AGN JET – CLOUD INTERACTION IN PKS B2152-699

REDNECK GROUP

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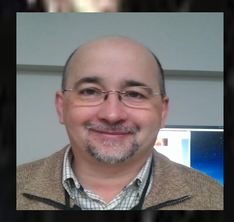


ABSTRACT

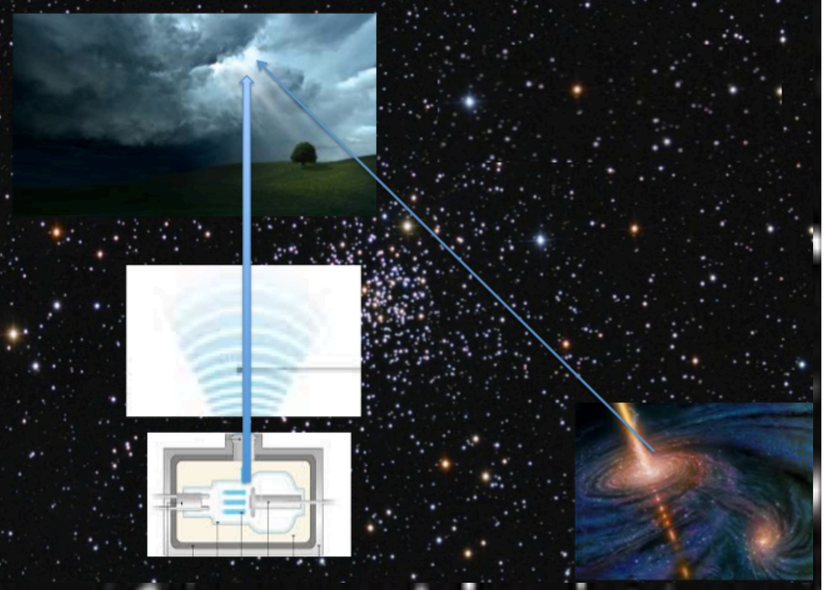
The radio-loud galaxy PKS B2152-699 is the site of an interaction between the AGN jet and a nearby gas cloud, the High Ionization Cloud (HIC) which contains species such as FeVII and FeX in the optical, in addition to low-ionisation species typical of an HII region. The cloud is also bright in X-rays. Cloudy modeling has established that the X-rays from the cloud could have produced the high-ionisation species but not the AGN.

INTRODUCTION

The radio-loud galaxy PKS B2152-699 is one of the brightest radio sources in the southern sky by virtue of its proximity (z=0.028). It is of morphology intermediate between FRI and FRII with bright lobes and hotspots and a visible jet. At ~ 8 kpc projected lies a gas cloud visible at optical and X-ray wavelengths, the High Ionization Cloud (HIC) which contains several species in a high ionization state such as FeVII, FeX, FeXIV and ArIV in addition to those to be expected in a HII region.

IFU data of the optical emission has established an electron density ~ 10^3 cm^{-3} via the [SII] doublet ratio and a temperature of ~ 15,000 K via the [OIII] ratio. Earlier work by Worrall et al (2012) showed that the X-ray emission was characteristic of a temperature of ~ 10^7 K.

Cloudy modeling carried out during the workshop shows that the X-ray source, modeled initially as a point source of luminosity 10^{30} erg/s at a distance from the optical gas of 10^{12} cm, reproduces the observed high-ionization species confirming that they were produced by a mechanism separate to the low-ionization optical emission which does not appear in the simulation output.



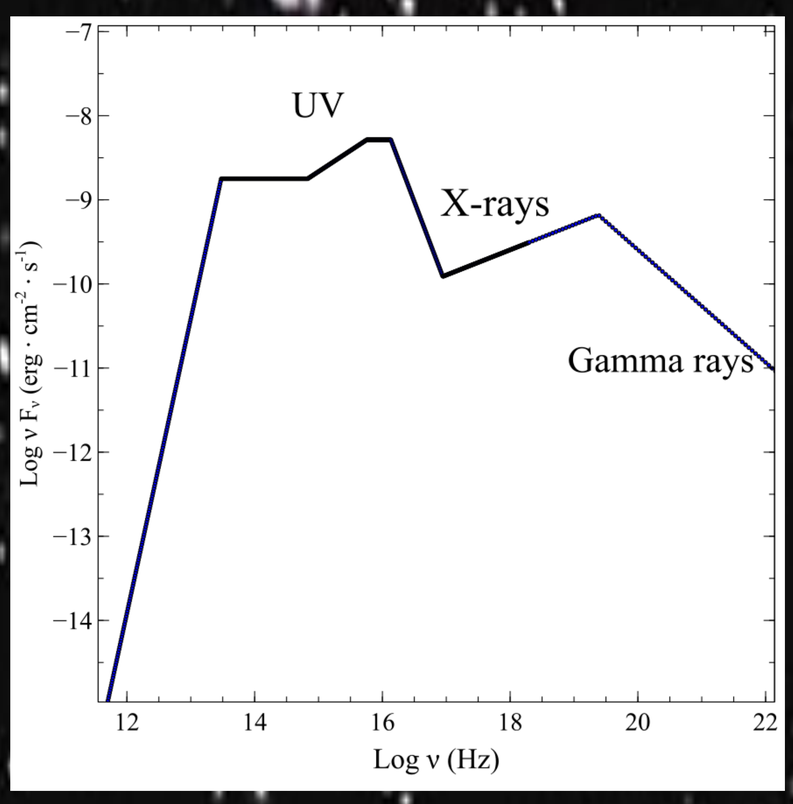
THE MODELS

1. The two models are a simple 10^7 K corona plus a 10^7K point source with a luminosity of 10^{30} erg/s at a distance of 10^{12} cm (i.e. 10^{10}m, equivalent to closer in than the Earth to the Sun).
2. The coronally induced emission lines peak in the X-ray and UV and we do not observe the following species :

NE 5	3426.03A	1.0142e-02
NE 3	3868.75A	1.9805e+00
O 2	3728.81A	5.1993e+00
O 2	3726.03A	4.8400e+00
AR 4	4711.26A	1.4684e-03
AR 4	4740.12A	1.0714e-03
FE14	5303.01A	3.7071e-03
FE 7	5720.71A	4.1394e-03
FE 7	6086.97A	6.3061e-03
FE10	6374.54A	4.6505e-02
AR 3	7135.79A	3.9544e-01

3. The X-ray point source produces all the observed species but ratios to H_β are unobtainable because there is no H_β.

In the AGN model for the SED input of the gas, the temperature is 112 K. This is too low to produce the observed emission lines.



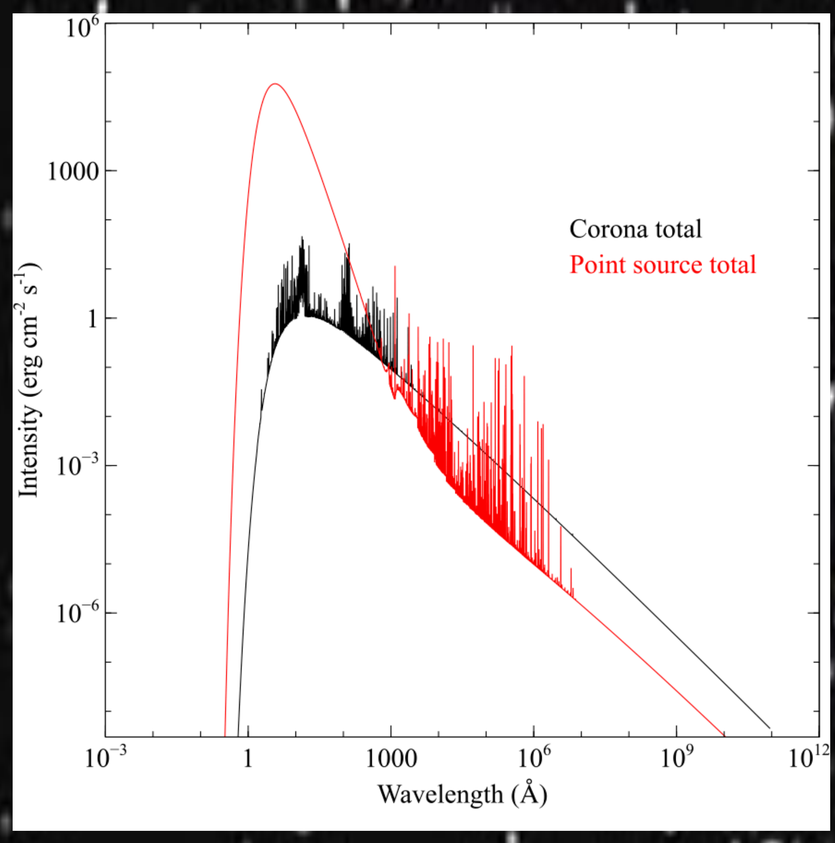
Bolometric luminosity of AGN is: $L_{bol} = 5 \times 10^{41}$ (SED on left)

Cloudy simulations shows that this only heats the distant gas to 112 K : this is too cold to produce the observed emission spectrum.

Must be something else…

X-ray emission enough to produce high ionization lines but not low Ionization lines:

Emission lines are the result of a combination of corona/point source ionizing flux (see right) and another source (possibly heating from a shock front).



CCONCLUSIONS AND PERSPECTIVES

(1) Modelling the X-ray emitting plasma as a point source (exact distance and luminosity to be established) produces all the optical lines from high-ionizarion species, an excellent initial result, while the low-temperature (~15,000K) emission lines were produced by a different mechanism, probably collisional heating by shockwave induced by the interaction of the AGN jet with the cloud.

(2) The AGN seems to produce only a slight warming of the cloud (~100K), so does not contribute to line emission from the distant source.