**Blowing SuperBubbles with 3D MHD: Effects on Polarization**

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**Introduction:** We use a 3D MHD code based on Ryu et al. (1998) to model the development of a super bubble in a magnetized galactic disk with constant gravity. This model is then used to create synthetic observations of K-band polarization to explore the impacts of superbubbles. Bubbles are created assuming a continuous wind after Castor, McCray, and Weaver (1975). Energy is injected as pressure every time step into a region of 5 voxels in radius centered on the grid. The amount of energy injected each time step is dependent on the size of the time step to insure constant luminosity.

To simulate an exponential atmosphere while keeping the adiabatic index 5/3 we set density to be an exponential and solve for the pressure required for hydrostatic equilibrium. The magnetic field energy density is then subtracted from this pressure. At a resolution of one parsec per voxel this method is static to a few percent of the sound speed of the gas.

**Input parameters:**

- Scale Height = 44.9 pc
- Time injection = 10^7 years
- $P_0 = 1.38 \times 10^{32}$ ergs/cm^2
- $M_{\text{injected}} = 10^4$ M$\odot$/yr
- $\beta = 3.85$
- $\rho_0 = 1.67 \times 10^{-24}$ g/cm^3
- $L = 3.16 \times 10^{37}$ ergs/s
- $\gamma = 5/3$
- $B = 0$
- $B_z = 3$ micro gauss

**Discussion of Simulations:** The images to the left represent the development of typical bubble in the first few million years of development. There are a couple of things to note. First is that the magnetic field is dragged along with the shock. This is expected and important when determining the effect of the superbubble on polarization measurements. The creation of vertical fields is clear. Also important is the evidence for the beginning of blowout seen in the 'pinching' of the bubble at the midplane. As the shock travels out, it is noticeably easier to propagate above and below the plane of the disk than into it. This is expected and has been seen before (see Mac Low and McCray 1988).

**Polarization Maps:** Since the magnetic field is pulled vertically by the superbubble expansion it is possible that polarization of interstellar light would be affected as well. Vertical fields would align grains parallel to the plane of the disk and cause an increase in light polarized perpendicular to the plane of the disk, effectively reducing the total observed polarization. To investigate this we made synthetic polarization maps of our simulations at 2.2 microns. To avoid having to include scattering of polarized light into the beam, we only take the lines of sight that allow us to assume polarization is dominated by extinction out of the beam. This requires us to look at the disk edge on.

**Fig. 1.** Images of density with magnetic field lines. Yellow lines represent magnetic field vectors. Top left: looking down y-axis (perpendicular to the magnetic field) at a simulated time of 1 million years. Top right: looking down x-axis (along field lines) at a simulated time of 1 million years. Bottom left: looking down y-axis (perpendicular to the magnetic field) at a simulated time of 3.3 million years. Bottom right: looking down x-axis (along field lines) at a simulated time of 3.3 million years.

**Fig. 2.** Polarization maps for grid only at simulated time of 3.3 million years. a) Polarization for line of sight perpendicular to the field. b) parallel to field.

**Conclusions and Future Work:** Superbubbles are clearly capable of producing vertical fields and vertical polarization. However, it is still unclear whether this effect is measurable when the entire line of sight through the galaxy is taken into account. Future work will include this. Future work will also include density and magnetic field fluctuations to break the bubble's symmetry. With more computer time we plan to simulate the bubble's development until it stalls in order to compare with real observations.


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