Dark Matter Compact Stars February 15 Meeting Summary

Tov Solver Code Updates

- We all now have working code
- There seems to be a small error in all of our codes
- Adam will share another TOV solver code from Dr. Sagunski so we can compare our results.

Tasks Moving Forward

1. Equate cooling time and freefall time using Eq 36 and 37 from Structure Formation and Exotic Compact Objects in a Dissipative Dark Sector paper

    - The Λ factor in the cooling time is the Bremsstrahlung energy emission rate per unit mass, which can be calculated from Eq 40 in the same paper. The expression for Λ is a function of mass density and temperature. The portion of the equation which makes this applicable to dark matter is the decaying exponential term, which is added because DM takes longer and is less efficient in structure formation.

    - The exponential term is a function of β, the ratio of the dark photon mass to the dark boson mass, and T', which is the temperature divided by the boson mass.

    - α is the coupling strength, which is related to the value y from our TOV code, this number should be <1 for optically thin regimes

    - The mass of the the dark photon is a parameter we can vary, where $m_{\gamma} << m_{b}$.

    - Only the Λ from Bremsstrahlung is considered because the Λ from Compton scattering will be significantly smaller.

    - The goal is to plug Λ into the expression for cooling time and equate htat the the expression for freefall time.

2. Plot the equated $t_{cooling}$ and t_{ff} with density and temperature, try to recreate figure 5 in the paper.
    - We can try to vary the coupling strength, α .

3. Generate and plot the Jeans Mass as a function of ρ and T, using Eq 28 from the paper.
    - We will need an expression for the speed of sound, which is defined as:

$$c_s^{\ 2} = \frac{dP}{d\varepsilon}$$

      The derivative of the pressure with respect to the energy density.

Next meeting will be Wednesday February 21 at 8am/10am/4pm.