CONSTRAINING ASYMMETRIC DARK MATTER WITH ASTEROSEISMOLOGY

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(Albert-Einstein-Institut)

Unterstützt von / Supported by
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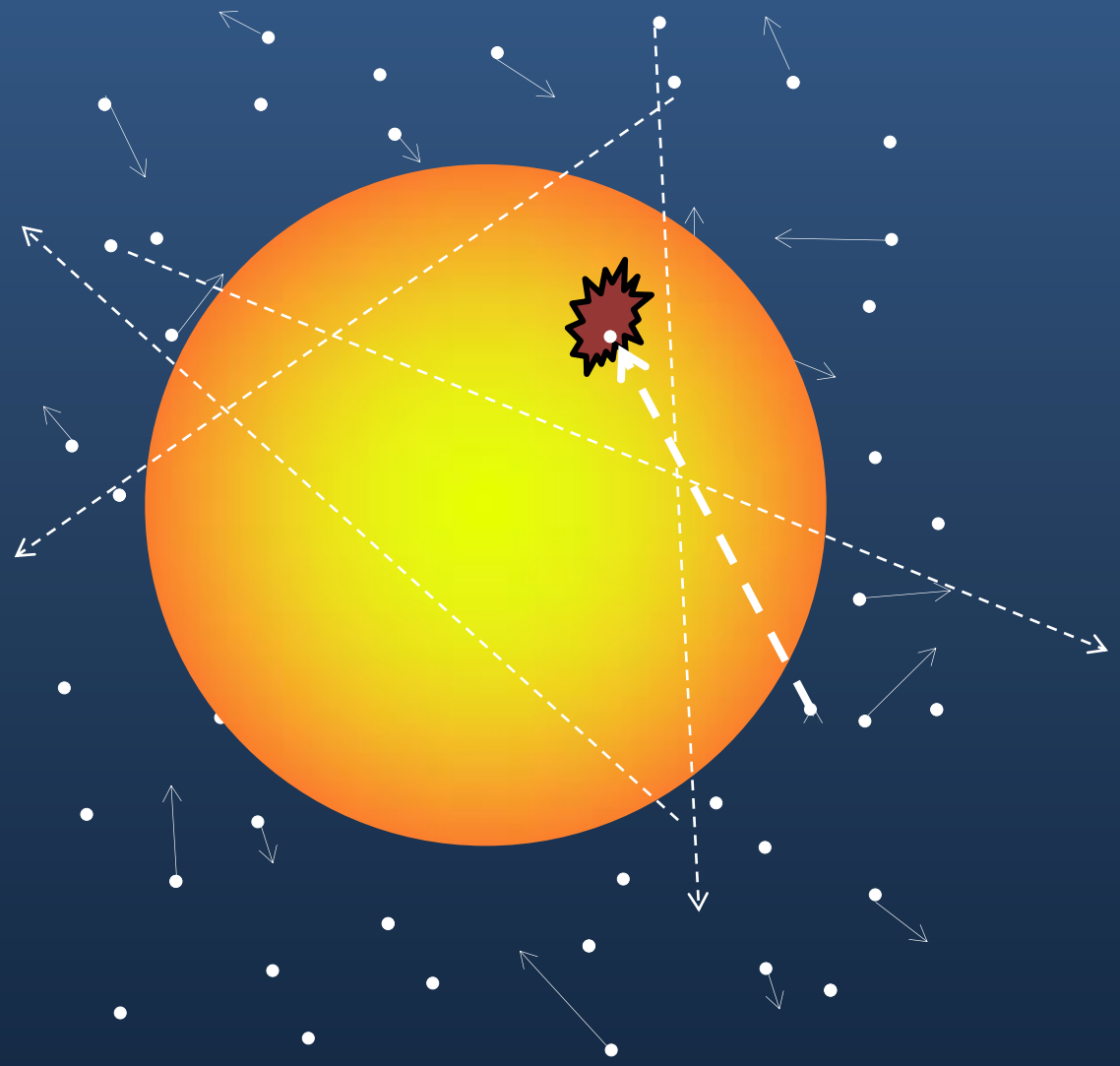
Impact of Dark Matter on stars



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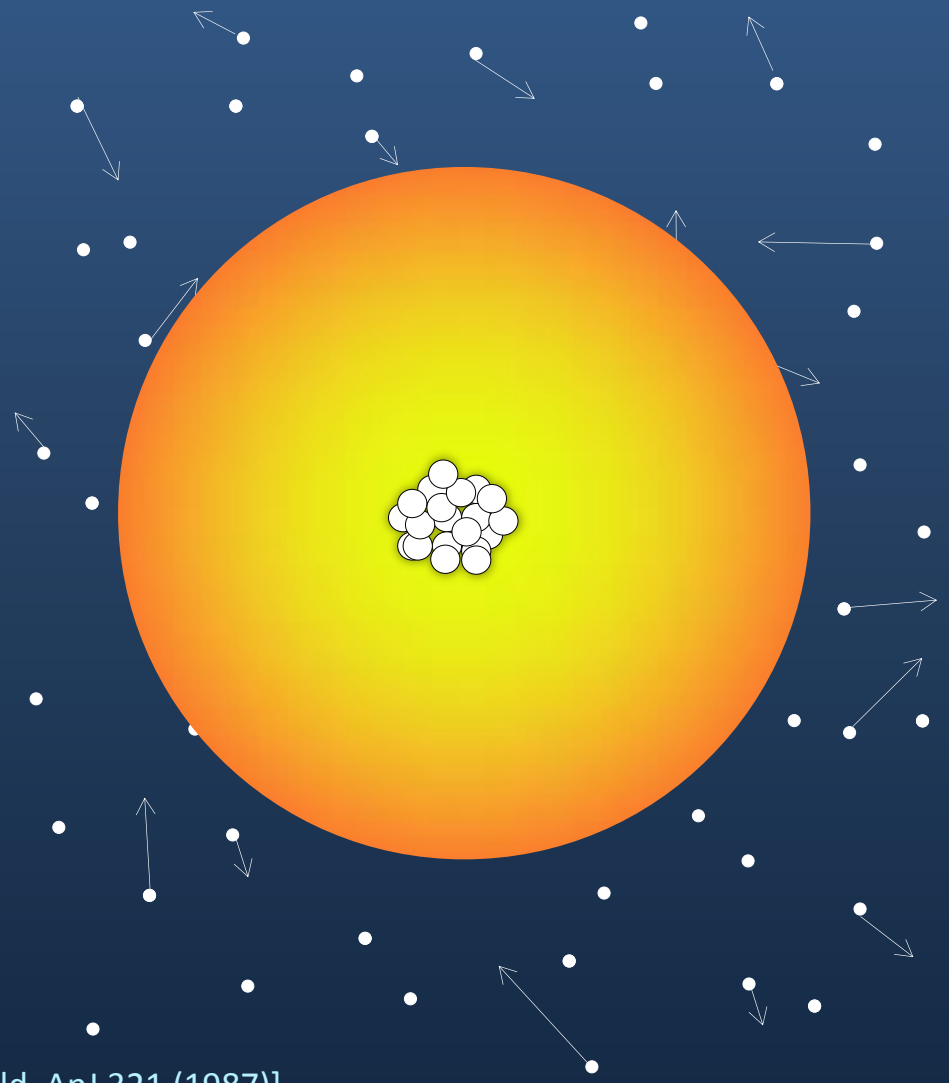

DM Capture [Gould, ApJ 321 (1987)]

Impact of Dark Matter on stars

DM Capture [Gould, ApJ 321 (1987)] + DM energy transport [Gould & Raffelt ApJ 352 (1990)]

Impact of asymmetric Dark Matter on stars

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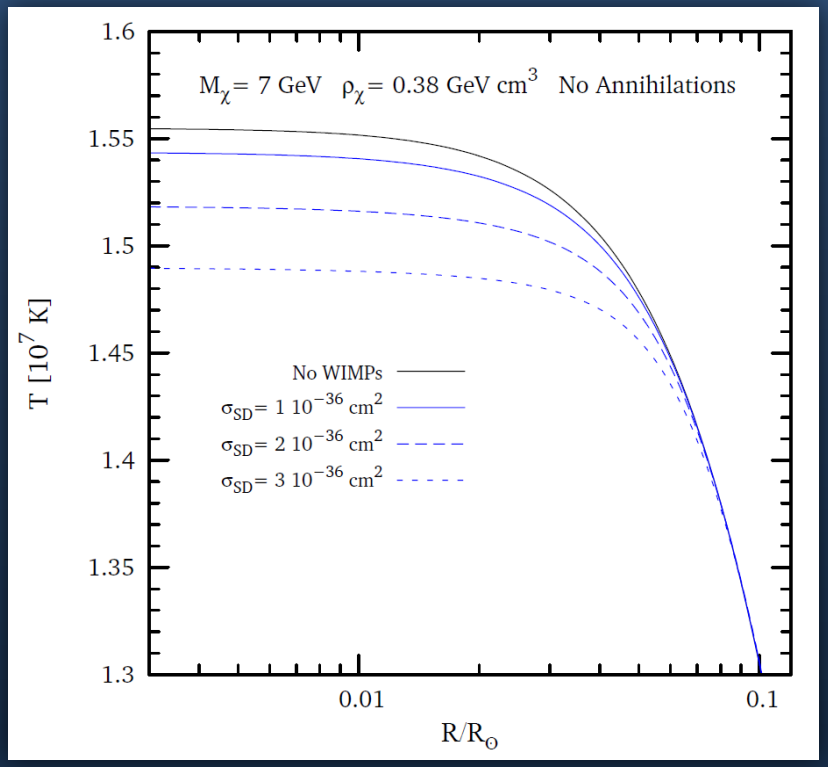
Impact of asymmetric Dark Matter on stars

Reduction central temperature

[Spergel and Press, ApJ 294 (1985)
Lopes, Bertone & Silk, MNRAS 337 (2002)]

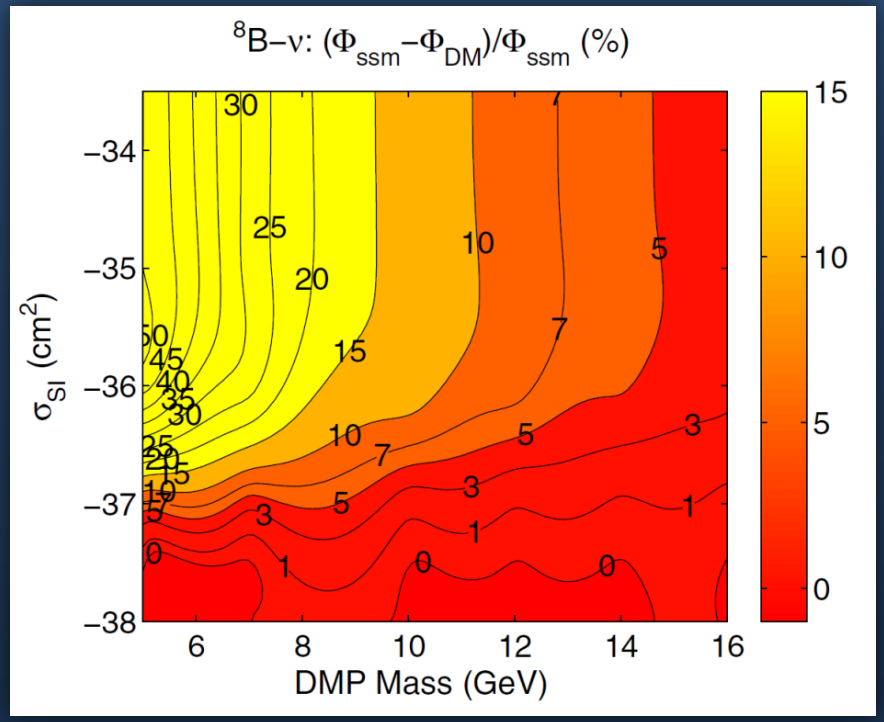


[Taoso *et al*. Phys. Rev. D 82 (2010)]

Impact of asymmetric Dark Matter on stars

Reduction central temperature

SUN: solar neutrinos, helioseismology



[Lopes & Silk, ApJL 752 (2012)]

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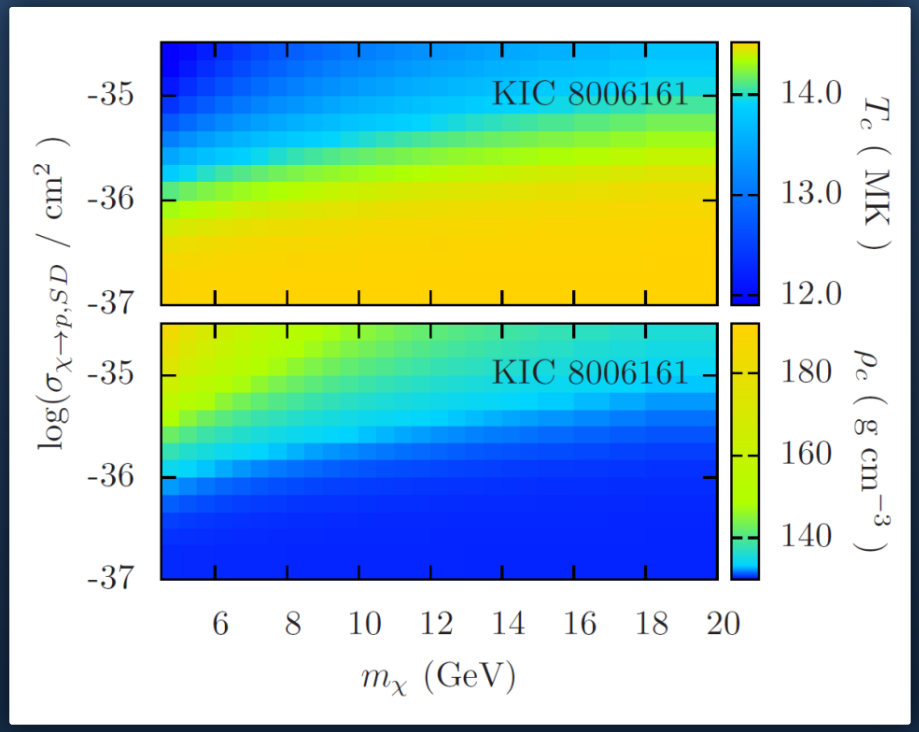
WHY OTHER STARS?

- $M_\star \downarrow \Rightarrow$ stronger DM impact



[**Casanellas** & Lopes , ApJL 765 (2013)]

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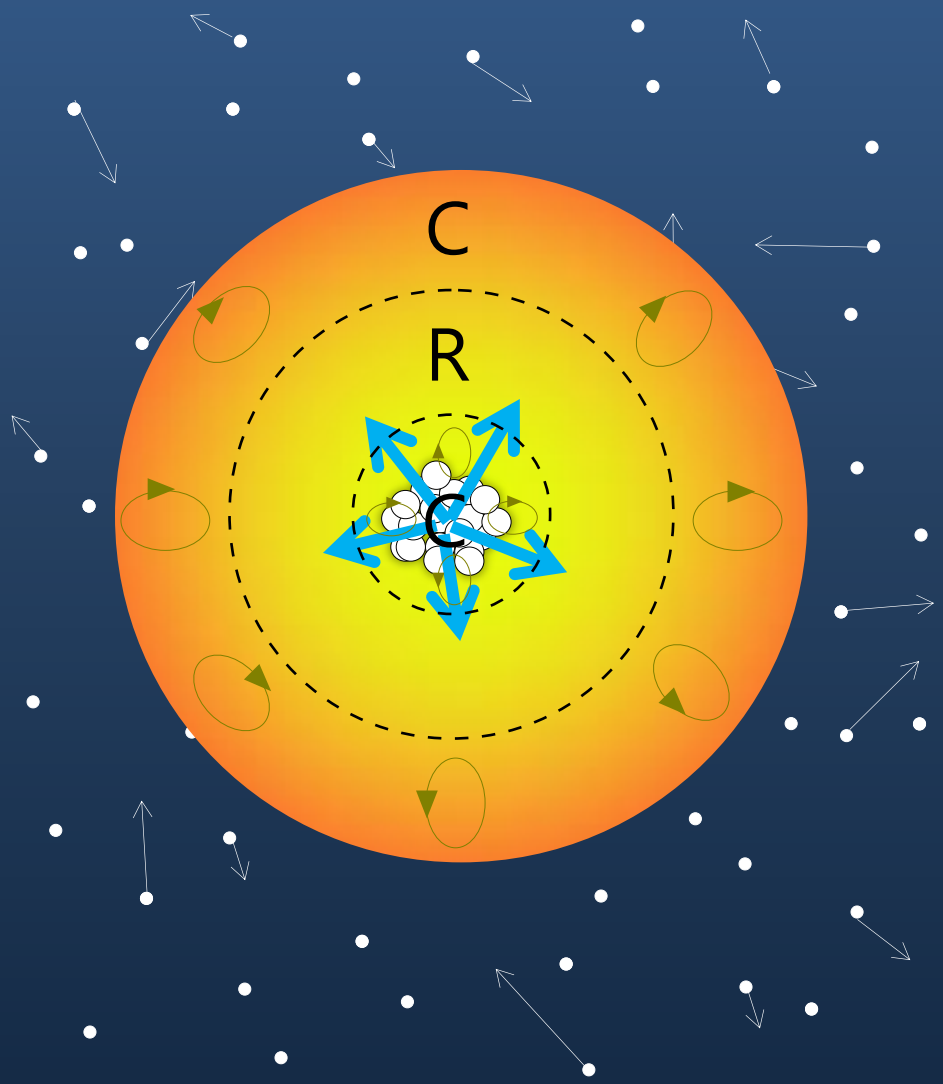

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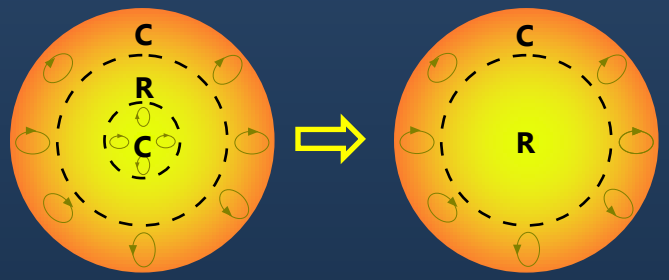
- $M_\star \downarrow \Rightarrow$ stronger DM impact
- Suppression of **convective core** in 1.1-1.3 Ms stars



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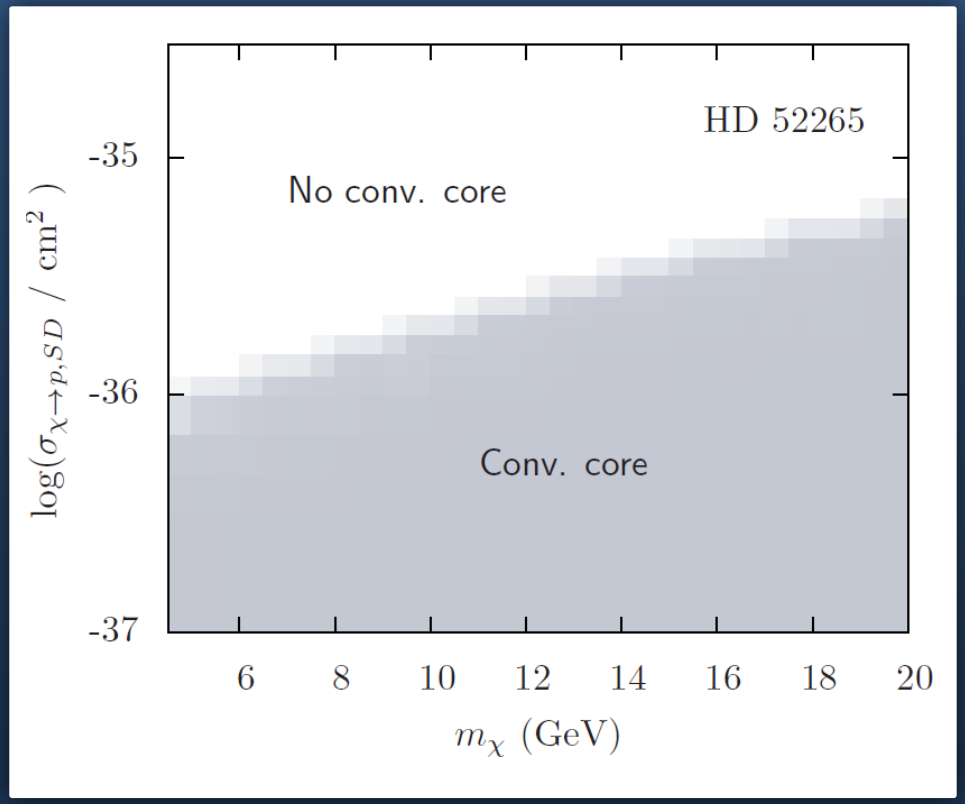

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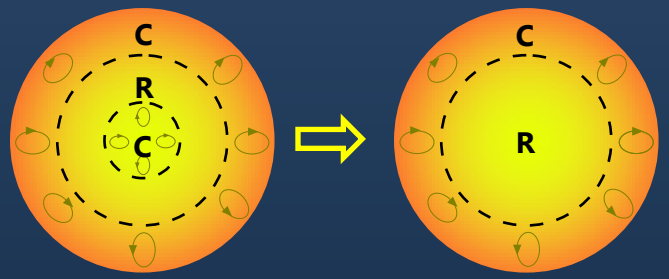

[**Casanellas** & Lopes , ApJL 765 (2013)]

Star	M ($M_\odot$)	R ($R_\odot$)	L ($L_\odot$)	T_{eff} (K)	$(Z/X)_s$	$\langle\Delta\nu_{n,0}\rangle^a$ (μHz)	$\langle\delta\nu_{02}\rangle^a$ (μHz)
HD 52265							
Observ. [19, 23]	1.18-1.25[b]	1.19-1.30[b]	2.09 ± 0.24	6100 ± 60	0.028 ± 0.003	98.07 ± 0.19	8.18 ± 0.28
Stand. mod./DM mod.[c]	1.18	1.30	2.22	6170	0.028	97.92/98.05	8.16/7.65

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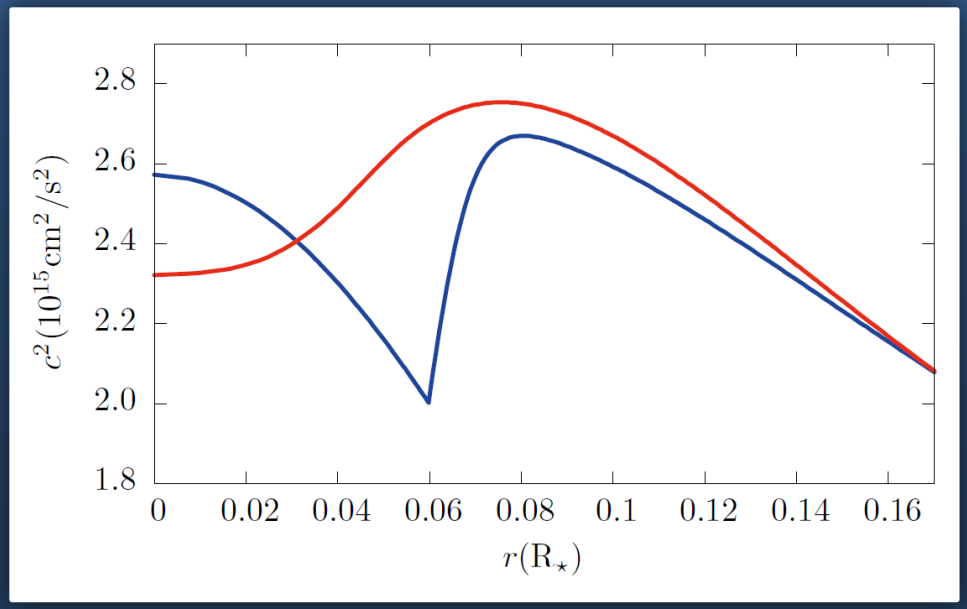

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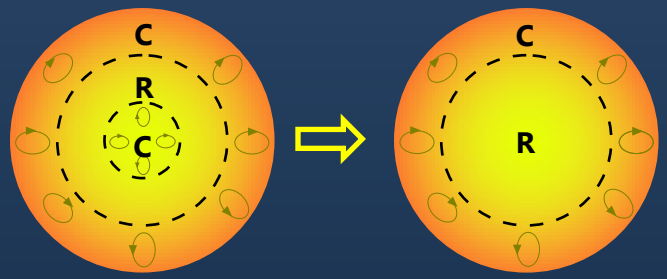

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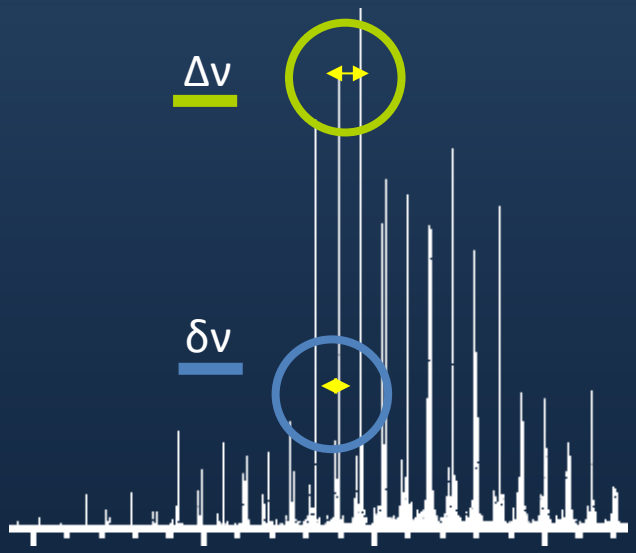


⇨ **ASTEROSEISMOLOGY**

$|S\{\Delta\nu\, r_{010}\}|$ [Brandao *et al.* , MNRAS 438 (2014)]

Constraining asymmetric Dark Matter with asteroseismology

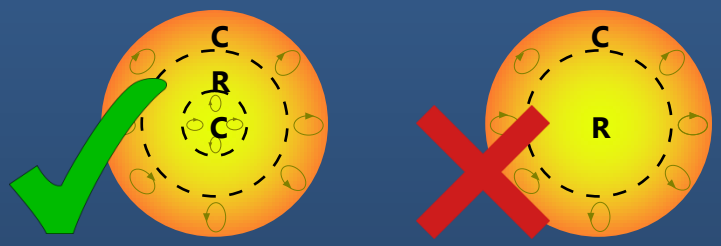
Impact of asymmetric Dark Matter on stars

- Presence or abscence of a **convective core** in Dushera (KIC 12009504)

  [Silva Aguirre *et al.*, ApJL 769 (2013)]

- Modelling of Dushera

  [**Casanellas** & Brandao , in prep.]



T_{eff}	$\log(g)$	Z/X_s [1]	$\langle\Delta\nu\rangle_{012}$
6200 ± 200	4.30 ± 0.2	0.023 ± 0.09	88 ± 0.6

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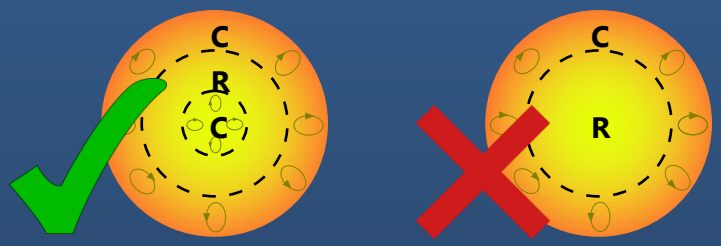

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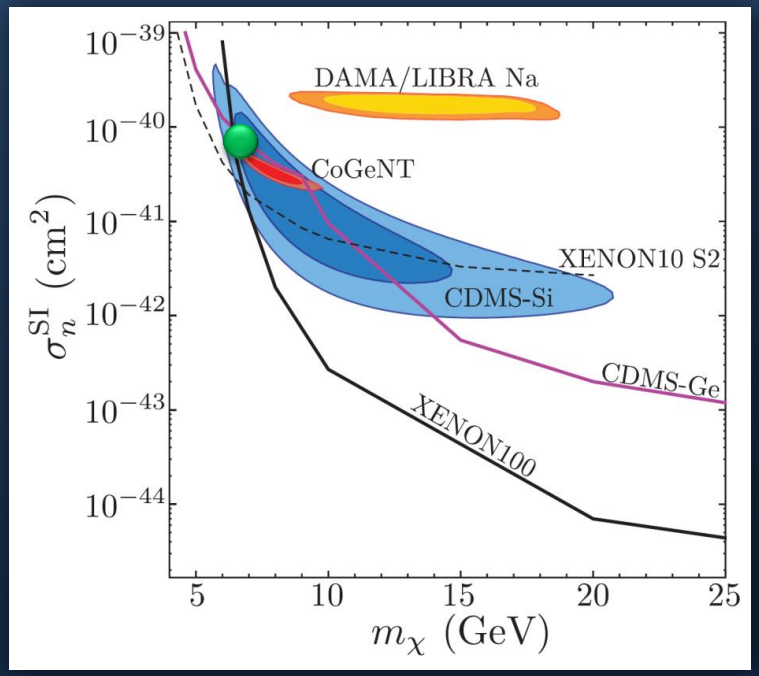
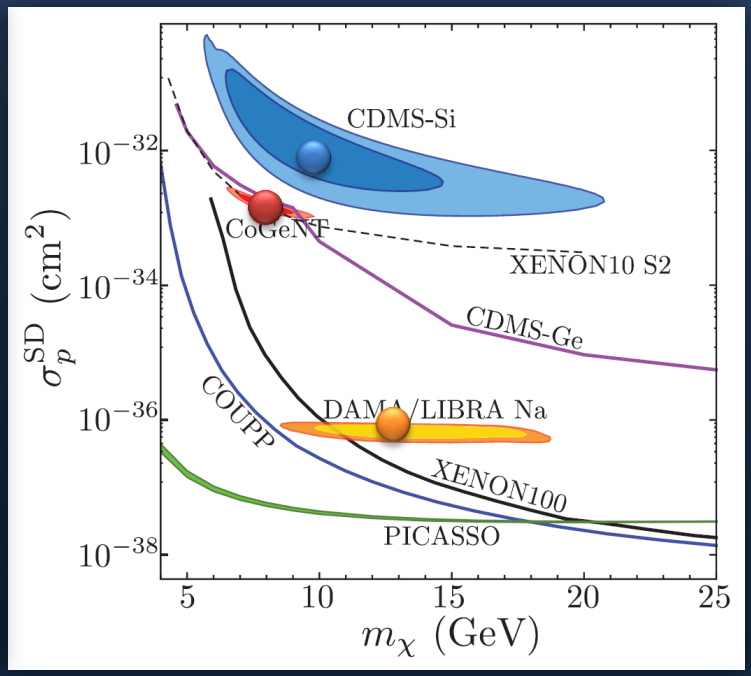
- DM model 1 (SI best fit)
- DM model 2 (DAMA)
- DM model 3 (CDMS)
- DM model 4 (CoGeNT)





[Buckley M. & Lippincott W. H., Phys. Rev. D 88 (2013), Arina , arXiv:1310.5718, (2013)]

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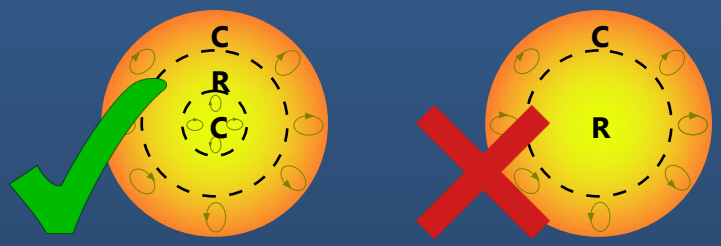

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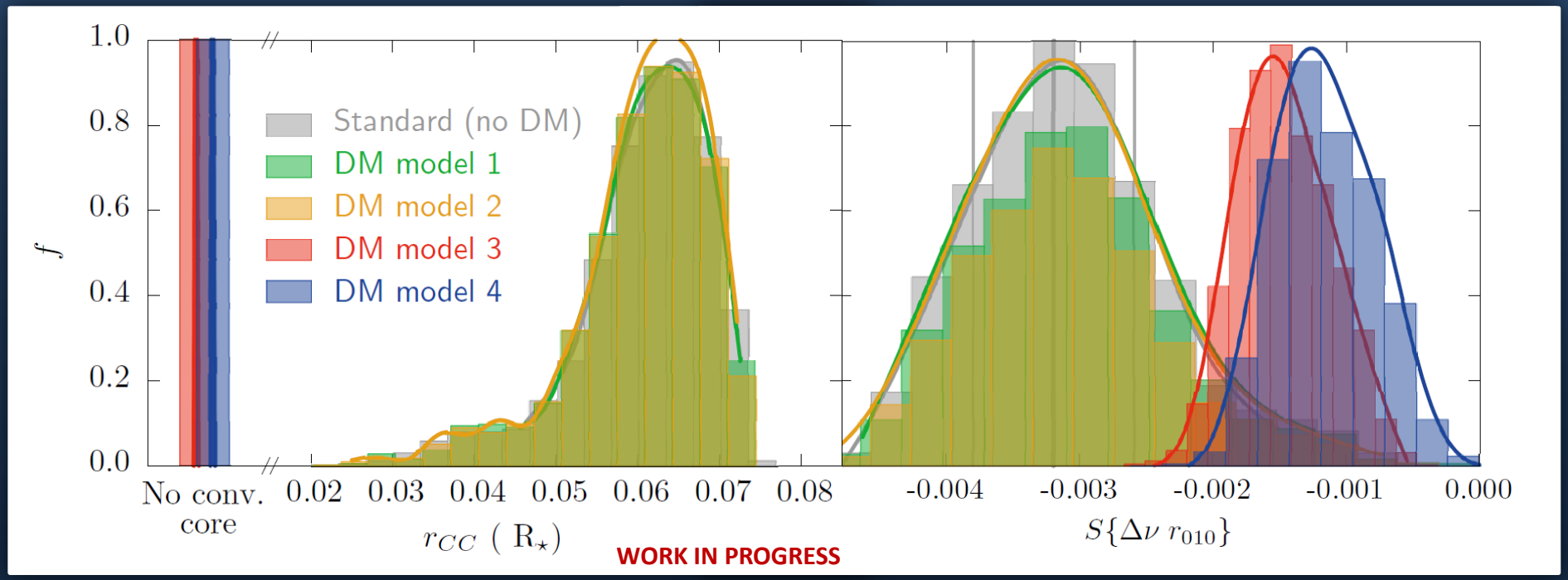


WORK IN PROGRESS

Constraining asym Dark Matter with asteroseismology

- Modelling of **α Cen B**
  ($M_\star$, closest, binary)

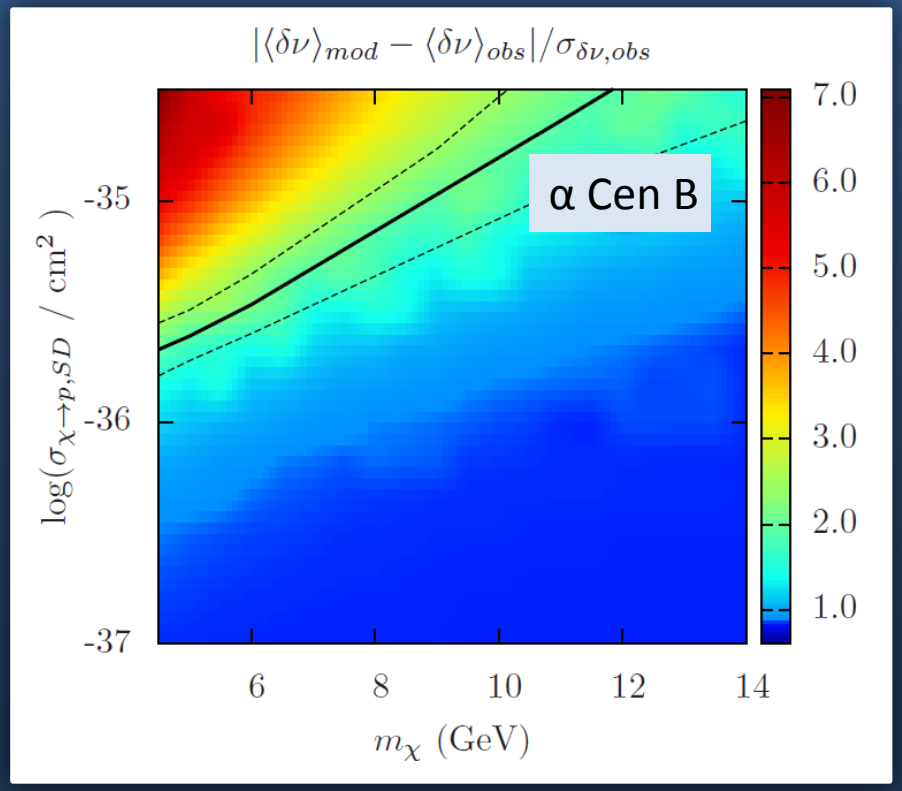
[**Casanellas** & Lopes , ApJL 765 (2013)]

Asymmetric DM candidates with

$$m_\chi = 6 \text{ GeV} \quad \text{and}$$

$$\sigma_{\chi,SD} \geq 3 \cdot 10^{-36} \text{cm}^2$$

excluded at 95% confidence level.



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α Cen B							
Observ. [24, 25]	0.934 ± 0.006	0.863 ± 0.005	0.50 ± 0.02	5260 ± 50	0.032 ± 0.002	161.85 ± 0.74	10.94 ± 0.84
Stand. mod./DM mod.[c]	0.934	0.868	0.51	5245/5230	0.031	162.56/162.45	10.23/8.95

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