TRANSPORT MODEL VALIDATION

S.M. Kaye

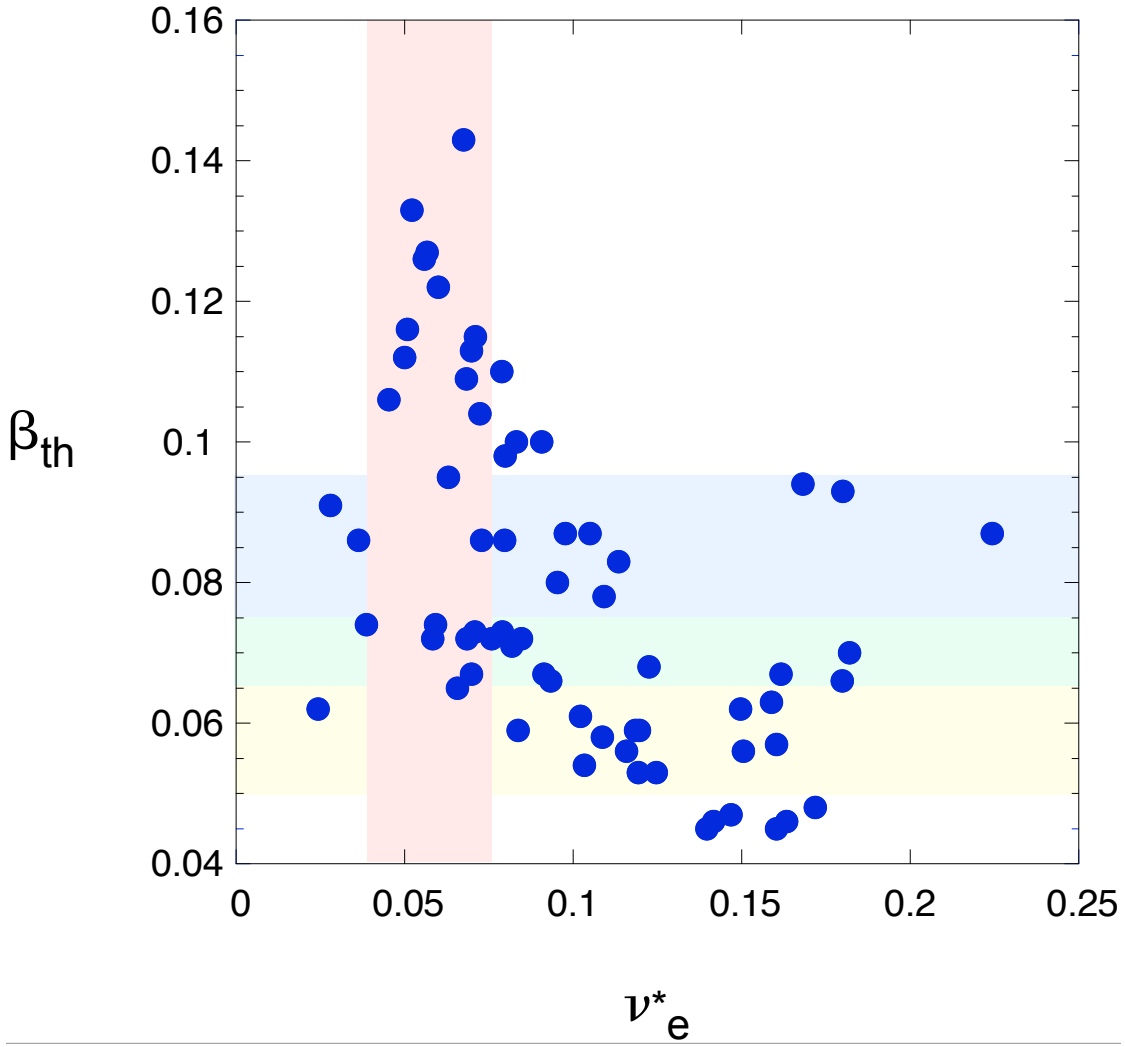
R18-3 Status Meeting

Dec. 7, 2017

TRANSP predictions used to test transport models

- Motivation is to determine parameter regimes where models are valid (or not)
- Defines direction for further model development (and/or "administrative" guidelines for use)
- Use existing TRANSP runs from NSTX and define single parameter scans
  - β scan at fixed v_{*e} [$v_{*e}(x=0.5)$ = 0.04-0.075]
    - β_{th}=6.75-14.3%
  - 3 v_{*e} scans at fixed β_{th}
    - β_{th}=7.5-9.5%: v_{*e}=0.028-0.224
    - β_{th}=6.5-7.5%: v_{*e}=0.039-0.182
    - B_{th}=5-6.5%: v_{*e}=0.024-0.160
  - q_{95} not uncorrelated

Beta and collisionality scans



TRANSP Runs

- Use original EFIT02/LRDFIT0x reconstructions (full equilibrium) for predictive runs
- Not self-consistent: differences in T_e affect equilibrium
- T_e prediction only (x=0.2 – 0.8)
  - T_i, n_e, n_{imp}, v_φ from measurement
- Models used
  - RLW: crude, prehistoric model based on μtearing
    - Good agreement with NSTX discharges calculated to be unstable to μtearing (GYRO); poor agreement otherwise
  - MMM: Multi-Mode
    - Updated version with μtearing (Rafiq) to be tested fully; will show initial predictions (and issues with it)
  - TGLF: 2016 version
    - Does not fully take e-m effects into account
    - Newer version has very high KBM fluxes: convergence issues
    - Working on a numerical technique to deal with this

Compare profiles (predicted vs analyzed) using metrics

$$OFFSET = \frac{1}{N}\sum_{1}^{N} \varepsilon_j$$

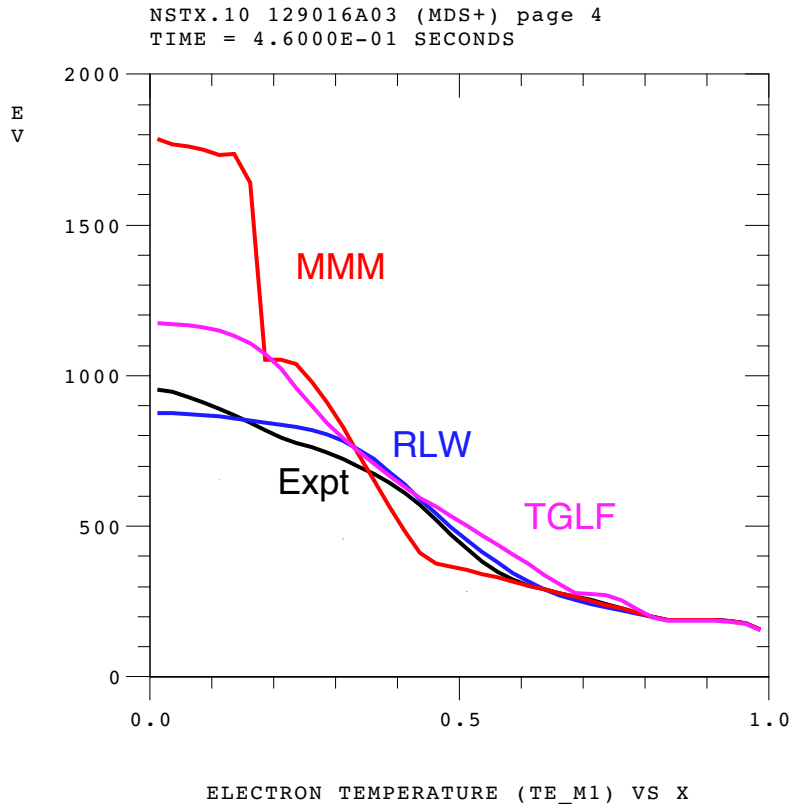
$$DELTA = \sqrt{\frac{1}{N}\sum_{1}^{N} \varepsilon_j^2}$$

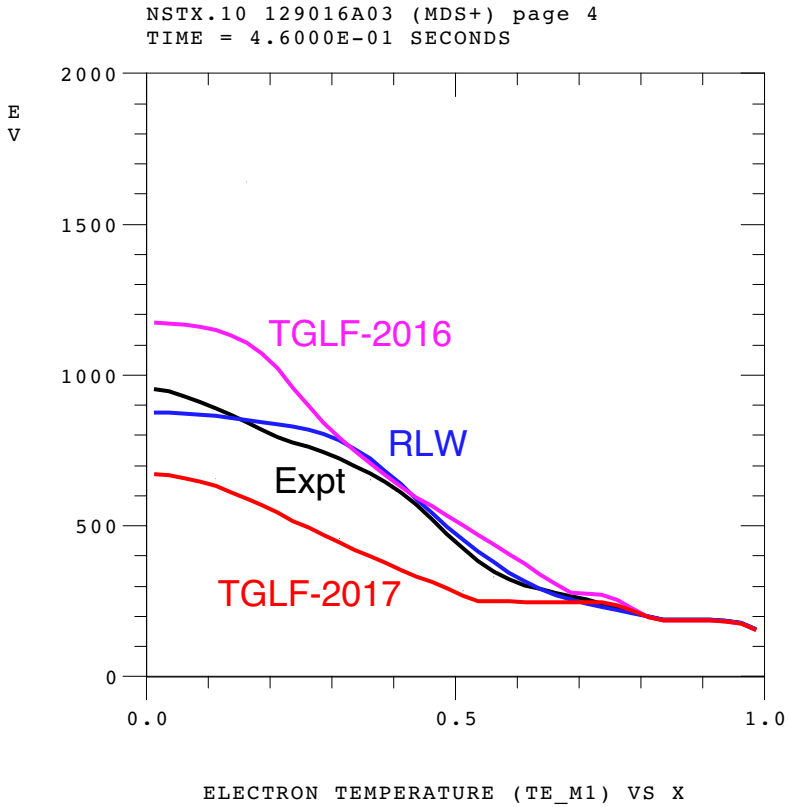
$$where$$

$$\varepsilon_j = \frac{Te_{pred,j} - Te_{\exp,j}}{\max(Te_{\exp,j})}$$

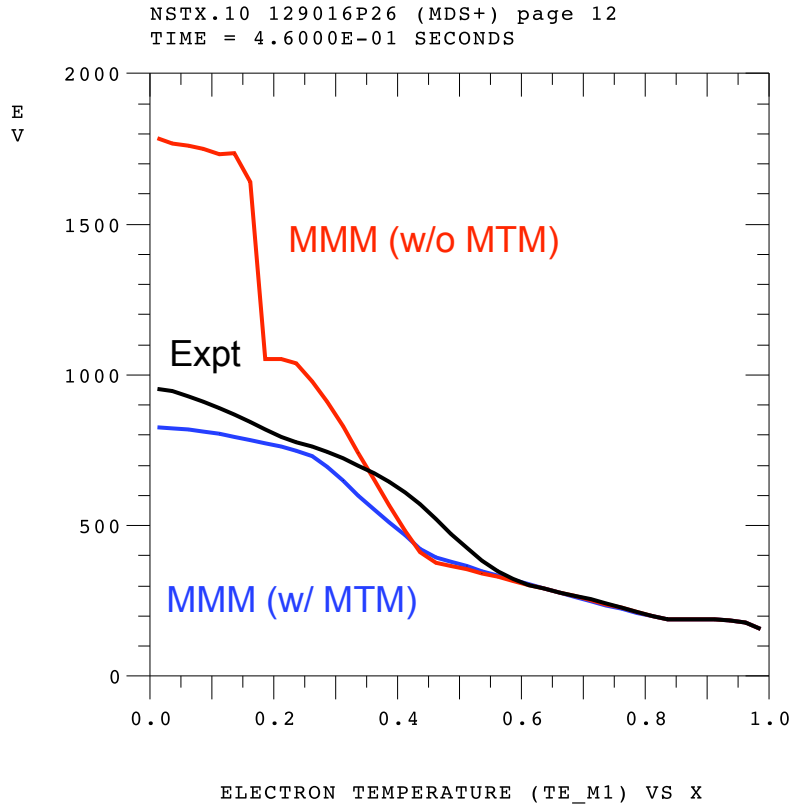
- Bottom line:
  - Statistically, little correlation of metrics with either beta or collisionality
  - Largest dependence on q(r/a=0.5)!

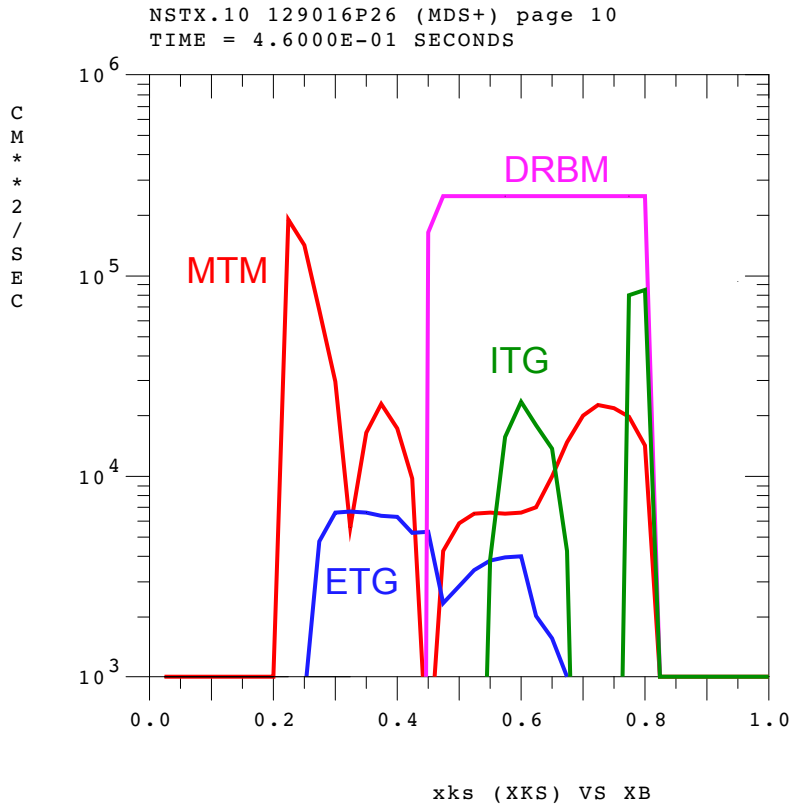
High collisionality NSTX discharge (TGLF comparison)



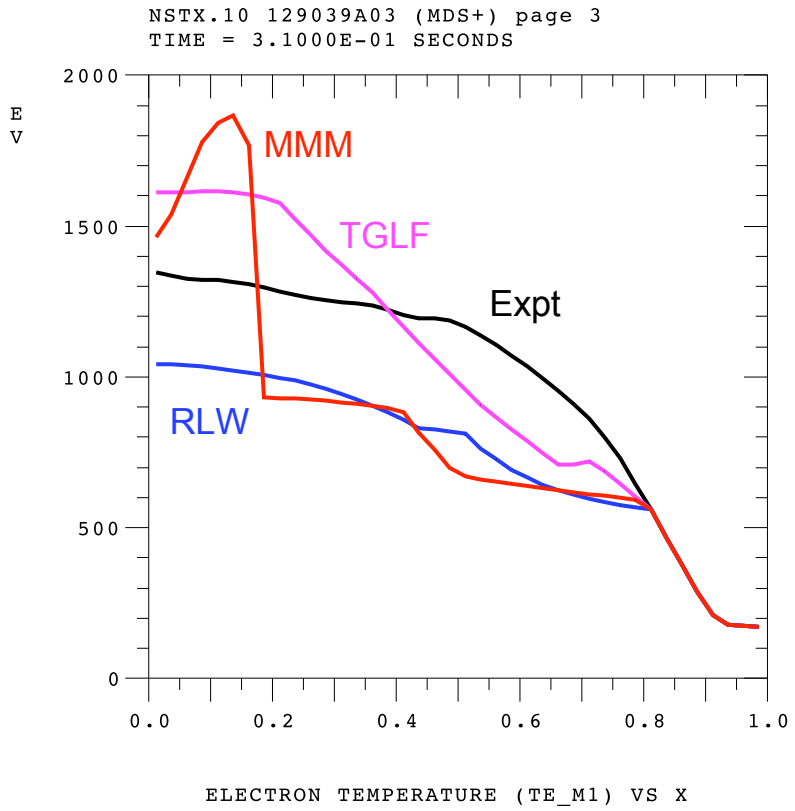


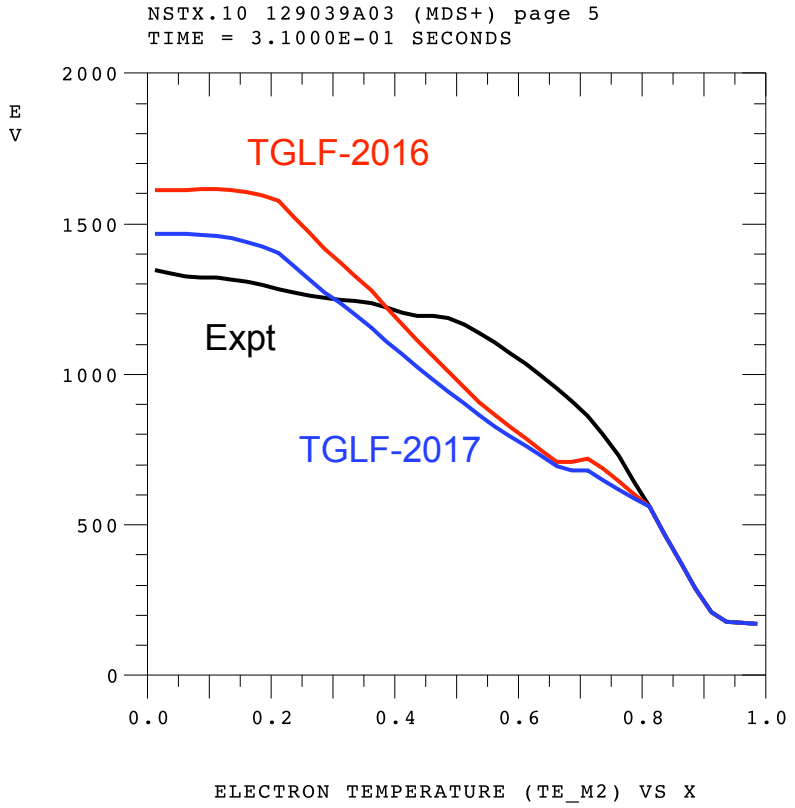
High collisionality NSTX discharge – MMM7.1 vs 7.2



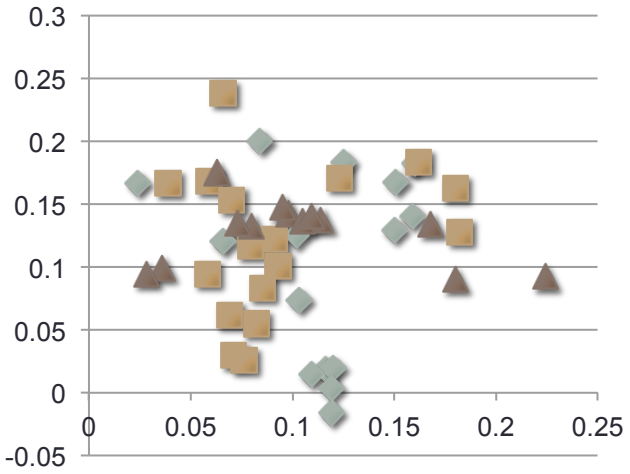


Low collisionality NSTX discharge

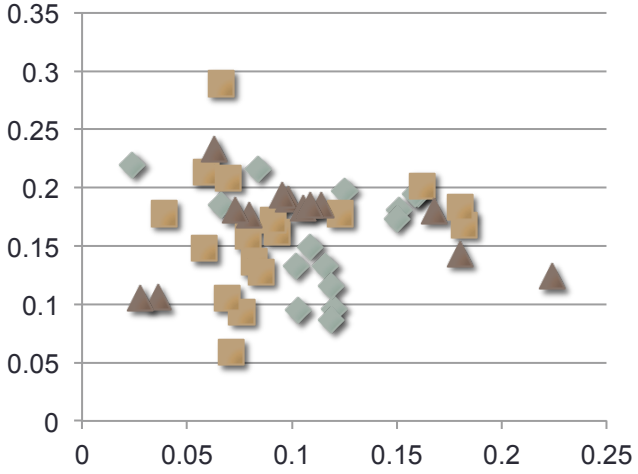


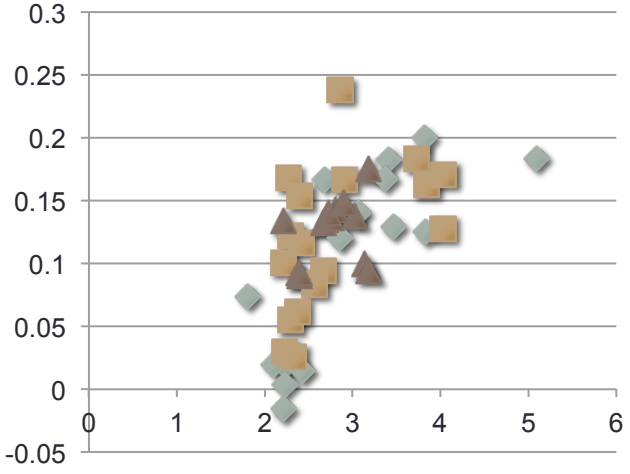


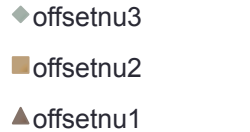
MMM Stats – Collisionality scans



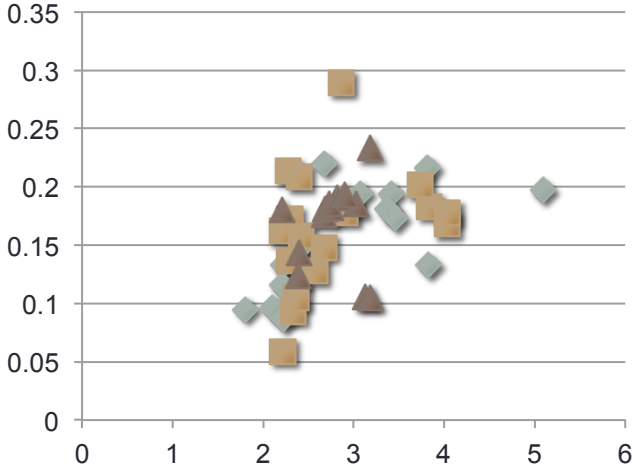
vs collisionality



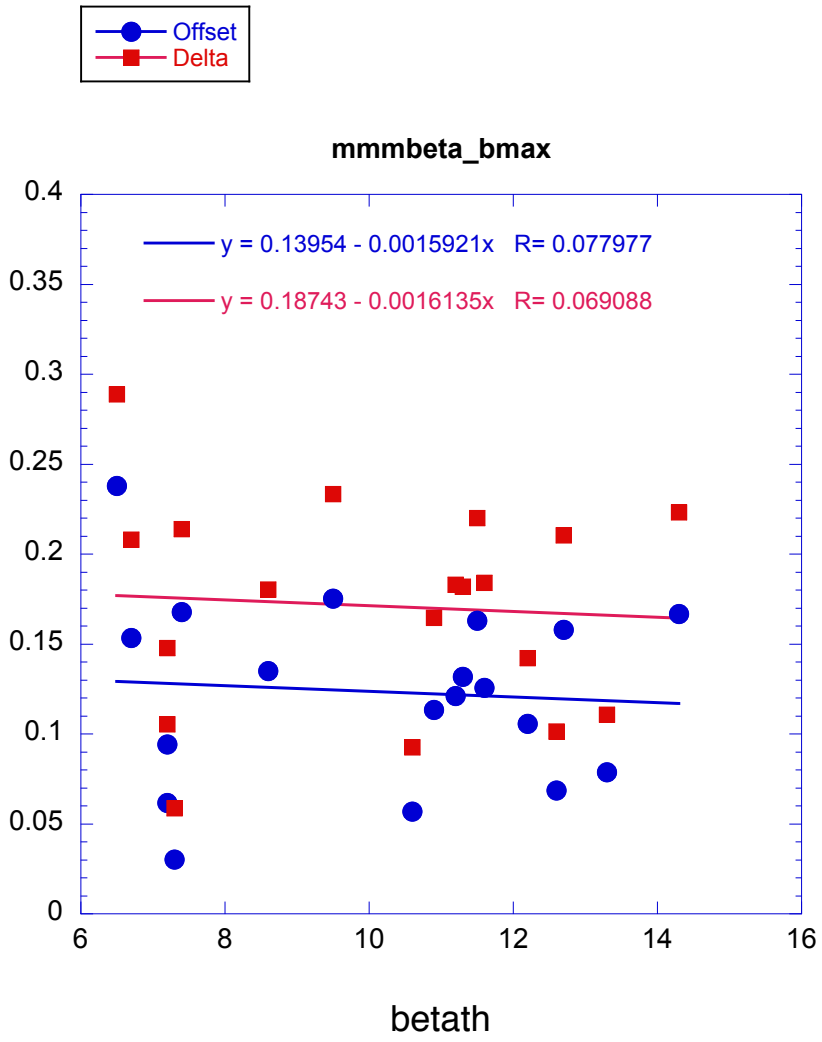


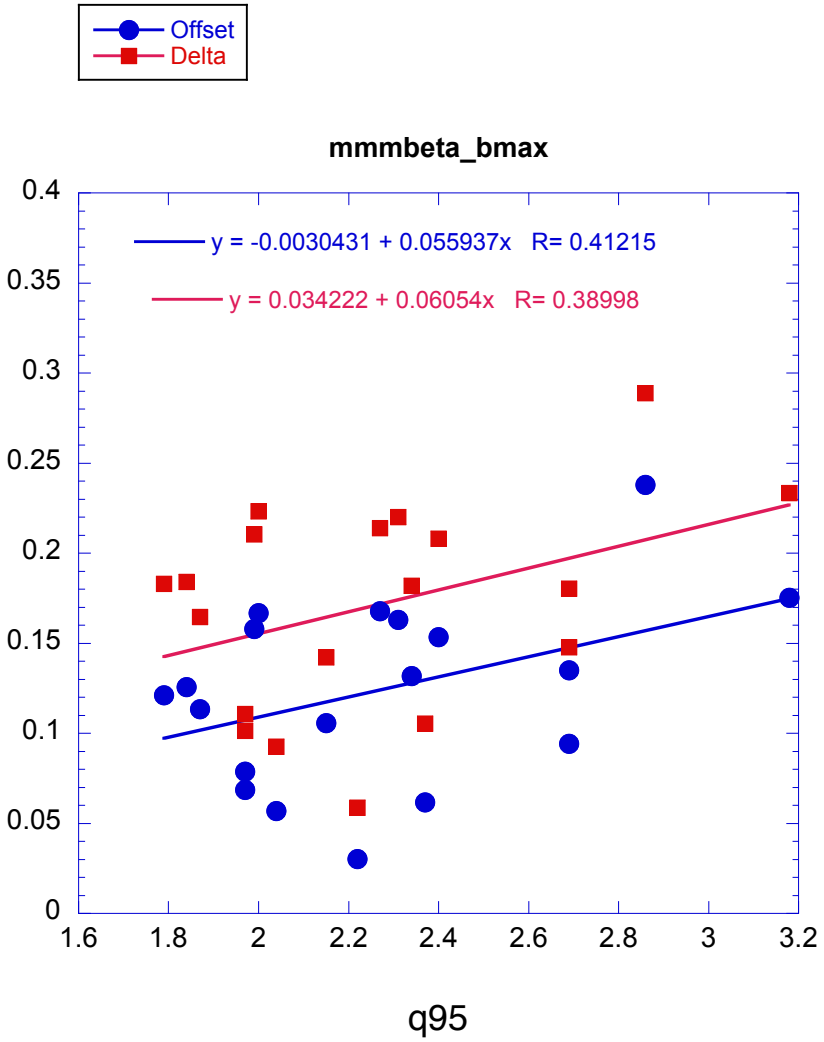


vs q_{95}

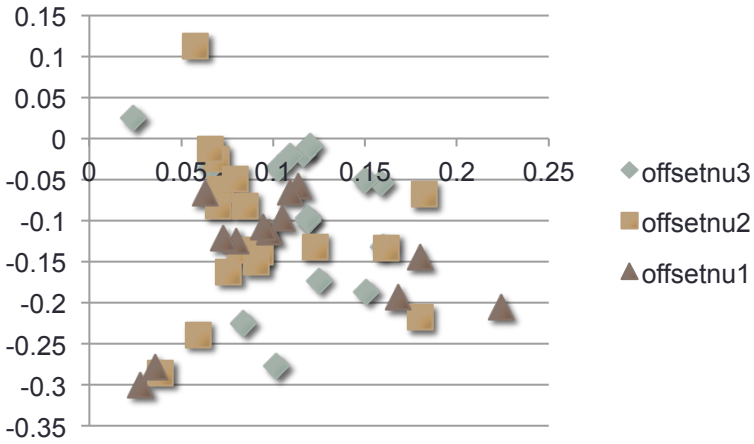


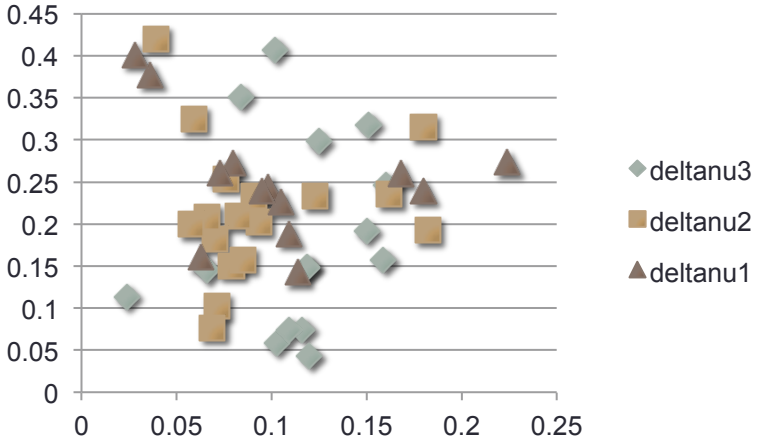
MMM Beta Scan



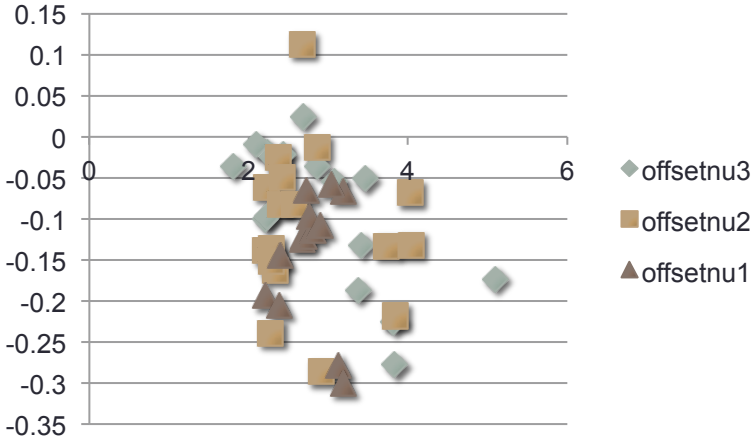


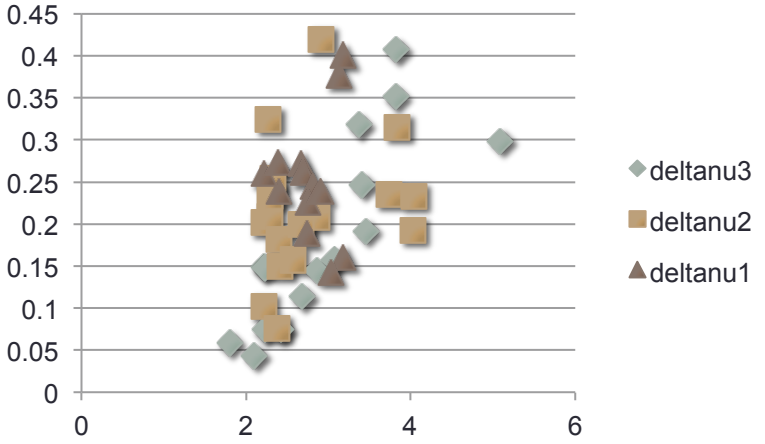
TGLF collisionality scans





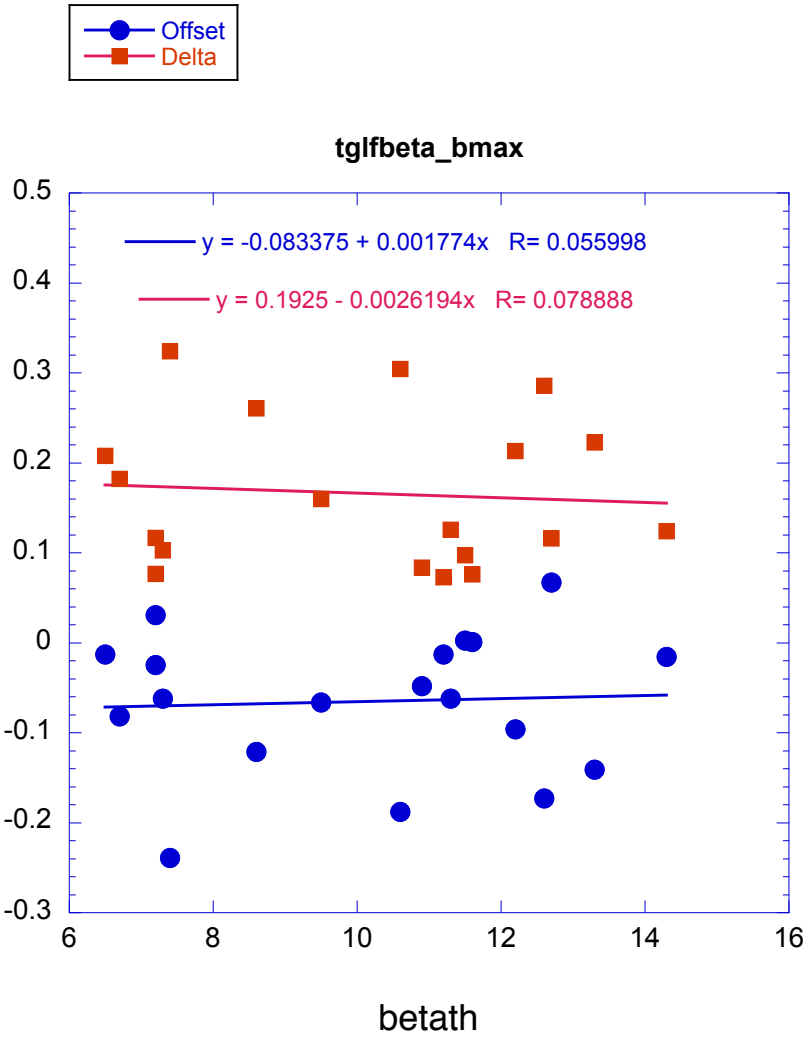
vs collisionality

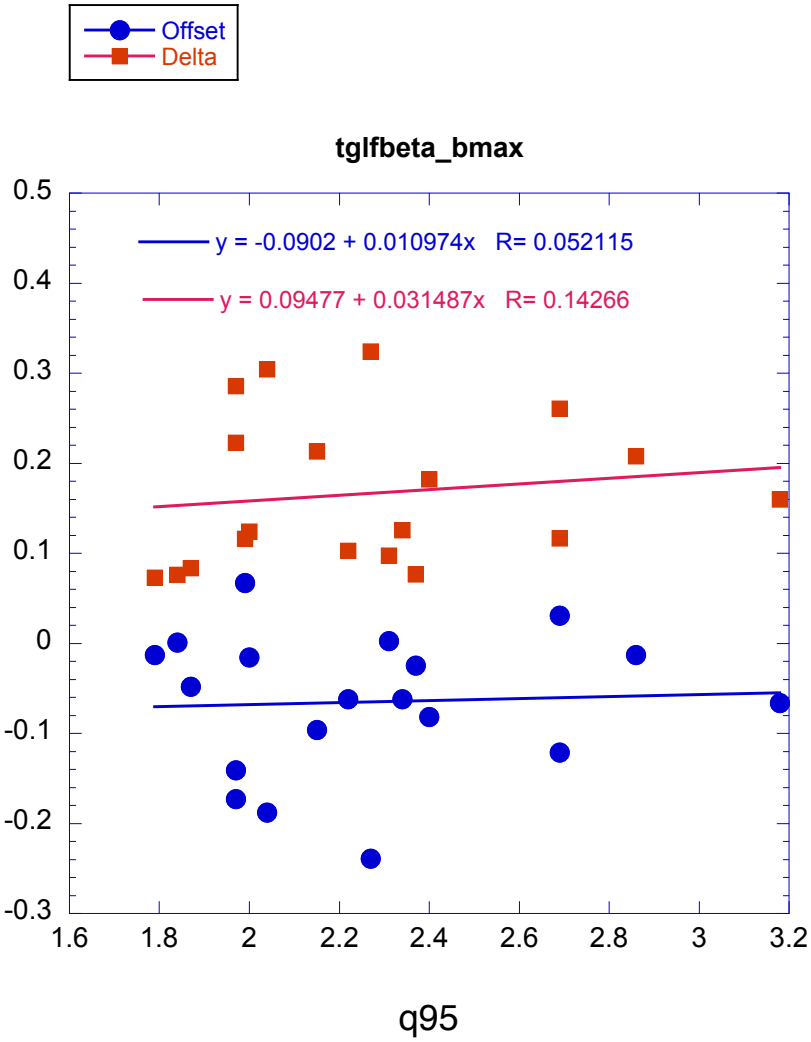




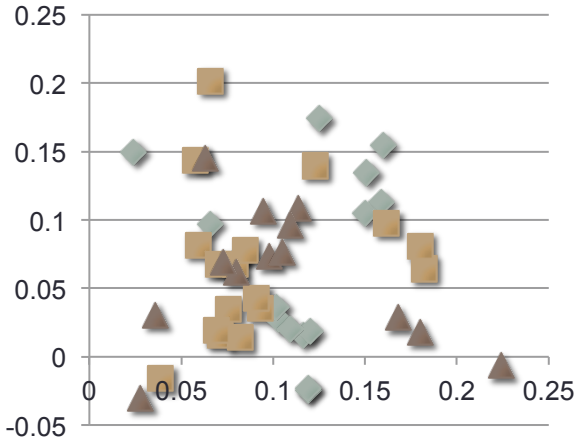
vs q_{95}

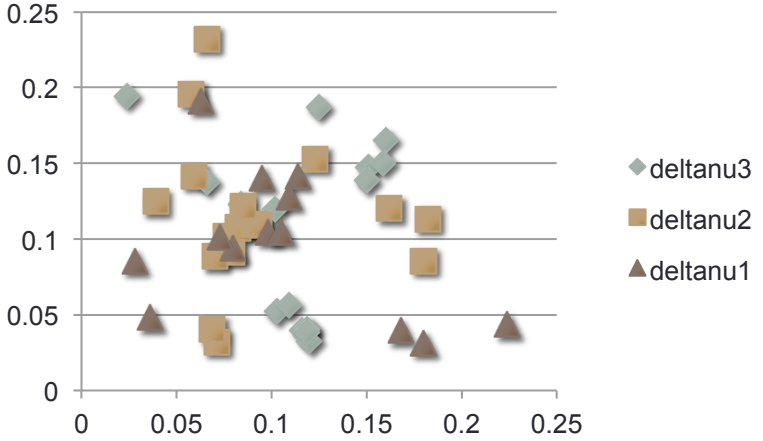
TGLF beta scan



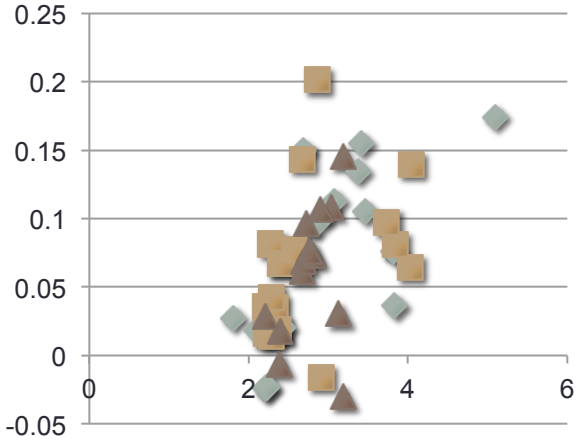


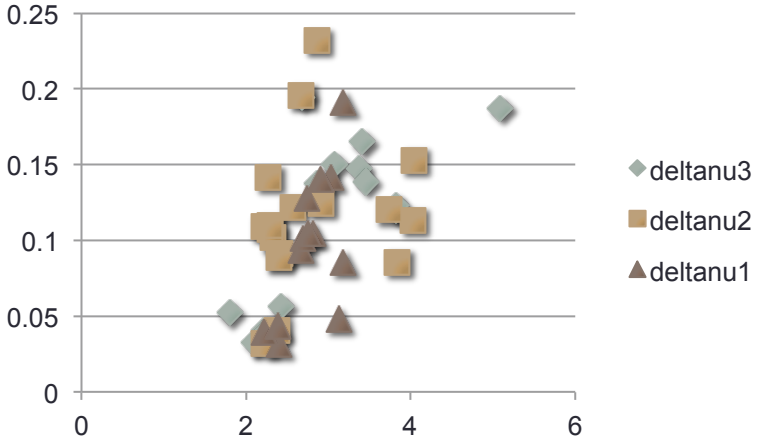
RLW collisionality scans





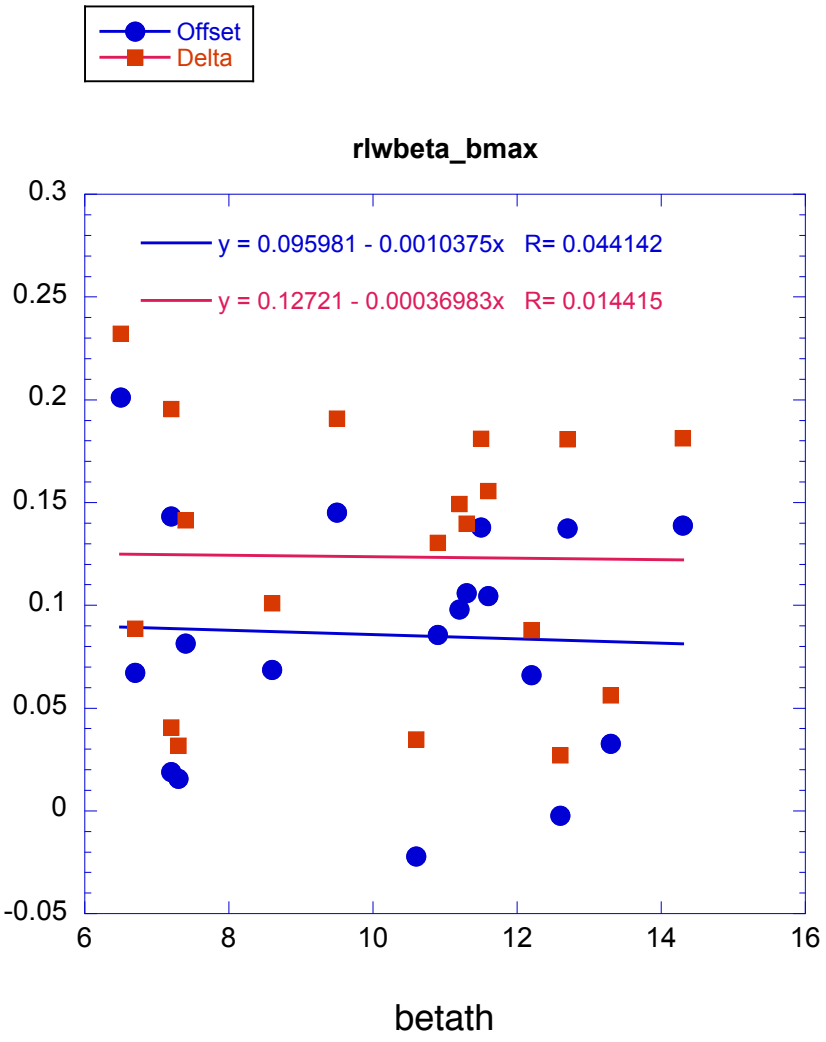
vs collisionality

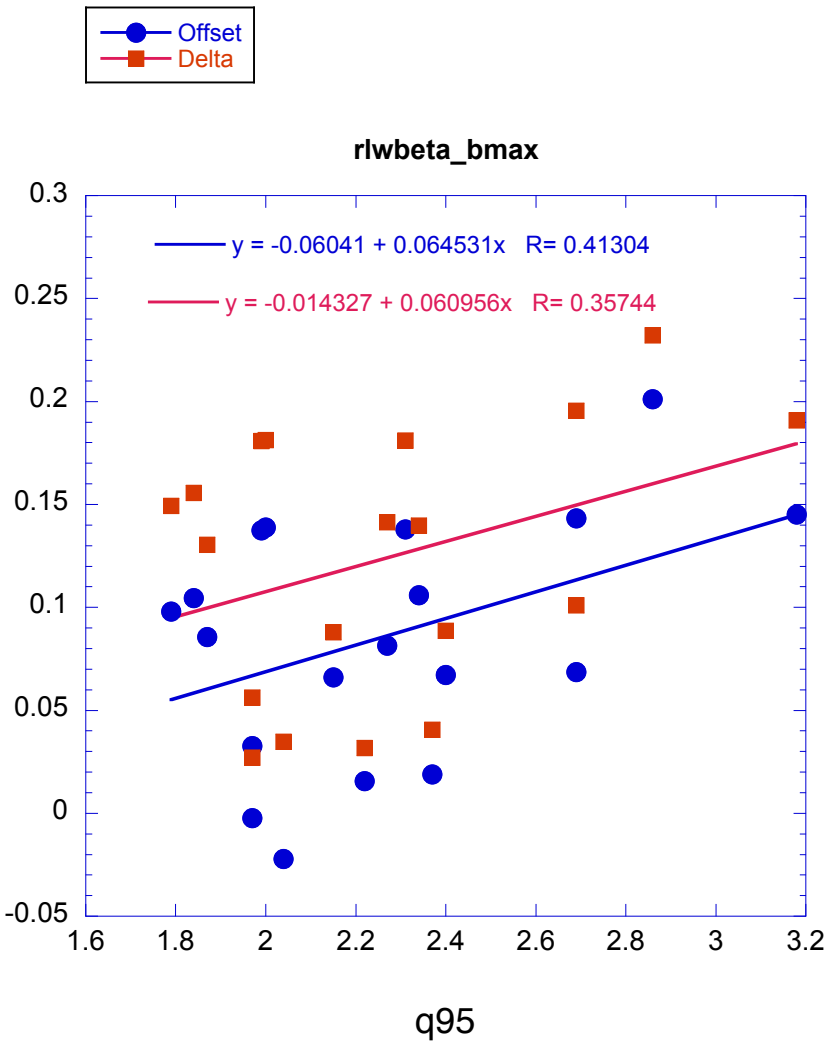




vs q_{95}

RLW beta scan





List of TRANSP runs can be found at

- https://docs.google.com/spreadsheets/d/1yMYCLfAs6m-VWjjP88gshYxQ2xOn8shbgr5-kdL_-pY/edit?usp=sharing