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Modelling the Kinematics of Quasar Disk-winds

Manhattan Microlensing 2017

Overview

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1. Disk-wind Model
2. Modelling the Disk-wind
3. Results
   - Wind velocities
   - Emission line profile
   - Black hole estimation

Overview

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Disk-wind Model

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- Provide geometric unification of quasars
- Broad absorption lines are seen when the line-of-sight intersects the wind

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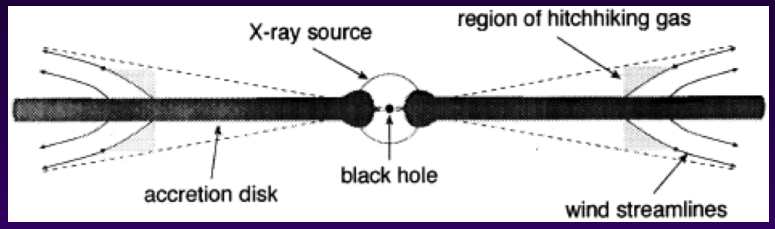

Image credit: Murray et al. (1995)

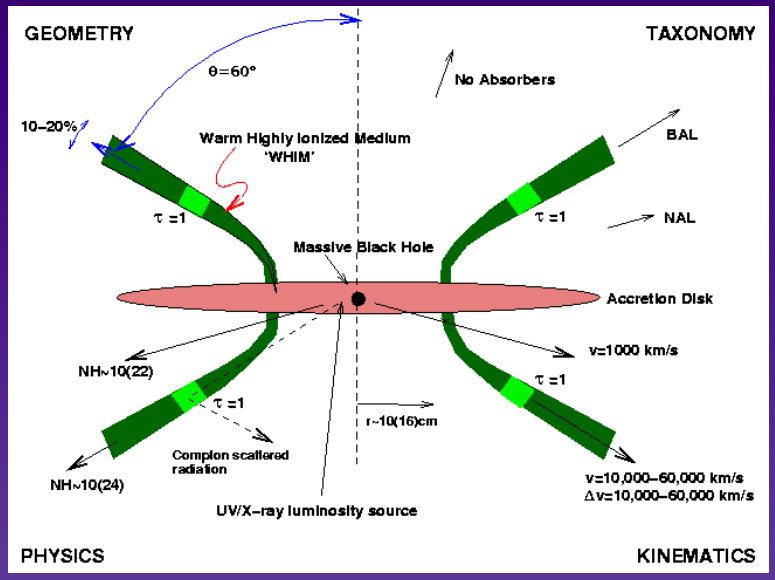

Image credit: Elvis (2000, 2004)

Overview

Modelling the Disk-wind

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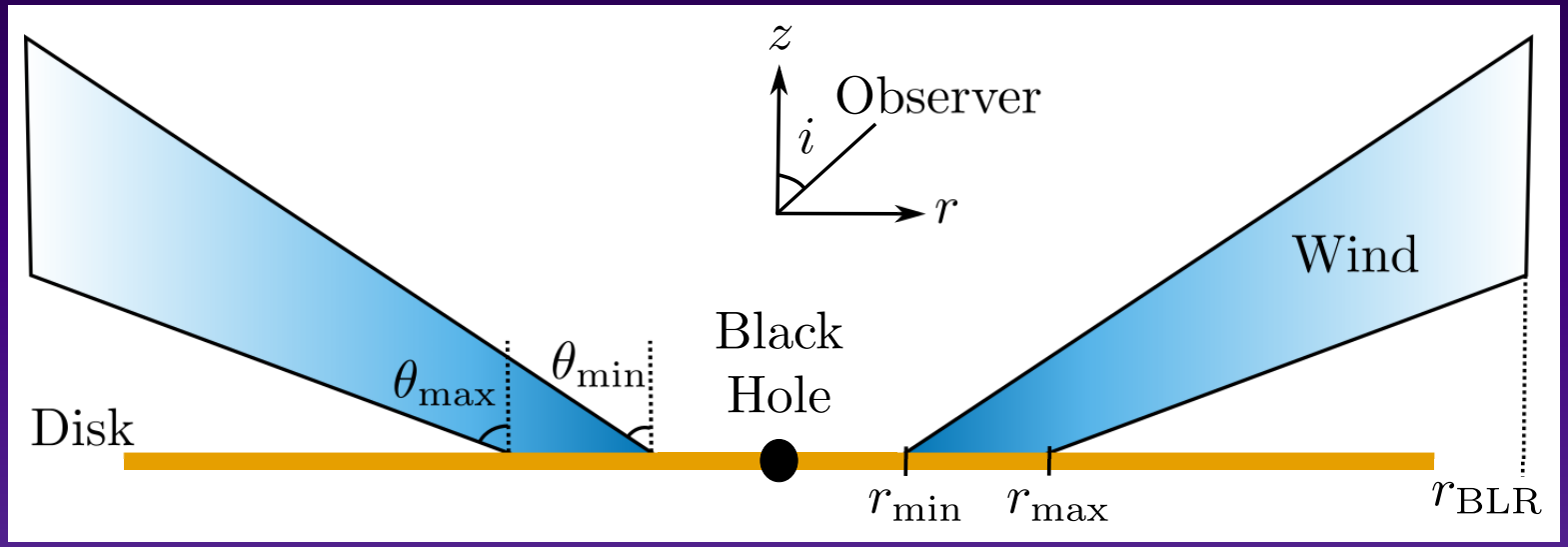
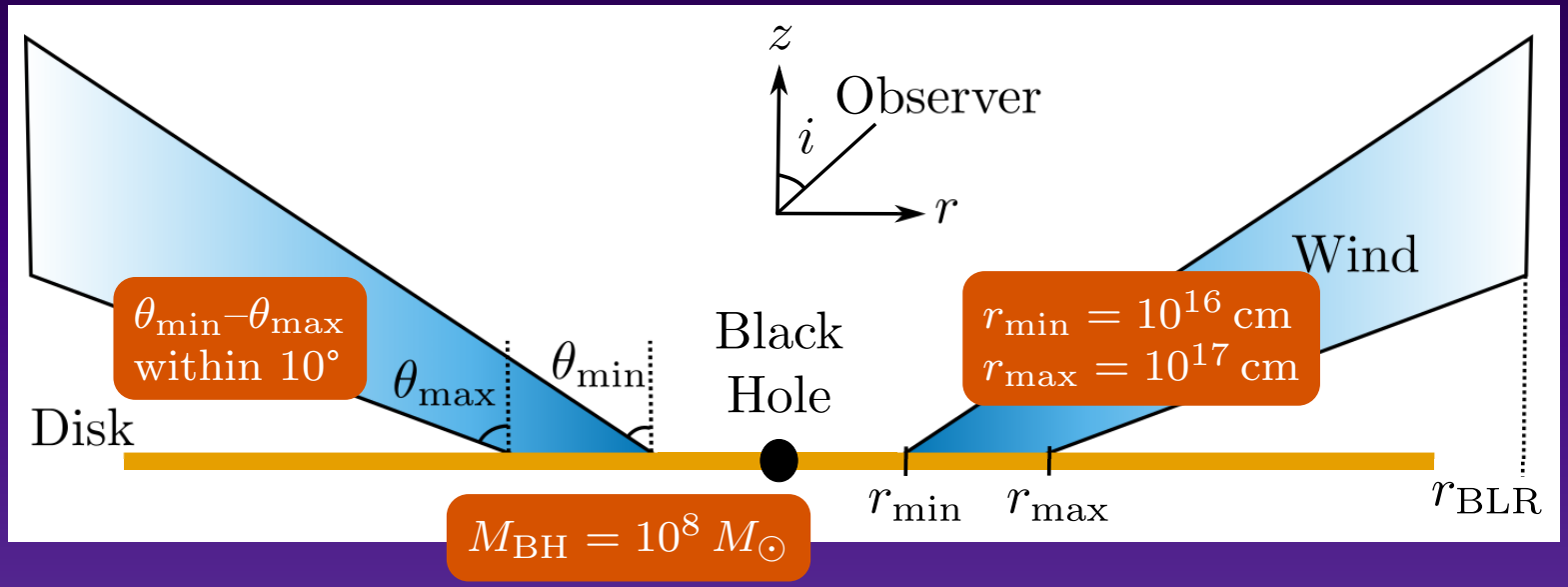
- Kinematical disk-wind model with a narrow outflowing wind angle
- Kinematics adopted from Shlosman and Vitello (1993)
- Explore emission line shapes as a function of inclination angle

Modelling the Disk-wind



Modelling the Disk-wind



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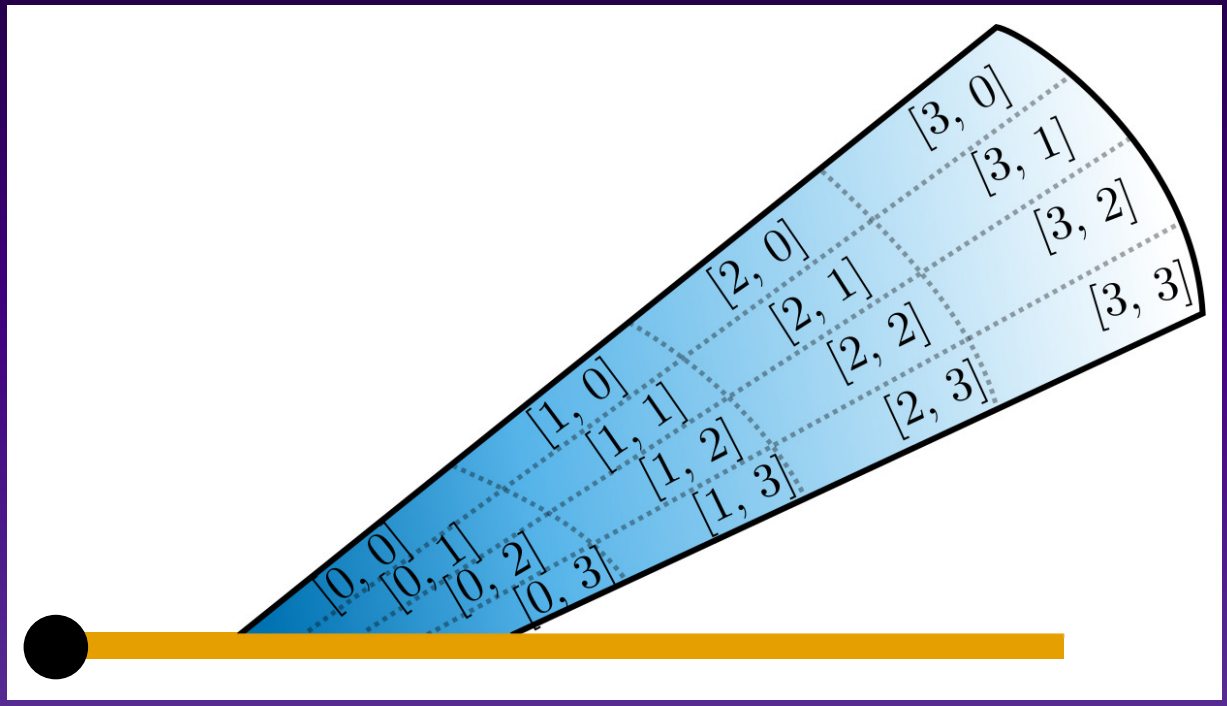

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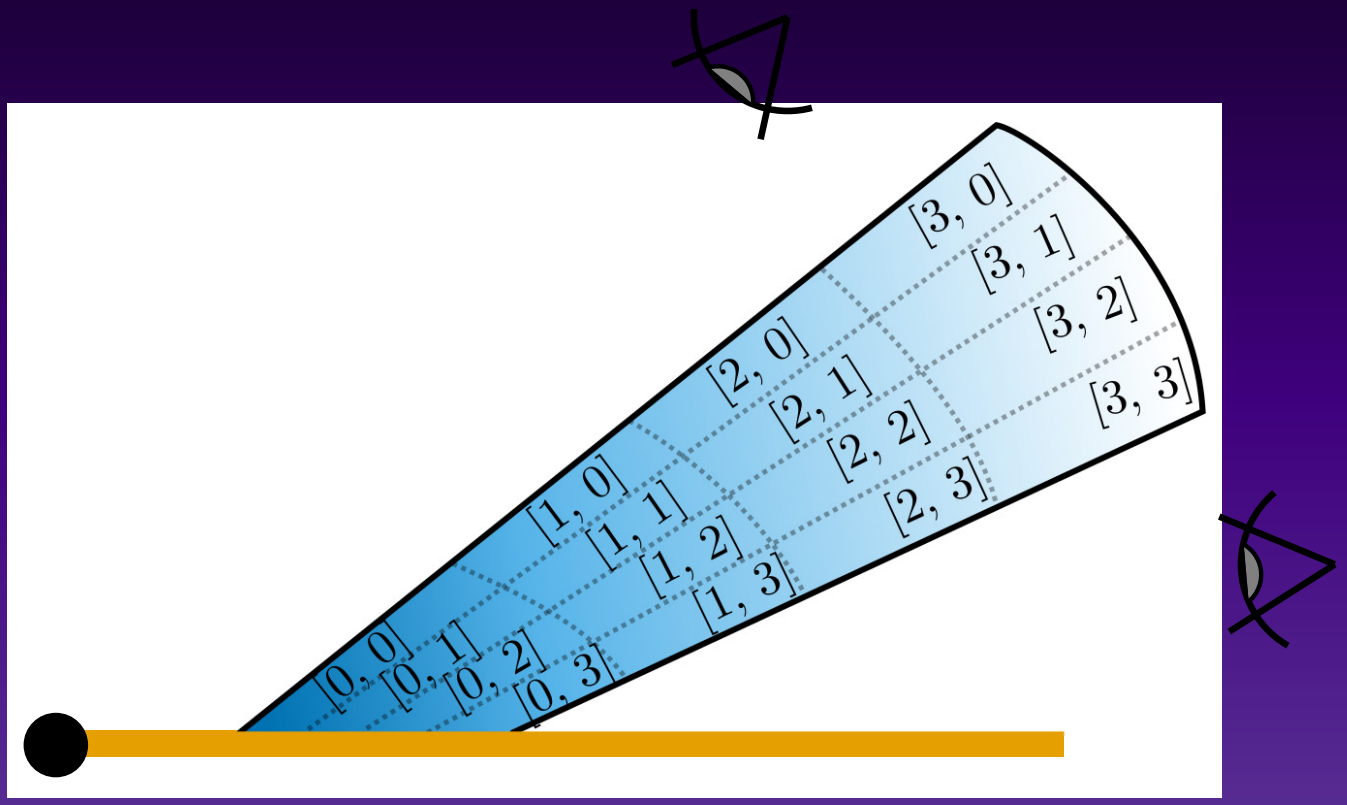

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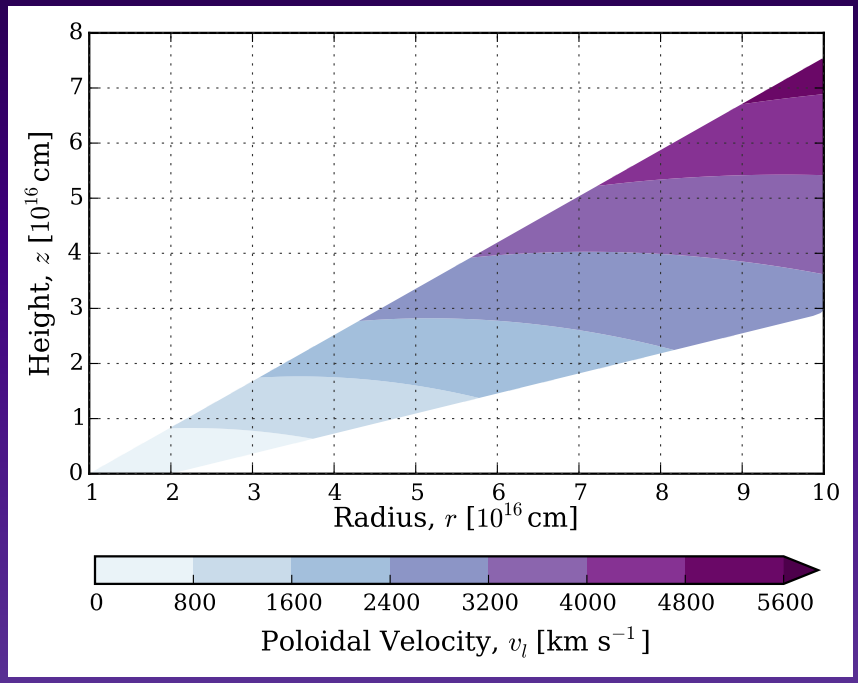
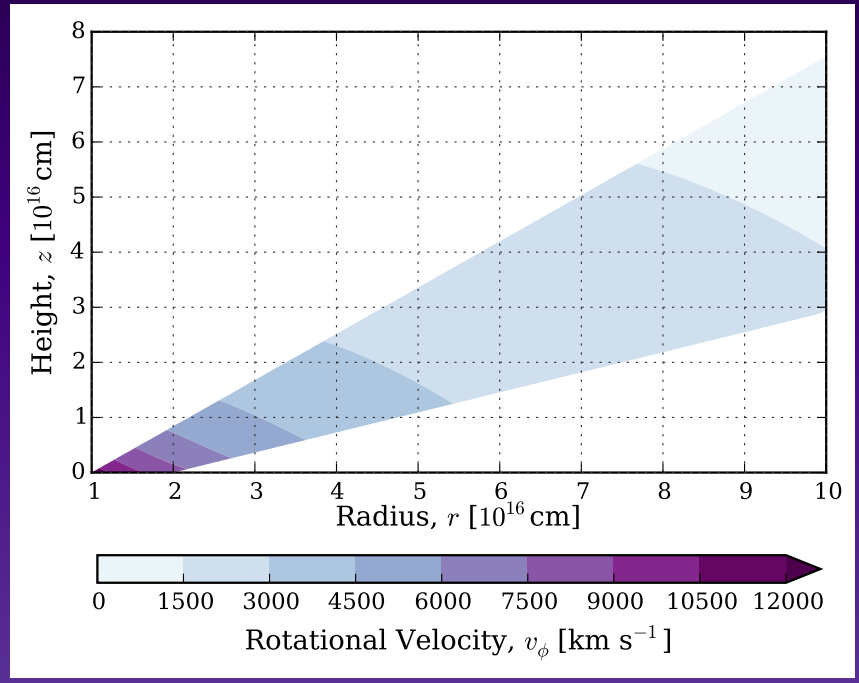
Result

Wind velocities



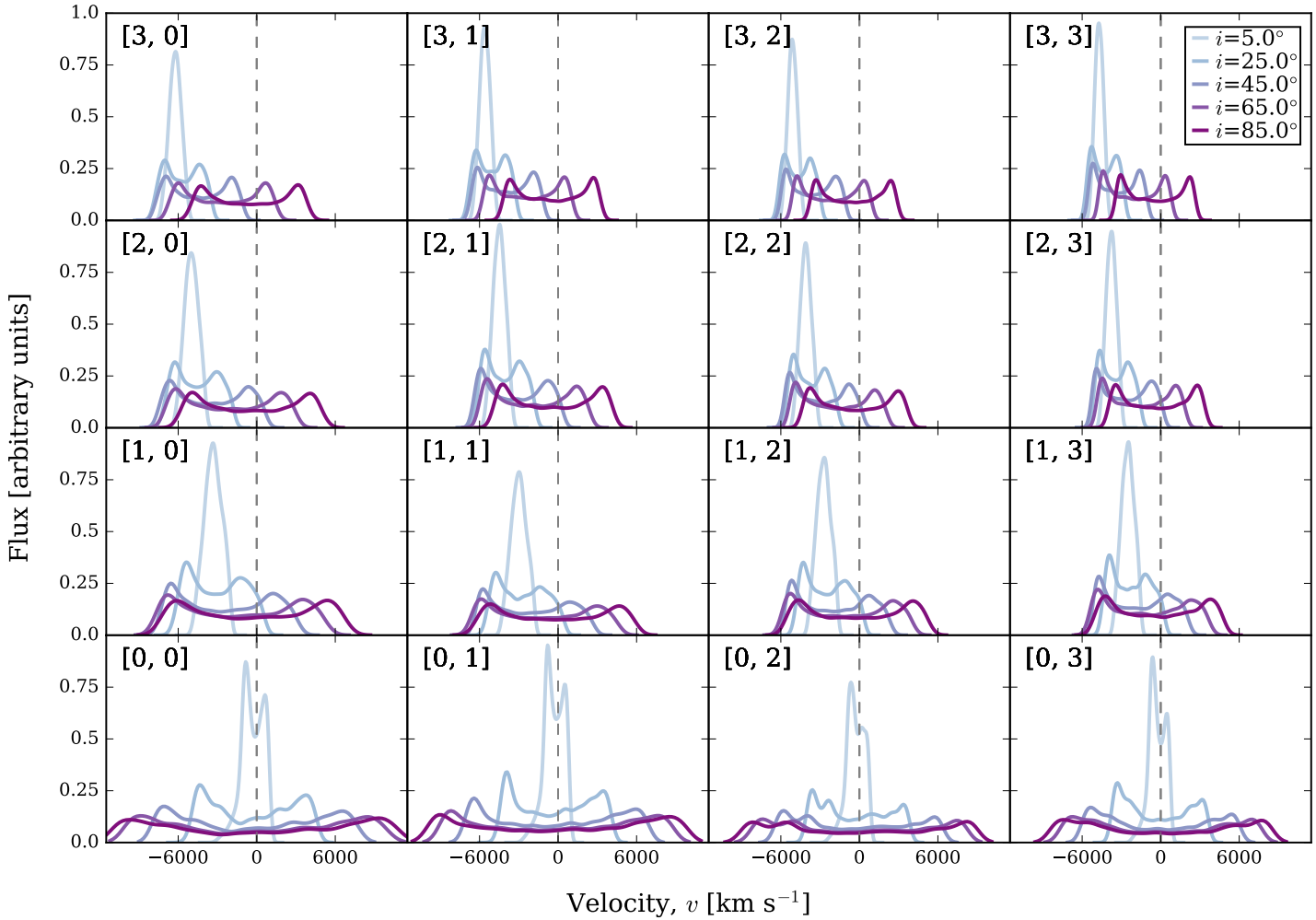
Poloidal velocity



Rotational velocity

Result

Emission line profile: Polar wind 5°–15°



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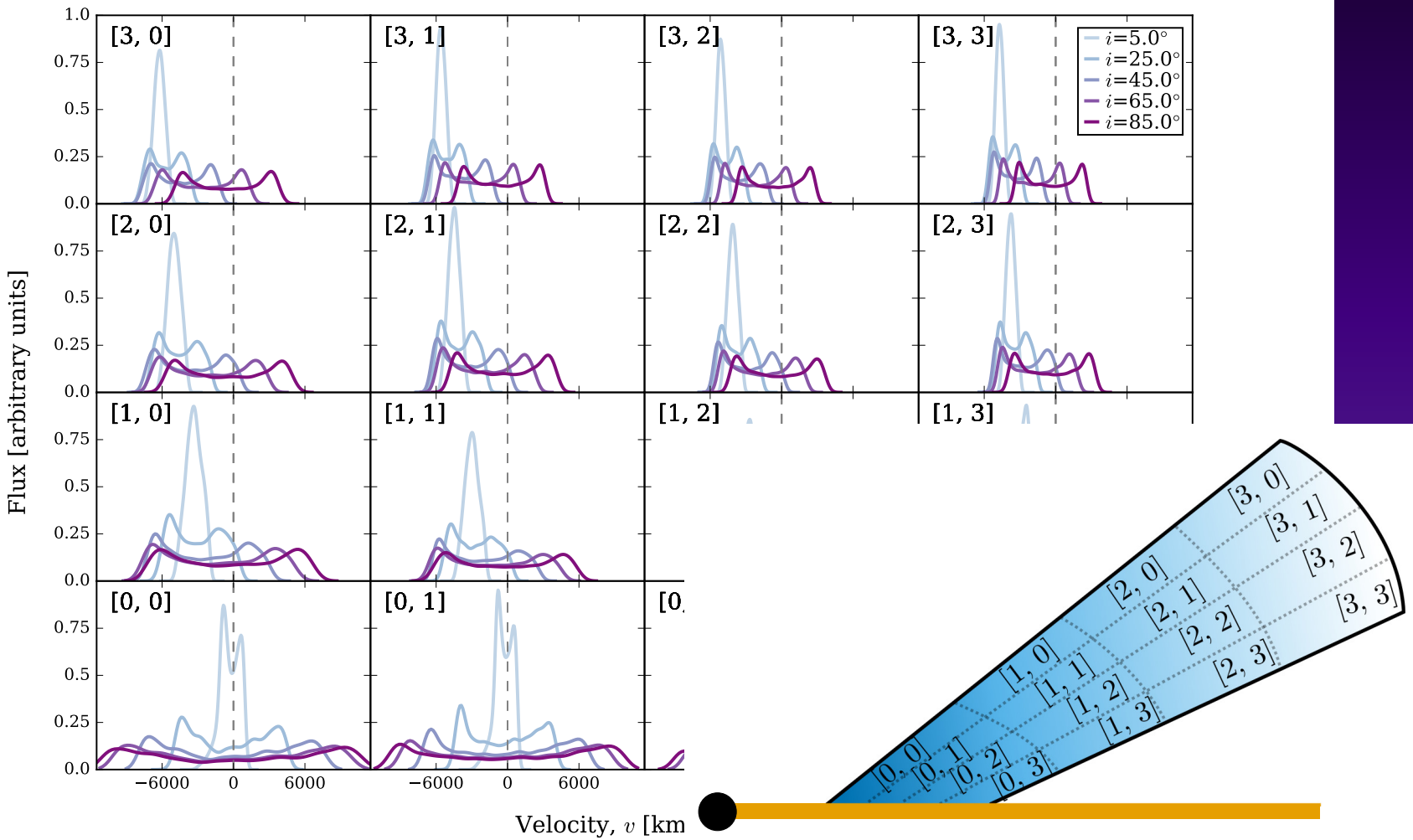

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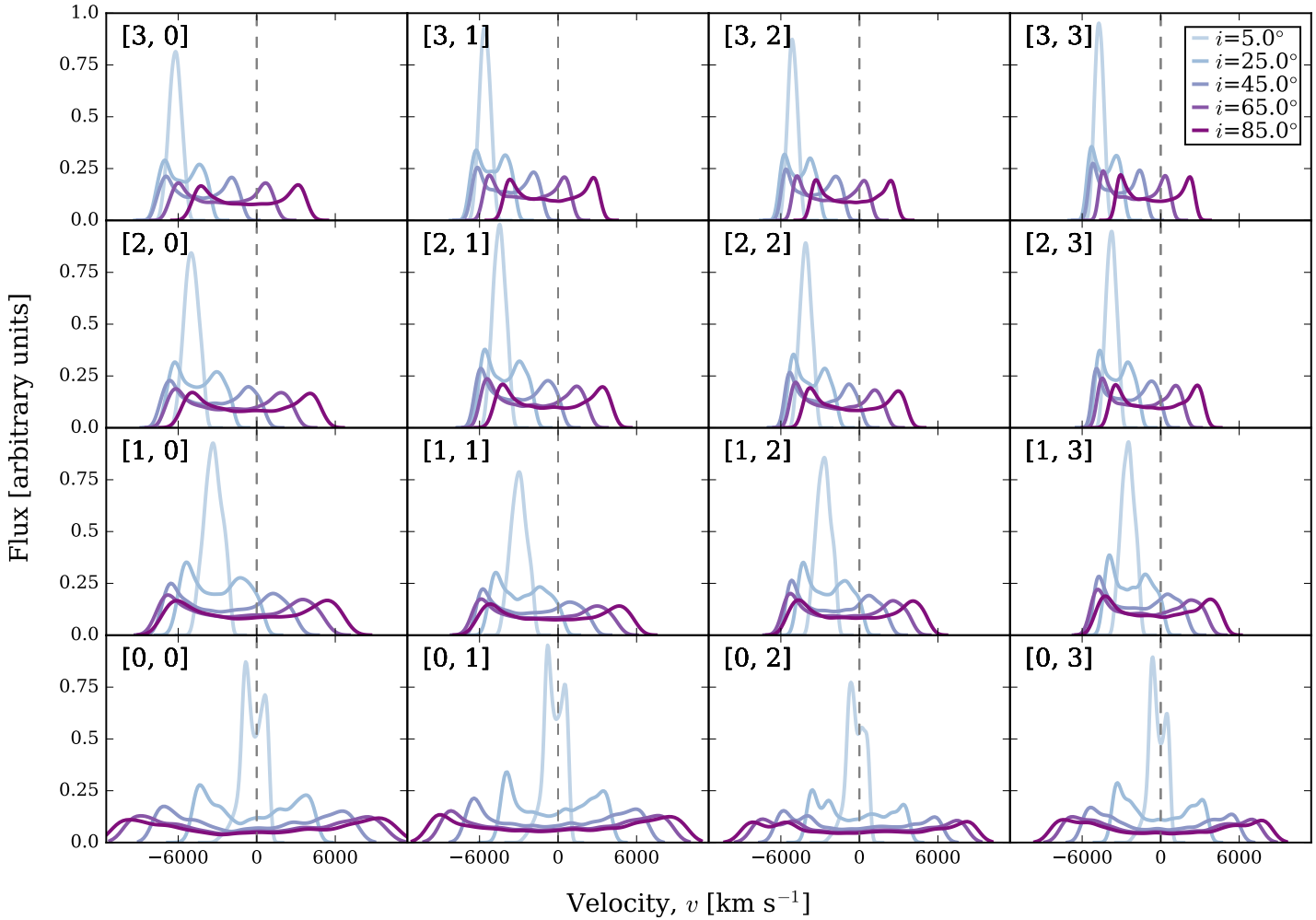
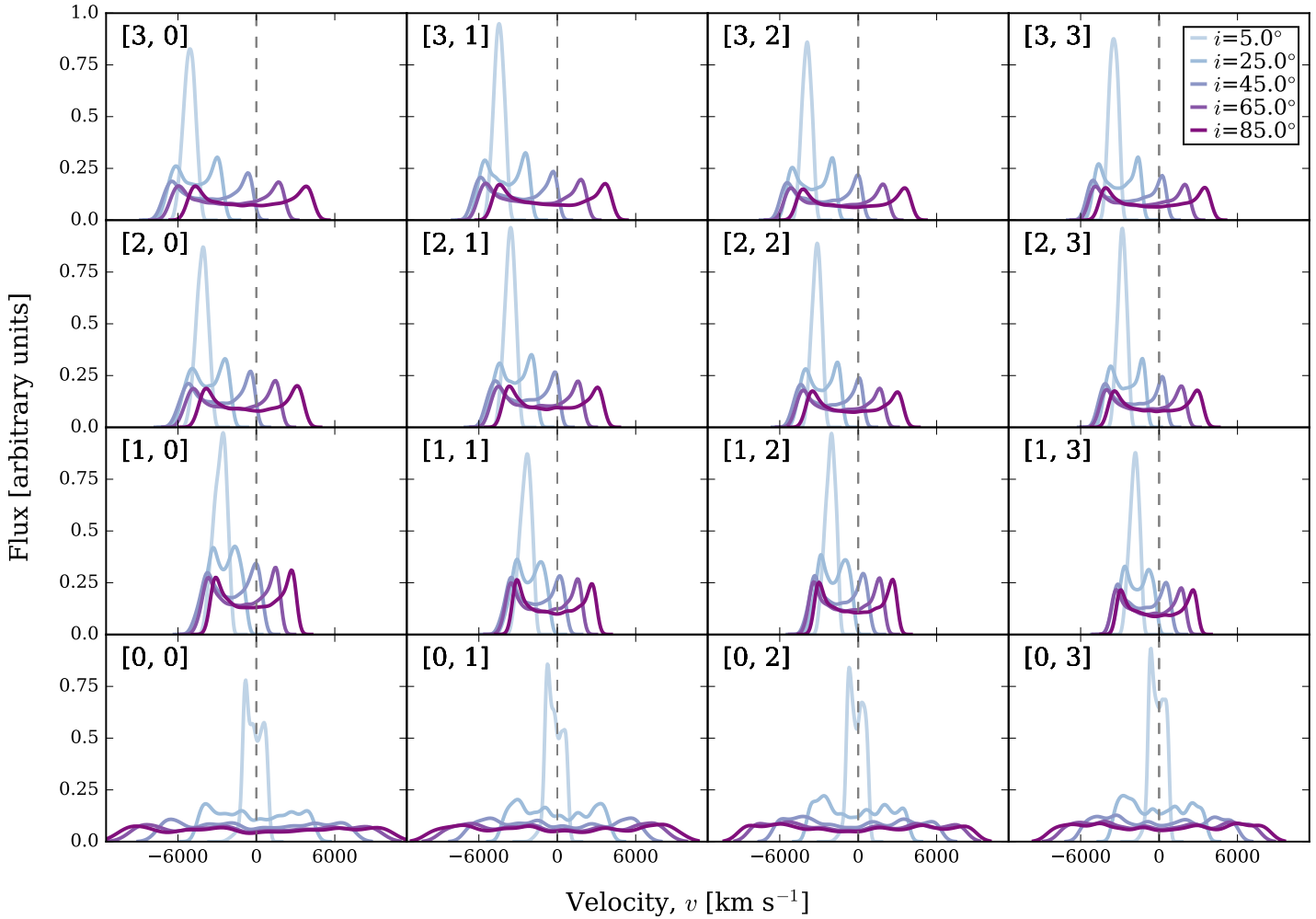


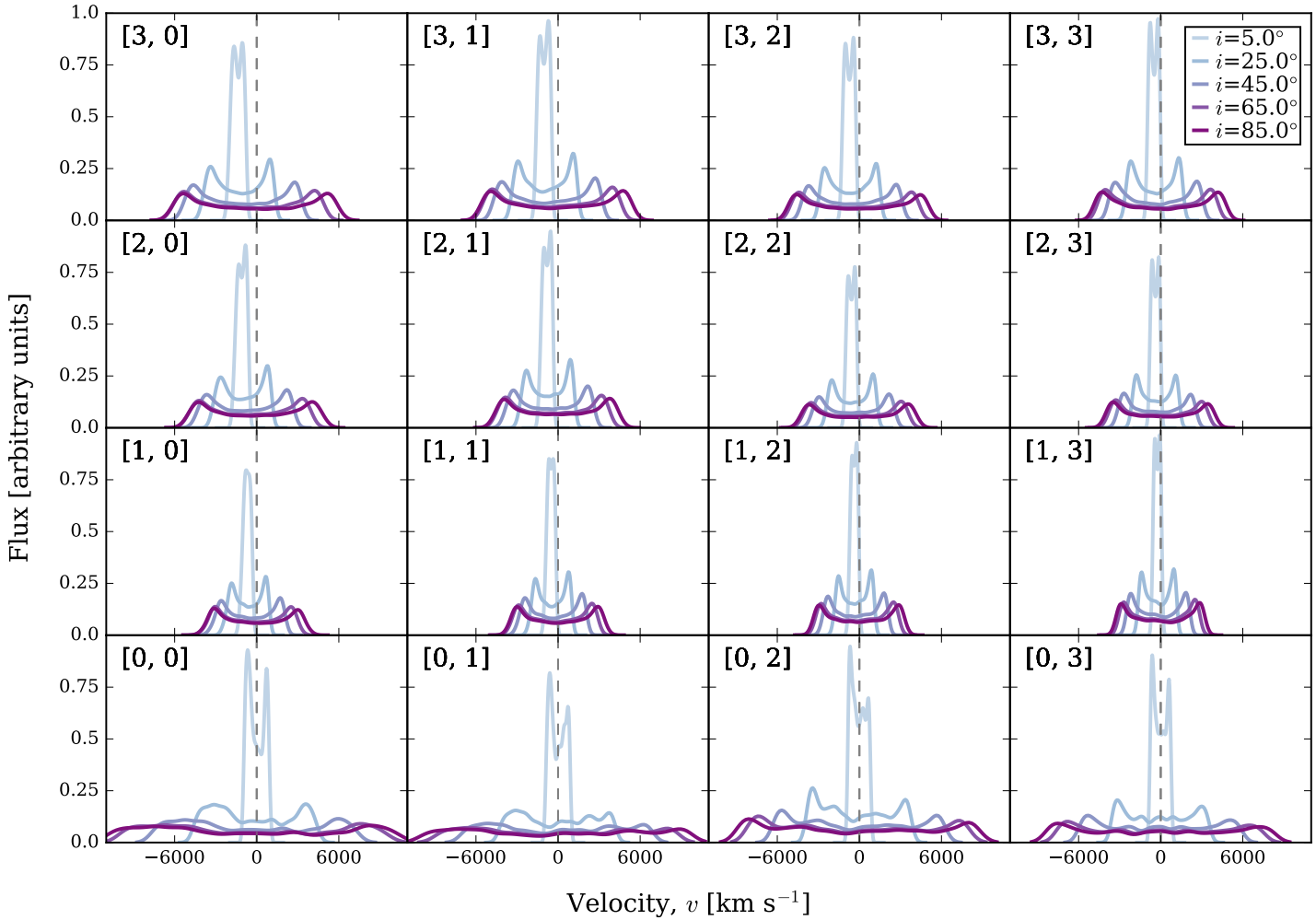
Result

Emission line profile: Intermediate wind 40°–50°



Result

Emission line profile: Equatorial wind 75°–85°



Result

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- Line width increases with inclination angle towards edge-on
- Blueshift increases with poloidal distance from black hole
- Blueshift is smaller as the wind opening angle approaches equatorial

Black Hole Estimation

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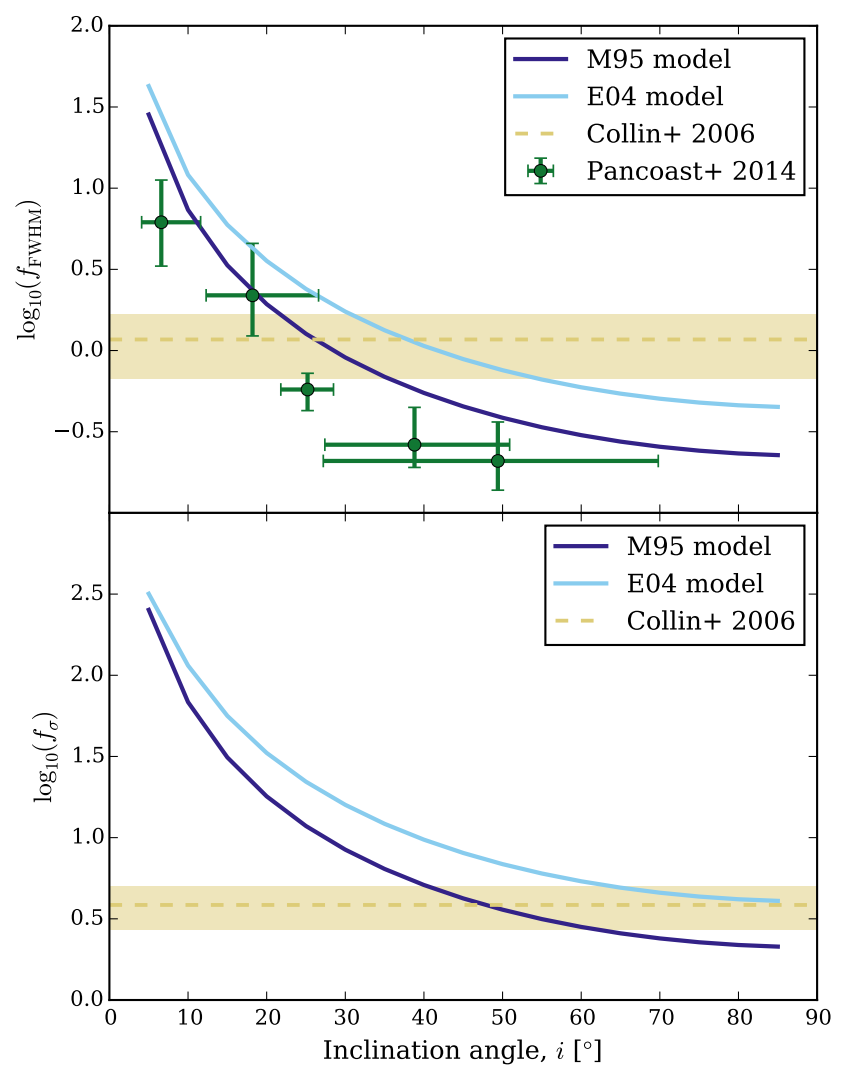
$$M_{\rm BH} = f\left(\frac{\Delta V^2 R}{G}\right),$$

- f: Virial factor
- ΔV: Velocity dispersion
- R: Radius of emitting line

Black Hole Estimation

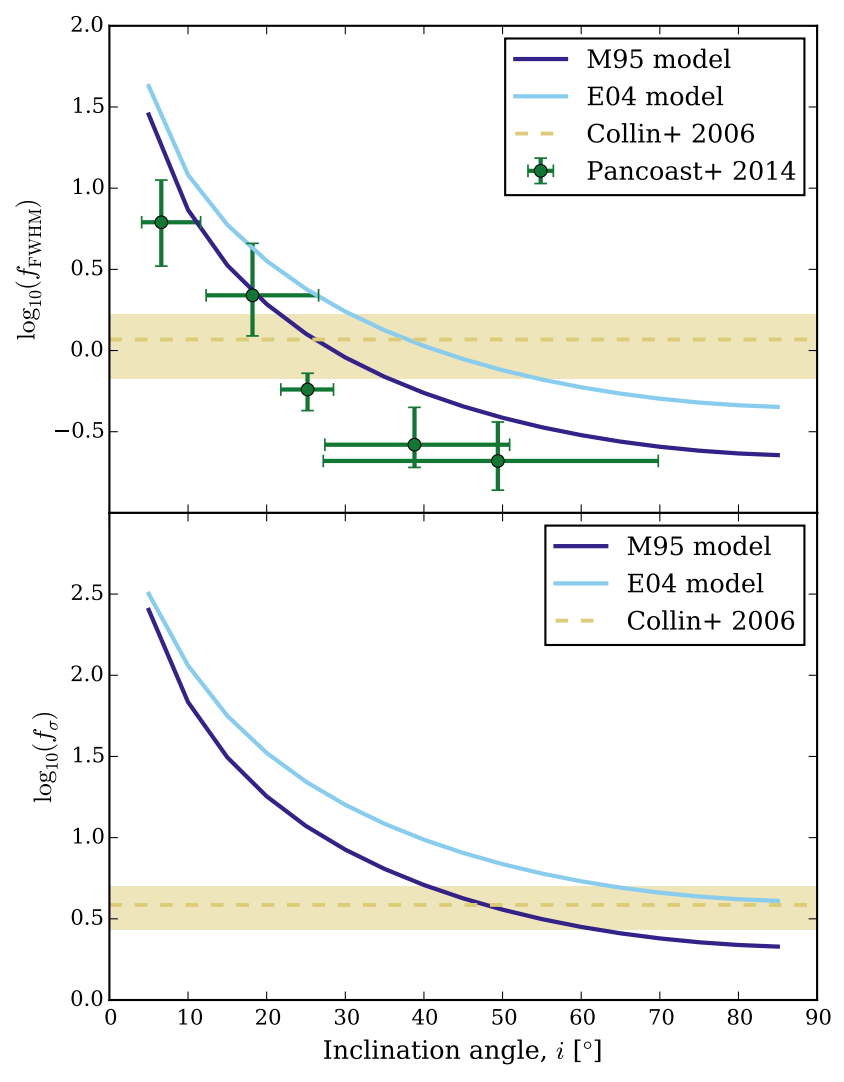
Virial factor as a function of inclination



- Murray et al. (1995): M95
- Elvis (2004): E04

Black Hole Estimation

Virial factor as a function of inclination



- Small f with inclination angles close to edge-on
- If f =constant, might induce a bias into virial black hole estimates for large sample of quasars

Thank you

Summary

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