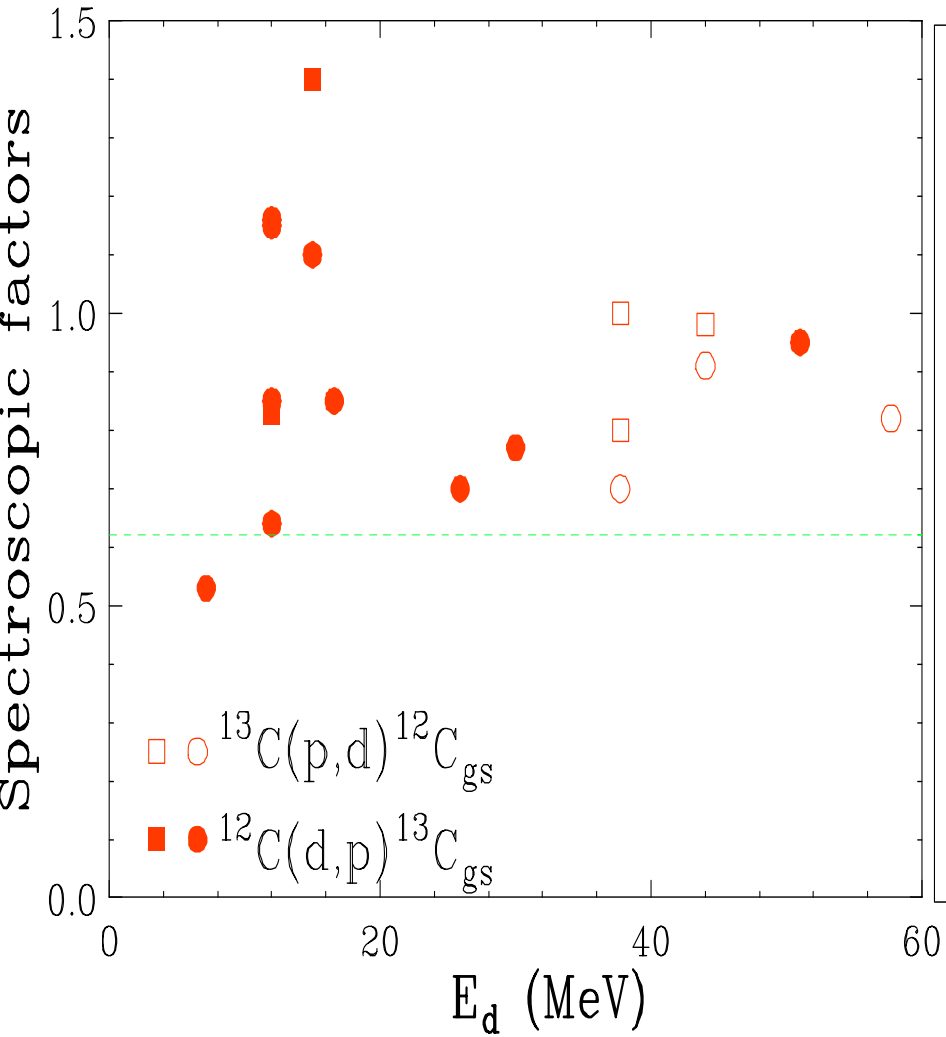
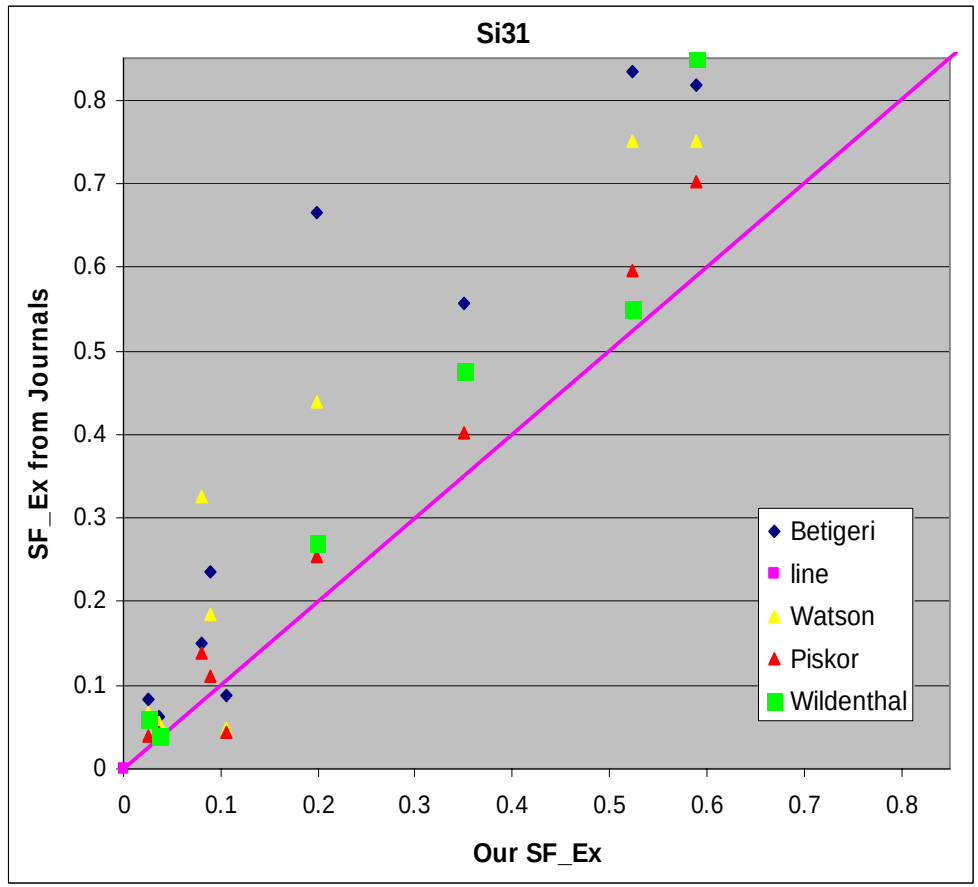
Spectroscopic Factors For SD shell

With two new interaction models:

USDA and USDB

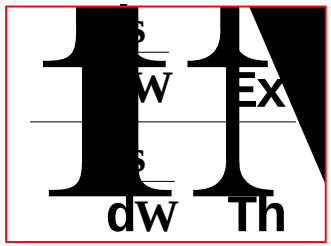
Spectroscopic Factors from literatures





Need a consistent method

TWOFNR for Experimental SF

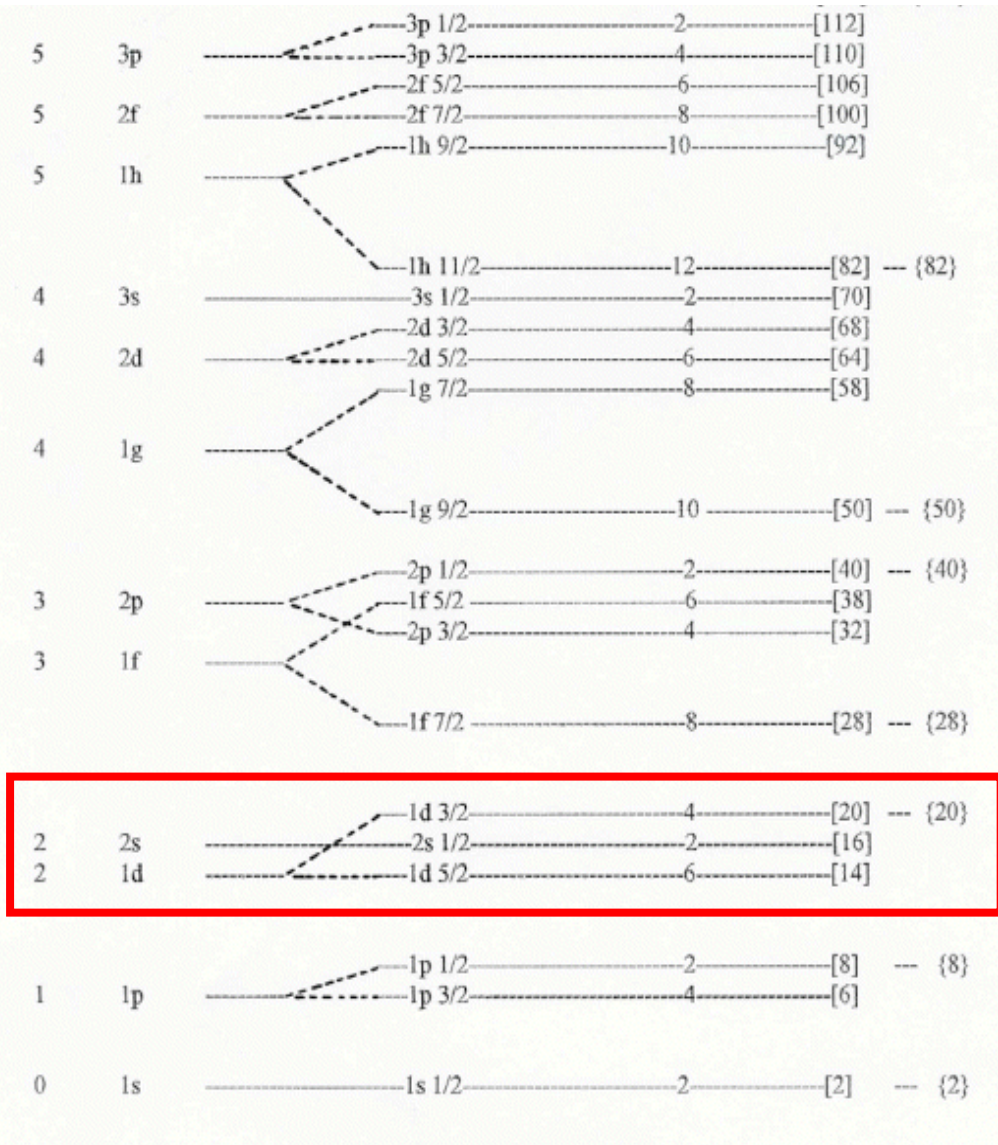
➢SF_Ex= 

➢Johnson- Soper Adiabatic Approximation to take care of d-break-up effects – Adiabatic 3-bodies model

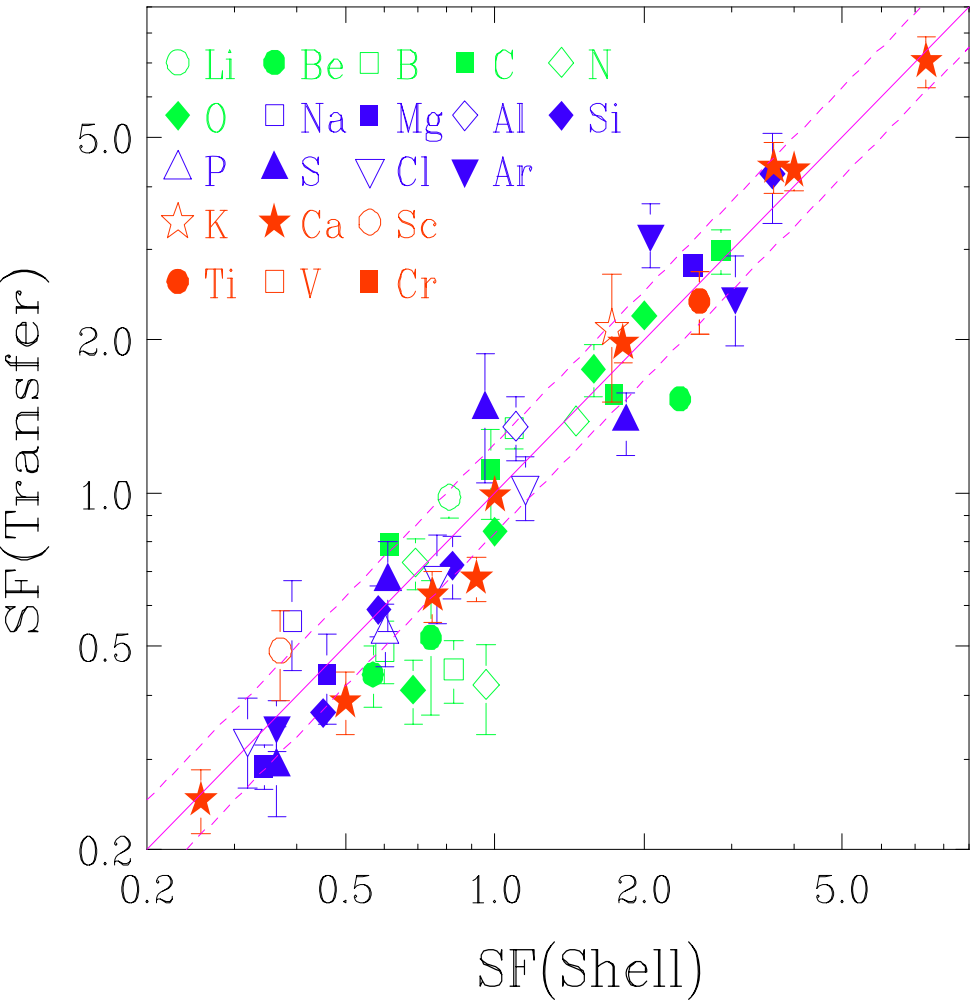
➢ Use global optical potential with standardized parameters (CH89)

➢n-potential : Woods-Saxon shape r_0 =1.25 fm & a_0 =0.65

Oxbash for Theoretical Model



What we have gotten so far



For ground state only, SF>0.2

What happen to small SF<0.2 ?

Importance of Neutron Spectroscopic Factors in the study of rp(proton capture)

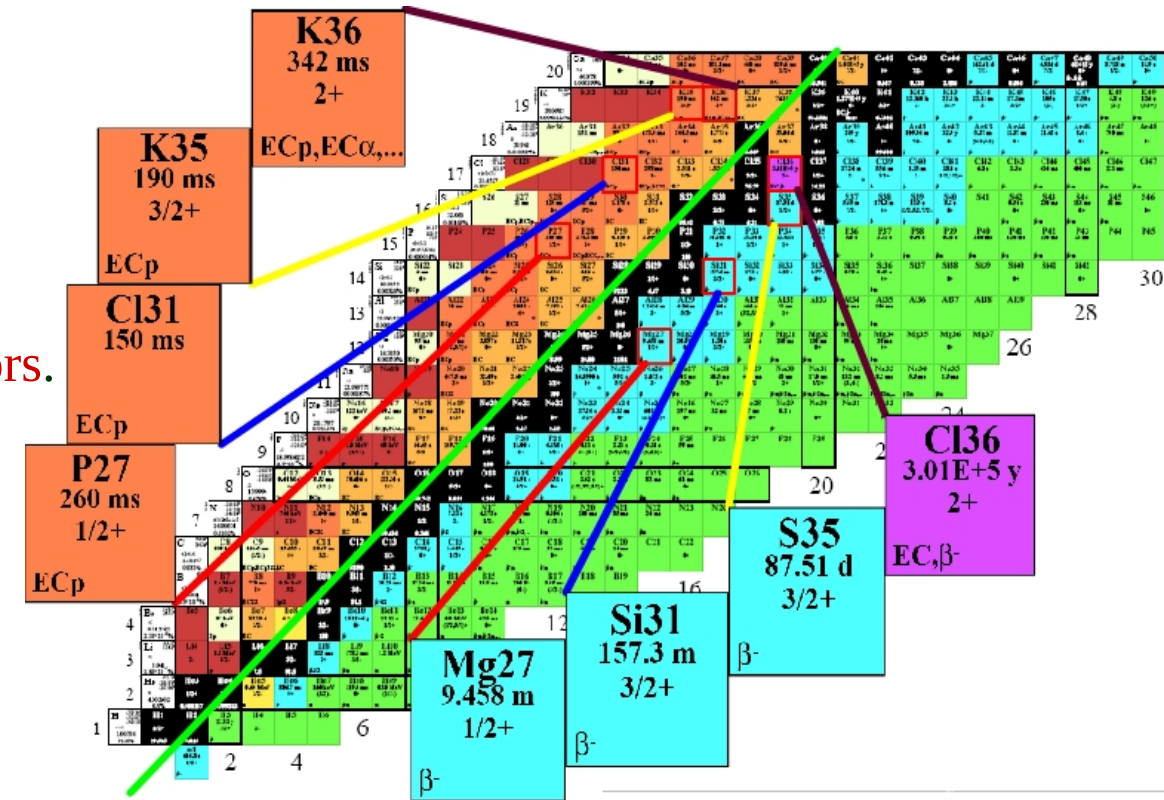
- Spectroscopic factors (SF) determine the reaction rates

  → important input to astrophysical network calculations.

- Most SFs of the relevant states for nucleosynthesis processes are not available experimentally → calculated by shell model.

➢ Therefore, it is important to establish the accuracies of these calculations by comparing experimental spectroscopic factors.

➢Use **MIRROR NUCLEI!!**



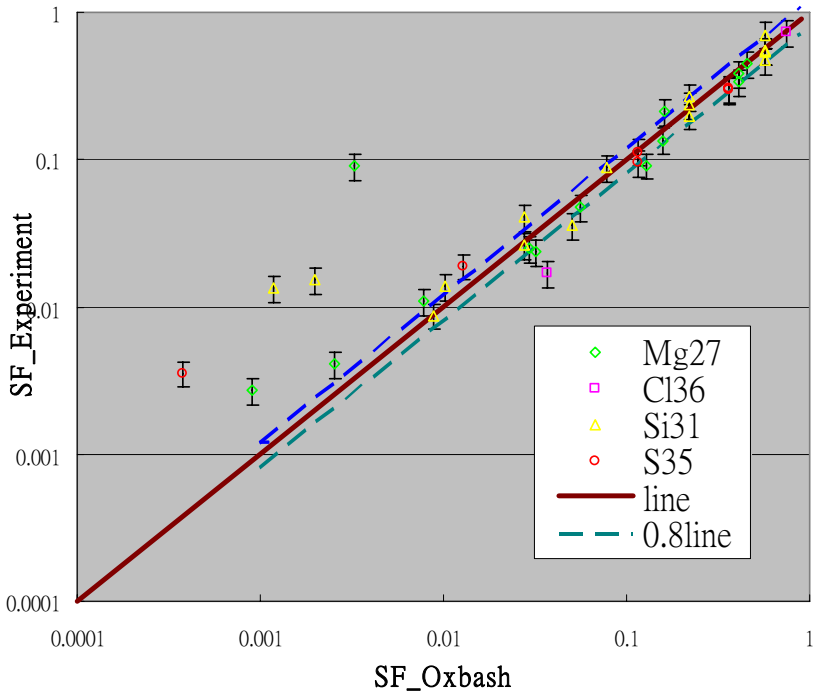
USDA and USDB

- Original USD → 452 energy data from 66 nuclei → least square fit to obtain the Hamiltonians

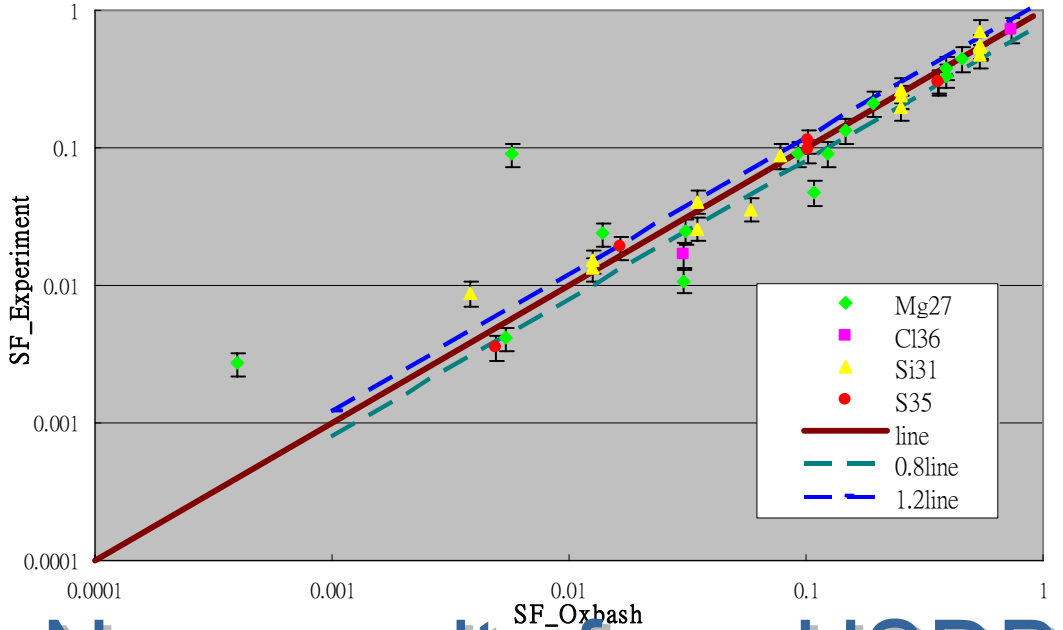
- USDA and UDSB → 608 energy data in 77 nuclei distributed over sd-shell nuclei

- USDA and UDSB are using different linear combination of parameters

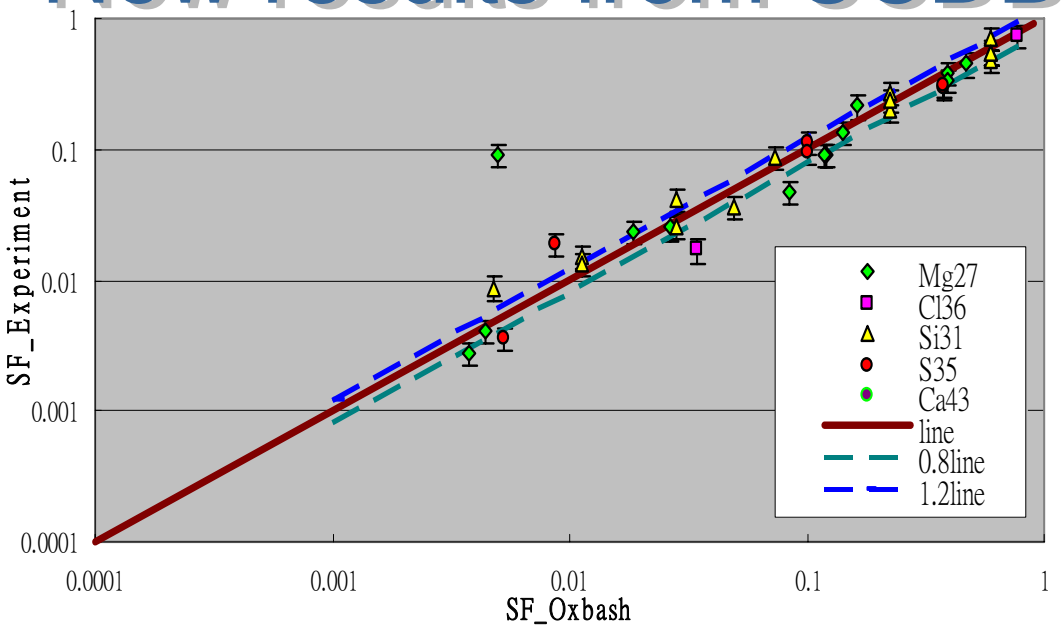
Previous Results from USD

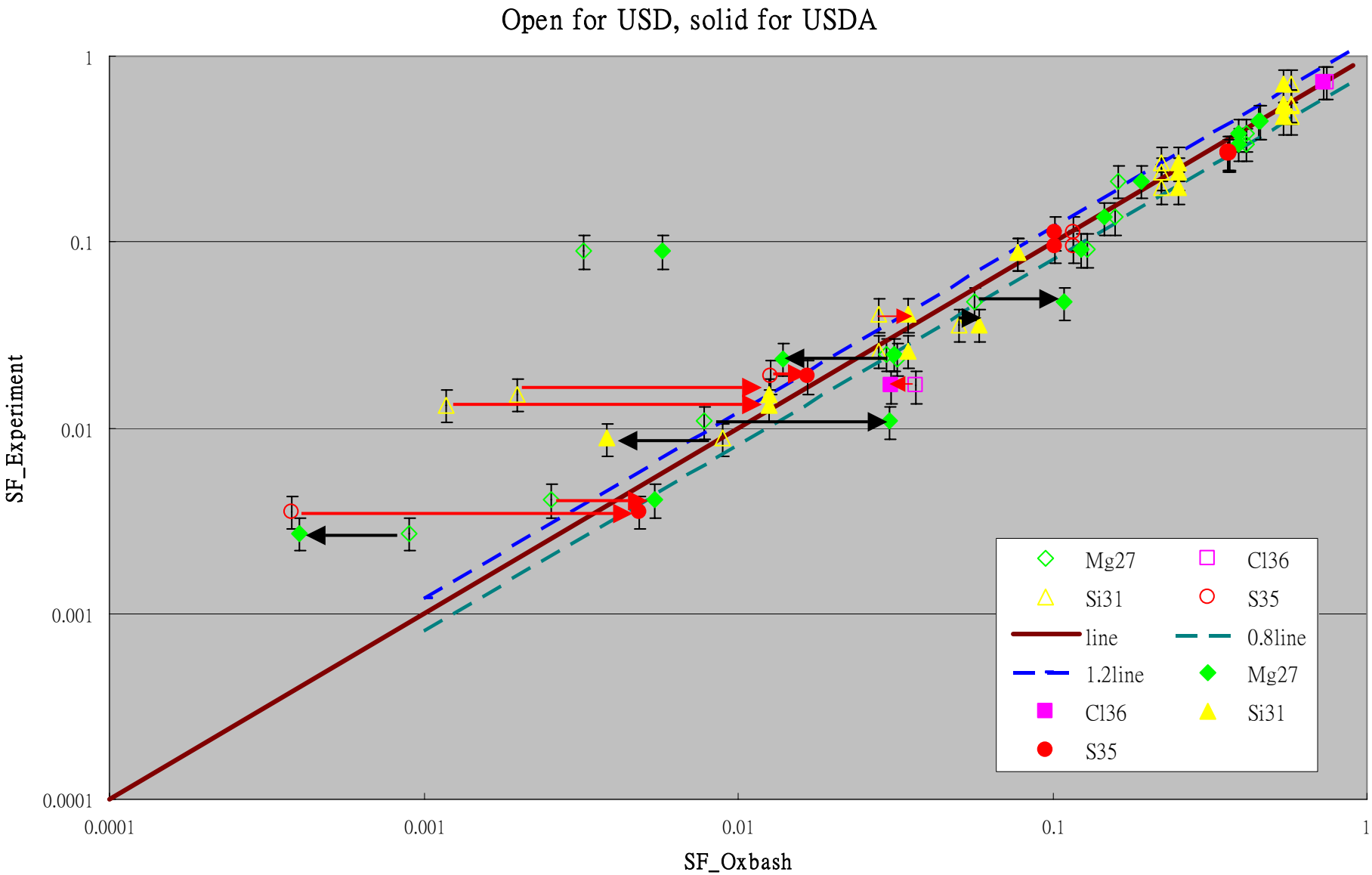


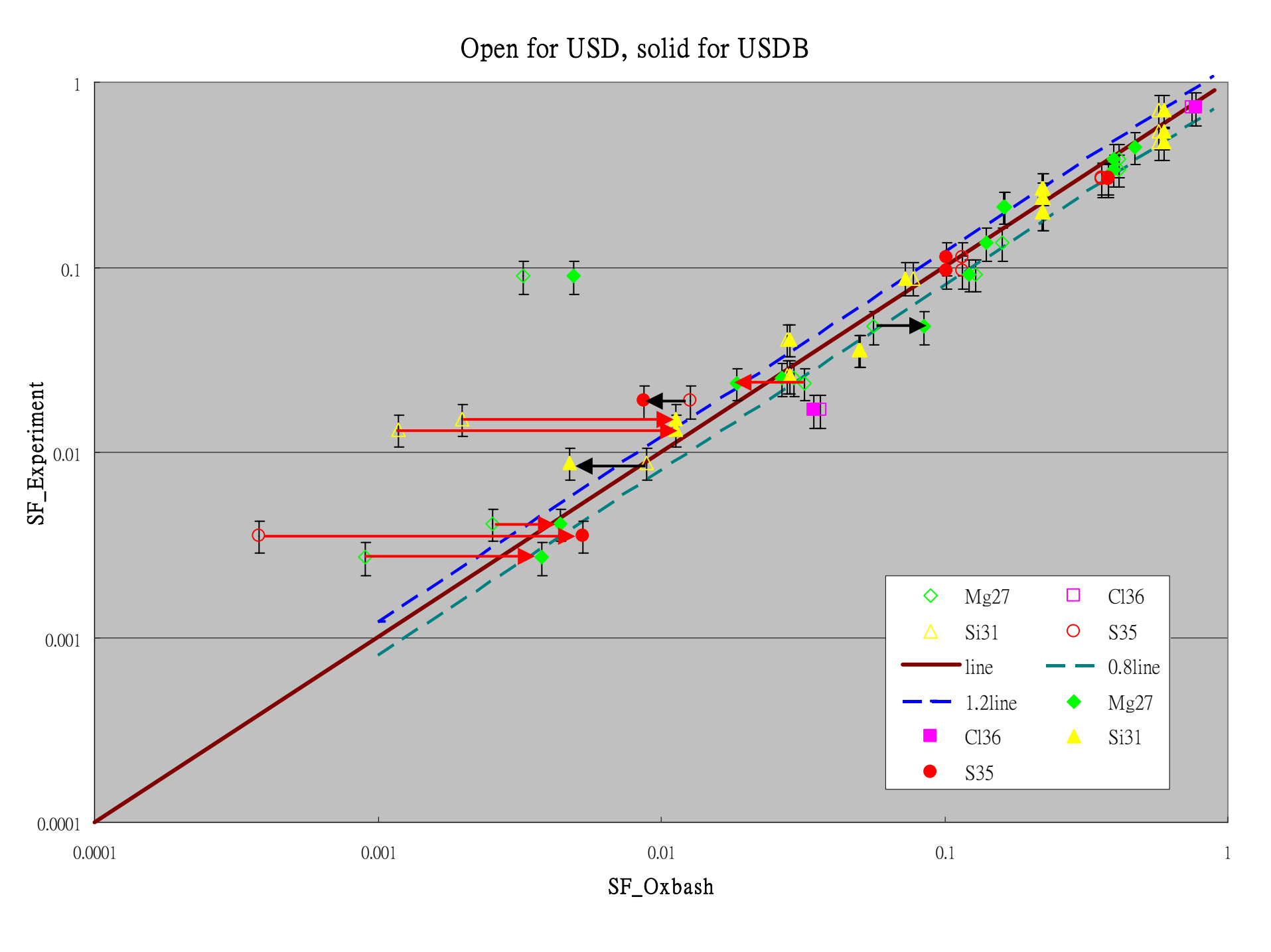
New results from USDA

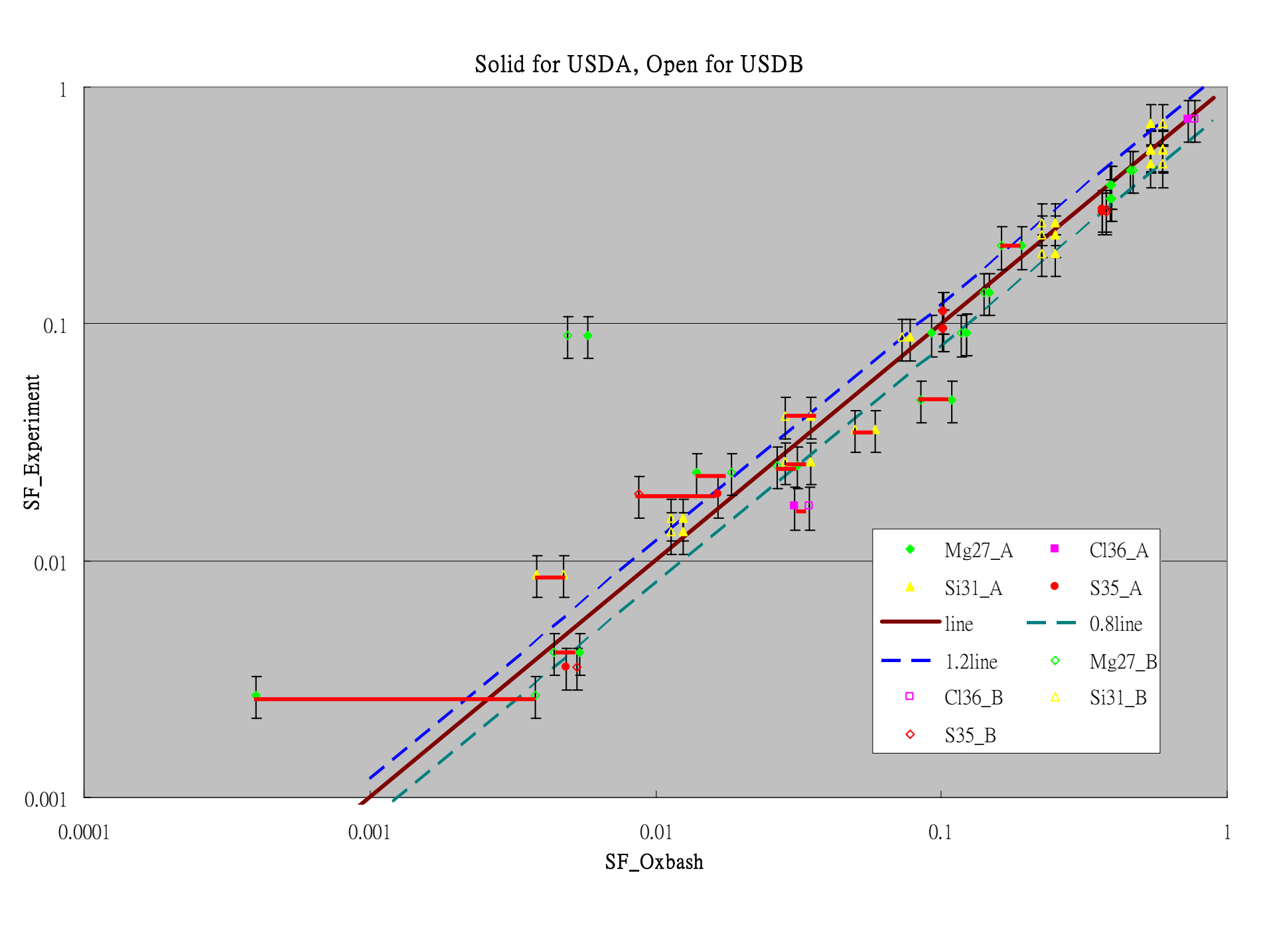


New results from USDB

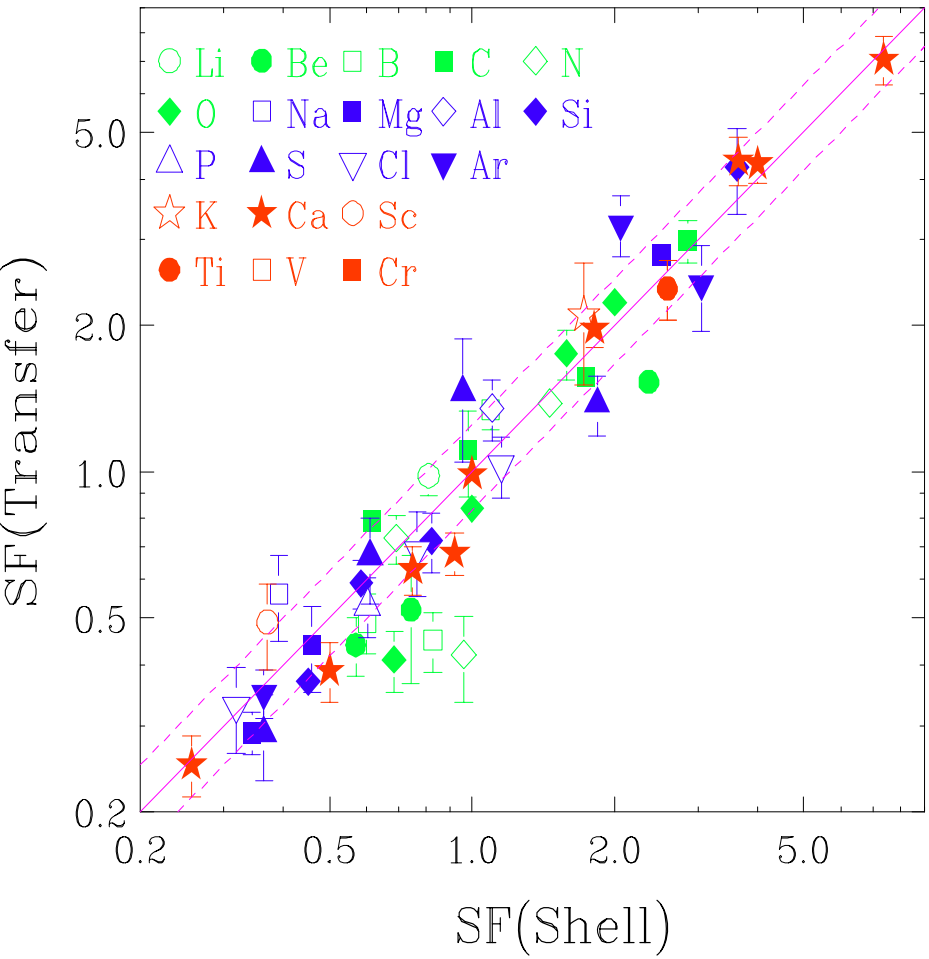


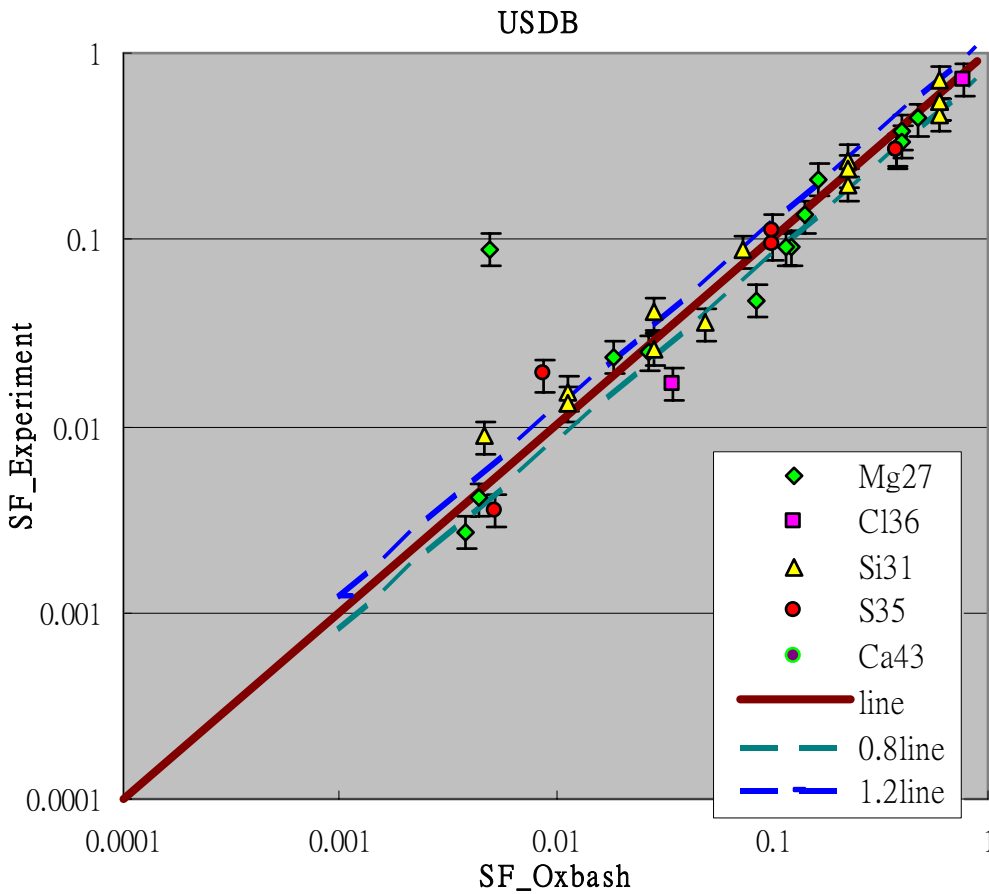

Open for USD, solid for USDA
SF_Experiment
SF_Oxbash
1
0.1
0.01
0.001
0.0001
0.0001
0.001
0.01
0.1
1
Mg27
Cl36
Si31
S35
line
0.8line
1.2line
Mg27
Cl36
Si31
S35


Open for USD, solid for USDB
SF_Experiment
SF_Oxbash
1
0.1
0.01
0.001
0.0001
0.0001
0.001
0.01
0.1
1
Mg27
Cl36
Si31
S35
line
0.8line
1.2line
Mg27
Cl36
Si31
S35


Solid for USDA, Open for USDB
1
0.1
0.01
0.001
SF_Experiment
0.0001
0.001
0.01
0.1
1
SF_Oxbash
Mg27_A
Cl36_A
Si31_A
S35_A
line
0.8line
1.2line
Mg27_B
Cl36_B
Si31_B
S35_B

What we have gotten more than before



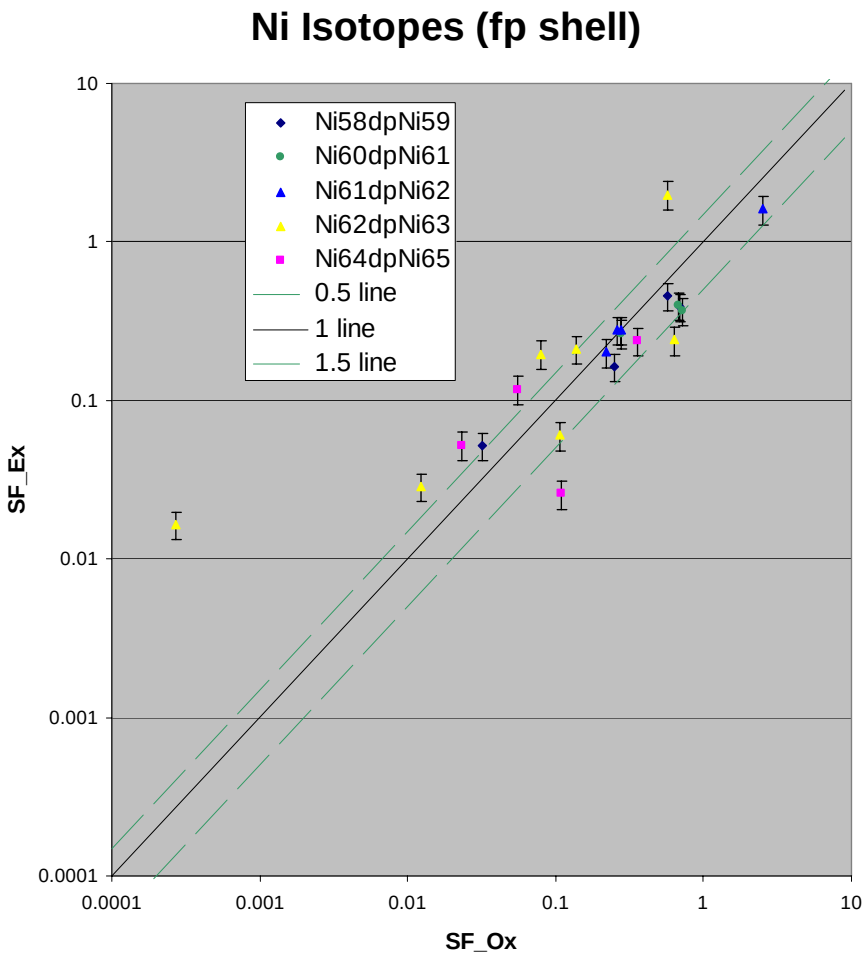


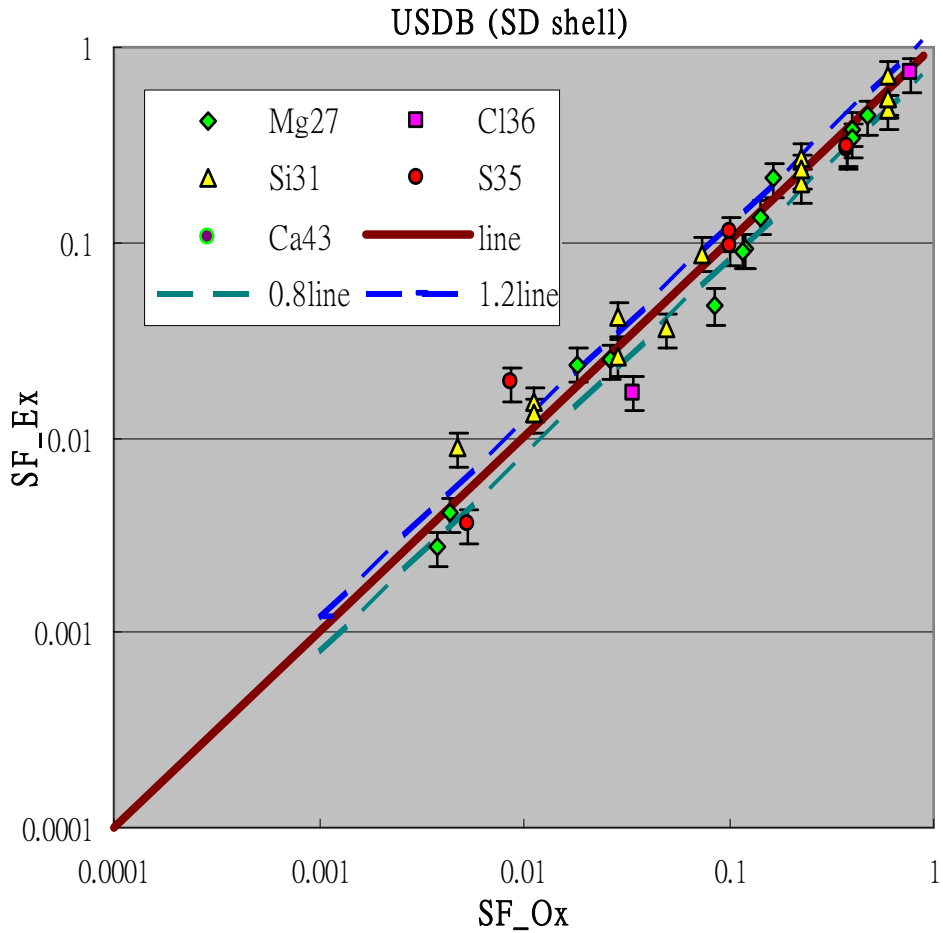
Excited states → extent to much smaller SFs !!

Extract j values

Reaction	E*_USD	E*_USDA	E*_USDB	E*_Ex	SF_USD	SF_USDA	SF_USDB	SF_Ex	J_pi	nlj
Mg26dpMg27	5.399	5.493	5.628	5.625	0.15901	0.14653	0.14099	0.135329	3/2+	1d5/2
Mg26dpMg27	5.454	5.683	5.696	5.625	0.00324	0.00577	0.00493	0.089739	5/2+	1d3/2

Other shell


Ni Isotopes (fp shell)
Ni58dpNi59
Ni60dpNi61
Ni61dpNi62
Ni62dpNi63
Ni64dpNi65
0.5 line
1 line
1.5 line
SF_Ex
SF_Ox
10
1
0.1
0.01
0.001
0.0001
0.0001
0.001
0.01
0.1
1
10


USDB (SD shell)
Mg27
Cl36
Si31
S35
Ca43
line
0.8line
1.2line
SF_Ex
SF_Ox
1
0.1
0.01
0.001
0.0001
0.0001
0.001
0.01
0.1
1

Summary

- By using a consistent analysis approach, we are able to extract spectroscopic factors of the excited states from different reactions and compare between them
- The extracted spectroscopic factors are sensitive to the different interactions used in shell model calculations
- With the newest interaction USDB, the comparisons between experimental and theoretical values is good within 20% uncertainty for SF as small as ~0.001 – the theoretical uncertainties are important in astrophysics network calculations
- Systematics also suggest that the j values could be extracted by comparing to shell model calculations that give good predictions of energy levels and spectroscopic factors

END

Thank you!