

# A&M data needs for injected impurities in fusion research

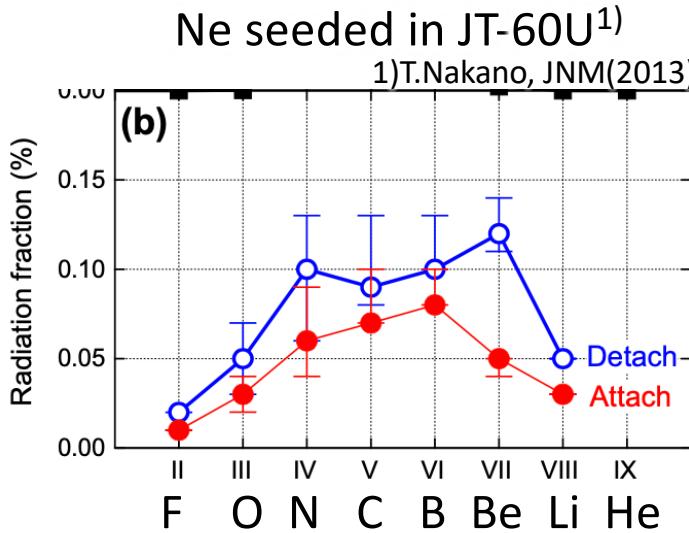
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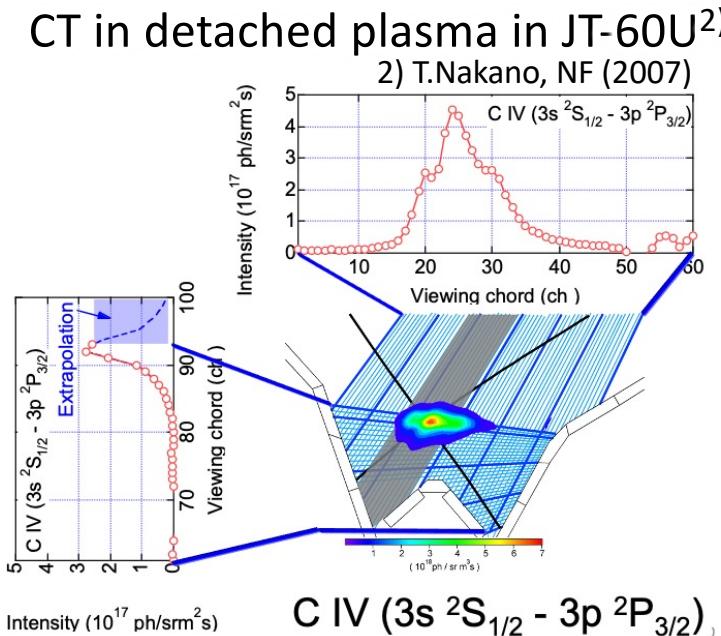
# Why highly charged impurity ions

In impurity seeded plasmas, we want to know;

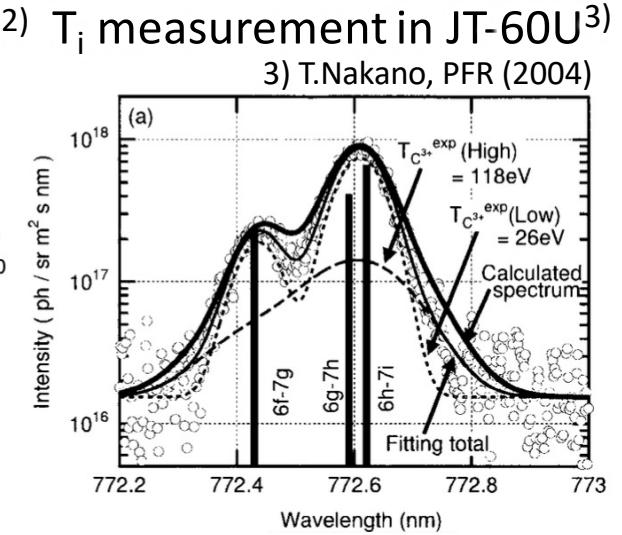
- Radiative power
- Radiation/spectral spatial distribution
- Plasma parameters ( ex.  $T_i$  )



⇒ Higher Z (up to Li-like) is responsible for radiation



$C\text{ IV} (3s\ 2S_{1/2} - 3p\ 2P_{3/2})$ ,  
Wavelength  $\sim Z^{-2}$   
⇒ Lower Z is better for visible spectroscopy



$$\tau_{Z, D+}^{\text{relax}} < \tau_Z^{\text{ioniz}}$$

$$\tau_{Z, D+}^{\text{relax}} \sim Z^{-2}$$

$$\tau_Z^{\text{ioniz}} \sim Z^3$$

⇒ Higher Z is better

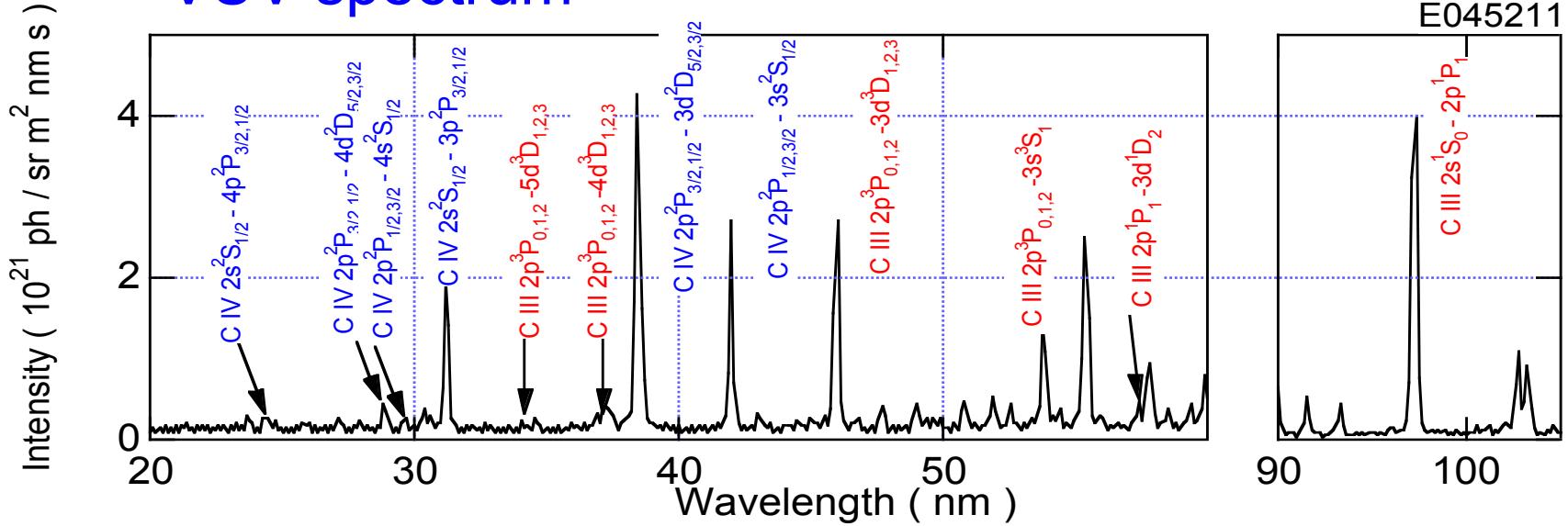
Only hope on good visible diagnostic lines is  $\Delta n = 0$  transitions of highly charged (Z) imp. ions

# $\Delta n=0$ transitions

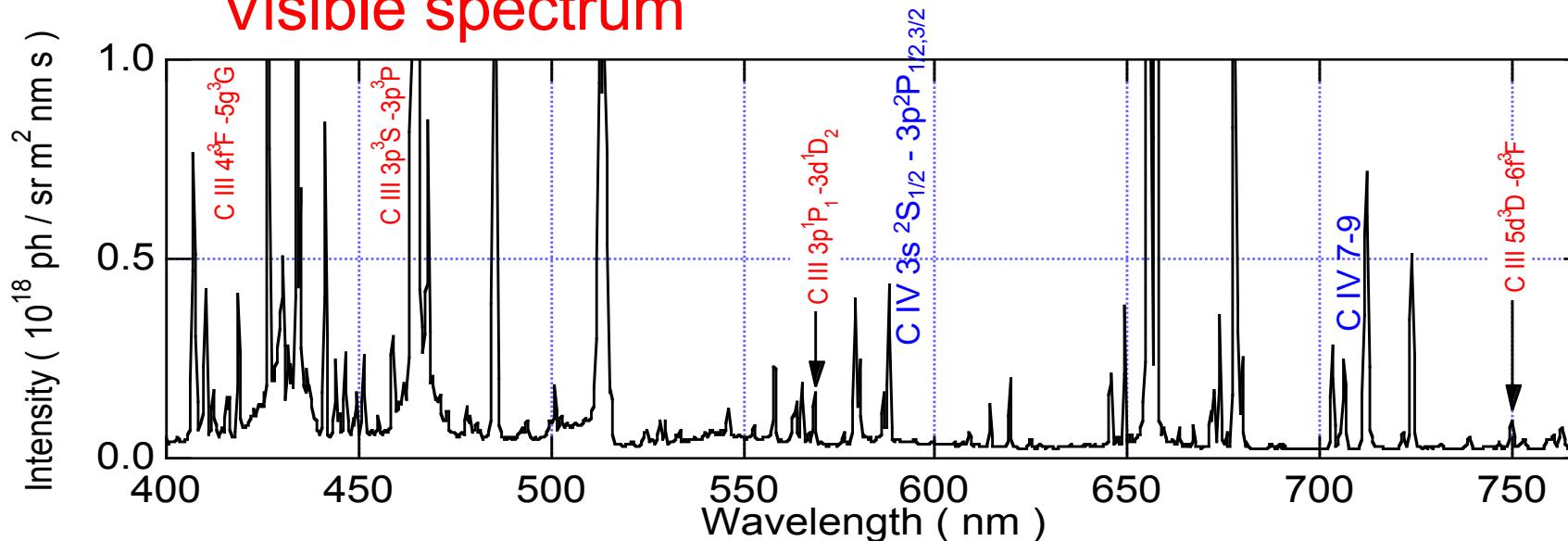
## C IV 3s-3p: good diagnostic line

-- high PEC, isolated, and one of very few visible lines --

### VUV spectrum

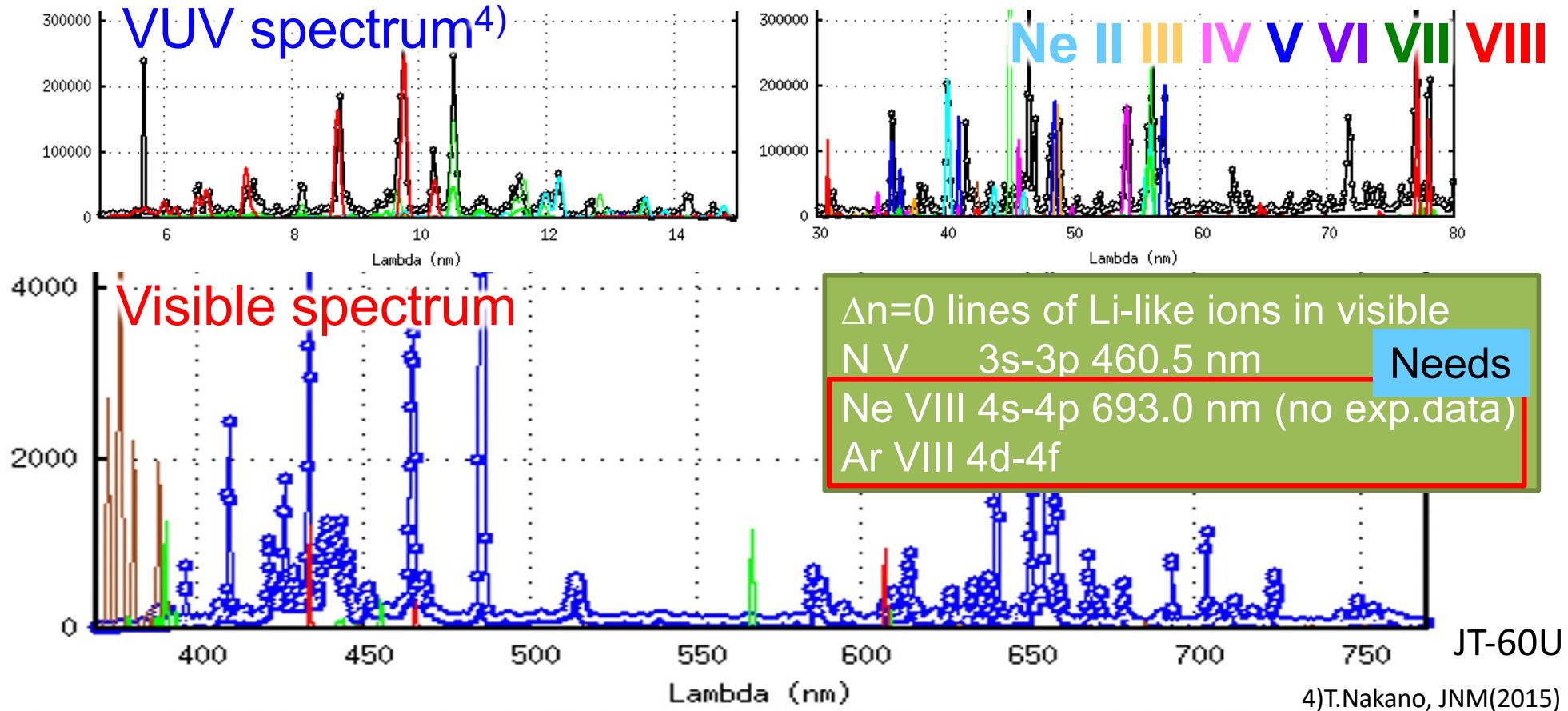


### Visible spectrum



# $\Delta n=0$ transitions

Ne VIII 4s-4p line not yet identified

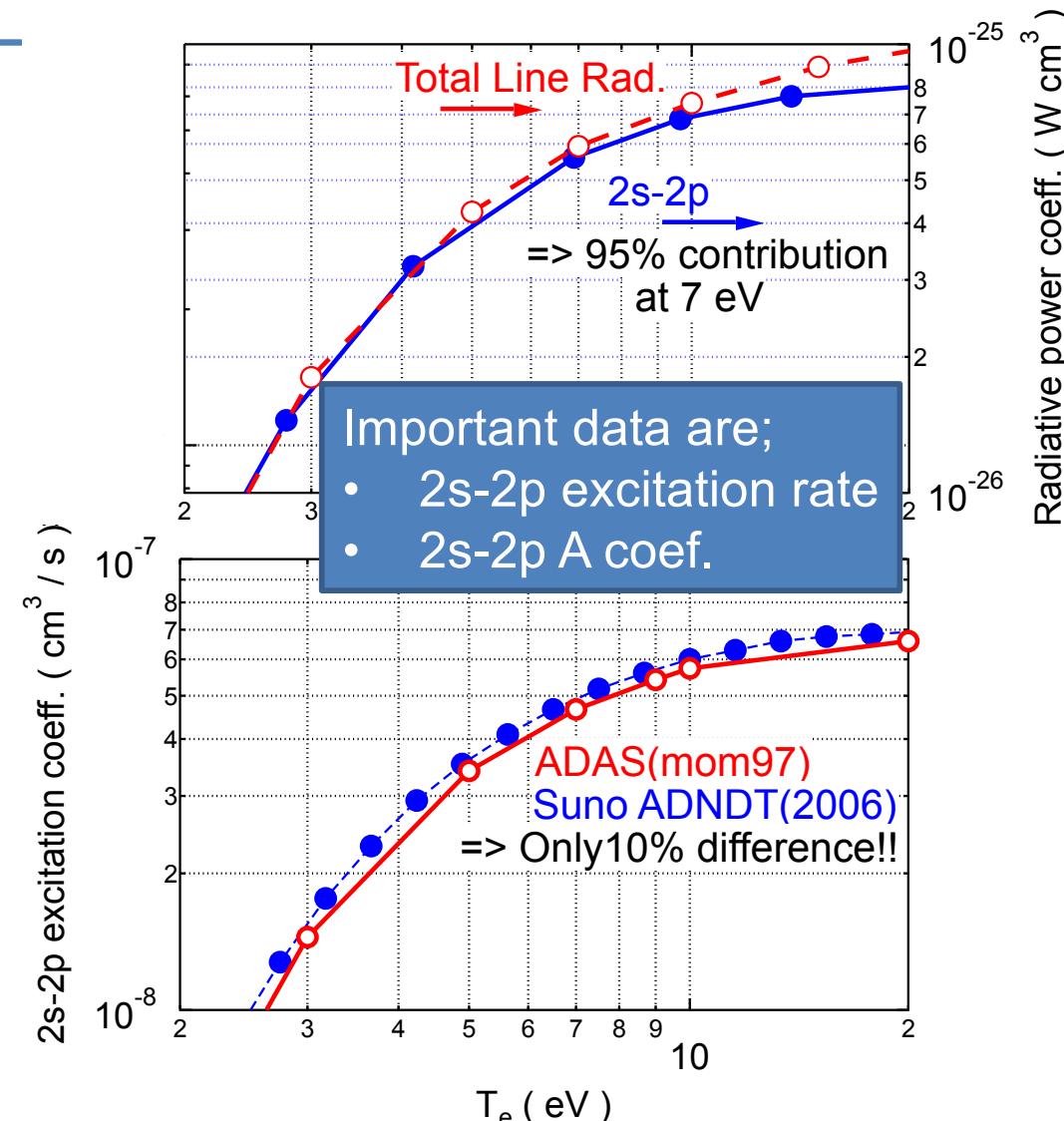
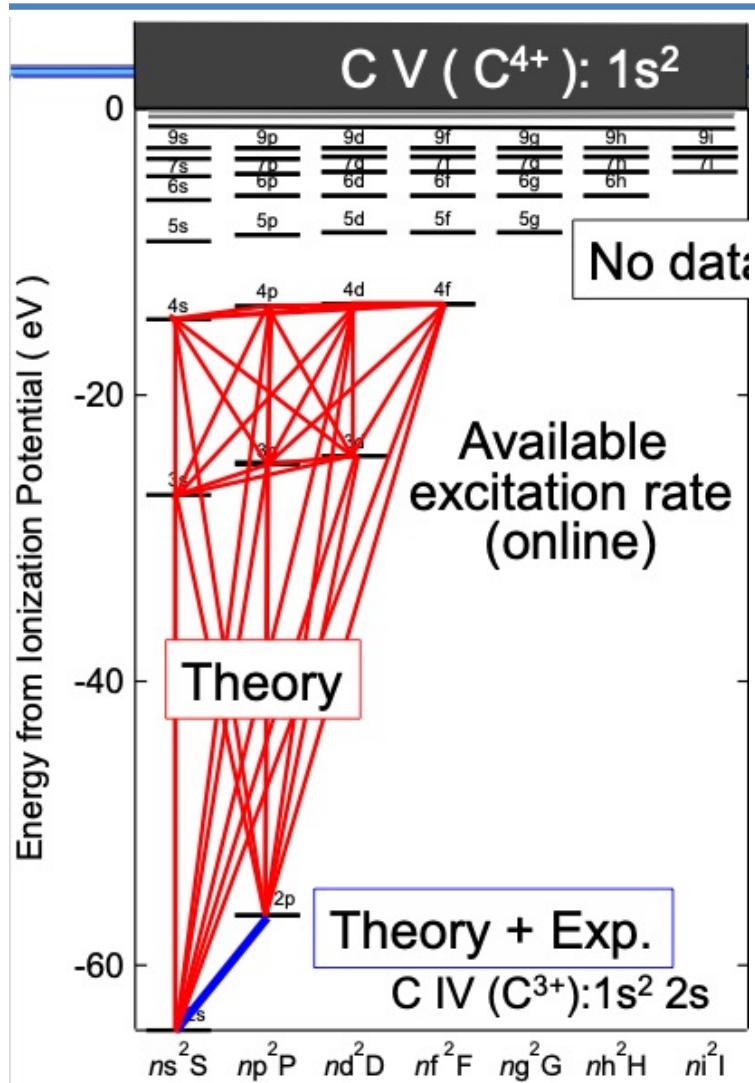


NIST ASD v5.9:

Observed Wavelength Air (nm)	Ritz Wavelength Air (nm)	Unc. (nm)	Rel. Int. (?)	$A_{ki}$ ( $s^{-1}$ )	Acc.	$E_i$ ( $cm^{-1}$ )	$E_k$ ( $cm^{-1}$ )	Lower Level Conf., Term, J	Upper Level Conf., Term, J	Type	TP Ref.	Lin Ref.	
???	689.4	1.0		1.67e+07	B	[1 469 616]	- [1 484 117]	1s <sup>2</sup> 4s    2S    1/2	1s <sup>2</sup> 4p    2P°    3/2		T7495		
	699.3	1.0		1.59e+07	B	[1 469 616]	- [1 483 912]	1s <sup>2</sup> 4s    2S    1/2	1s <sup>2</sup> 4p    2P°    1/2		T7495		
26.034	0.006	26.0260	0.0017	2600bl*	1.04e+10	A	[1 099 886.0]	- [1 484 117]	1s <sup>2</sup> 3s    2S    1/2	1s <sup>2</sup> 4p    2P°    3/2		T7495	L9090
26.034	0.006	26.0399	0.0016	2600bl*	1.05e+10	A	[1 099 886.0]	- [1 483 912]	1s <sup>2</sup> 3s    2S    1/2	1s <sup>2</sup> 4p    2P°    1/2		T7495	L9090

no experimental wavelength recorded

# C IV 2s-2p line is a dominant radiation loss channel



Uncertainty of  $C_e(2s, 2p)$   $\sim$  that of the total radiative power coef.

Evaluation of  $C_e(2s, 2p)$  is the most important

Similar needs for N V, Ne VIII and Ar VIII

Needs

# Summary: Data needs for seeded impurities

 QST

## For diagnostic:

- Experimental wavelength of Ne VIII 4s-4p transition
- Experimental wavelength of Ar VIII 4d-4f transition

Note: if too weak to measure,

another spatial resolved diagnostics is needed such as AXUV...

## For (spectroscopic) data analysis:

- Experimentally evaluated excitation rate of N V/Ne VIII 2s-2p
- Experimentally evaluated A coefficient of N V/Ne VIII 2s-2p
- Similar data for Ar VIII

Note: Accuracy in calculation increases with Z, i.e., C IV, N V,,, Ne VIII

⇒ Should be OK for Ne VIII given that C IV is OK

But uncertainty quantification for Ar VIII (Na-like) is not yet done (I think)