A Real-Time Radio Transient Pipeline for ARTS

Alessio Sclocco, Joeri van Leeuwen, Henri E. Bal, Rob V. van Nieuwpoort

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VU UNIVERSITY AMSTERDAM Faculty of Sciences

ASTRON Netherlands Institute for Radio Astronomy

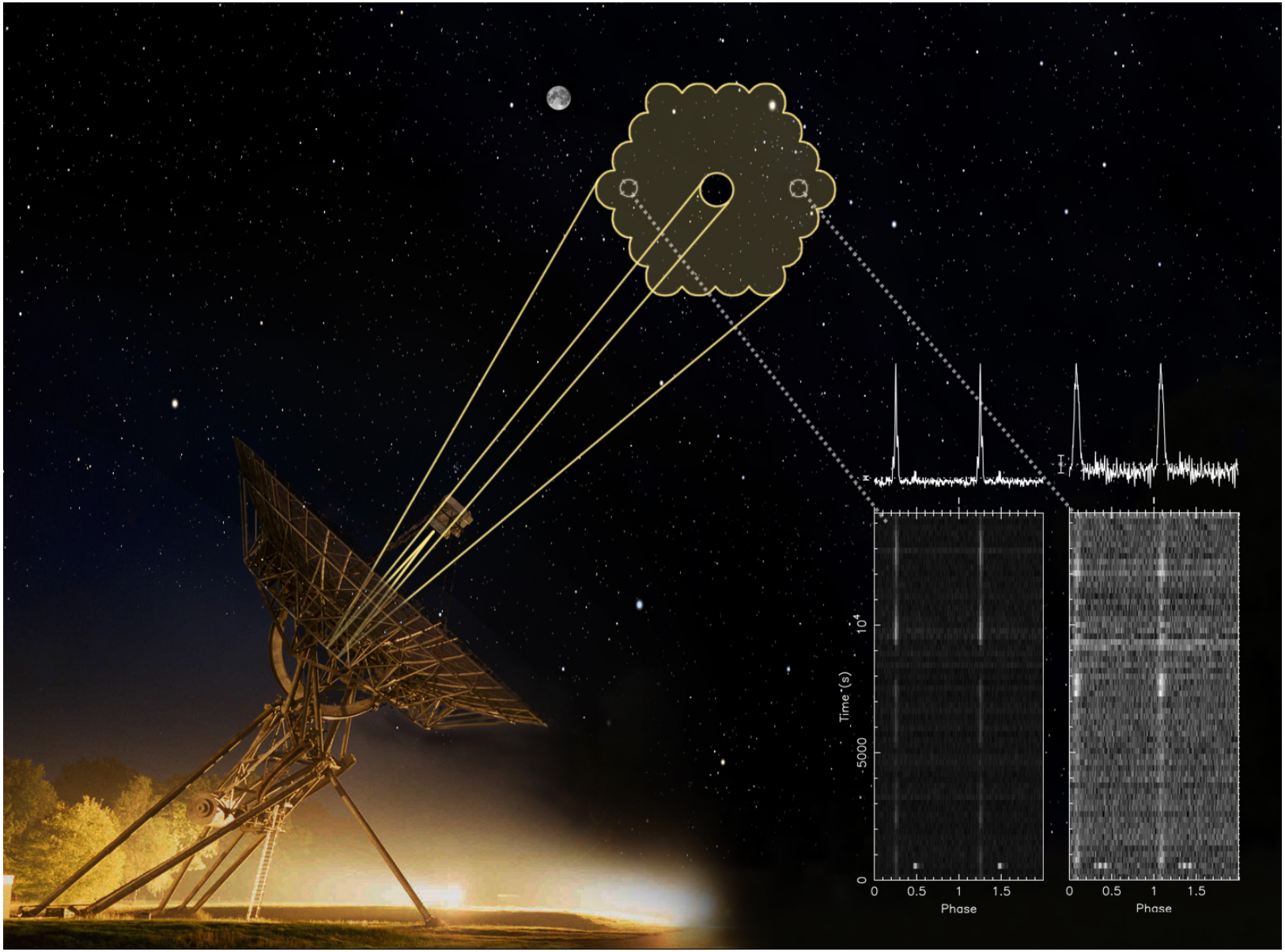
netherlands eScience center

Introduction

- ARTS, the Apertif Radio Transient System, is the system we are buiding to find FRBs in real-time

- Fast Radio Burst (FRB): “high energy astrophysical phenomenon manifested as a transient radio pulse lasting only a few milliseconds” (Wikipedia)

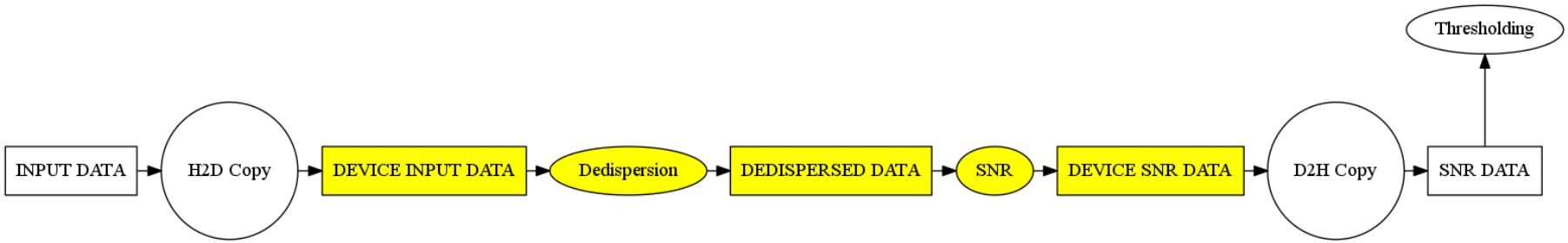
Apertif



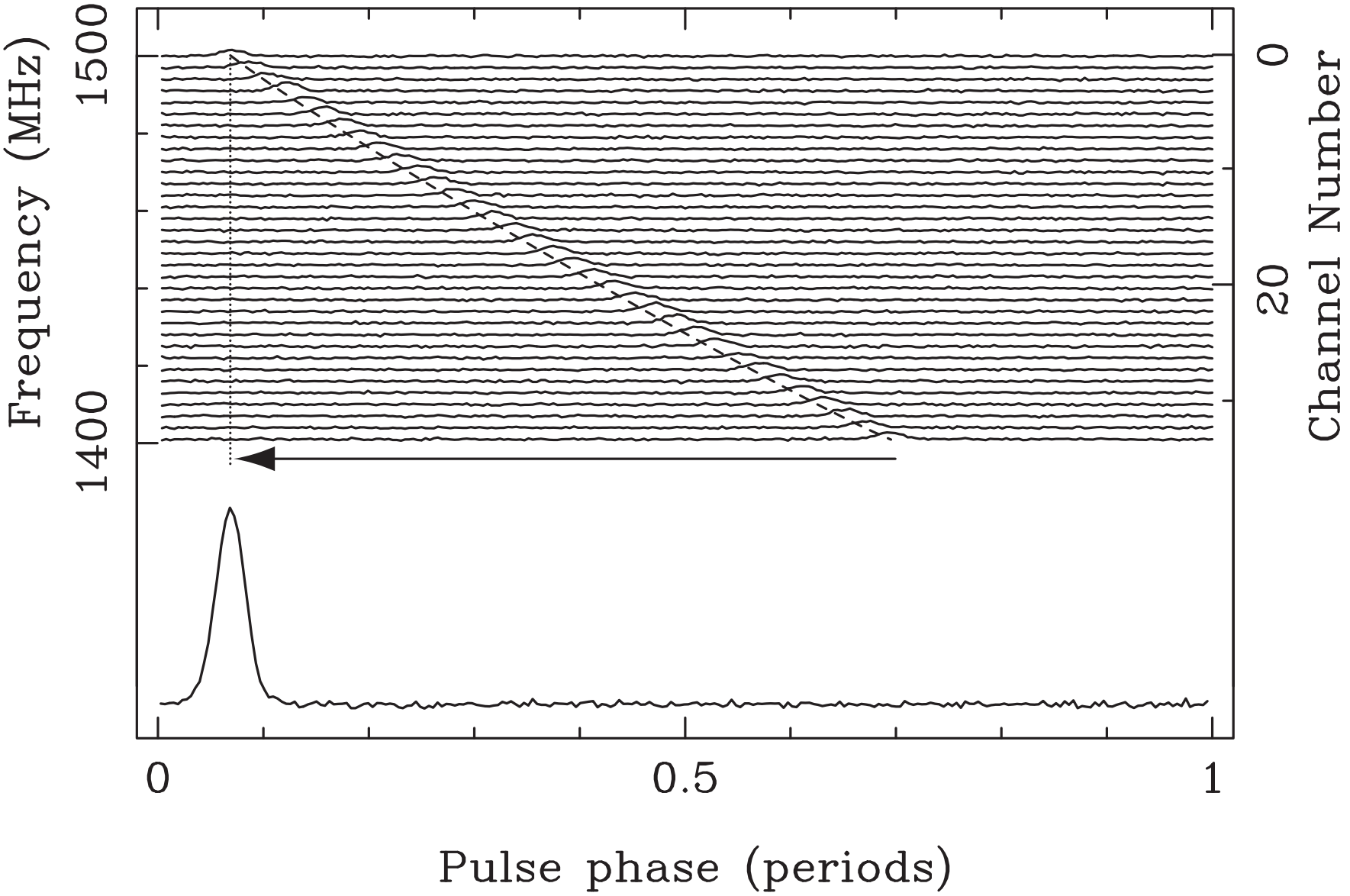
Preliminary Software Pipeline

- We are designing a software pipeline that can:
  - Detect FRBs in real-time
  - Cope with more than 36 GB/s of input data
  - Have a throughput of more than 18 TFLOP/s

- The pipeline is fully parallelized and runs on many-core accelerators (e.g. GPUs)



Dispersion (Lorimer and Kramer 2005)



Pipeline Requirements

- Functional:
  - Discover new FRBs surveying the northern sky
- Non-functional:
  - Real-time performance
  - Linear scalability
  - Portability

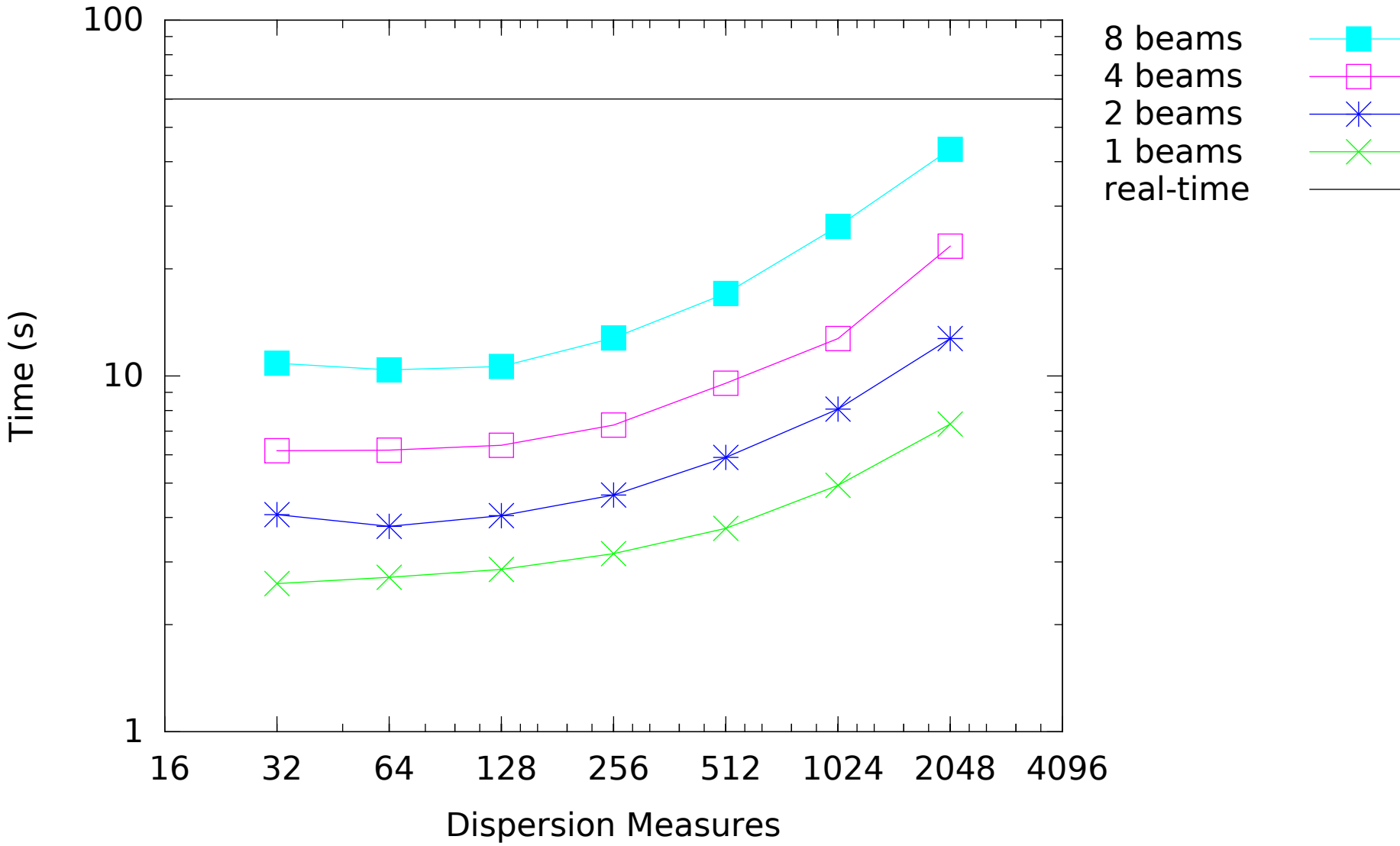
ARTS Characteristics

- Beams: 444
- Bandwidth: 300 MHz
- Channels: 1,024
- Sampling: 50 μs (20,000 samples per second)
- Dispersion measures: 2,000

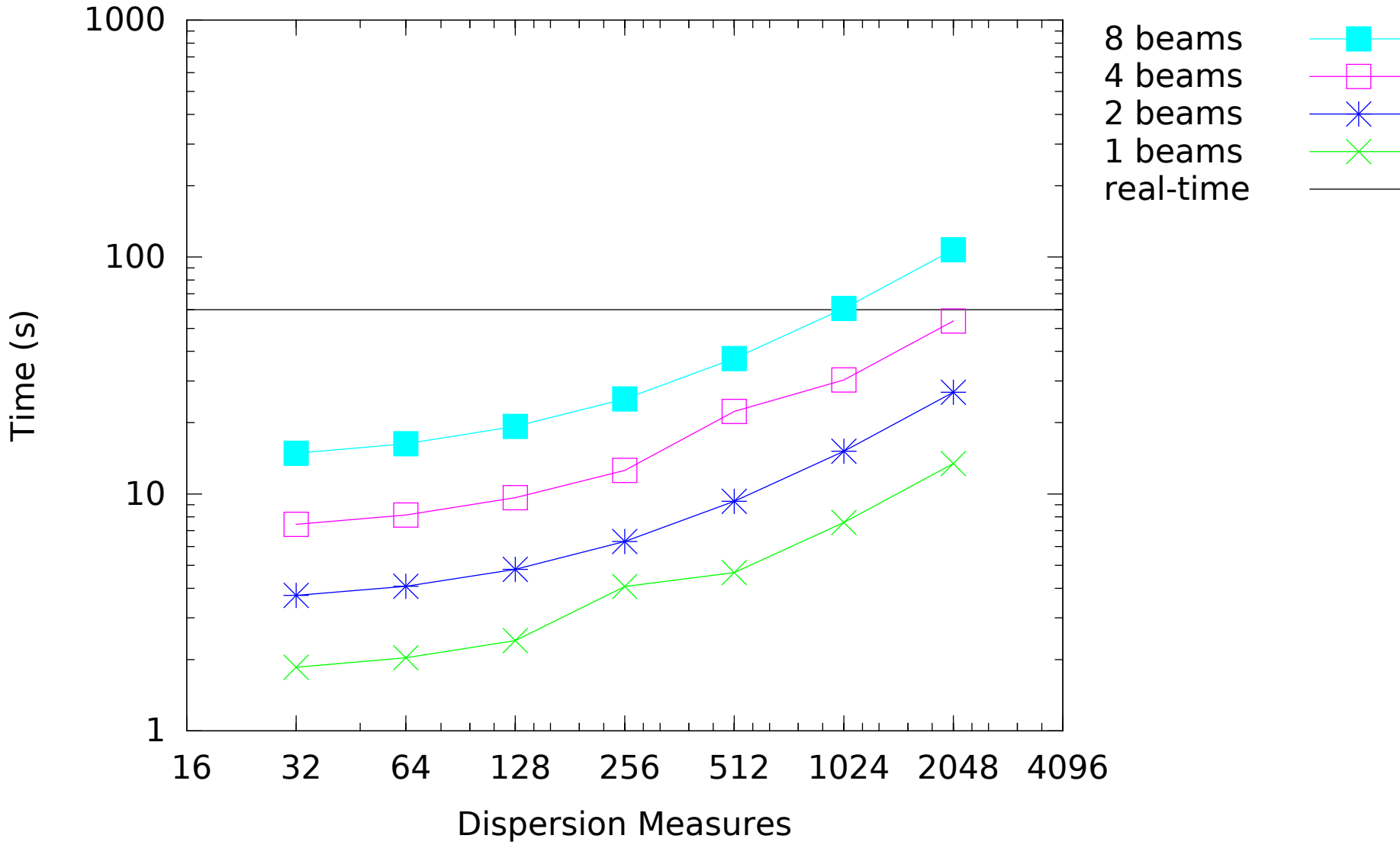
Experimental Parameters

- Input: 60 seconds of data
- Platforms (GPUs):
  - AMD HD7970
  - NVIDIA K20X
  - NVIDIA Titan X
- Varying parameters:
  - Number of Dispersion Measures (DMs)
  - Number of beams

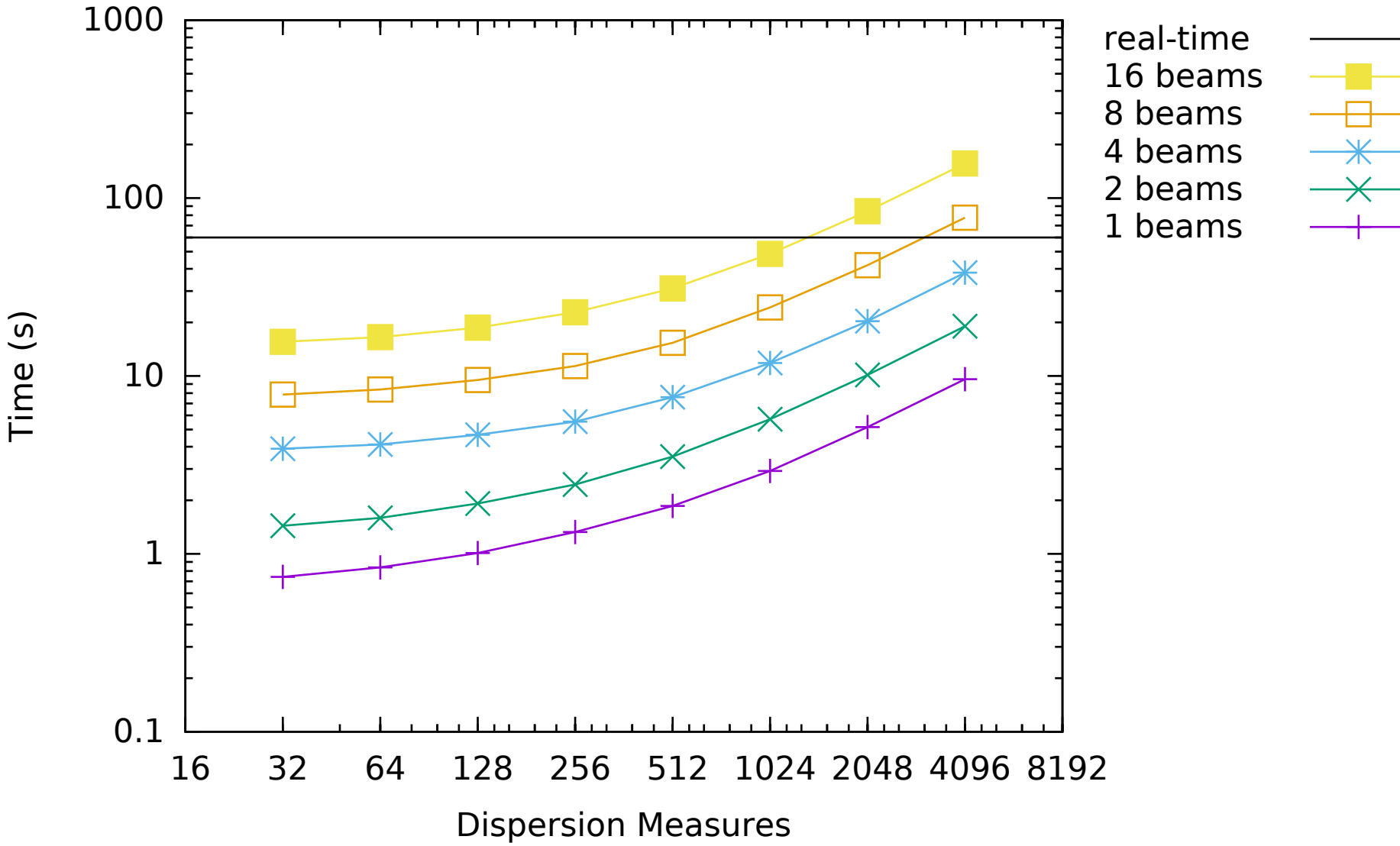
AMD HD7970 Performance



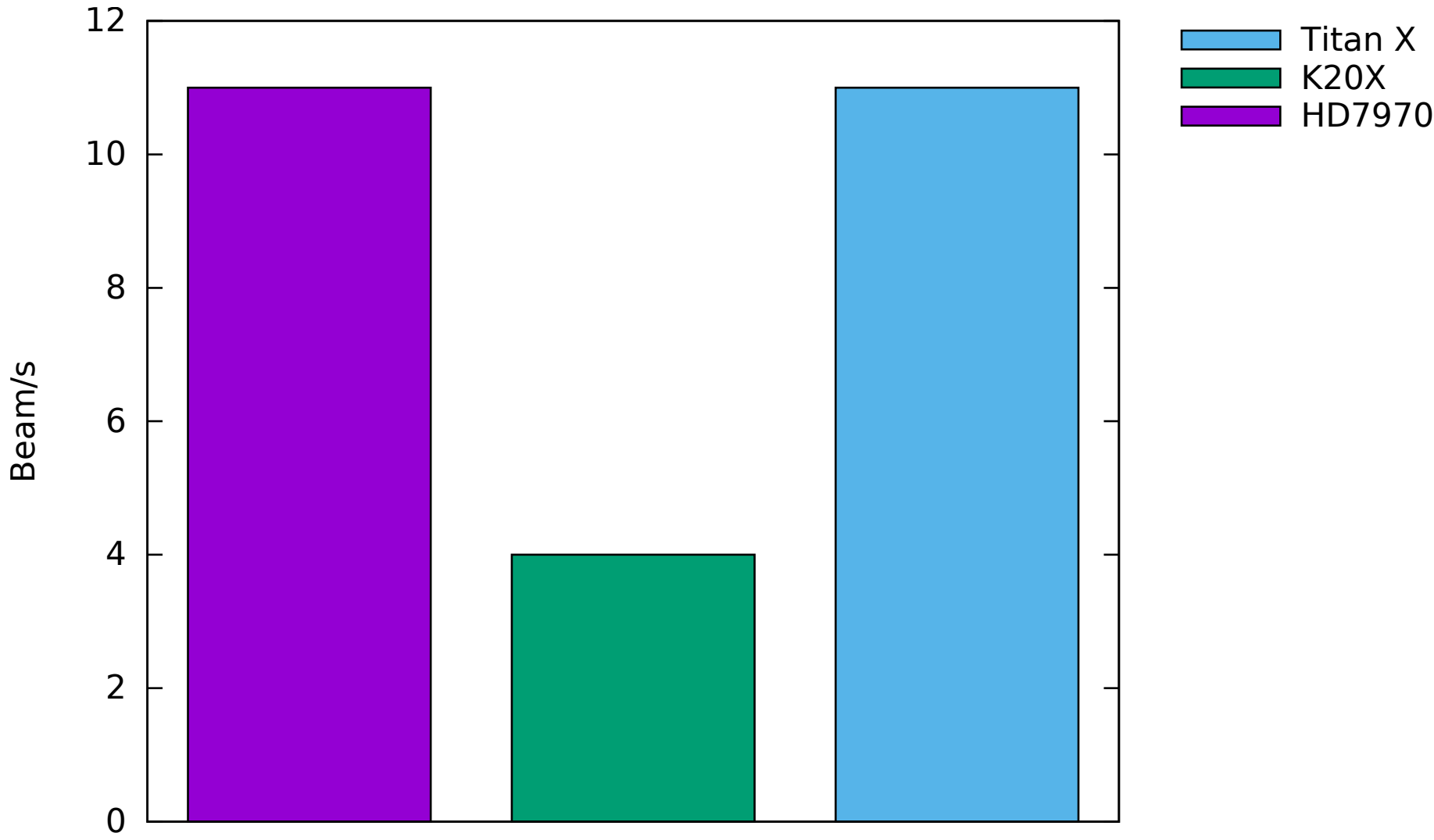
NVIDIA K20X Performance



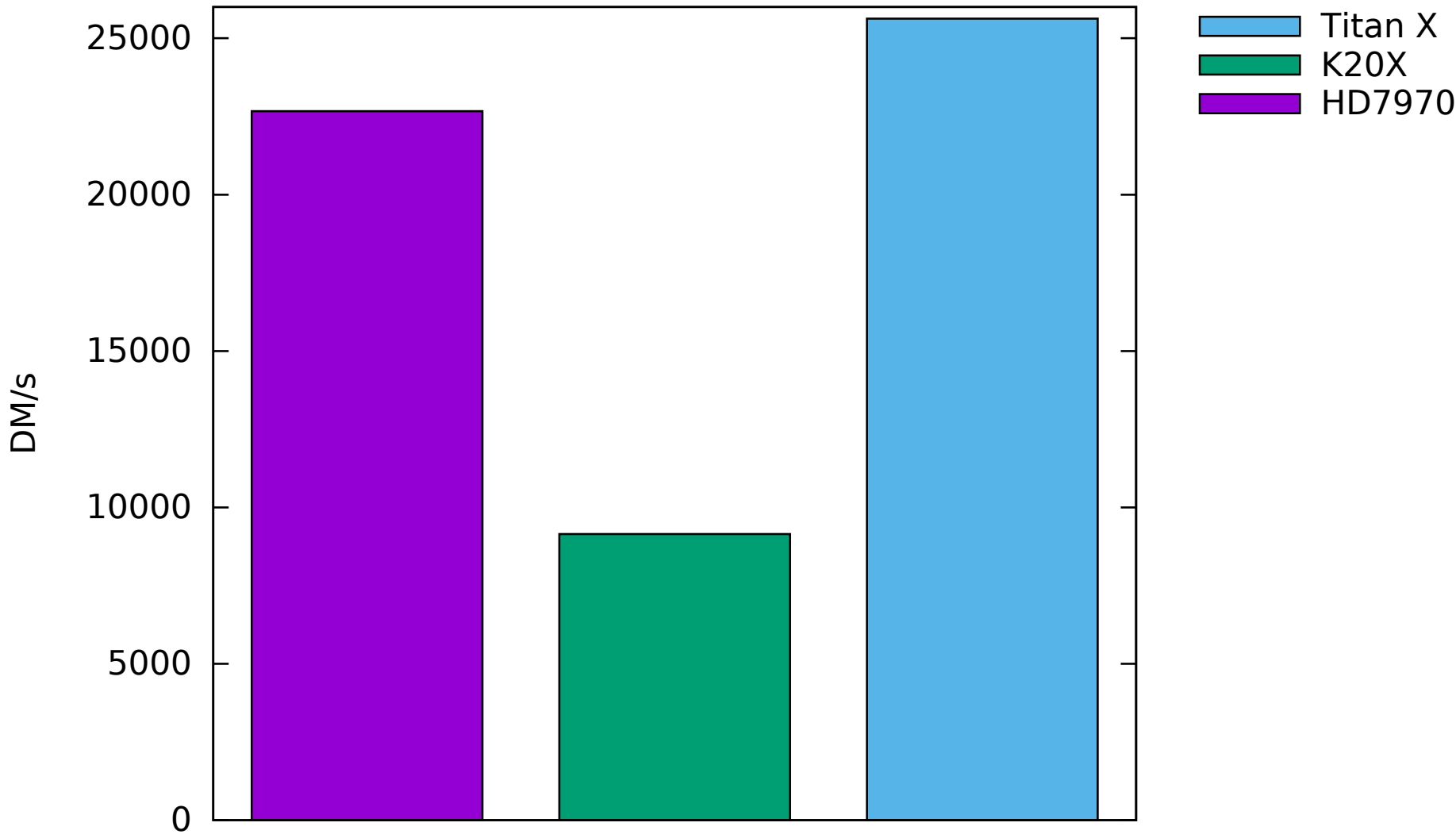
NVIDIA Titan X Performance



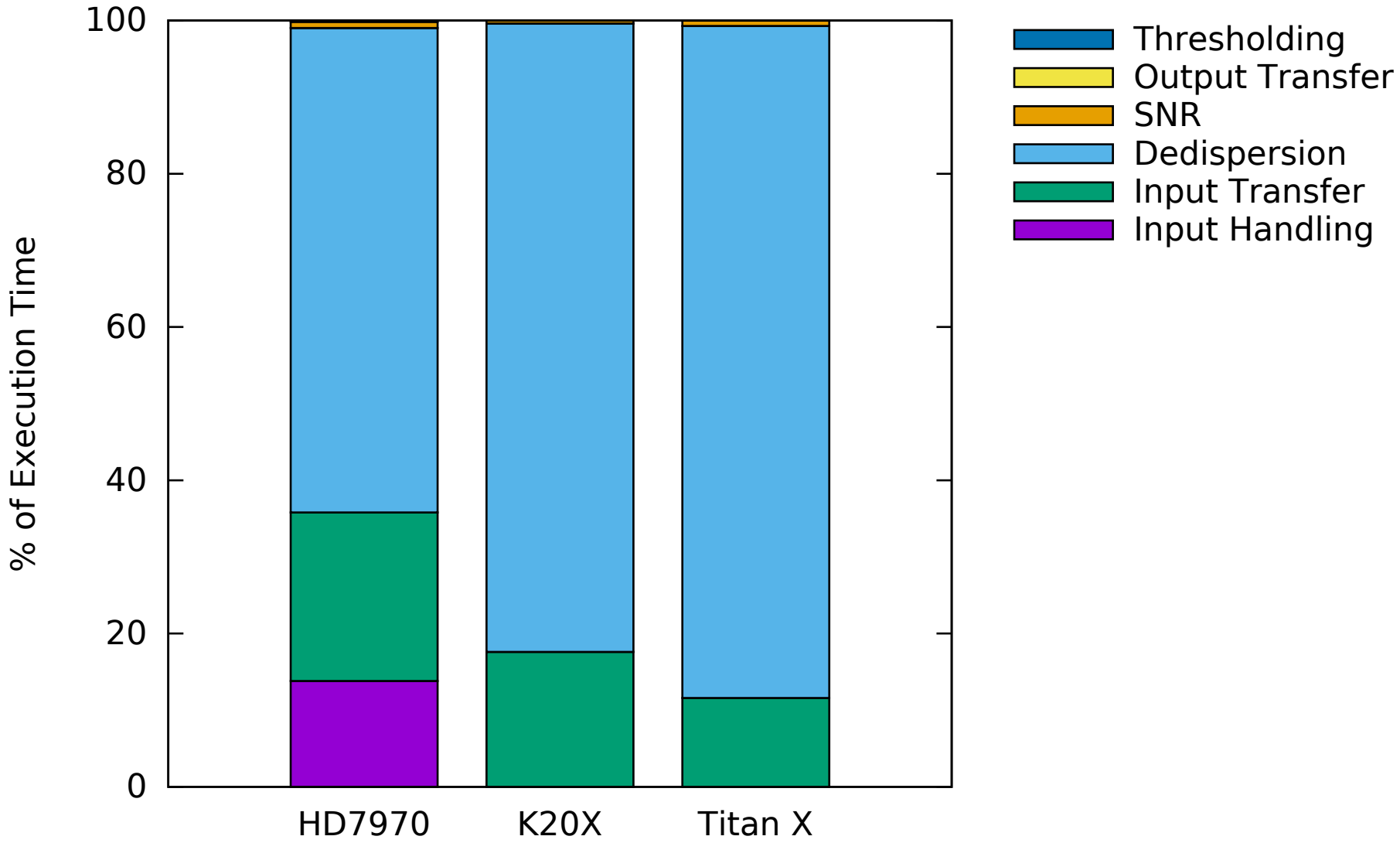
Throughput in Beams, 2000 DMs



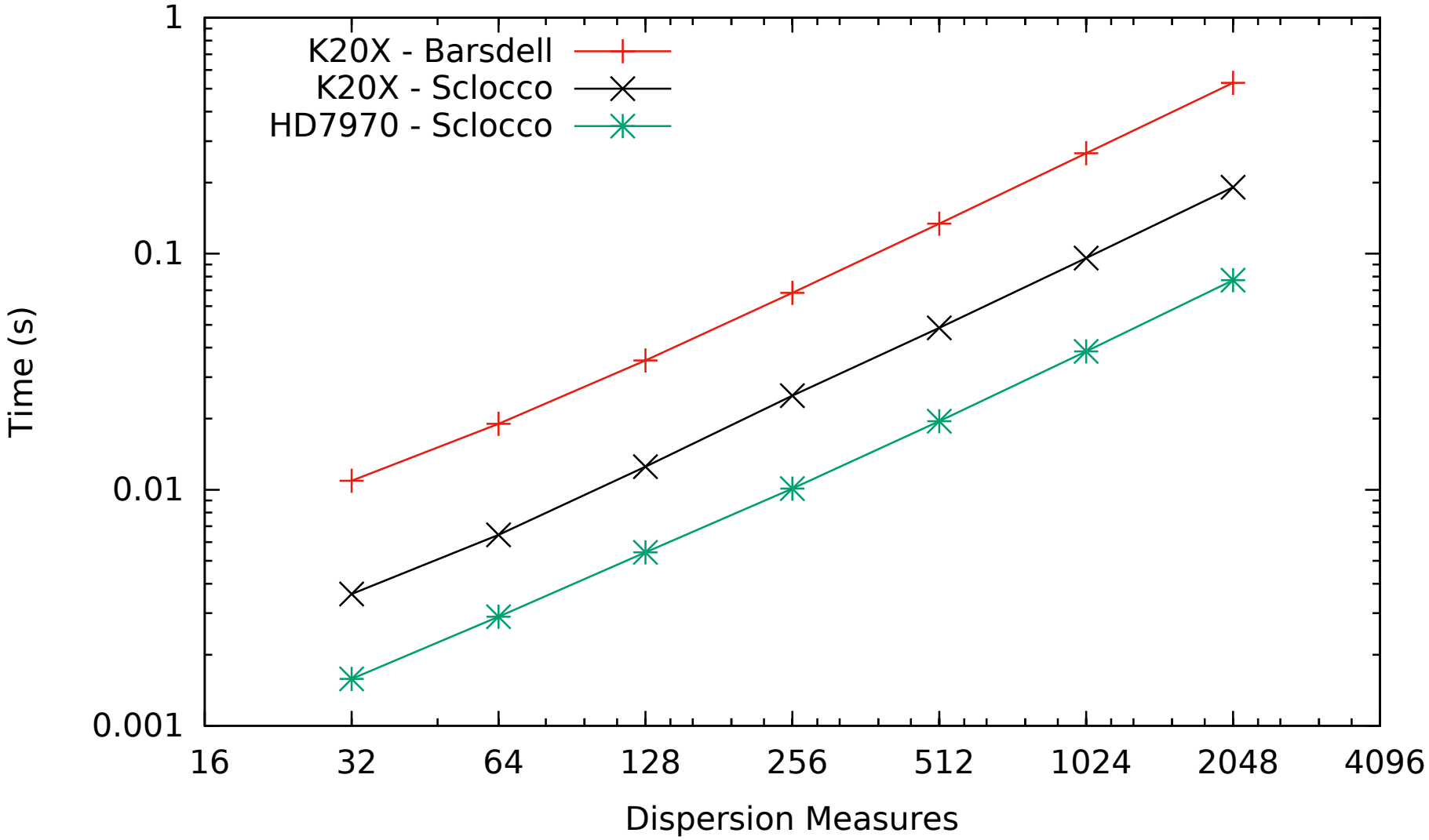
Throughput in DMs, 1 beam



Performance Breakdown



Related Work: Dedispersion



Conclusions

- We designed and implemented a radio transient searching pipeline for ARTS that:
  - Is portable
  - Achieves real-time performance
  - Scales linearly
  - Is open source[1]

- ARTS can be implemented today with 40 GPUs

[1] https://github.com/isazi/TransientSearch