

# Dark-matter admixed neutron stars

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## 2 NSs with mass above $2M_{\odot}$

- PSR J0348-0432:  $M = 2.01^{+0.04}_{-0.04} M_{\odot}$  (Antoniadis et al.'13)
- PSR J0740+6620:  $M = 2.14^{+0.20}_{-0.18} M_{\odot}$  (Cromartie et al.'19)

## Dark matter EoS

- **Asymmetric dark matter** (relativistic Fermi gas of noninteracting particles, spin  $\frac{1}{2}$ )  
**A. Nelson, S. Reddy, D. Zhou, JCAP, 07, 012 (2019)**

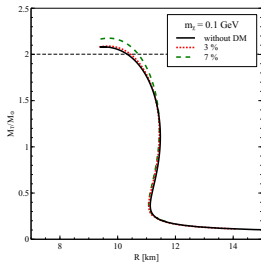
## Baryon matter EoS

- **EoS with induced surface tension (IST EoS)**  
*consistent with:* nuclear matter ground state properties, proton flow data,  
heavy-ion collisions data, astrophysical observations,  
tidal deformability constraint from the NS-NS merger (GW170817)

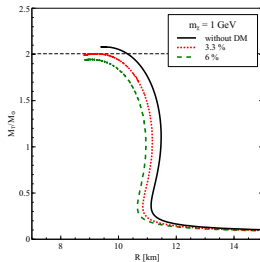
**VS, I. Lopes, A. Ivanytskyi, ApJ, 871, 157 (2019)**

**VS, A. Ivanytskyi, K. Bugaev, et al., NPA, 924, 24 (2014)** 1/3

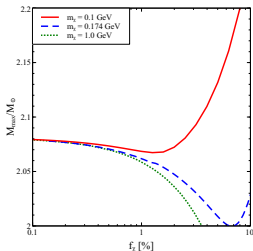
# Mass-Radius diagram of the DM admixed NSs



$M_{max} > 2M_{\odot}$  for any  $f_{\chi} \Rightarrow$  extended halo of DM



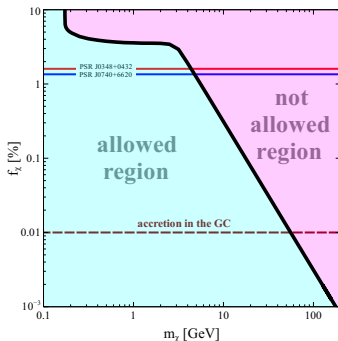
for  $f_{\chi} = 3.3\%$   $M_{max}$  equals to  $2M_{\odot}$



- For  $m_{\chi} = 0.174$  GeV  $M_{max}$  is  $2M_{\odot}$
- DM particles with  $m_{\chi} \leq 0.174$  GeV are consistent with the  $2M_{\odot}$  constraint for any  $f_{\chi}$
- For heavier DM particles the NS mass can reach  $2M_{\odot}$  only if  $f_{\chi}$  is limited from above

O. Ivanytskyi, V.S. I. Lopes, arXiv:1910.09925 (2019)

# Constraint on the mass of DM particles



$2M_{\odot}$  NS in the GC  $\Rightarrow m_x < 60$  GeV

## Conclusions:

- Using the observational fact of existence of the two heaviest known NSs (i.e., PSR J0348+0432, PSR J0740+6620) with the masses exceeding the two solar ones, we presented an allowable range of masses and fractions of DM particles.
- Measurements of a  $2M_{\odot}$  NS in the Galactic center will impose an upper constraint on the mass of DM particles of  $\sim 60$  GeV.
- DM lighter than 0.2 GeV can create an extended halo around the NS leading not to decrease but to increase of the NS total (gravitational) mass.