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**Dynamical analysis  
of the morphologically distorted galaxy Kaz364  
using IFU spectroscopy**

por

**Ing. Abdías Morales Vargas**

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**Tesis**

sometida a la Universidad de Guanajuato  
para obtener el grado de  
**Maestro en Ciencias (Astrofísica)**

*Supervisor: Dr. César A. Caretta*

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División de Ciencias Naturales y Exactas

Departamento de Astronomía

Junio 2013

**Universidad  
de Guanajuato**

# Acknowledgements

Al alumnado, personal administrativo y docente del Departamento de Astronomía de la Universidad de Guanajuato, en especial a los profesores Juan Pablo Torres, Astrid Wachter y Erick Nagel.

A mis mejores amigos, Marysol Díaz Infante, José Antonio Martínez, Grzegorz y Asia Gawelko ¡Por lo que hemos vivido y compartido juntos!

A mi segunda familia, Carlos Fernando Ortega, Daniel Marcos Neri, René Alberto Ortega, Josué de Jesús Trejo, Juan Luis Verbena, Carlos Arturo Flores, María Isabel Pérez, Ilse Plauchu, Tatiana Rodríguez, Renata Sampaio, Benjamín Vázquez, Santiago Arceo, Sac Nicté Serrano, Alma Emilia Ruiz, Hugo Marcel Saavedra, Jaime Pérez, Héctor Ibarra, Sergio Sánchez, María de los Milagros Cabrera, Faustino Neri y Sergio Quintero, por cuatro de mis mejores años. Gracias por todo lo que me han dado y aceptarme como su amigo. Espero seguir conviviendo con ustedes y compartir lo que el futuro nos reserve.

A quienes contribuyeron directamente al desarrollo de esta tesis, la cual también pertenece a ellos. Muchísimas gracias al personal del Observatório do Pico dos Dias/Laboratório Nacional de Astrofísica por habernos concedido las noches de observación, además de proporcionarnos, muy amablemente, las herramientas necesarias para el procesamiento de los datos. A mi asesor, César Augusto Caretta, gracias por su inagotable paciencia al lidiar con mi necesidad y brindarme su conocimiento además de su invaluable guía. A Juan Manuel Islas, por su proyecto, sus ideas, soporte y sugerencias ¡Gracias hermano!

A mis hermanas, Arely y Sahira, gracias por soportarme por tanto tiempo además del que vendrá. A mis sobrinos, Joshua, Jocelyn y Leonardo, quienes dan color a mi vida y a quienes quiero como si fueran mis propios hijos ¡A mi compañero y amigo, Mateo, siempre feliz de verme, sin quejas ni reproches... a mi pareja de tortugas y a mi recién agregada Gatúbela!

Y finalmente, a mis dos pilares, mis padres, Abdías y María de Jesús, gracias por haberme criado, educado y amado desde que tengo razón... sin ellos soy nada.

# Abstract

Active galaxies both nuclear and star formation are of special concern. Likewise it is to understand how galaxies in general have evolved to the variety of morphologies seen today. The UV emission excess galaxy Kaz364 ( $z=0.0446$ ) is an interesting example of this evolution in act: it shows a notable distorted morphology and has been probably subjected to pre-processing effects triggered by a probable interaction of its group with a rich cluster of galaxies. Our main goal is to find a convincing proposition to describe this special case and give clues to the evolution of galaxies in general, involving local, global, and even extragalactic effects. Based on low resolution IFU spectroscopy (600 l/mm) in a wavelength range around  $H\alpha$  (6480–7120 Å), we effectively observed four fields ( $30\times 15$  arcsec, corresponding to  $\sim 23\times 11.5$  kpc each) and give a first insight ever of the physical phenomena taking place in the central one. We also used a complement of photometric data from several databases in order to infer the shape of its SED. Kinematical maps from absorption and emission lines reveal dipole-like velocity distributions centered on  $\sim 13400$  km s<sup>-1</sup>, with PAs for the kinematical major axes of  $\sim 60^\circ$ , presenting rotation velocities of  $\sim \pm 215$  km s<sup>-1</sup> at about 2.5 kpc from both kinematical centers. The derived rotation curves have both rigid-like behaviours extending towards the limits of our sampled region. The similarities between correlation and emission patterns suggest coherent motions of stars and gas, and that recombination and ionization processes occur in the same regions. The  $H\alpha$  line EW and flux distributions depict structures which resemble the standard biconical one, that of NLRs as suggested by the UM. We consequently perceive a line of nodes (PA  $\sim 45^\circ$ ) oriented practically along the kinematical major axes. [NII]  $\lambda 6583$  EW and flux distributions, combined with  $H\alpha$  line patterns and [NII] and [SII] line ratios give the location of the AGN, around which there is evidence of circumnuclear (and possibly nuclear) star formation thanks to our diagnostic diagrams. Besides, their spatial distributions show a barrier and several disseminated regions of star formation which might conform HII regions. FWHMs due to Doppler broadening (of about 350 km s<sup>-1</sup>) and radio continuum emission show characteristics not strong enough for a Seyfert 1 galaxy. Our approximated SED of Kaz364 indicates relative low intensities in UV and optical bands, consistent with the IR excess due to an excessive amount of dust (probable nuclear torus), which is typical of Seyfert 2 galaxies. We have advanced on detecting some confirming characteristics of the AGN nature of Kaz364 and mapped its central kinematics. However, a good fraction of evidence is still missing to find answers to our main question, pointing that it is paramount to continue with the data processing of the additional fields and follow the investigation with new objectively designed observations and analyses.

# Acronyms

**2MASS** 2 Micron All Sky Survey

**A85** Galaxy cluster Abell 085

**A87** Galaxy cluster Abell 087

**A89** Galaxy cluster Abell 089

**AAO** Anglo-Australian Observatory

**ADU** Analogue-to-Digital Unit

**AGN** Active Galactic Nucleus

**BCD** Blue Compact Dwarf

**BCG** Brightest Cluster Galaxy

**BCM** Brightest Cluster Member

**BL Lac** BL Lacertae type object

**BLR** Broad Line Region

**BLRG** Broad Line Radio Galaxy

**CCD** Charge Coupled Device

**CGs** Compact Groups

**CTIO** Cerro Tololo Inter-American Observatory

**Dec** Declination

**DR** Data Release

**ESO** European Southern Observatory

**EW** Equivalent Width

**FC** Featureless Continuum

**FIR** Far Infra-Red band

**FIRST** Faint Images of the Radio Sky at Twenty cms

**FUV** Far Ultra-Violet band

**FWHM** Full Width Half Maximum

**GALEX** Galaxy Evolution Explorer

**HCGs** Hickson Compact Groups

**HICM** Hot Intra-Cluster Medium

**HRI** High Resolution Imaging

**HST** Hubble Space Telescope

**IAG-USP** Instituto de Astronomia, Geofísica e Ciências Atmosféricas-Universidade de São Paulo

**IFU** Integral Field Unit

**IR** Infra-Red band

**IRAF** Image Reduction and Analysis Facility

**IRAS** Infra-Red Astronomical Satellite

**IRG** Infra-Red Galaxy

**ISM** Interstellar Medium

**J2000** Julian year 2000

**LINER** Low Ionization Nuclear Emission Region

**LLAGN** Low Luminosity Active Galactic Nucleus

**LNA** Laboratório Nacional de Astrofísica

**LSS** Large Scale Structure

**NIR** Near Infra-Red band

**NLR** Narrow Line Region

**NLRG** Narrow Line Radio Galaxy

**NRAO** National Radio Astronomy Observatory

**NUV** Near Ultra-Violet band

**OPD** Observatório do Pico dos Dias

**OVV** Optically Violently Variable quasar

**PA** Position Angle

**PAHs** Poly Aromatic Hydrocarbon molecules

**PSF** Point Spread Function

**PSPC** Positional Sensitive Proportional Counter

**QSO** Quasi-Stellar Object

**Quasar** Quasi-Stellar Radio Source

**RA** Right Ascension

**RMS** Root Mean Square

**ROSAT** Röntgen Satellit

**SBG** Star-Burst Galaxy

**SDSS** Sloan Digital Sky Survey

**SED** Spectral Energy Distribution

**SF** Star Formation

**SFR** Star Formation Rate

**SIFS** SOAR Integrated Field unit Spectrograph

**S/N** Signal to Noise ratio

**SOAR** Southern Astrophysical Research telescope

**SPIRAL** Segmented Pupil/Imaging Array Lenses

**Sy1** Seyfert galaxy type 1

**Sy2** Seyfert galaxy type 2

**TO** Transition Object

**UCD** Ultra Compact Dwarf

**ULIRG** Ultra-Luminous Infra-Red Galaxy

**UM** Unified Model for AGNs and Radio Quasars

**UMass** University of Massachusetts

**UV** Ultra-Violet band

**ZC-CGs** Updated Zwicky Catalogue of Compact Groups

**VLA** Very Large Array

**WISE** Wide field Infra-red Survey Explorer

**XSC** Extended Source Catalogue