Active OB stars: structure, evolution, mass loss, and critical limits
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The e-MERLIN Cyg OB2 radio survey (COBRaS†)

Raman K. Prinja and Danielle Fenech

Dept. of Physics & Astronomy, University College London,
Gower Street, London WC1E 6BT, UK

Abstract. The e-MERLIN Cyg OB2 Radio Survey (COBRaS) is designed to exploit e-MERLIN's enhanced capabilities to conduct uniquely probing, targeted deep-field mapping of the massive Cyg OB2 association in our Galaxy. The project aims to deliver (between 2010 to 2013) the most detailed radio census for the most massive OB association in the northern hemisphere, offering direct comparison to not only massive clusters in general, but also young globular clusters and super star clusters. With the COBRaS Legacy project we will assemble a uniform dataset of lasting value that is critical for advancing our understanding of current astrophysical problems in the inter-related core themes of (i) mass loss and evolution of massive stars, (ii) the formation, dynamics and content of massive OB associations, and (iii) the frequency of massive binaries and the incidence of non-thermal radiation.

Keywords. stars: evolution, stars: mass loss, radio continuum: stars

1. Introduction

We introduce here a e-MERLIN Legacy project is designed to conduct uniquely deep radio mapping of the tremendously rich Cyg OB2 stellar association in our Galaxy. The Cyg OB2 radio survey (COBRaS) has been awarded Legacy status, with a substantial allocation of 252 hrs for C-band (5 Ghz) and 42 hrs for L-band (1.6 Ghz) e-MERLIN observations (www.merlin.ac.uk/legacy/projects/cobras.html). Our goal is to conduct the most detailed radio census for the most massive OB star association in the northern hemisphere, offering direct comparisons to not only massive stellar clusters in general, but also young globular clusters and super star clusters. This programme will advance our understanding of the role of evolution in stellar mass-loss, constrain stellar cluster formation scenarios, and provide new perspectives of the formation of massive stars in high binary fractions. The substantial COBRaS dataset will be assembled between 2010 and 2013, and will ultimately also be combined with other multi-waveband international surveys of the Cygnus X region, from both current (Spitzer and Chandra)

Several factors combine to make the Cyg OB2 association a uniquely important laboratory for studying the collective and individual properties of massive stars. The COBRaS project will exploit the e-MERLIN datasets to obtain solutions to current fundamental problems in three key areas of massive star astrophysics: (i) the mass loss, energy feedback and evolution process, (ii) the kinematics and formation of massive stellar clusters, and (iii) the incidence of non-thermal radiation and the frequency of massive binaries.

2. Planned e-MERLIN pointings

The COBRaS project will map the core of Cyg OB2 at 5 GHz, going to a depth of ~ 3 μJy (1-sigma), plus additional pointings at 1.6 GHz (see Fig. 1). The investment of

† COBRaS: http://www.homepages.ucl.ac.uk/∼ucapdwi/cobras/team_members.html

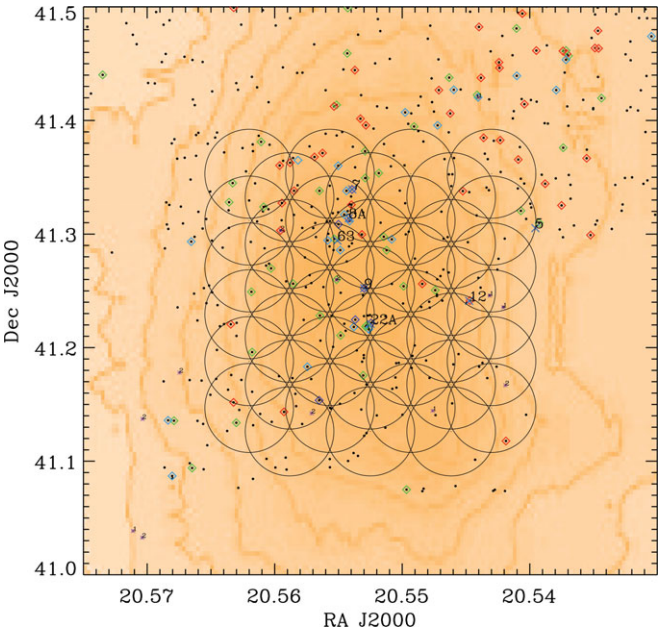

Figure 1. COBRaS Legacy project planned C-band mosaicing of the core of Cyg OB2, 42 (6-hr) pointings are plotted and a further 7 will be executed for the L-band. The background figure is the outline of the Cyg OB2 association (based on counts from the 2MASS survey).

a substantial amount of e-MERLIN observing time ($\sim$ 300 hrs awarded) to this young massive star cluster is important as it is one of only a few examples known in our Galaxy. As Cyg OB2 is a smaller version of the super star clusters (SSCs) seen in e.g. M82, it can therefore serve as a Rosetta Stone to help interpret the information from these much more distant clusters.

The 5 GHz frequency is the primary band for our purposes: its 2 GHz broad bandwidth allows us to determine not only the flux, but (generally) the spectral index as well. This will allow us to distinguish between thermal and non-thermal radiation. We estimate that at least 10^3 sources will be detected in our survey. For the O stars, based on estimated thermal radio fluxes, all supergiants will be detectable, most giants, but only the brightest main-sequence stars. Another key goal is to use the high spatial resolution offered by e-MERLIN to obtain milliarcsec accuracy astrometric observations of the radio stars within Cyg OB2 at multiple epochs, in order to determine their proper motions. As part of our consortium (see below) we have an ongoing program of high resolution spectroscopic observations of the massive stellar populations within Cyg OB2 to identify and characterise massive stars, which provide radial velocity measurements of comparable accuracy; taken together these complementary datasets will allow a full 3 dimensional picture of the kinematics of Cyg OB2 to be constructed.

The COBRaS e-MERLIN Legacy dataset will be secured between 2010 to 2013. It will allow us to deliver new results on mass-loss via clumped outflows, high energy phenomena associated with massive binary stars, and the dynamics of clusters of stars.

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