

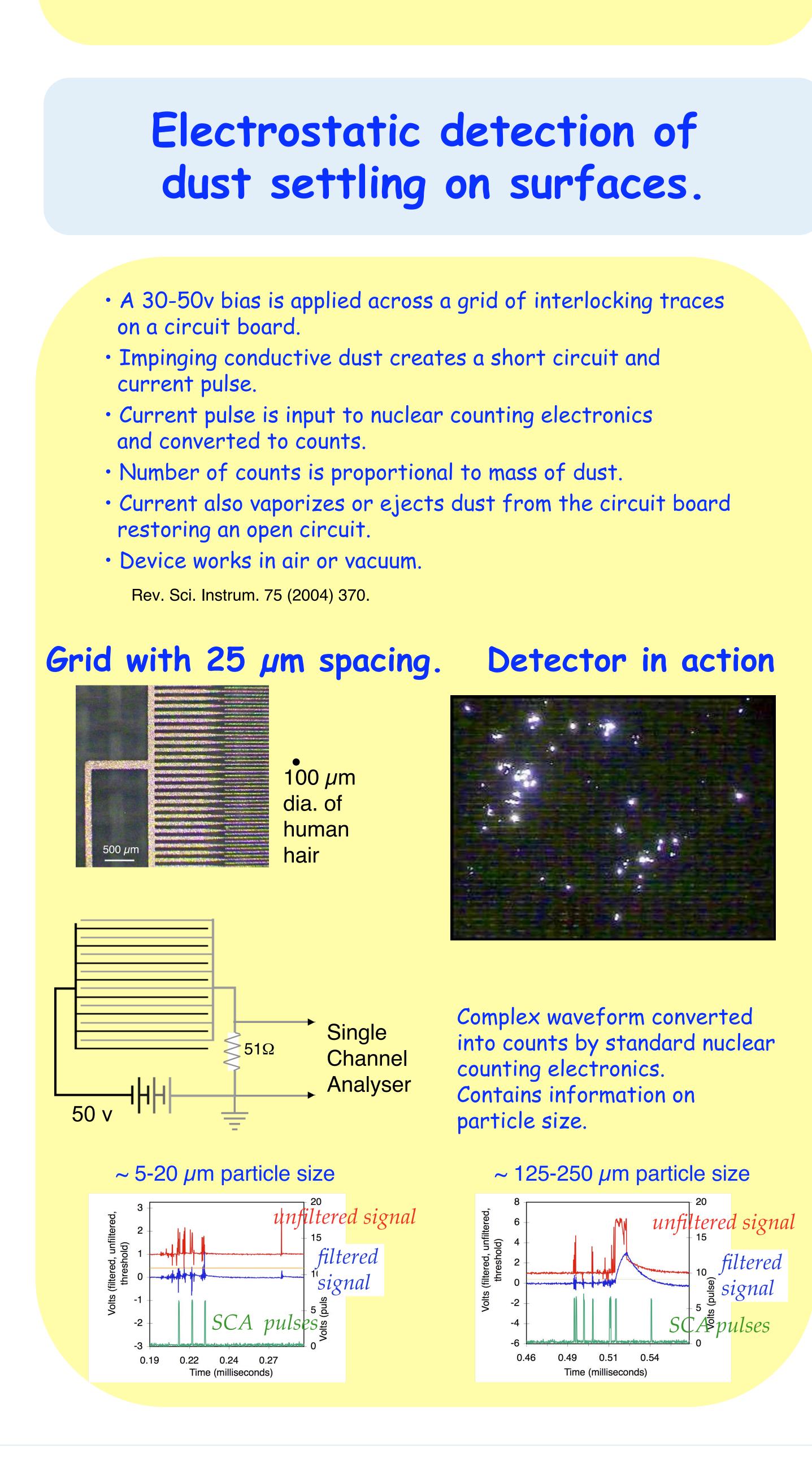
# First real-time detection of surface dust in a tokamak

### Motivation:

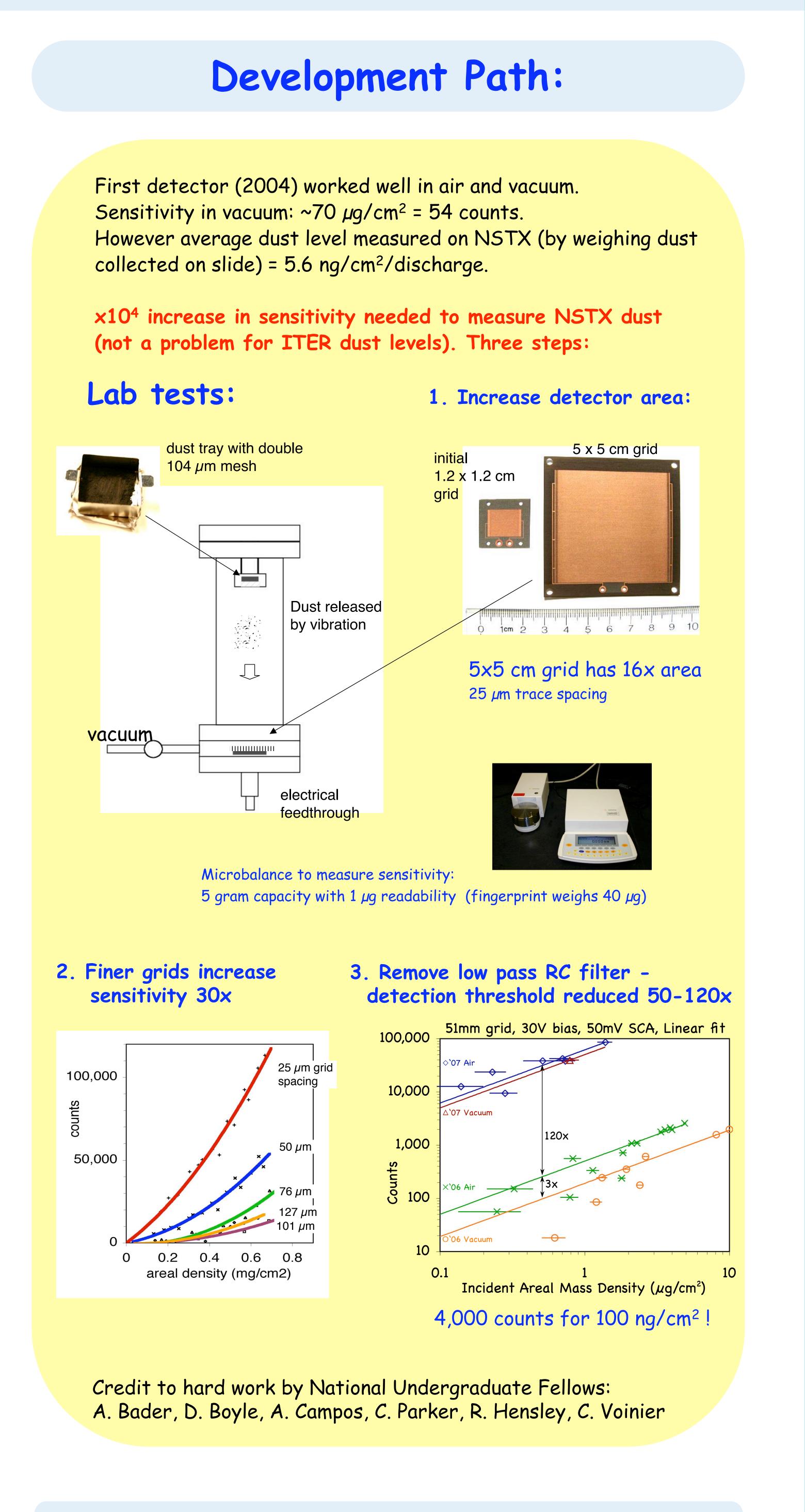
- High levels of dust in ITER are expected from more intense PMI and longer pulse duration.
- Dust will have important safety and operational consequences.
- 670 kg is ITER limit on mobilizable cold dust (public safety).
- 6 kg is limit on W, Be, C hot dust (vacuum vessel integrity - a 4 kg H<sub>2</sub> 2 bar overpressure limit)
- Transport of W dust could prevent fusion burn (limit unknown).
- Dust could obscure diagnostic first mirrors (limit unknown).
- Tritiated dust can levitate
- Tritiated dust is more hazardous than HTO vapor.

#### <u>ITER plans to:</u>

- Diagnose dust inventory from divertor erosion measurements (laser rangefinder).
- Install local dust monitors (so far not demonstrated in tokamaks).



C. H. Skinner, A. L. Roquemore, H.W. Kugel, R. Marsala, T. Provost, Princeton Plasma Physics Laboratory, 51th APS/DPP meeting, Atlanta, GA, 2-6 November, 2009

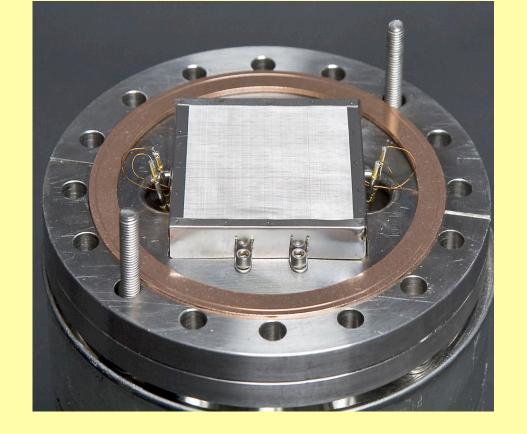


## Differential detection:

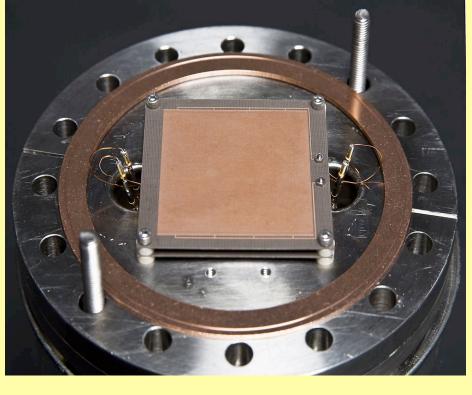
SPAs and RF antenna are a powerful source of noise on NSTX. First detection circuit suffered from electrical noise pickup. Differential circuit has high noise immunity. Grid at NSTX Bay C bottom One-shot attenuator 30 m Triax Rack

## Signal validation:

Increased sensitivity also increased potential for electrical noise. Additional 'blind' detector measures only electrical pickup.



Mesh cover (125 µm pore) shields from fibers and large particles that might cause a permanent short.

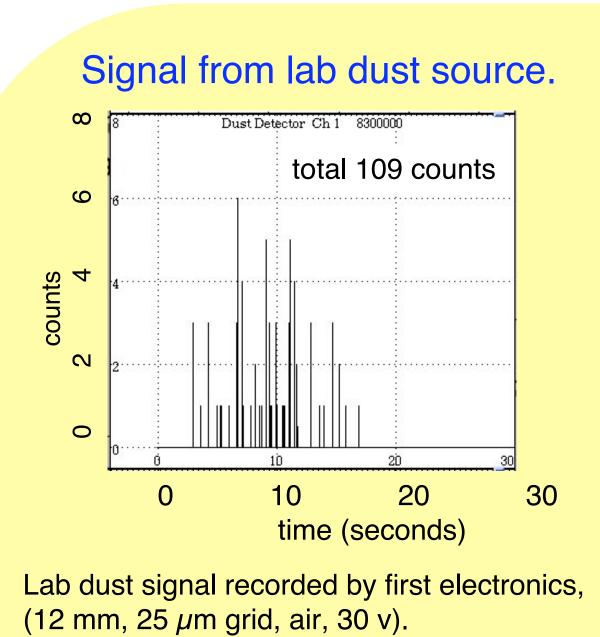


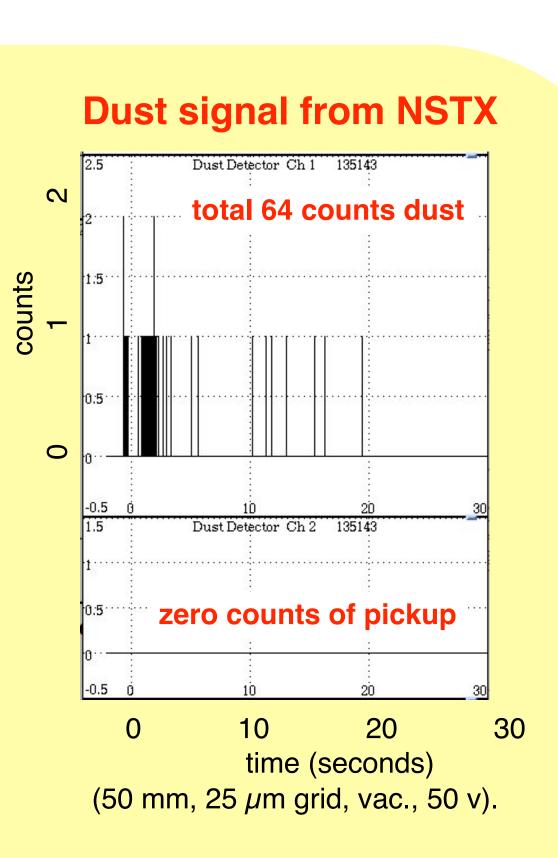
Two grids in same electrical environment. Only top grid (#1) exposed to dust.

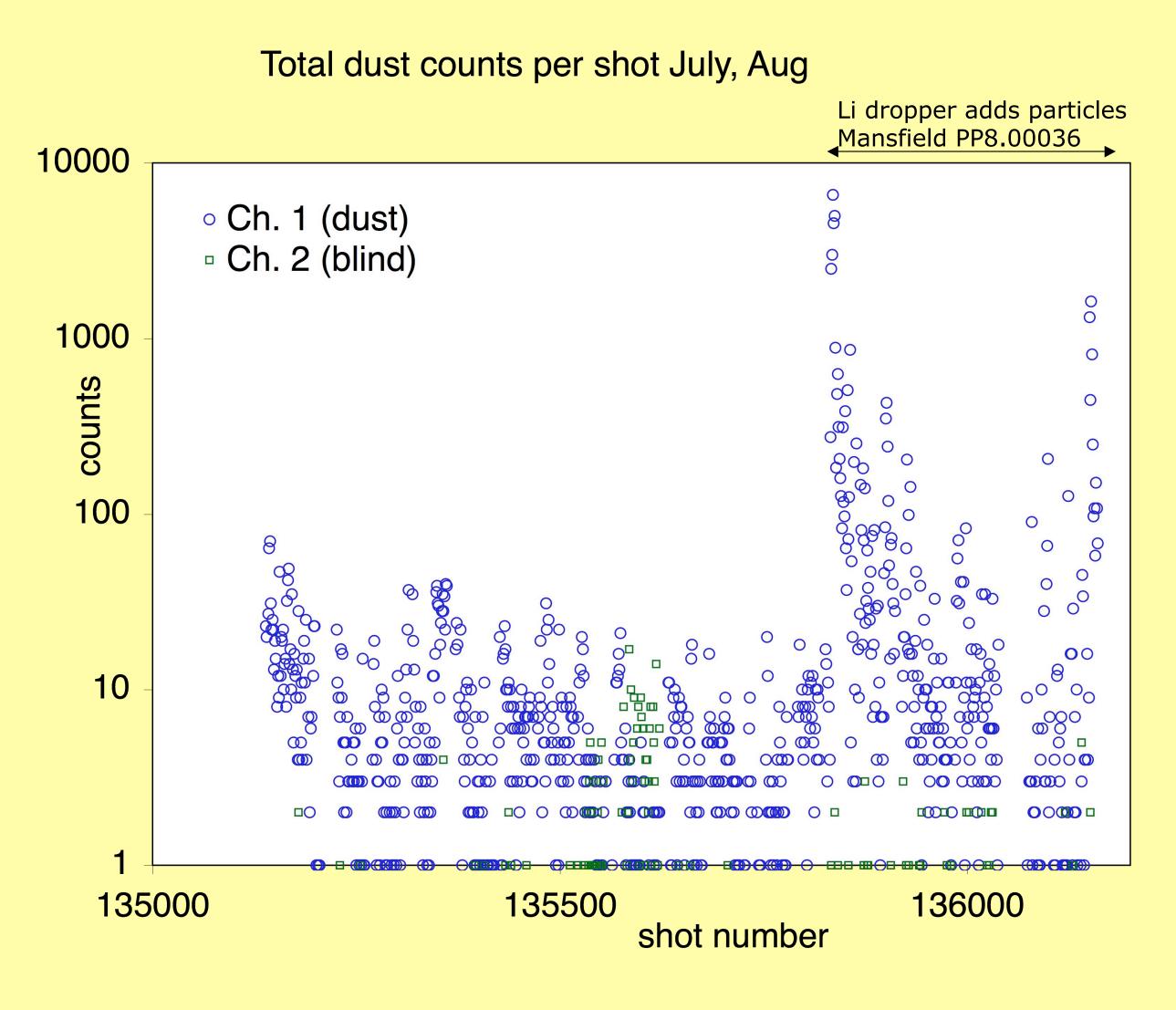


Mica cover to shield bottom grid (#2).

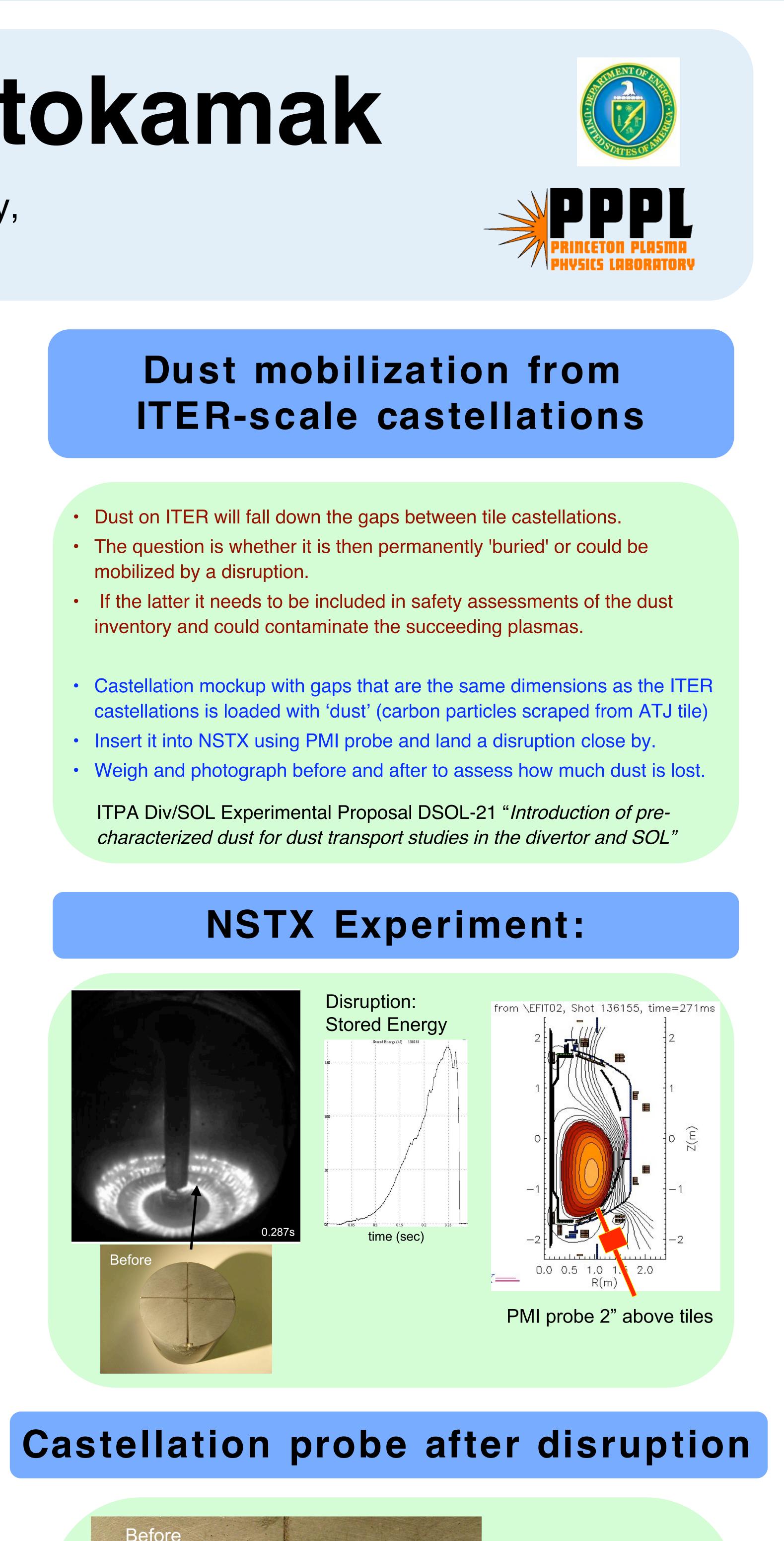
#### First dust signals

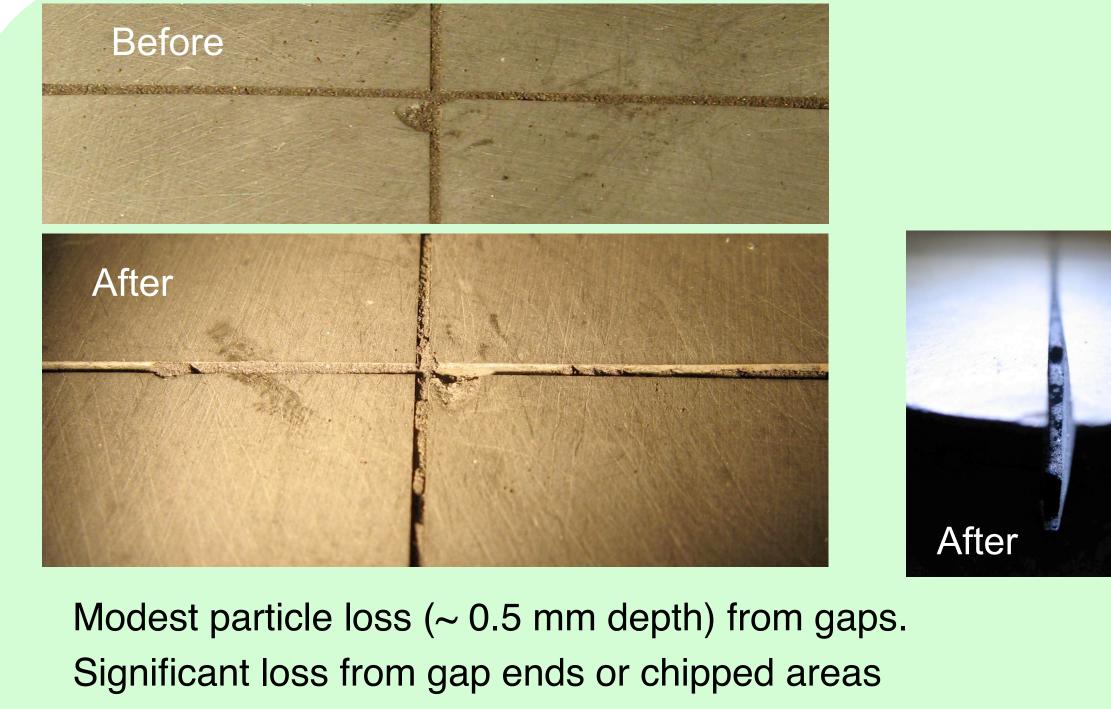






FIRST real-time measurements of surface dust in ANY tokamak.





#### **Conclusions:**

12% of dust (by weight) was mobilized Dust at ends of gaps or near surface imperfections is more mobilizable.

#### Acknowledgements

The authors would like to thank C. Bunting, M. Cropper, T. Holoman and T. Provost for technical assistance, and National Undergraduate Fellows: A. Bader, D. Boyle, A. Campos, C. Parker, R. Hensley, C. Voinier for previous work. Supported by US DOE Grant No DE AC02-09CH11466