Subject: Less violent deceleration
From: Robert Laing <rlaing@eso.org>
Date: Mon, 18 Sep 2006 18:27:14 +0200 (CEST)
To: Alan Bridle <abridle@nrao.edu>

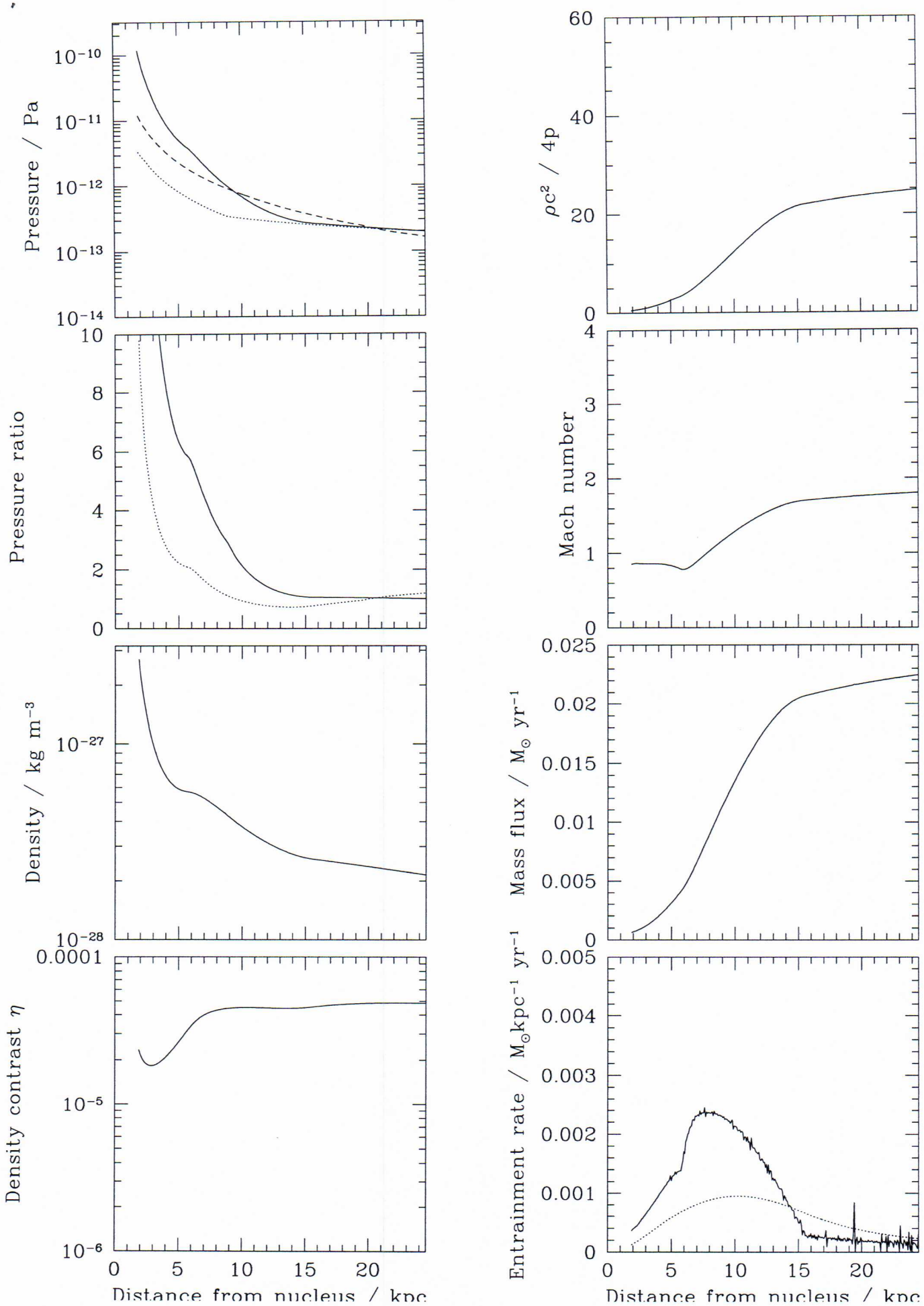
Dear Alan

Here are the plots for 3C296 redone with a few scale and unit tweaks and the inner velocity transition set to its minimum value from the error analysis (2.3 kpc). As you will see, this is enough to produce a much more sensible looking entrainment rate curve.

Cheers

Robert

3c296plots.ps.gz	**Content-Description:**	Revised plots
	Content-Type:	APPLICATION/x-gzip
	Content-Encoding:	BASE64


Pressure / Pa
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
Pressure ratio
10
8
6
4
2
0
Density / kg m^{-3}
10^{-27}
10^{-28}
Density contrast η
0.0001
10^{-5}
10^{-6}
0
5
10
15
20
Distance from nucleus / kpc
ρc^2 / 4p
60
40
20
0
Mach number
4
3
2
1
0
Mass flux / $M_\odot$ yr^{-1}
0.025
0.02
0.015
0.01
0.005
0
Entrainment rate / $M_\odot$kpc^{-1} yr^{-1}
0.005
0.004
0.003
0.002
0.001
0
0
5
10
15
20
Distance from nucleus / kpc

Subject: Re: Status of XMM data for jet model sources
From: Robert Laing <rlaing@eso.org>
Date: Mon, 18 Sep 2006 11:00:03 +0200 (CEST)
To: Judith Croston <jcroston@star.herts.ac.uk>
CC: Diana Worrall <D.Worrall@bristol.ac.uk>, Martin Hardcastle <mjh@star.herts.ac.uk>, Alan Bridle <abridle@nrao.edu>

Dear Judith

Here's a first pass at the conservation law analysis for 3C296, based on your new results. I've also attached the same plots for 0326, as I can't recall whether I copied them to everybody.

This is VERY preliminary, as I only got the code going yesterday during a meeting, but in the interests of allowing time to draft a proposal, I thought I'd circulate it warts and all.

The panels are:

Pressure (bold = jet internal, dashed external, dotted synchrotron minimum)

Pressure ratios (full = internal/sync minimum; dotted internal/external)

Internal density

Internal/external density ratio

Bicknell R parameter = \rho c^2/4p

Generalised Mach number

Mass flux (sorry the units are different ...)

Entrainment rate (ditto) Full line = model; dotted = stars

For 3C296, the stars line is not right, as I haven't had time to work out the mass input rate properly, but it does represent a generic radio galaxy. The glitch in the entrainment rate at 6 kpc is a consequence of the very sudden decrease in deceleration in our model. I believe this is unphysical and that interpolating over the glitch gives a better estimate of what is really going on. The entrainment rate profile also needs to be smoothed (or the calculation of mass flux done to higher precision).

Although the pressure does not match the external quite as closely in 3C296 as in 3C31 or 0326, I think that the solution is pretty reasonable. If the jet is propagating inside the lobe, the pressure it experiences may not be quite the external value anyway.

I think we can certainly use the 3C296 case as justification for needing XMM as well as Chandra.

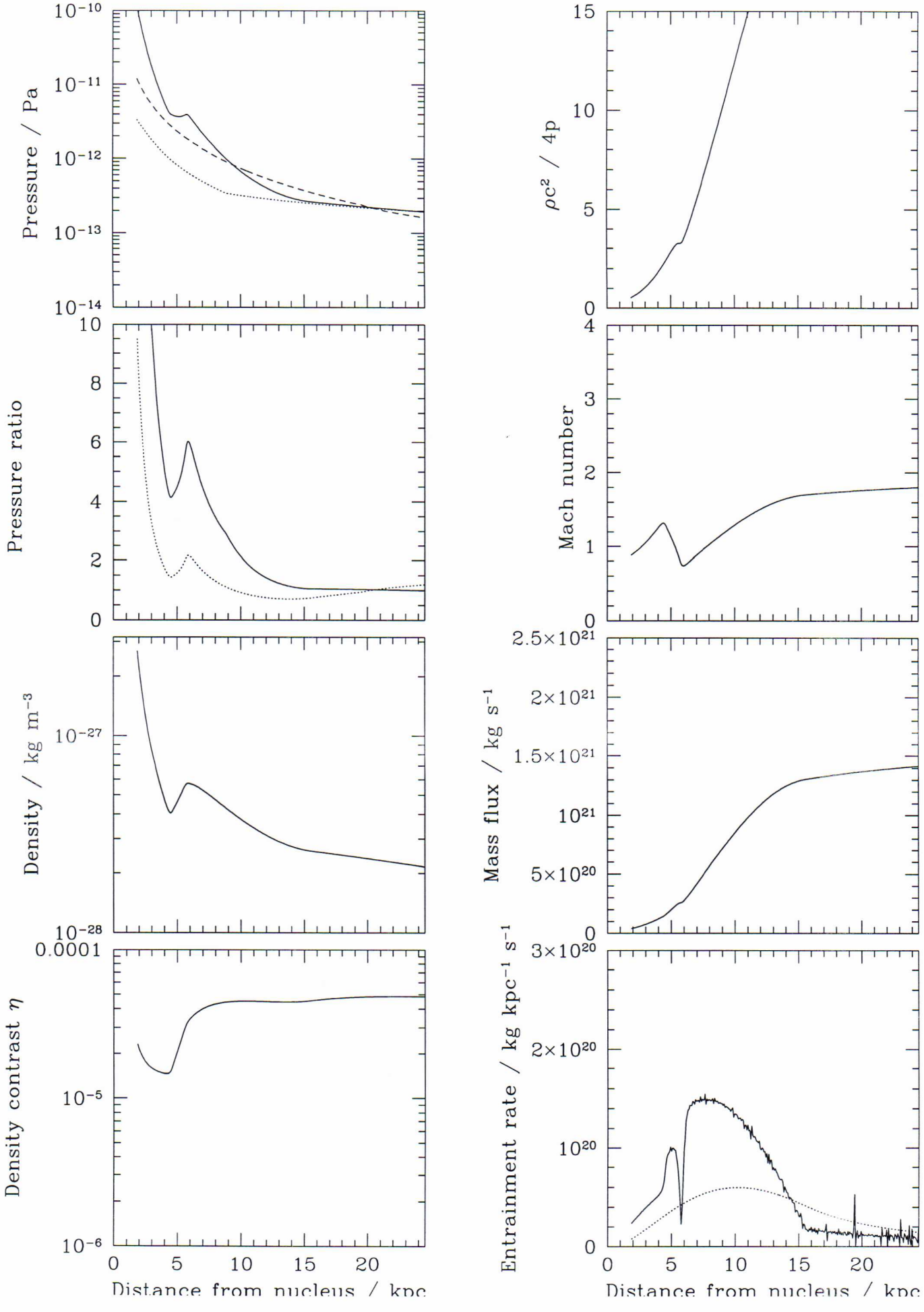
Regards

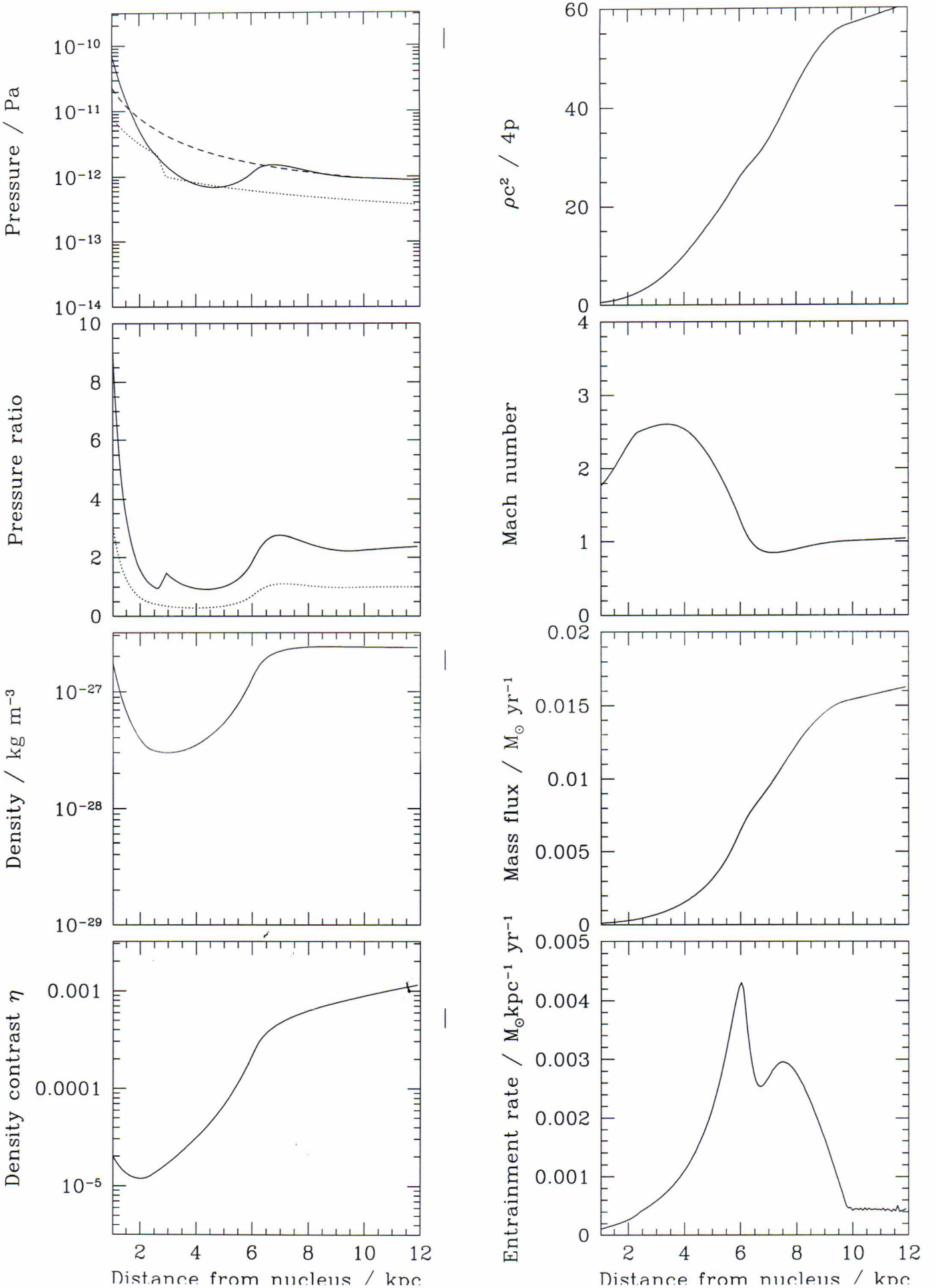
Robert

3c296plots.ps.gz	**Content-Description:**	3C296 plots
	Content-Type:	APPLICATION/x-gzip
	Content-Encoding:	BASE64

0326plots.ps.gz	**Content-Description:** 0326 plots

3C296


Pressure / Pa
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
ρc^2 / 4p
15
10
5
0
Pressure ratio
10
8
6
4
2
0
Mach number
4
3
2
1
0
Density / kg m^{-3}
10^{-27}
10^{-28}
Mass flux / kg s^{-1}
2.5×10^{21}
2×10^{21}
1.5×10^{21}
10^{21}
5×10^{20}
0
Density contrast η
0.0001
10^{-5}
10^{-6}
Entrainment rate / kg kpc^{-1} s^{-1}
3×10^{20}
2×10^{20}
10^{20}
0
0
5
10
15
20
Distance from nucleus / kpc
Distance from nucleus / kpc


Pressure / Pa
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
Pressure ratio
10
8
6
4
2
0
Density / kg m^{-3}
10^{-27}
10^{-28}
10^{-29}
Density contrast η
0.001
0.0001
10^{-5}
2
4
6
8
10
12
Distance from nucleus / kpc
ρc^2 / 4p
60
40
20
0
Mach number
4
3
2
1
0
Mass flux / $M_\odot$ yr^{-1}
0.02
0.015
0.01
0.005
0
Entrainment rate / $M_\odot$kpc^{-1} yr^{-1}
0.005
0.004
0.003
0.002
0.001
0
2
4
6
8
10
12
Distance from nucleus / kpc

Subject: Re: 3C296 backflow
From: Robert Laing <rlaing@eso.org>
Date: Fri, 26 Sep 2008 12:20:16 +0200
To: Alan Bridle <abridle@nrao.edu>
CC: parma@ira.inaf.it

Dear Alan

I think I have now managed to come up with something approaching an acceptable backflow model for 3C296 (see attached plots). The main problem was how to turn off the backflow close to the nucleus: as you will see from VEL.PS, I did this more gradually than in earlier attempts.

The new models reproduce the regions with sidedness ratio < 1 by design, but also do a much better job of the transverse polarization profile in the main jet. The overall chi-squared is significantly lower than for the pure outflow models.

There is one unsatisfactory feature, which is that the deceleration is even more abrupt than it was previously, as the model decided to turn on the backflow almost exactly at the point where the jet slows suddenly. I'm not sure whether this is fundamental, as I haven't finished optimizing yet and one of the geometry parameters which should have been adjusted was actually frozen during the last attempt.

I did not attempt to model the knot at the base of the counter-jet: the emissivity model for the outflow is actually simpler than the published one, with 3 rather than 4 power-law regions.

I'll try to refine the model over the next few days and will also apply the new version to 0206.

Regards

Robert

3c296plots.tgz	**Content-Type:** application/x-gzip **Content-Encoding:** base64