X-Ray Spectral Analysis of Supernova Remnant G292.0+1.8

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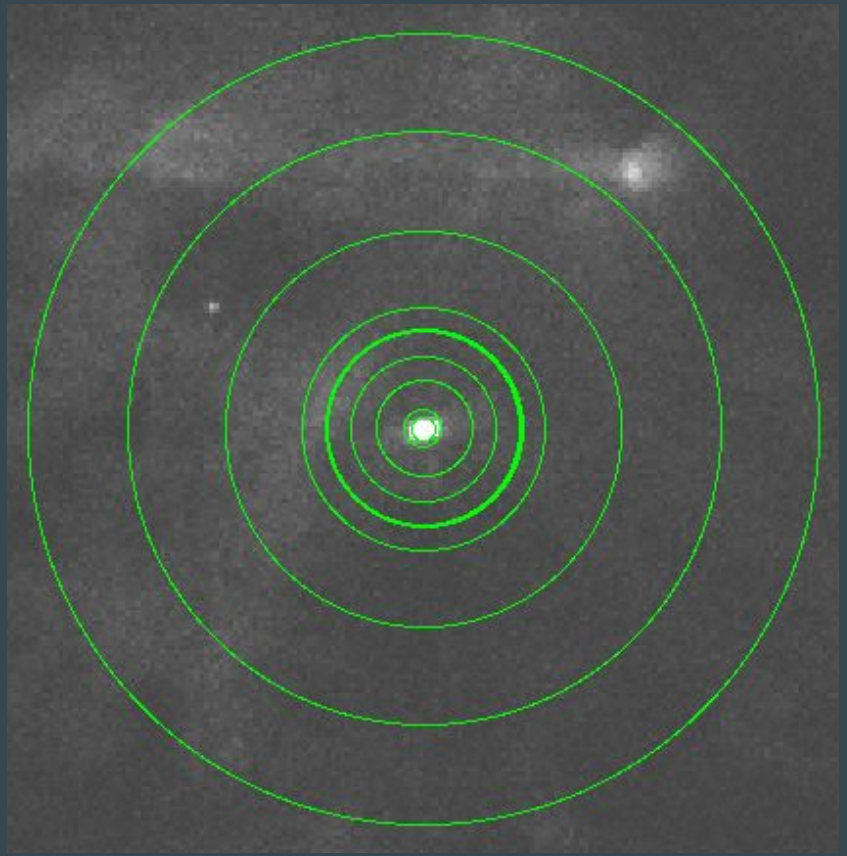
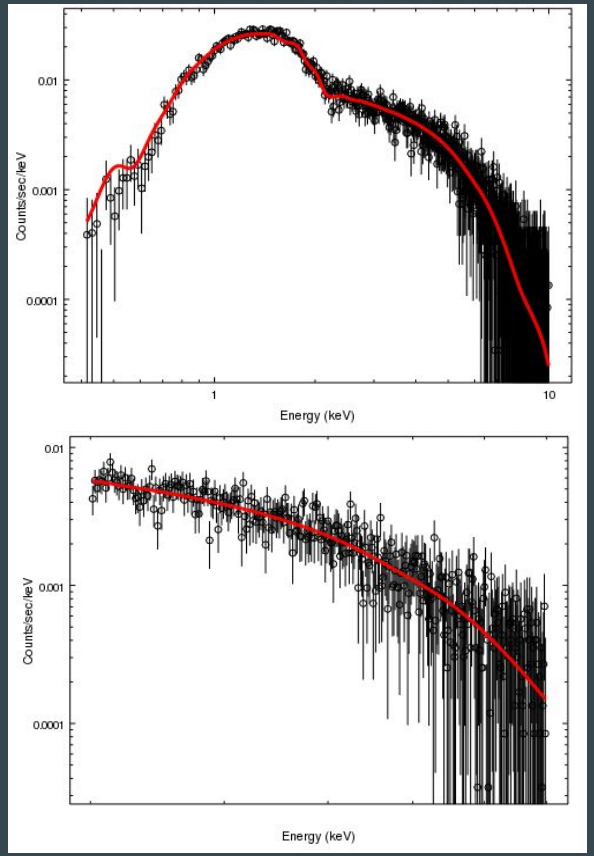
Purpose:

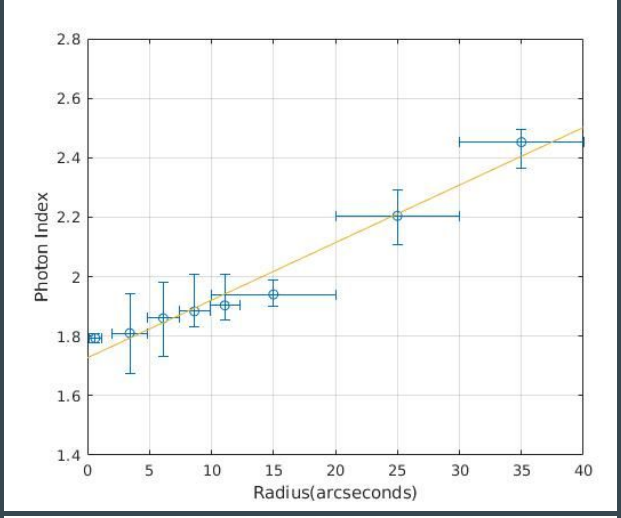
- Obtain a power law fit for the pulsar and the surrounding wind nebula at various radii
- Determine how the magnetic field varies with radius
- Determine the Luminosity of Pulsar and Pulsar Wind Nebula (PWN)

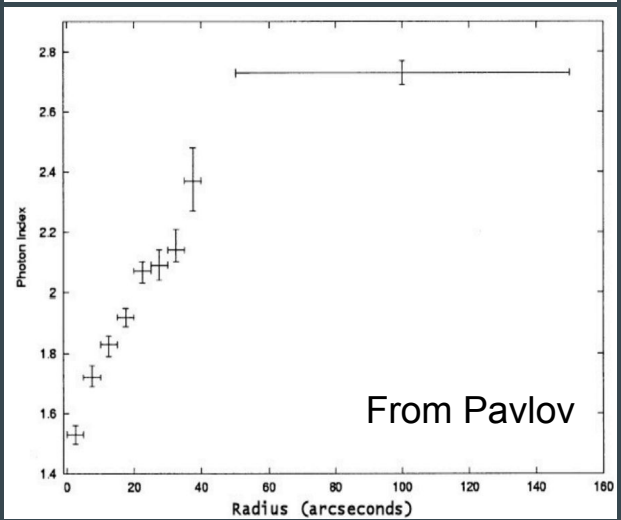


Obtained from ciao’s imager (ds9)

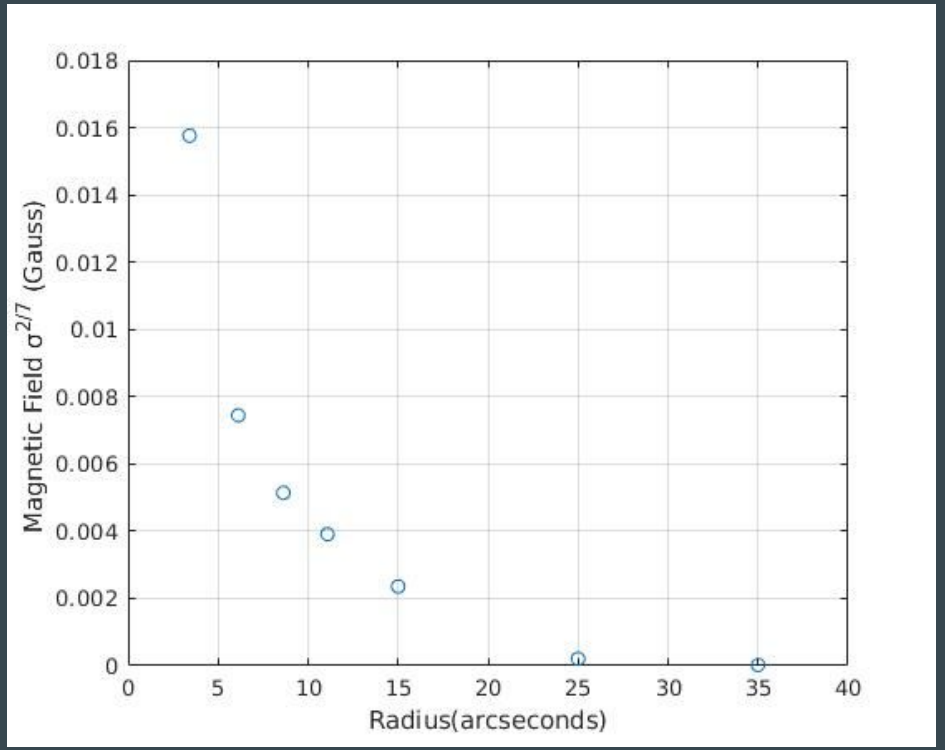


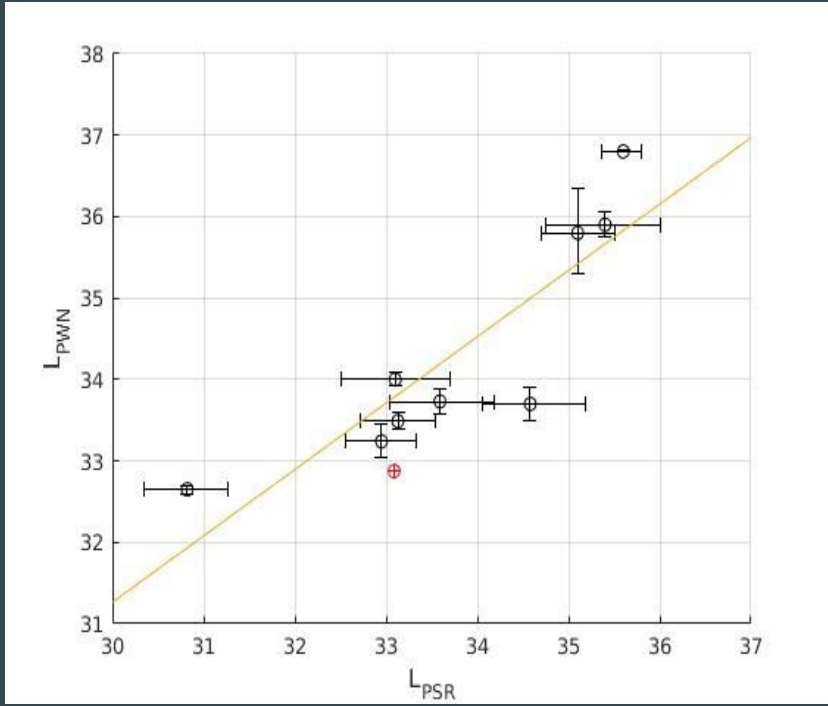
Obtained from ciao’s modeling and fitting application (sherpa)





$$B = \left[\frac{L(\nu_m, \nu_M)\sigma_s}{\mathcal{A}V} \frac{\Gamma - 2}{\Gamma - 1.5} \frac{\nu_1^{1.5-\Gamma} - \nu_2^{1.5-\Gamma}}{\nu_m^{2-\Gamma} - \nu_M^{2-\Gamma}} \right]^{2/7}$$

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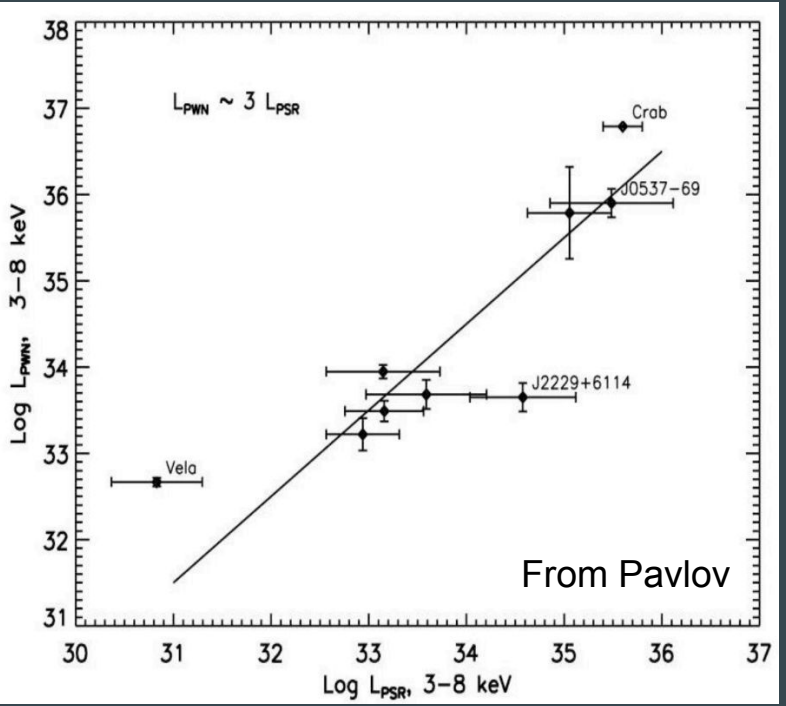
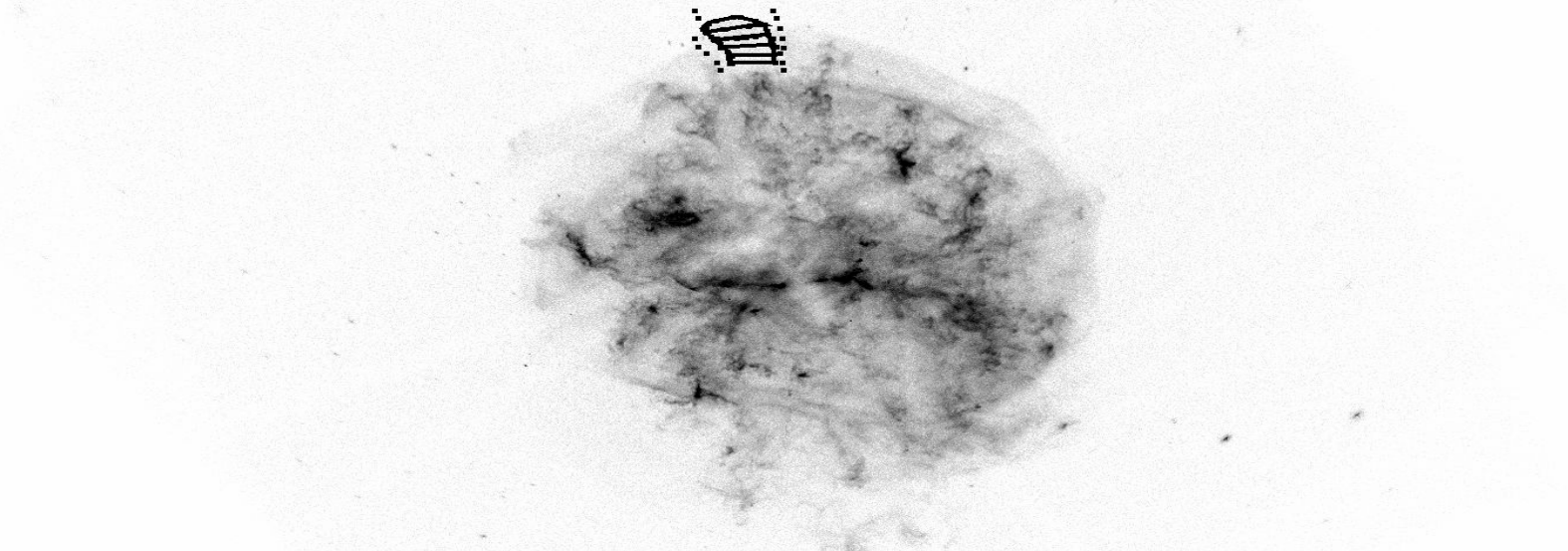
L_{PWN}
L_{PSR}


$L_{PWN} \sim 3\ L_{PSR}$
Crab
J0537−69
J2229+6114
Vela
Log L_{PWN}, 3−8 keV
Log L_{PSR}, 3−8 keV
From Pavlov

Supernova Remnant G292+1.8

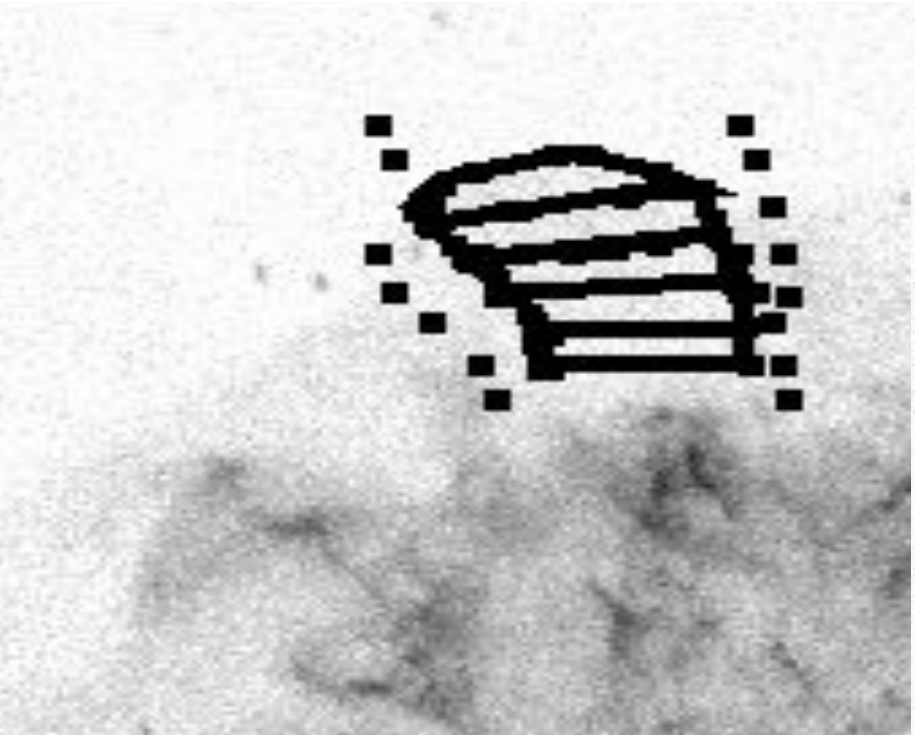


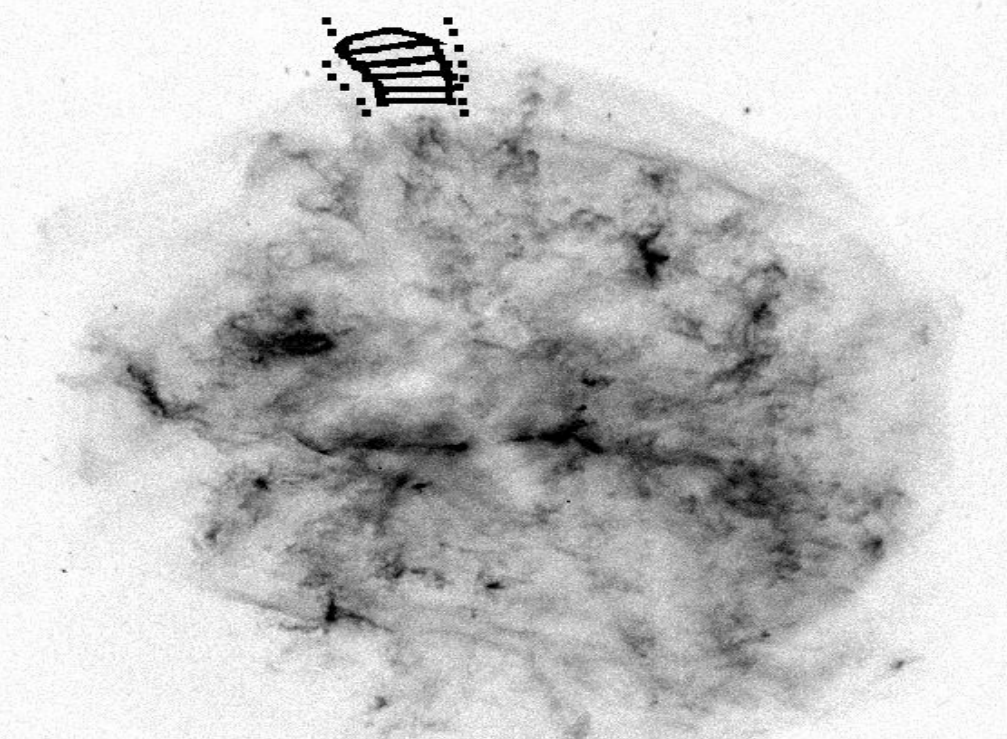
- 3400 year old remnant of a core collapse supernova (Winkler et al. 2006)
- Has extensive ejecta emission from O-Ne-Mg-Si rich material (Hughes et al. 2001; Park et al. 2007)

Purpose

- To analyze the temperatures near the shock front from a 750 kilo-second Chandra observation of G292.0+1.8
  - Compare temperatures to predictions from self similar solutions for supernova remnants of arbitrary density profile in circumstellar gas of arbitrary density profile (Chevalier 1982)
- To find the density of the of the pre-shocked circumstellar material (winds)
  - Using the normalization from within the vpshock model
  - Combine with an assumed stellar wind velocity (10 km/s) to obtain the mass loss rate of the red giant progenitor

Regions



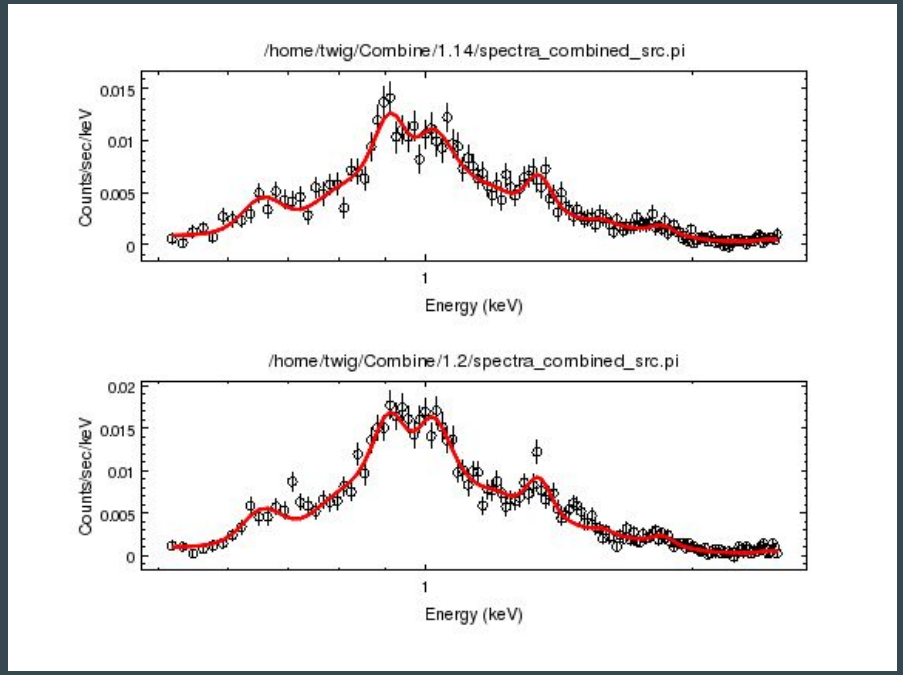


Model Parameters for vpshock model from XSPEC

Hydrogen Column Density		Positive Bound	Negative Bound
H_n	0.412874	-0.02	-0.03
Elements	Solar Abundance	Positive Bound	Negative Bound
O	0.63	0.17	-0.12
Ne	0.88	0.31	-0.06
Mg	0.46	0.06	-0.06
Si	0.3	0.05	-0.06
S	0.57	0.19	-0.26
Fe	0.12	0.03	-0.02
Normalization	5.9084e-05		

vpshock: a plane-parallel shock model for thermal X-ray emission from gas of arbitrary density and abundances

Spectral Fits



Region 1

Region 2

Temperatures and Pre-Shock density

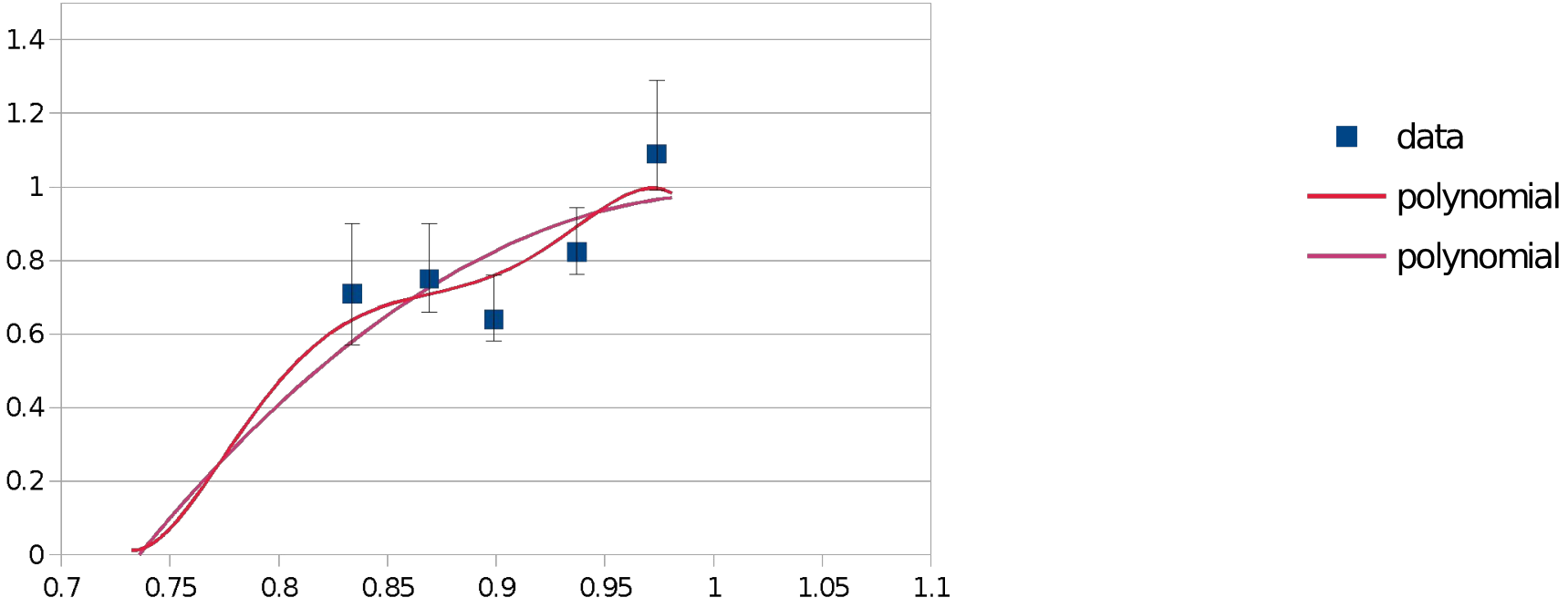
	Temperature (kT)	Negative Bound	Positive Bound
Region 1 - 0.9738’	1.09	-0.1	0.2
Region 2 - 0.937’	0.83	-0.05	0.21
Region 3 - 0.8989	0.64	-0.06	0.12
Region 4 - 0.8692	0.75	-0.09	.15
Region 5 - 0.8338	0.71	-0.14	0.19

$$(10^{-14}/(4\pi[D_A(1+z)]^2)) \int n_e n_H dV$$

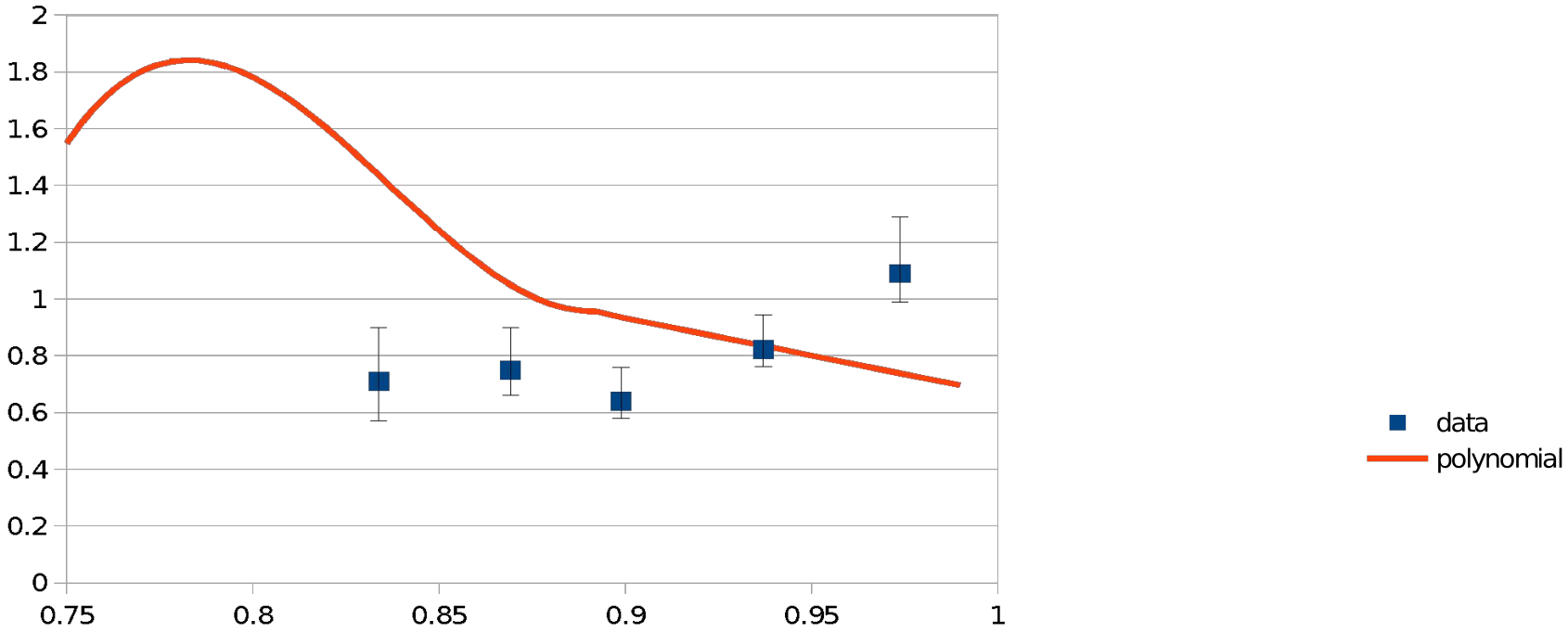
Norm	5.9 * 10^-5
D	1.851 * 10^22 cm
Volume	1.25*10^55 cm
Density	.35

z = 0 (source isn’t cosmological)

Comparison to Plane Parallel Shock Model (vpshock)



Comparison to Plane Parallel Shock Model



Mass Loss

$p = M/4(pi)r^2v_w$, where p represents density(Lee et. al 2010)

We find that the average mass loss is approximately $5e10^{-5}\ M_s\ yr^{-1}$

This is in agreement with the higher bound found in the Lee et. al 2010 paper