CURRENT STATUS OF FAT (V5.0.3)

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1. Introduction

The Fully Automated TiRiFiC is an IDL/GDL wrapper around the tilted ring fitting code (TiRiFiC) that aims to fully automate the process of fitting simple tilted ring models to line emission cubes. This code is still in the development phase and hence errors and bugs can be present. Nevertheless, the code has extensively been tested and the results and a more extensive description of the code are documented in Kamphuis et al. (2015).

This document provides an overview of plots from Kamphuis et al. (2015) which illustrate the performance of the current version of FAT. This fully tested version is available on the master branch. Typically the current version works much better then the version from 2015. However, as we have also reduced the applied errors the plots in this document show that performance is comparable, i.e. the fits are equally accurate with smaller errors. Additionally, as FAT now employs a Monte Carlo method in the regularisation of the parameters the final model can sometimes differ slightly. However this should always be within the calculated errors. If not please open an issue on the GitHub. The very latest version of FAT will always be available on the FAT-GDL-Beta branch. Although this branch will contain a stable version that has been tested on some galaxies, it will not be tested on the full database and overview plots will not be available. If you are looking for specific functionality or find that FAT is not performing well despite the galaxy having regular rotation or just want to chat about tilted ring modelling pipelines please do not hesitate to contact me.

It is important to remember that FAT is meant for batch fitting. Hence, the aim of the code is to provide tilted ring models that are accurate for a large fraction of galaxies. Ideally, FAT should identify galaxies that are not fitted well however this feature is not optimal yet. When fitting individual galaxies it is recommended to run FAT and subsequently fine tune the model by hand in TiRiFiC. In most cases such fine tuning will be limited to a few outer rings but in the case of complex galaxies with significant non-cylindrically symmetric motions the models can fail (Or in the case of very bad data but that is not a FAT issue).

FAT is not an automated version of the extended functionality of TiRiFiC. FAT fits simple rotationally symmetric discs with asymmetric warps and surface brightness distributions. However, TiRiFiC itself provides a much more extended functionality and should be used for identifying significant non-cylindrically symmetric motions, thick discs, bars and other such HI features. When modelling such galaxies ideally FAT can provide a base model and setup a .def file with merely a thin disc. These can then be used in TiRiFiC in order to explore large scale motions not captured by FAT's simple model. For examples of such modelling please see Kamphuis et al. (2011), Zschaechner et al. (2011), Kamphuis et al. (2013), Gentile et al. (2013).

2. LVHIS Galaxies

This section shows Figures 7, 11 and 12 from Kamphuis et al. (2015).

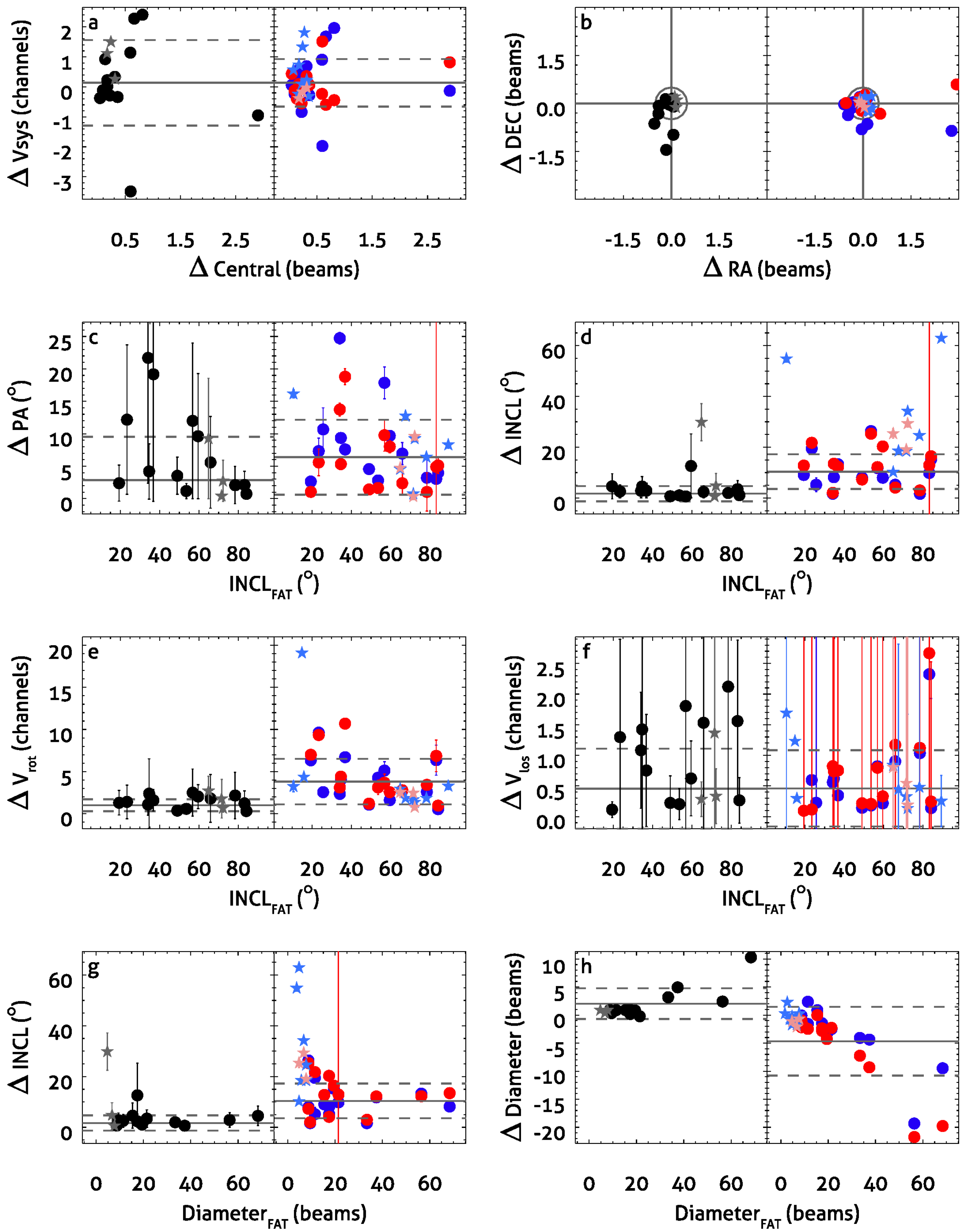

FIGURE 1. Differences between the final fits with FAT, ROTCUR and DISKFIT. Left hand side of each panel: the difference between ROTCUR and DISKFIT, i.e. ROTCUR - DISKFIT, Right hand side of each panel: blue: the difference between ROTCUR and FAT, red: the difference between DISKFIT and FAT. The solid grey lines show the weighted average and the dashed lines show the 1σ deviation from this average in each plot. Stars correspond to final fits outside the previously determined reliable range (see Section ??) and circles to ones inside these limits. The errors on the points are calculated as the average of the error for all rings divided by $\sqrt{\mathrm{N}}$ with N the number of rings in the model. This is Figure 7 from Kamphuis et al. (2015).

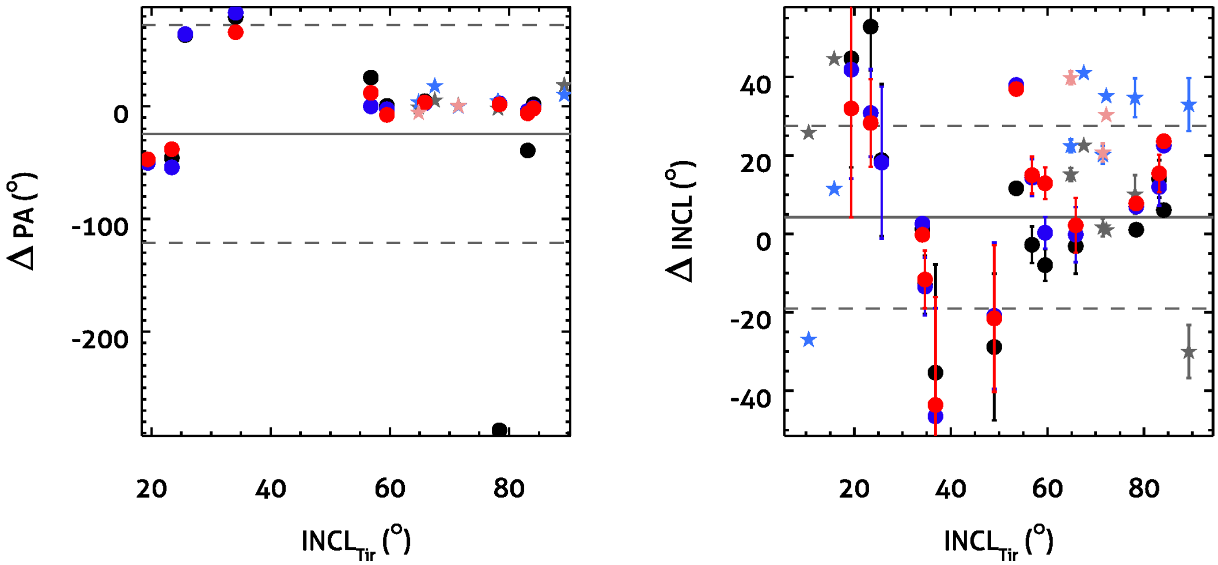

FIGURE 2. Comparison between the PA and inclination of the optical values and the different fits, black - FAT, blue - ROTCUR, red - DISKFIT. Stars are galaxies where the final FAT model is in a part of parameter space that is considered unreliable. The grey dash line denote the scatter on the deviations between literature and the ROTCUR interactive fit. This is Figure 11 from Kamphuis et al. (2015).

3. ARTIFICIAL GALAXIES

This shows the results on the set of Artificial Database as described in Kamphuis et al. (2015).

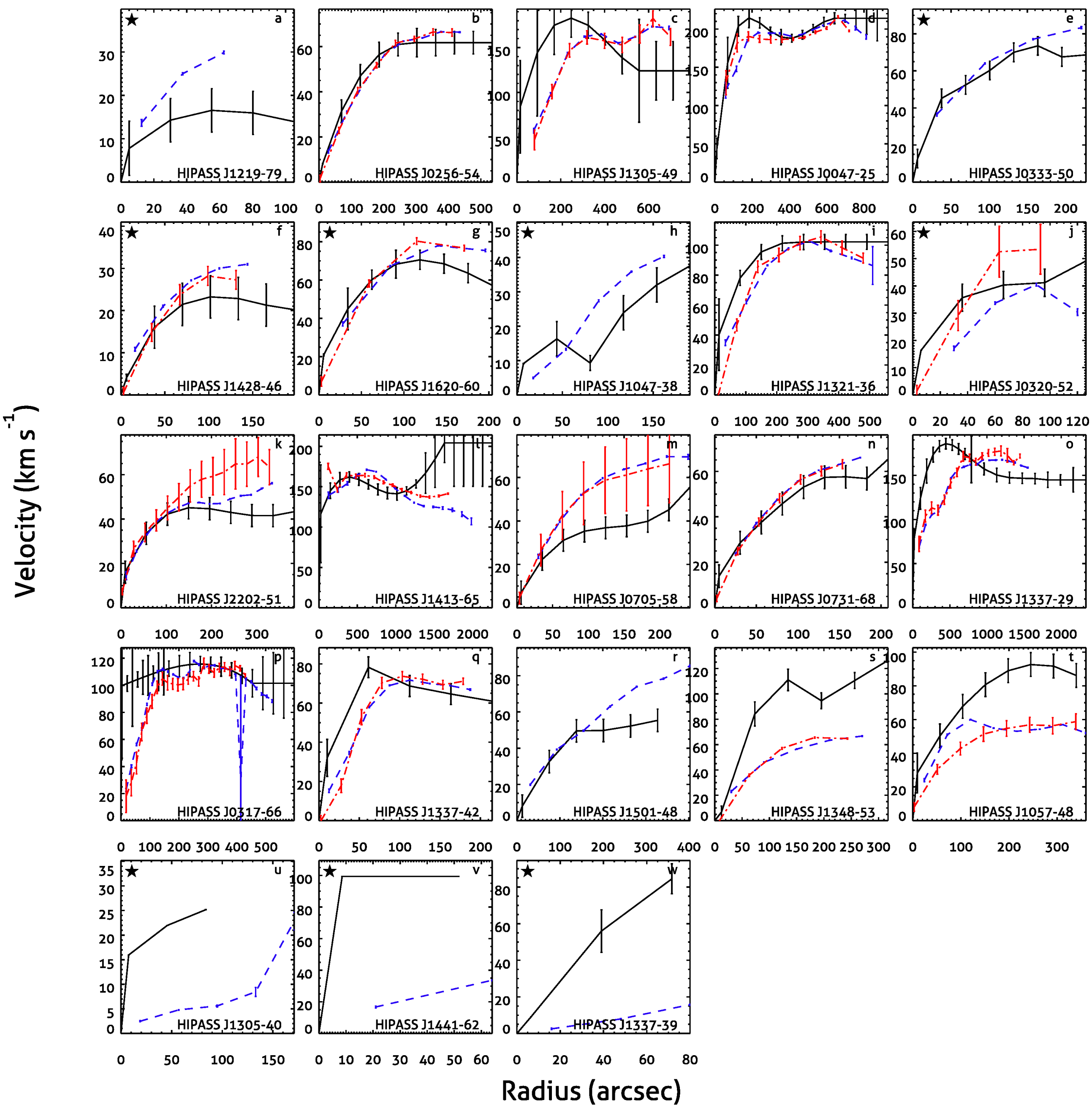

FIGURE 3. Rotation curves for all the galaxies in the LVHIS Sample. The plots are ordered according to their FAT inclination, with the lowest inclination in the bottom left. Black lines: FAT, Red Lines:DISKFIT, Blue lines:ROTCUR. The error bars are the formal errors derived by DISKFIT and ROTCUR for the red and blue lines respectively. For FAT the error is an empirical estimate derived from the regularisation process (see § ??. Stars indicate curves outside the reliably fitted range. This is Figure 12 from Kamphuis et al. (2015).

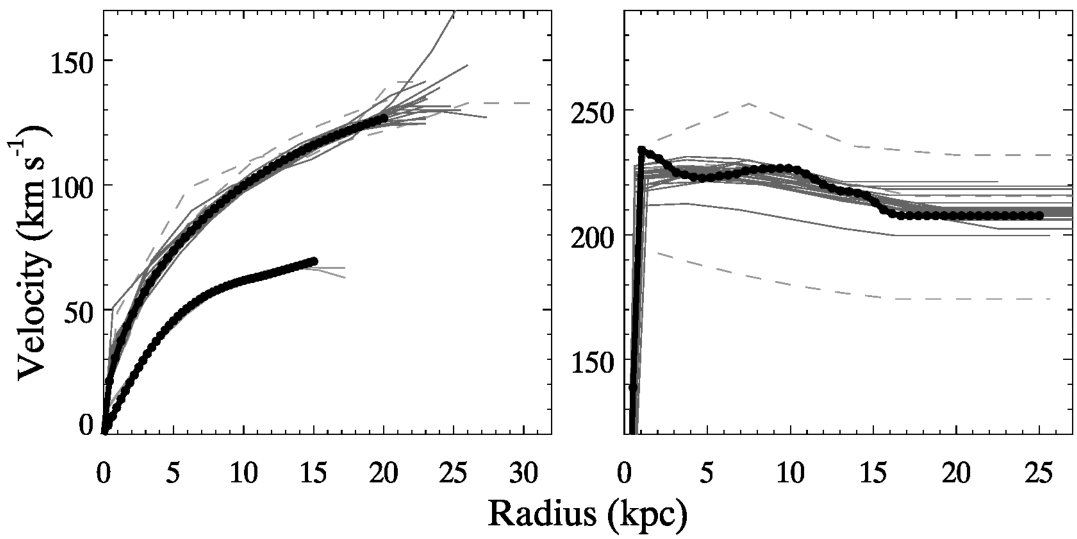

Figure 4. Rotation curves used and fitted in the artificial galaxy database. Left panel: dwarf galaxy and intermediate galaxy. Right panel: massive galaxy. The black circles and lines indicate the input rotation curves, grey solid lines are the reliable output curves, grey dashed lines are from artificial galaxies outside the reliable fitting range. Figure 4 in Kamphuis et al. (2015)

4. Extended Artificial Galaxies

This shows the results on an extended set of Artificial Database as described in Kamphuis et al. (2015). Typically these galaxies are warped, as opposed to flat like the artificial database of the paper, and they explore a range of different velocity resolutions. This addition of the database was made to show that the accuracy of the code should really be expressed in beams and channels and not in arcsec and km s^{-1}. Table 1 is a copy of Table one in Kamphuis et al. (2015) for this extended set of galaxies.

References

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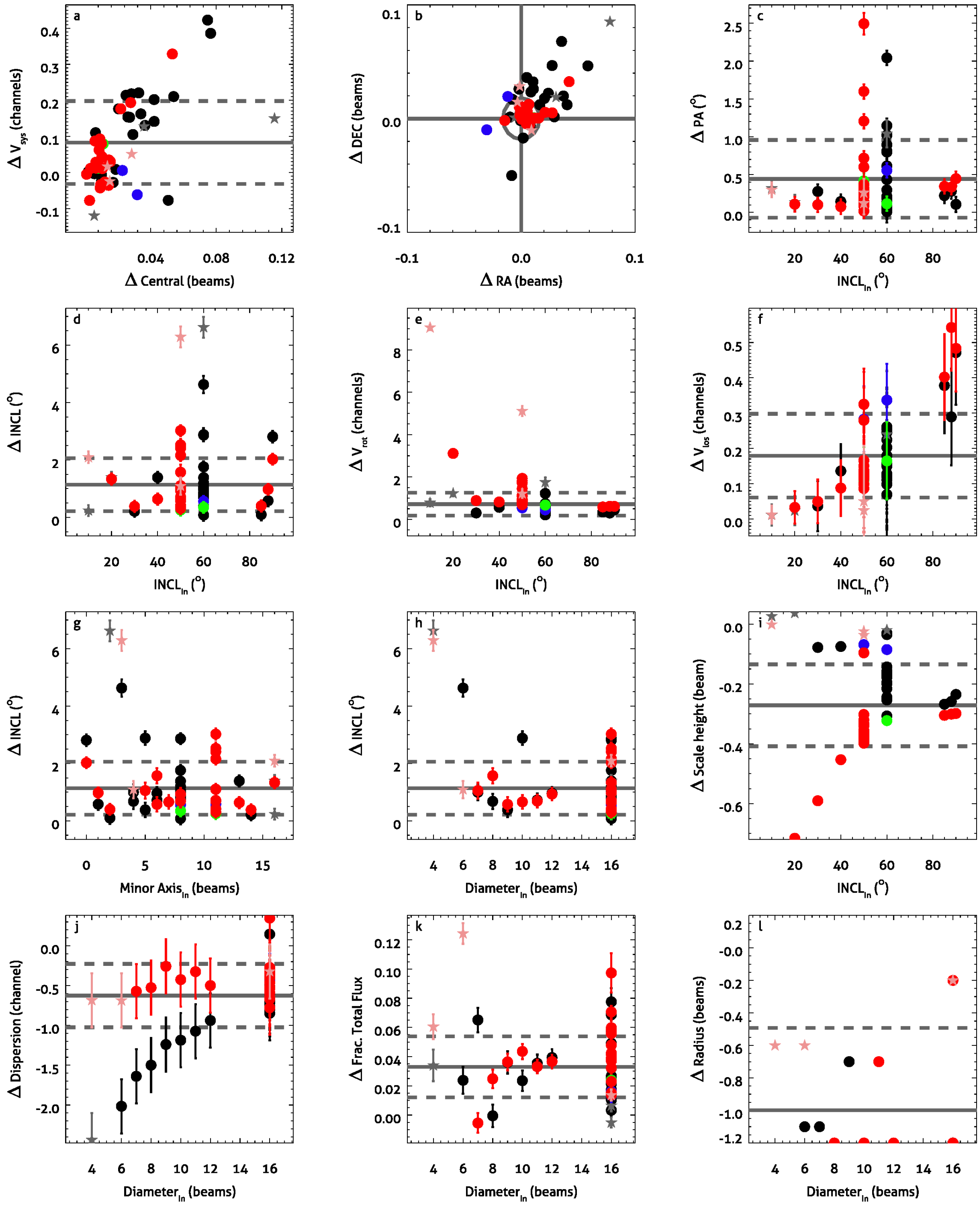

Figure 5. Difference between the artificial galaxy inputs and FAT output. On the y-axis the difference between the model input and best fitting FAT values is shown for various parameters. The solid line shows the mean deviation over the whole sample and the dashed lines show the 1σ offsets from this average. The errors on the points are calculated as the average of the FAT error for all rings divided by $\sqrt{\mathrm{N}}$, where N is the number of rings in the model. The stars show galaxies outside the reliable range for FAT whereas circles are inside this range. The colour coding indicates: blue - dwarf galaxy, black - intermediate galaxy, red - massive galaxy. Figure 6 in Kamphuis et al. (2015)

	Database Galaxies		Variations
Parameter	Base 1	Base 2	Sample Values
Beams across the major axis	16	16	32
Inclination (°)	60	50	-
PA (°)	45	55	-
Inner-Outer Dispersion (km s^{-1})	8.0-8.0	8.0-8.0	
Inner-Outer $\Delta\ \theta$ (rad)	0-0.05	0-0.05	0-0.15
Inner-Outer $\Delta\ \phi$ (rad)	0-0.2	0-0.2	0-0.05
Inner-Outer scale height (kpc)	0.3-0.3	0.2-0.2	-
Channel width (km s^{-1})	2	2	4, 8
Signal-to-Noise	8	8	-
Rotation Curve	intermediate	massive	-

TABLE 1. Values for the two base galaxies (columns 2 & 3) and the values by which they are varied (column 4). We change only one parameter at a time while all other parameters for the base galaxies are unchanged.

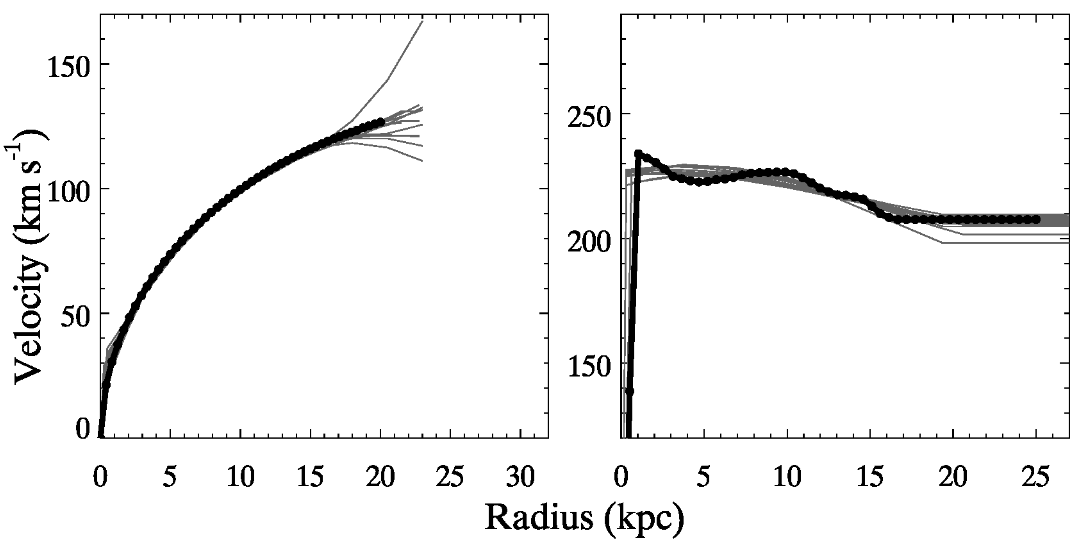

FIGURE 6. Rotation curves used and fitted in the artificial galaxy database. Left panel: dwarf galaxy and intermediate galaxy. Right panel: massive galaxy. The black circles and lines indicate the input rotation curves, grey solid lines are the reliable output curves, grey dashed lines are from artificial galaxies outside the reliable fitting range. Figure 4 in Kamphuis et al. (2015)

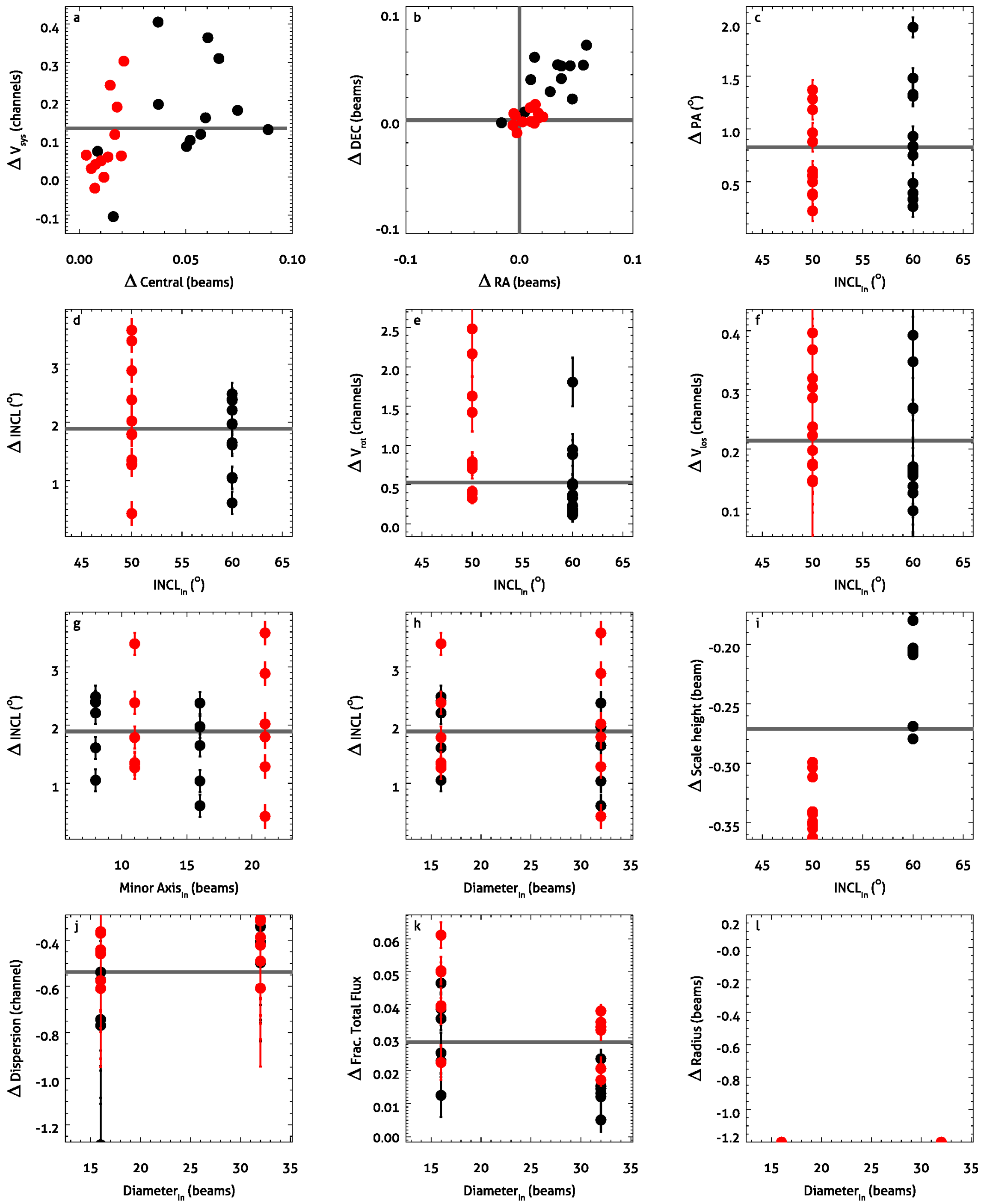

Figure 7. Difference between the artificial galaxy inputs and FAT output. On the y-axis the difference between the model input and best fitting FAT values is shown for various parameters. The solid line shows the mean deviation over the whole sample and the dashed lines show the 1σ offsets from this average. The errors on the points are calculated as the average of the FAT error for all rings divided by $\sqrt{\mathrm{N}}$, where N is the number of rings in the model. The stars show galaxies outside the reliable range for FAT whereas circles are inside this range. The colour coding indicates: blue - dwarf galaxy, black - intermediate galaxy, red - massive galaxy. Figure 6 in Kamphuis et al. (2015)