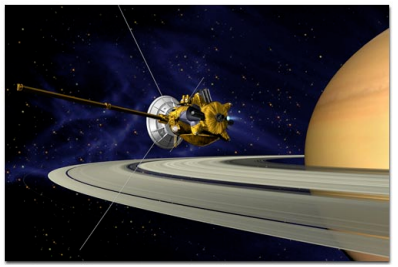
CASSINI

MISSION TO SATURN



Monitoring of Solar Wind Conditions: Magnetopause Modelling

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Introduction

- MAG Team have developed an empirical pressure-dependent model of Saturn's magnetopause [*Arridge et al.*, submitted]

- Have used this to study the distribution of stand-off distances [*Achilleos et al.* later in this workshop]

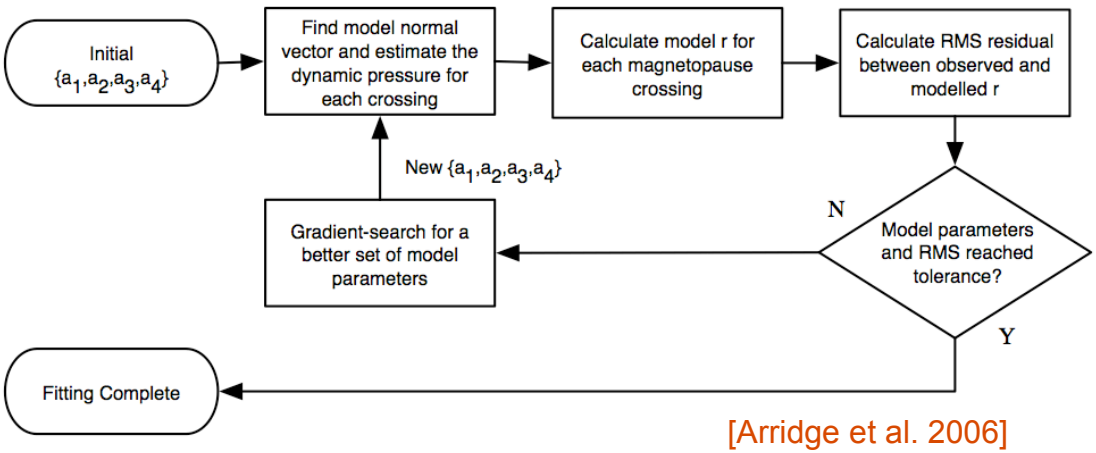
- Using observed crossings of the magnetopause boundary can estimate the solar wind dynamic pressure

Magnetopause Modelling Method

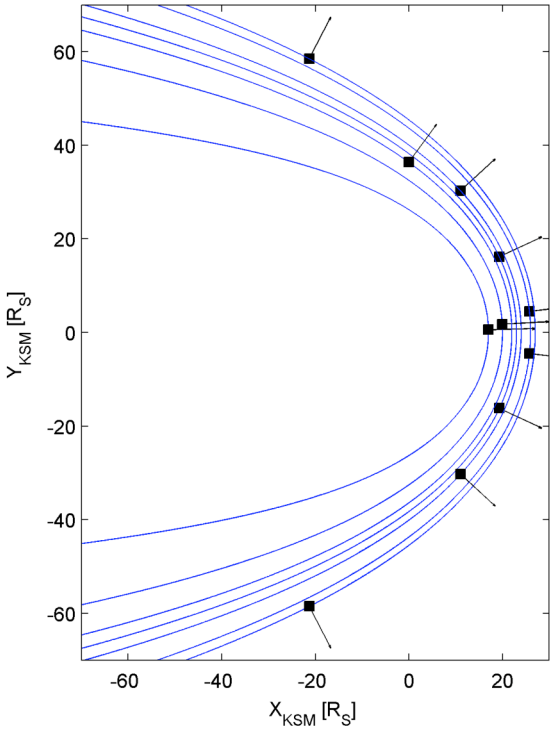
- No simultaneous upstream measurements (D_p)
- Use a Newtonian approximation, with an MVA normal to reconstruct the pressure balance
- Lots of low-magnetic shear crossings at Saturn - poor intermediate:minimum eigenvalue ratios

$$kD_p \cos^2\Psi + P_0 \sin^2\Psi = \frac{B^2}{2\mu_0}$$

- Our method uses the normal vector to a model in order to reconstruct the pressure balance → get pressure for each crossings (model dependent)
- Can fit a model iteratively



[Arridge et al. 2006]



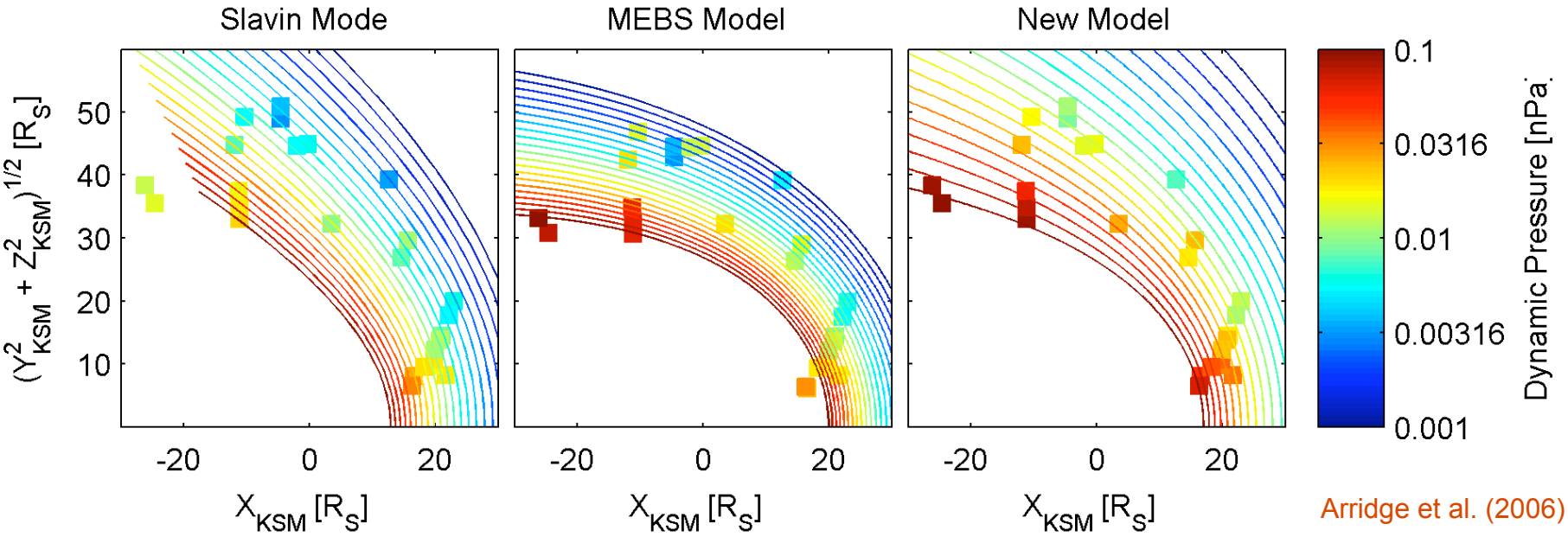
Our Magnetopause Model

- Use this method with an adaptation of the Shue et al. (1997) functional form
- Pressure dependent size and shape
- Flaring can change with pressure

$$r(\theta) = r_0\left(\frac{2}{1+\cos\theta}\right)^K$$

$$r_0 = a_1 D_p^{-a_2}$$

$$K = a_3 + a_4 D_p$$

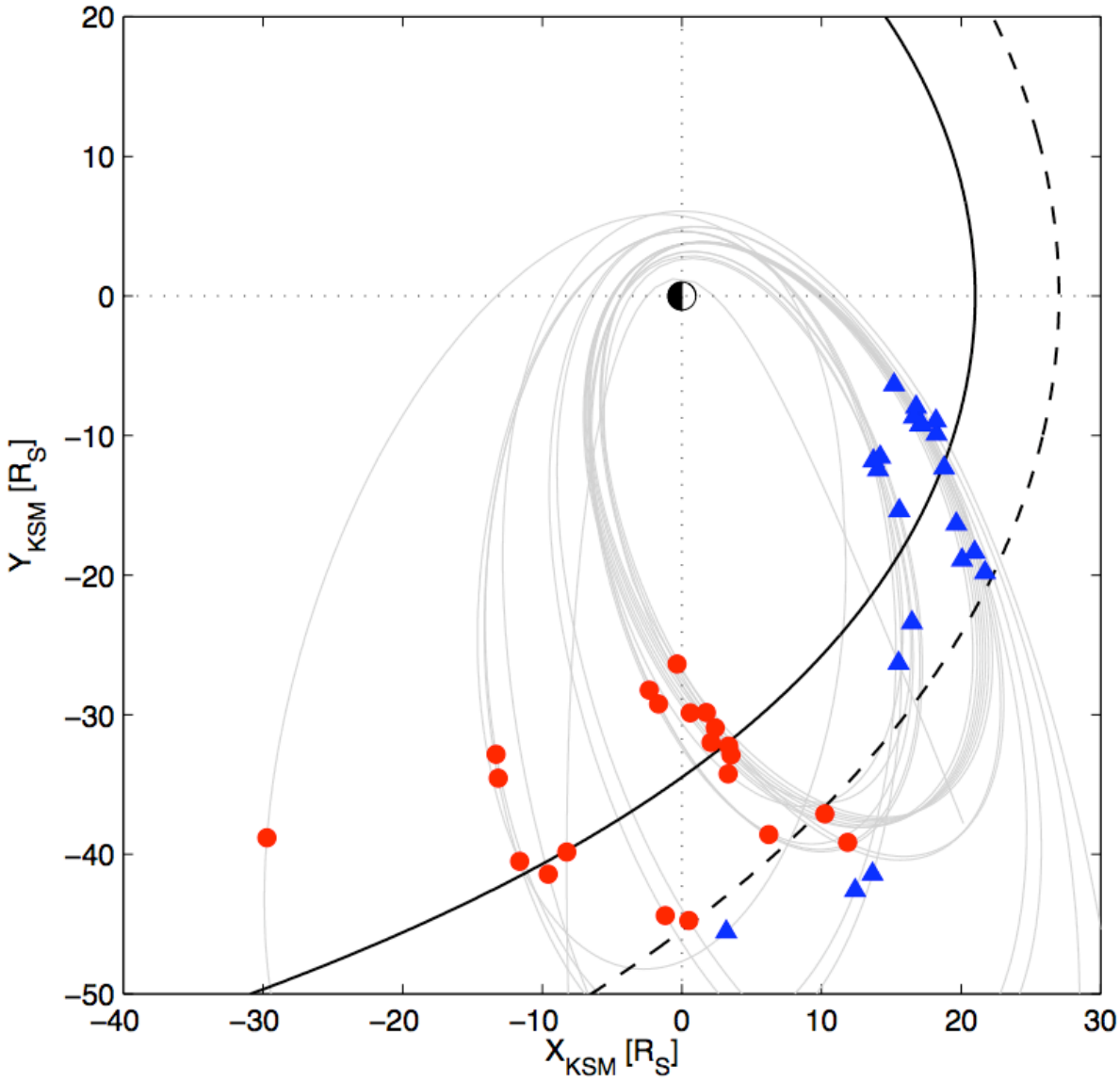


Arridge et al. (2006)

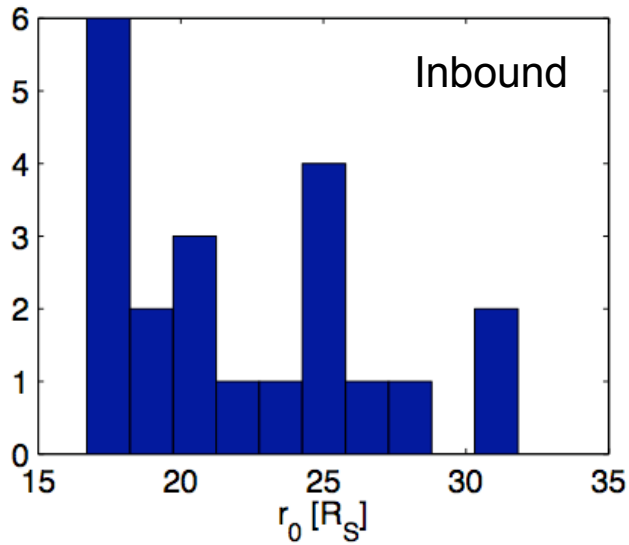
Observed Crossings and Nominal MP

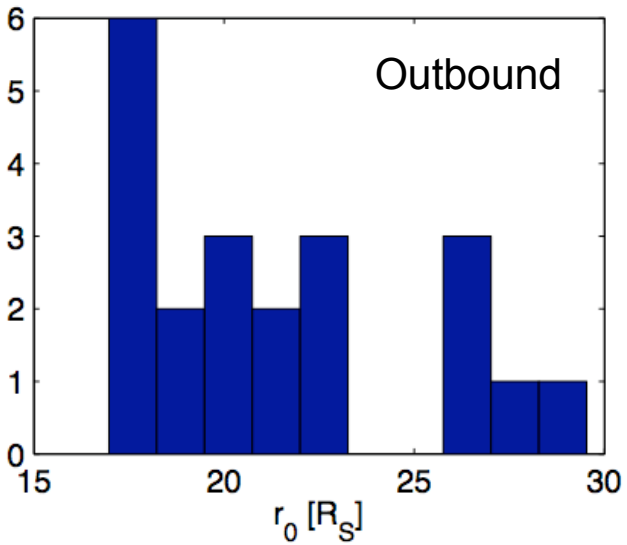
- Two shapes: $r_0=21R_S$ and $r_0=27R_S$
- Inbound crossings (blue triangles)
- Outbound crossings (red circles)

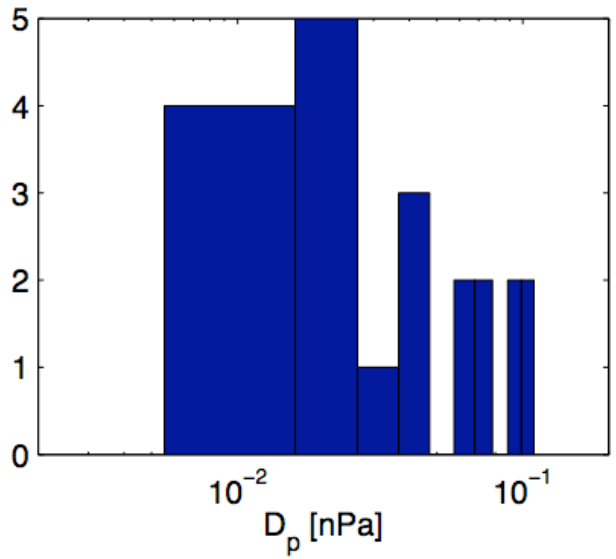
- Crossings from CAPS/ELS and MAG
  - Supplement survey by CAPS/ELS with MAG timings
  - MAG timings for SOI outbound, Rev C inbound, Rev 8/9/10, Rev 18 inbound

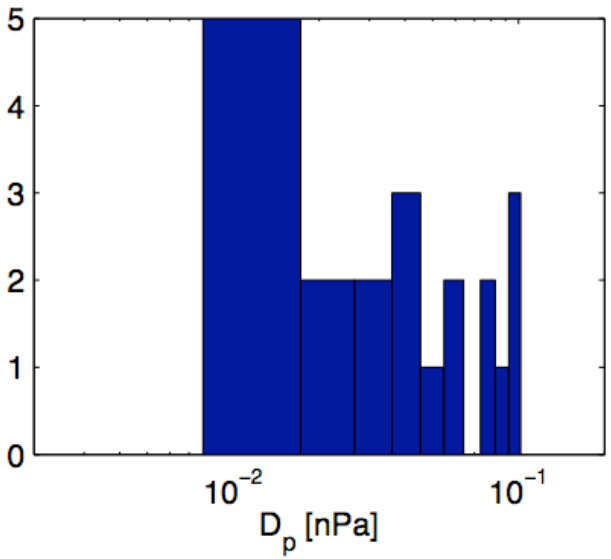


Histograms


Inbound
6
5
4
3
2
1
0
15
20
25
30
35
r_0 [R_S]


Outbound
6
5
4
3
2
1
0
15
20
25
30
r_0 [R_S]


5
4
3
2
1
0
10^{-2}
10^{-1}
D_p [nPa]


5
4
3
2
1
0
10^{-2}
10^{-1}
D_p [nPa]

Discussion

- Pressures and stand-off distances are available for the last inbound and first outbound MP crossing for each Cassini Rev (beware - ambiguous MP timings at later rev's)
  - Machine-readable table available

- Model constructed by pressure balance

- Achilleos et al. study suggests magnetopause location is bimodal

- What is the source of this bimodality?
  - Intrinsic bimodality in the solar wind [consistent with Jackman et al. showing pattern of compression/rarefactions in the solar wind]
  - Internal control? [Espinosa et al. 2003; Clarke et al. 2006]
  - We do not describe this with our model

- The crossings (only one per leg per orbit) are roughly lined-up with the bimodality in location - have we minimised the internal control in some statistical sense?