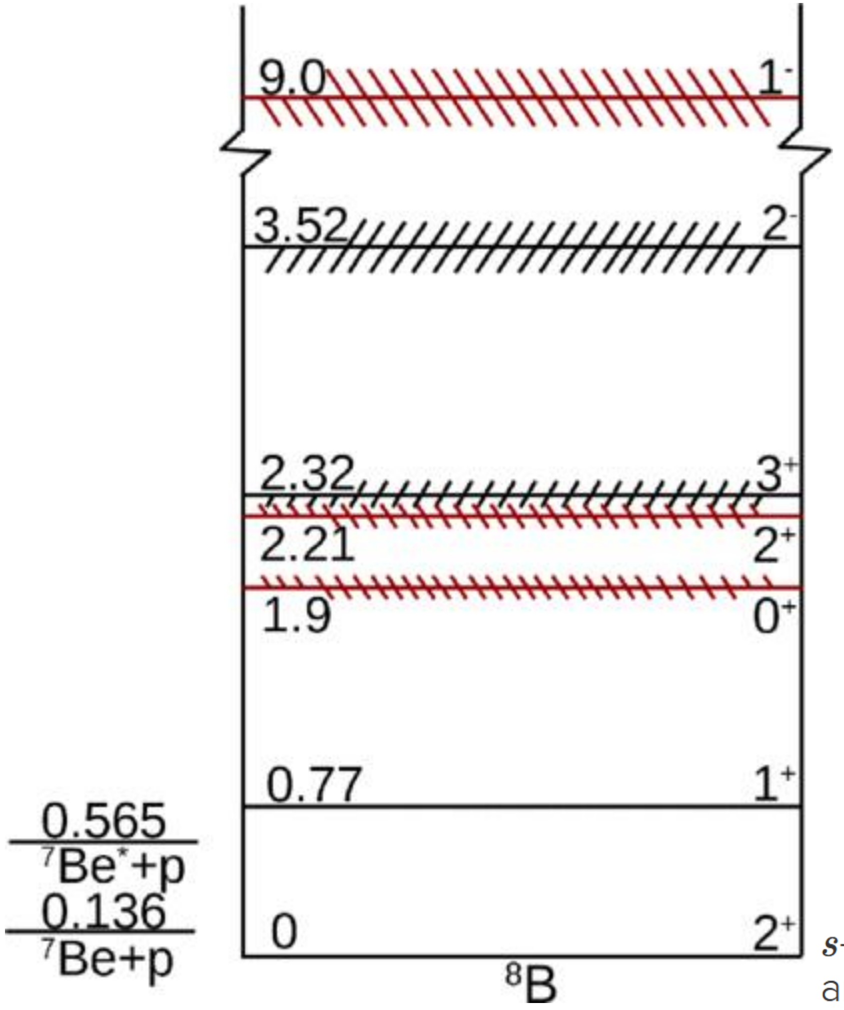
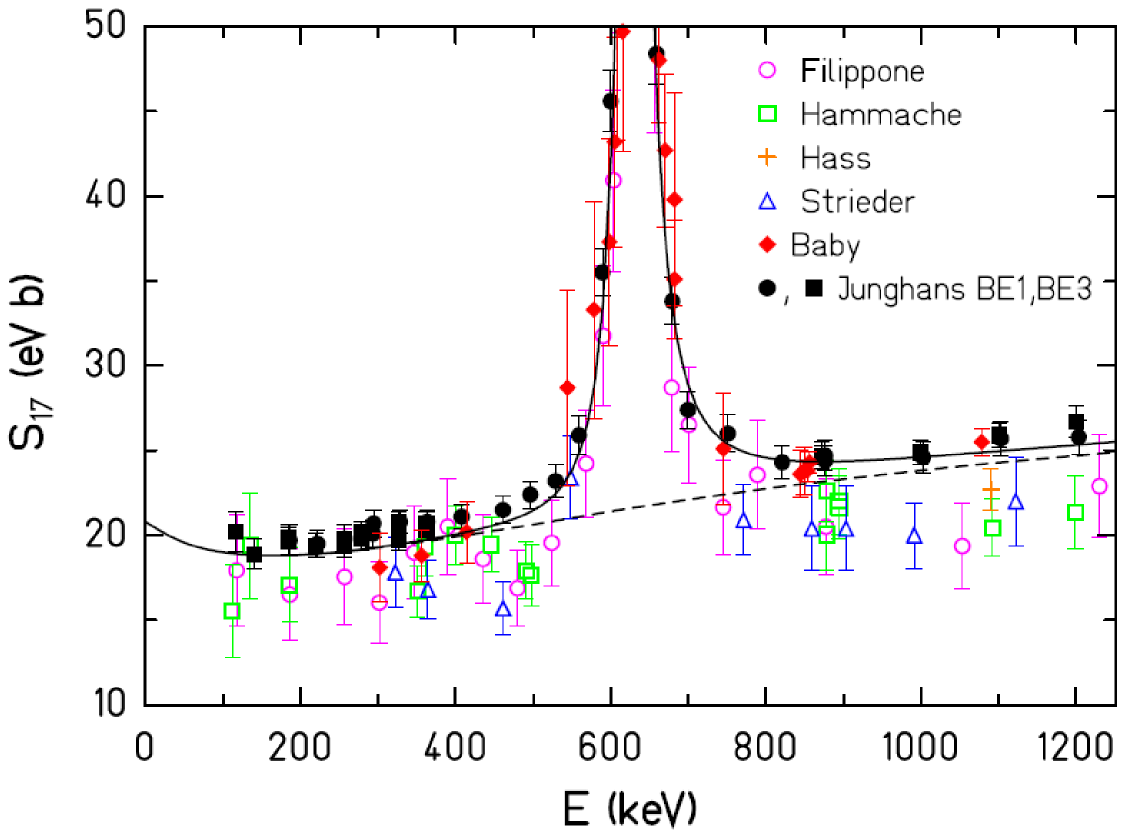
# WG5 - $S_{17}$ [$^7Be(p, \gamma)^8B$]




*s*-wave scattering lengths for the $^7\mathrm{Be} + p$ system from an $R$-matrix analysis

S. N. Paneru *et al.*
Phys. Rev. C **99**, 045807 – Published 30 April 2019

1.Theoretical models. In SF2 the RGM model of Descouvemont was used, although potential models and R-matrix provided a good description of the energy dependence of 7Be+p.
A question is whether fully microscopic calculations progressed and possibly provide a deeper insight into the reaction mechanism and the absolute scale of the cross section, that is an issue in the experimental data.

Contents lists available at SciVerse ScienceDirect
Physics Letters B
www.elsevier.com/locate/physletb

Ab initio many-body calculation of the $^7Be(p,\gamma)^8B$ radiative capture

Petr Navrátil [a,b,*], Robert Roth [c], Sofia Quaglioni [b]

PHYSICAL REVIEW C **89**, 051602(R) (2014)

**Combining *ab initio* calculations and low-energy effective field theory for halo nuclear systems: The case of $^7Be + p \to {}^8B + \gamma$**

Xilin Zhang, Kenneth M. Nollett, and D. R. Phillips

ELSEVIER Nuclear Physics A 983 (2019) 175–194
www.elsevier.com/locate/nuclphysa

New result for the $p^7Be \to {}^8B\gamma$ astrophysical $S$-factor from 10 keV to 5 MeV and reaction rate from 0.01 to 10 $T_9$

Dubovichenko S.B. [a,b,*], Burkova N.A. [b], Dzhazairov-Kakhramanov A.V. [a,*], Tkachenko A.S. [a,b]

PHYSICAL REVIEW C **98**, 034616 (2018)

**Models, measurements, and effective field theory: Proton capture on $^7Be$ at next-to-leading order**

Xilin Zhang,[1,2,*] Kenneth M. Nollett,[3,4,2,†] and D. R. Phillips[2,‡]

PHYSICAL REVIEW C **106**, 014605 (2022)

**Low-energy $^7Li(n,\gamma)^8Li$ and $^7Be(p,\gamma)^8B$ radiative capture reactions within the Skyrme Hartree-Fock approach**

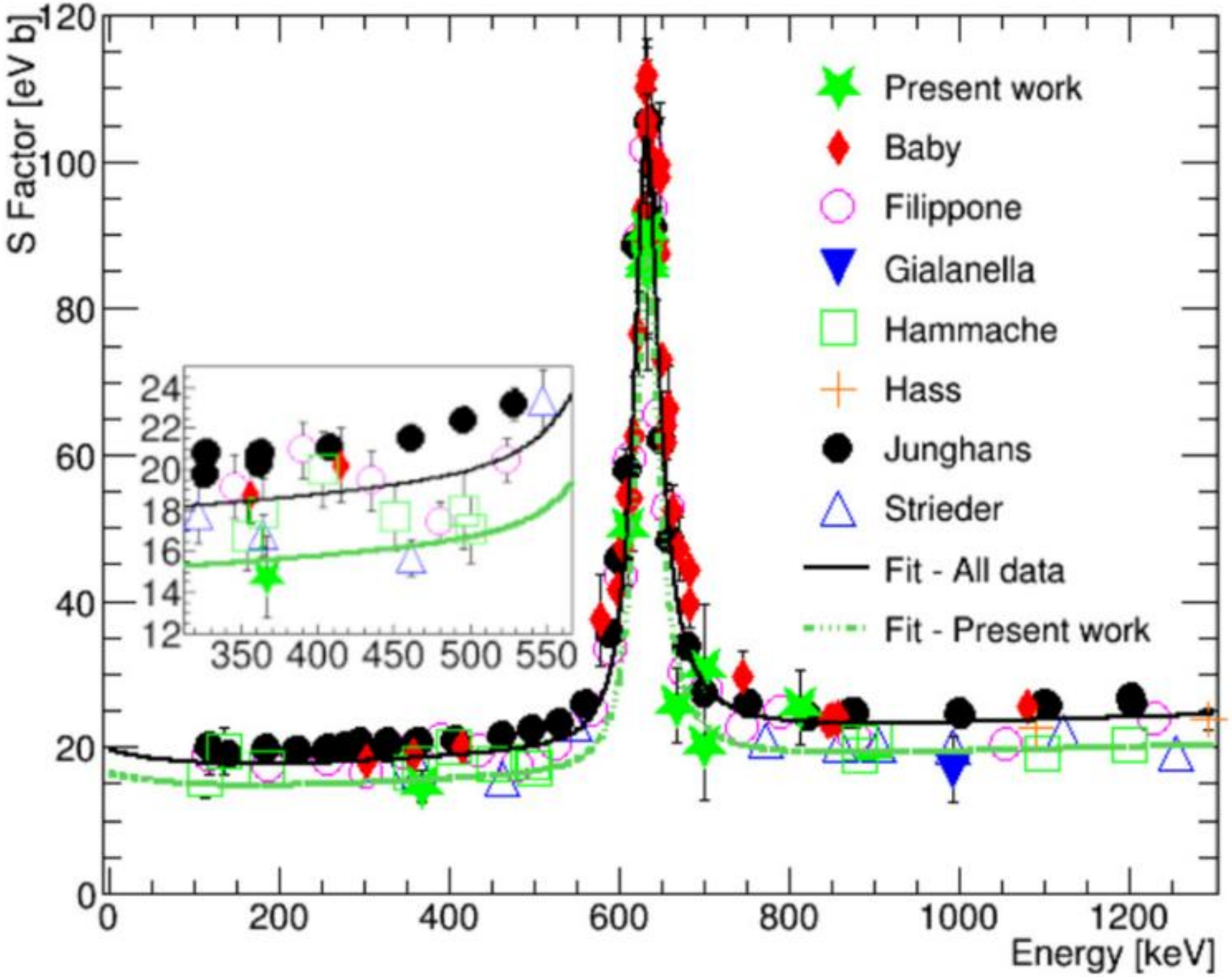
Nguyen Le Anh [*]

CAL REVIEW C **106**, 014601 (2022)

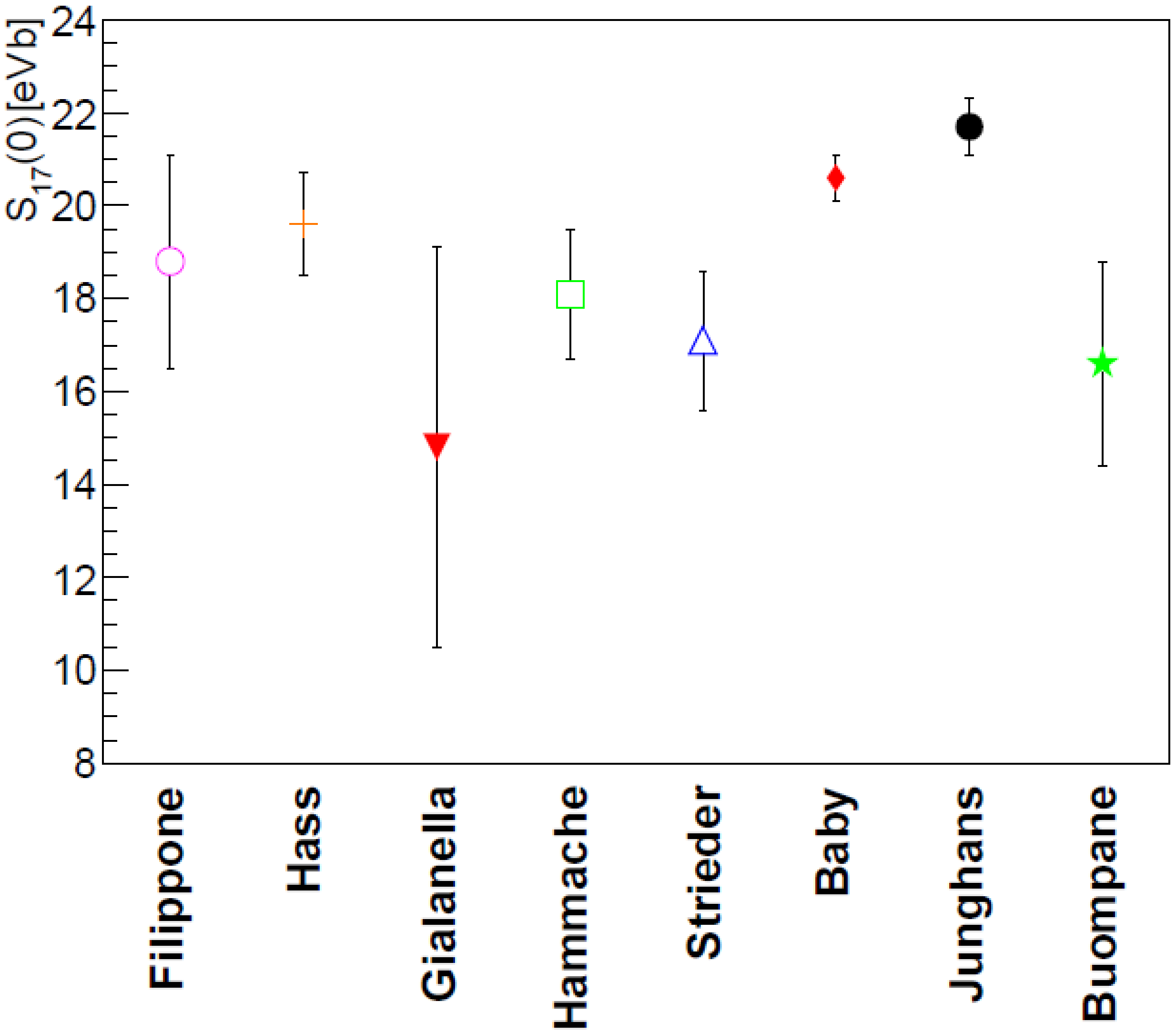
**Coupled-channels treatment of $^7Be(p,\gamma)^8B$ in effective field theory**

Renato Higa,[1,*] Pradeepa Premarathna,[2,†] and Gautam Rupak[2,‡]

Also, some data sets show some structure below the narrow resonance at E=632 keV. Is it an experimental, or statistical,  effect, or could it be significant from the theoretical point of view?

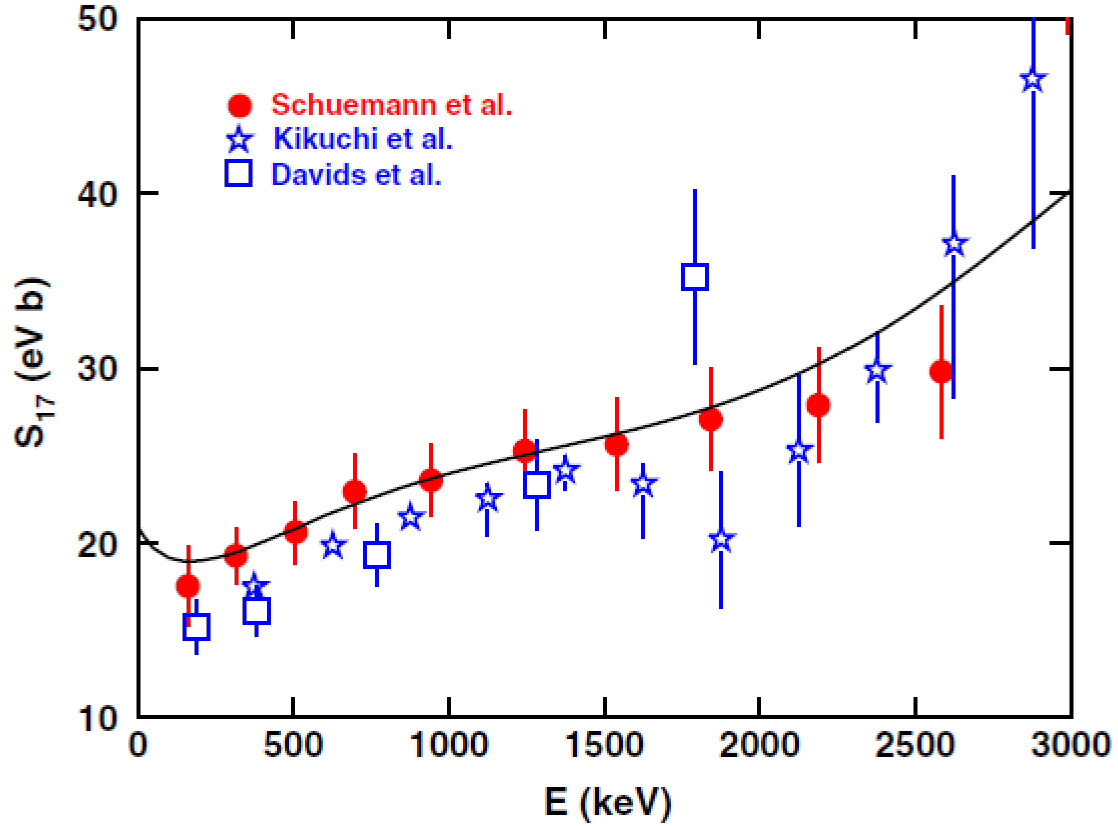


2. Direct measurements. The selection of experiments done at SF2 should be fine, unless new criteria are found more appropriate, e.g. because of a new analysis procedure. Not much work has been done since SF2, but of course it should be included in the evaluation. The absolute scale of the cross section remains the main issue.



1.Indirect measurements. The conclusion of SF2 was not to include Coulomb Dissociation in the determination of S17 experiments in the determination of S17: is that still the better choice?

SF2: Moreover, the good agreement between the shapes of the GSI CD and the radiative-capture data eliminates the concern about systematically different slopes of $S_{17}$ derived from the respective methods. However, we believe it would be premature to include the CD results in our determination of a recommended value for $S_{17}$, as a better understanding of the role of E2 transitions and higher-order effects in $_8$B breakup at various energies is needed.




Physics, Mechanics & Astronomy

• Article •

June 2015 Vol. 58 No. 6: 062001
doi: 10.1007/s11433-015-5653-z

**Determination of astrophysical $^7$Be(p, $\gamma$)$^8$B reaction rates from the $^7$Li(d, p)$^8$Li reaction†**

DU XianChao[1], GUO Bing[1*], LI ZhiHong[1], PANG DanYang[2,3], LI ErTao[4] & LIU WeiPing[1]

Statistical treatment of data. This is a critical issue, on which there will be necessarily a shared approach through the different WG’s, since the case of discrepancy among different data sets is quite frequent.

The IFM scales all experimental errors by the same fractional amount, resulting in equal internal and external errors on the mean.

As the method maintains the relative precision of discrepant data sets, it apportions a larger absolute fraction of the identified systematic error to the less precise data sets. This is consistent with naive expectations that a large, unidentified systematic error is more likely to "hide" within a low-precision data set than within a high-precision one, given the advantages a high-precision data set offers an experimentalist who does "due-diligence" cross checks to identify systematic errors.

| Data set | $\nu$ | $\chi^2$ | A | Eres(keV) | $\Gamma_p$(keV) | $\Gamma_\gamma$(meV) | $S_{17}(0)(eV \cdot b)$ |
|---|---|---|---|---|---|---|---|
| Filippone [14] | 21 | 22.6 | 0.762±0.015 | 631.6±0.6 | 38.1±1.5 | 25.9±0.9 | 18.80±0.37 |
| Hass [19] | 1 | 0.03 | 0.79±0.03 | [a] | [a] | [a] | 19.59±0.79 |
| Gialanella [4] | [b] | [b] | 0.60±0.16 | [a] | [a] | [a] | 14.8±4.0 |
| Hammache 1 [17] | 11 | 4.9 | 0.73±0.02 | [a] | [a] | [a] | 18.05±0.37 |
| Hammache 2 [18] | 2 | 0.85 | 0.77±0.07 | [a] | [a] | [a] | 19.05±1.6 |
| Strieder [20] | 9 | 13.1 | 0.69±0.02 | 630[c] | 35.7[c] | 25.2[c] | 17.05±0.36 |
| Baby [15,16] | 33 | 18.9 | 0.833±0.012 | 635.4±0.6 | 37.8±2.2 | 26.6±1.1 | 20.58±0.30 |
| Junghans BE1[21-23] | 25 | 21.3 | 0.872±0.006 | 629.8±0.3 | 35.3±0.9 | 25.7±0.4 | 21.52±0.15 |
| Junghans BE3[22-23] | 7 | 4.4 | 0.872±0.008 | [a] | [a] | [a] | 21.53± 0.21 |
| Junghans BE3S[22-23] | 9 | 8.1 | 0.881±0.005 | [a] | [a] | [a] | 21.93± 0.12 |
| Present work | 6 | 3.8 | 0.67±0.09 | 630[c] | 33±6 | 20±4 | 16.6± 2.1 |

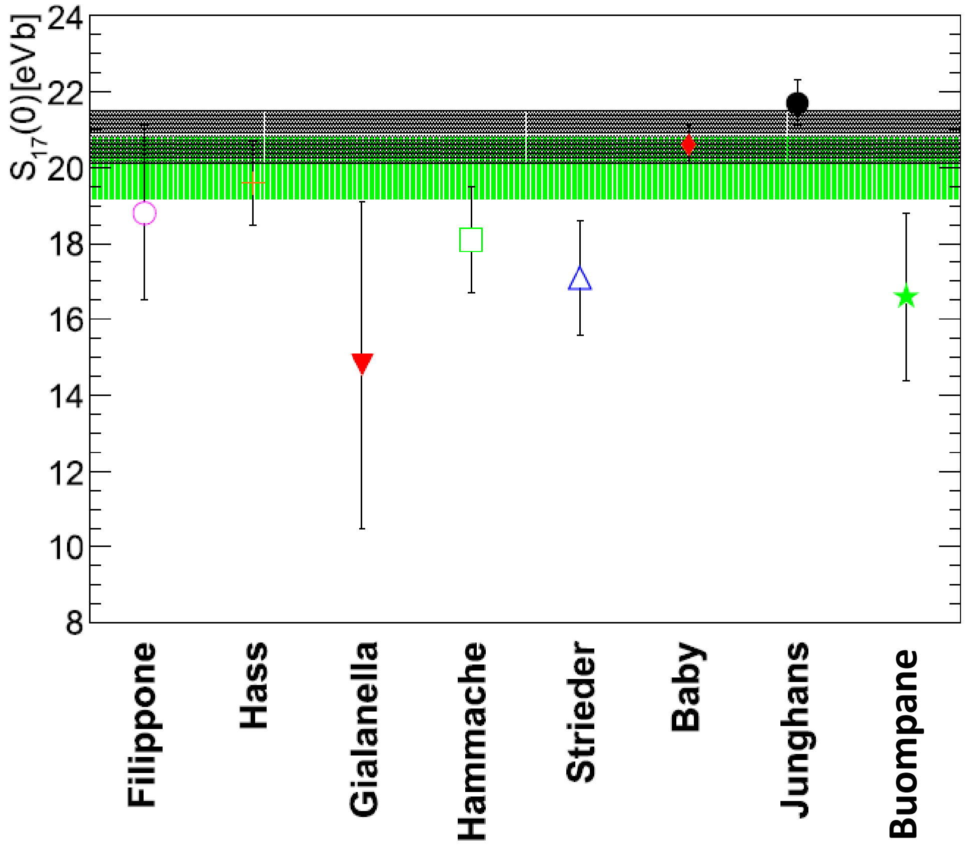
[a] No data on resonance. Fitted with scaled Sfactor(MN).

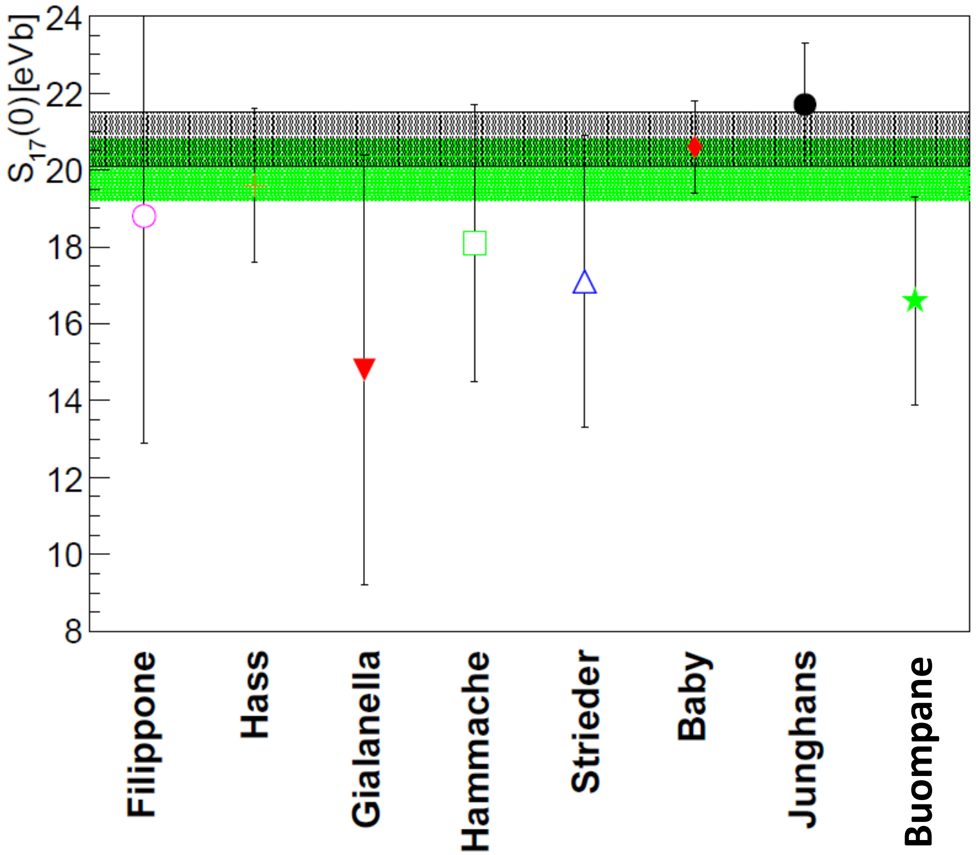
[b] One point on dataset.

[c] Fixed from [Tilley04].

| Data set | $\delta_{sys}(\%)$ |
|---|---|
| Filippone [14] | 11.9 |
| Hass [19] | 3.6 |
| Gialanella [4] | 10.0 |
| Hammache [17,18] | 7.5 |
| Strieder [20] | 8.3 |
| Baby [15,16] | 2.2 |
| Junghans [21-23] | 2.7 |
| Present work | 4.0 |

We scaled the systematic uncertainties alone until the internal and external errors get equal


S17(0)[eVb]
24
22
20
18
16
14
12
10
8
Filippone
Hass
Gialanella
Hammache
Strieder
Baby
Junghans
Buompane


S17(0)[eVb]
24
22
20
18
16
14
12
10
8
Filippone
Hass
Gialanella
Hammache
Strieder
Baby
Junghans
Buompane

Proposal:

1. Fit single data sets
2. If needed inflate the statistical errors of single data sets independently
3. Perform a global fit
4. If needed inflate systematic errors until internal and external errors on the mean are equal

If models are uncertain, then a Bayesian approach could be the best way to go. Similarly if different sources of data are available, e.g indirect measurements.