9th Serbian Conference on Spectral Line Shapes in Astrophysics
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The intrinsic Baldwin effect in a sample of AGNs with broad lines

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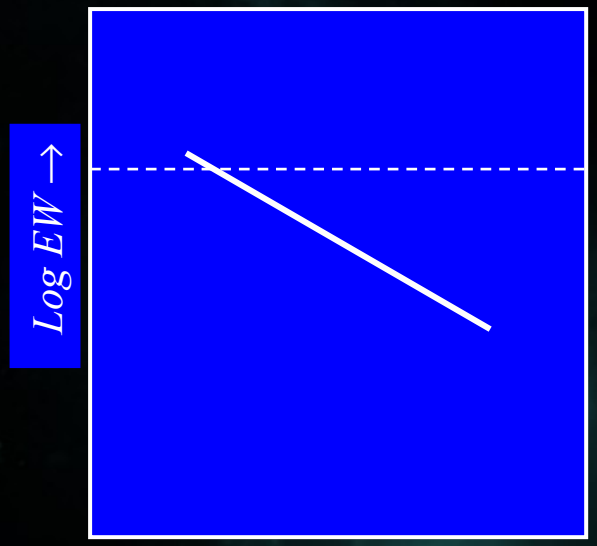
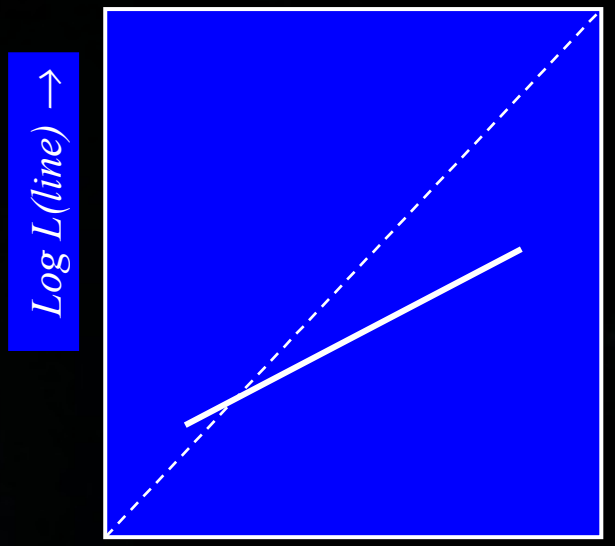
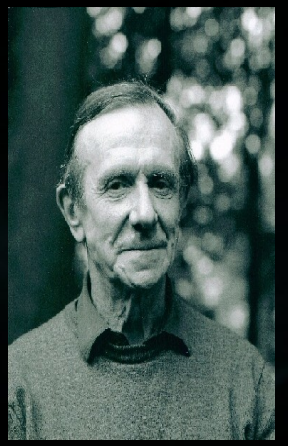
Dragana Ilić

Baldwin Effect





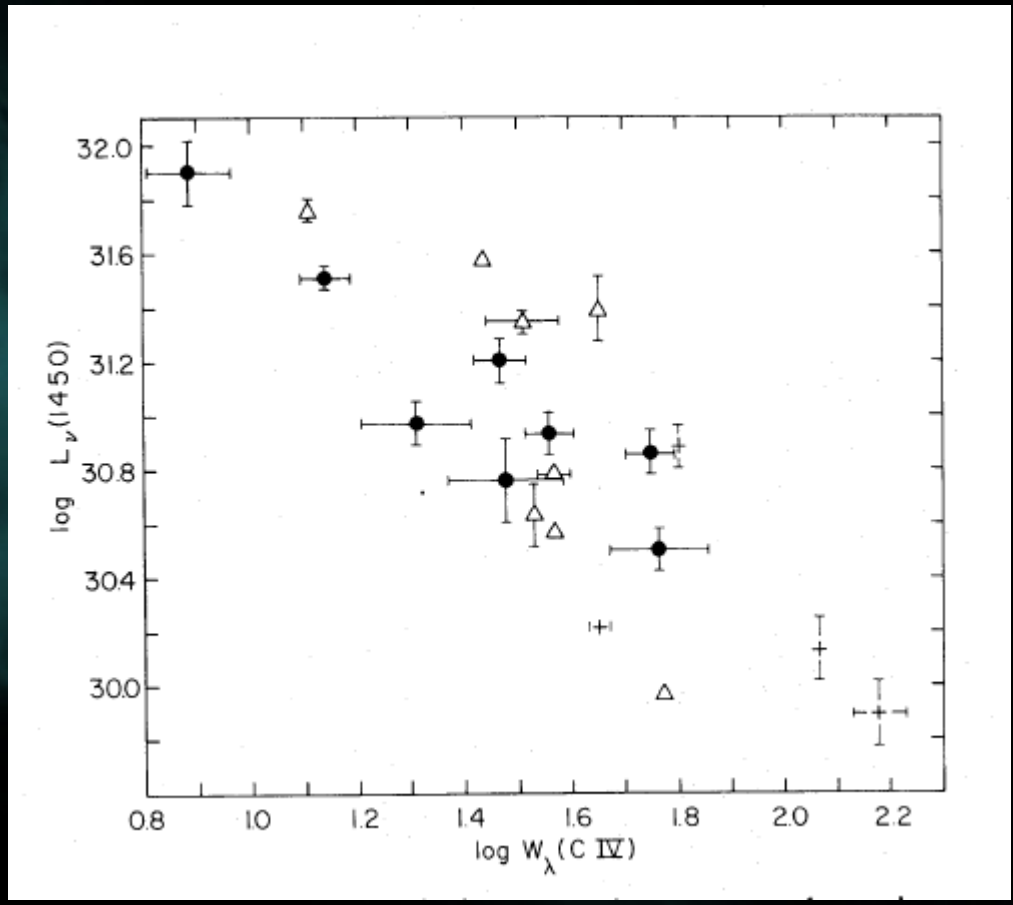
Gllobal and Intrinsic Baldwin Effect



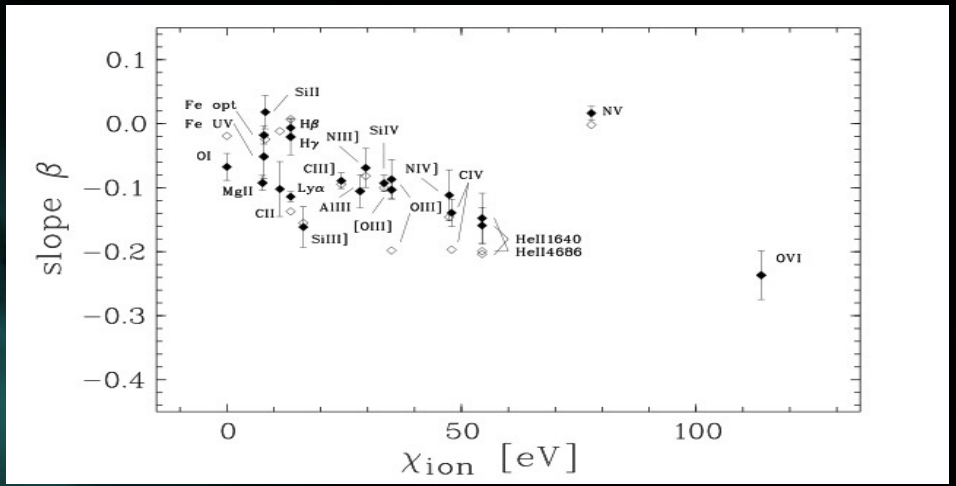
A bit of history of Beff

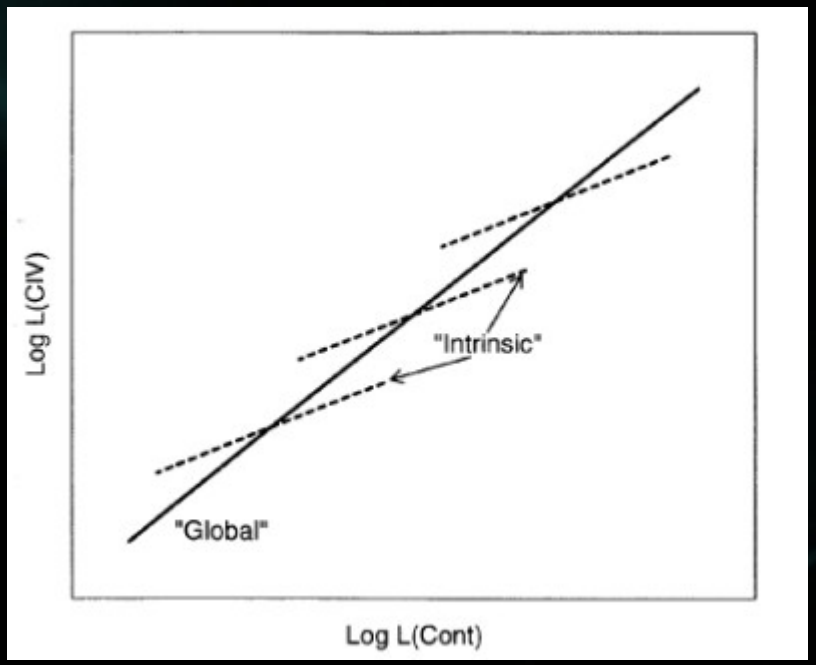
- Jack A. Baldwin 1977 showed

  strong correlation between EW and L (1450Å)
- Carswell and Smith 1978 refered that as Baldwin effect.
- Pogge and Peterson in 1992 dubbed ”intristic” Baldwin effect for individual variable AGNS



- Its shown for almost all the lines in UV/optical
- Progress is going on also in X-ray in last couple of years
- Kinney et al. (1990) intrinsic Beff has a steeper slope than global
- M.R. Goad, K.T. Korista and C. Knigge in 2004 reported non constant slope of the Intrinstic Baldwin Effect for Hbeta line NGC 5548





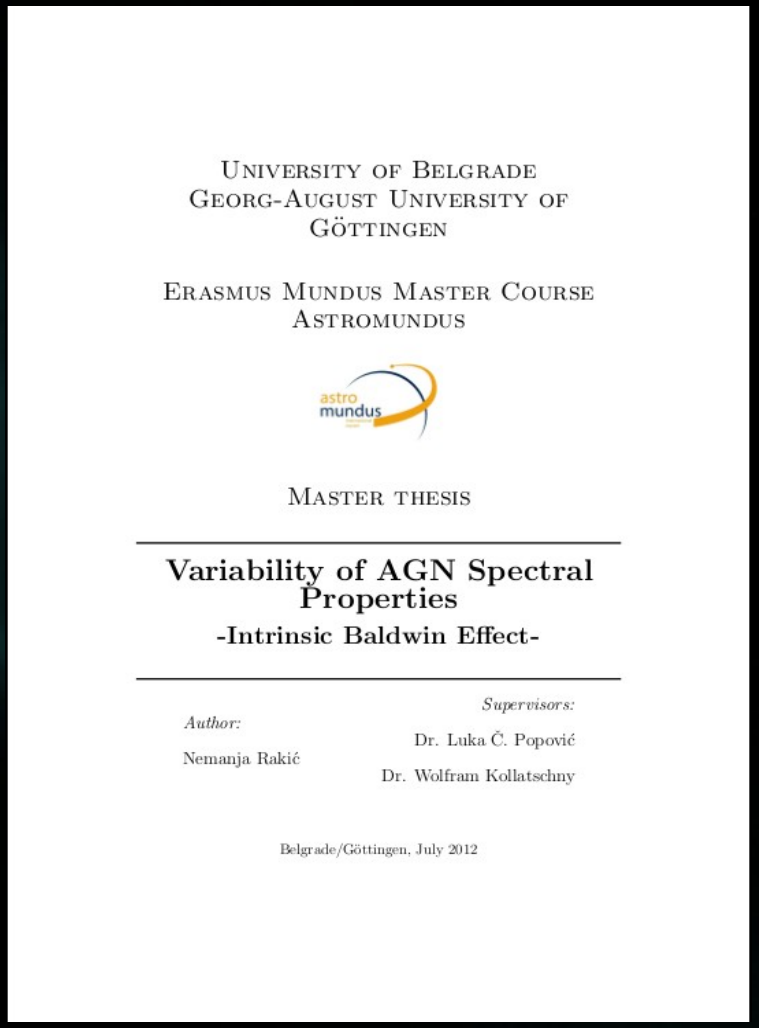
Physical origin

- Eddington ratio (Baskin & Laor 2004)
- SED (proposed by many authors)
- Mass of the BH (Warner et al. 2003)

Non constant slope

Found in:

- NGC 4151 (Kong et al., 2006, and this thesis)
- Fairall 9 (Wamsteker & Colina, 1986; Osmer & Shields, 1999),
- NGC 5548 (Goad et al., 2004),



University of Belgrade
Georg-August University of Göttingen

Erasmus Mundus Master Course
Astromundus

Master thesis

Variability of AGN Spectral Properties
-Intrinsic Baldwin Effect-

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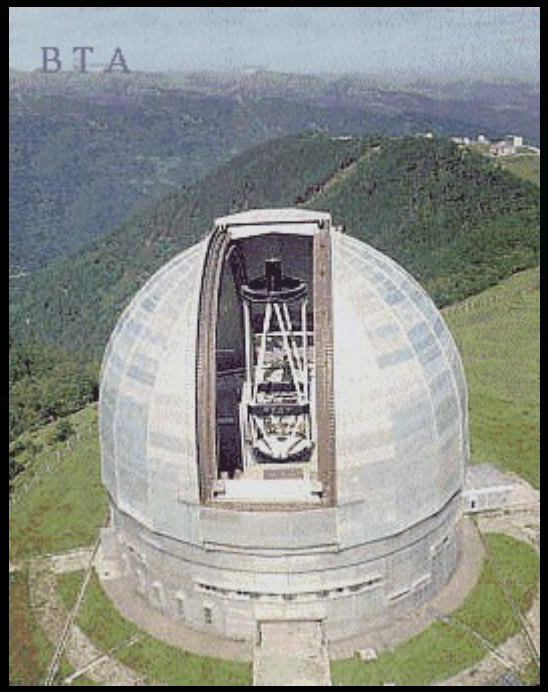
Belgrade/Göttingen, July 2012

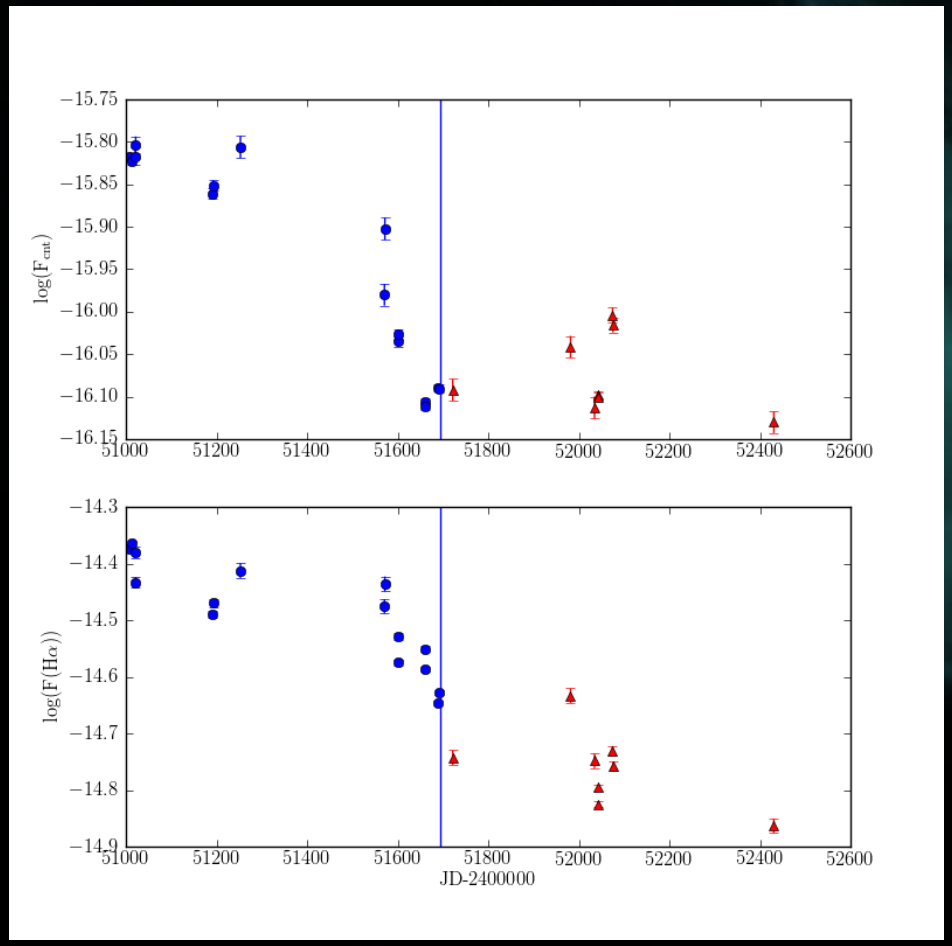
Data and Results

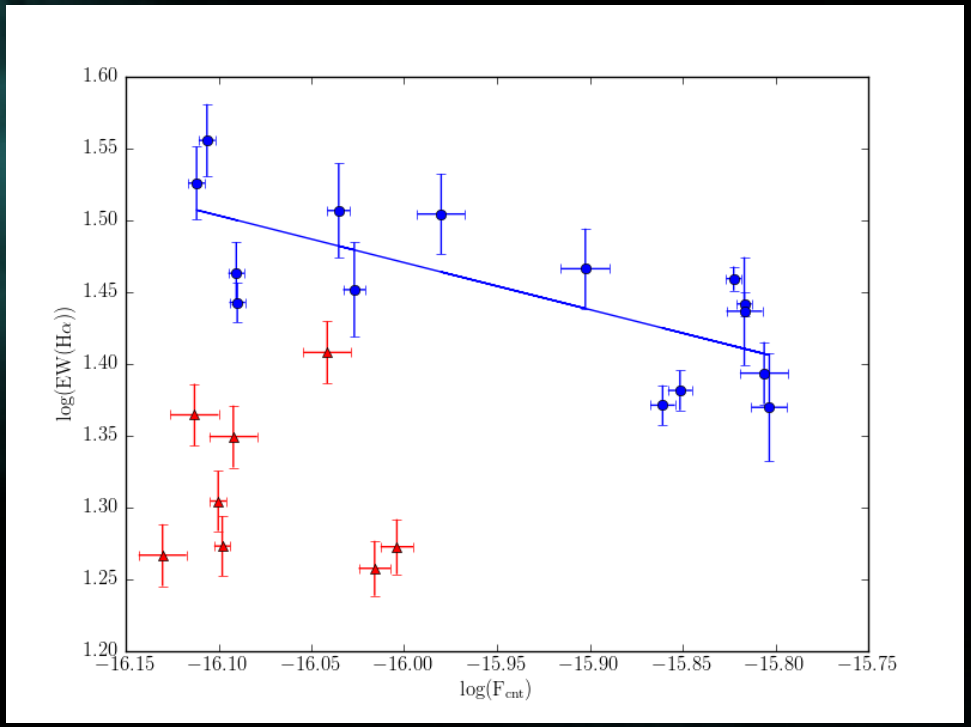


(Shapovalova et al., 2004, 2008, 2010)

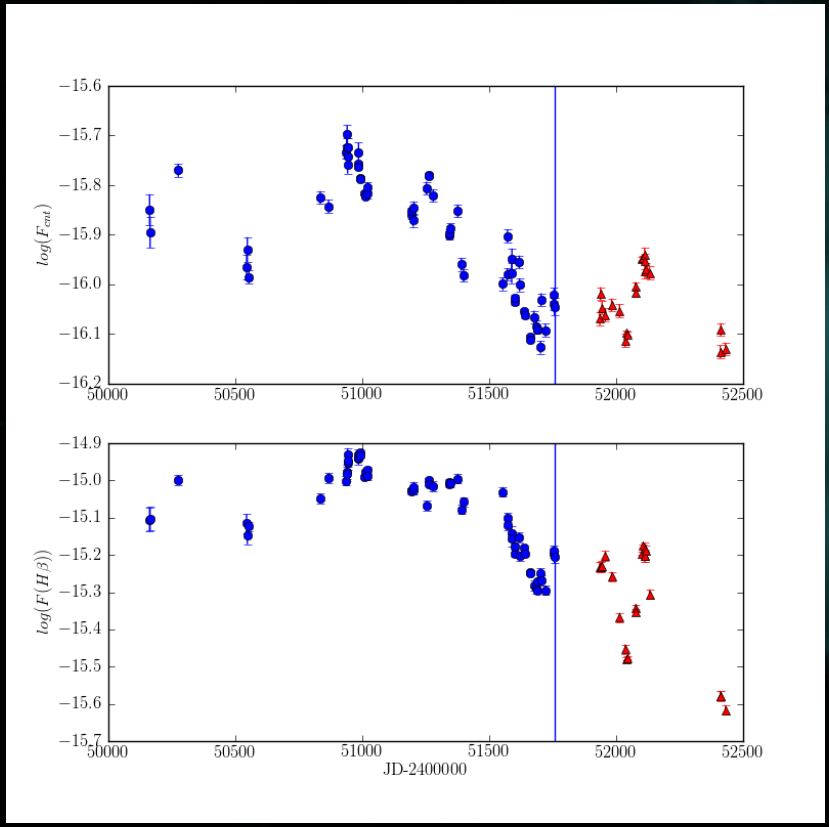
NGC 5548

Seyfert 1.5 galaxy





NGC 5548



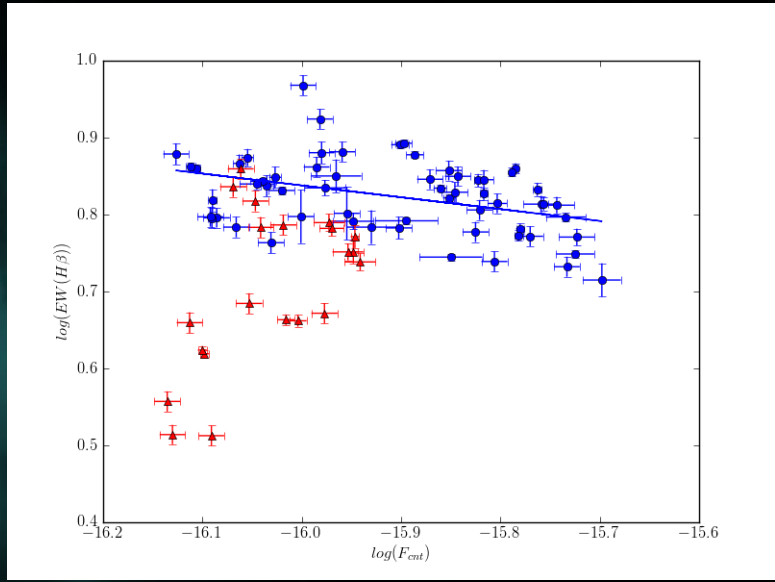
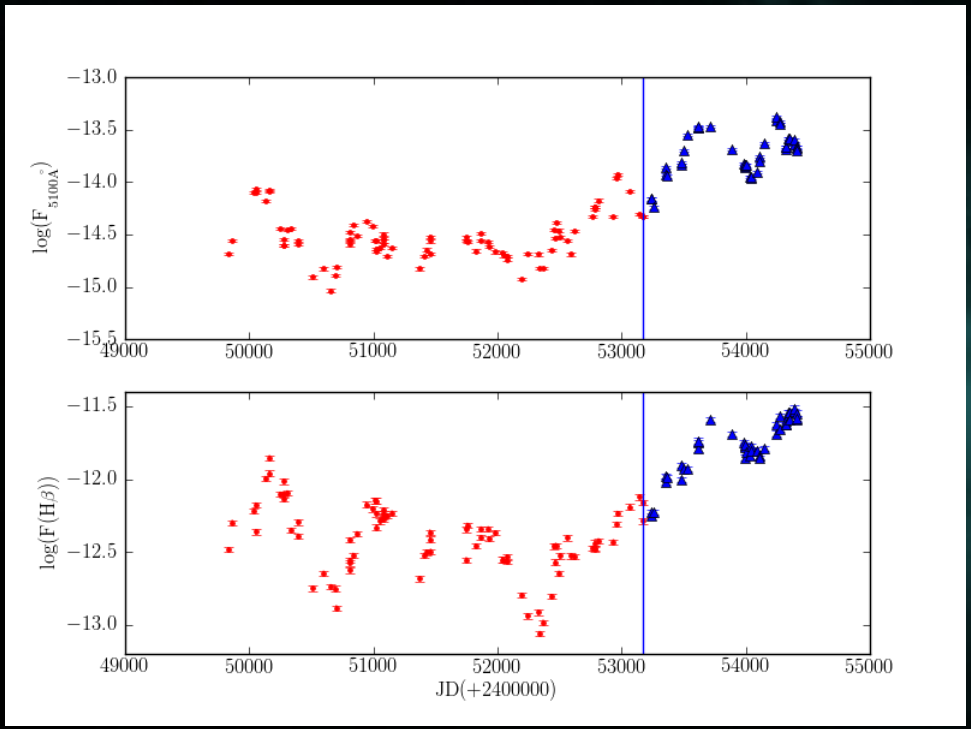


Table 5: The parameters of the intrinsic Beff in NGC 5548. r is the Pearson coefficient of correlation, P is the statistical significance, β the slope of the least square-fit, and log A constant of the linear fit. P 1 + P 2 represents full data range, and P 1 only period 1

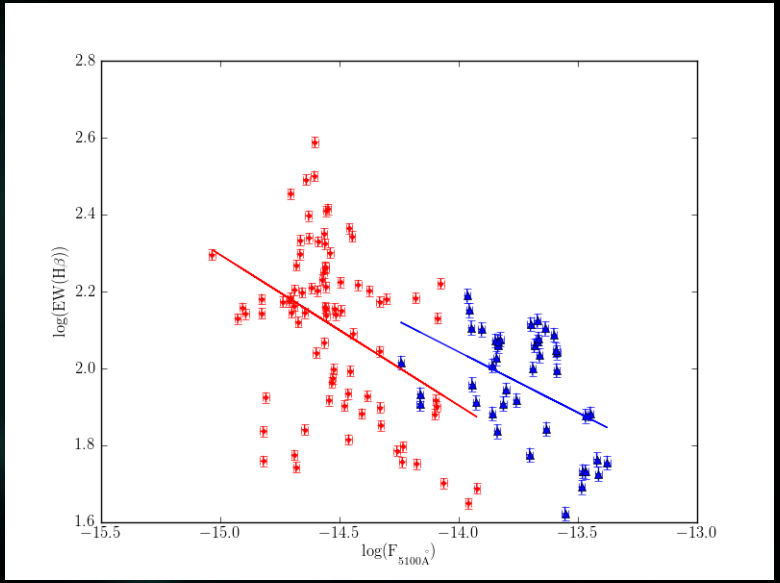
line	r	P	β	log A	data set
Hα	0.102	0.64	-	-	P 1 + P 2
	-0.723	0.023	-0.33	-3.77	P 1
Hβ	0.19	0.08	-	-	P 1 + P 2
	-0.40	0.0017	-0.15	-1.62	P 1

Shapovalova et al. (2004)

3C390.3

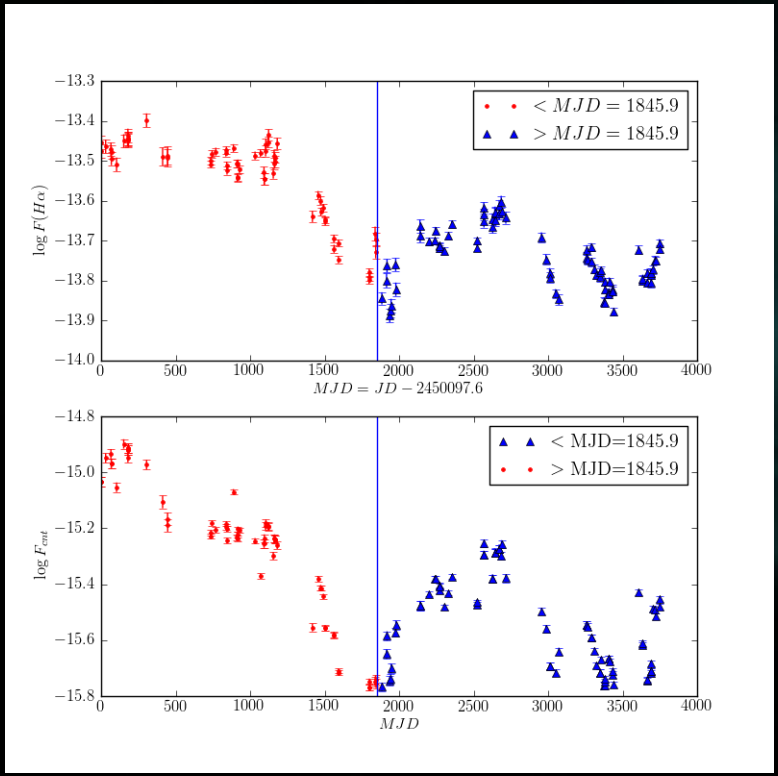


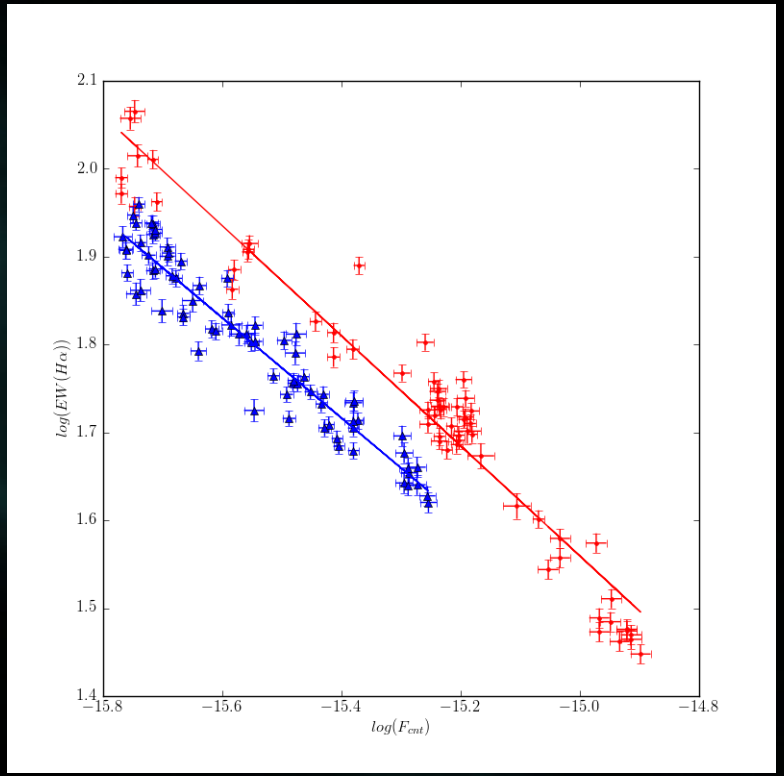
FR II radio galaxy



Pearson correlation coefficient has been calculated separately for each period, as well as the least square fit. Results that we obtained are the following: r = −0.414 with P = 8 × 10−5 , β = −0.391 and constant log A =−3.575 for period 1 and for period 2 r = −0.463 with P = 0.002, B = −0.316 and log A = −2.380

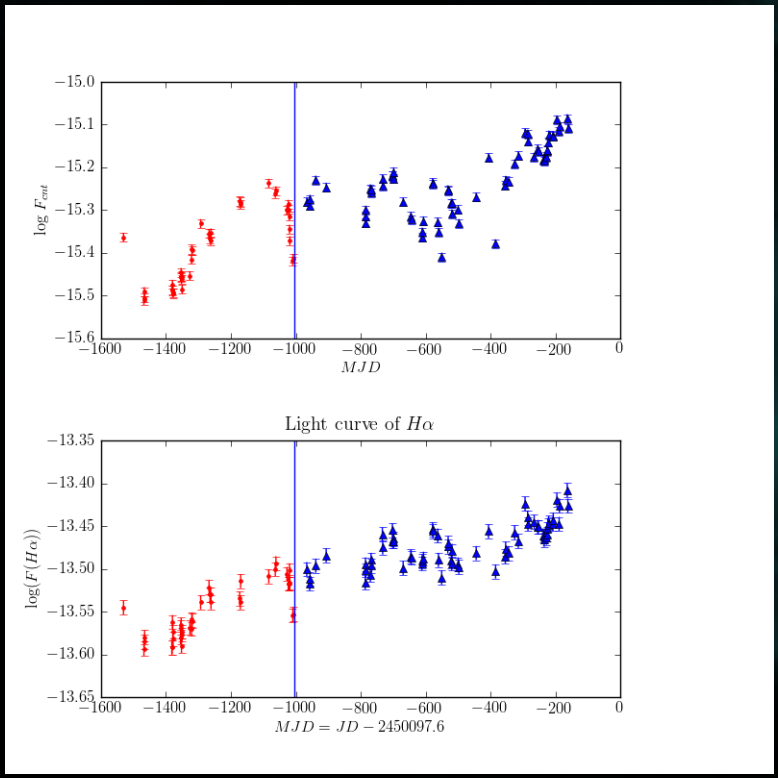
NGC 4151





Shapovalova et al. (2008)

NGC 4151



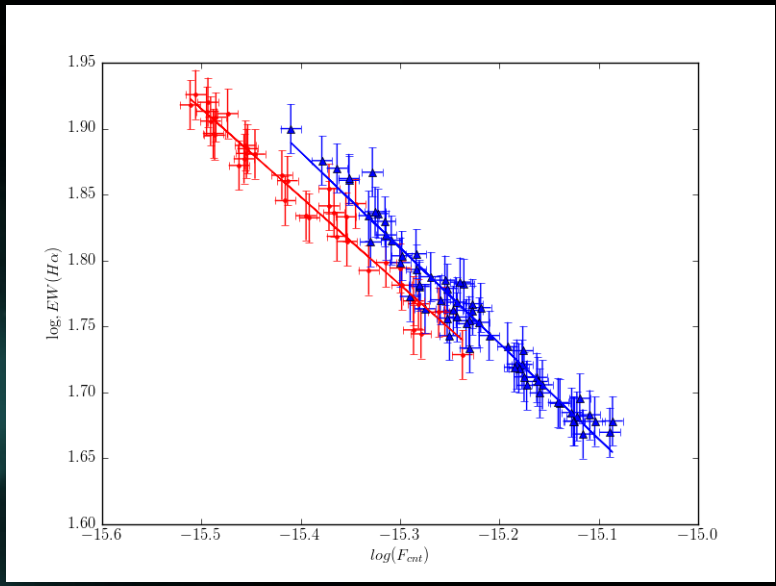
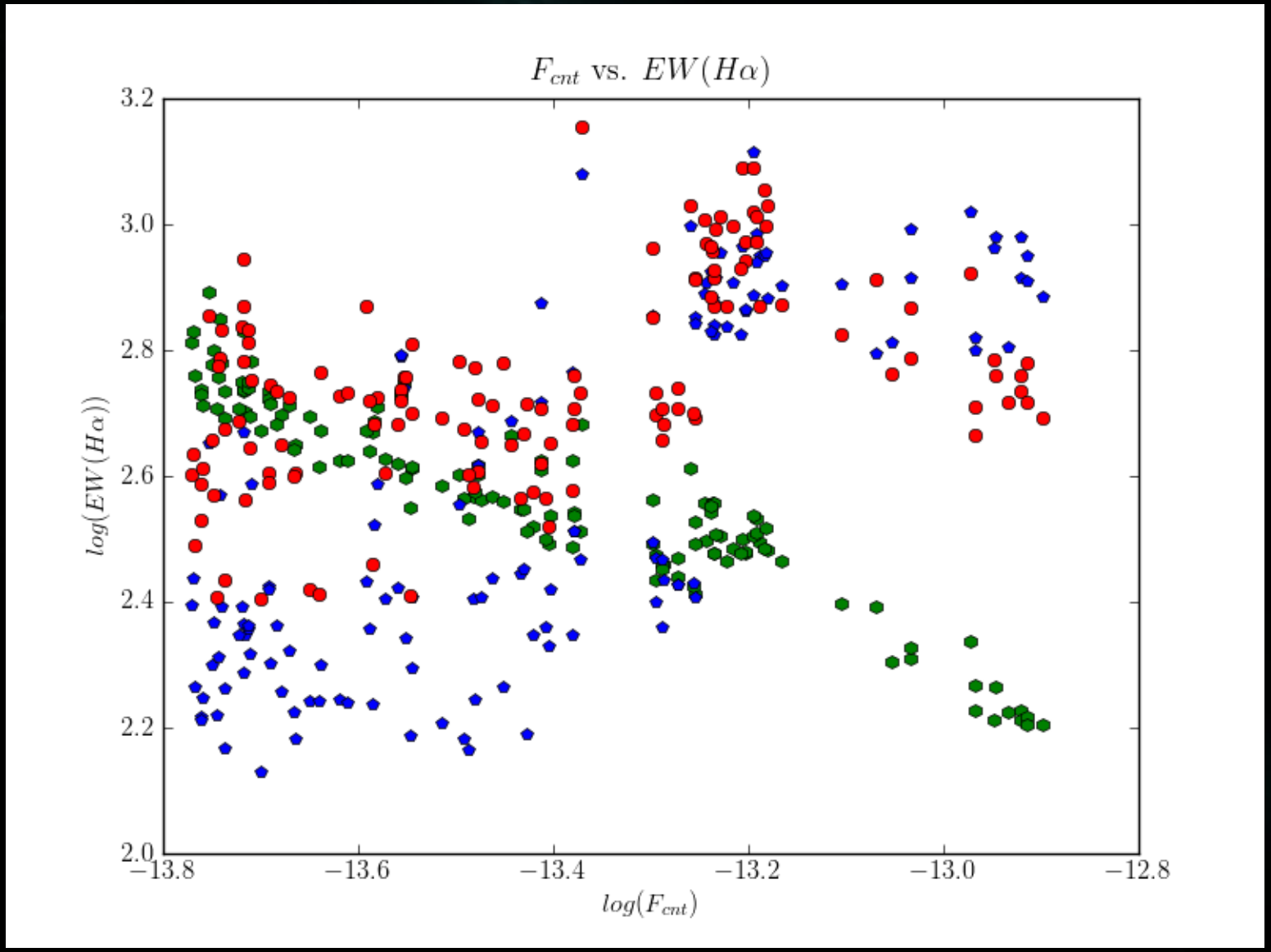


Table 6: The coefficients of the intrinsic Beff in NGC 4151 are summarized. r is the Pearson coefficient of correlation, P is the statistical significance, β the slope of the least square-fit, and log A constant of linear fit. Sh represents data obtained from Shapovalova et al. (2008) and Ma data from Malkov et al. (1997a).

Line	r	P	β	log A	data sets
Hα	-0.971	8×10^{-40}	-0.626	-7.835	period 1 Sh
	-0.957	2×10^{-40}	-0.569	-7.054	period 2 Sh
	-0.922	10^{-57}	-0.498	-5.919	p1+p2 Sh
	-0.979	10^{-26}	-0.663	-8.353	period 1 Ma
	-0.969	10^{-39}	-0.699	-8.888	period 2 Ma
	-0.972	3×10^{-65}	-0.612	-7.557	p1+p2 Ma
Hβ	-0.860	7×10^{-27}	-0.310	-3.663	period 1 Sh
	-0.657	9×10^{-19}	-0.307	-3.666	period 2 Sh
	-0.748	10^{-33}	-0.262	-2.948	p1+p2 sh

Malkov et al. (1997)

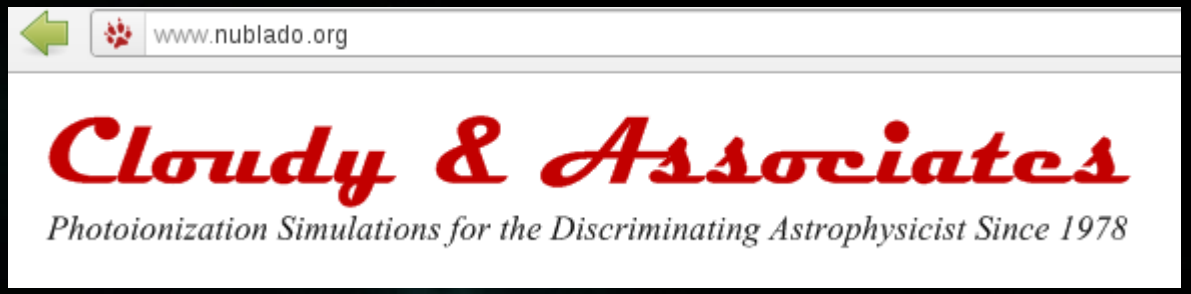
NGC 4151


F_{cnt} vs. $EW(H\alpha)$
3.2
3.0
2.8
2.6
2.4
2.2
2.0
$log(EW(H\alpha))$
−13.8
−13.6
−13.4
−13.2
−13.0
−12.8
$log(F_{cnt})$

CONCLUSIONS 1

1. In all three objects in some period the intrinsic Beff may be present, but significant Beff can be detected only in NGC 4151. Also in 3C390.3
in the period of high flux state.

2. In both data sets taken from the Shapovalova et al. (2008) and Malkov et al. (1997a) we found a strong intrinsic Baldwin effect in NGC 4151. In addition we found that the slope of the intrinsic Beff is changing in the time.



Cloudy is a spectral synthesis code designed to simulate conditions in interstellar matter under a broad range of conditions.

41.0_113.in

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9
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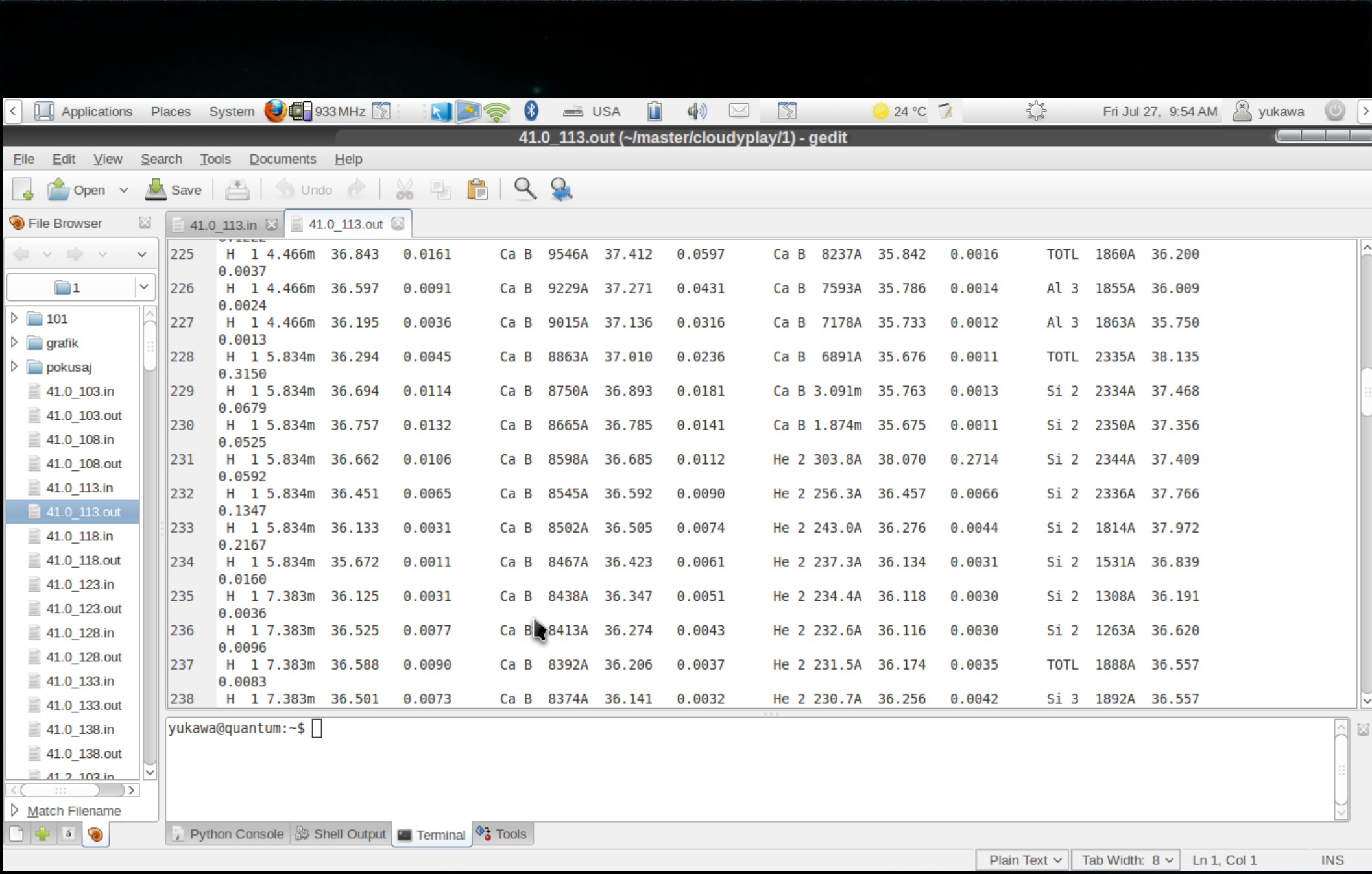
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236 H 1 7.383m 36.525 0.0077 Ca B 8413A 36.274 0.0043 He 2 232.6A 36.116 0.0030 Si 2 1263A 36.620 0.0096
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Python Console Shell Output Terminal Tools
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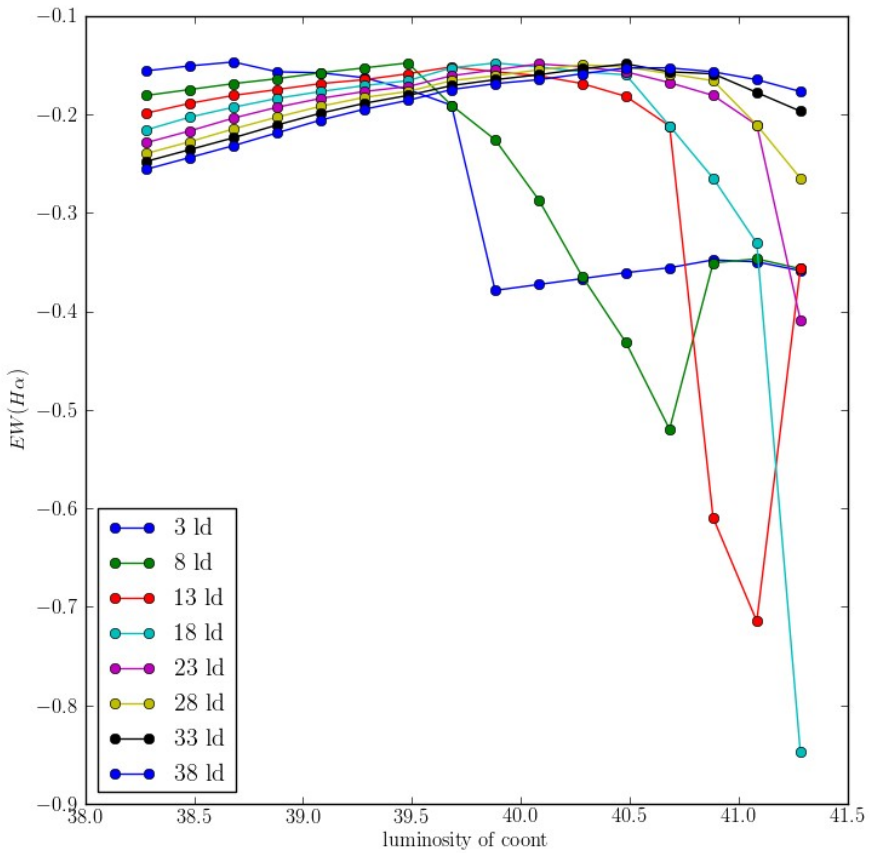
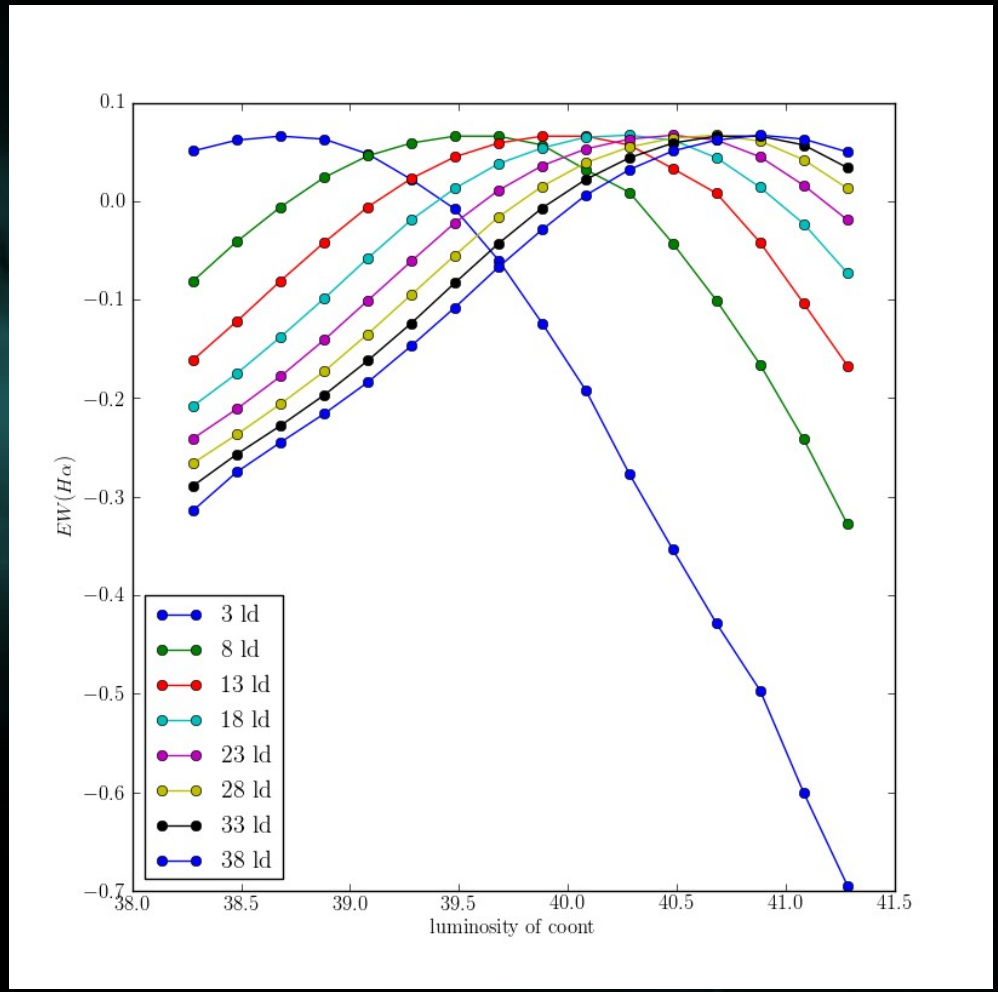
CLOUDY



H density 10^9



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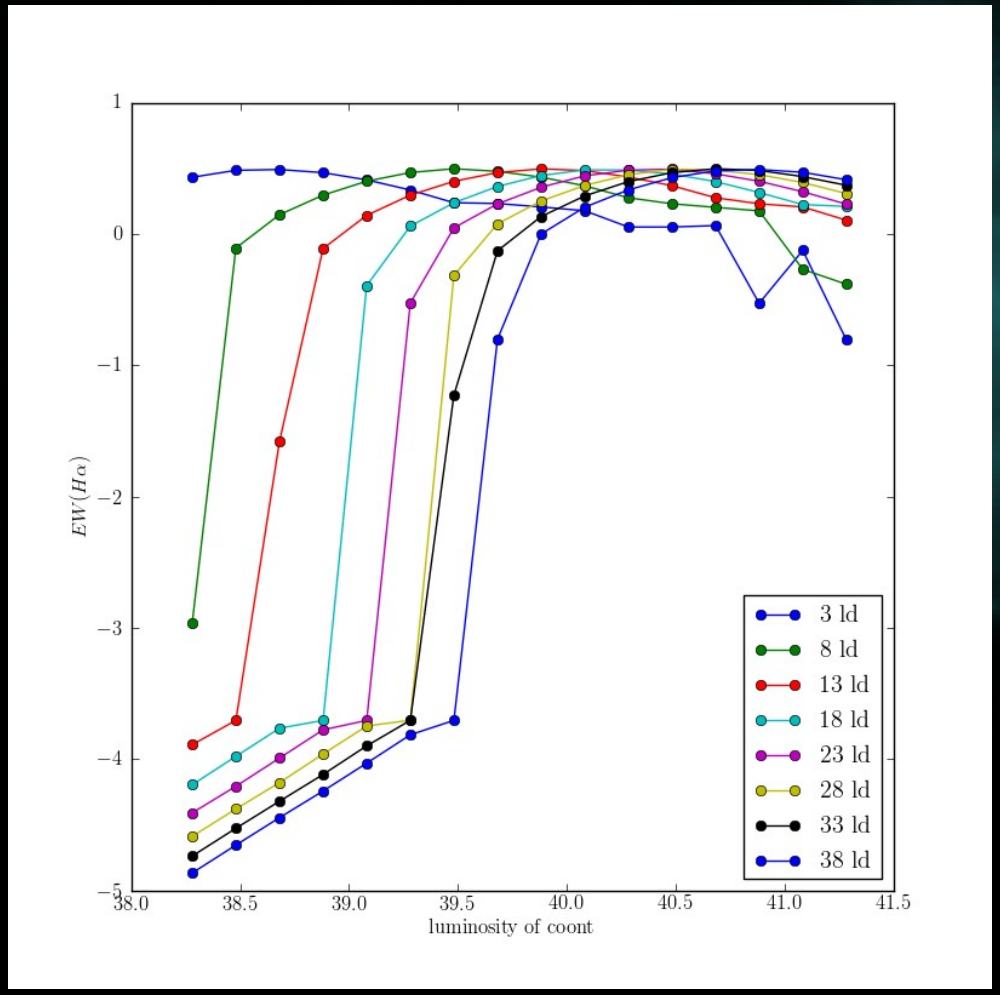
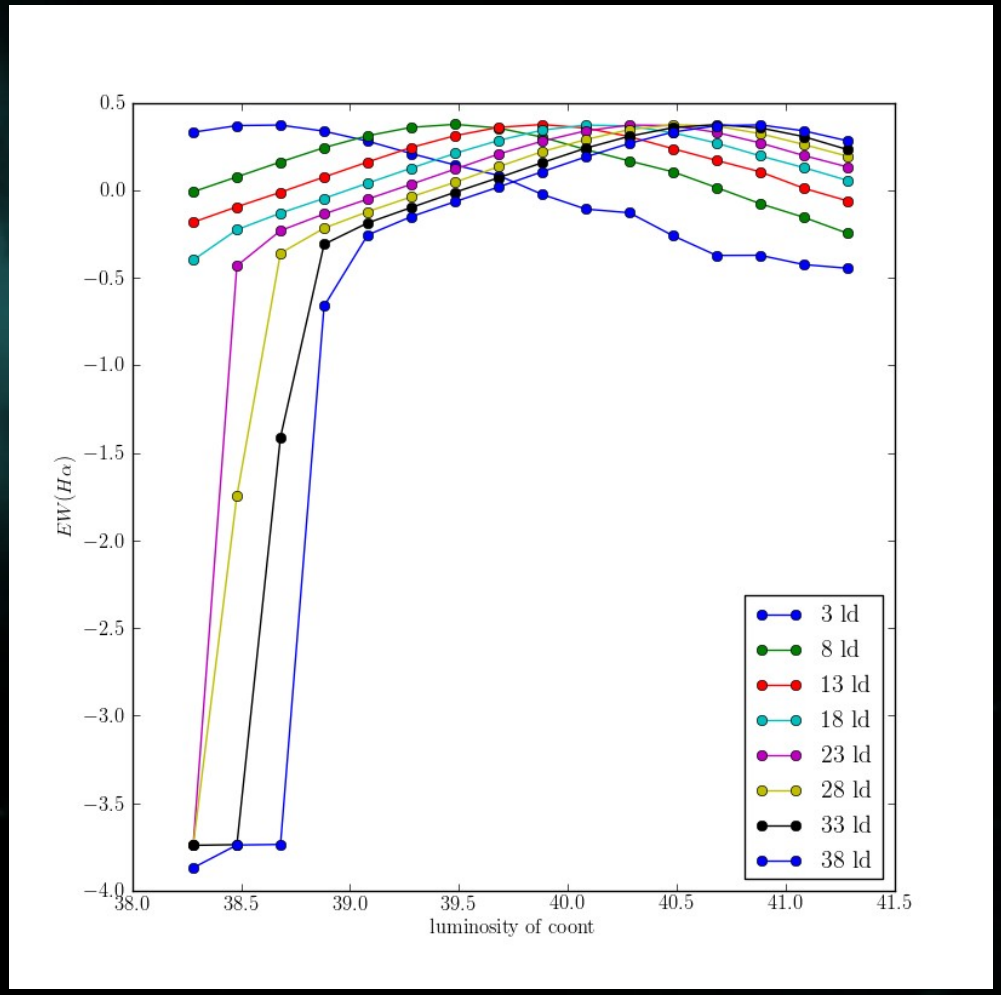
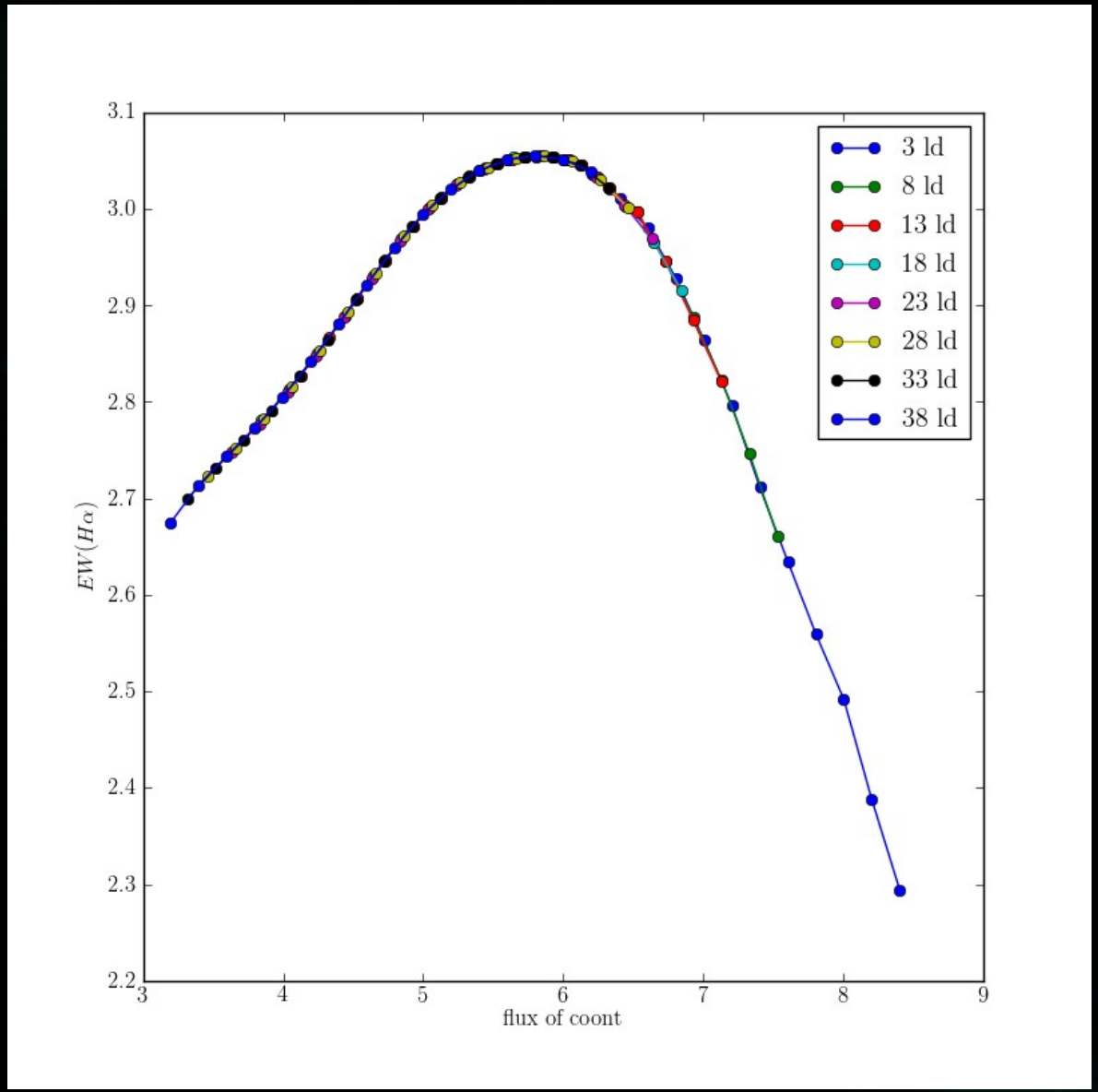


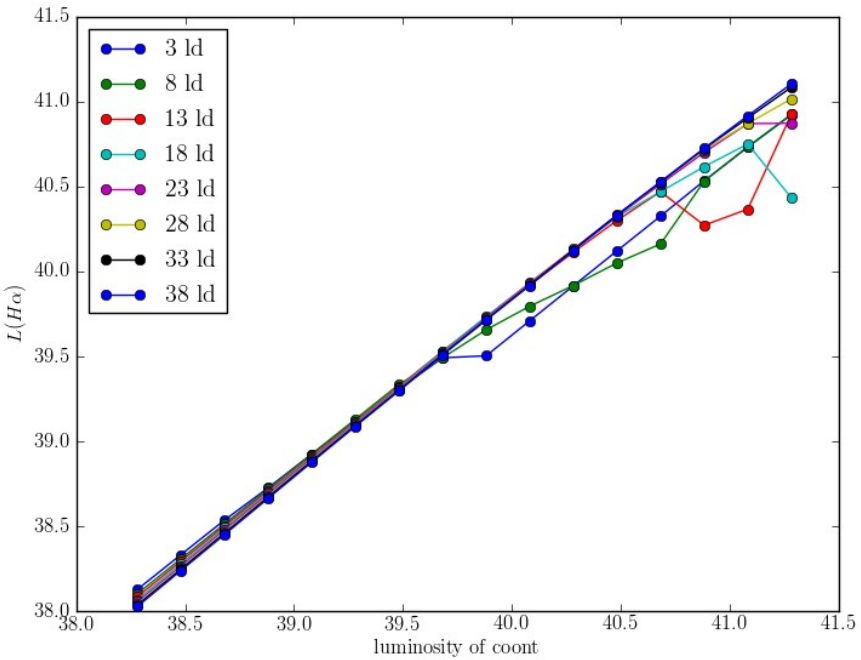
H density 10^11



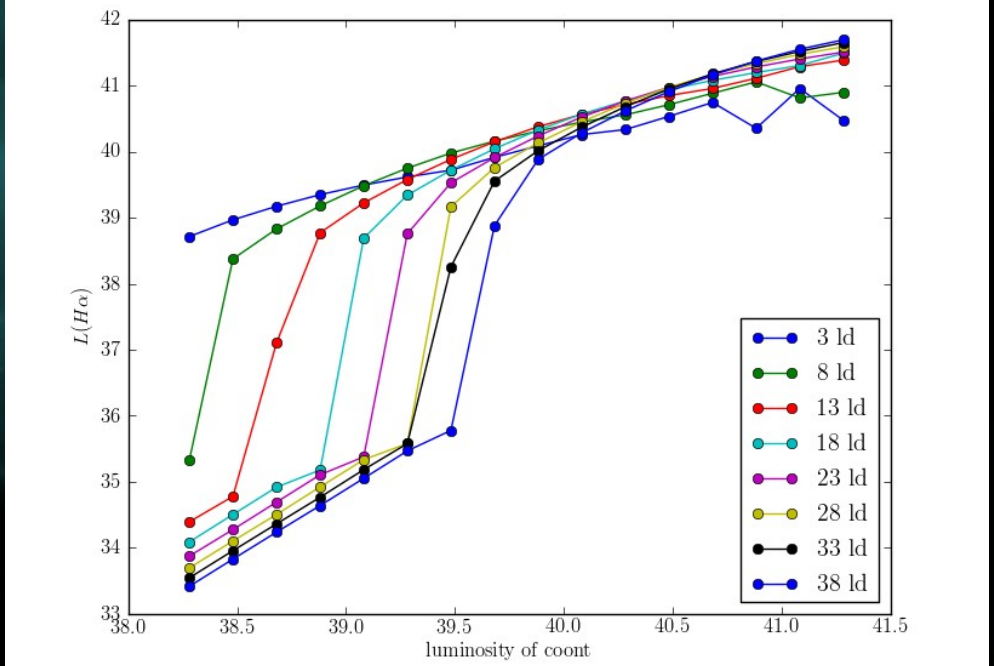
H density 10^12



H density
10^10



H density 10^9



H density 10^12

Remarks about CLOUDY

some kind of wave-like effect, in the sense that

-increasing the continuum luminosity at first increases line EW, which, after a limiting value, starts decreasing;

- inversion occurs at high luminosity for faraway gas;

- low density gas is subject to discontinuously dropping EW, whereas high

density gas has a discontinuity in the range of increasing EW

- low density gas might be kept ionized and hot by strong radiation fields, causing a sharp drop off in line luminosity close to the source

-high density gas is optically thick for lines, too, so they tend to be

weak unless the source is powerful or close enough to ionize a significant

fraction of the gas

Interpretation of the Baldwin Effect (and of its different slopes in line core-wings) might be given as a combination of gas structure and density for a variable source (intrinsic case) or for sources of different power (global case)


ЛУКА Ч. ПОПОВИЋ