WALLABY Pilot Survey Data Release 1: Description of Kinematic Parameters and Data Products

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1 Overview

This document describes the kinematic model parameters and data products that are contained in the first WALLABY Pilot Data Release (PDR1). A full description of the sources is found in the (Westmeier et al. 2022) and a more complete description of the kinematic modelling is found in (Deg et al. 2022)

2 Kinematic Model Parameters

The kinematic models are generated through the WALLABY Kinematic Analysis Proto-Pipeline (WKAPP). This pipeline utilizes the 3D kinematic modelling codes FAT[1] (Fully Automated TiRiFiC) and 3DBarolo[2] (3D-Based Analysis of Rotating Objects From Line Observations) as well as MCGSuite[3] (Mock Cube Generator Suite) to fit the observed cubes and construct an average model.

In brief, sources in WALLABY PDR1 are modelled using both FAT and 3DBarolo. The two fits are visually inspected and, if both are of sufficient quality, WKAPP constructs an optimized model by averaging the two fits and producing model data products using MCGSuite.

2.1 List of Kinematic Model Parameters

A full list of the kinematic model specific parameters is contained in Table 1. These are not the complete set of parameters contained in the kinematic model catalogue. The extra set of parameters are from the source catalogue and allow for cross-matching between the two sets of parameters.

Going through the additional parameters that appear in the catalogue:

- `name` – The official WALLABY source name, which is the form "WALLABY Jhhmmss±ddmmss" in accordance with the official IAU naming scheme.
- `ra` and `dec` – The right ascension and declination in degrees from the source catalogue.
- `freq` – The central frequency of the galaxy in Hz from the source catalogue.
- `team_release` The name of a set of sources from each source finding run.
- `team_release_kin` The name of a set of kinematic models corresponding to the sources found in the run.

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[1]Kamphuis et al. 2015

[2]Di Teodora et al. 2015

[3]Spekkens et al., in prep

Name	Type	Unit	Description
X_model	double	px	x-coordinate of the kinematic center†
e_X_model	double	px	Uncertainty in X_model†
Y_model	double	px	y-coordinate of the kinematic center.†
e_Y_model	double	px	Uncertainty in Y_model†
RA_model	double	deg	Right ascension (J2000) of the kinematic center
e_RA_model	double	deg	Uncertainty in RA_model†
DEC_model	double	deg	Declination (J2000) of the kinematic center
e_DEC_model	double	deg	Uncertainty in DEC_model†
Vsys_model	double	km s^{-1}	Heliocentric systemic velocity
e_Vsys_model	double	km s^{-1}	Uncertainty in Vsys_model
Inc_model	double	deg	Inclination
e_Inc_model	double	deg	Uncertainty in Inc_model
PA_model	double	deg	Position angle in pixel coordinates (counterclockwise from x=0)†
e_PA_model	double	deg	Uncertainty in PA_model†
PA_model_g	double	deg	Position angle in equatorial coordinates (East of North)
e_PA_model_g	double	deg	Uncertainty in PA_model_g
Rad	double array array	arcsec	Radial grid for Vrot_model
Vrot_model	double array	km s^{-1}	Rotation curve
e_Vrot_model	double array	km s^{-1}	Uncertainty in Vrot_model from the averaging process
e_Vrot_model_inc	double array	km s^{-1}	Uncertainty in Vrot_model due to e_Inc_model
Rad_SD	double array	arcsec	Radial grid for SD_model and SD_FO_model
SD_model	double array	$M_\odot$ pc^{-2}	Projected surface density profile
e_SD_model	double array	$M_\odot$ pc^{-2}	Uncertainty in SD_model
SD_FO_model	double array	$M_\odot$ pc^{-2}	Deprojected surface density profile using a cos(Inc_model) correction
e_SD_FO_model_inc	double array	$M_\odot$ pc^{-2}	The uncertainty in SD_FO_model due to e_Inc_model
QFlag_model	integer		Kinematic model quality flag

† In pixel coodinates relative to the preprocessed cubelet, which starts from the point (1,1).

Table 1: WKAPP model parameters.

File suffix	Type	Description
_AvgMod.txt	ascii file	Model parameters
_DiagnosticPlot.png	PNG file	Model summary plot
_ProcData.fits	FITS cube	Pre-processed cubelet
_ModCube.fits	FITS cube	Model realization with pre-processed cubelet properties
_DiffCube.fits	FITS cube	Data - model cube with pre-processed cubelet properties
_ModRotCurve.fits	FITS binary table	Table containing the model rotation curve parameters
_ModSurfDens.fits	FITS binary table	Table containing the model surface density parameters
_ModGeo.fits	FITS binary table	Table containing the model geometry parameters
_FullResProcData.fits	FITS cube	Full spectral resolution cubelet with velocity units
_FullResModelCube.fits	FITS cube	Model realization with full resolution cubelet properties
_FATInput.txt	ascii file	The input file of the FAT run
_FATMod.txt	ascii file	The results of the FAT run
_BaroloInput.txt	ascii file	The input file of the 3DBarolo run
_BaroloMod.txt	ascii file	The geometry and rotation curve results of the 3DBarolo run
_BaroloSurfDens.txt	ascii file	The surface density results of the 3DBarolo run

Table 2: WKAPP data products available for each successfullly modelled PDR1 source.

3 Kinematic Model Data Products

There are a number of data products that may be downloaded for each kinematic model. These are available on both CASDA and CADC. Table 2 lists the various data products. It should be noted that only FITS format products are currently available from CASDA.