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Gas Kinematics and Excitation Study of the OH Megamaser Galaxy IRAS 06487+2208

Douglas A. Silva[1], Dinalva A. Sales[1], Rogemar A. Riffel[2], Andrew Robinson[3], Jack Gallimore[4], Claudia M. Cassanta[2], Thaisa Storchi-Bergmann[5], C. Hekatelyne[6], Christopher O'Dea[7], & Stefi Baum[7]

[1] Instituto de Matemática, Estatística e Física, Universidade Federal do Rio Grande, 96203-900, Rio Grande, Brazil
[2] Departamento de Física, CCNE, Universidade Federal de Santa Maria, 97105-900, Santa Maria, RS, Brazil
[3] School of Physics and Astronomy, Rochester Institute of Technology, 84 Lomb Memorial Drive, Rochester, NY 14623, USA
[4] Department of Physics, Bucknell University, Lewisburg, PA 17837, USA
[5] Departamento de Astronomia, Universidade Federal do Rio Grande do Sul, 91501-970, Porto Alegre, RS, Brazil
[6] Universidad Tecnológica, Polo Educativo Tecnológico Rivera, Ruta 5 km 496, CP 40000, Rivera, Uruguay
[7] Department of Physics and Astronomy, University of Manitoba, 30A Sifton Rd., Winnipeg, MB R3T 2N2, Canada

Abstract. IRAS 06487+2208 is an ultra-luminous infrared galaxy ([U]LIRG) showing OH megamaser emission, associated with dense gas and mergers. We analyze excitation and ionized gas kinematics using GMOS/IFU, HST, and VLA data. Emission-line modeling and diagnostic diagrams reveal nuclear star formation with signs of a dust-obscured, low-luminosity AGN, supporting OH megamasers as tracers of key merger-driven evolutionary stages in [U]LIRGs.

Resumo. IRAS 06487+2208 é uma galáxia infravermelha ultraluminosa ([U]LIRG) com emissão megamaser de OH associada a gás denso e fusões. Analisamos a excitação e a cinemática do gás ionizado com dados GMOS/IFU, HST e VLA. A modelagem das linhas e os diagramas de diagnóstico indicam formação estelar nuclear e indícios de um AGN de baixa luminosidade obscurecido por poeira, reforçando os megamasers de OH como traçadores de estágios evolutivos impulsionados por fusões em [U]LIRGs.

Keywords. Galaxy merger – [U]LIRG – OH megamaser

1. Introduction

[U]ltra-luminous infrared galaxies ([U]LIRGs) are key merger stages that trigger star formation and nuclear activity (Anders et al. 1988; Lo 2005). Some present OH megamaser emission, produced in dense and disturbed molecular gas (Sales et al. 2015, 2019; Hekatelyne et al. 2017, 2020). IRAS 06487+2208 is an excellent case to study the connection between merger dynamics, gas excitation, and maser activity. We used GMOS/IFU (Gemini), *HST*/WFPC2 (F814W), and VLA data, including the OH 1665–1667 MHz lines, to map ionized and molecular gas properties. Standard reduction steps were applied—bias and flat correction, cosmic-ray removal, cube construction, and continuum subtraction. Emission lines were modeled with multi-Gaussian fits using IFSCube (Ruschel-Dutra et al. 2021), and the radio and optical data were consistently calibrated with AIPS/CASA.

2. Data Analysis

The analysis combined the datasets to produce a comprehensive multiwavelength view of the galaxy. The *HST*/WFPC2 optical image (Figure 1) reveals a highly disturbed morphology and tidal features characteristic of an ongoing merger. The integrated GMOS/IFU spectrum provides high spatial and spectral resolution across the 4500–7000 Å range, allowing identification of emission lines such as Hβ, [O III] λ5007, [N II] λ6583, and Hα, which were modeled using multi-Gaussian fitting with the IFSCube tool.

From these fits, we obtained maps of flux, velocity, and velocity dispersion for the ionized gas (Figure 2). The velocity field shows a rotating structure with local disturbances, while the dispersion map reveals turbulent gas possibly linked to shocks

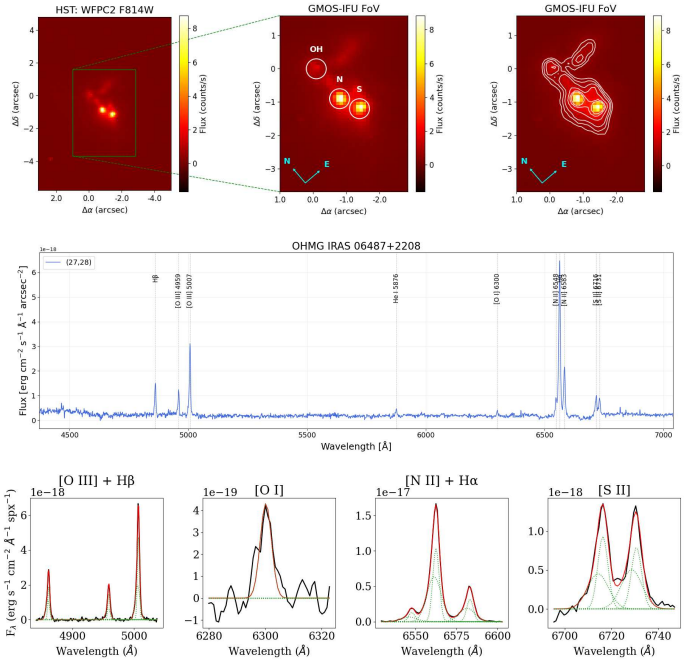

Figure 1. Panel (a): *HST*/WFPC2 optical image of IRAS 06487+2208. Panel (b): Integrated GMOS-IFU spectrum covering 4500–7000 Å, highlighting the spectral region corresponding to the OH maser emission. Panel (c): Spectral fits performed with IFSCube, illustrating the modeling of the main emission lines.

or outflows. BPT diagnostic diagrams (Figure 3) indicate pre-

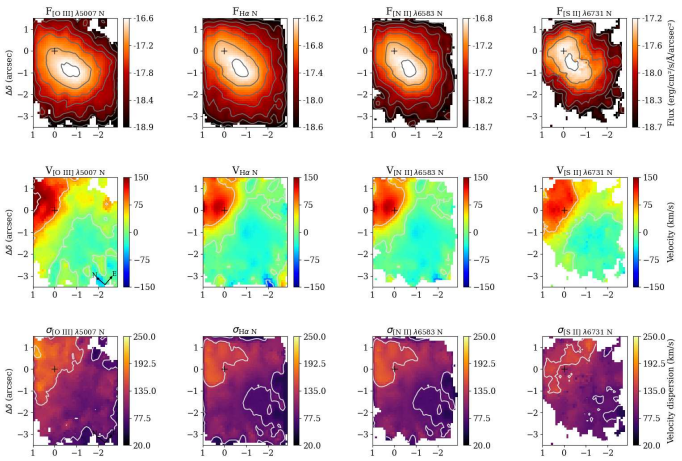

Figure 2. Maps of (a) flux, (b) velocity, and (c) velocity dispersion derived from the GMOS-IFU data for the ionized gas component.

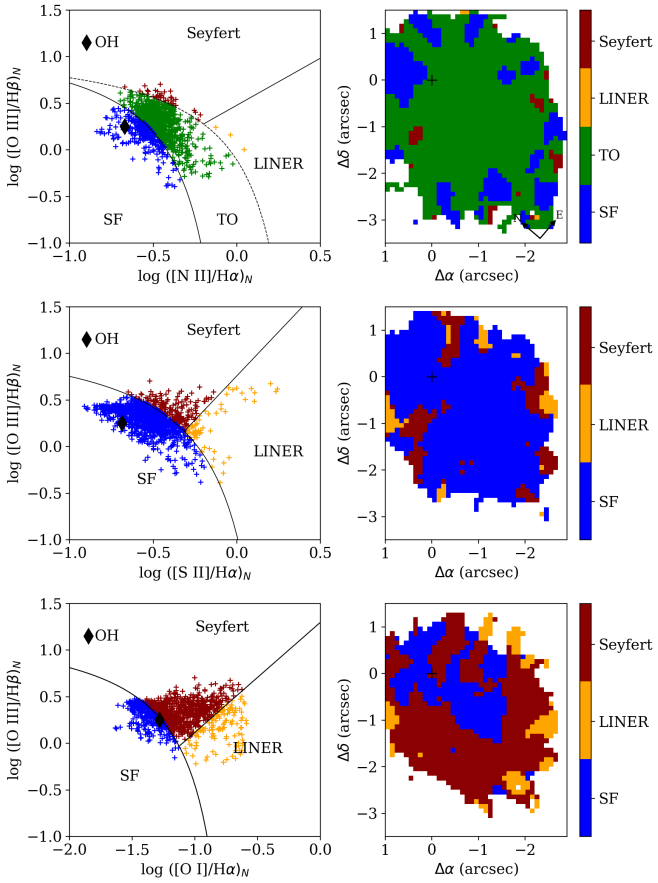

Figure 3. BPT diagnostic diagram showing the classification of ionization mechanisms based on narrow emission-line ratios. The solid and dashed curves correspond to the empirical and theoretical separation lines by Kauffmann et al. (2003) and Kewley et al. (2001), respectively.

dominantly star-forming excitation, with a minor component extending toward composite and AGN regions, suggesting a dusty, low-luminosity AGN embedded within a merger-driven starburst nucleus.

Complementary VLA radio observations in the C, X, L, and OH bands (Figure 4) trace the distribution of continuum and megamaser emission. The alignment between radio and optical

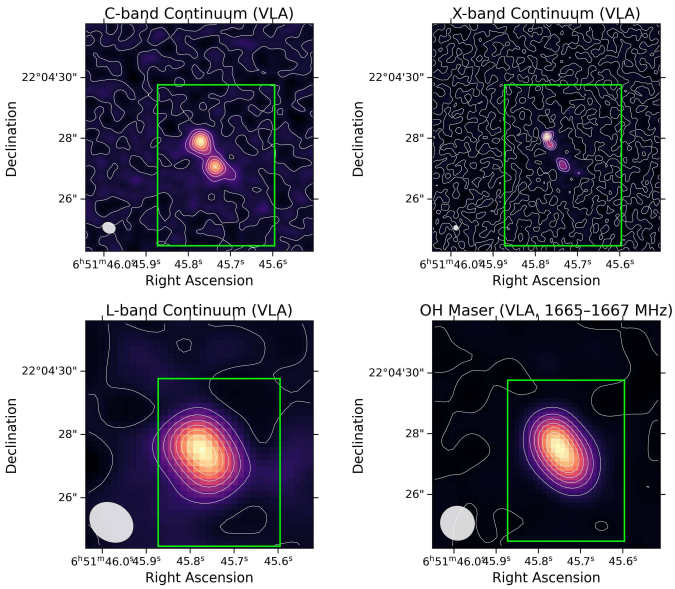

Figure 4. Composite VLA images of IRAS 06487+2208 in the C, X, L, and OH bands. The emission distribution at each frequency is shown in units of Jy beam^{-1}.

structures confirms that the OH maser emission originates in the nuclear region, coincident with the kinematically disturbed gas observed in the optical data.

Together, these datasets provide a coherent view of IRAS 06487+2208 as a merger-driven [U]LIRG, where intense star formation and compact radio emission coexist with molecular and ionized gas structures. This highlights the close connection between merger dynamics and OH megamaser activity.

The OH megamaser emission in IRAS 06487+2208 is tightly linked to disturbed gas kinematics and merger-driven processes. Our results support the view that OH megamasers trace transient stages of [U]LIRG evolution marked by gas inflows, starbursts, and emerging AGN activity, with evidence of a dust-obscured, low-luminosity nucleus.

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