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Kronian bow shock survey: results from the first five orbits of the Cassini spacecraft

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A survey of Saturn's bow shock is conducted based on data obtained by the fluxgate and vector helium magnetometers mounted on the Cassini orbiter. Data from the first five spacecraft orbits is used. The data analysis indicates that Cassini crossed a mainly quasi-perpendicular bow shock boundary 54 times in both the pre-dawn and post-dawn sectors. A consideration of shock crossing positions implies a series of magnetospheric compressions and expansions associated with solar wind pressure variations. The magnetic signatures of most of the quasi-perpendicular bow shock crossings show clear 'foot', 'ramp' and 'overshoot' regions. RMS magnetic field fluctuations are presented**,** in the directions perpendicular and parallel to the time-averaged field in intervals downstream and upstream of each crossing. The upstream field data show a ratio of parallel to perpendicular fluctuations $\Delta B_{par}/ \Delta B_{perp} \sim 100$, with relative amplitude $\Delta B_{par} / <B> \sim 1\%$. By contrast, the downstream field shows $\Delta B_{par} / \Delta B_{perp} \sim 1$ (quasi-perpendicular shock) and $\sim$0.1 (quasi-parallel shock), with $\Delta B_{par} / <B> \sim 10\%$. The normal vector to the shock surface is determined using the Coplanarity Analysis (CA) technique. To inform the choice of downstream time interval, a Nesting Analysis is carried out. The CA normals show varying degrees of agreement with those predicted by existing shock surface models. The survey also includes an estimation of the instantaneous velocity of the shock surface. This is estimated to be of the order of Vsh $\sim$ 100 kms^{-1} for most crossings, with some estimates indicating Vsh $\sim$ 10 kms^{-1}. The survey results are used to inform further development of an empirical shape model of Saturn's bow shock.