



Imaging Pulsar Scintillation Screens Using Earth-Space VLBI

Daniel T. Baker^{*(1)}, Ue-Li Pen⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾⁽⁵⁾⁽⁶⁾

(1) Institute of Astronomy and Astrophysics, Academia Sinica, Taipei, Taiwan; email dbaker@asiaa.sinica.edu.tw; pen@asiaa.sinica.edu.tw;

(2) Canadian Institute for Theoretical Astrophysics, Toronto, ON, Canada

(3) Department of Physics, University of Toronto, Toronto, ON, Canada

(4) Perimeter Institute for Theoretical Physics, Waterloo, ON, Canada

(5) Canadian Institute for Advanced Research, CIFAR program in Gravitation and Cosmology

(6) Dunlap Institute for Astronomy & Astrophysics, University of Toronto, Toronto, ON, Canada

As pulsar signals propagate through the Interstellar Medium (ISM), variations in electron density result in refraction and the formation of multiple images of the pulsar on the sky. When observed from Earth, the interference of these images causes the pulsar to scintillate with the intensity of its pulsed emission varying over both time and frequency. The study of these scintillation patterns, also known as dynamic spectra, open a window into structures in the ISM down to the AU scale. While early work in the field attributed the scintillation to Kolmogorov turbulence, the more recent discovery of “scintillation arcs” by [1] in scintillation power spectra suggest that for many pulsars the scintillation is caused by a few localized structures along the line of sight. Several proposals [2,3] call for inclined noodles or sheets of plasma as the source of the scattering, with structures inclined along the line of sight having the strongest impact.

In order to determine the properties of these structures, ground based VLBI observations have to be used to image lens towards PSR B0834+06 [4]. These results show the lensing to be dominated by a single lens approximately halfway to the pulsar whose resulting images form a nearly straight line on the sky. A reanalysis of the data using more recent techniques, such as the θ - θ transform, refined this result showing small scale variations from the straight line. However, in order to test models that call for inclined structures a full 3D map of the image locations is required. Our best hope for such a picture is through Earth-Space VLBI.

We will discuss how new techniques developed for single dish and Earth based VLBI can be adapted to the problem of space VLBI. In particular how we can compensate for the low sensitivity of smaller dishes. This is achieved through the coherent use of all single dish and two dish correlations with the θ - θ transform. Finally, we discuss the application of these techniques to existing RadioAstron data and future prospects.

References

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