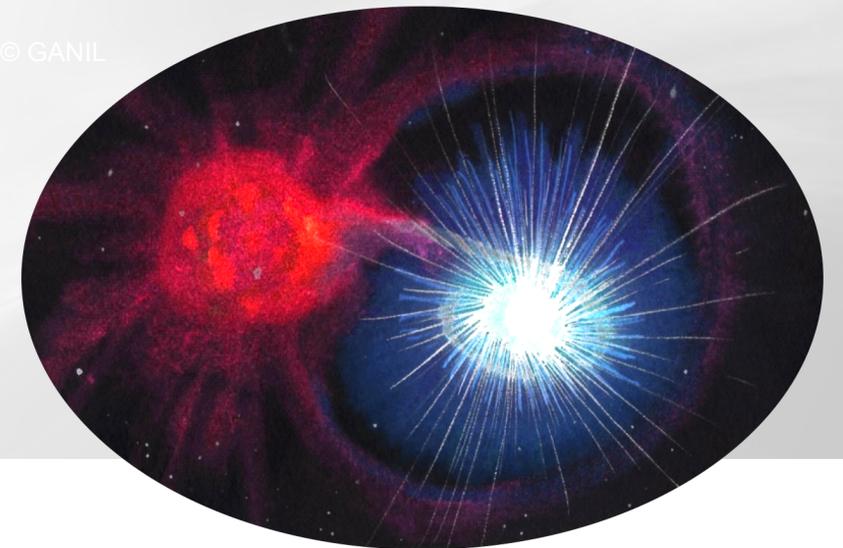


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Search for ^{22}Na in novae supported by a novel method for measuring femtosecond nuclear lifetimes

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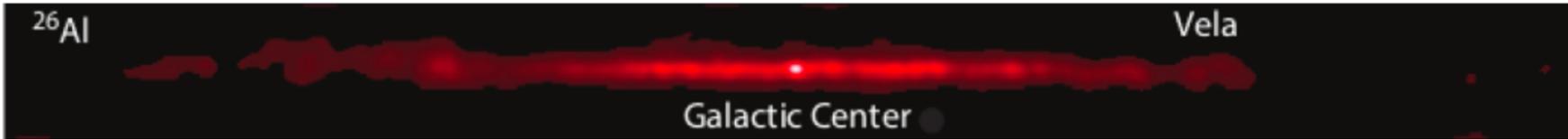
Motivations: astronomy with radioactivities

The Milky Way

Visible light



γ -ray



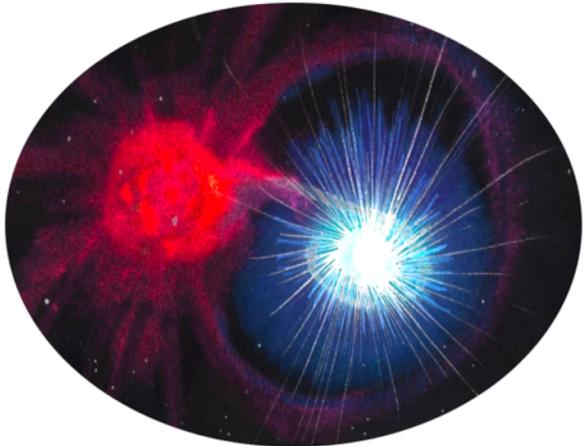
^{22}Na ?

$E_\gamma=1.275$ MeV

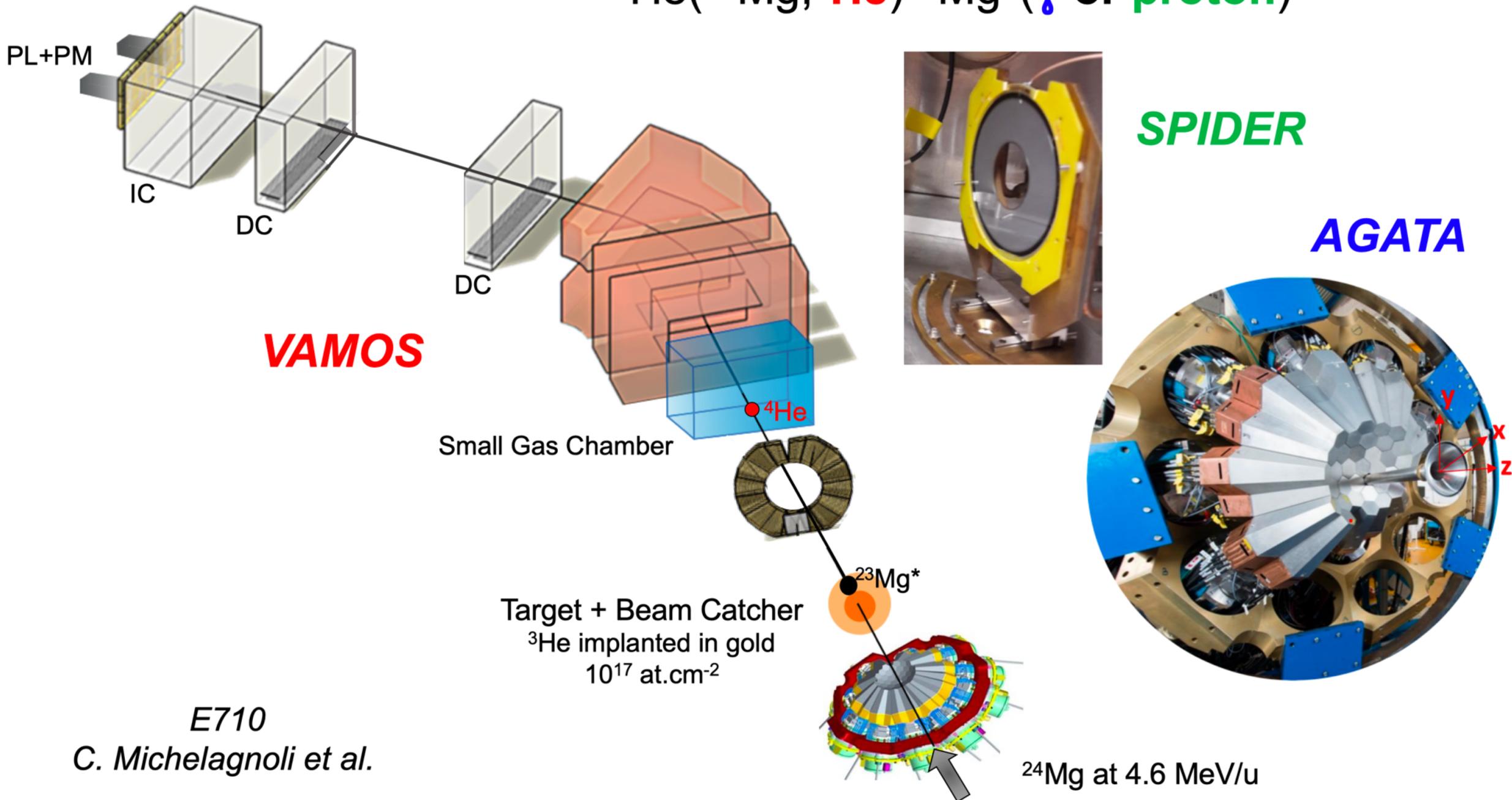
Predicted to be produced in novae explosions
It has not yet been observed
How likely is it that we will observe it?

Depends on the rate of $^{22}\text{Na}(p,\gamma)^{23}\text{Mg}$
 BR_p and τ of the $Ex=7.785$ MeV

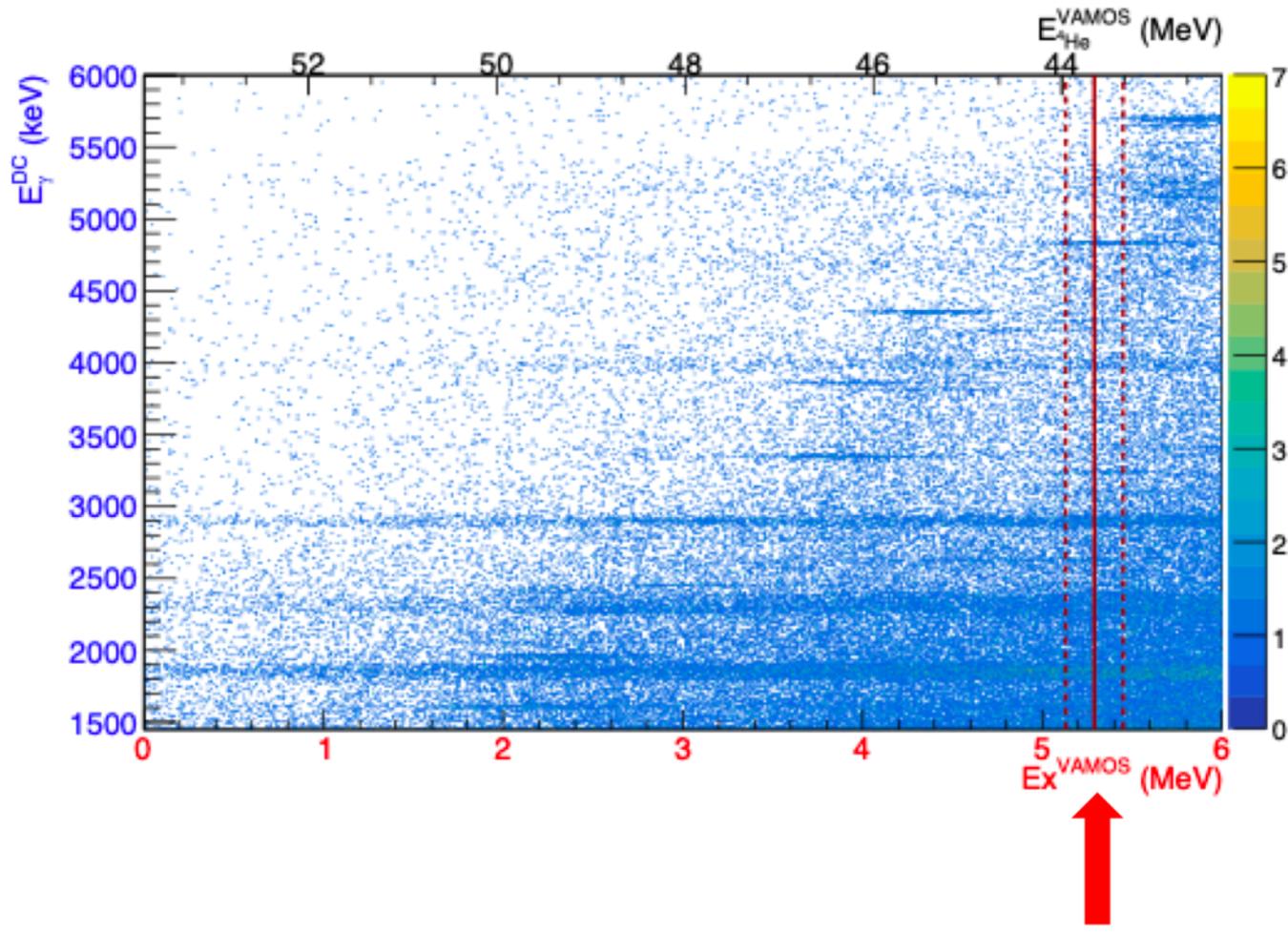
Integral, ASTROGAM, COSI



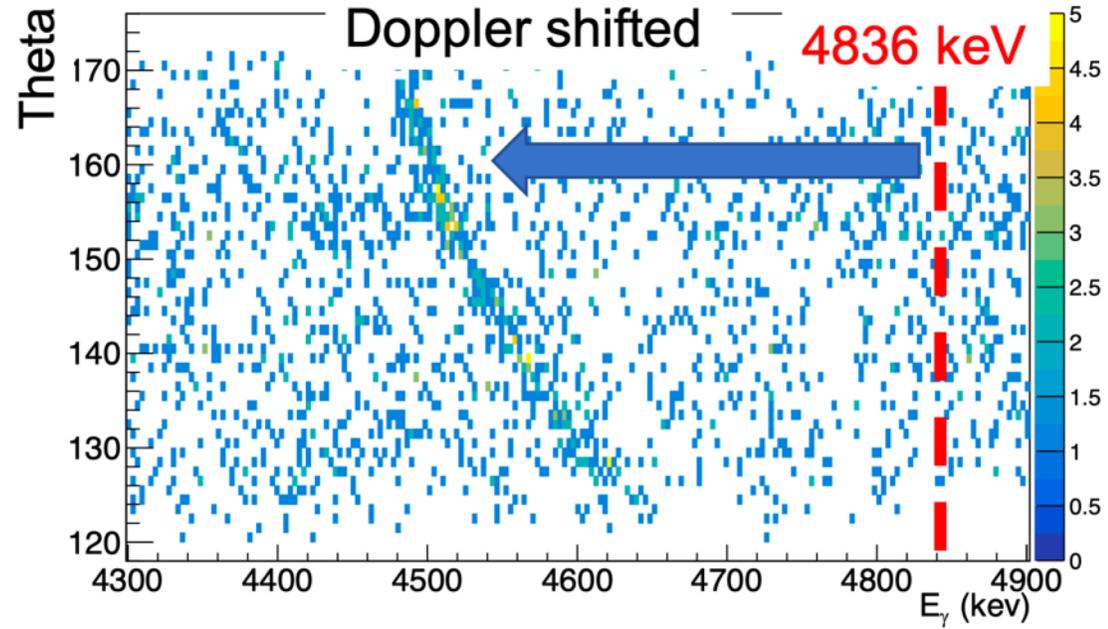
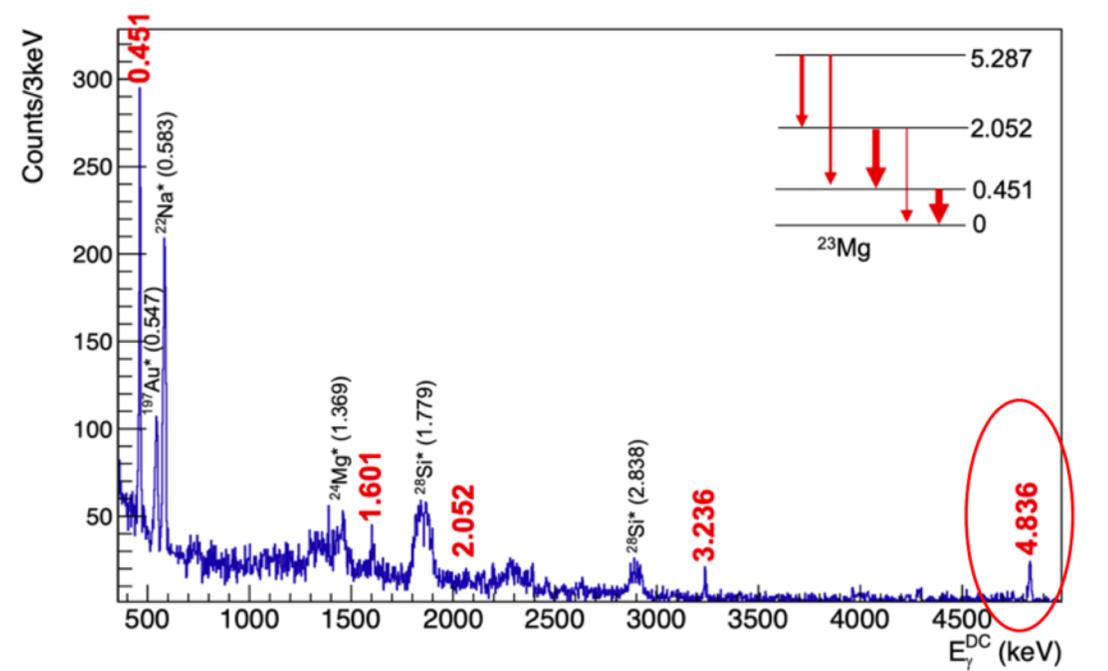
Experimental set-up



Identification of the populated states



$E_x = 5.29(16)$ MeV



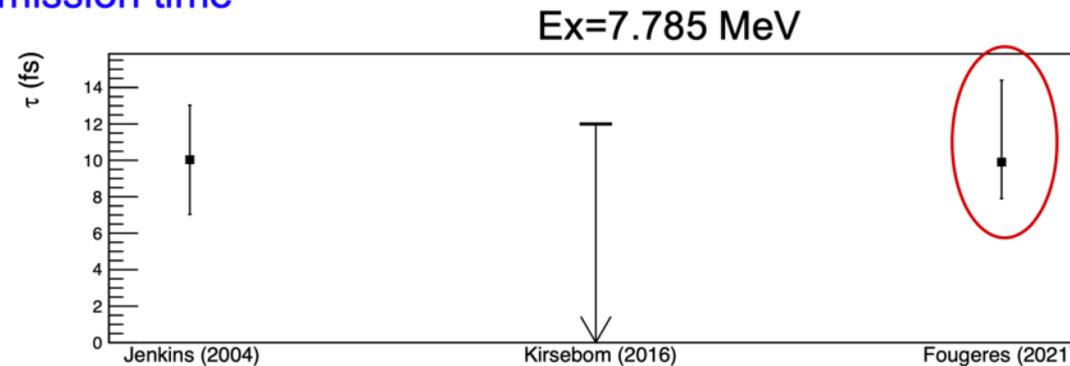
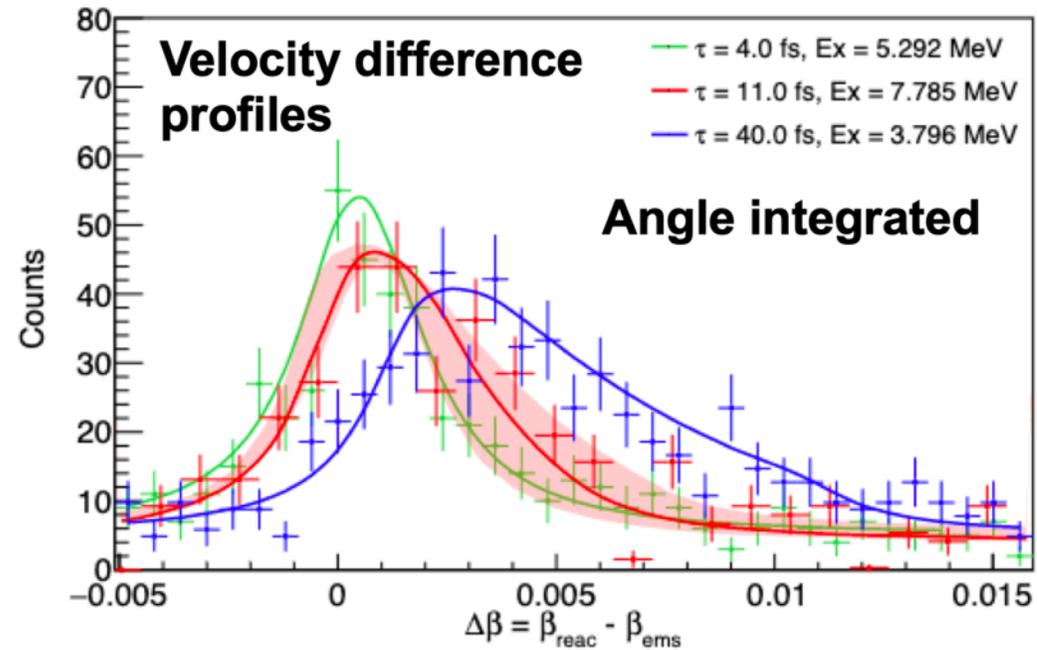
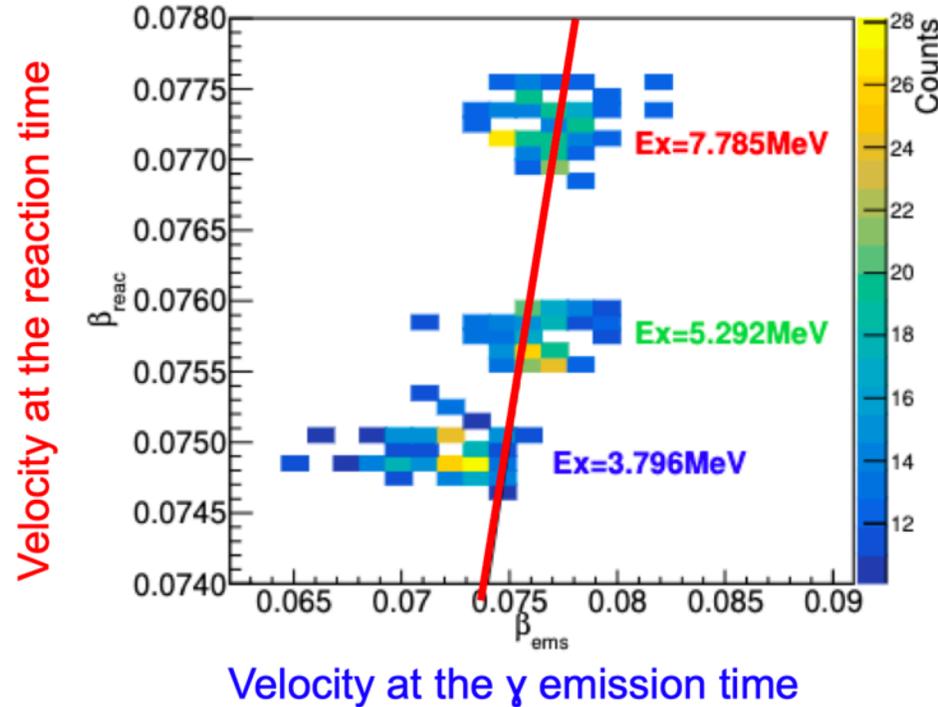
Gamma Energy

Novel method to measure lifetimes



Doppler shifted

$$\beta = \frac{R^2 \cos(\theta_{\text{DS}}) + \sqrt{1 + R^2 \cos(\theta_{\text{DS}})^2 - R^2}}{R^2 \cos(\theta_{\text{DS}})^2 + 1} \quad R = \frac{E_\gamma}{E_{\gamma,0}}$$



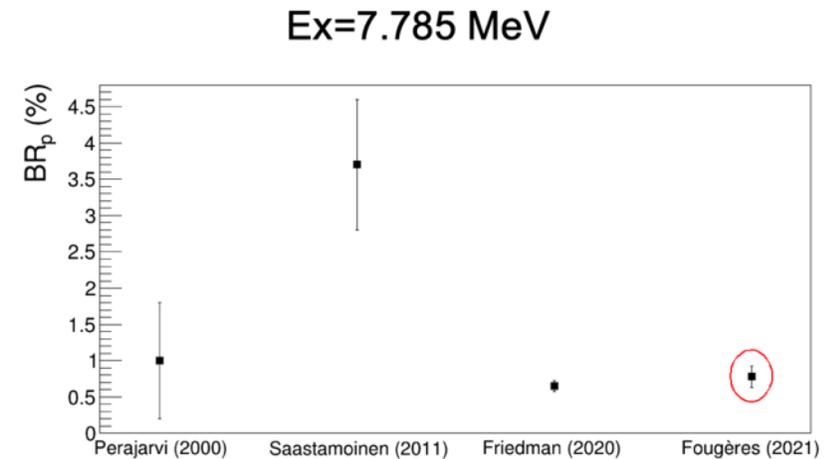
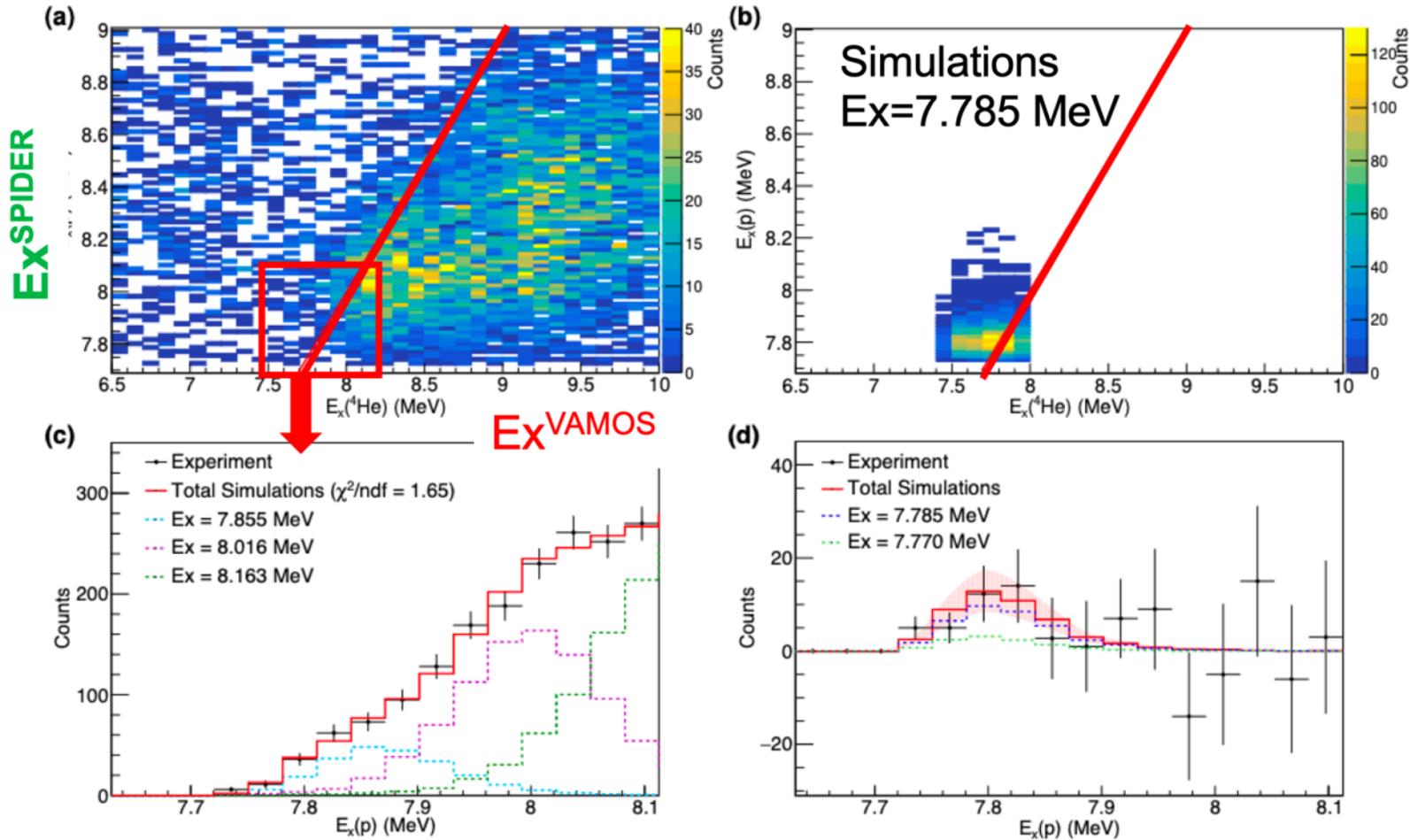
C. Fougères et al.
Submitted, 2023

Branching ratio also measured



E_x^{VAMOS}

E_x^{SPIDER}

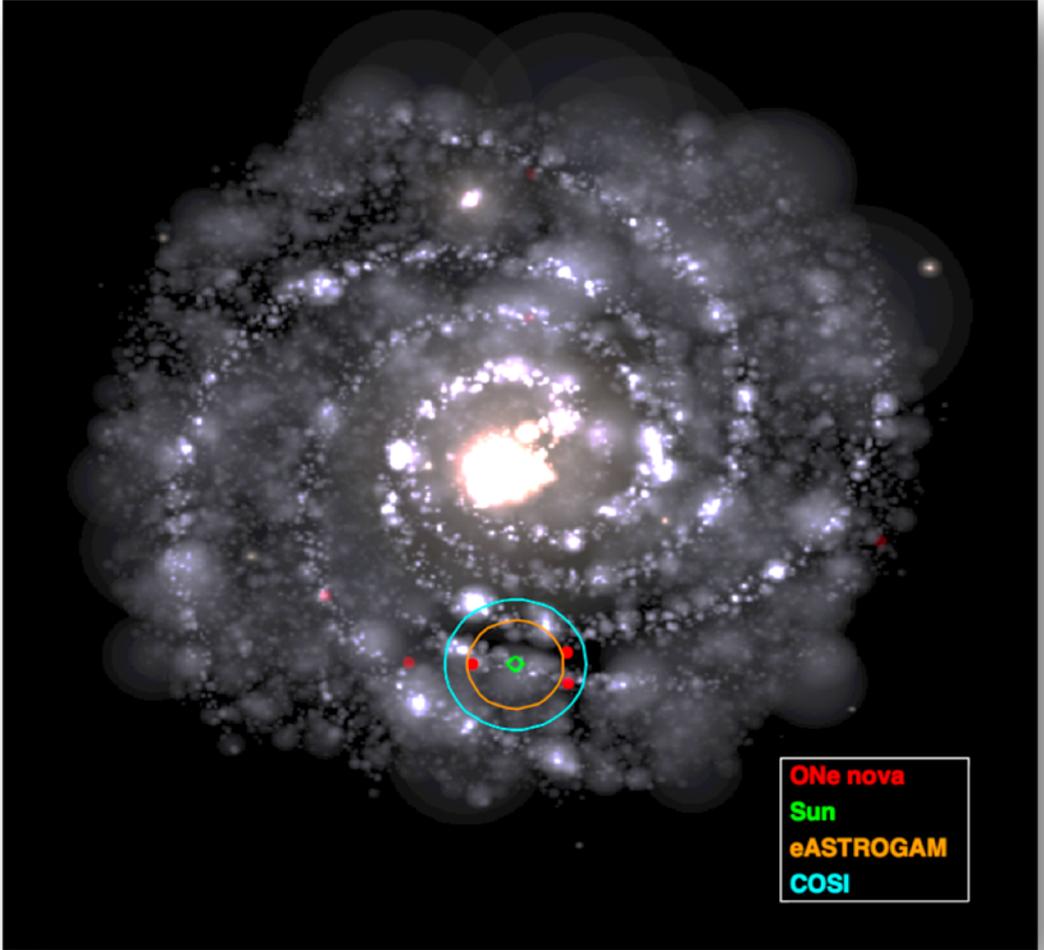
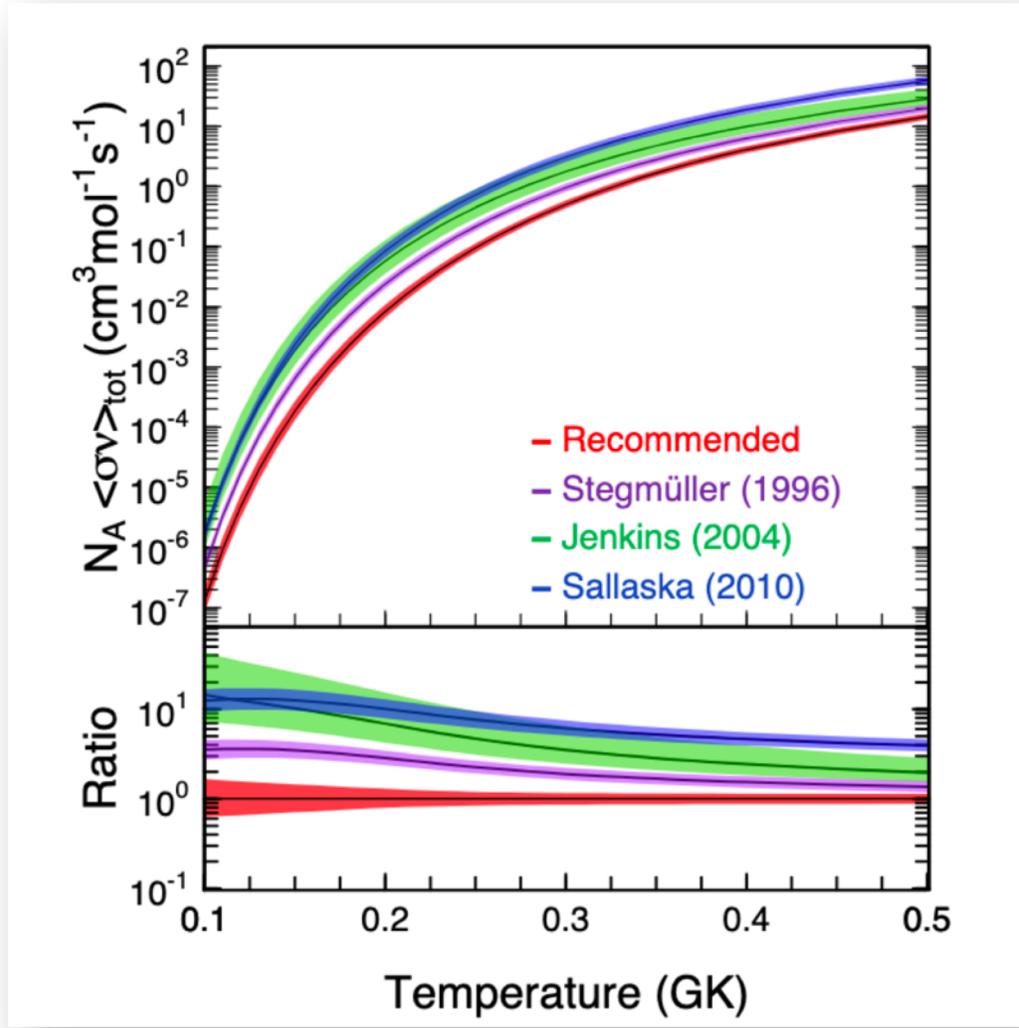


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Reevaluation of the $^{22}\text{Na}(p,\gamma)^{23}\text{Mg}$ reaction rate

Monte-Carlo approach

Longland (2010)

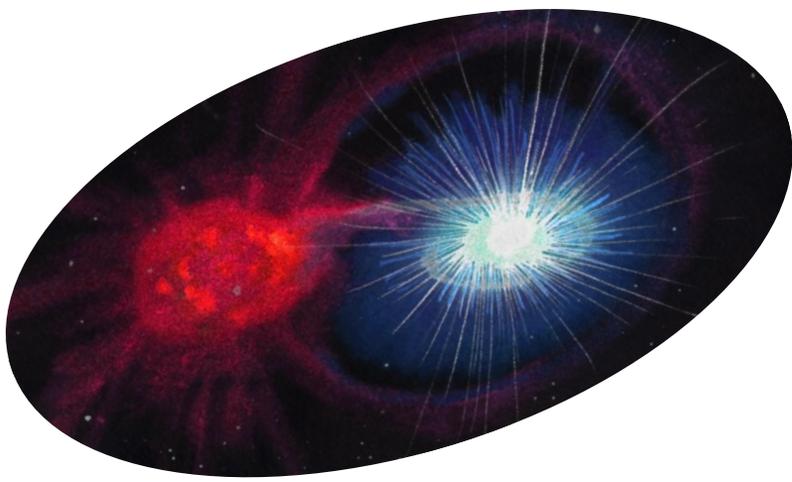


Survey of 8 observed ONe novae over past 60 yr

Hachisu (2019), José (2020)

Frequency in detected ^{22}Na
 ≥ 1 event / 60 yr
 ≥ 1 event / 20 yr

New maximum detectability distances of 4.0 kpc (COSI) 18% uncertainty



Thank you

