

Quantifying Feedback from Narrow Line Region Outflows in Nearby Active Galaxies - III. Results for the Seyfert 2 Galaxies Markarian 3, Markarian 78, and NGC 1068*†

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Истечения ионизованного газа из АЯГ могут значительно влиять на эволюцию галактик, где эти ядра находятся.

Но для определения параметров истечений не в среднем, а на разных расстояниях от ядра, необходимо высокое спектральное разрешение для близких Сейфертовских галактик. Также есть неопределённости в нахождении масс истечений.

$$M_{slit} = N_{\text{H}} \mu m_p \left(\frac{L_{\text{H}\beta}}{F_{\text{H}\beta_m}} \right)$$

$$\dot{M} = Mv / \delta r$$

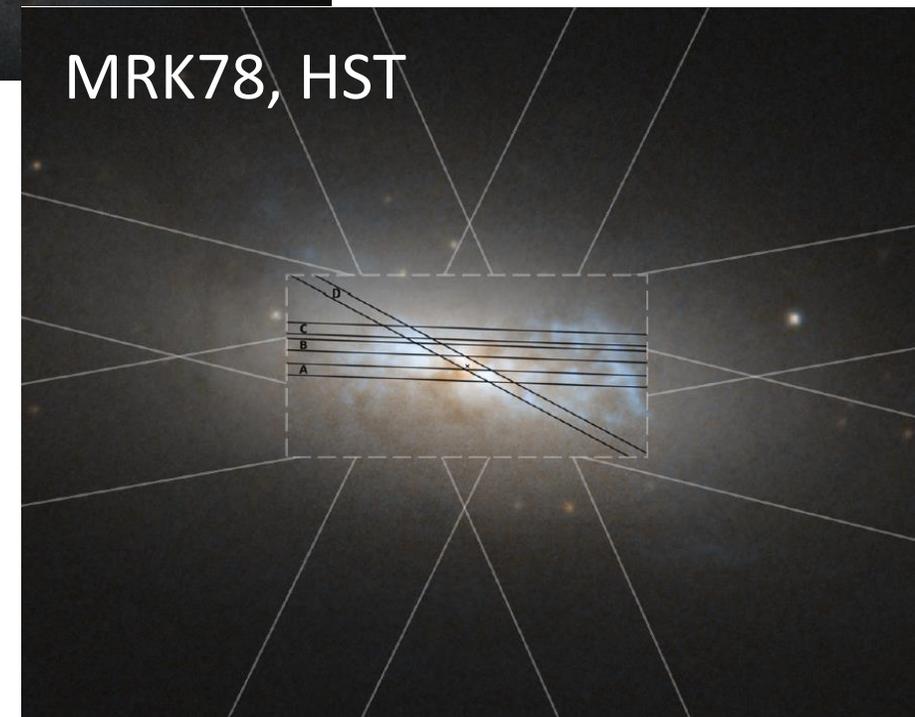
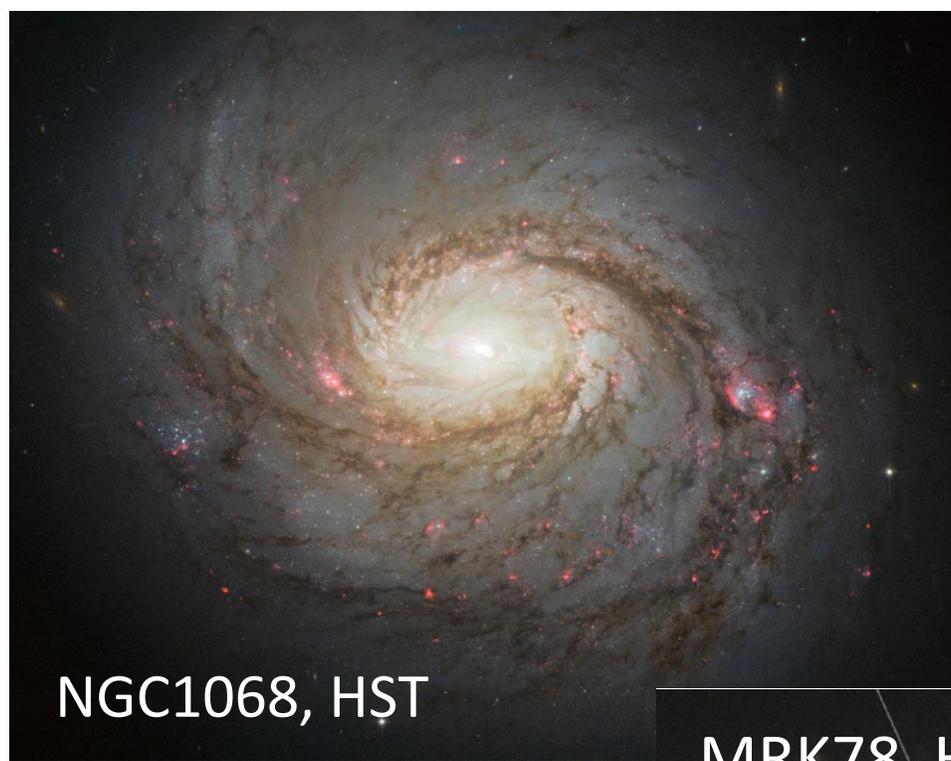
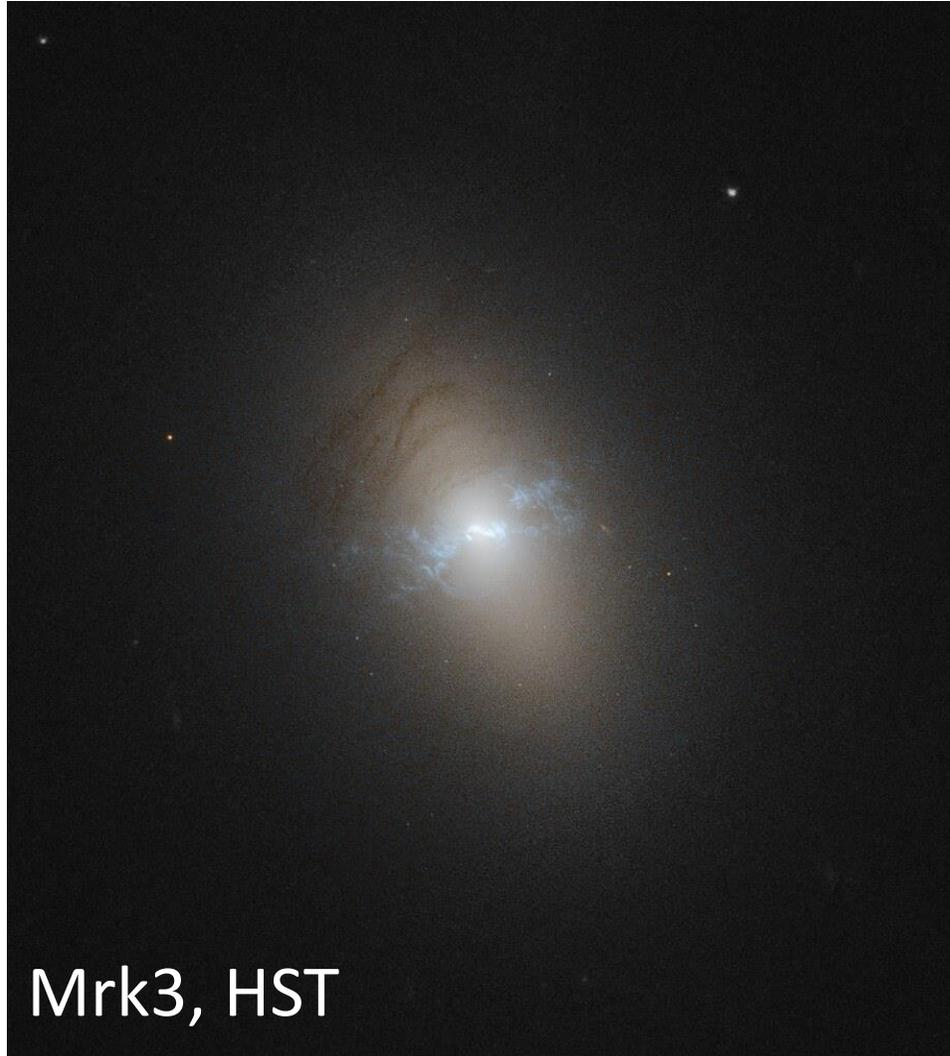
$$E = 1/2 Mv^2$$

$$\dot{E} = 1/2 \dot{M}v^2$$

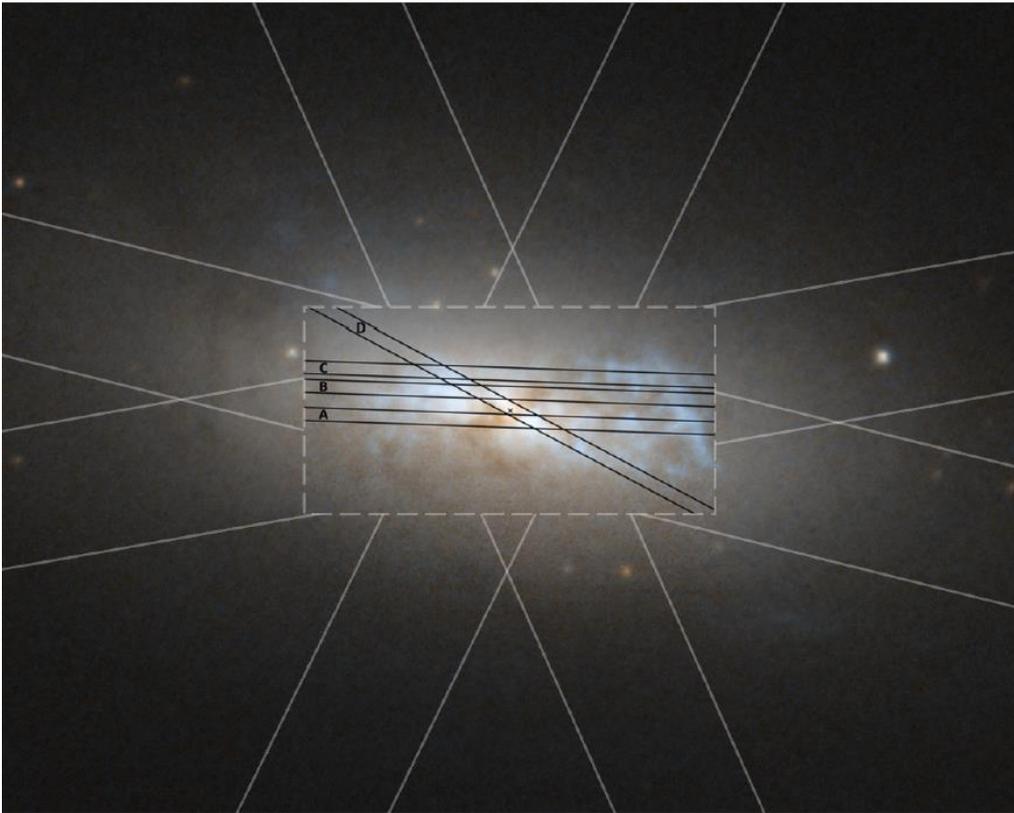
$$p = Mv$$

$$\dot{p} = \dot{M}v$$

Выборка



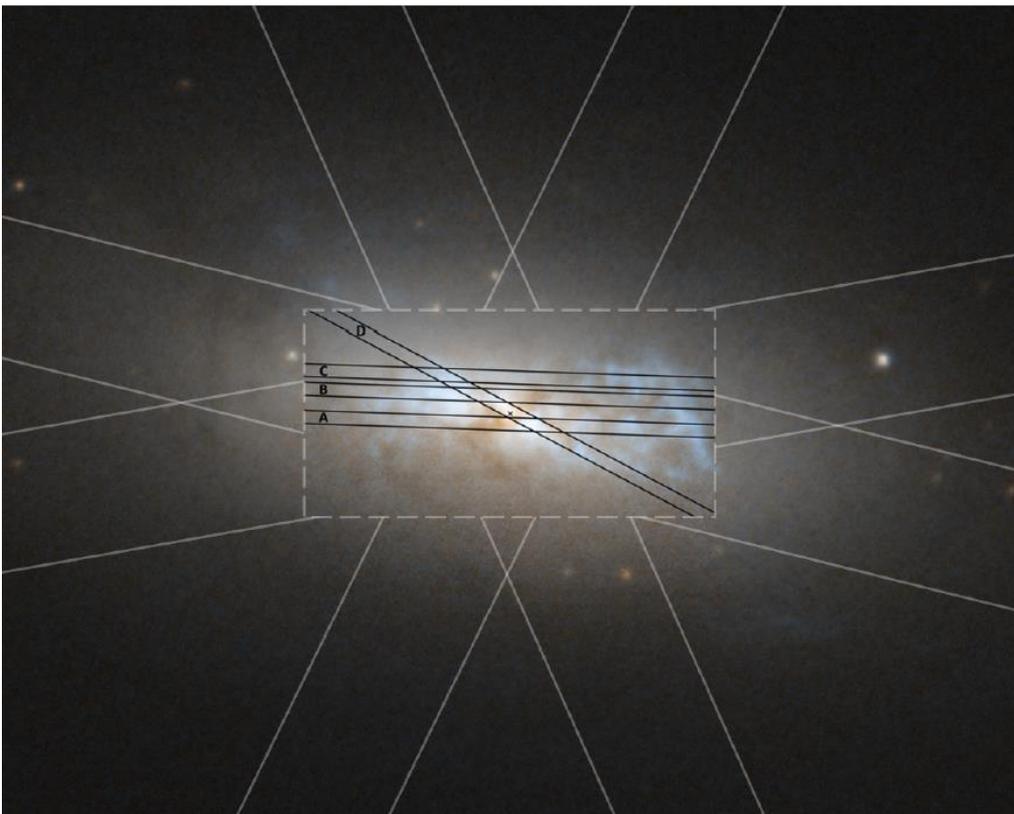
Наблюдения – HST



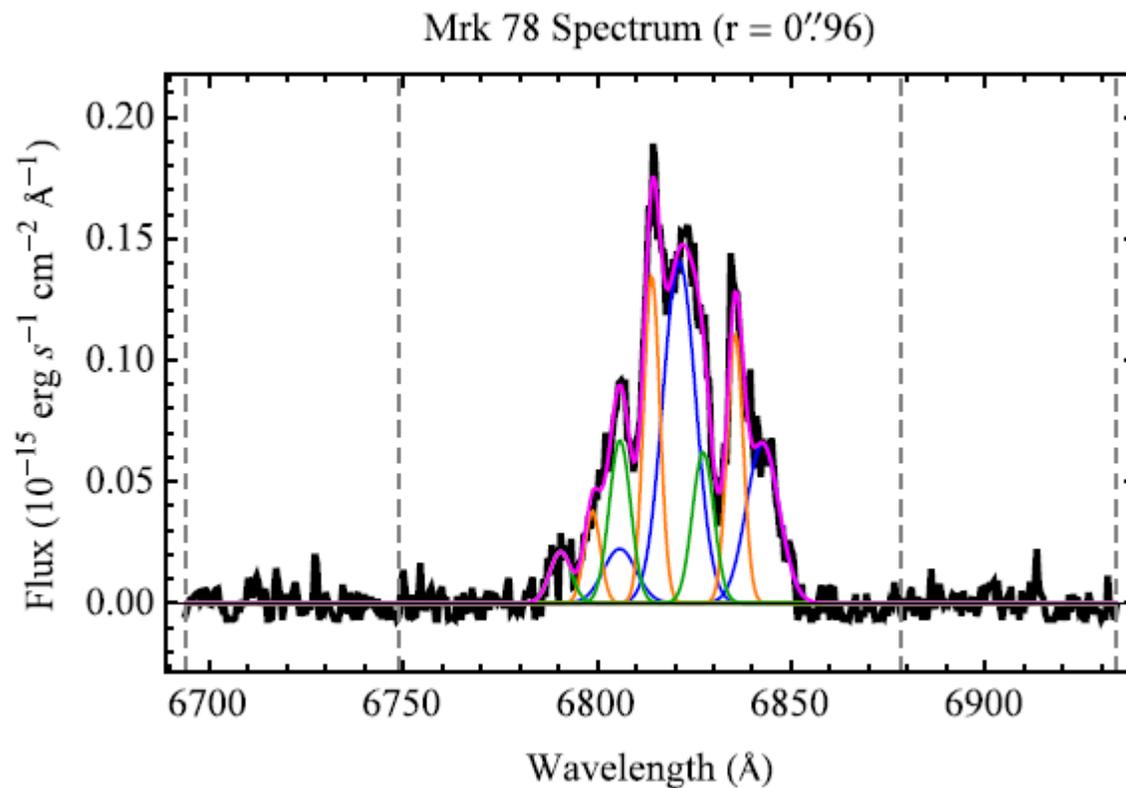
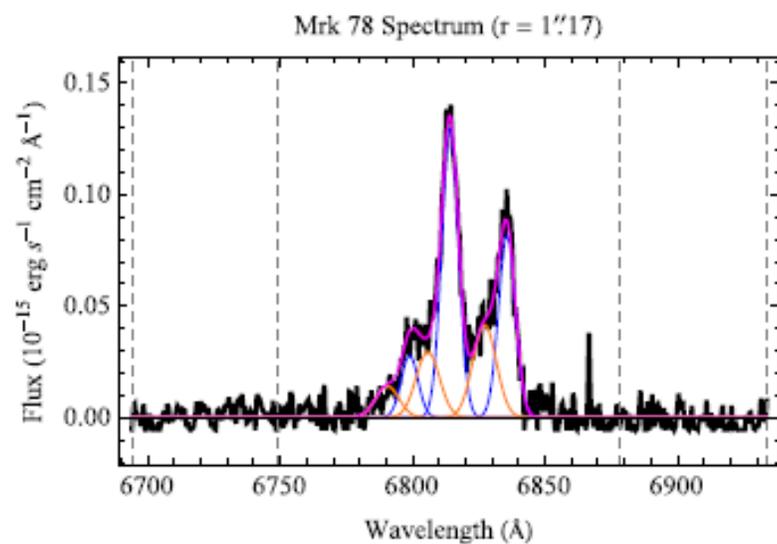
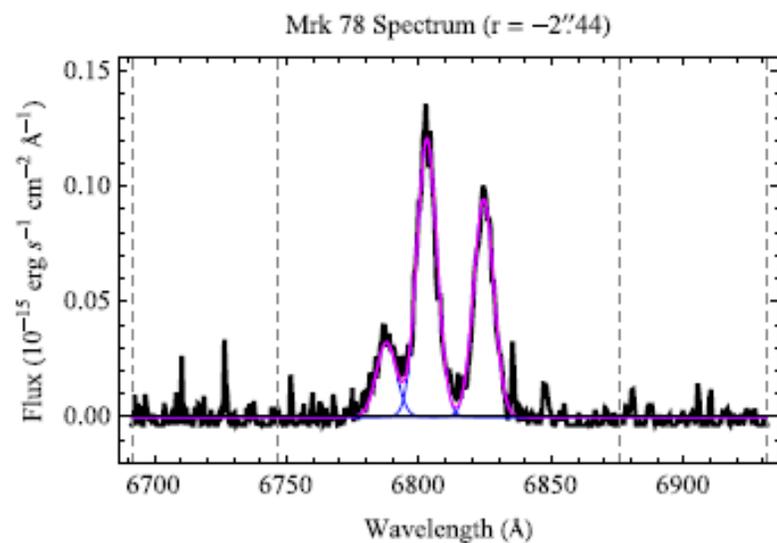
- HST: длиннощелевая спектроскопия и карты [OIII]5007 с использованием STIS, WFPC2, FOC.
- *Mrk78: G750M – кинематика, G430L – фотоионизационные модели; [OIII] – F502M (FOC)*
- *Mrk3: G140L, G230L, G430L; [OIII] – F502M (FOC)*
- *NGC1068: G140L, G230L, G430L; [OIII] – F502M (WFPC2)*

Наблюдения – АРО (3.5m)

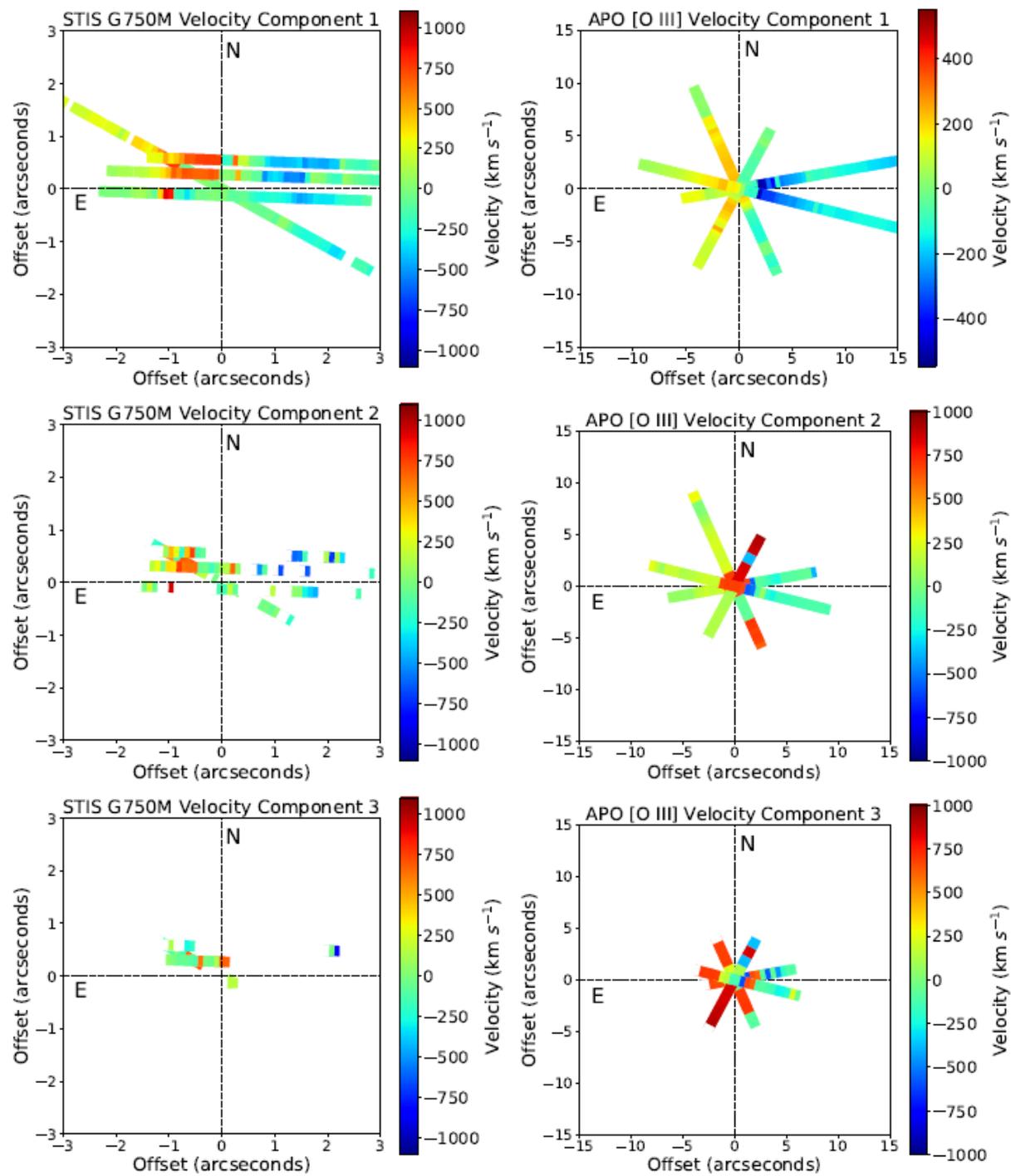
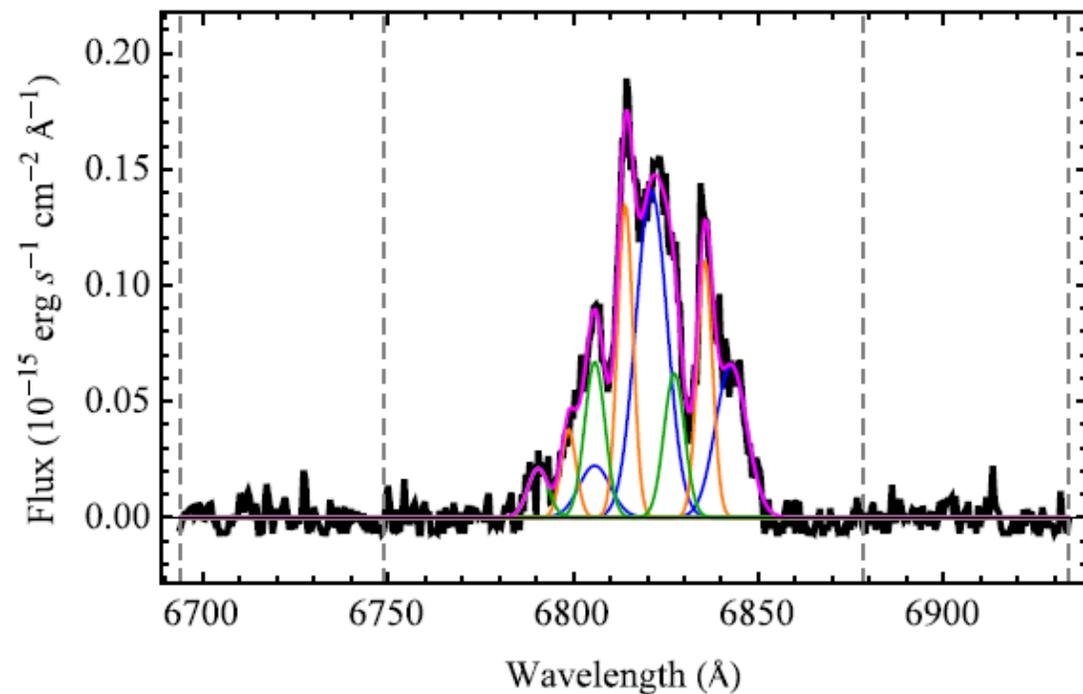
- Только для Mrk78 – Dual Imaging Spectrograph (DIS)



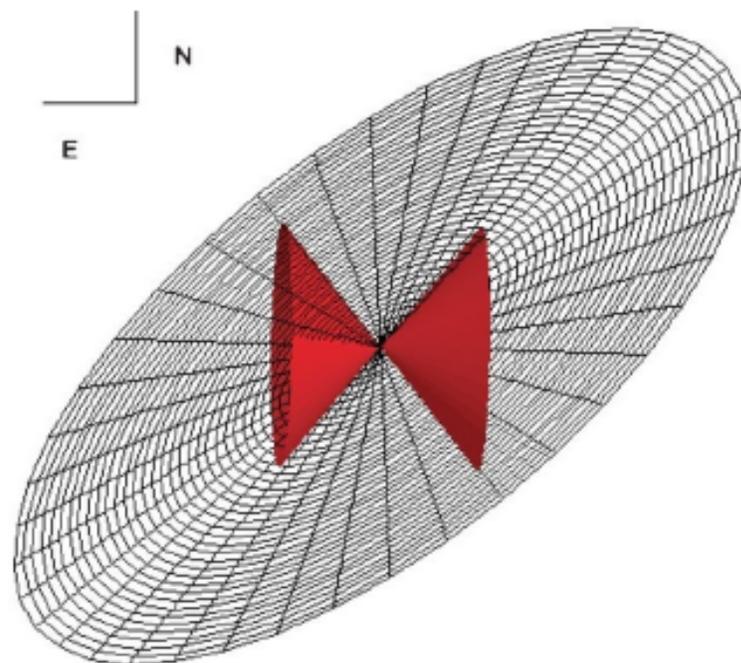
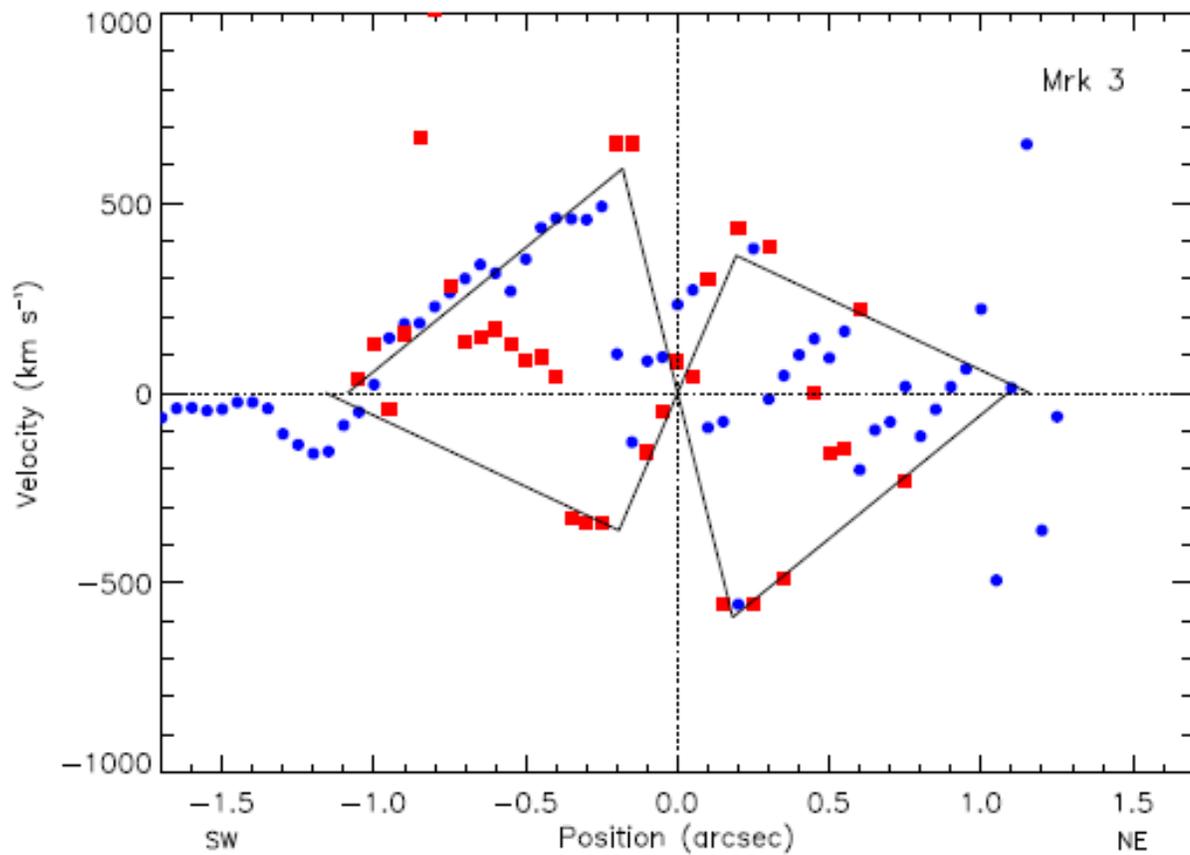
Кинематика ионизованного газа

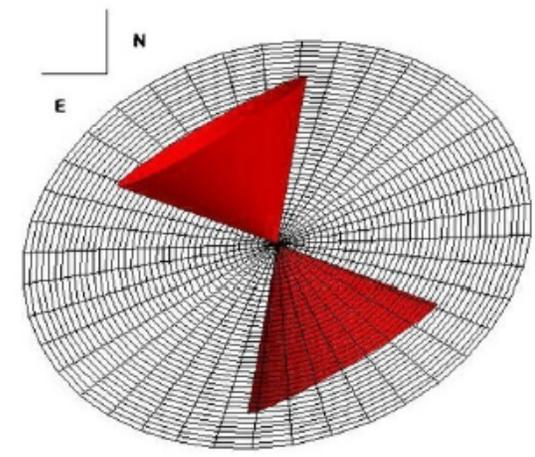
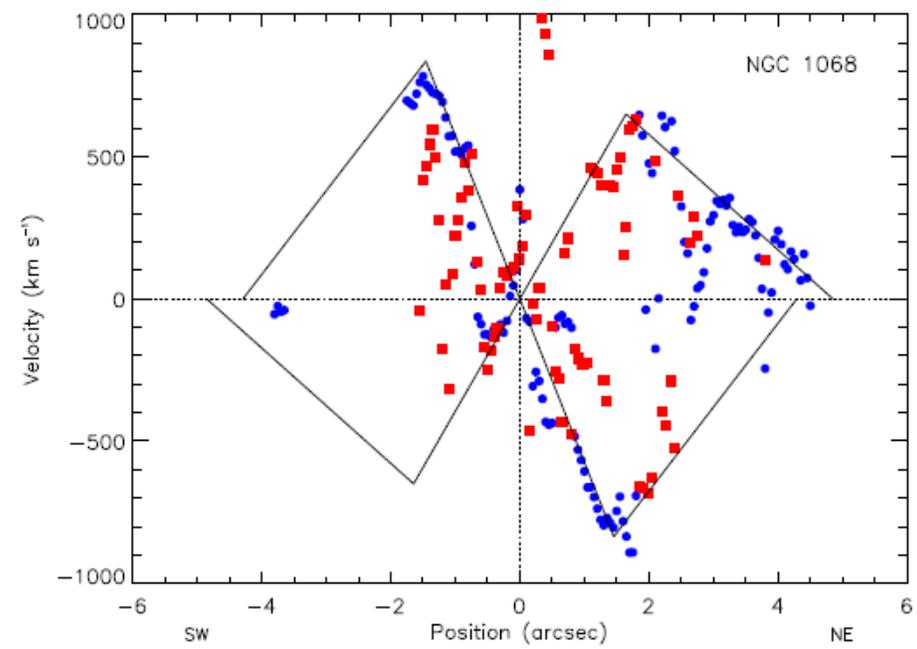
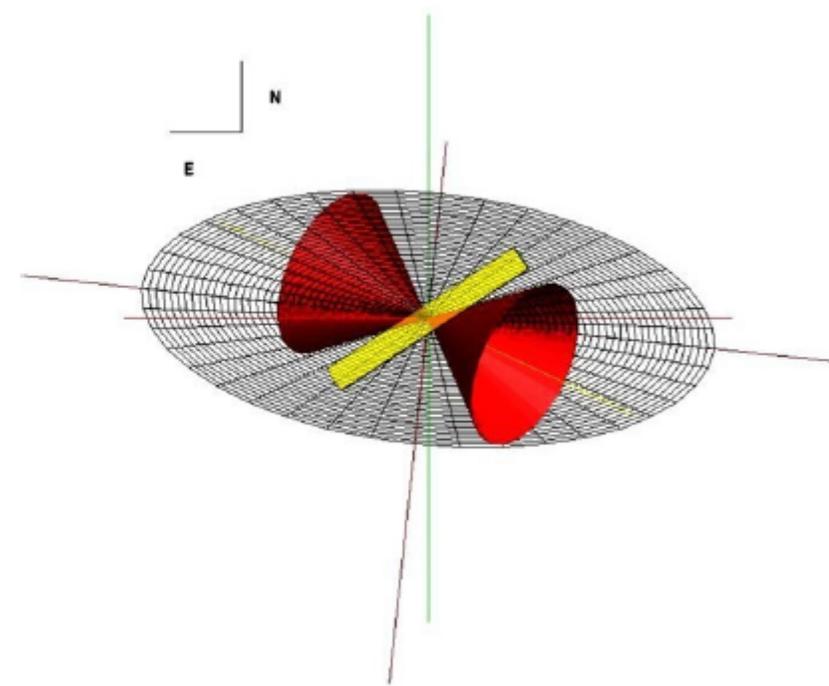
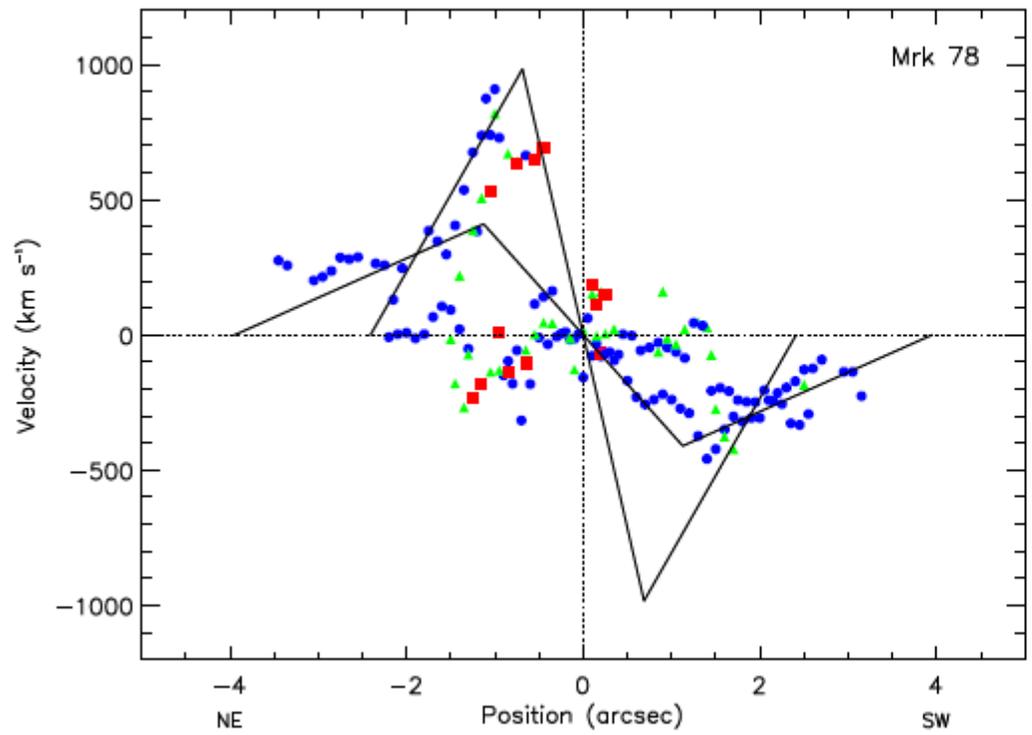


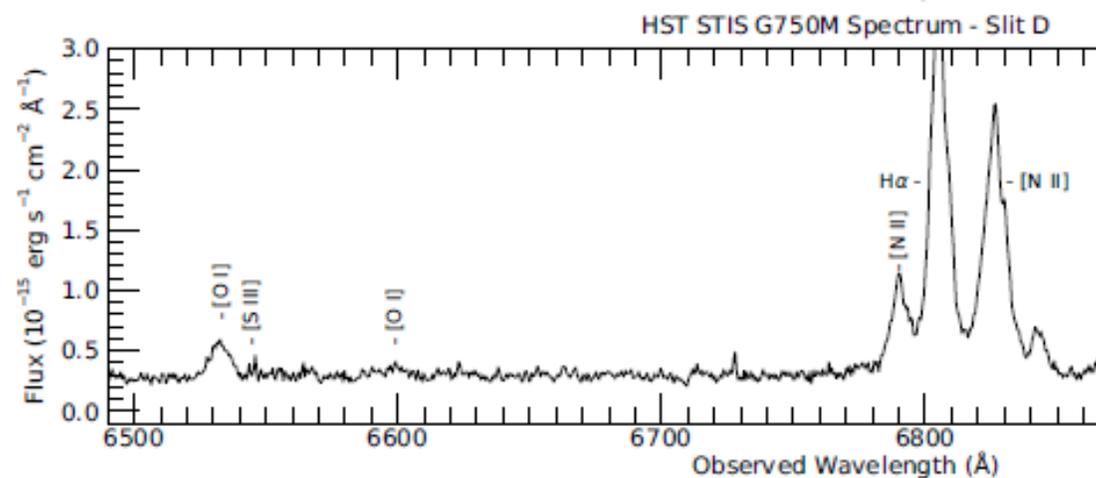
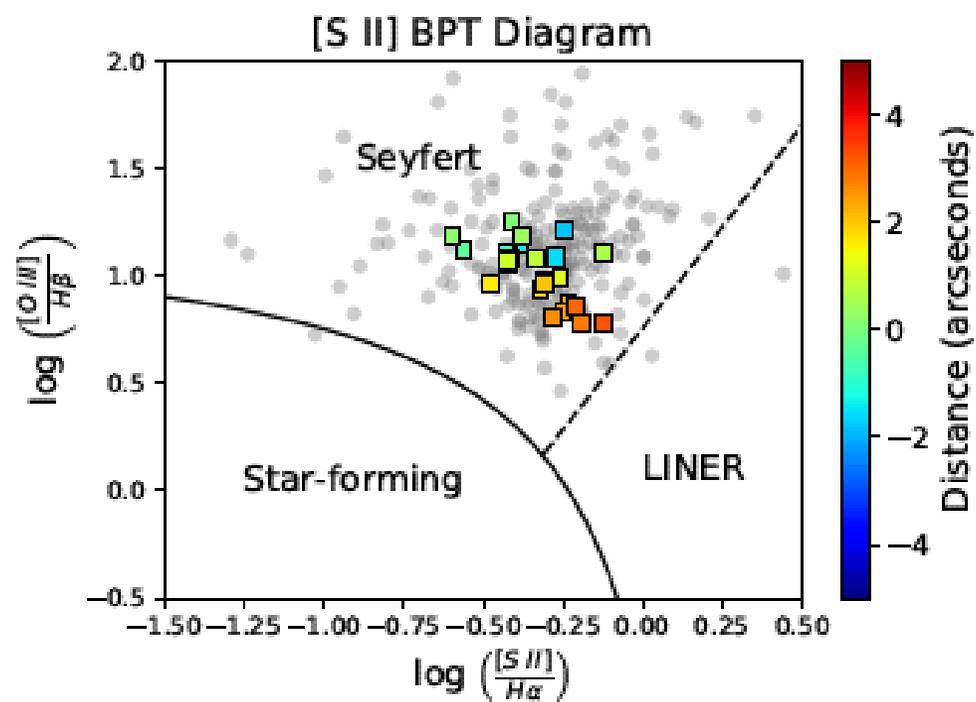
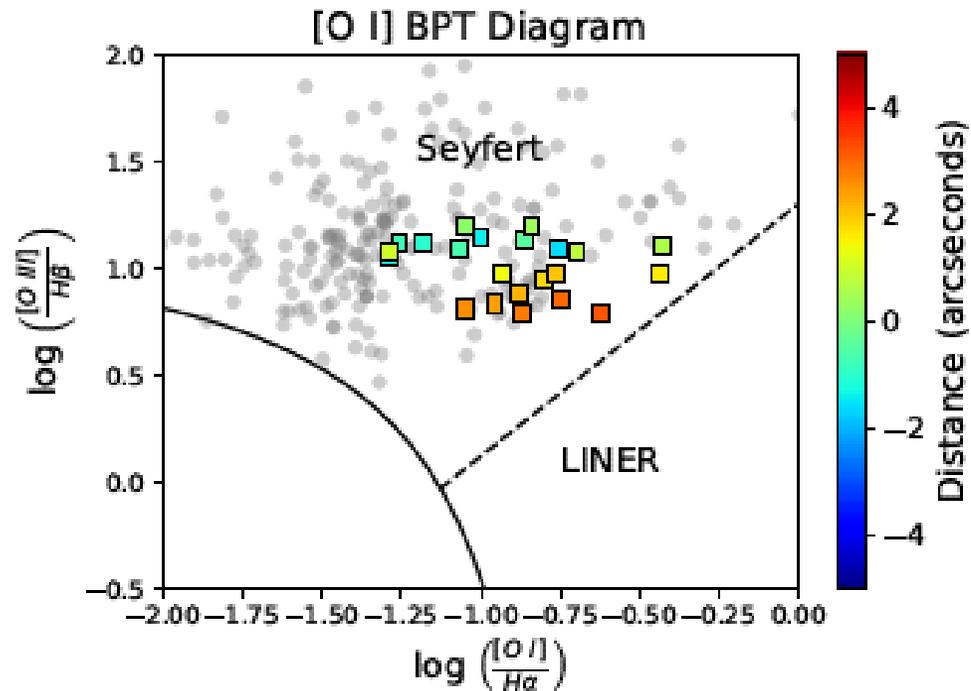
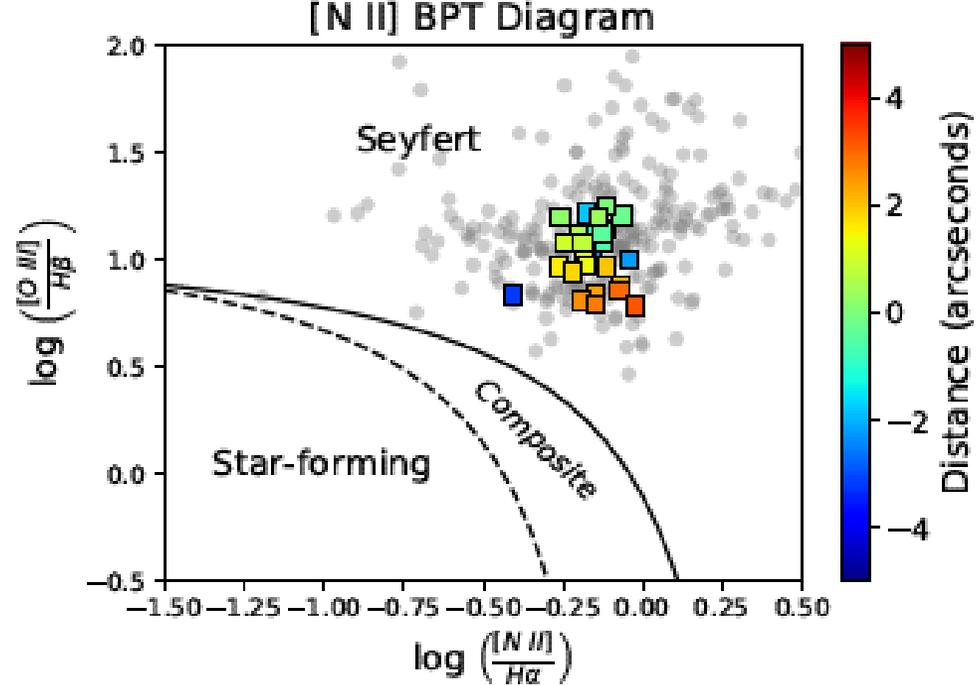
Mrk 78 Spectrum ($r = 0''.96$)



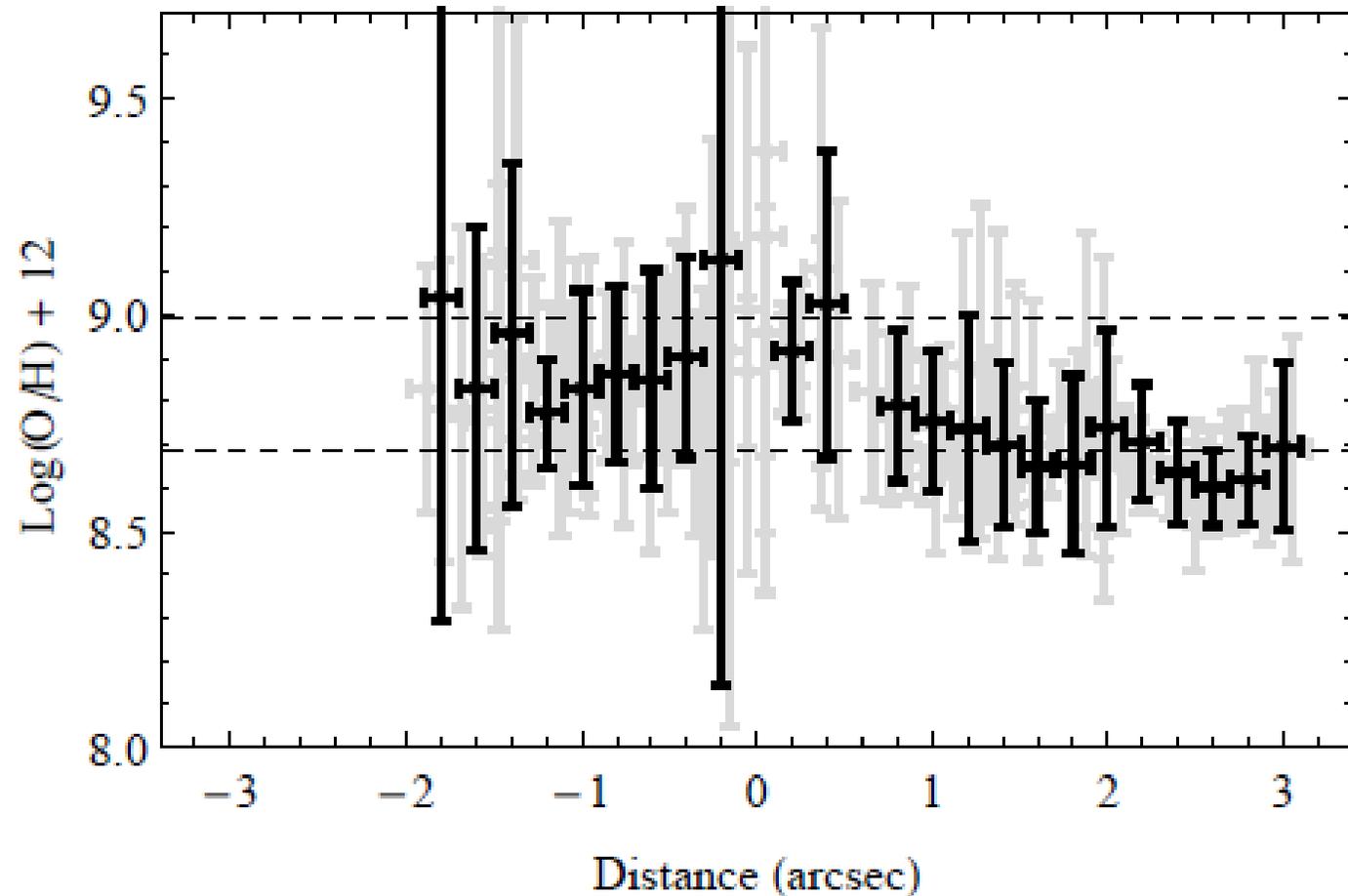
Name	P.A. ($^{\circ}$)	Incl. ($^{\circ}$)	H.O.A. ($^{\circ}$)	r_{turn} (pc)	v_{max} (km s^{-1})	r_{max} (pc)	v_{deproj} (near/far)	r_{deproj} (near/far)	Refs.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MRK 3	71	5 (NE)	20	55	1400	330	2.37/3.86	1.10/1.04	1, 2
MRK 78	65	30 (SW)	10, 35	900	1200	3300	1.10/3.86	2.37/1.04	3
NGC 1068	30	5 (NE)	35	148	1300	435	1.56/2.00	1.30/1.16	4







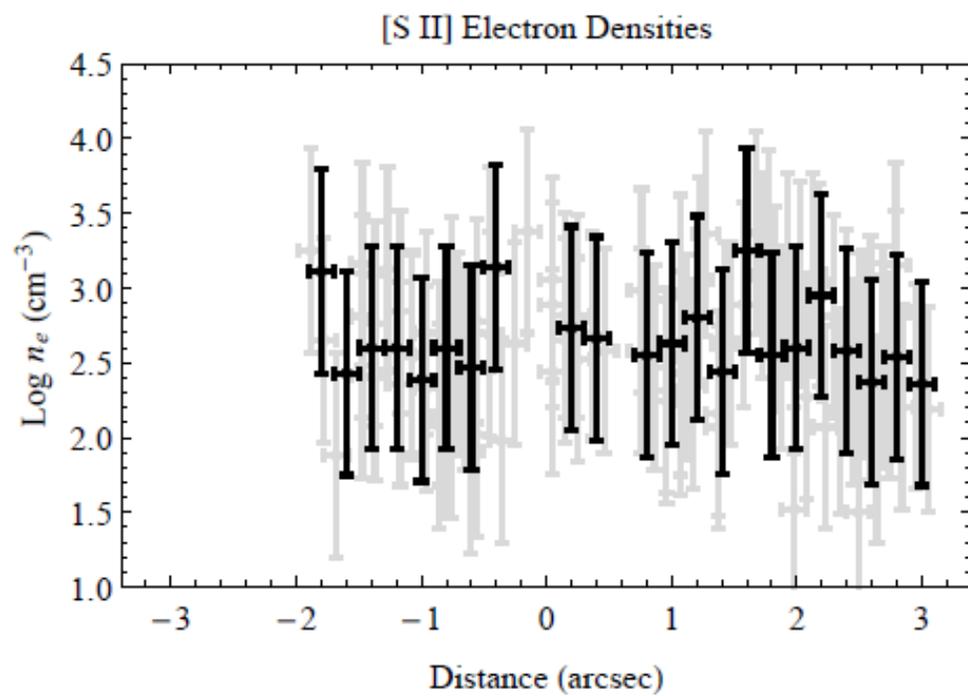
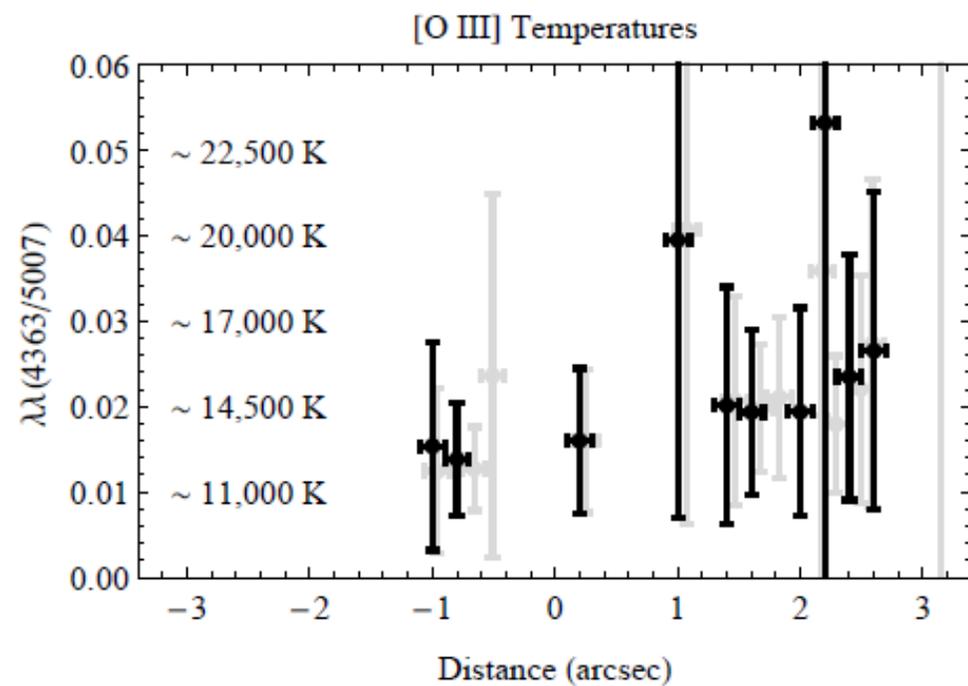
Oxygen Abundances

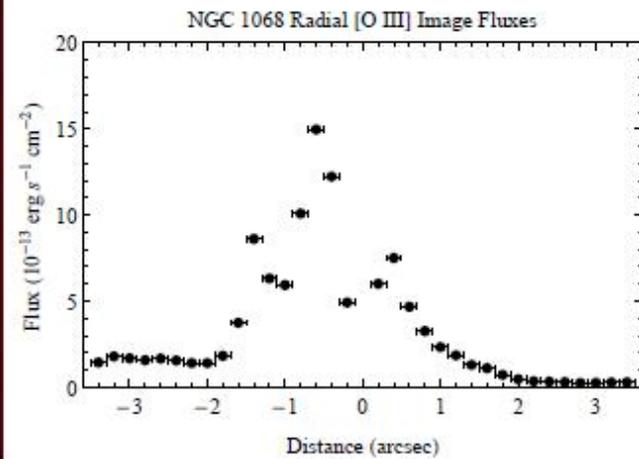
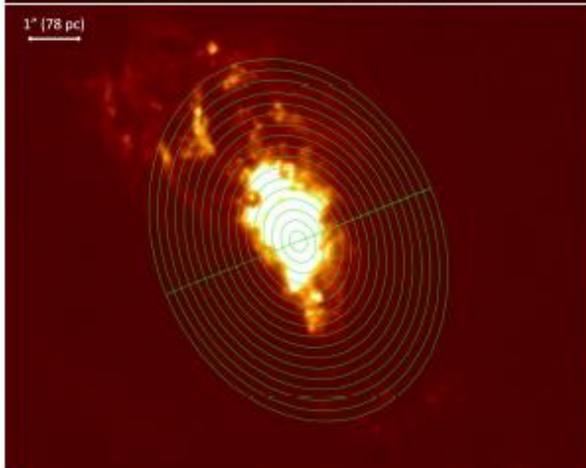
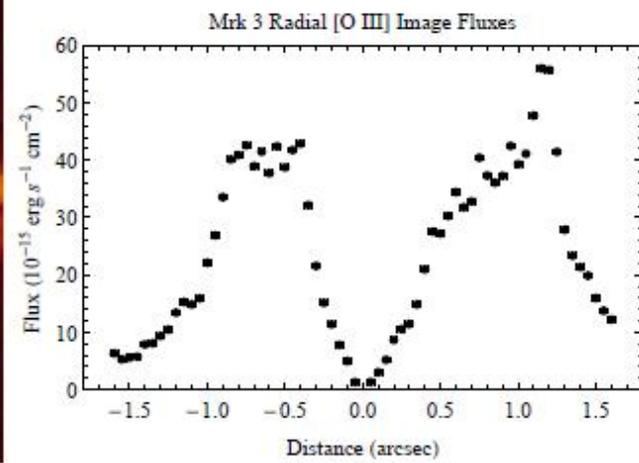
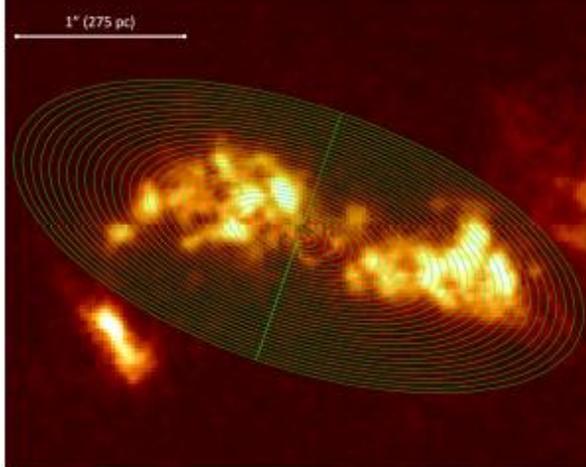
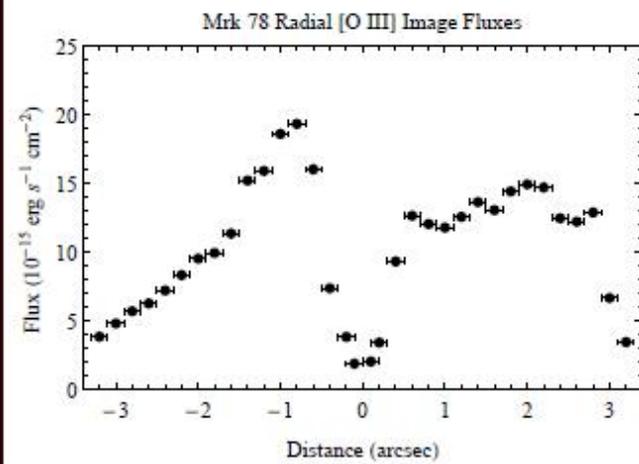
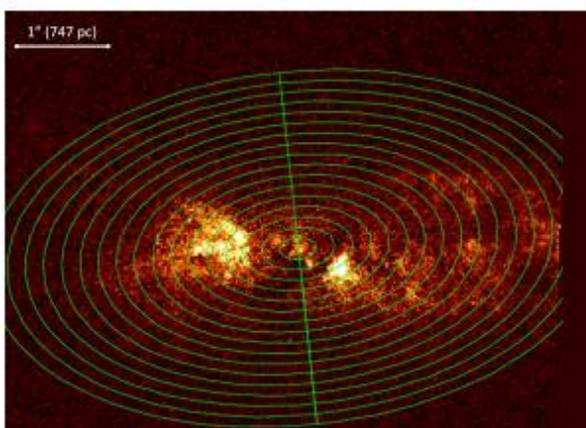


emission-line ratios. For the first diagram (Fig. 1) we obtain, for $x \equiv [\text{N II}]/\text{H}\alpha$ and $y \equiv [\text{O III}]/\text{H}\beta$, interpolating in the interval $8.4 \leq (\text{O}/\text{H}) \leq 9.2$,

$$\begin{aligned} (\text{O}/\text{H}) = & 8.34 + 0.212x - 0.012x^2 - 0.002y \\ & + 0.007xy - 0.002x^2y + 6.52 \times 10^{-4}y^2 \\ & + 2.27 \times 10^{-4}xy^2 + 8.87 \times 10^{-5}x^2y^2 . \quad (2) \end{aligned}$$

Storchi-Bergmann et al. (1998)





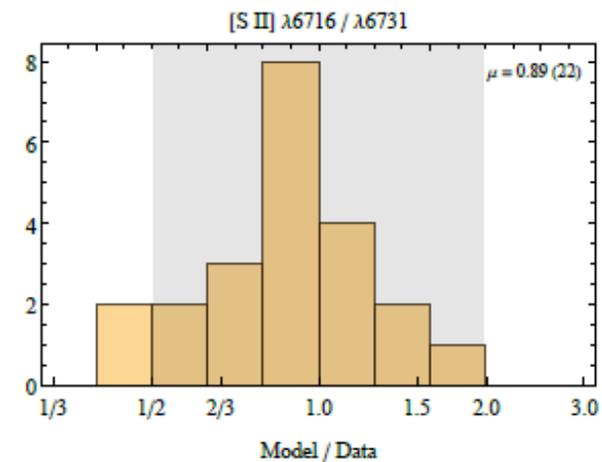
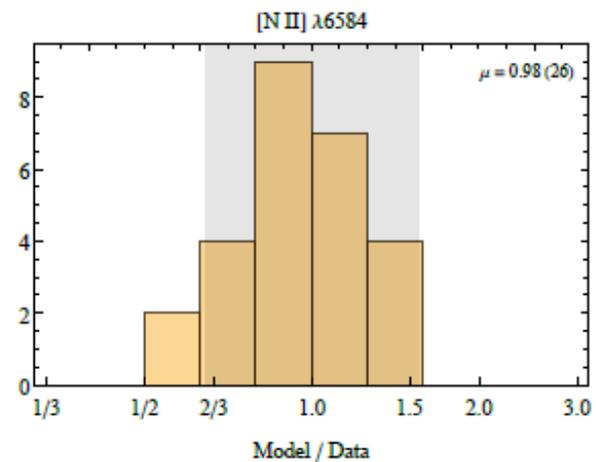
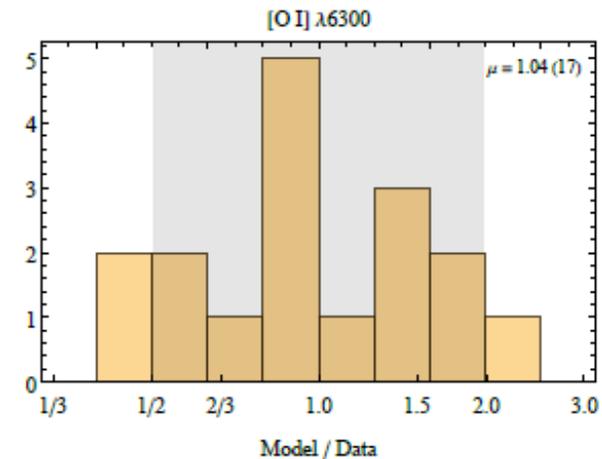
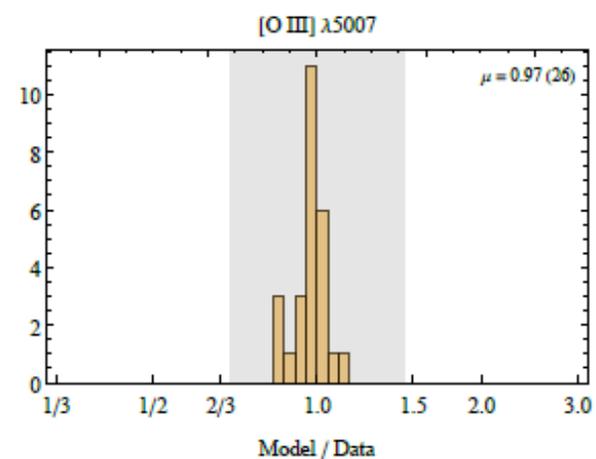
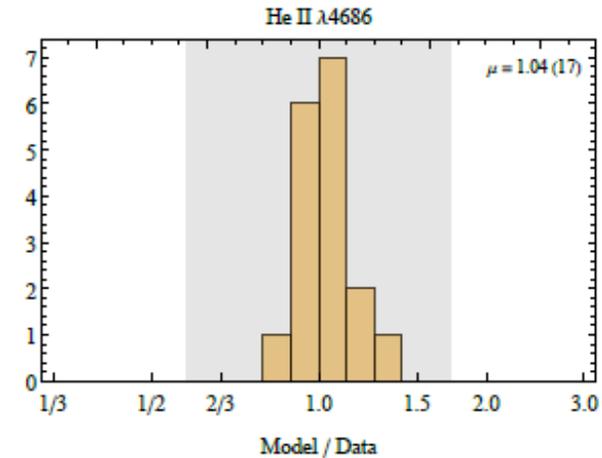
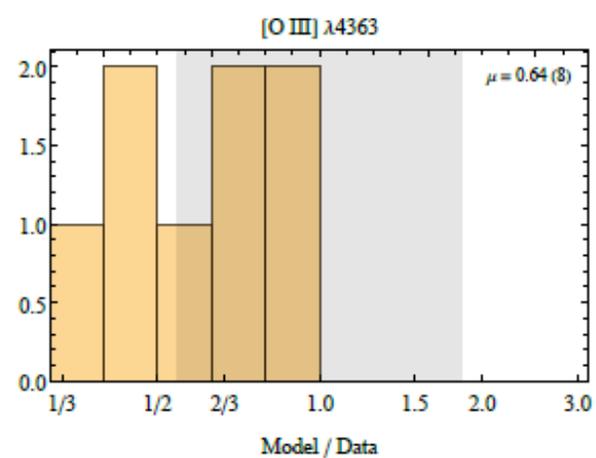
Фотоионизационная модель

Начальные параметры +

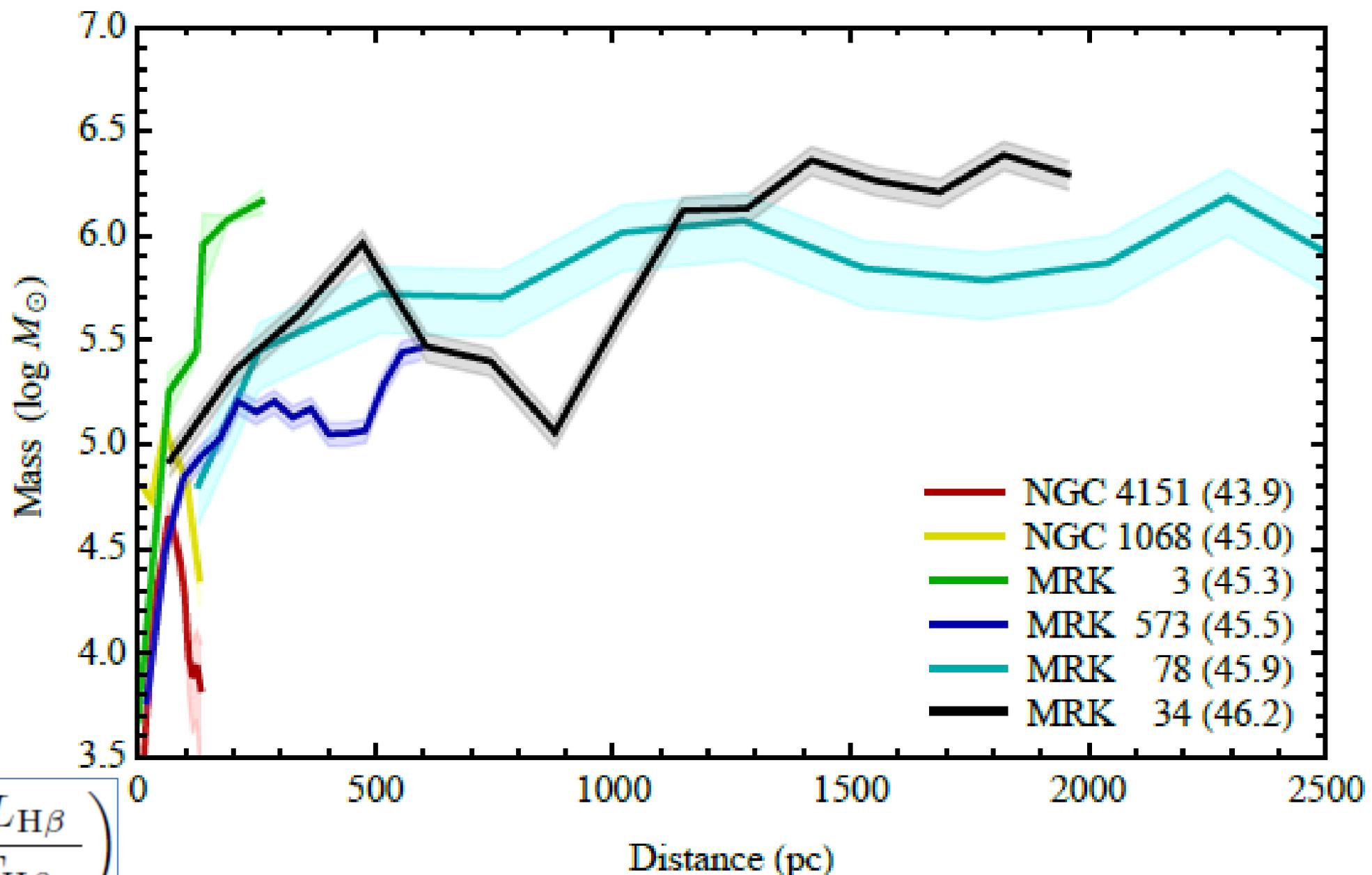
Collins et al. 2009). The logarithmic abundances relative to hydrogen by number for the dusty models are: He = -0.96, C = -3.63, N = -3.94, O = -3.32, Ne = -3.96, Na = -5.65, Mg = -4.57, Al = -5.70, Si = -4.66, P = -6.48, S = -4.77, Ar = -5.49, Ca = -5.81, Fe = -4.67, Ni = -5.93.

$$U = \frac{Q(H)}{4\pi r^2 n_H c},$$

$$Q(H) = 3.8 \times 10^{54} \text{ photons s}^{-1}$$

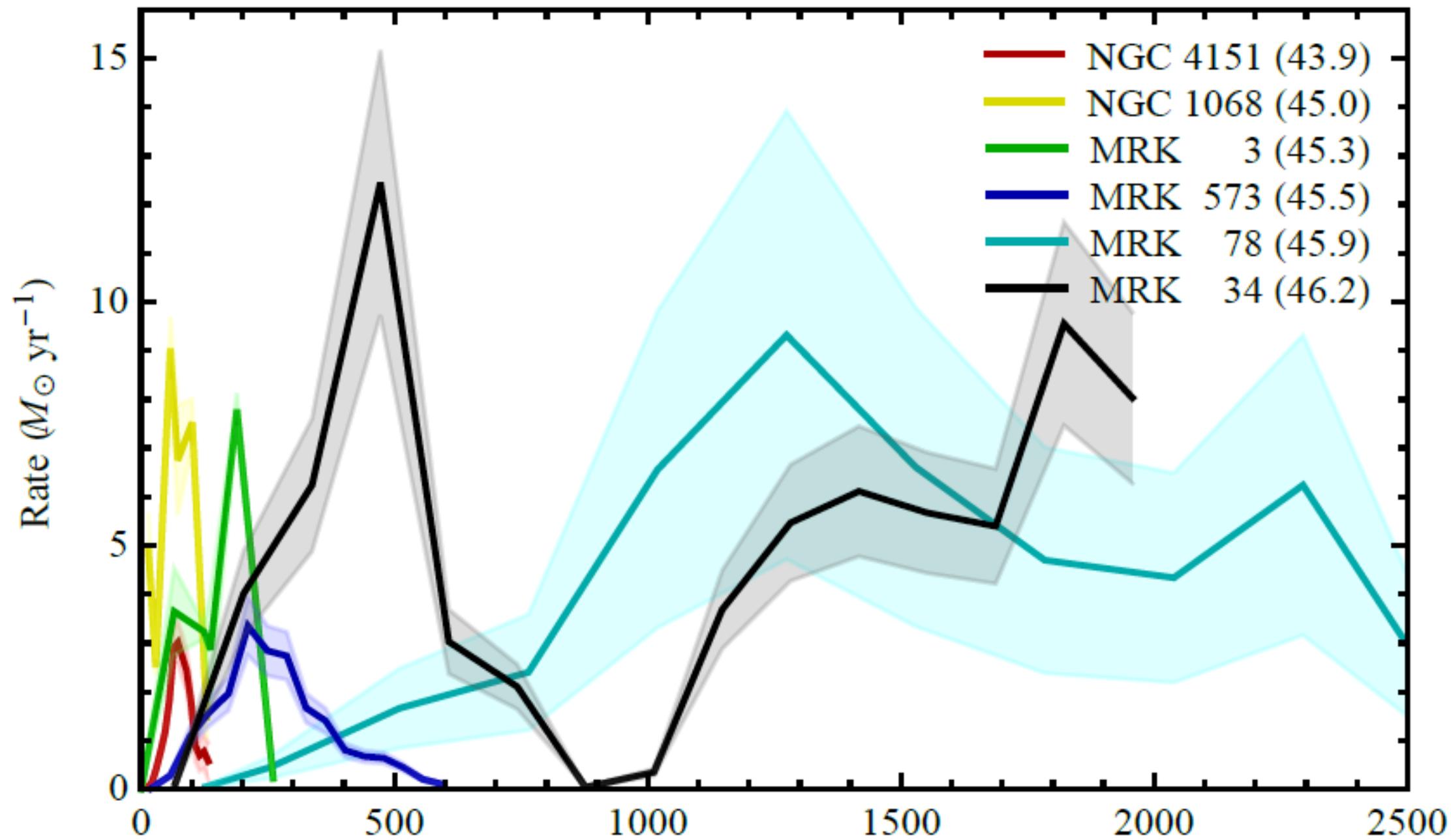


Gas Mass Profiles

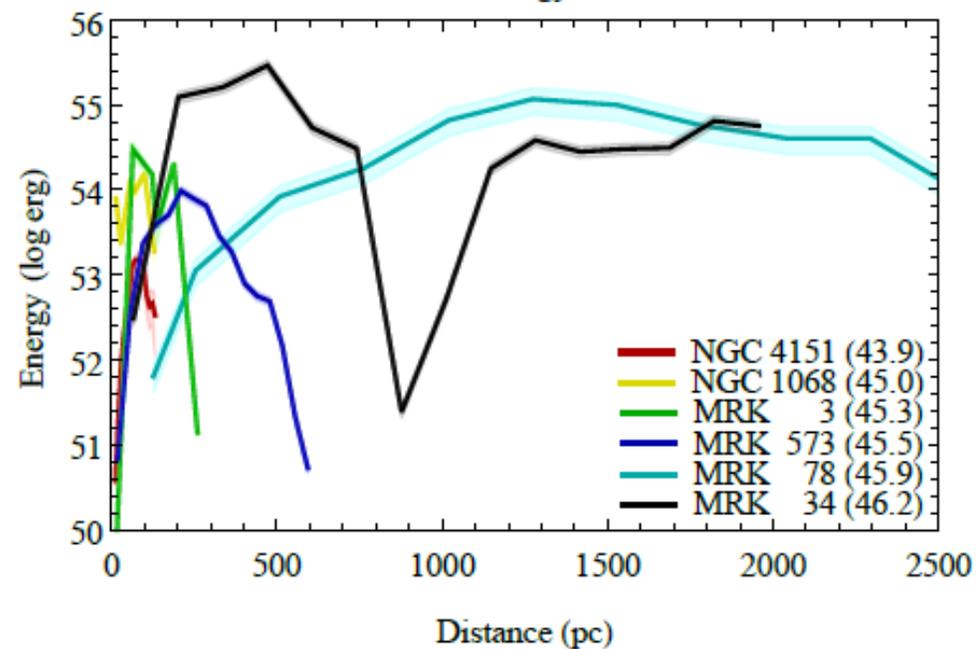


$$M_{slit} = N_{\text{H}} \mu m_p \left(\frac{L_{\text{H}\beta}}{F_{\text{H}\beta_m}} \right)$$

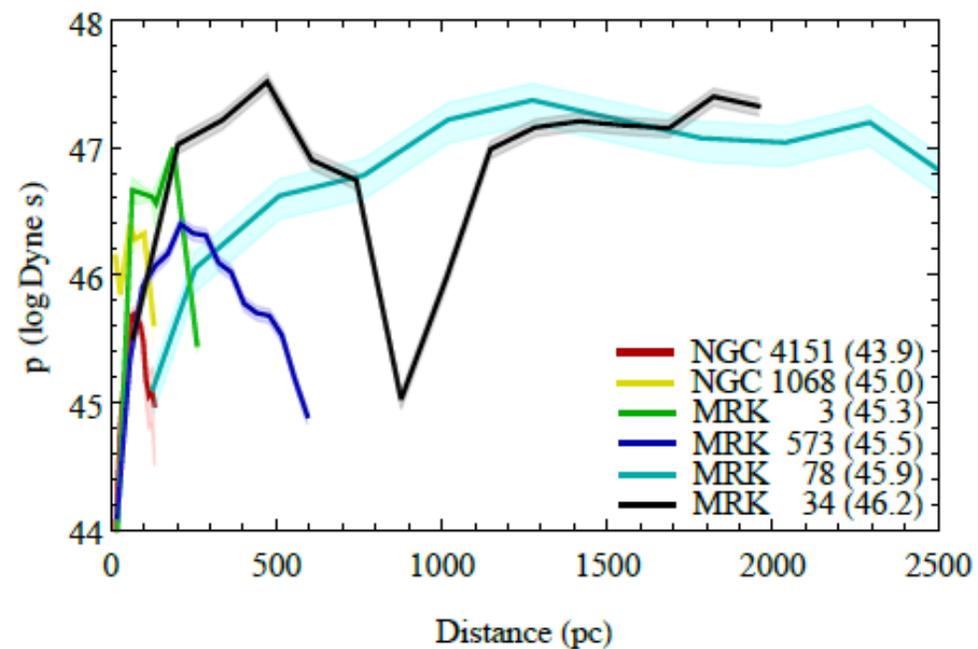
Mass Outflow Rates



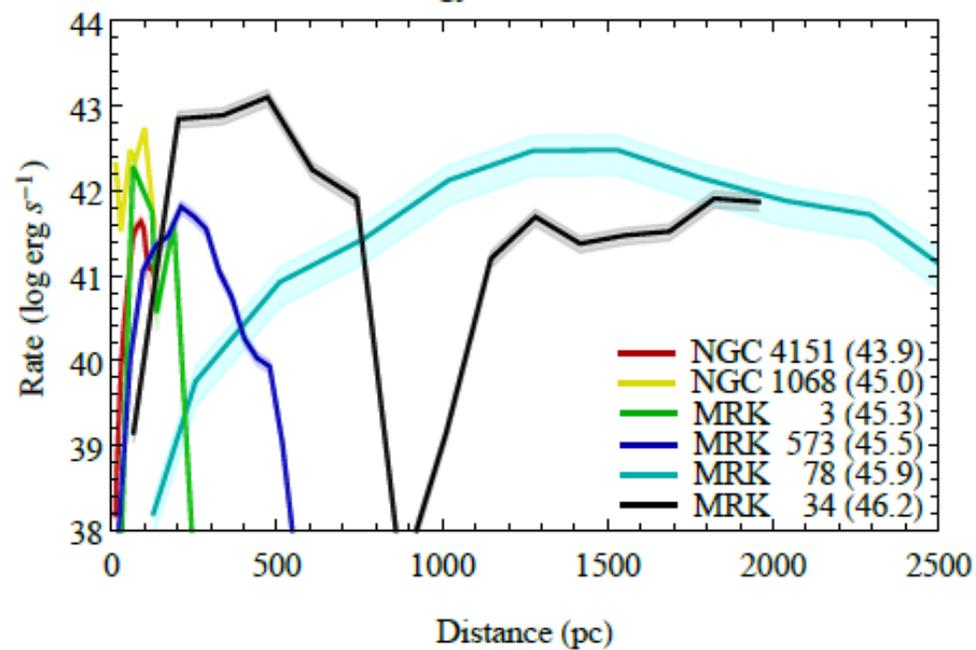
Kinetic Energy Profiles



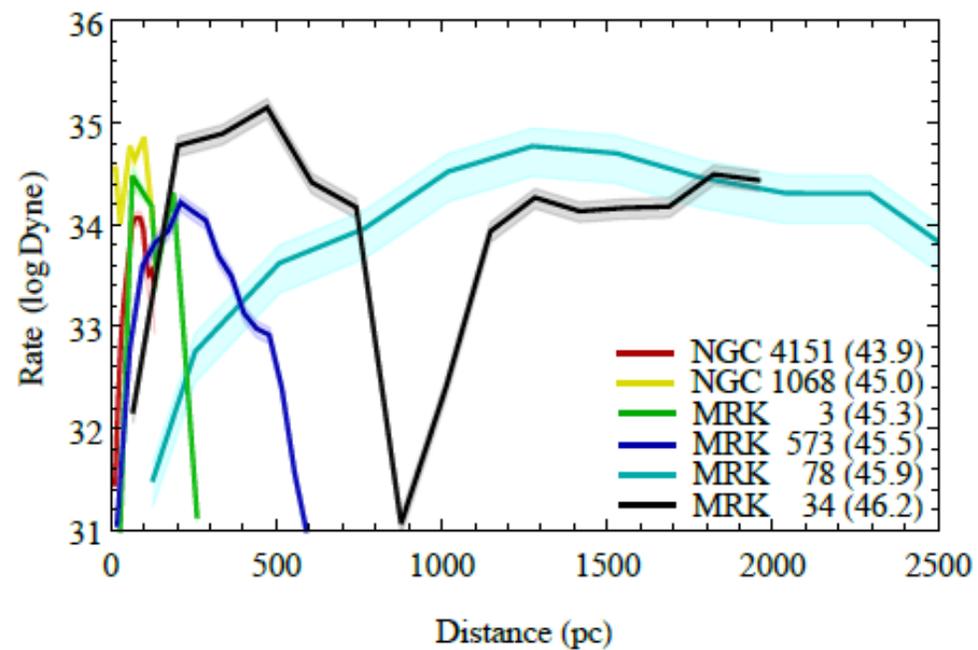
Momentum Profiles



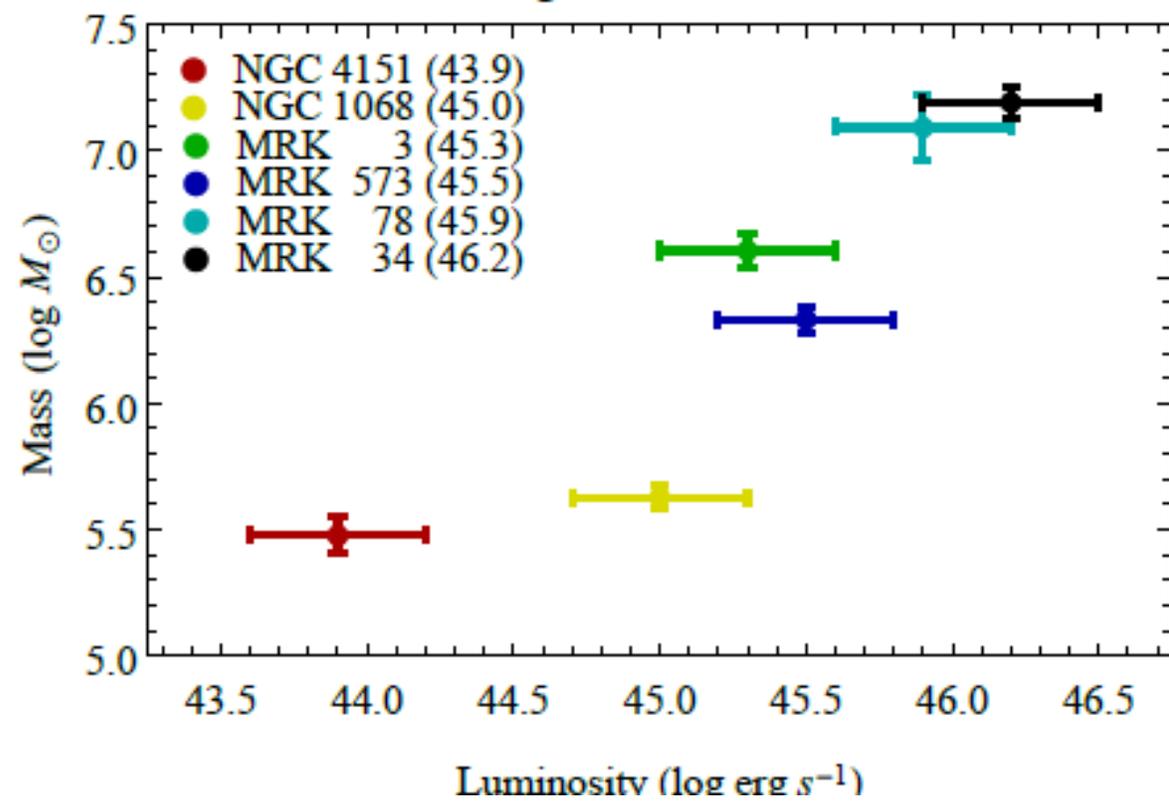
Energy Outflow Rates



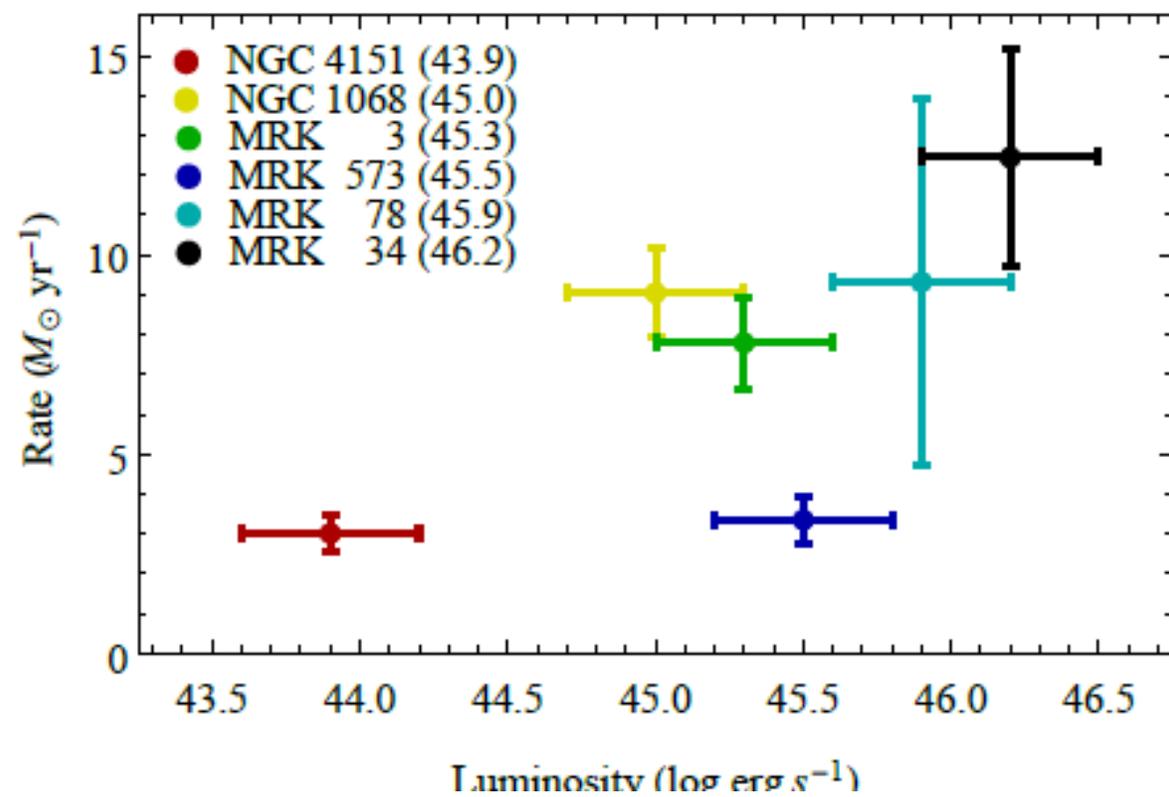
Momentum Outflow Rates



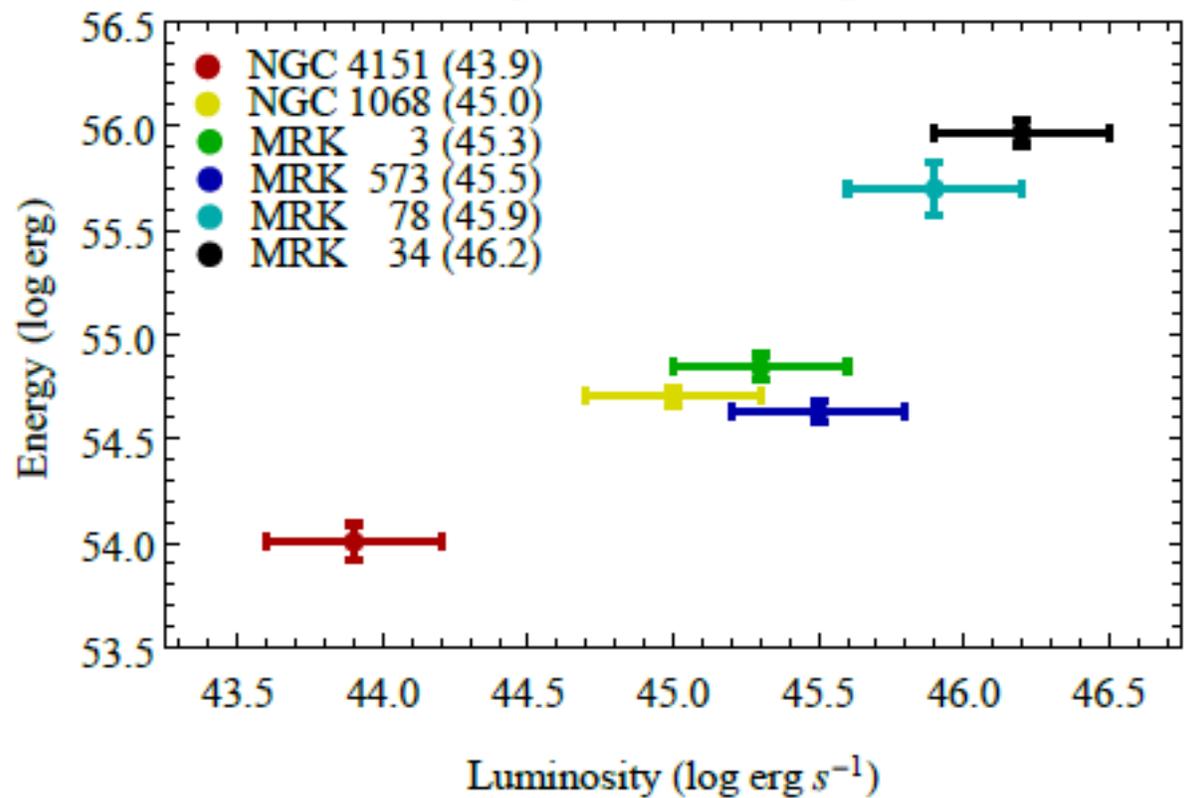
Integrated Gas Masses



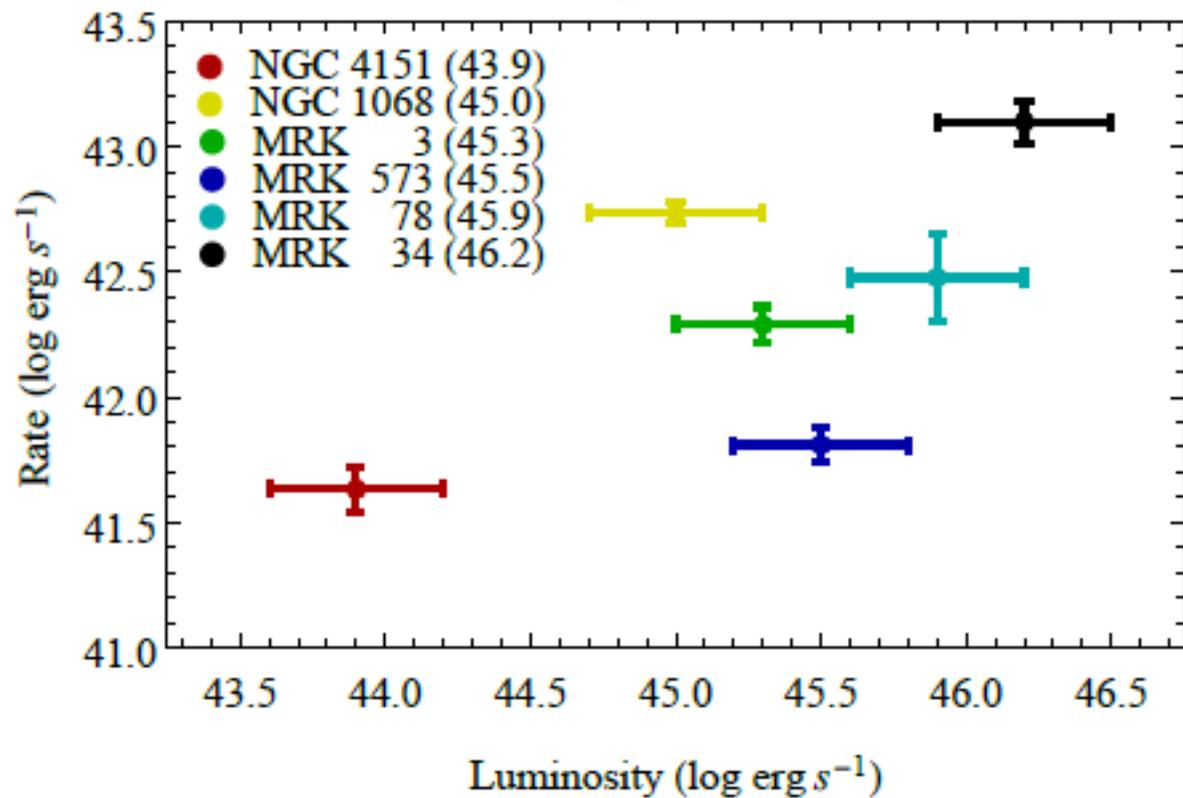
Peak Mass Outflow Rates



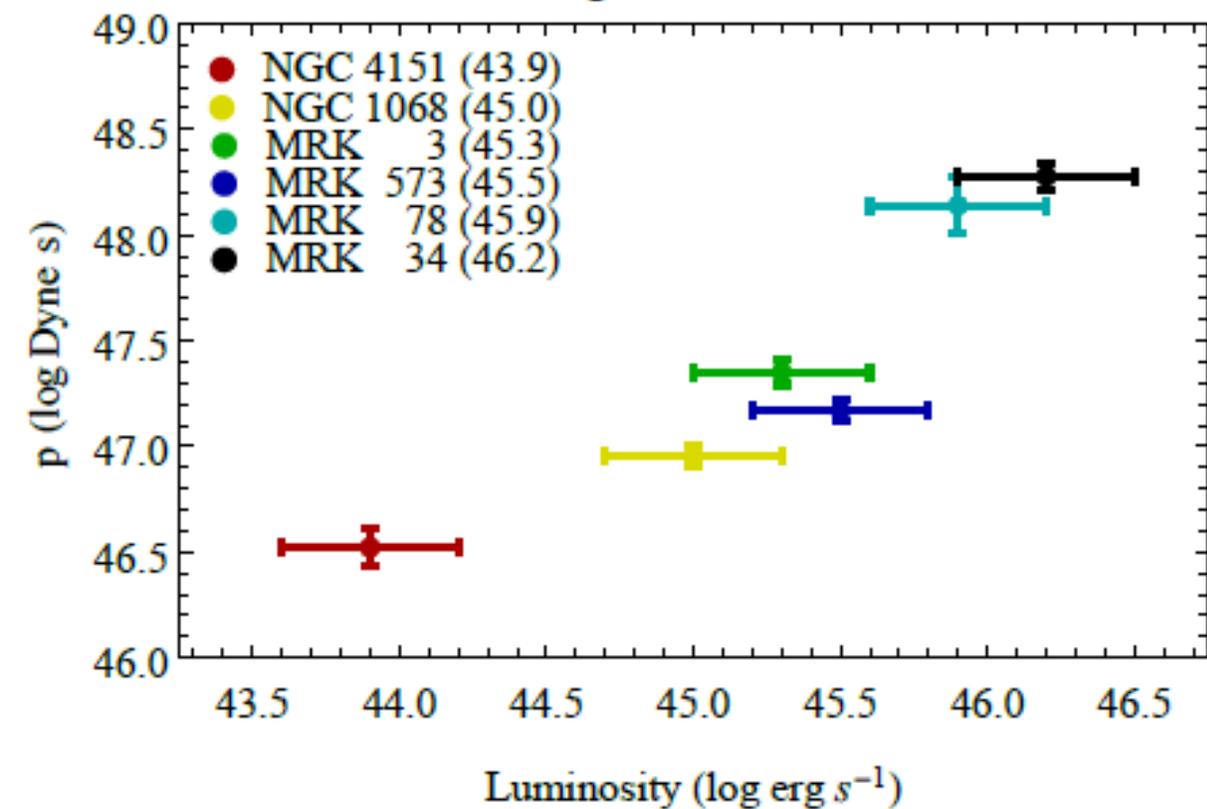
Integrated Kinetic Energies



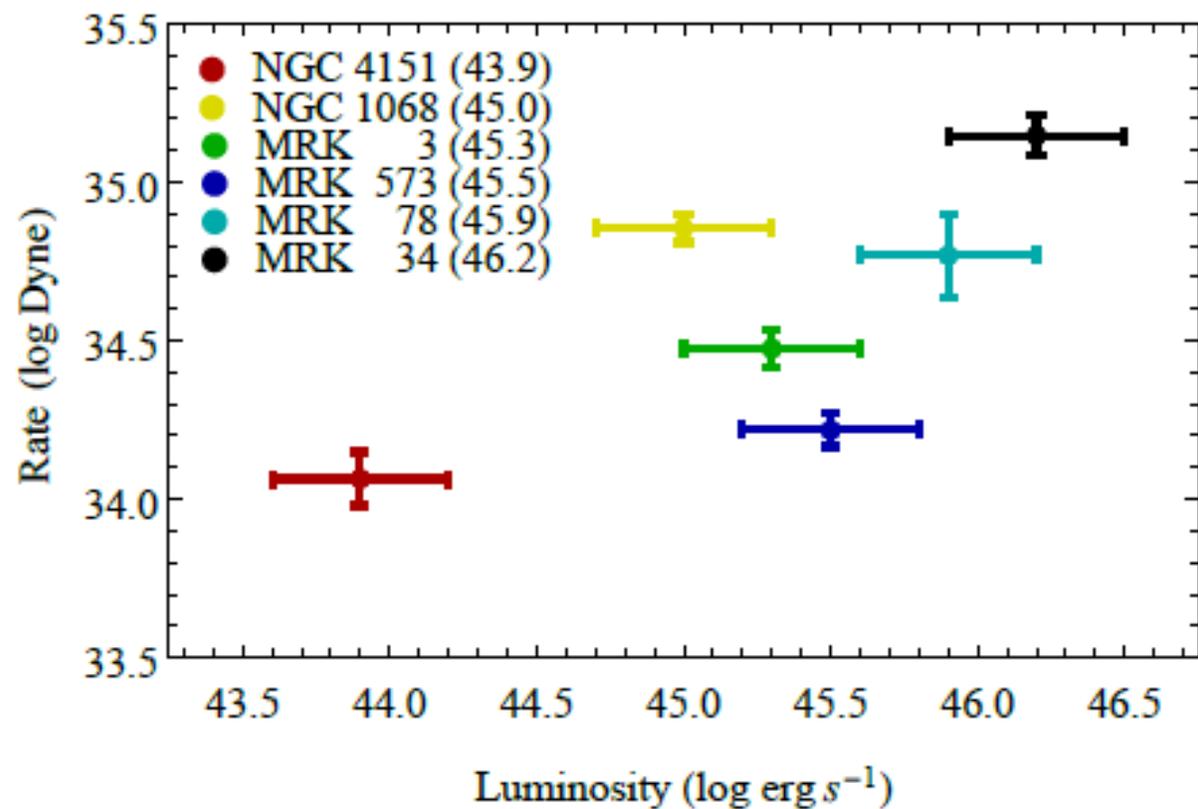
Peak Energy Outflow Rates



Integrated Momenta



Peak Momenta Outflow Rates



$$M_{ion} = 3.5 \times 10^7 M_{\odot}$$

$$\text{HIGH} = 1.5(\pm 0.2) \times 10^7 M_{\odot} \rightarrow 42(\pm 6)\%$$

$$\text{MED} = 1.9(\pm 0.2) \times 10^7 M_{\odot} \rightarrow 56(\pm 5)\%$$

$$\text{LOW} = 7.0(\pm 0.7) \times 10^5 M_{\odot} \rightarrow 2(\pm 1)\%$$

$$\log(n_{\text{H}}) \approx 0.6 - 6 \text{ cm}^{-3}.$$

Проблемы при определении параметров вдоль радиуса:

- Расстояние до галактик
- Геометрия истечений
- Ионизационная модель
- Поправка за покраснение

Так будет ли фидбек эффективным?

- Эффективный, если максимальное значение темпа потока энергии составляет 0.5-5% светимости АЯГ (для больших z)
- Газ может быть вынесен за пределы диска на временах порядка 10^6 лет.

