

## Nuclear Lunch Questions for Oct 8, 2014

Discussion on “Detection of an unidentified emission line in the stacked X-ray spectrum of galaxy clusters”

Reference: Astrophysical Journal **789** (2014) 13

### Satellites, Detectors, Data, ...

1. What are the differences between XMM and CHANDRA satellites? (**Tyler**)
2. Why are galaxy clusters used to study dark matter? (**Shamim**)
3. What are the MOS and PN detectors made of? What do they look like? Why were these materials chosen? How do they work? The background in PN was greater than in MOS. Why? (**Andrea**)
4. In Fig. 5, what do MS and KS in the text boxes on the plots denote? In Fig. 10, the left panel has a crest while the right one has a trough; why? Is it possible that this  $\sim 3.5$  KeV line came from elements other than Cl or K? (**Sushil**)

### Atomic Physics, Nuclear Physics, Astrophysics, ...

1. What is an X-alpha line? Why is Perseus bright at  $\sim 3.5$  keV? What is dielectric recombination? Which atoms can undergo this process? (**Linda**)
2. What possible nuclear reactions can occur in dark matter so that neutrinos are produced? (**Cody**)
3. What theory predicts Eddington's approximation leading to

$$I_{obs} = I_0 \left( \frac{2}{5} + \frac{3}{5} \cos \theta \right).$$

Shouldn't the Eddington approximation imply that an entire emission spectrum is weighted by the line of sight angle? (**Rekham**)

4. What is red shift? Why is the limiting red-shift important? How does one measure the red-shift? (**Brain**)

### Sterile and Standard Model (SM) Neutrinos, Dark Matter, ...

1. What are sterile neutrinos? How are they different from regular SM neutrinos? What are their decay modes? What are the constraints on the sterile neutrino model? Can sterile  $\nu$ 's be detected with current technology? Why can't the SM neutrinos be dark matter candidates? Who is winning - axion, chameleon, sterile neutrinos, ...? (**Arbin**)
2. How did they obtain the value of 13 – 19 % for dark matter? Who assumed the width of the dark matter decay line to be 15 eV and why? (**Taya**)