Nonlocal parallel transport in divertor plasmas

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- Steep temperature gradients along field lines
- ==> classical heat flow is invalid.
- Flux limiting is *ad hoc* and unsatisfactory
- The heat flow depends on the entire profile, not only on the local T_e gradient.
- The velocity distribution is non-Maxwellian
- ==> enhanced ionization in the cold plasma

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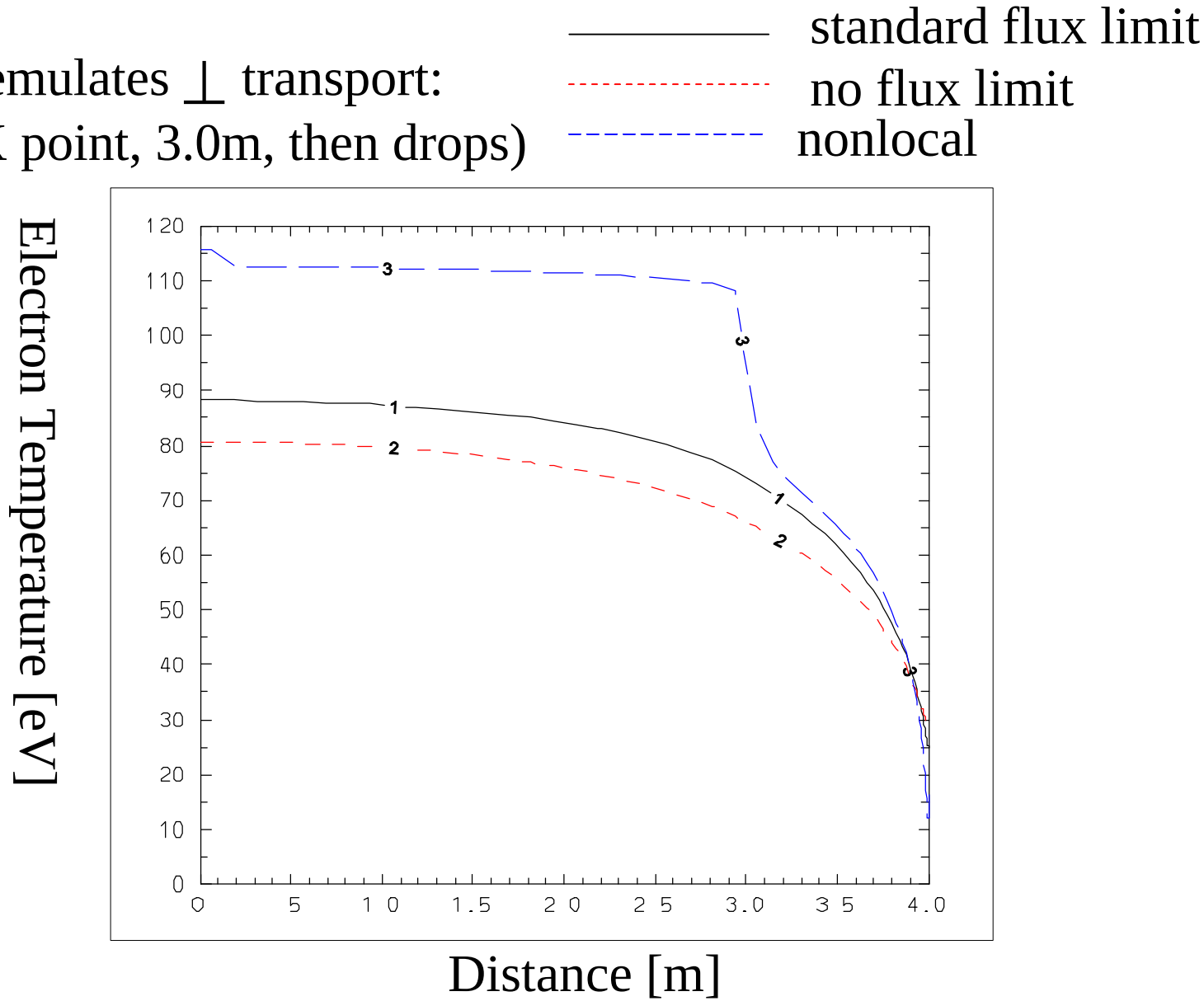
- A nonlocal heat flow formula was developped and validated by comparing to Fokker-Planck simulations for an advancing heat front.
- Implemented in UEDGE. Dramatic effect on T_e profile, compared to usual formula. (next slide).
- Large non-Maxwellian enhancement of the ionization rate in the cold plasma, using a collisional-radiative model similar to that in UEDGE (for Maxwellians). (not shown).

T_e : e and i input power: 1e5 W

Source (emulates ⊥ transport:
peak at X point, 3.0m, then drops)



DISCUSSIONAND FUTURE WORK

- Assumption here: source heating << e-e relaxation.

- Simulations on laser plasmas show that removing this limitation changes nonlocal heat flow. **But** there, heating is by laser absorption, preferentially into slow electrons ($\propto \sim 1/v^3$).

- Challenge to gyro-kinetic code modellers: what is the energy dependence of cross-field transport? Given this dependence, we will be able to modify our nonlocal heat flow formula accordingly. This could have an effect on the physics shown here.

- Ongoing: develop a nonlocal formula for the ionization rate enhancement due to non-Maxwellian effects.