Unified Model Active Galactic Nuclei: An Overview

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Introduction

The Unified Model of Active Galactic Nuclei (UMAGN) is a theoretical framework that reconciles the observed diversity of AGN phenomena into a cohesive arrangement. This model proposes that the differences between AGN types are due to the orientation of the observer relative to the accretion disk, torus, and relativistic jet of the AGN. In this work, we provide an overview of the observational evidence, empirical and theoretical research supporting the formulation of UMAGN. We describe the properties of the objects that comprise it and conclude by emphasizing the role that recent multimessenger research involving electromagnetic waves, gravitational waves, astroparticle, and neutrinos, taking place in collaborations such as Event Horizon Telescope, LIGO/Virgo, IceCube, Pierre Auger, and KM3Net, can play in enhancing and improving UMAGN and our understanding of AGNs. The UMAGN has important implications for our understanding of the formation and evolution of galaxies, and the role that AGNs play in these processes. The recent advances in observational and theoretical research, as well as the development of new multimessenger techniques, provide opportunities for further progress in this field.

Evidence & Observational Support

Seyfert (1943): observed the emission lines in the spectra of extra galactic nebulae, with a focus on a rare class of objects characterized by high-excitation emission lines superposed on typical spectra [1].

Schmidt (1963): The presence of certain emission lines suggests a Redshift, indicating a high apparent velocity. There are two possibilities as explanations: the object is either a star with a large gravitational Redshift or the nuclear region of a distant galaxy wit a cosmological Redshift [2].

Lynden-Bell (1969): Quasars evolve into powerful radio sources with two well-separated radio components. The energies involved in these outbursts are calculated to be enormous, and it is suggested that gravity may play a dominant role in providing the necessary energy [3]

Martin Rees and Roger Blandford (1978): Observations of strong radio sources in galactic nuclei have provided insights and interpretations on the historical significance of strong radio sources as evidence of violent activity in galactic nuclei [4].

The Unified Era

Antonucci (1982): studied the alignment of optical polarization position angles with the large-scale radio structure in low-polarization quasars. Such alignment implies a geometrical relationship between the inner, optically-emitting region and outermost, radio-emitting region [5].

Antonucci (1993): the complex nature of Active Galactic Nuclei (AGN) and quasars, because they have been a source of confusion, primarily due to the strong orientation effects in their unresolved central regions. It is now clear that much of the diversity in AGN types can be attributed to varying orientations relative to the line of sight [6].

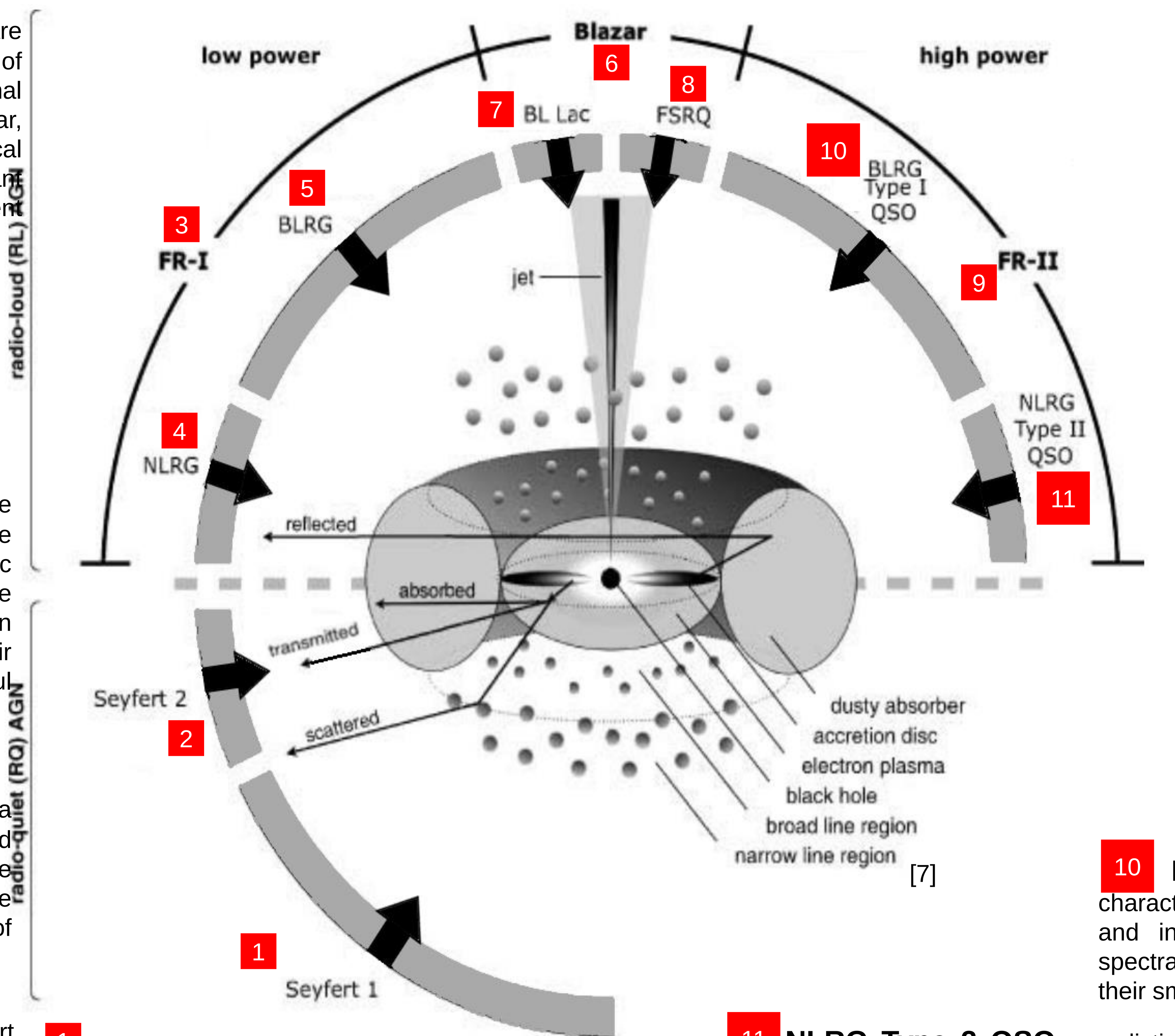
6 **Blazar:** Blazars are the most extreme variety of AGN known. Their signal properties include irregular, rapid variability; high optical polarization; core dominant radio morphology; apparent superluminal motion [11].

5 **BLRG:** Barrow-line radio galaxy describe a type of radio galaxy with specific characteristics related to the emission lines observed in their spectra [10].

4 **NLRG:** Narrow-line radio galaxy describe a type of radio galaxy with specific characteristics related to the emission lines observed in their spectra and their association with powerful radio emissions [9].

3 **Fanaroff-Riley Type 1 (FR-1):** is a classification scheme used in astronomy to categorize radio galaxies based on the structure and properties of their radio emission [9].

2 **Seyfert 2:** The Seyfert are in Class 2, because which the forbidden lines and Balmer lines are the samewidth [8].



[7]

1 **Seyfert 1:** The Seyfert galaxies are either class 1, in which the Balmer lines arebroader than the forbidden lines. These widths are greater than those of the forbidden lines in class 1 objects [8].

7 **BL Lac:** Are consistent with the expected properties of stellar disruptions in standard loss-cone models of quasar energy generation. BL Lac bears a strong resemblance to a faint giant elliptical [12].

8 **FSRQ:** Flat-spectrum radio quasars are characterized by specific features related to their spectra, their strong radio emissions, and their association with extremely energetic and variable sources in the universe [13].

9 **Fanaroff-Riley Type 2 (FR-2):** is a classification scheme used in astronomy to categorize radio galaxies based on the structure and properties of their radio emission [9].

10 **BLRG Type 1 QSO:** are characterized by the presence of broad and intense emission lines in their spectra. Are ideal targets because of their small cosmological distance [14].

11 **NLRG Type 2 QSO:** are distinguished by their broad emission lines being obscured by a surrounding torus of gas and dust. This obscuration makes the central region, including the broad-line region, less visible to observers. Provide us with an opportunity to examine properties of a host galaxy of a QSO, thanks to its intrinsic obscuration of a very bright nucleus if we apply the unified scheme of AGNs [15].

Future & Multimessenger Astronomy

One possibility to continue improving our understanding of AGNs may come from active collaborations.

EHT

Can provide direct observation of black holes. The EHT made headlines in 2019 when it captured the first image of the supermassive black hole at the center of the galaxy M87 and in 2022 captured the first image of black hole Sagittarius A, in the center of Milky Way [16].

LIGO/VIRGO

Measures gravitational waves resulting from the collision and merger of two black holes [17].

IceCube

The IceCube Neutrino Observatory can be used to detected high-energy neutrino, that can be originating from AGN [18].

Pierre Auger

The Pierre Auger Observatory it is designed to detected and study ultra-high-energy cosmic rays, that also can be originating from Active Galactic Nuclei [19].

KM3Net

KM3NeT is a research infrastructure housing the next generation neutrino telescopes. KM3NeT will open a new window on our Universe, but also contribute to the research of the properties of the elusive neutrino particles [20].

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