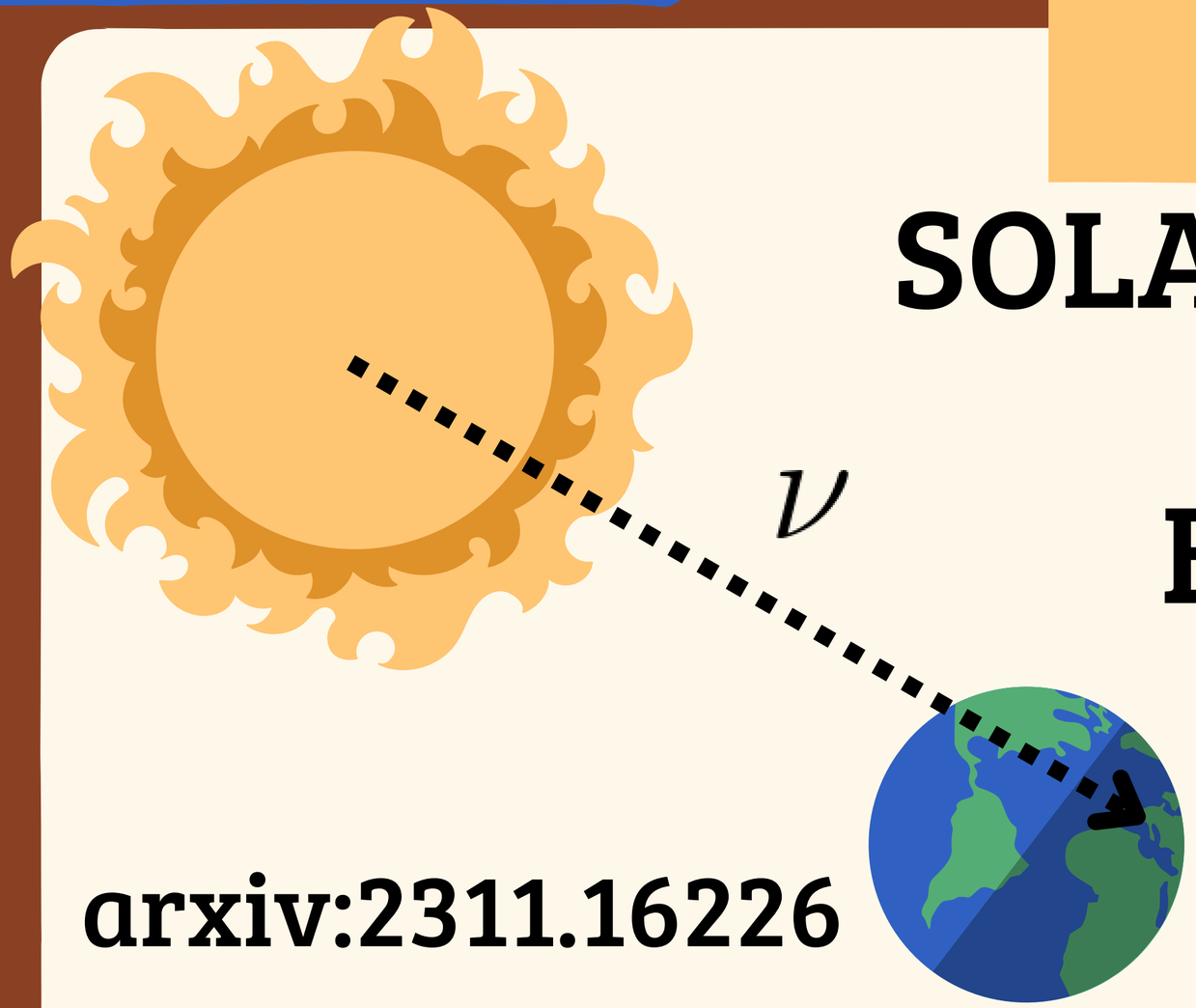
HIDDeν
Hunting Invisibles: Dark sectors, Dark matter and Neutrinos

MOST RECENT BOUNDS!

SOLAR NEUTRINOS AND BOREXINO



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arxiv:2311.16226

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EXPERIMENTS

Updated version of 1601.00972

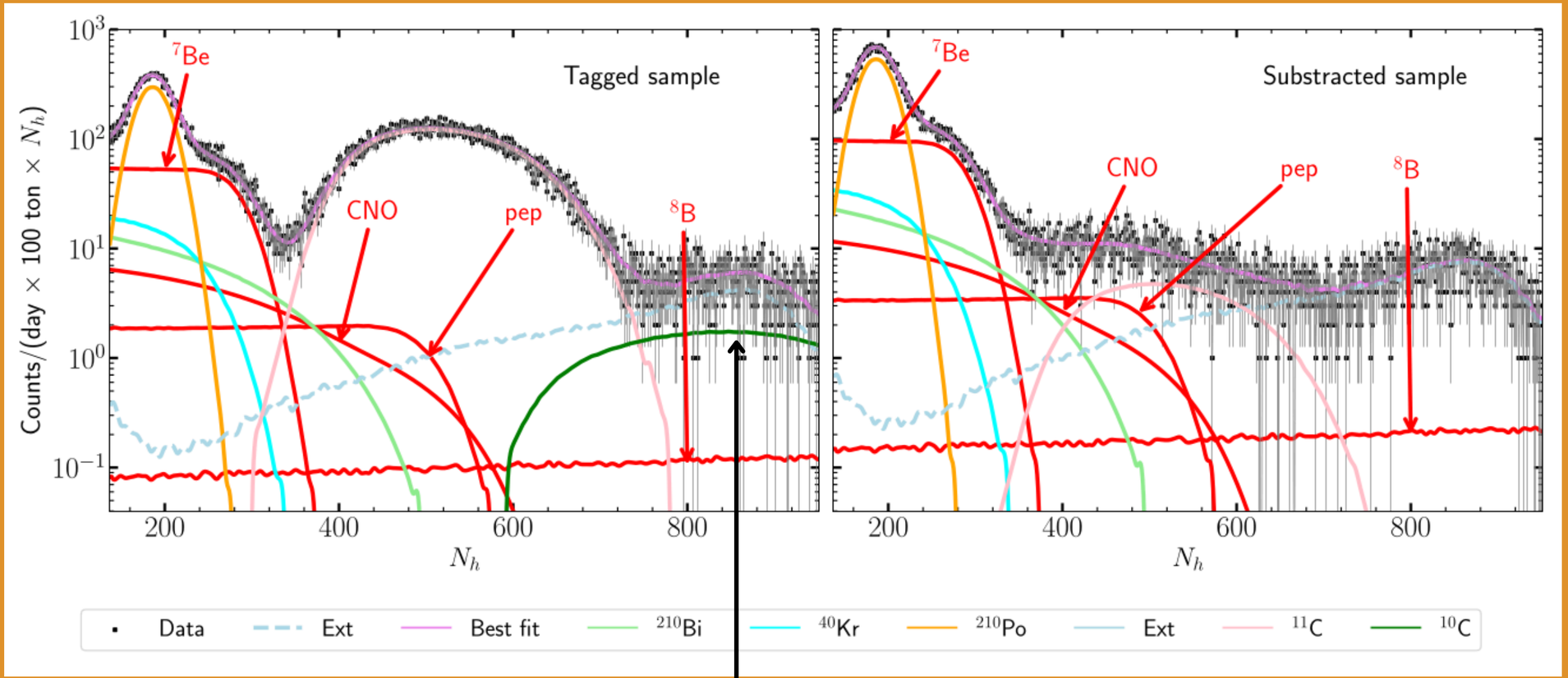
-Chlorine Gallex/GNO
-SAGE
-Super-Kamiokande(I-IV)
-SNO (I-III)
-Borexino (I, II and III)

Developed in 2204.03011

Developed in this paper

Novelties of this paper:

Fit of Borexino phase III - signal and background with free oscillation solar parameters: Δm^2_{12},$\sin^2\theta_{12}$



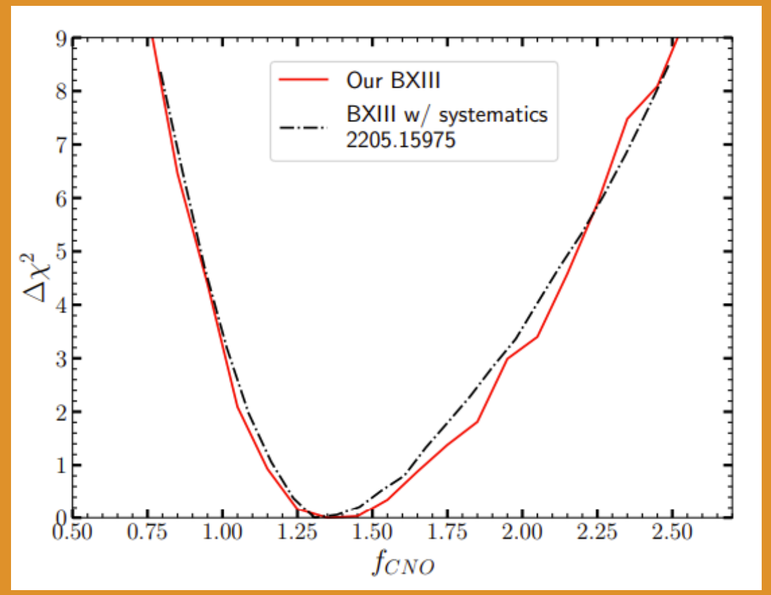
Our reproduction of Borexino phase III

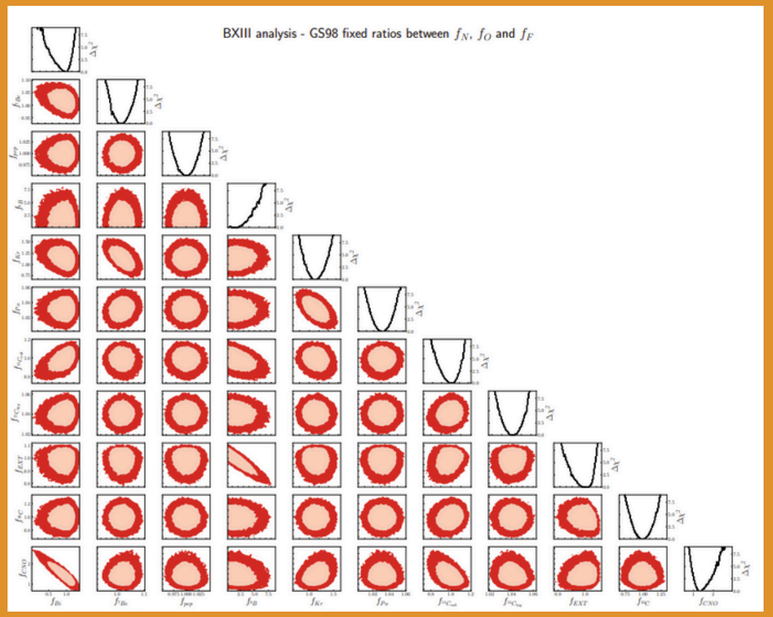
CNO determination: 2307.14636

What I did in this paper?

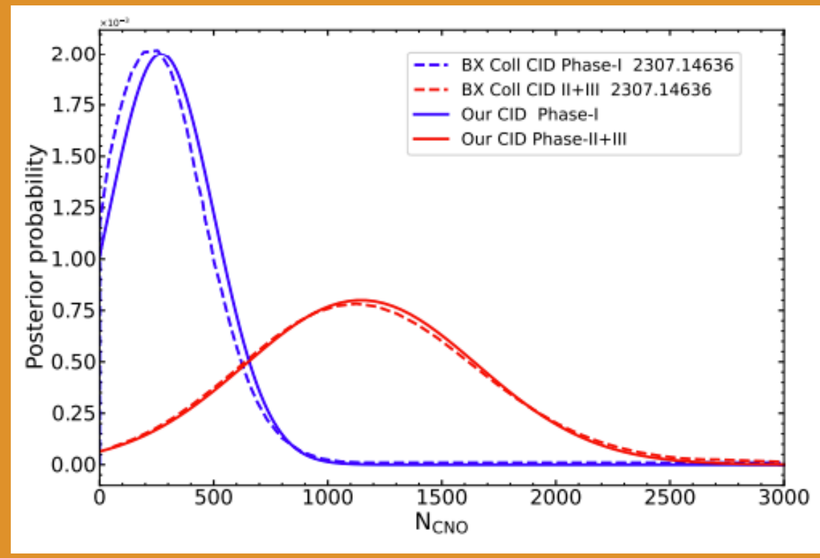
-I reproduced the results from 2205.15975

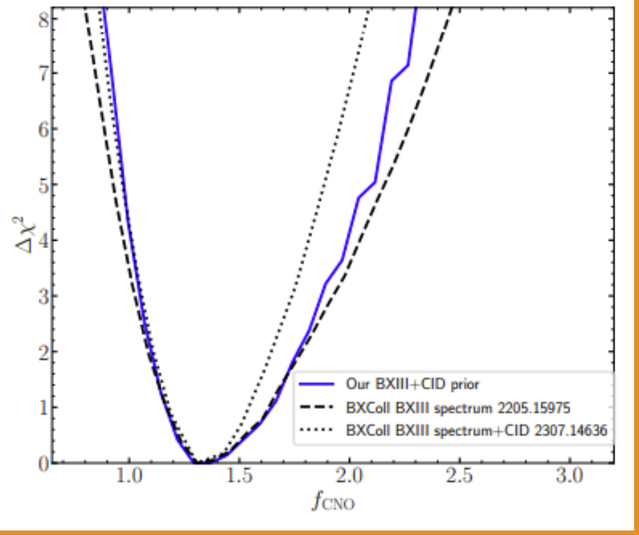
- I analysed the signal and background as free parameters





I reproduced the CID analysis of the Borexino Collaboration 2307.14636





MAIN RESULTS

With Luminosity Constraint*

$$\Delta m^2_{21} = 7.43^{+0.30}_{-0.30}\,[^{+0.44}_{-0.49}] \qquad \sin^2\theta_{12} = 0.300^{+0.020}_{-0.017}\,[^{+0.031}_{-0.027}]$$

$$\frac{L_{\text{pp-chain}}}{L_\odot} = 0.9919^{+0.0035}_{-0.0030}\,[^{+0.0082}_{-0.0077}] \iff \frac{L_{\text{CNO}}}{L_\odot} = 0.0079^{+0.0009}_{-0.0011}\,[^{+0.0028}_{-0.0026}]$$

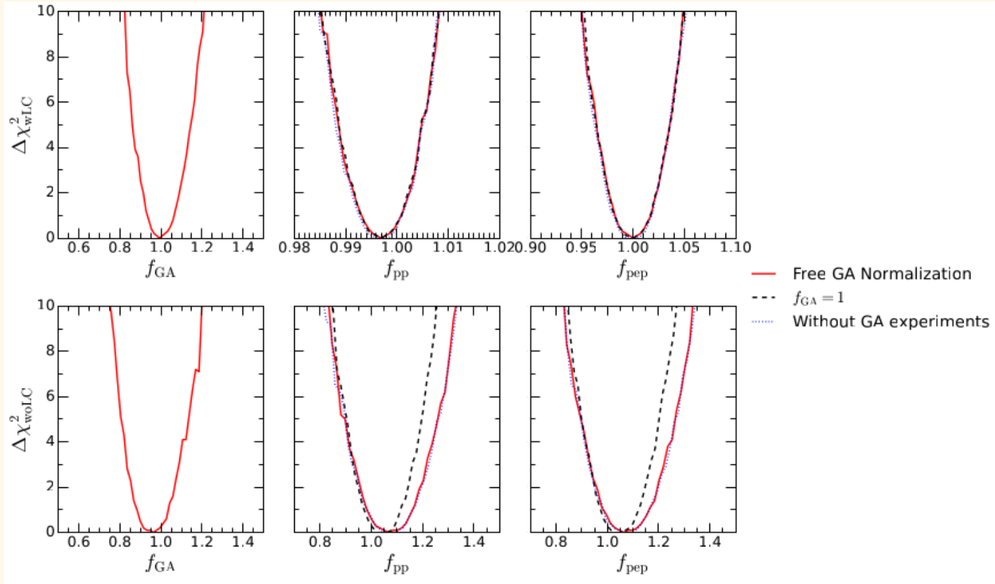
Without Luminosity Constraint

$$\frac{L_{\text{pp-chain}}}{L_\odot} = 1.030^{+0.070}_{-0.061}\,[^{+0.17}_{-0.15}] \quad \text{and} \quad \frac{L_{\text{CNO}}}{L_\odot} = 0.0075^{+0.0013}_{-0.0013}\,[^{+0.0030}_{-0.0029}]$$

$$\frac{L_\odot(\text{neutrino-inferred})}{L_\odot} = 1.038^{+0.069}_{-0.060}\,[^{+0.17}_{-0.15}]$$

*Overall sum of the thermal energy generated together with each solar neutrino flux coincides with the solar luminosity

Do not support a modification of the neutrino capture cross section in Gallium!



UPDATED SOLAR MODELS:

HIGH METALICITY:

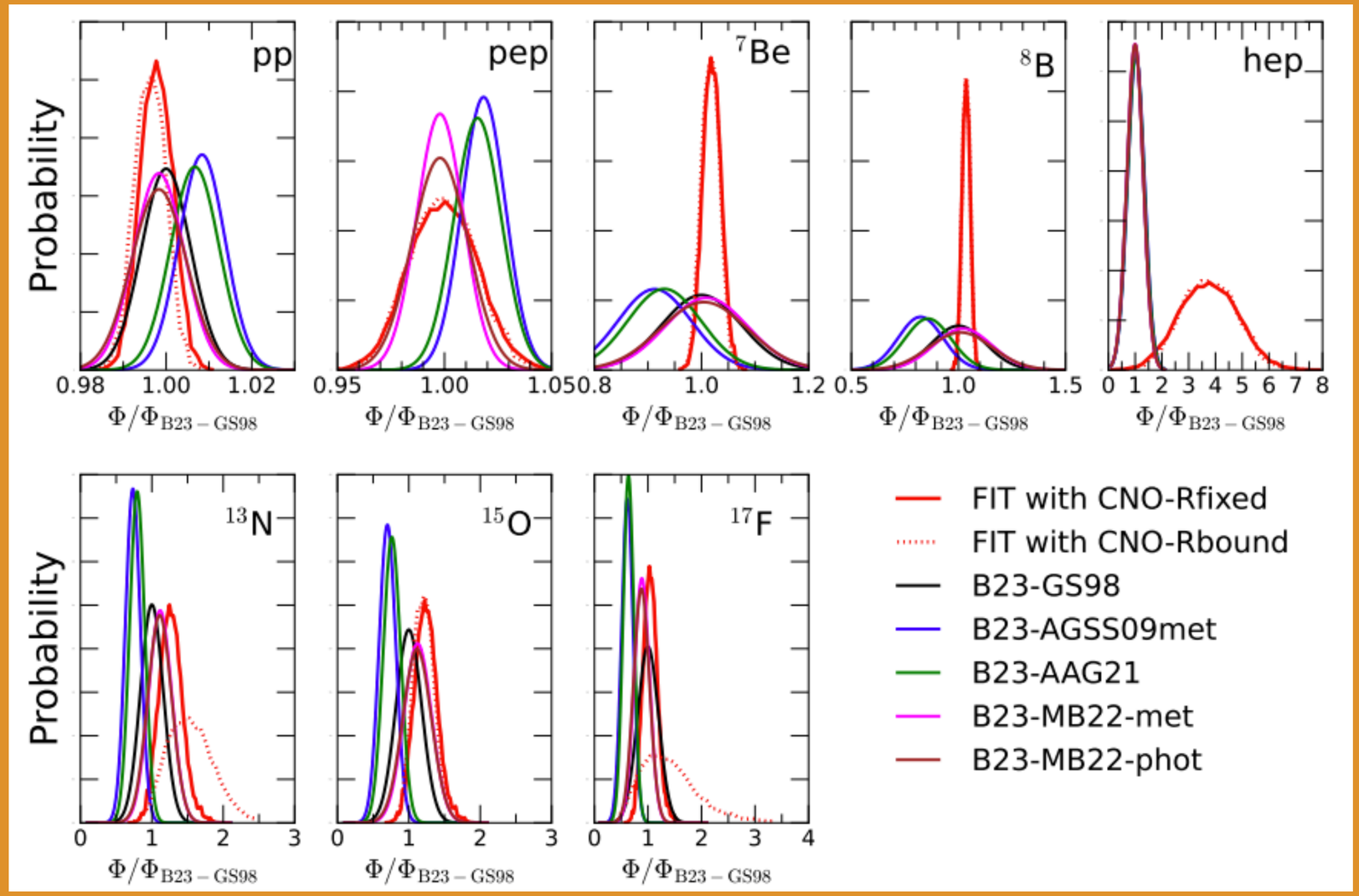
MB22-photon
MB22-met
GS98

LOW METALICITY:

AGSS09-met
AAG21

Marginalized one-dimensional probability distributions

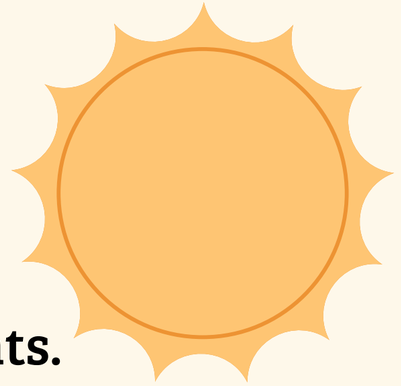
Data preference for HZ models!



Results of the PG test for the different models and data samples considered.

FIT	B23-SSM	FULL			Be+B+CNO			CNO		
CNO-Rfixed		n=6			n=3			n=1		
		$\Delta\chi^2$	p_{GF}	CL [σ]	$\Delta\chi^2$	p_{GF}	CL [σ]	$\Delta\chi^2$	p_{GF}	CL [σ]
	AGSS09-met	14.5	0.024	2.3	9.8	0.020	2.3	7.2	0.0073	2.7
	GS98	8.1	0.24	1.2	3.0	0.39	0.86	2.4	0.12	1.5
	AAG21	12.5	0.052	1.9	7.8	0.05	2.0	6.2	0.013	2.5
	MB22-met/phot	7.1	0.31	1.0	2.2	0.53	0.62	2.0	0.16	1.4
CNO-Rbound		n=8			n=5			n=3		
		$\Delta\chi^2$	p_{GF}	CL [σ]	$\Delta\chi^2$	p_{GF}	CL [σ]	$\Delta\chi^2$	p_{GF}	CL [σ]
	AGSS09-met	14.1	0.079	1.8	9.3	0.098	1.7	7.2	0.066	1.8
	GS98	6.7	0.57	0.57	1.7	0.88	0.14	1.6	0.66	0.44
	AAG21	11.7	0.16	1.4	6.8	0.24	1.2	5.7	0.13	1.5
	MB22-met/phot	5.9	0.66	0.44	1.1	0.95	0.06	1.0	0.80	0.25

SUMMARY:



1. Overview of Solar Neutrino Flux Determination:
   - Update on determination using data from all three phases of the Borexino experiments.

2. Evidence from Borexino Experiments:
   - Introduction of the first direct evidence of neutrinos produced in the CNO cycle.

3. Improvements in Neutrino Flux Measurement:
   - Significant improvement in Be7 flux measurement by a factor of approximately 3.

4. Confirmation of CNO-cycle Neutrinos:
   - Clear determination that the three fluxes produced in the CNO cycle are non-zero.

5. Impact on Solar Standard Models (SSMs):
   - Observation of CNO neutrinos helps discriminate among SSMs with varying solar abundance inputs.

6. Compatibility of SSMs with Observations:
   - Analysis showing SSMs with lower metallicities are less compatible with observed solar neutrino data.

Thanks!

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