

# Calibration in the Presence of Satellites

Chris Finlay<sup>1,2</sup>

Bruce Bassett<sup>2</sup>, Martin Kunz<sup>1</sup>, Nadeem Oozeer<sup>2</sup>

University of Geneva<sup>1</sup>  
SARAO<sup>2</sup>

Swiss SKA Days 2022  
Oct 3-4, 2022



**UNIVERSITÉ  
DE GENÈVE**



**SARAO**  
South African Radio  
Astronomy Observatory

# Outline

- 1 Introduction
- 2 Simulation and Forward Model
- 3 Posterior Results
- 4 Application to Target Observation
- 5 Conclusion

# Introduction

# Introduction

- **RFI** in the L-band that is dominated by **satellite sources**.
- Our method removes satellite-based RFI but can be extended to other sources.

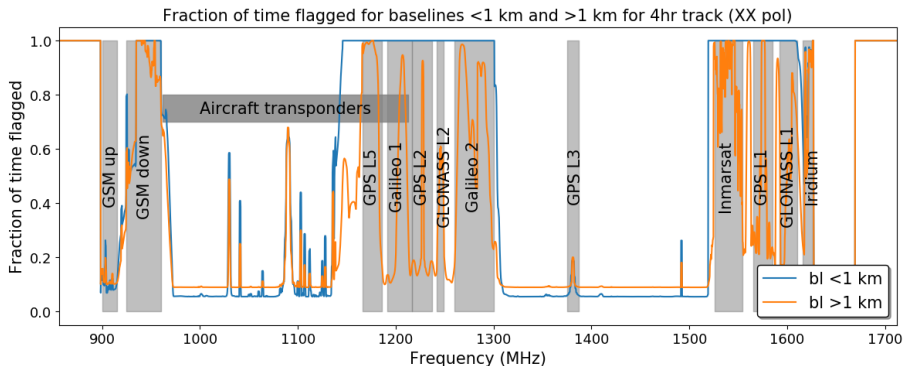


Figure: SARAO External Service Desk

# Simulation and Forward Model

# Simulation Definition

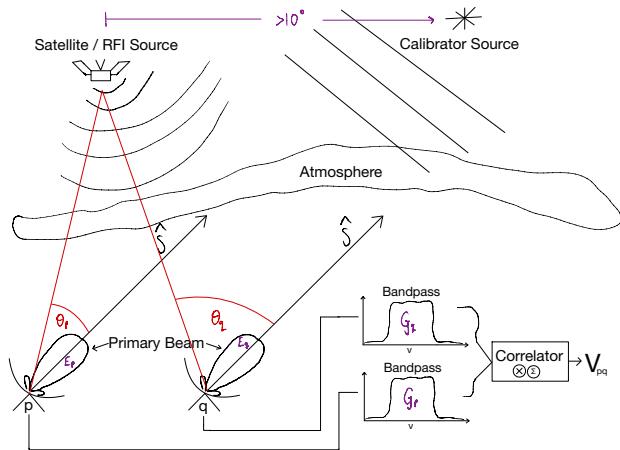
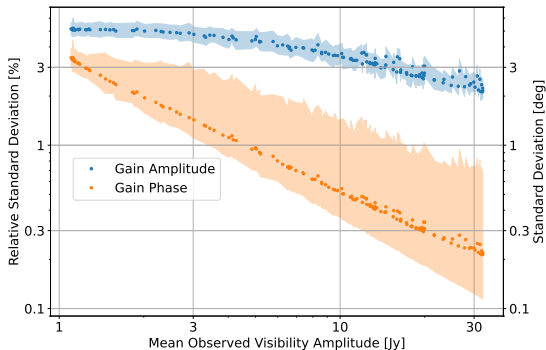
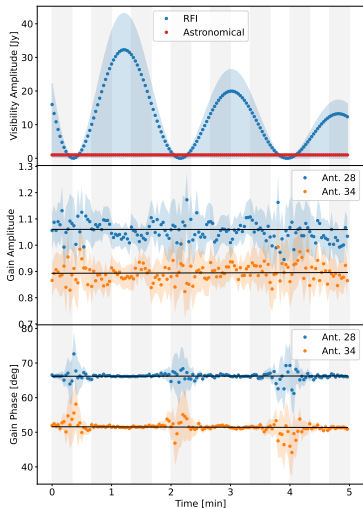


Figure: Simulation Diagram

# Posterior Results

# Gain Solutions





# Orbit Constraints

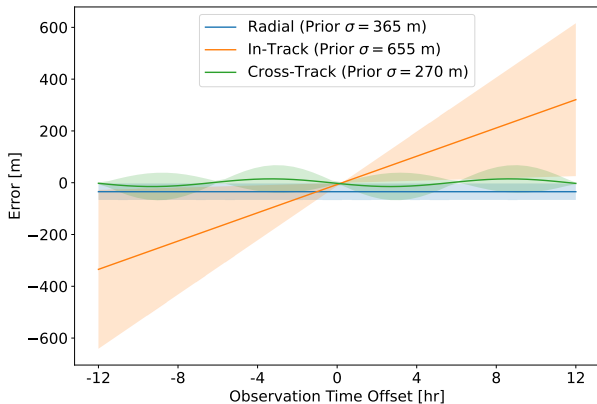


Figure: Posterior Constraints from 5 minutes of calibration data

# Application to Target Observation

# Flagging Improvement

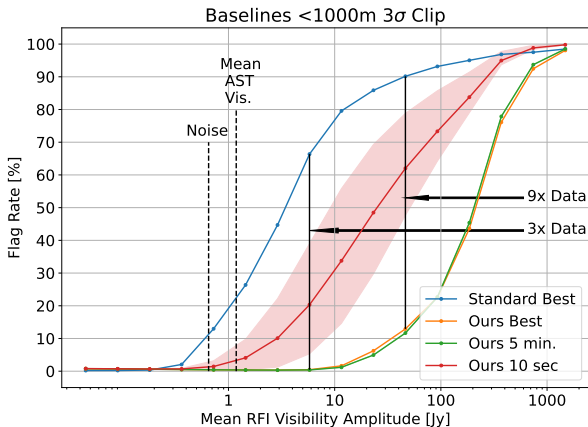


Figure: Flagging comparison after decontamination

# Imaging and Source Extraction

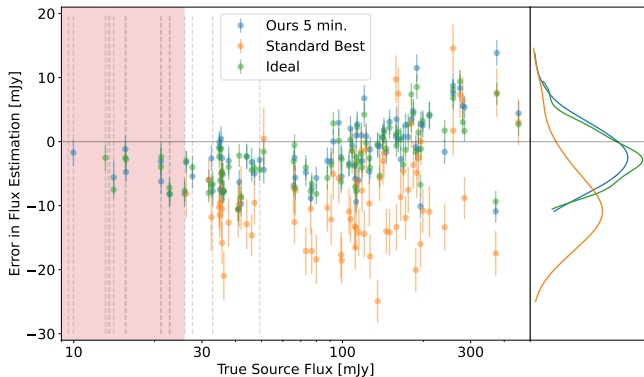


Figure: Flux estimation error on 100 source image

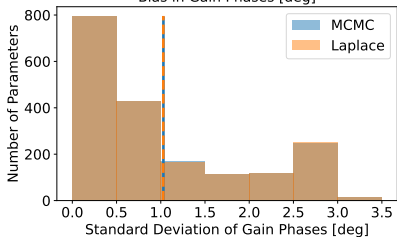
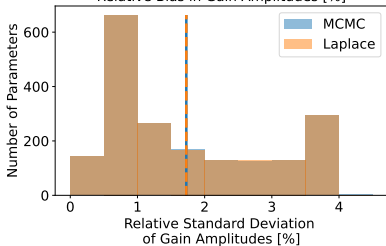
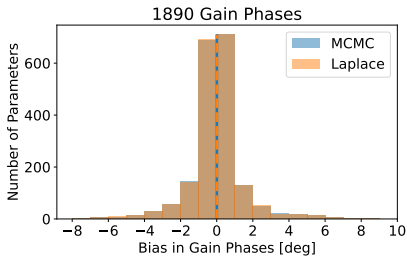
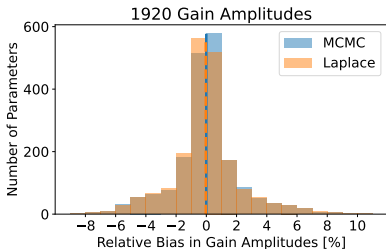
# Conclusion

# Conclusion

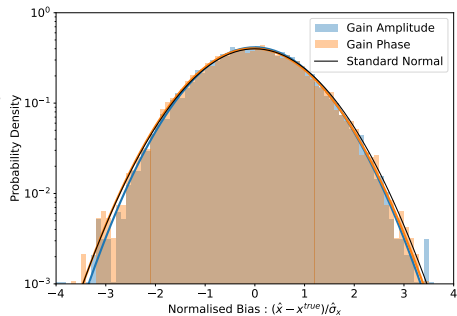
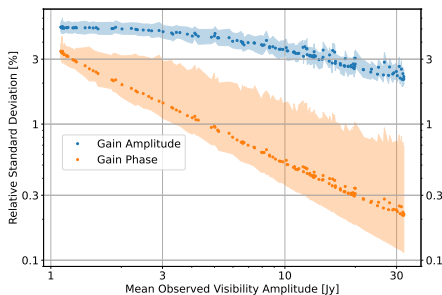
- Calibration in contaminated channels
- Calibration constraints as good or better than standard
- Statistically consistent errors
- Target Obs.  $\rightarrow 3x - 9x - \infty$  more data
- Comparable source extraction to uncontaminated data

E-mail: [christopher.finlay@unige.ch](mailto:christopher.finlay@unige.ch)

# Posterior Error Comparison Laplace vs MCMC

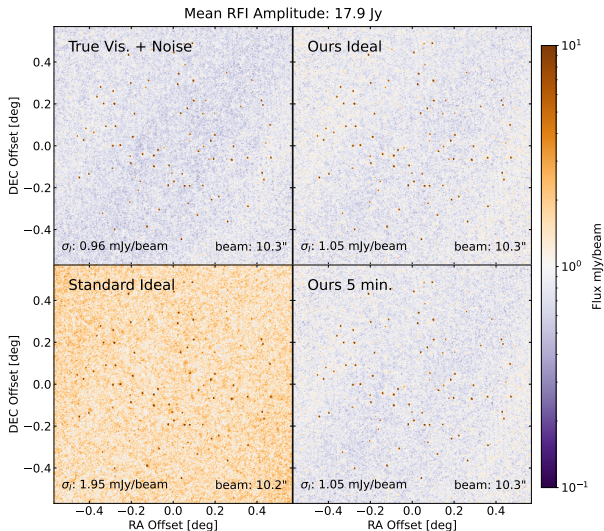


# Gain Constraints Error Analysis

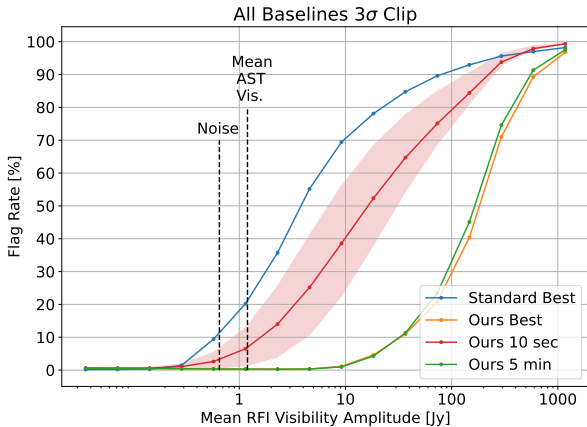




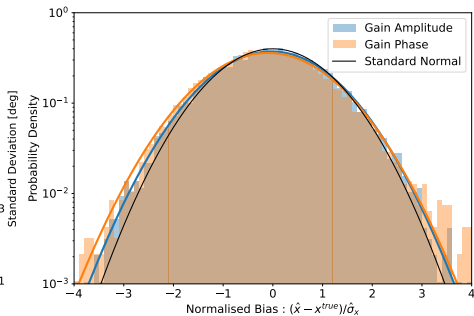
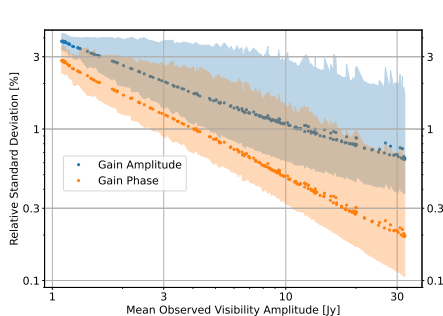
# Image Comparison



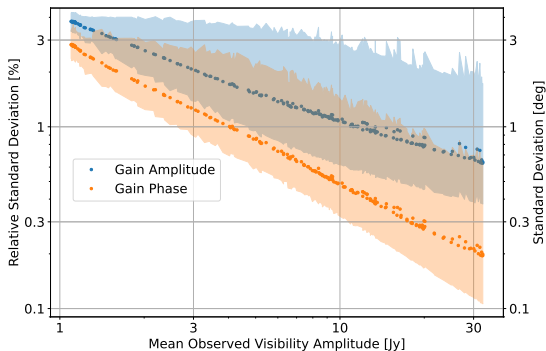
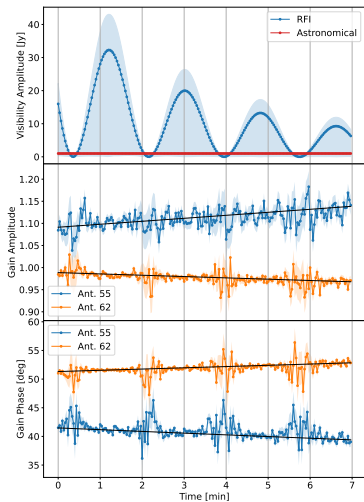
# Flagging All Baselines



# Gain Constraints using Correlated RFI Amplitude



# Gain Solutions using Correlated RFI Amplitude



# RFI Visibility Sampling Rate Convergence

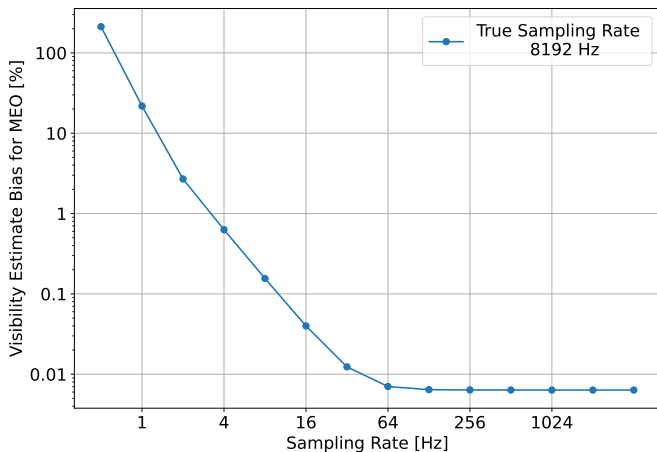


Figure:

# Probabilistic Model

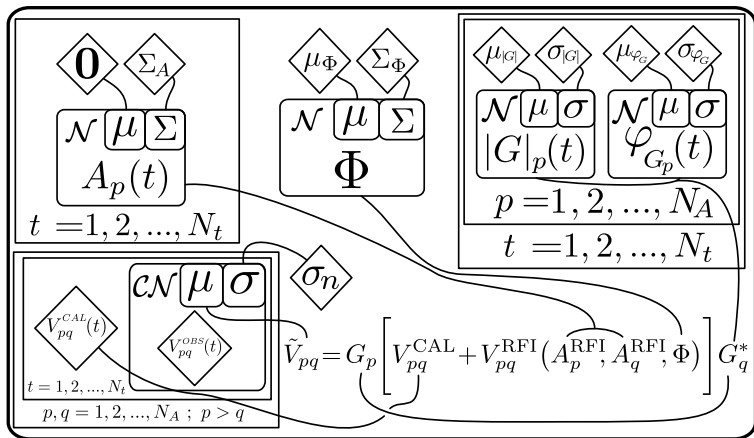


Figure: Priors, Model and Likelihood