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Solar & Magnetospheric Theory Group
University of St Andrews

Coronal Magnetic Field Extrapolation Using a Specific Family of Analytical 3D MHS Equilibria

-- Practical Aspects --

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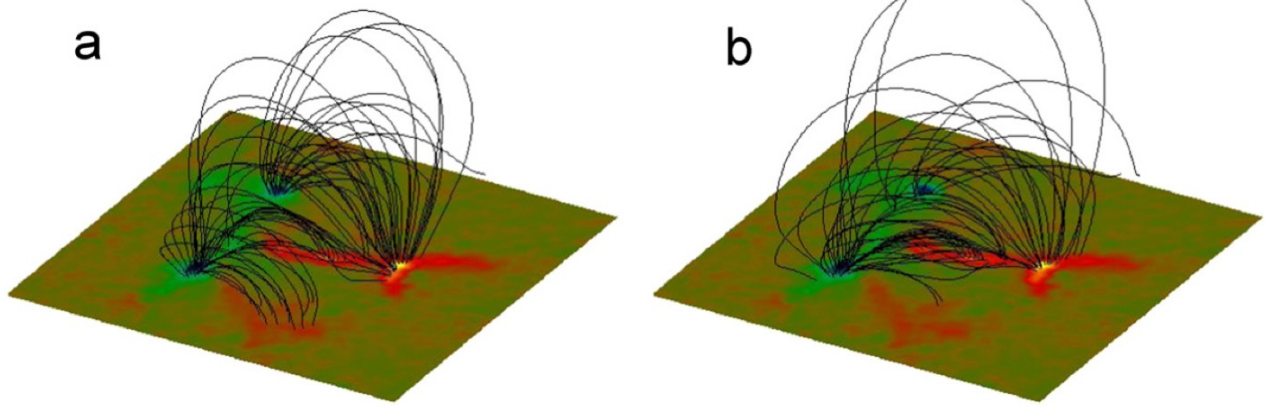
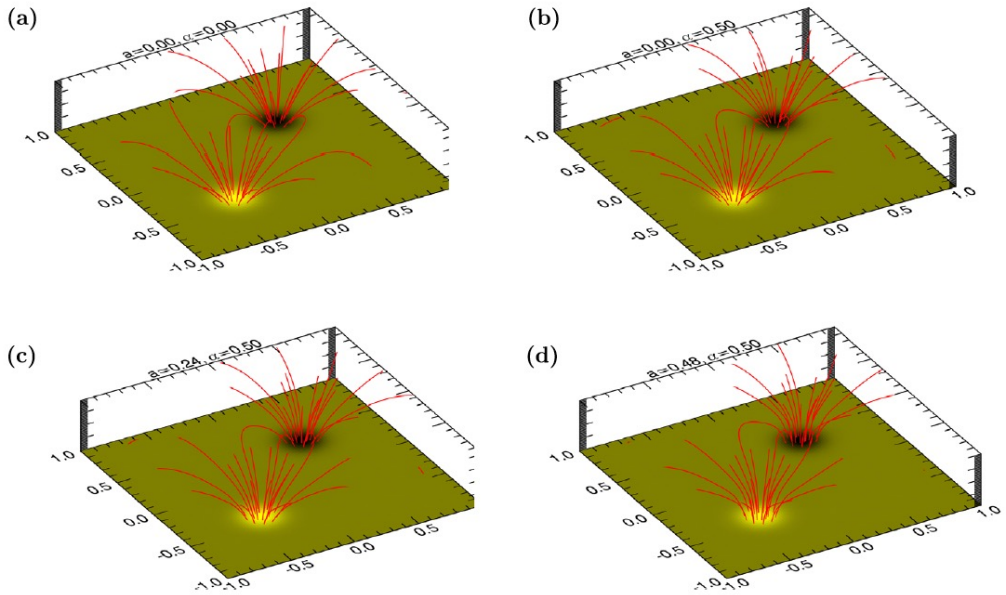
- Magnetic field is a major factor in structuring the solar corona
- Need extrapolation methods to determine coronal magnetic field from photospheric measurements
- Lower layers of solar atmosphere are not force-free but usually magnetic field extrapolations are force-free
- Use analytical 3D magnetohydrostatic equilibria (including pressure and gravity)

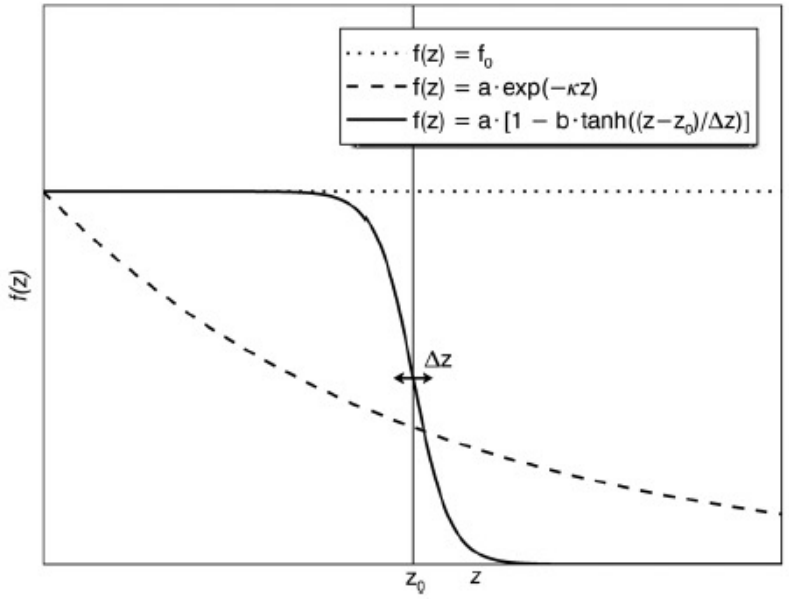


(Wiegelmann et al., 2015)

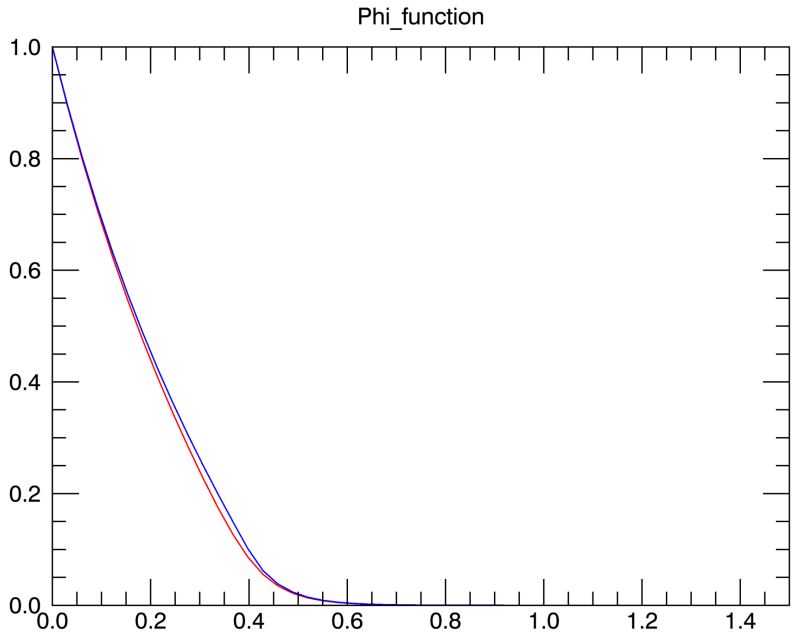


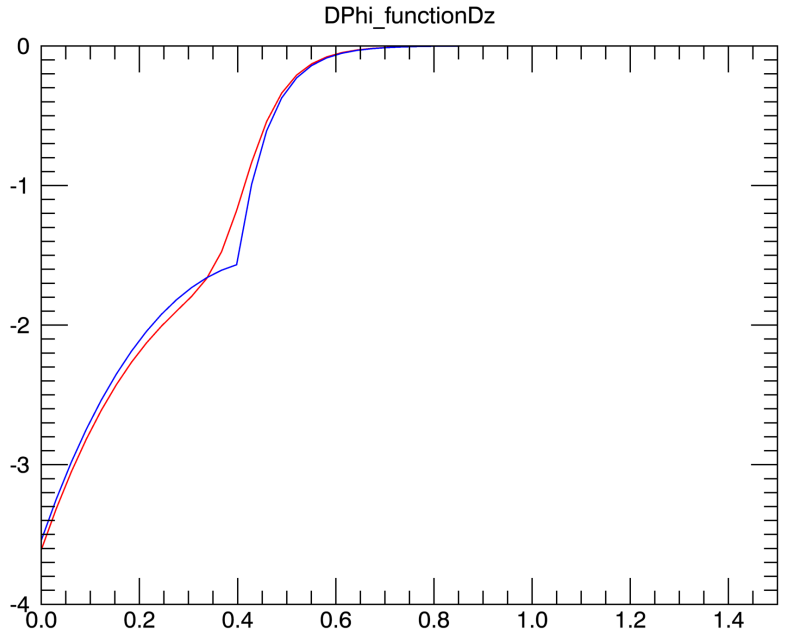
(Neukirch & Wiegelmann, 2019)

- Transition from non-force-free to force-free modelled by function f(z)
- Calculation of special function numerically inefficient and can be inaccurate
- Asymptotic approximation as an alternative



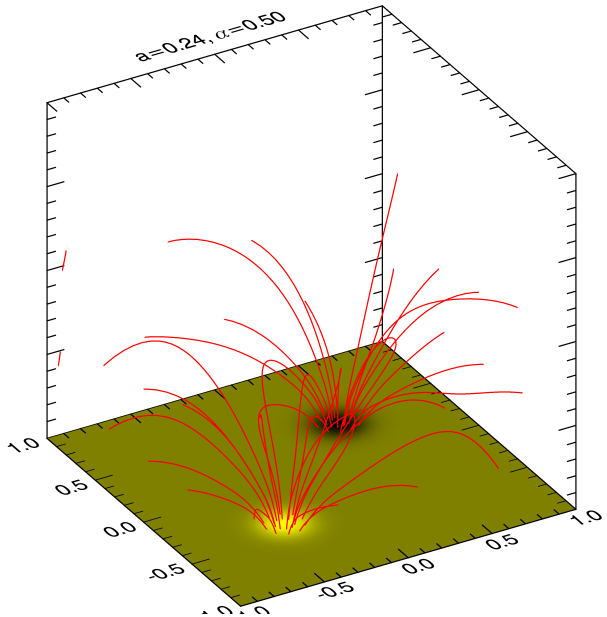
(Neukirch & Wiegelmann, 2019)

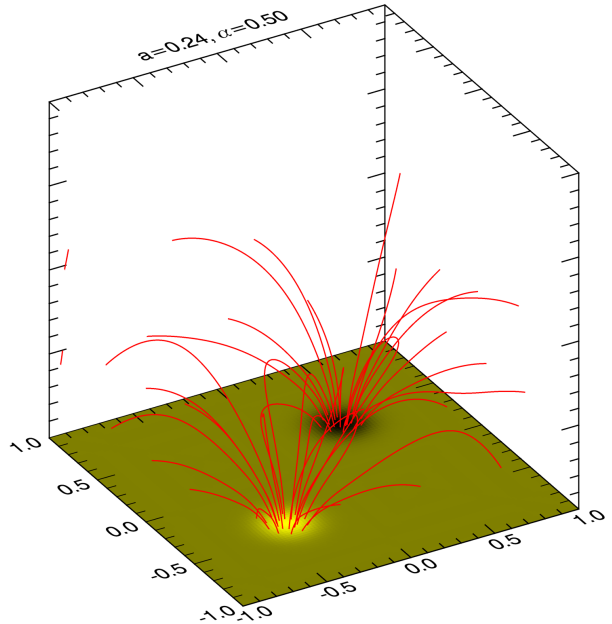


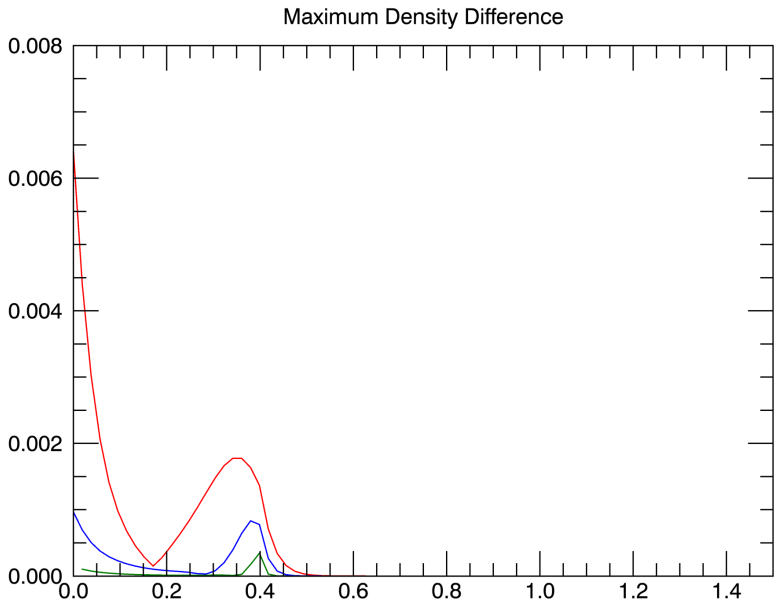


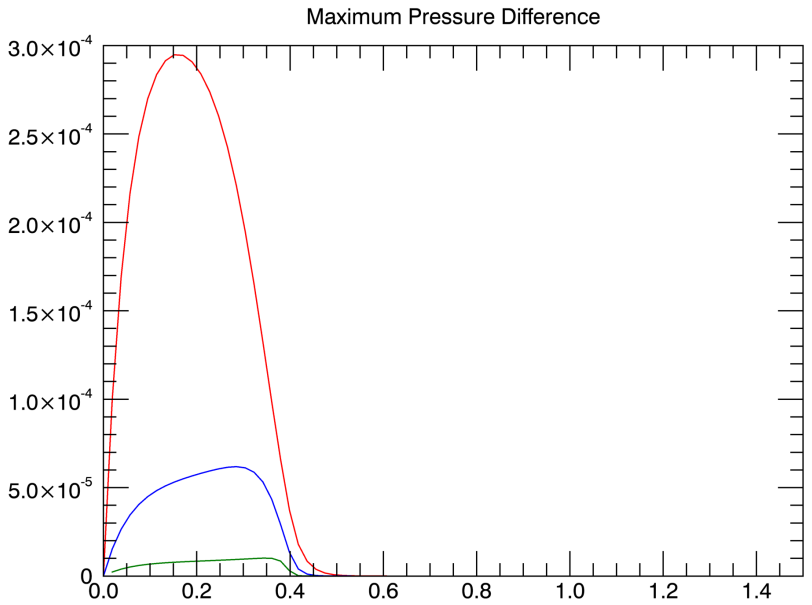
Exact function

Asymptotic approximation









$\Delta z = 0.1$
$\Delta z = 0.05$
$\Delta z = 0.02$

SUMMARY AND CONCLUSION

- We model the transition from non-force-free to force-free using a special function that allows for more flexibility
- Asymptotic approximation of hypergeometric function seems to perform well
- Error in B, ρ and p small in relevant parameter regimes

OUTLOOK

- How robust is our code? (Considering varied magnetic fields, measurement inaccuracies etc.)
- Use observational data and compare with results from other methods