

Mass measurement of ^{19}C

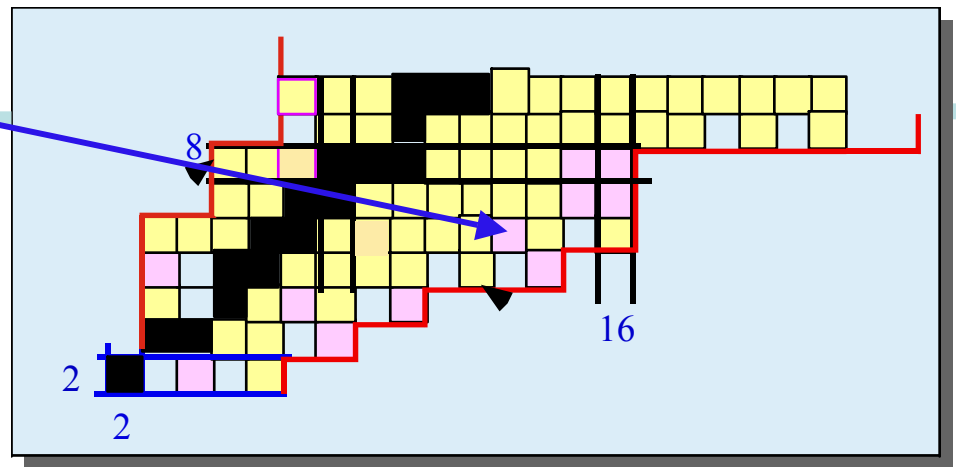
Rituparna Kanungo

TRIUMF

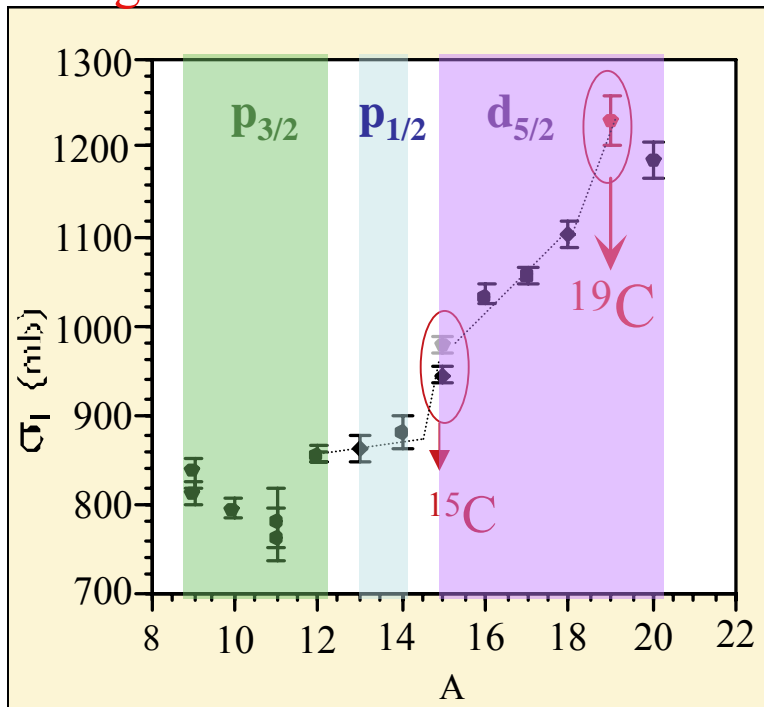
The interest in ^{19}C

$\tau = 49\text{ms}$

One-neutron halo ?



Large interaction cross section



- Large Coulomb dissociation cross section
- Moderately narrow momentum distribution

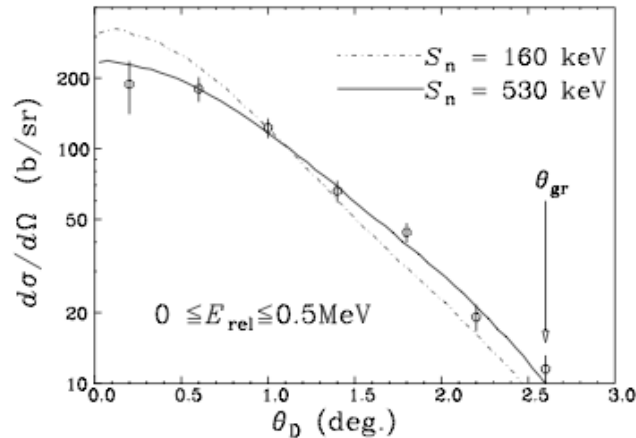
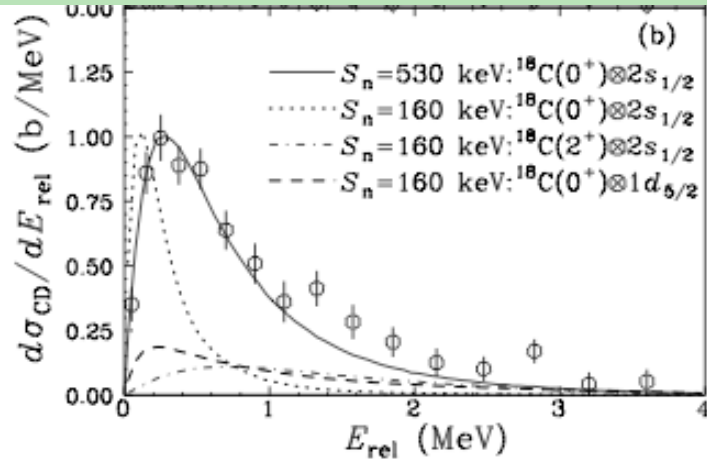
Uncertain facts about ^{19}C -1

One neutron separation energy : Mass of ^{19}C

40 keV - 1100keV !!

$S_n = 160 \pm 110$ keV (average of two mass measurements)

$S_n = 240 \pm 100$ keV (average of four mass measurements)

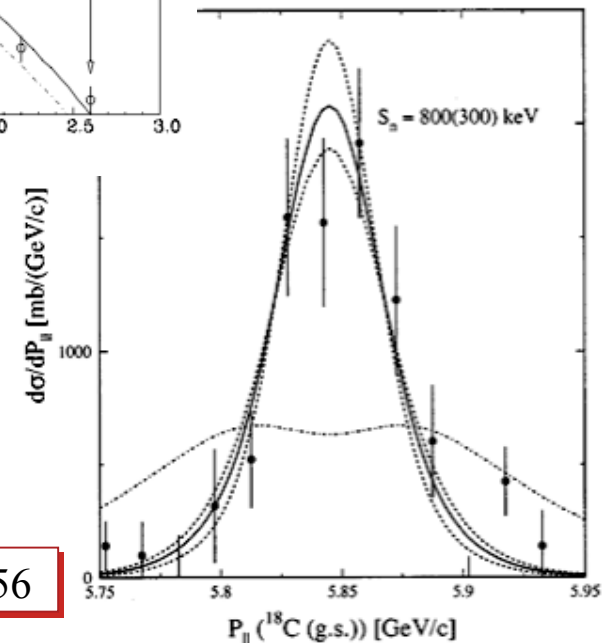


$S_n = 530 \pm 130$ keV (Coulomb dissociation)

S-wave = 0.67

$S_n = 800 \pm 300$ keV (Fragmentation @ MSU)

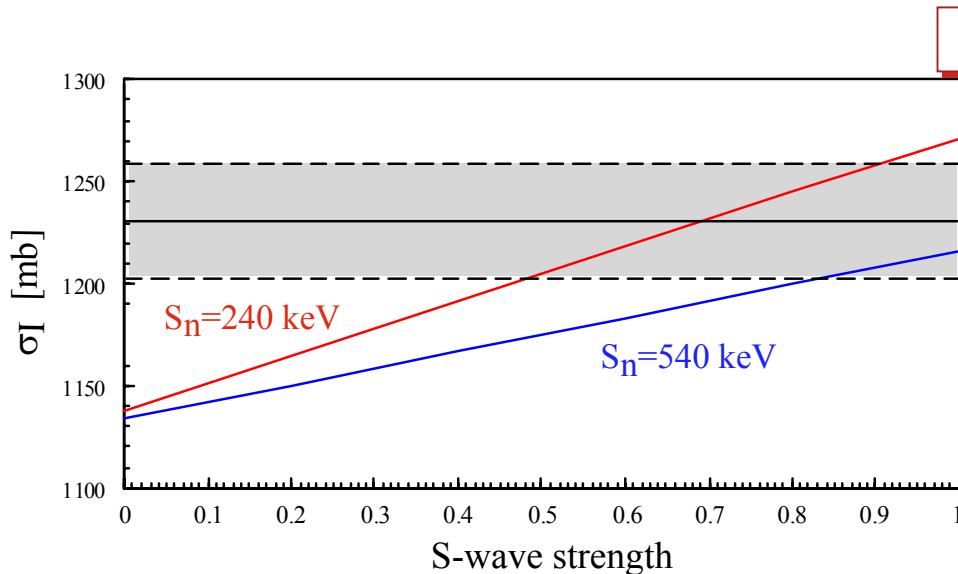
S-wave = 0.56



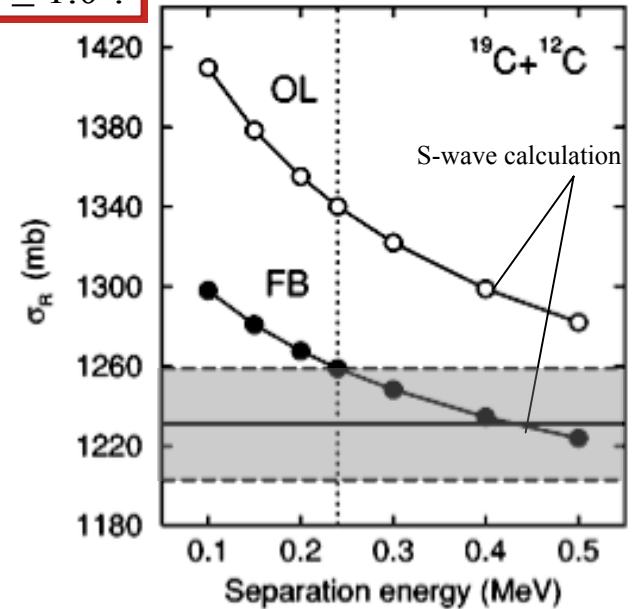
Uncertain facts about ^{19}C -2

Ground state spin

Abnormal spin = $1/2^+$ is suggested by reaction studies



R. Kanungo et al, NPA 677(2000)171

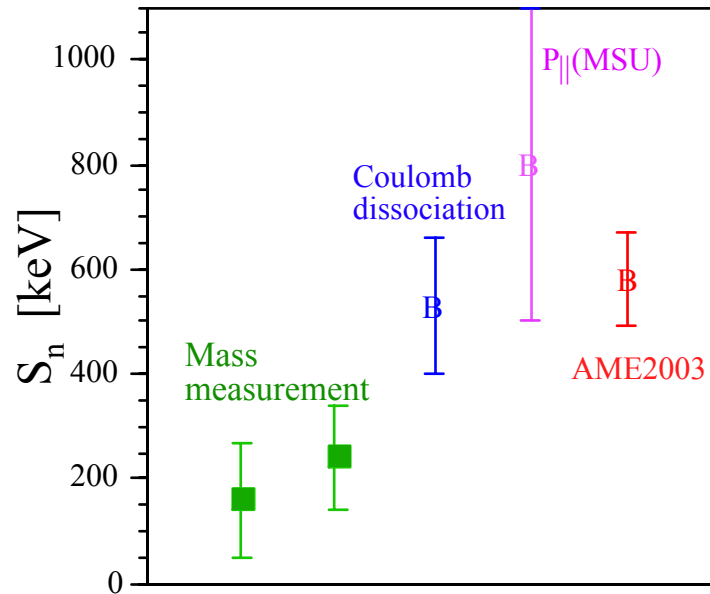


J.A.Tostevin and J.S.Al-Khalili PRC 59(1999)R5

Large uncertainty in the parentages of different components in the ground state of ^{19}C .

Other ground state spin $3/2^+$, $5/2^+$ cannot be ruled out without fixing S_n

Presently adopted value by AME'03 mass table : $S_n = 580 \pm 90$ keV



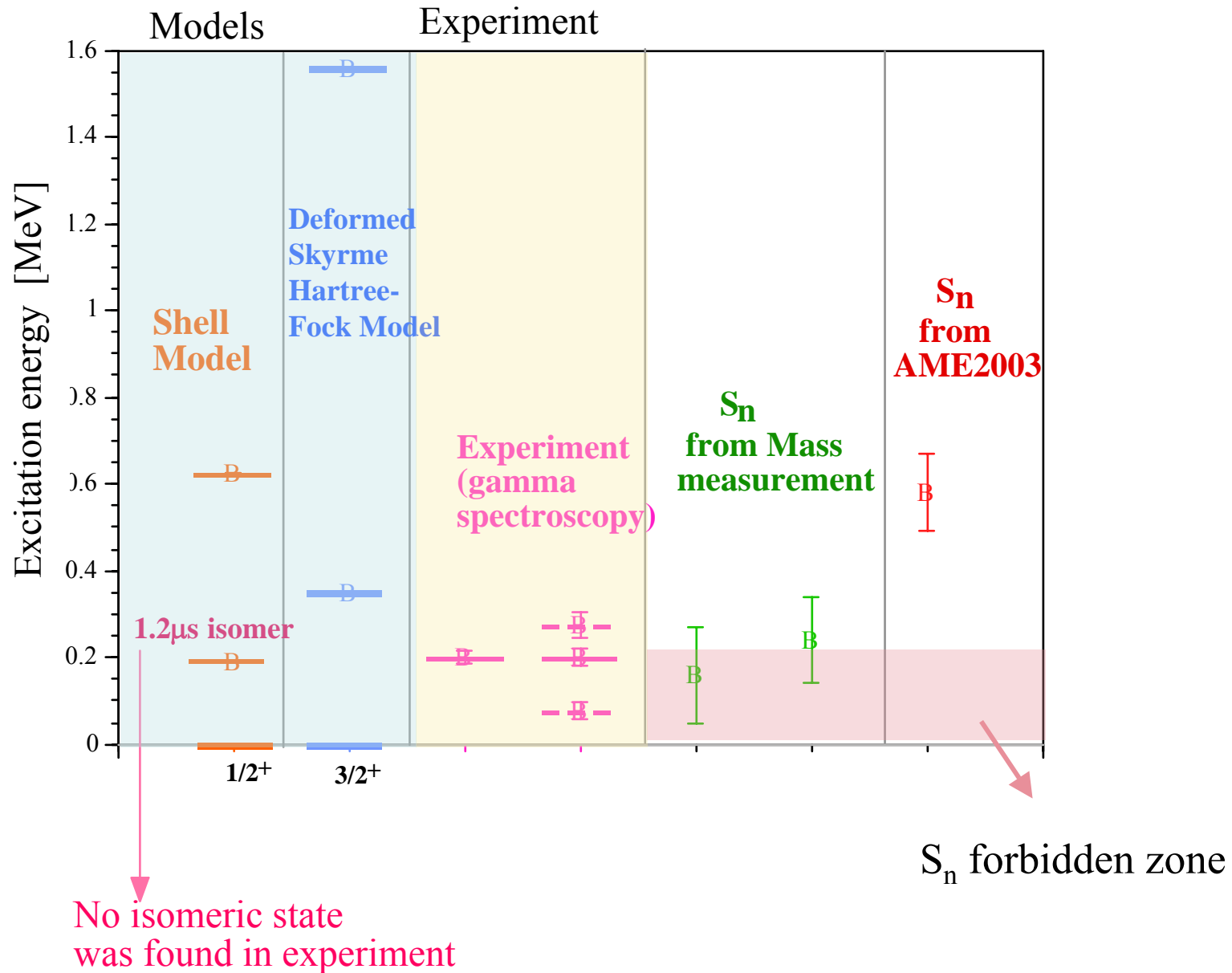
Higher than all weighted average of existing mass measurements

but, the S_n deduced from reactions have possibility of having admixture of ‘core’-excited configurations thereby reflecting “effective” S_n .

$$\Psi = \sum_i C_i \cdot \Phi_{core}^i \cdot \psi_{nucleon}^i$$

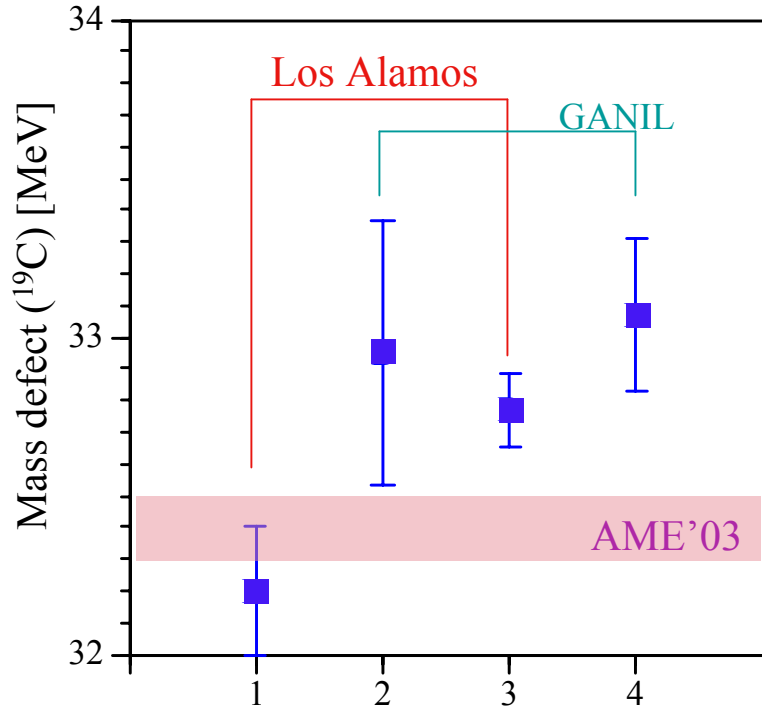
$$S_n^{eff} = \sum_i C_i \cdot (S_n + E_i^*)$$

Excited states in ^{19}C



Summary of existing mass measurements

Time-of-flight



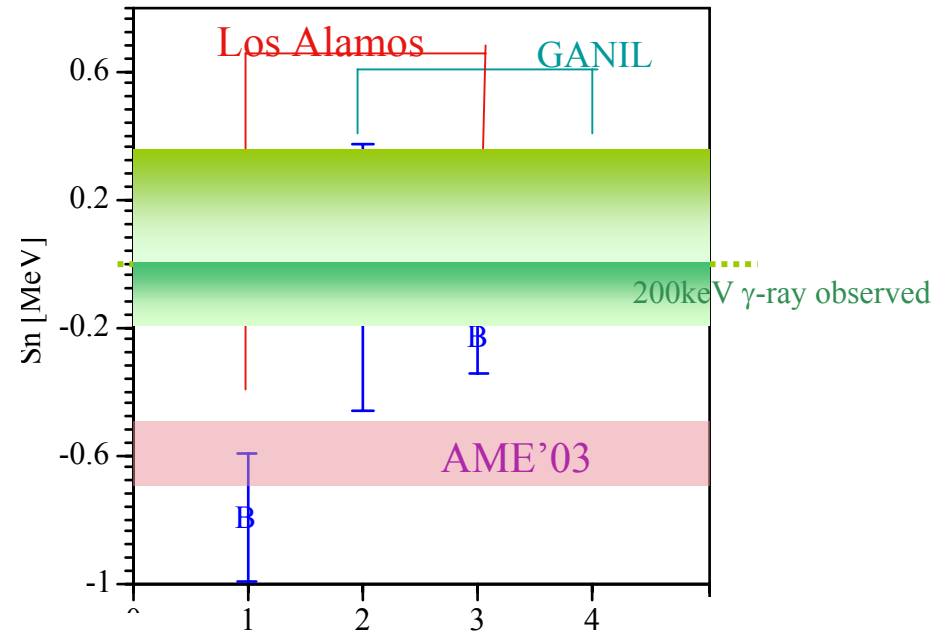
1986 1987 1988 1991

PRL57(1986)3253

ZPA 331 (1988) 229

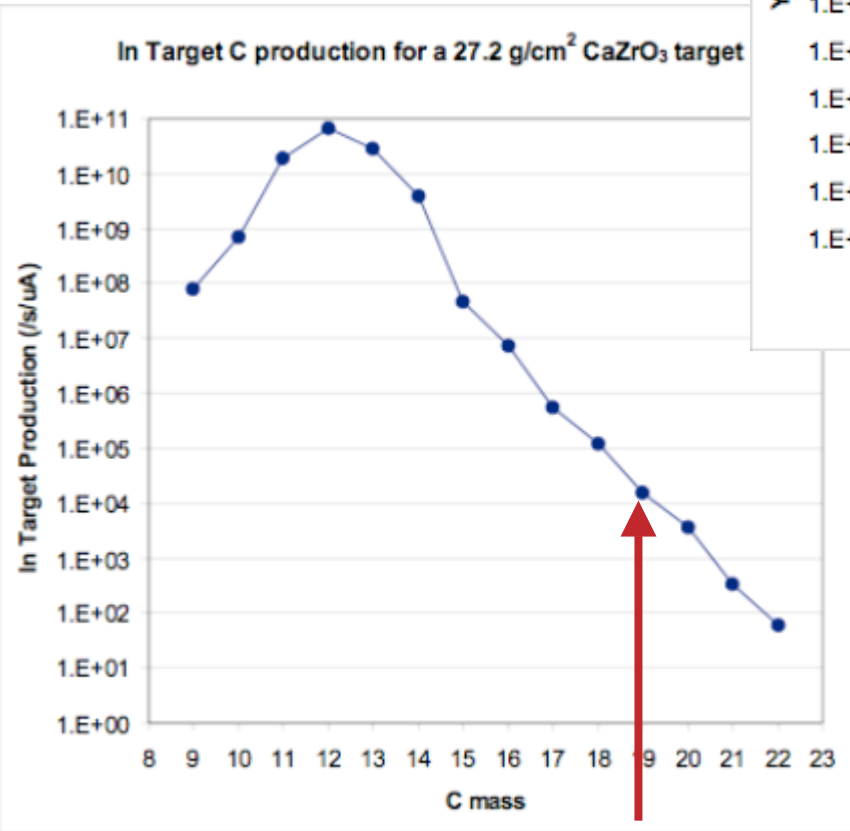
PLB 192 (1987) 39

PLB 258 (1991) 29

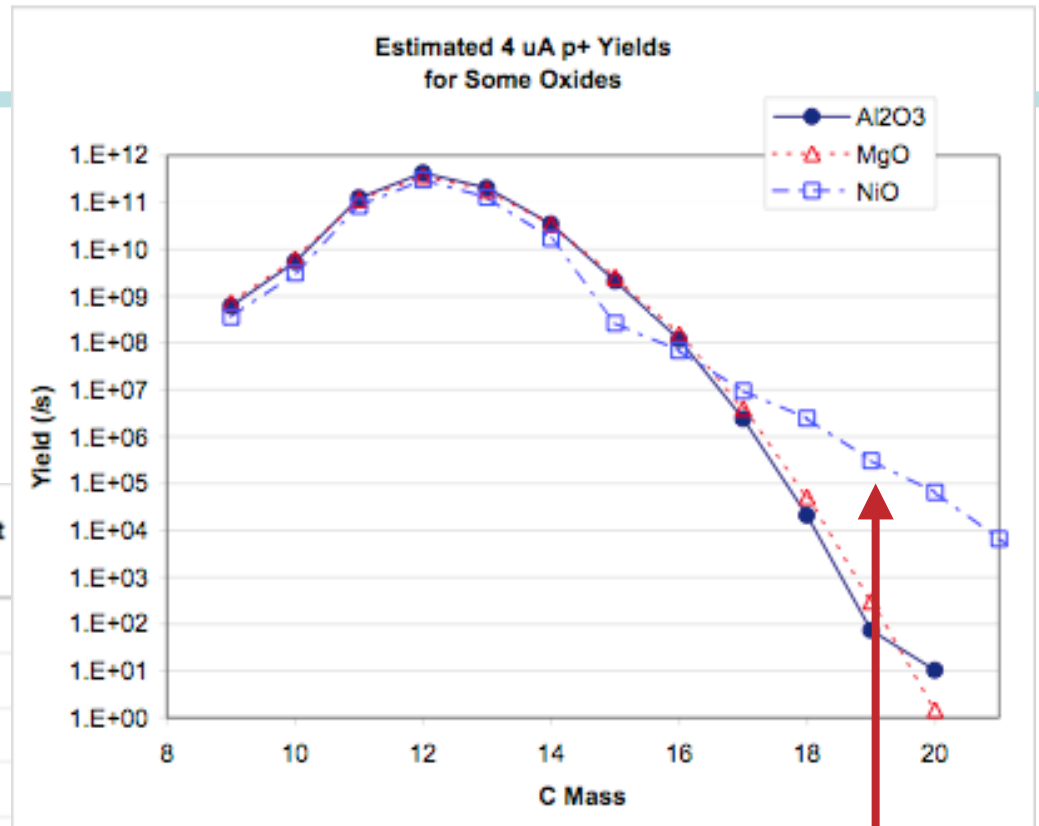


Need to measure mass defect of ^{19}C with precision ≤ 50 keV

^{19}C production yield



$^{19}\text{C} \sim 10^4/\text{sec}$



$^{19}\text{C} \sim 10^5/\text{sec}$

References of existing mass measurements

Mass of ^{19}C

- D.J. Vieira et al, PRL57(1986)3253 [TOF, Los Alamos] 32.30 ± 0.24 MeV
Sn= 0.694 ± 0.24
- A. Gillibert et al, PLB 192 (1987) 39 [TOF, GANIL] 32.95 ± 0.42 MeV
Sn= 0.044 ± 0.42
- J.M. Wouters et al, ZPA 331 (1988) 229 [TOF, Los Alamos] 32.77 ± 0.120 Sn
= 0.224 ± 0.120
- N.A.Orr et al, PLB 258 (1991) 29 [TOF, GANIL] 33.07 ± 0.24
Sn= $+0.076 \pm 0.24$

Mass of ^{18}C

- L.K.Fifield et al NPA 385(1982)505 [$^{48}\text{Ca}(^{18}\text{O},^{18}\text{C})$] 24.923 ± 0.03
Resolution = 200 keV.

32.40 ± 0.10 [AME'03]