Technology Development for a Standard Cartridge Multi-terabyte Tape System

NIST ATP PROGRAM 70NANB2H3040

TECHNOLOGY AND STATUS REPORT

MAJOR PARTICIPANTS:

PARTNERS

Accutronics (Transports/Actuators)
Advanced MicroSystems (Wafers)
Advanced Research Corporation (SW Hds./Hd. Fabr.)
Imation (Media/Data Channel/System Integration)
Peregrine Recording (Program Mgmt.)

MAJOR SUBCONTCRACTORS

CMU (DSSC) (Media/Modeling/Guiding/ECC)
UCSD (CMRR) (Electro-chemical Tribology)
OSU(NLIM) (Wear/Guiding/Edges)
Mountain Engineering II (MEII) (Transport Test & Integration/Servo Channel)

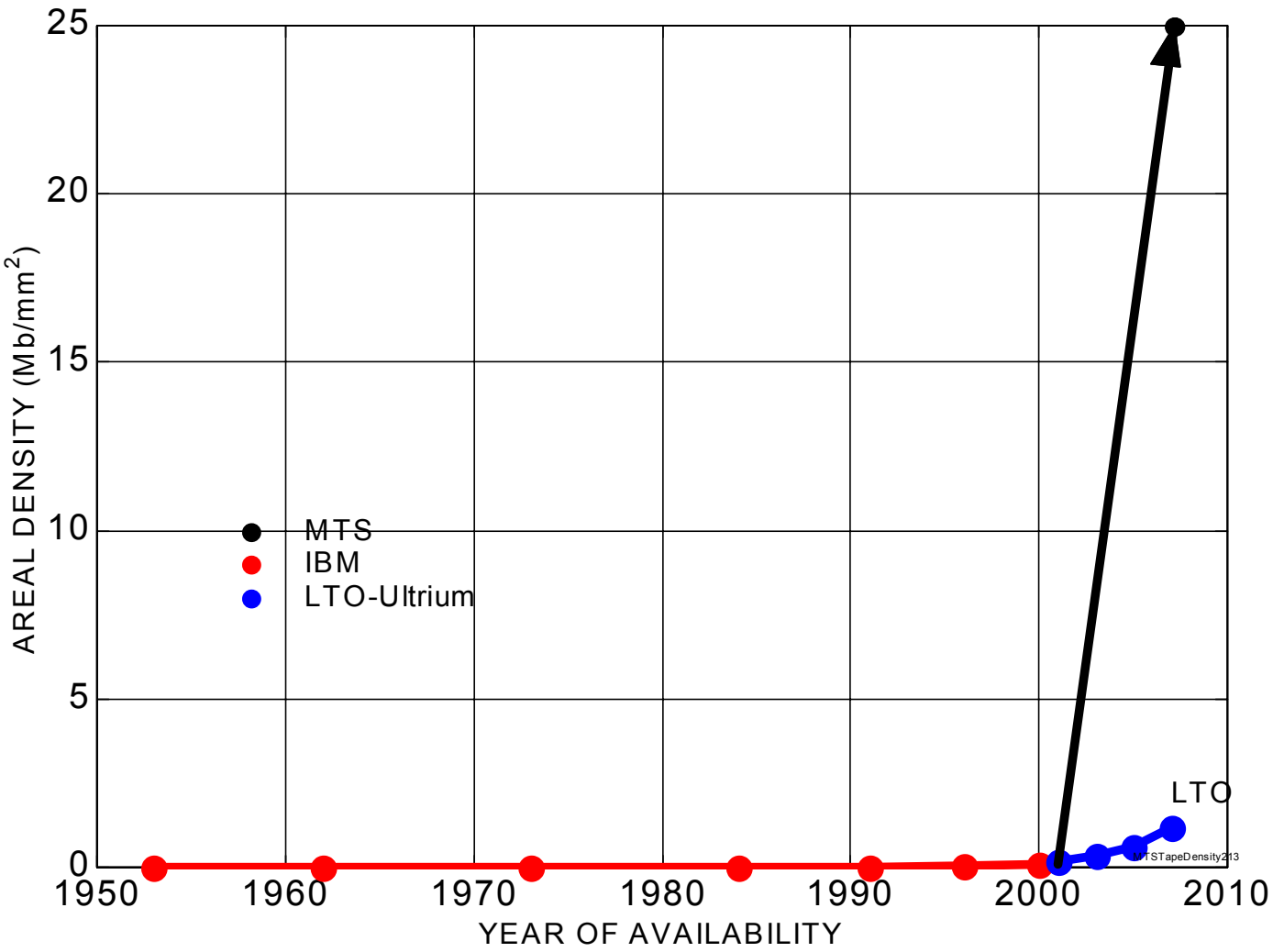
Performance Objectives

- Currently
  - 1500 tpi
  - 125 kbpi
  - **150-200 Mb/in^2**
  - 3600 Layers/in
  - **0.04 TB/in^3**
- Goal
  - ~50,000 tpi
  - 300+ kbpi
  - **15+ Gb/in^2**
  - ~5000 Layers/in
  - **~10 TB/in^3**

Mechanism

- Large Stable Laboratory Transport
- 10 m/sec
- 16 Channels
- Dual Independent Servoed Heads

Areal Density Comparison



Four Year Program

1 November 2002 – 31 October 2006

Two Phases

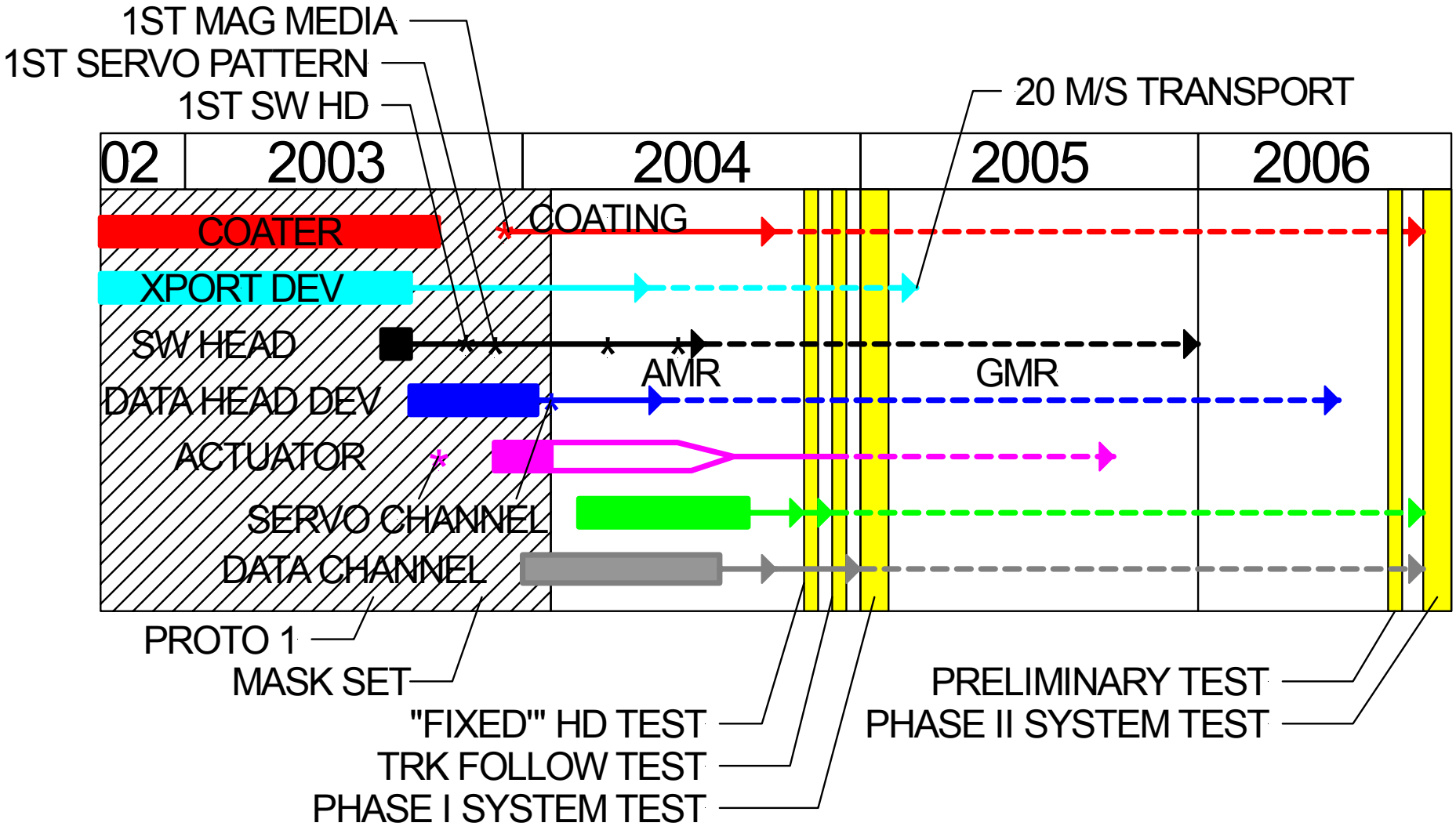
Phase I Demo

Equivalent 3480 Cart Capacity ~ 5-7GB

Phase II Demo

Equivalent 3480 Cart Capacity~ 25GB

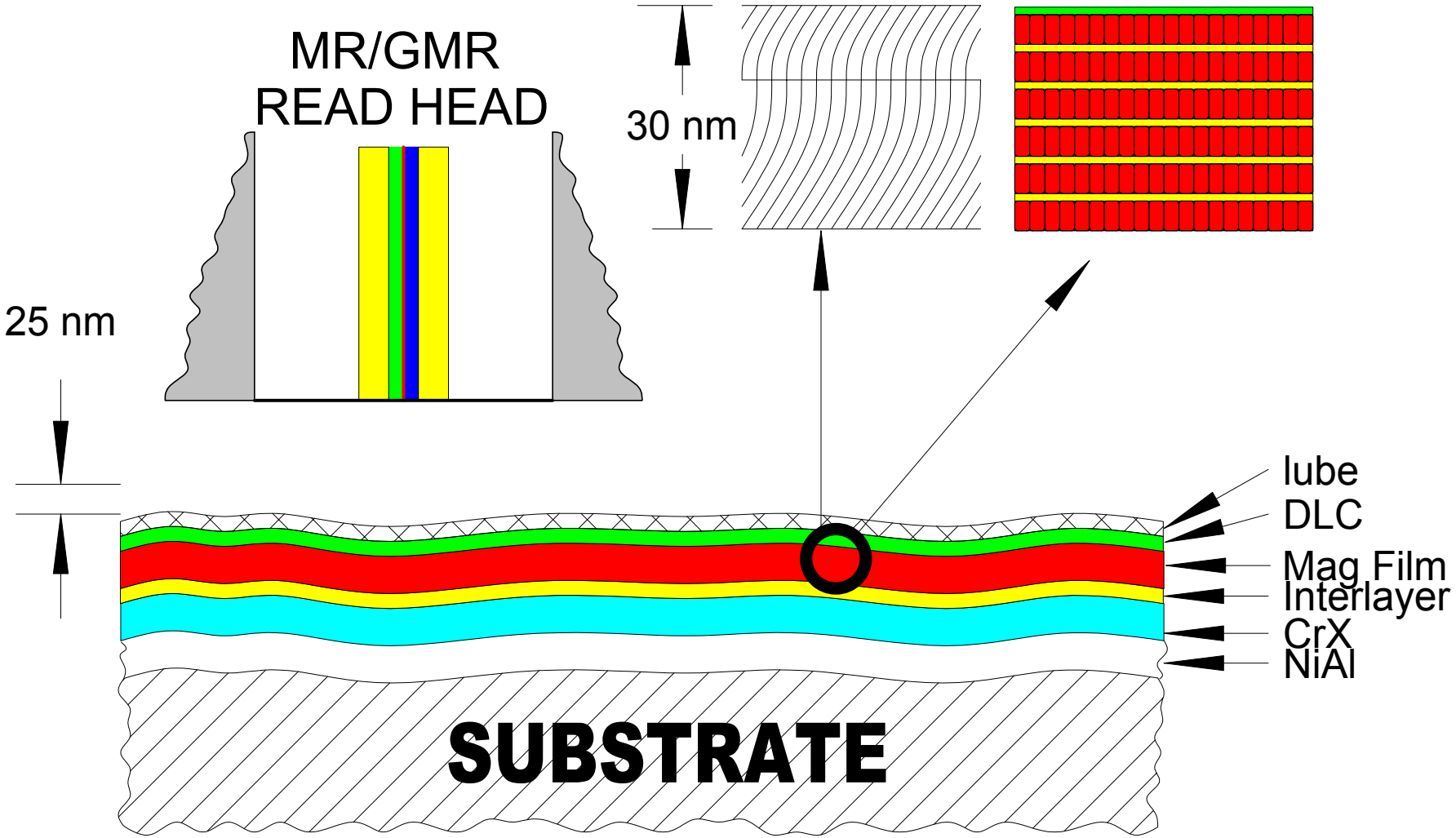
Program Timeline



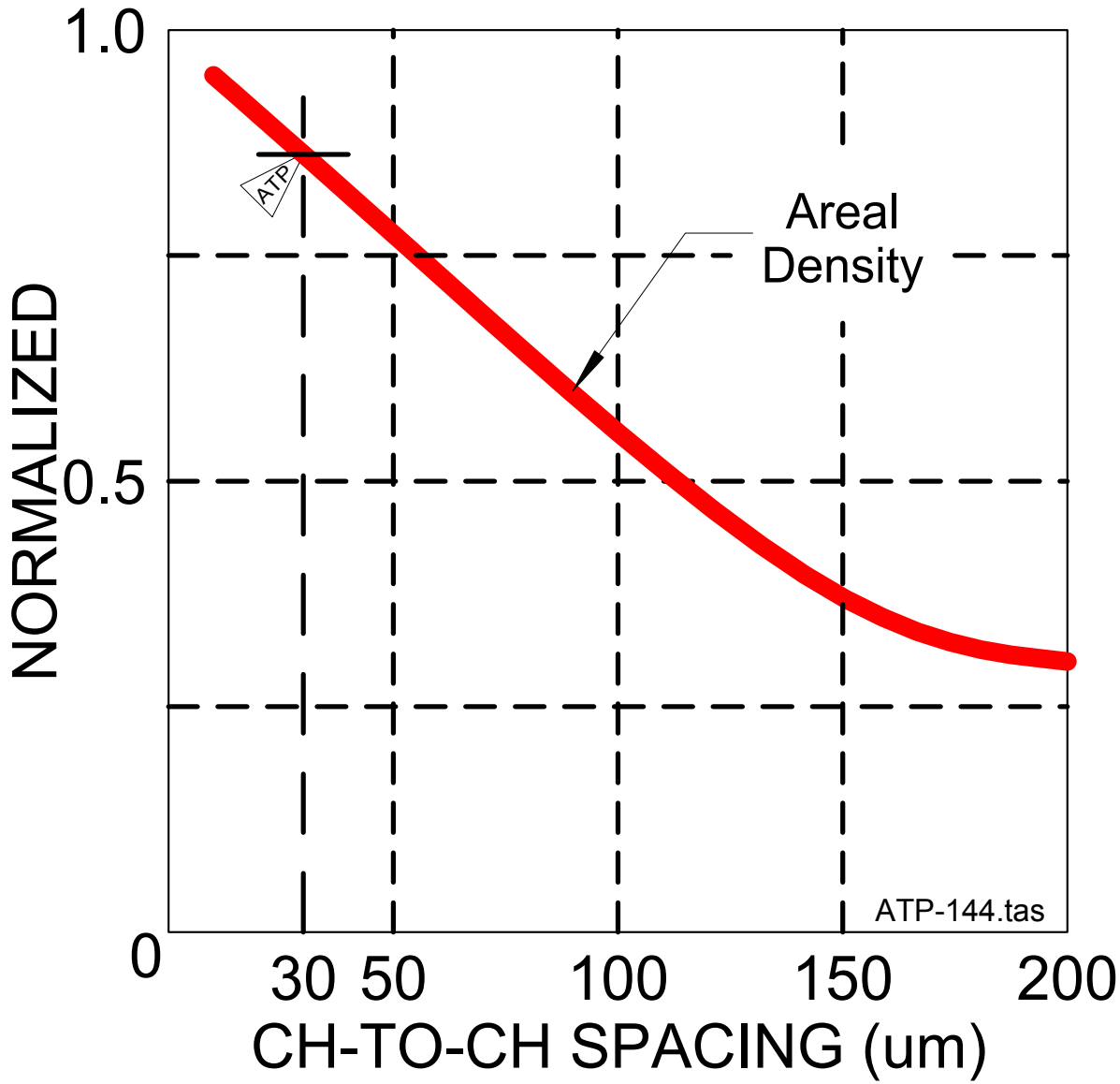
Key Program Elements

- Sputtered Metal Film Media
- Improved Substrate
- Small Ch.-to-Ch. Spacing multi-element Heads
- Corrosion/wear Resistant GMR Heads
- **LAZR** (**L**arge **A**ngle a**Z**imuth **R**ecording)
- Dual Actuators
- Advanced Data Channel
- Enhanced Tape Guiding

Metal Film

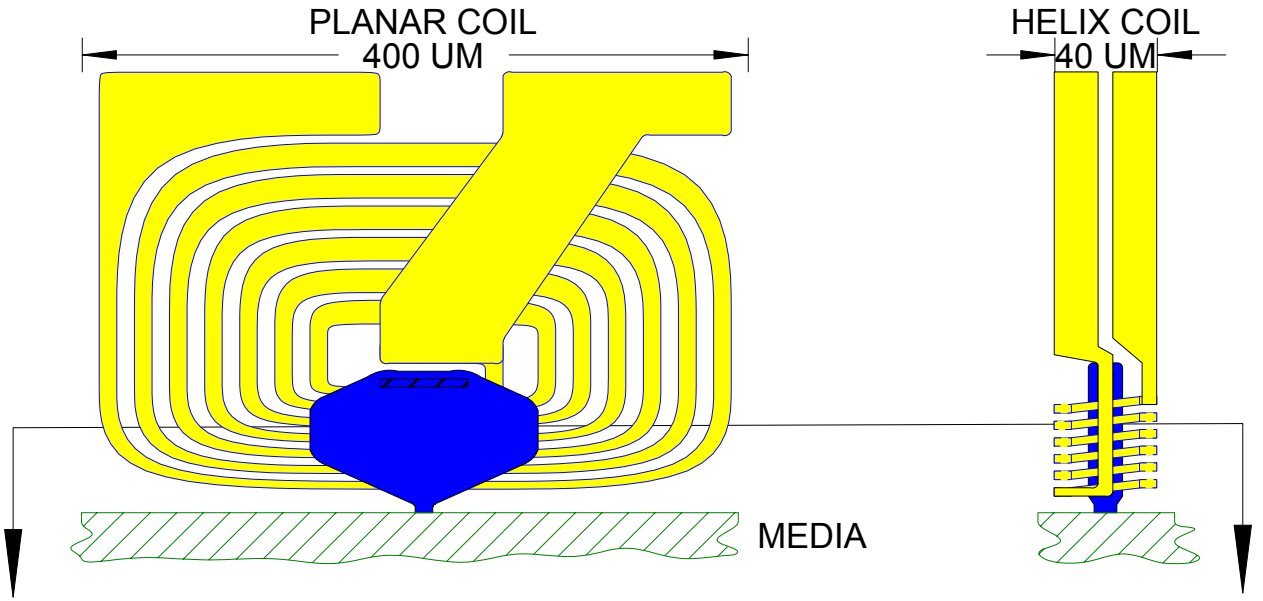

MR/GMR
READ HEAD
30 nm
25 nm
lube
DLC
Mag Film
Interlayer
CrX
NiAl
SUBSTRATE

Areal Density vs. Channel Spacing

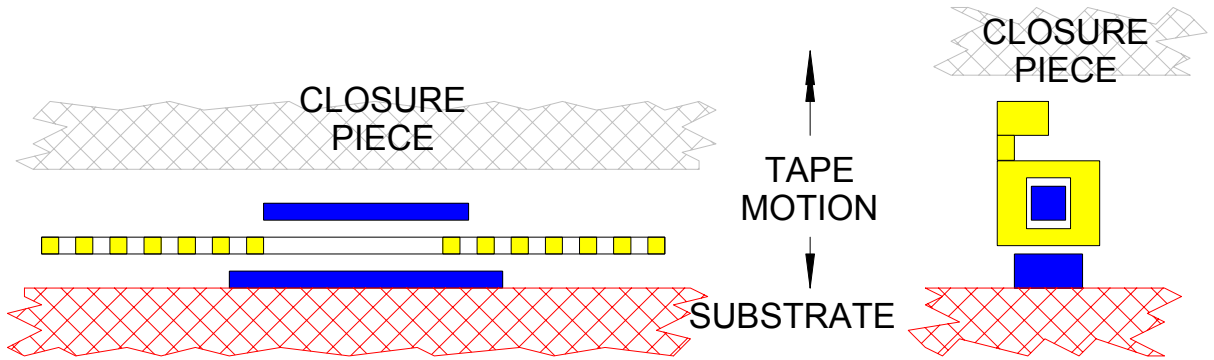


Reduced Channel Spacing

PLAN VIEW



TAPE BEARING VIEW



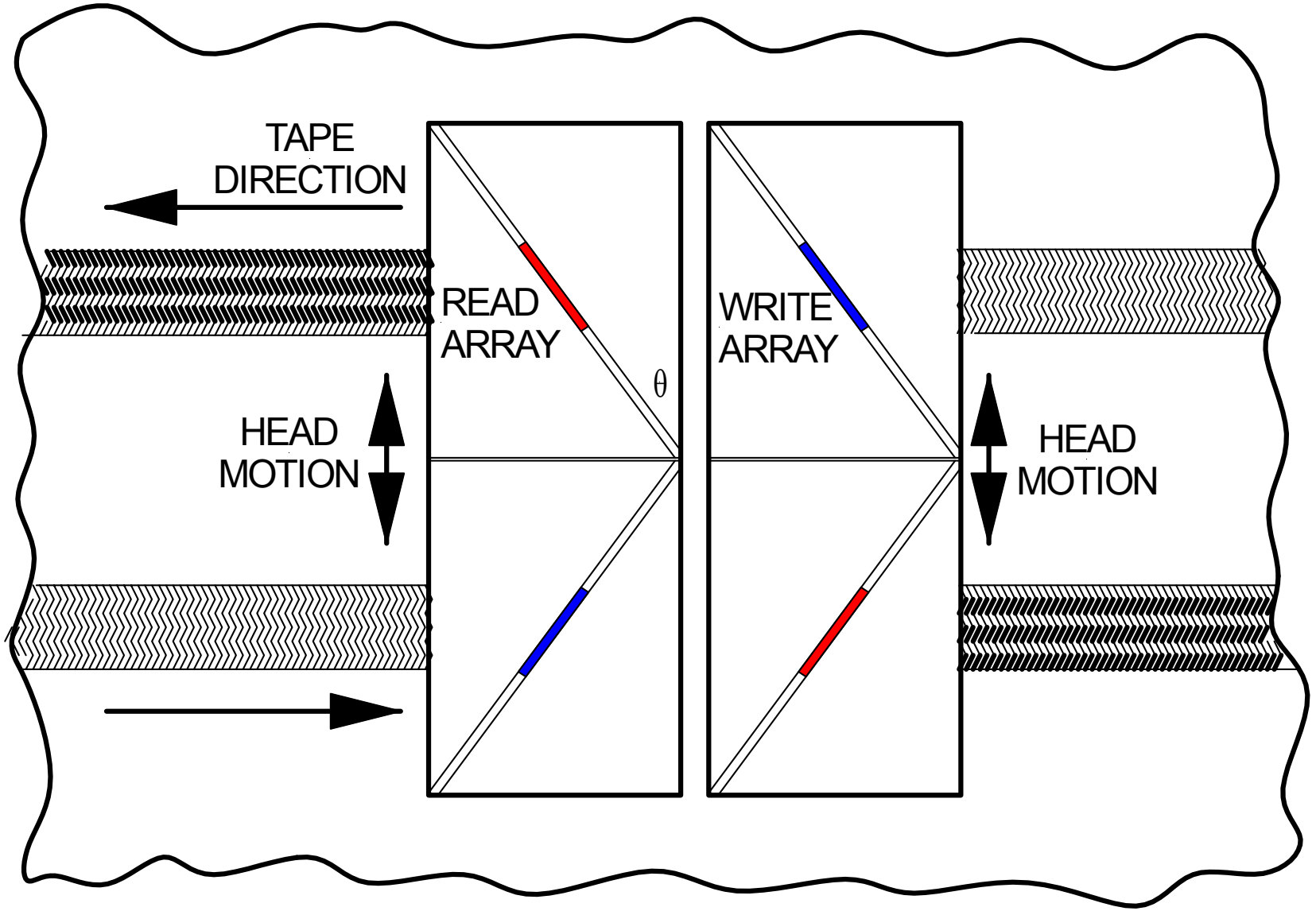
Corrosion/Wear Resistant GMR Heads

- Improved Head/Media Interface
- Smoother Media
- High Moment Pole Materials (FeX?)
- Low PTR Pole Material & Processing
- Copperless GMR
- Improved Head/Media Environment

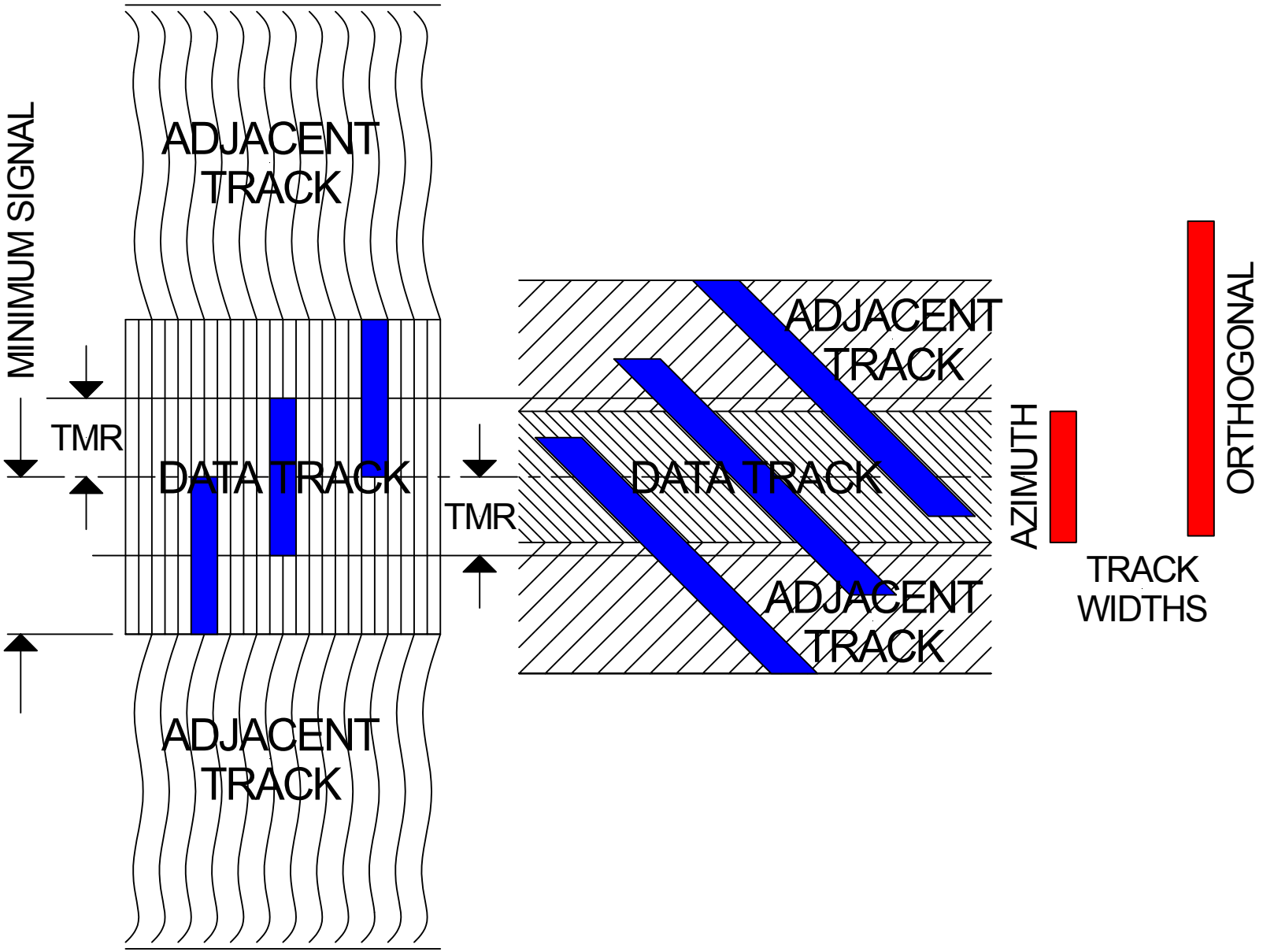
Sources of Tracking Error

- **Head**
  - Photolithographic Tolerances
  - Assembly Offset
- **Media**
  - Substrate Dimensional Instability
  - Servowriting
- **Drive/Transport**
  - Head Parallelism with Guides
- **Lateral Tape Motion**
  - Tape Edge “Weave”
  - Guiding
  - Vibration

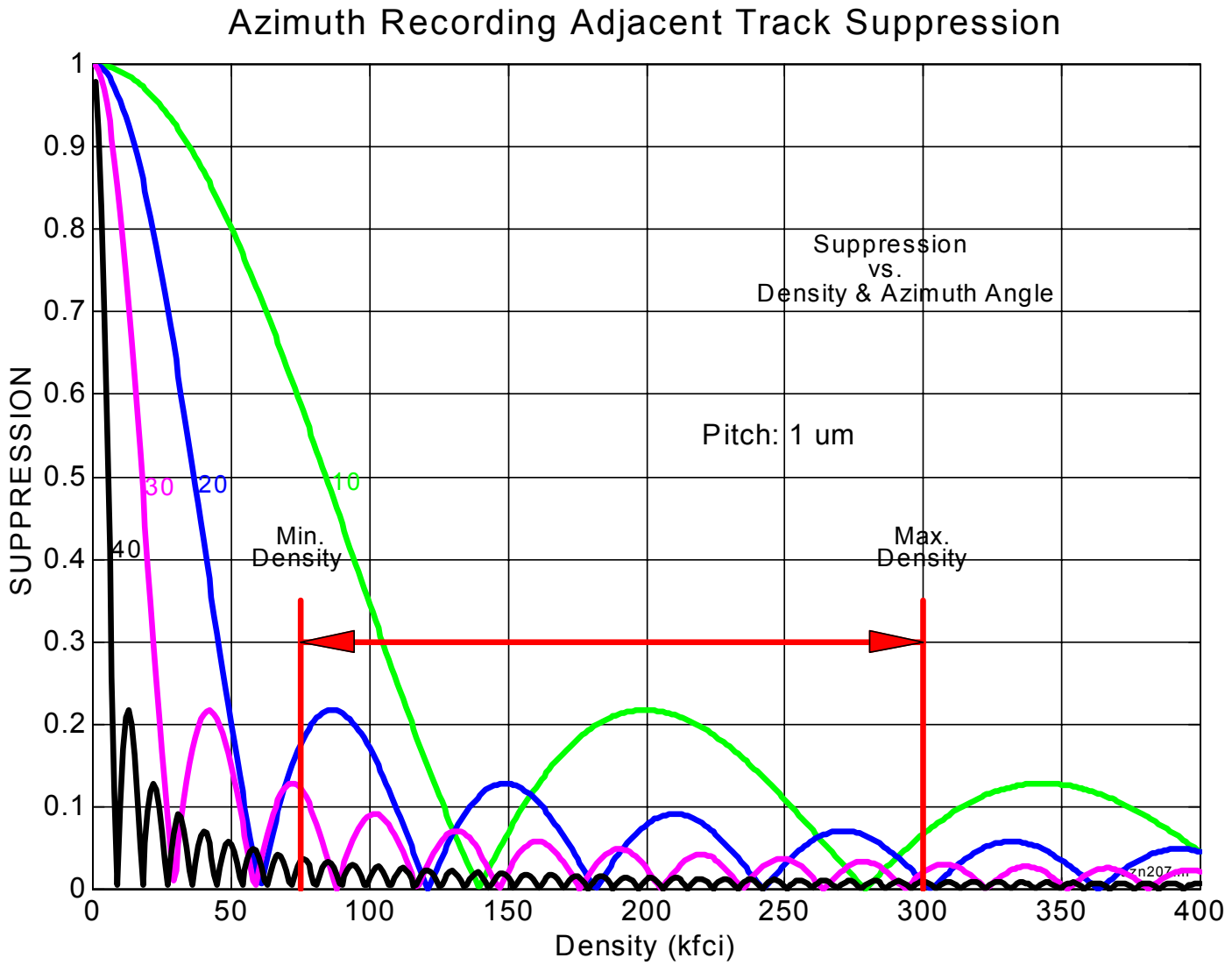
DUAL ACTUATORS



Large Angle Azimuth Recording



Large Angle Azimuth Recording



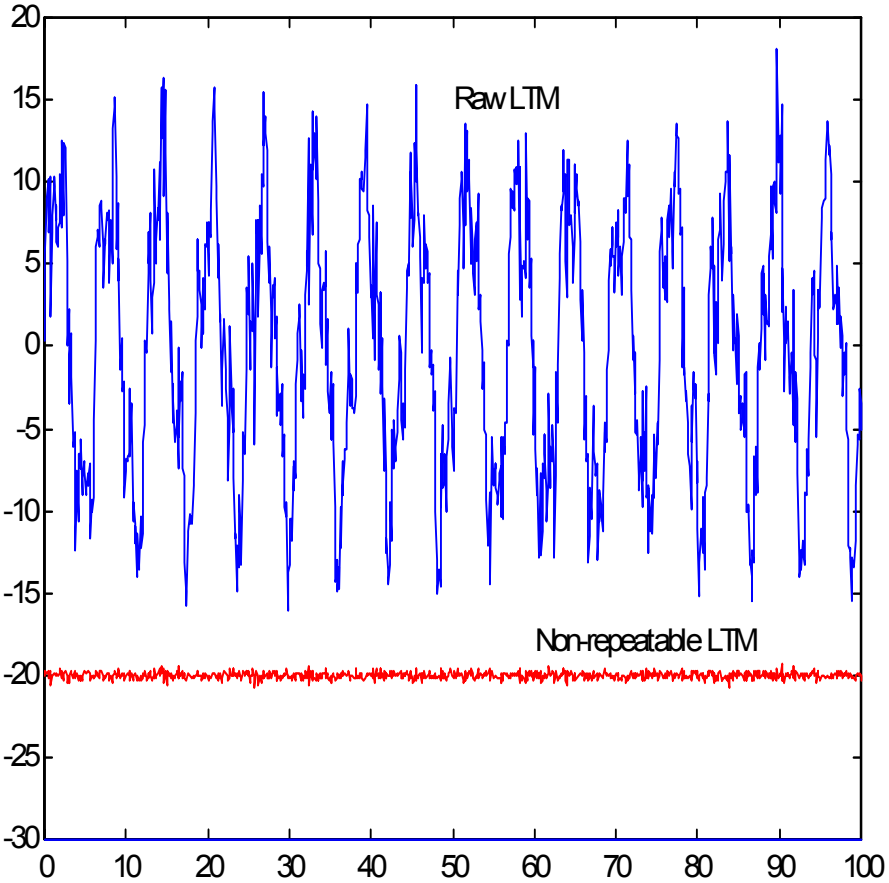
Tape Guiding

- Challenges
  - Thinner Substrates
  - High Speed
  - Tape Wander
  - Take-up
- Approaches
  - Long Guides
  - Improved Slitting
  - Non-Edge Guiding

Lateral Tape Motion (LTM)

- Tape Edge/
- Fotonic Probe

- Commercial Drives
  - 7um – 20 um p-p
- MTS Transport
  - 2um – 5 um p-p
  - **Non-Repeatable**
    - **0.1um – 0.2 um p-p**



Advanced Data Channel

- High Data Rate ~ 1.9 Gb/sec

  ~ **7 Hours**(@ 50 % efficiency.)
- High-Gain Encoding
- Low Density Parity Code (LDPC) Error Correction

Progress To Date:

- **AI/MEII**
  - –Delivers Tape Transports
  - –Delivers Version 2 Air Bearing Actuator
- **AMS** Joins Program
  - –Head Masks Completed – Heads in Wafer Fab.
- **ARC**
  - –Fabricates Servowriter head and records servo pattern
  - –Receives and Certifies “Back-end” Head Fabrication Equipment
- **IMN**
  - –Sputtered Metal Film Coater Installed and Running
  - –1st Magnetic Films with “Good” Magnetic Properties Fabricated
  - –2nd Set of Targets Received
  - –DLC and Lube Coater Built and Installed
  - –Evaluation Channel Electronics Installed on 1st Transports

Tomorrow

PEREGRINE
RECORDING TECHNOLOGY, INC.

END