# Measuring magnetic fields

April 9 2012

An optical image of the Pelican Nebula, a complex region forming young stars. New observations of a similar star forming region have determined the strength of its magnetic field. Credit: Martin Pugh

(Phys.org) -- Polarized light is a familiar phenomenon, as people who prefer polarized sunglasses can testify. The electric field in a beam of light can vibrate either left-right or up-down, and the scattering or reflection of light can result in the preferential absorption of one or the other of these two "polarizations." The majority of sunlight on Earth, for example, is preferentially polarized in one direction due to scattering in the atmosphere; that's what makes polarized sunglasses so effective.

Electromagnetic radiation from astrophysical sources can also be polarized. It often occurs because of selective scattering from elongated (possibly even needle-shaped) dust grains. When most of the grains in a volume have been oriented in the same direction by the region's magnetic field, the degree of polarization of scattered light will be significant. Astronomers are extremely interested in magnetic fields, which play a major - perhaps even a dominant - role in controlling the shapes and motions of interstellar gas clouds. Unfortunately, magnetic fields are very difficult to measure directly. Polarization observations, it turns out, offer a unique way to probe the magnetic fields.

SAO astronomer Paul Ho and two colleagues used the Submillimeter Array (SMA) to measure the polarization of millimeter wavelength light from a dusty region of particularly active star formation called W51e2, located about twenty two thousand light-years away from us. The SMA measures two properties of the scattered light: the angle of the vibration with respect to the cloud's contours, and the amount of polarization compared to the unpolarized light.

The scientists used this information, together with known features of the region, to develop a new and potentially wide-ranging scheme to determine magnetic field strengths in interstellar clouds. With some general assumptions, they show that the field strength can derived from the angle the polarization makes with the radiation's intensity contours. In the case of W51e2, they conclude that the field's strength is relatively strong (about 65 times weaker that the Earth's magnetic field; they suspected as much - that's why they chose this object in the first place).

This new technique, if corroborated by other research, can be expanded and applied to many other objects and potentially revolutionize our understanding of this key physical component of the interstellar medium.

Provided by Harvard-Smithsonian Center for Astrophysics