Brian Punsly

Position: Research Scientist
Period covered: 12/2023-12/2024

I Scientific Work

Black Holes and Quasars

1. Introduction

This report describes the research performed by Brian Punsly and collaborators in cooperation with ICRANet in 2024. The research was focused on the first image and its accretion diskof the jet launching region of a black hole. M87.

2. First image of a jet launching from a black hole accretion system: Kinematics

Abstract:

Jets are endemic to both Galactic solar mass and extragalactic supermassive black holes. A recent 86 GHz image of M\,87 shows a jet emerging from the accretion ring around a black hole, providing the first direct observational constraint on the kinematics of the jet-launching region in any black hole jetted system. The very wide ($\sim280\mu\rm{as}$), highly collimated, limb-brightened cylindrical jet base is not predicted in current numerical simulations. The emission was shown to be consistent with that of a thick-walled cylindrical source that apparently feeds the flow that produces the bright limbs of the outer jet at an axial distance downstream of $0.4 \,\rm{mas} <z<0.65\, \rm{mas}$. The analysis here applies the conservation laws of energy, angular momentum, and magnetic flux to the combined system of the outer jet, the cylindrical jet, and the launch region. It also uses the brightness asymmetries of the jet and counterjet to constrain the Doppler factor. The only global solutions have a source that is located $<34 \mu\rm{as}$ from the event horizon. This includes the Event Horizon Telescope annulus of emission and the regions interior to this annulus. The axial jet begins as a magnetically dominated flow that spreads laterally from the launch radius ($<34 \mu\rm{as}$). It becomes super-magnetosonic before it reaches the base of the cylindrical jet. The flow is ostensibly redirected and collimated by a cylindrical nozzle formed in a thick accretion disk. The flow emerges from the nozzle as a mildly relativistic ($0.3c<v<0.4c$) jet with a significant protonic kinetic energy flux.

2024 List of Publication

Punsly, Brian “First image of a jet launching from a black hole accretion system: Kinematics”, 2024 A&A 685, L3