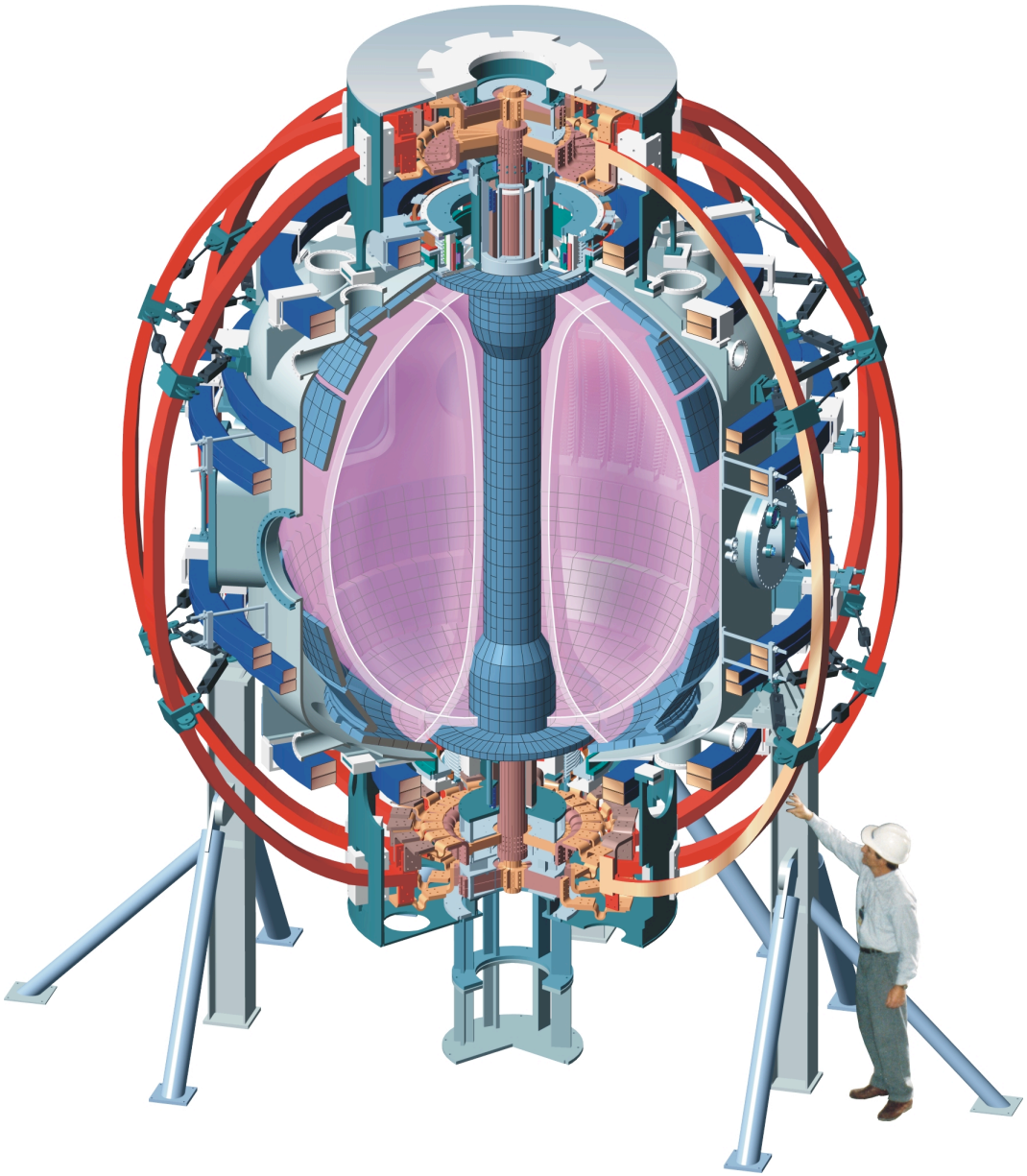
High Resolution Edge/SOL Profiles and Diagnostic Upgrades



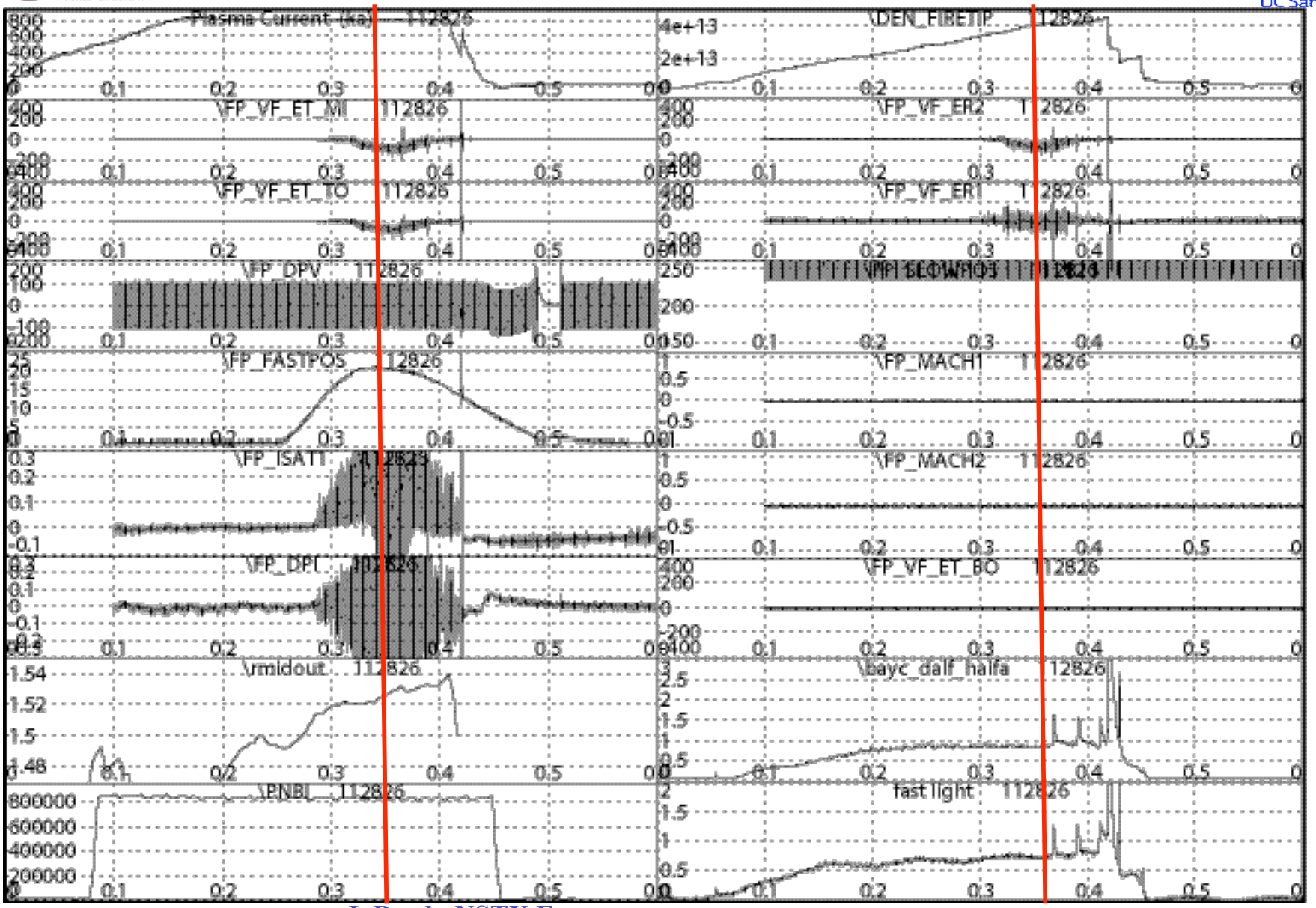
J. Boedo

H. Kugel, S. Zweben, D. Rudakov, H. Ji, T. Carter, N. Crocker, D. Rudakov, M. Umansky, D. Gray, A. Pigarov, D. D'Ippolitto, J. Myra, NSTX Team

Original Probe Proposal (2001)

- High resolution profiles
  - Scalings
- Turbulence
- Intermittency
- L-H Transition physics
  - Radial electric Field
  - Fluctuation changes
  - GAMs
  - Zonal Flows
  - Reynolds Stress

L-Mode discharges ~1.6 MW, Ne scan



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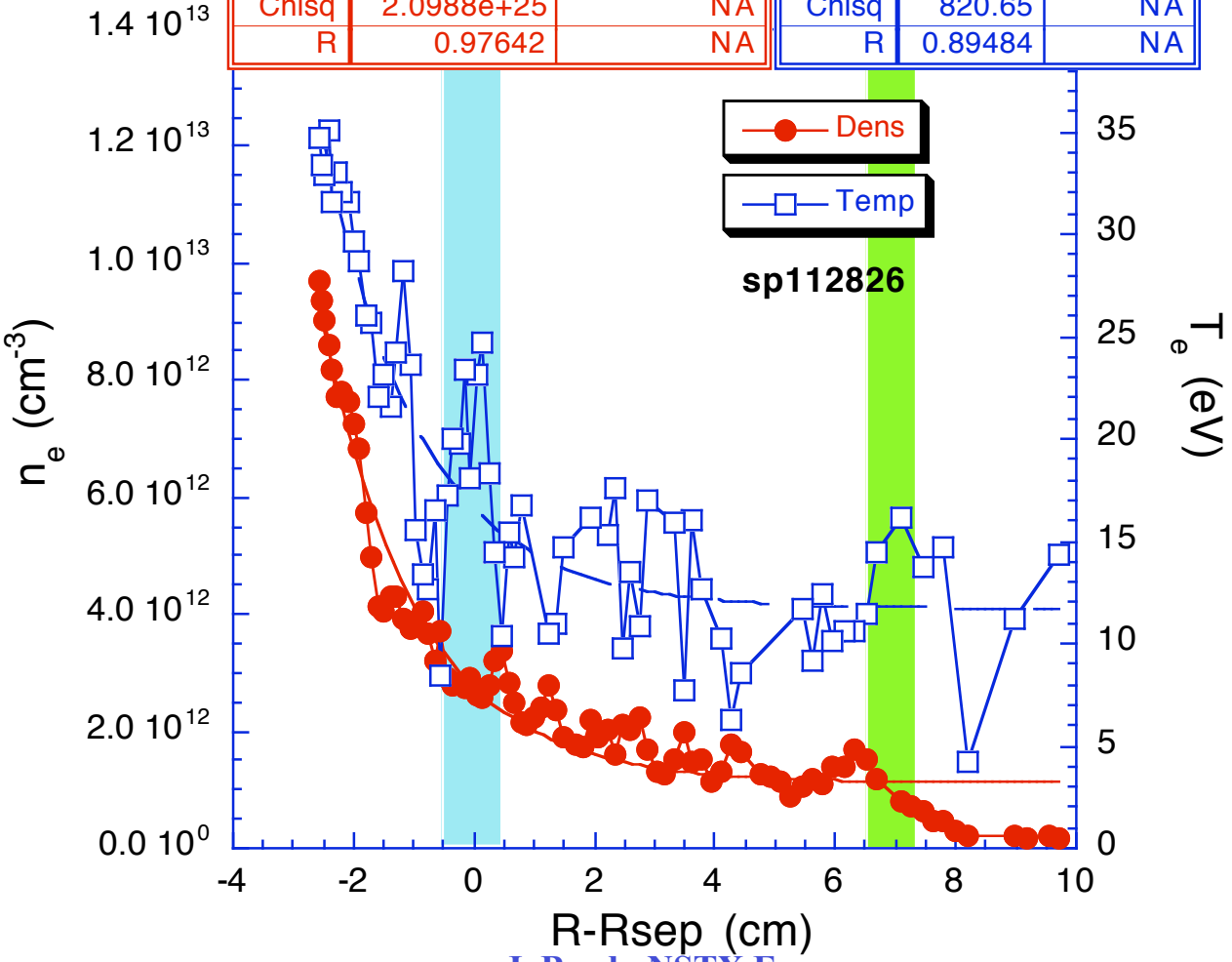
L-mode Te, ne, Profiles Obtained

y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	1.122e+12	9.1208e+10
m2	1.6365e+12	1.3754e+11
m3	1.6127	0.090256
Chisq	2.0988e+25	NA
R	0.97642	NA

y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	11.707	0.79124
m2	4.9492	1.0834
m3	1.6448	0.23845
Chisq	820.65	NA
R	0.89484	NA



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Profiles with high (~2 mm) spatial resolution

3 ms time resolution

Upgrading to 2 μs resolution

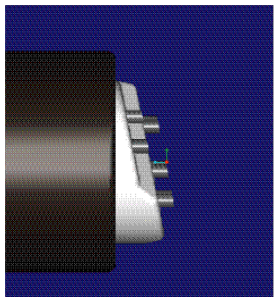
Data well inside the LCFS

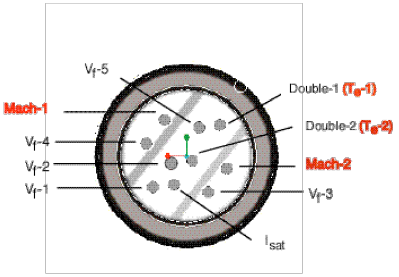
Plasma exists far into the SOL

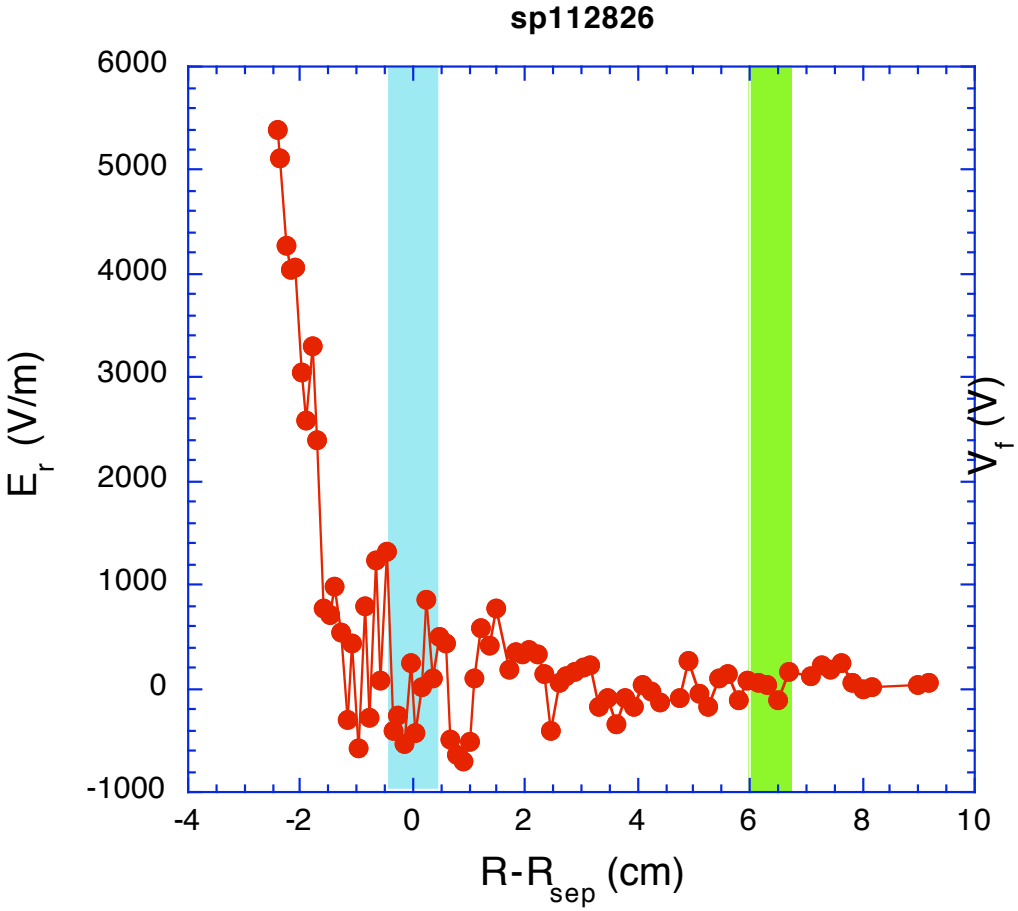
An offset is needed for fits

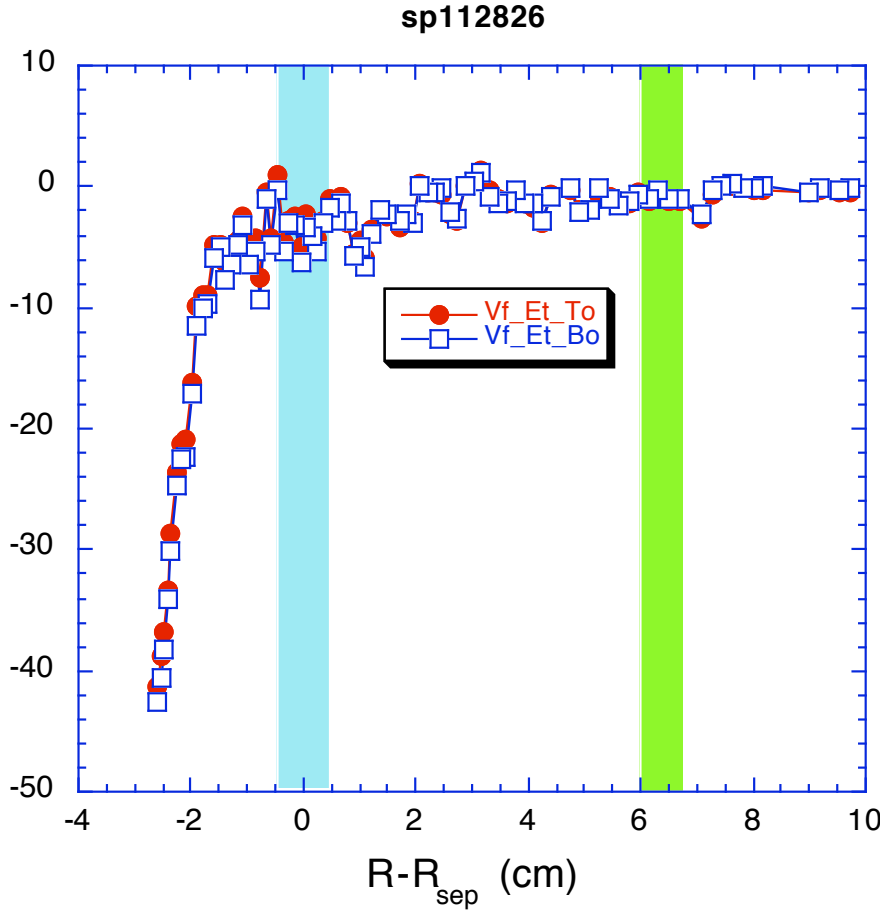
L-mode Vf, Er Profiles Obtained

Radial field increases quickly to ~5.5 kV/m
Poloidal tips well aligned
No dedicated H-mode data, mining database





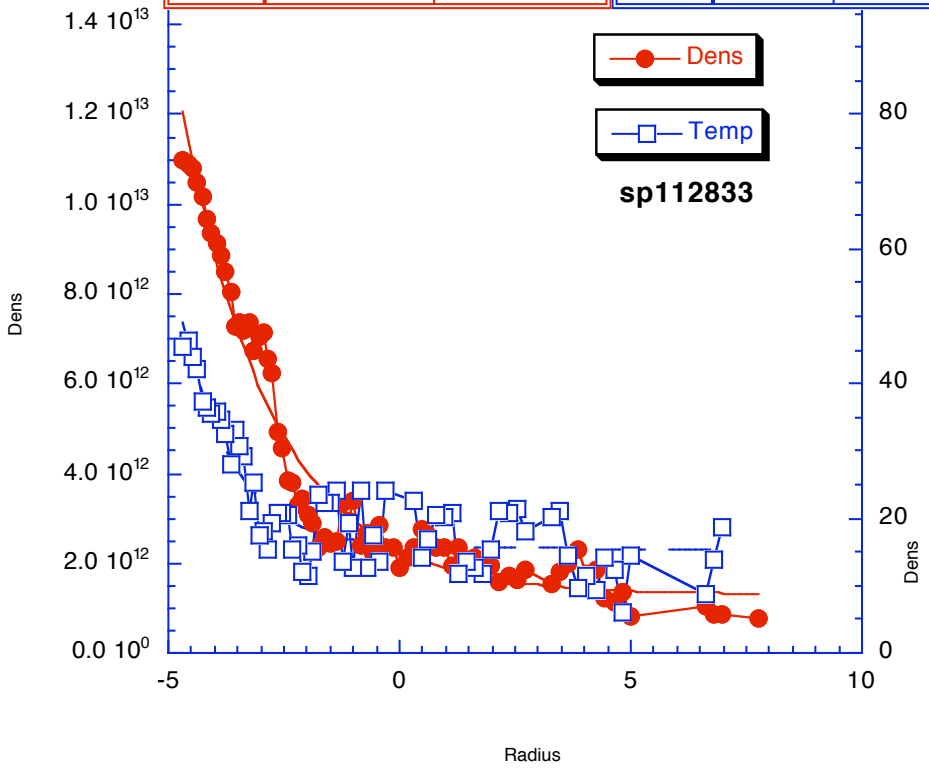




Ne profile wider than Te. Ne, Te quite flat in SOL

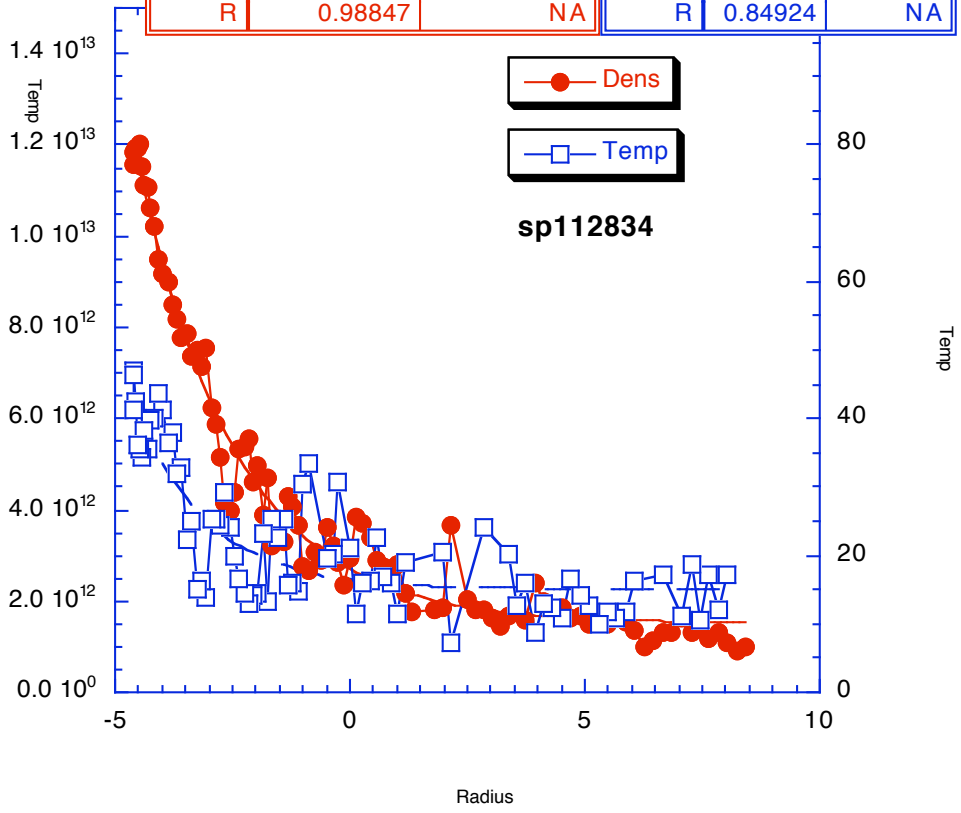
y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	1.3051e+12	1.392e+11
m2	9.9285e+11	1.2643e+11
m3	1.9655	0.10969
Chisq	2.3654e+25	NA
R	0.98149	NA

y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	15.51	0.77191
m2	0.50034	0.26542
m3	1.1133	0.14895
Chisq	1213.7	NA
R	0.89069	NA



y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	1.5088e+12	9.6874e+10
m2	1.1896e+12	1.0039e+11
m3	2.1114	0.082751
Chisq	2.3948e+25	NA
R	0.98847	NA

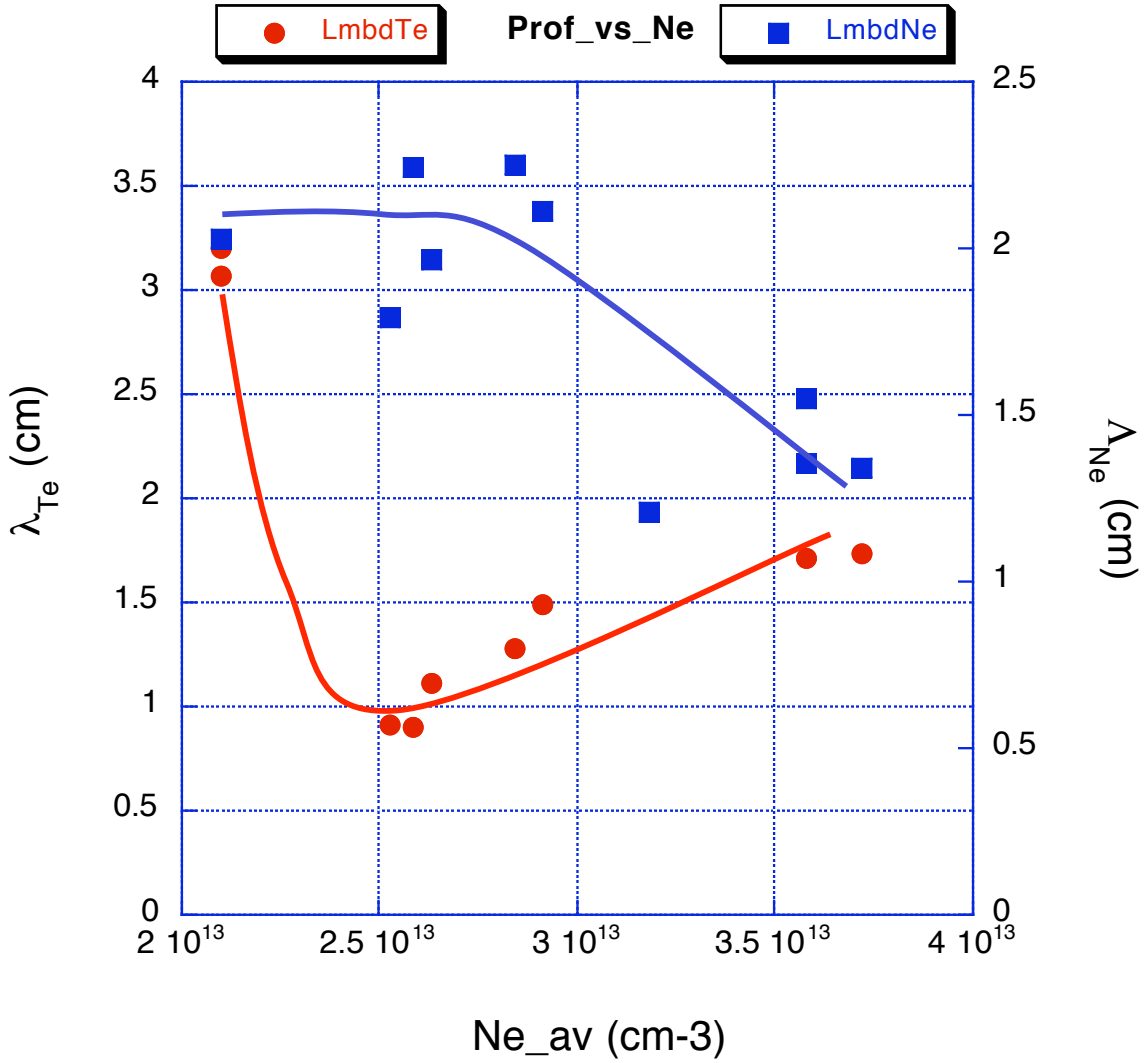
y = m1 + m2 * exp(-M0/m3)		
	Value	Error
m1	15.092	1.0257
m2	1.3725	0.684
m3	1.5326	0.25947
Chisq	2375.7	NA
R	0.84924	NA



Te rise is faster than Ne rise

Calibration or EFIT ~2 cm off

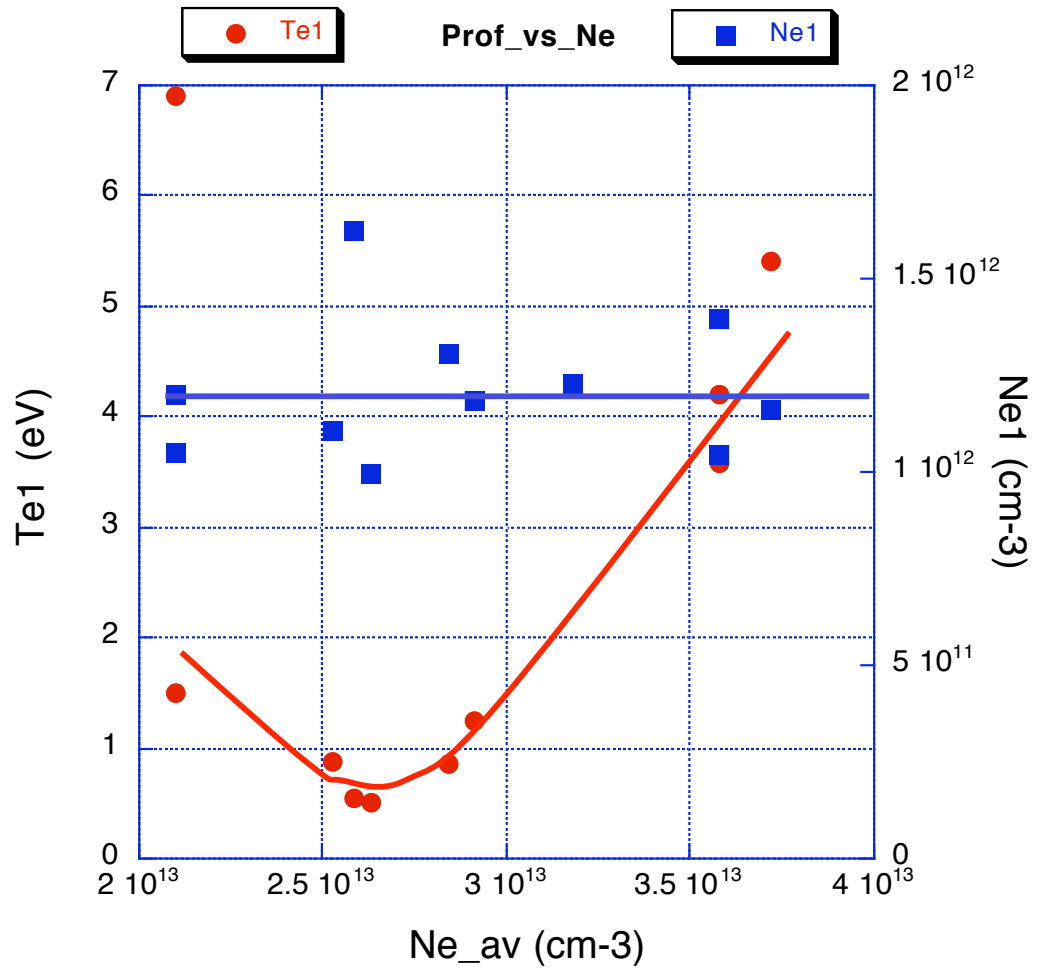
Scaling in λ_{Te}, λ_{ne}, can be obtained



Trend of Ne and Te decay length with ne averaged are opposite, but they converge at high ne_av

$$n_e = n_{e0} + n_{e1} \times e^{-\frac{(R-Rsep)}{\lambda_n}}$$

Scaling in Te1, ne1 obtained

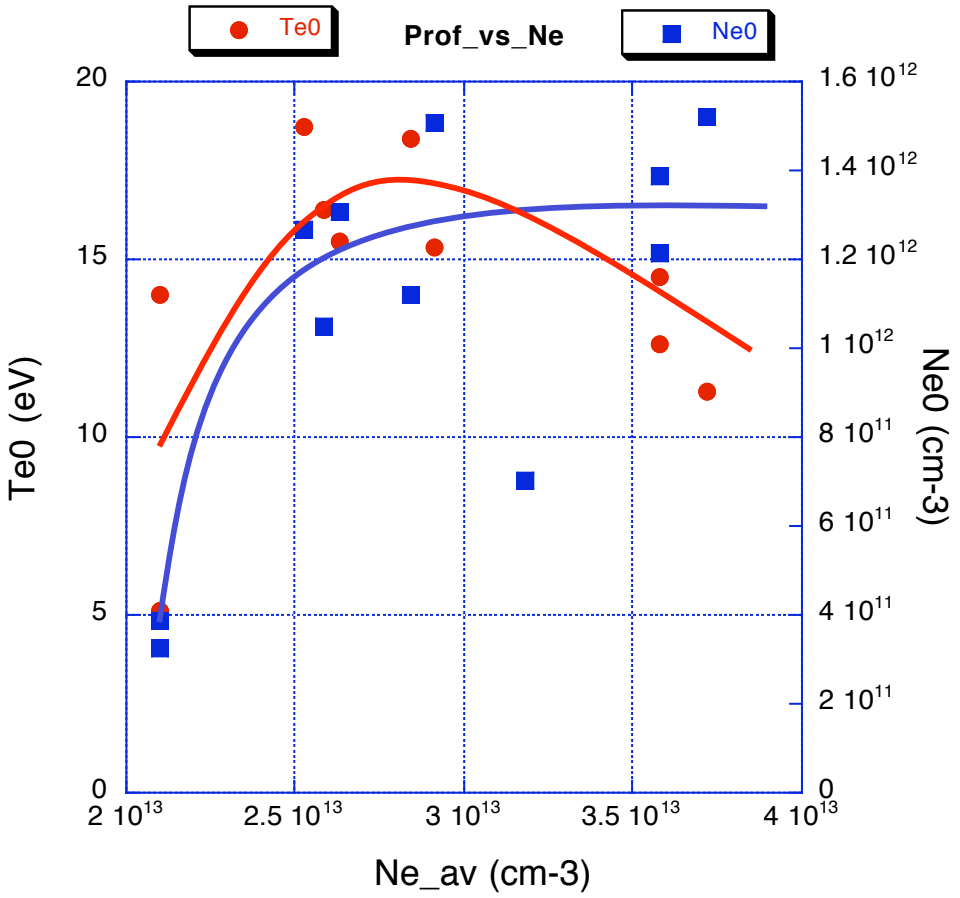


Te1 shows a marked dependence on average density

Ne1 does not!

$$n_e = n_{e0} + n_{e1} \times e^{-\frac{(R-Rsep)}{\lambda_n}}$$

Te0, Ne0, fairly constant (except at low Ne?)

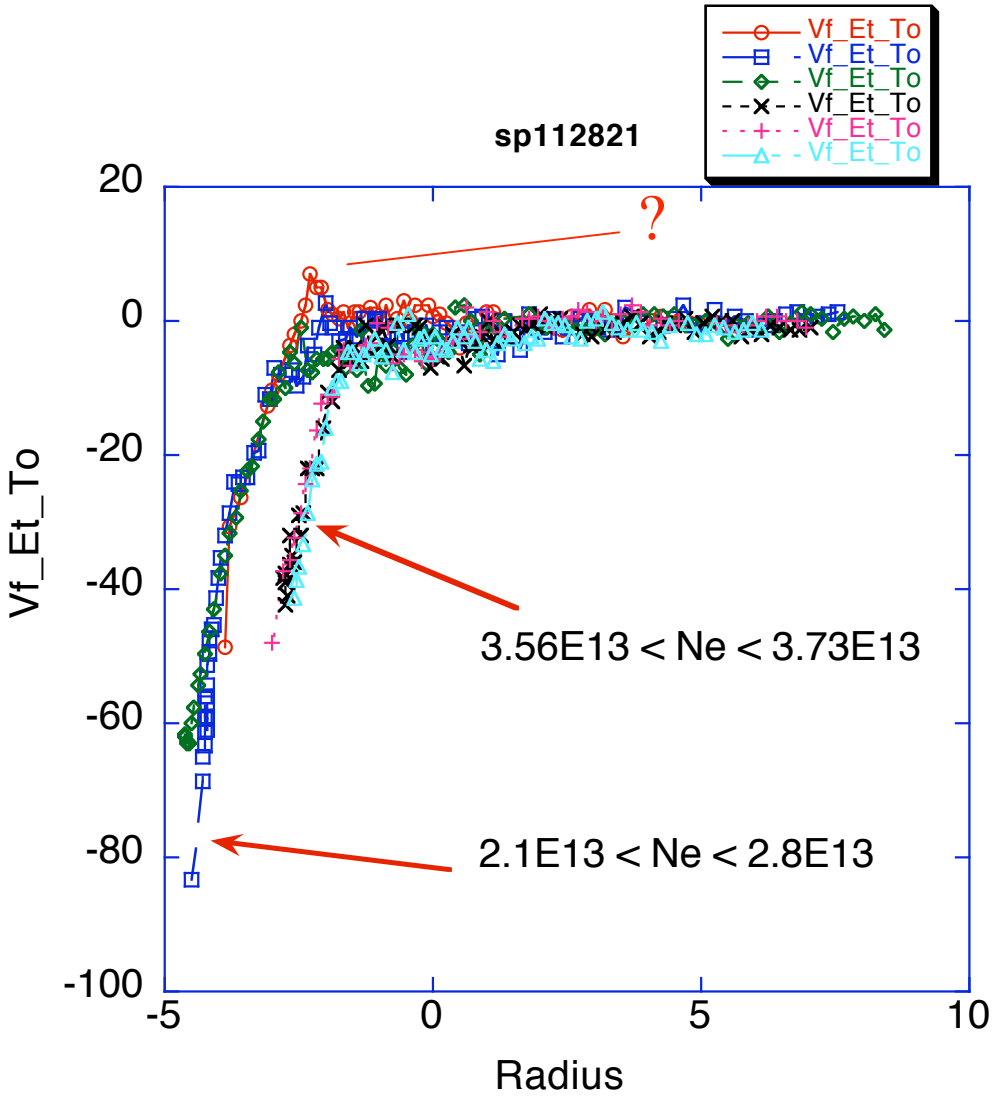


Need to examine low Ne behavior

More statistics needed

Scaling information useful to modelers (blob modeling, UEDGE, BOUT)

Electric field moves outward at high density



Clear "transition" at ~3.0E13 cm-3

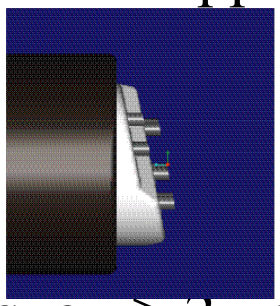
So far (nominal 5 cm inside), no well. Need to make further experiments and go further in.

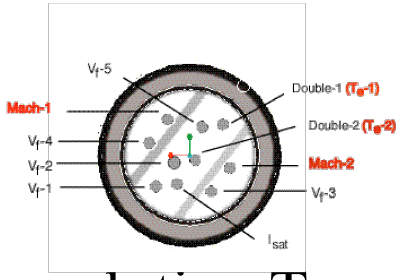
Further Upgrades Toward Final System

•After much development and many software and hardware updates probe system is productive. More data on intermittency, fluctuations, available (no time).

•New electronics with more channels and power supplies

•Enable Mach tips => Flows 01/05



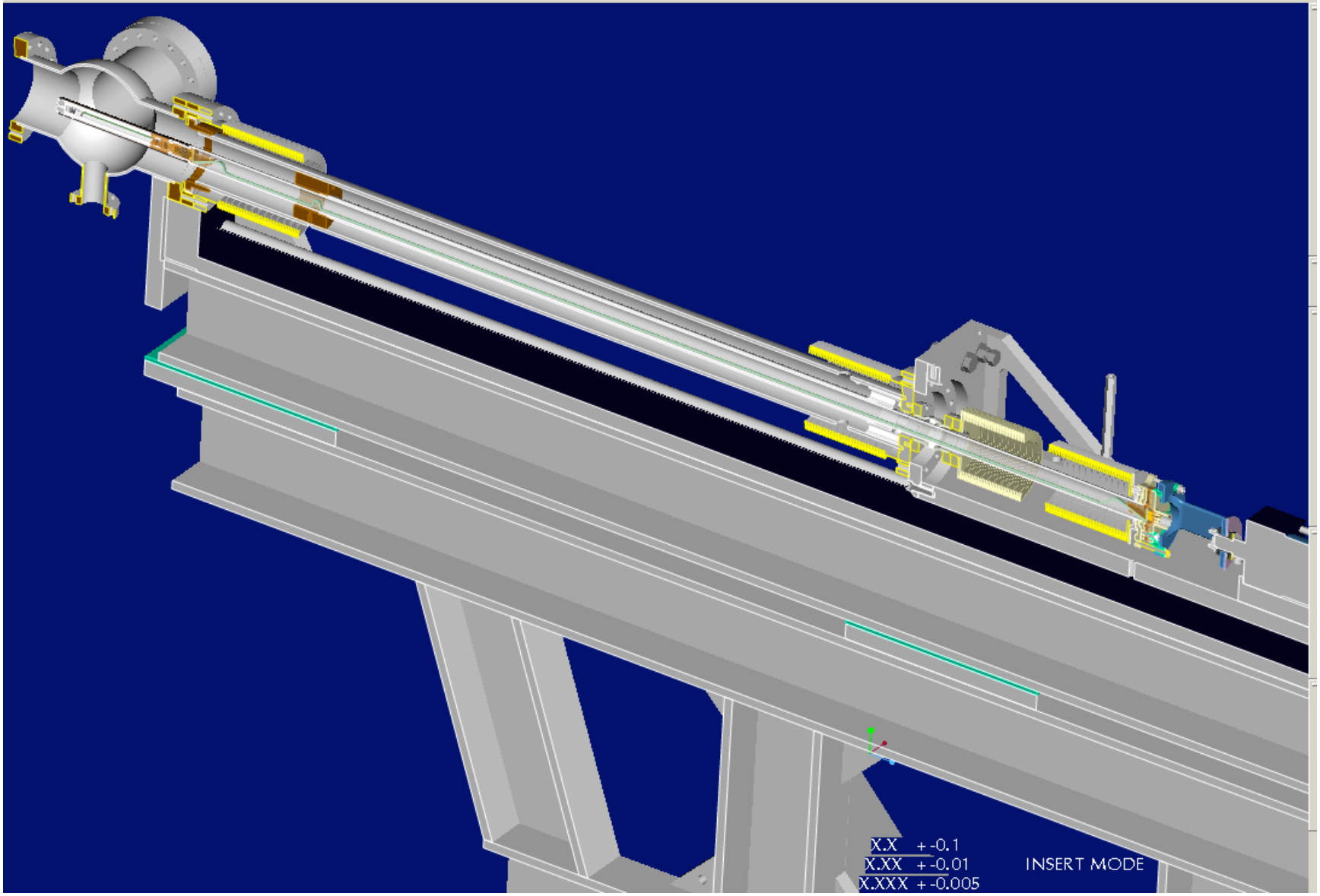


•Fast Te diagnostic using harmonics technique => 2 μs resolution Te and Ne => ELMs, Intermittency Te 03/05 ?

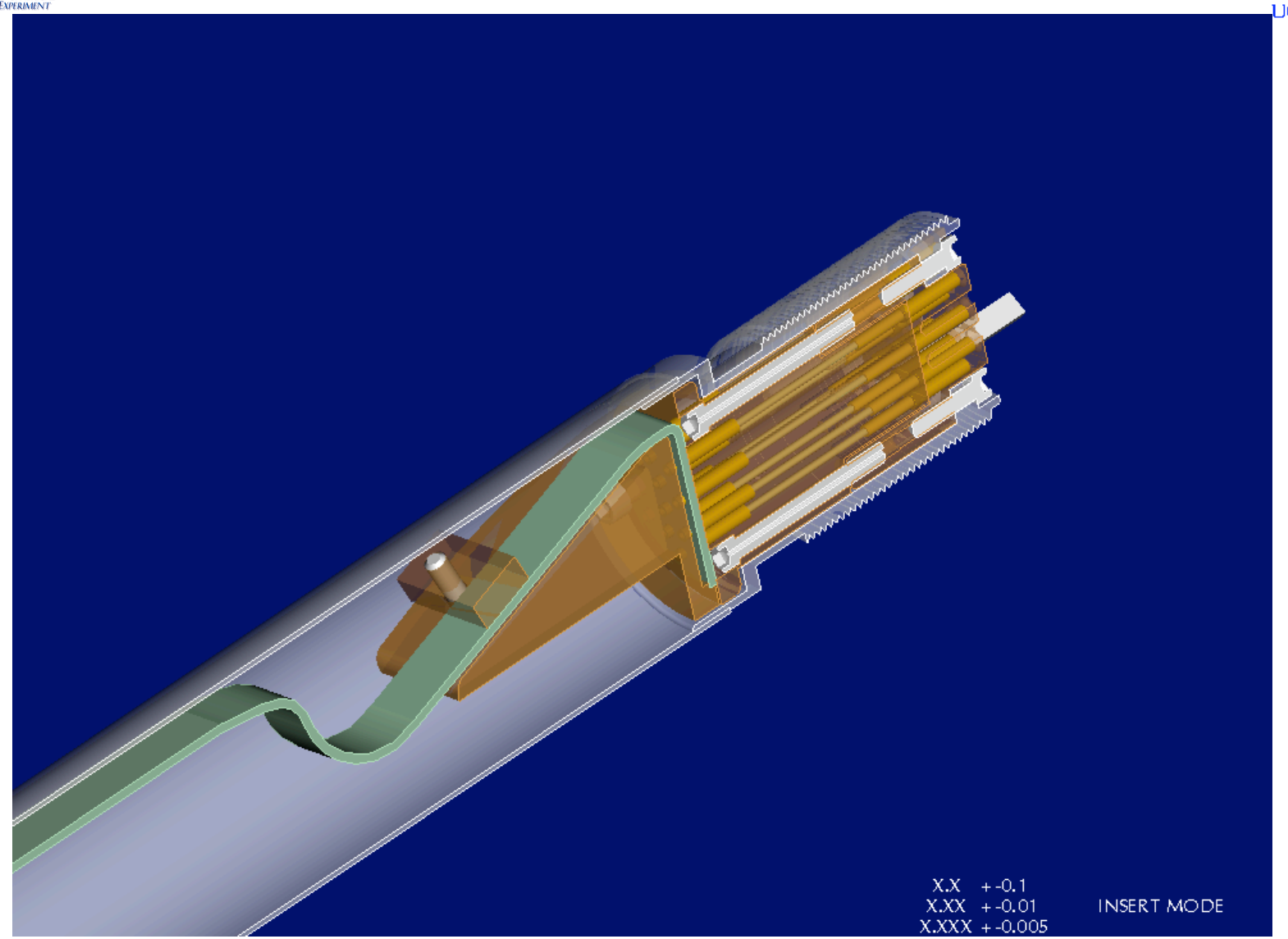
•New Electromagnetic Head => Magnetic field, electromagnetic transport, edge current? 03/05

•New, lower S/N, lower mass, higher acceleration shaft 01/05

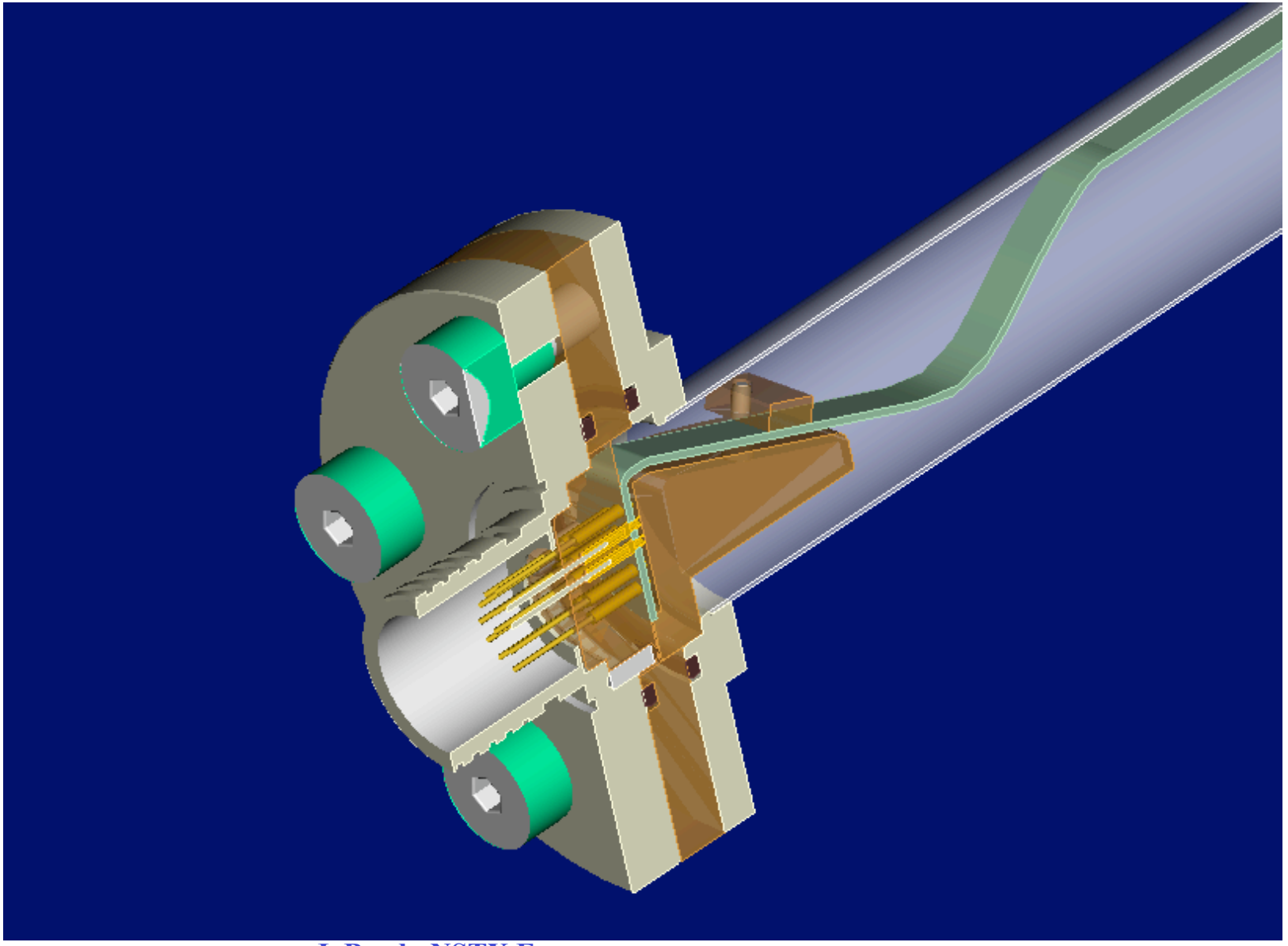
New Shaft Under Construction



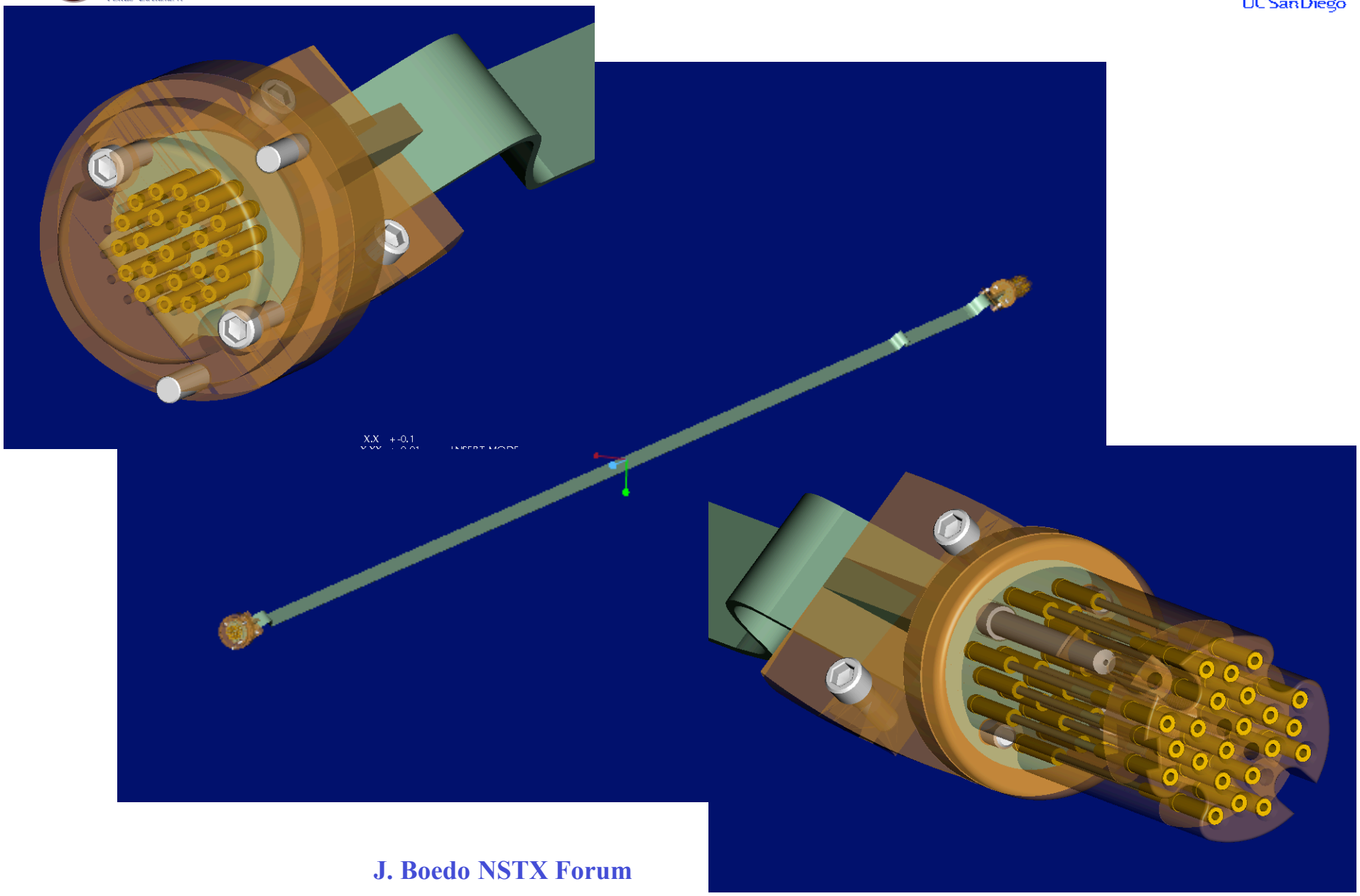
Circuit Boards Used Throughout

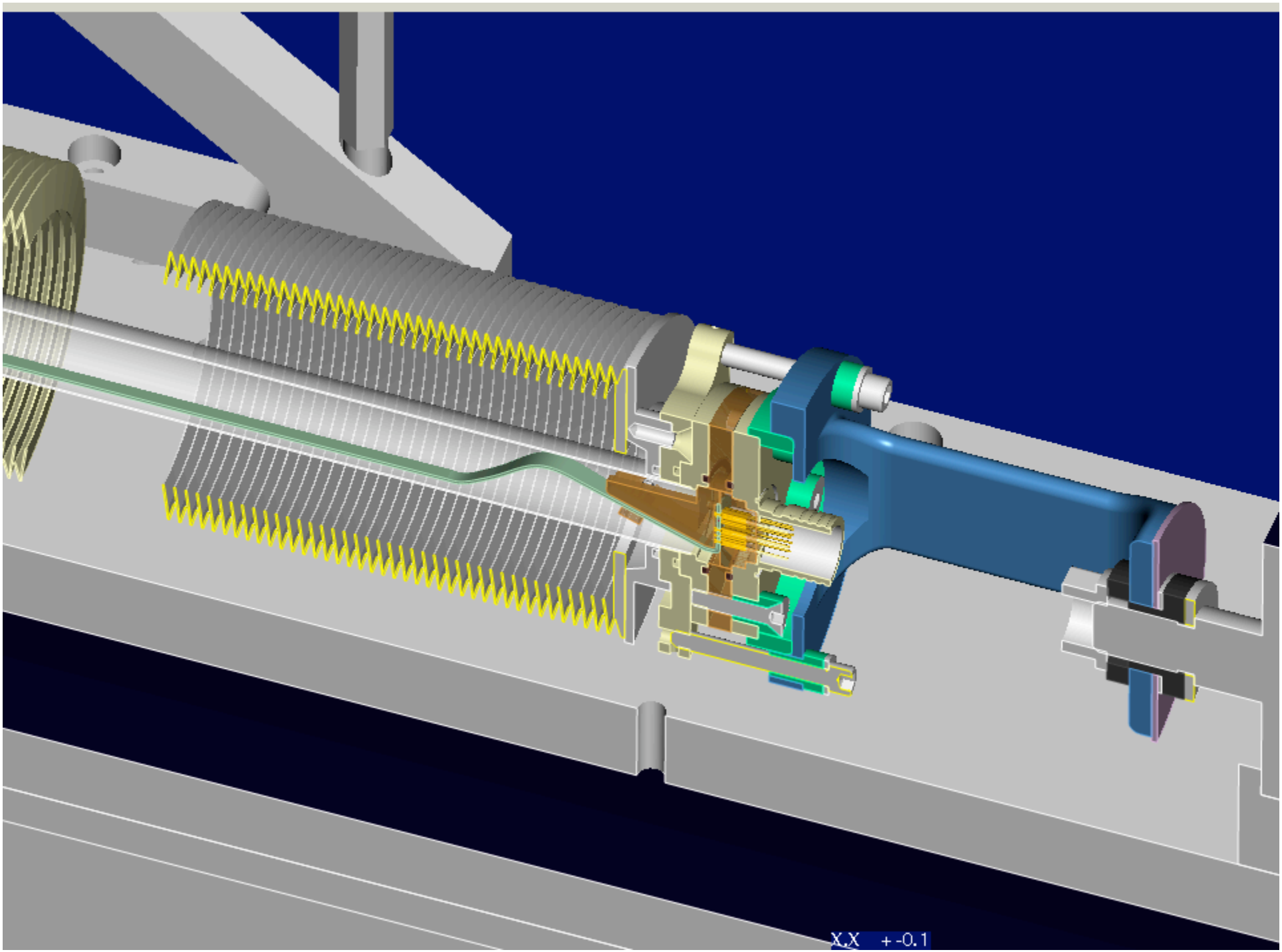


Feedthrough Simplified, Mass Reduced, Noise Reduced



Modular design




X,X + -0.1