE evolution for $\Lambda = 0$ and various prescribed $\Lambda(r, t)$.
  - Consider Boozer- and Wesson-type scenarios.
- whether $\Lambda(r, t)$ can be constrained based on measurements (e.g. I_p and l_i).
  - Iteratively find $\Lambda(r, t)$ based on simulation data (also with added uncertainties).
  - Attempt to constrain Λ in JET#85943.
  - Compare with similar JOREK efforts.

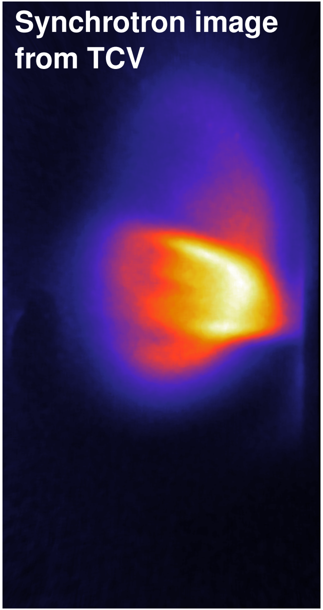
Longer term:

- Can Λ and χ_e be related during TQ?
  Provides additional modeling constraint for both validation and ITER predictions.



- Magnetic ripple pitch scattering operator implemented in DREAM.
- Reproduces TCV SR images with minimal fitting.
- To be tested experimentally on TCV.





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