Experimental Summary: Neon Pellet Ablation Measurements (MP2019-25-06)

by

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Goal of this experiment is to characterize neon pellet ablation profiles, and determine Ne-I S/XB values

- **S/XB photon efficiency relates number of photons to ionization events**
  - Values for neon are theoretically known but not experimentally measured
- **Measurements of neon pellet ablation rates and profiles, along with kinetic profiles, are needed to test theoretical ablation models**
  - Analogous to early pellet-fueling studies with hydrogenic pellets
- **This is a "basic science" experiment to enable modeling-experiment comparisons for disruption mitigation studies**

Need S/XB to determine particle deposition

Tests theoretical ablation models

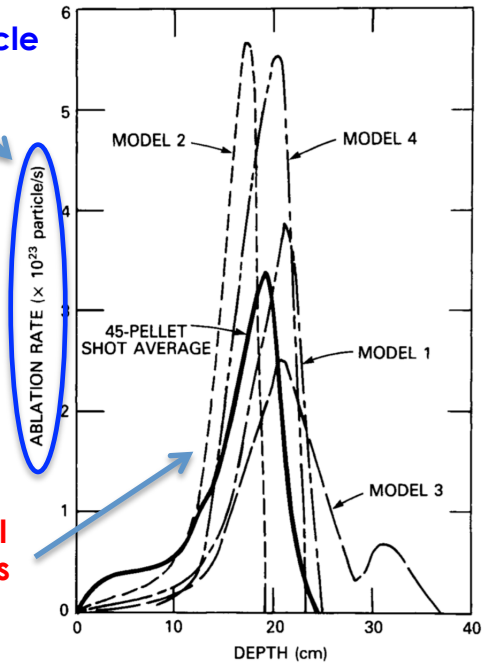
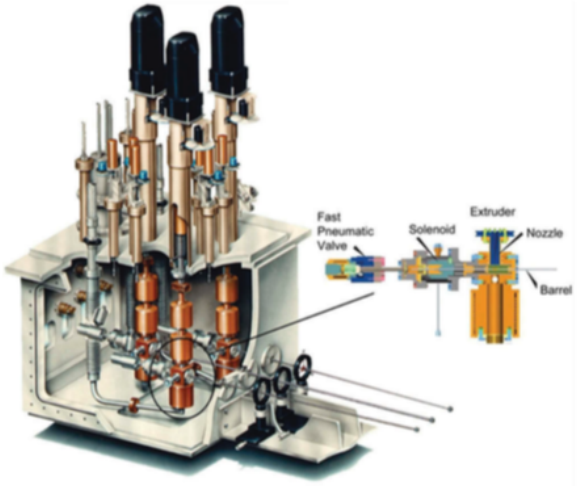


Fig. 1. Ablation profiles for ISX-B shot sequence 15678–15700.

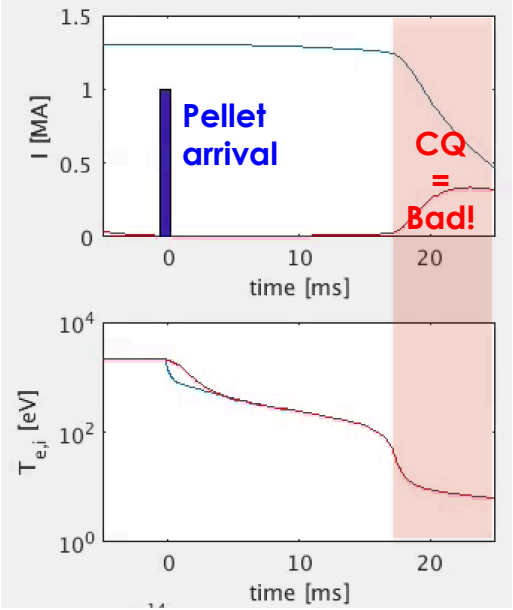
M. Gouge, et al. Fusion Tech. 1991

Small intact (un-shattered) pellets will be injected into high-W_{th} plasmas

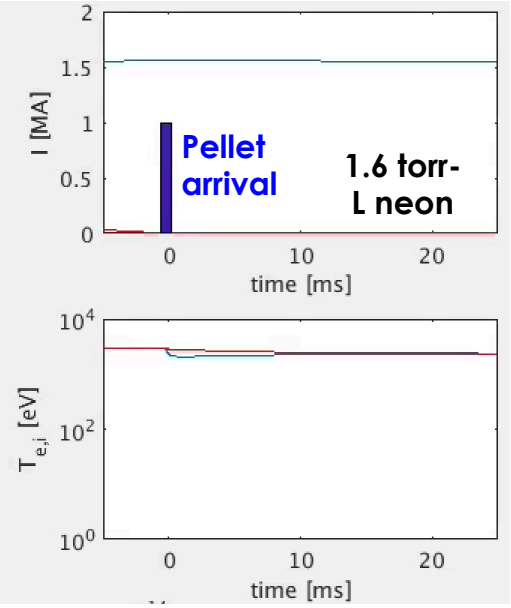
- **Pellets will be injected from RPI system typically used for core fueling and ELM pacing**



Example of disruption:
W_{th} = 0.7 MJ
Pellet size = 1.8 mm



Today's scenario:
W_{th} = 2.0 MJ
Pellet size = 1.3 mm



0D KPRAD simulations of single neon pellet

DIII-D NATIONAL FUSION FACILITY

Shot Plan (0.5 day)

1. **Reproduce target discharge, based on 179118** — **1 shot**
   - Initially wrong EFC algorithm, but plasma still ran

2. **Ne pellet injection at 2.0 MJ** — **14 shots**
   - Collect required measurements (see previous slide)

3. **Establish (approximate) lower bound of W_{th} that survives Ne pellet**
   - Reduced NBI power

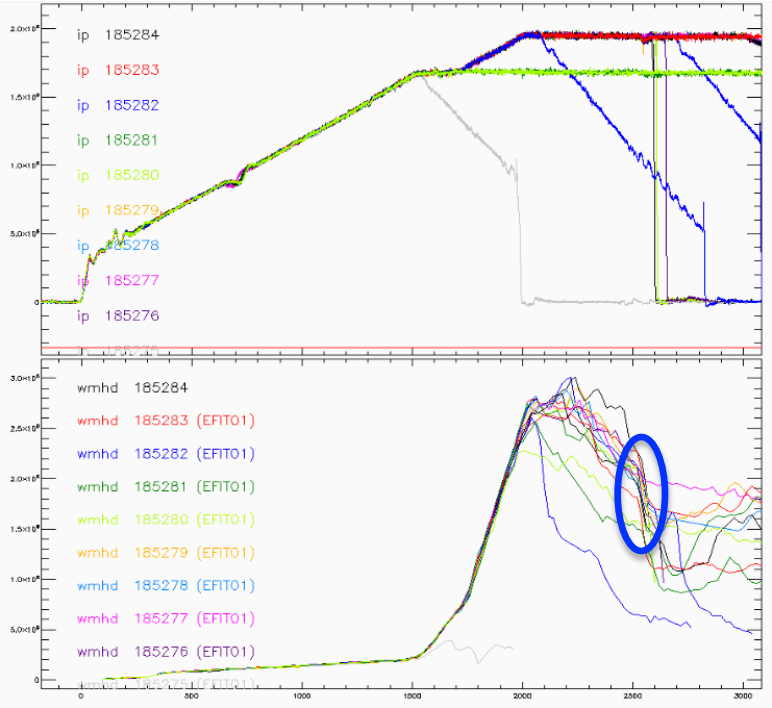
4. **Scan NBI power to vary ablation conditions** — **(Sort of)**
   - Two to three power levels within range established in Steps 2 and 3
   - Collect required measurements

Total: 15 shots

Some variation of stored energy occurred naturally

I_p

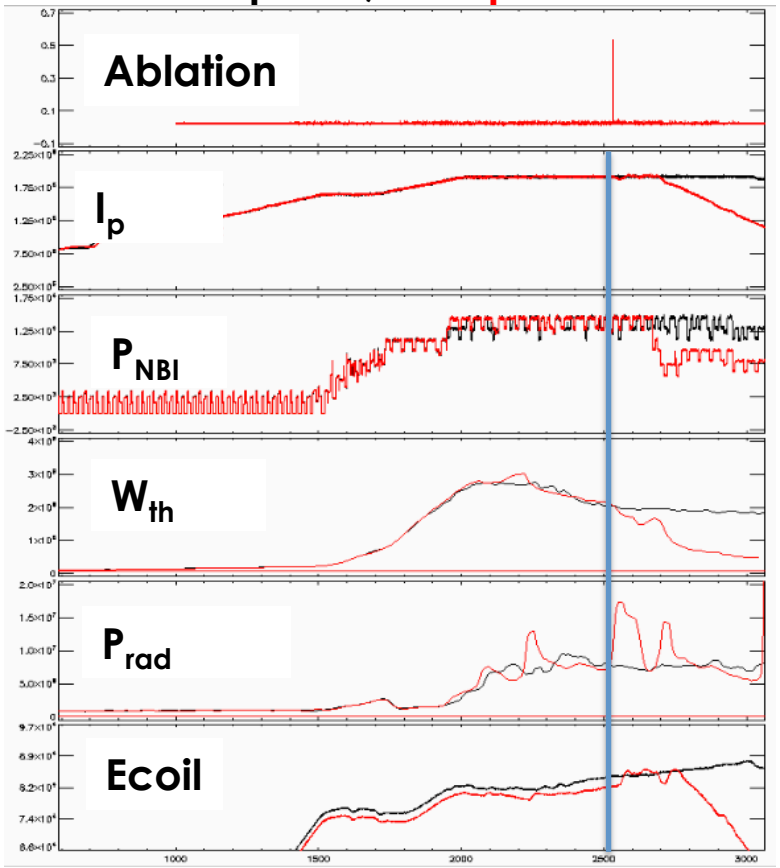
W_{th}



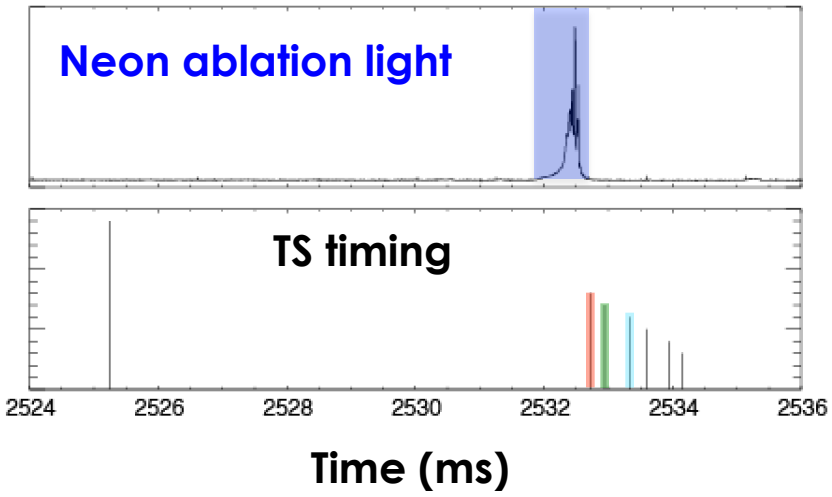
~ 1.9 ± 0.5 MJ at time of pellet

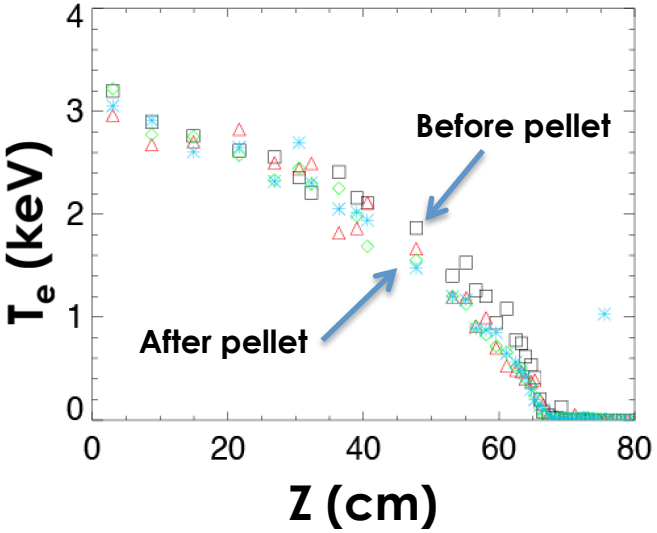
Plasma survives neon pellet

- **Radiative perturbation occurs on a longer timescale than the ablation**
- **Should be ignorable for ablation studies**
  - Should check profiles to be sure....



TS triggered asynchronously show only modest perturbations to profiles





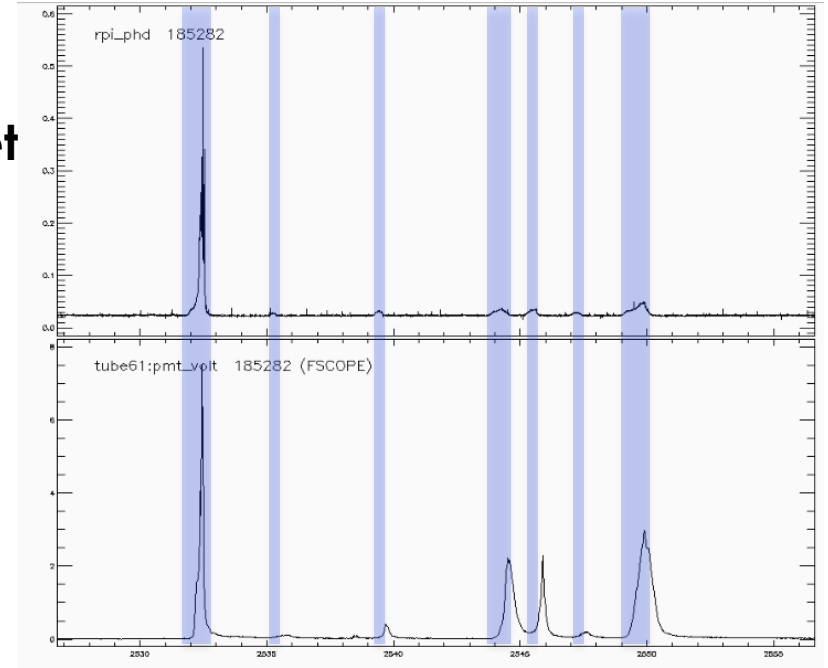
- Fast camera ran well
- Filterscopes supplement fast cam and pellet phototiode
- Survey spectrometer had trouble seeing Ne-I

Pellets often broken, analysis will focus on first piece

- **Photodiode, filterscopes, and fast cameras all see late fragments**
- **Small time shift (FS comes later)**
  - PHD is at 135
  - FS is at?
- **PHD sees smaller fragments, FS more even**
  - Do we know why?

Pellet PHD

FS



Pellet mass (of the leading piece) is relatively reproducible

- **Some shots lack cavity measurement due to noise**
  - Will likely focus on shots with mass measurement
- **From offline shots taken after the experiment, usually within ±10%**
- **Pellet mass needed for absolute magnitude of S/XB factor**
  - Still need to determine "voltage to mass" conversion