Historical Overview of Technologies for Audio, Video and Data Recording

Based in a talk on Magnetic Storage/Sensing Technologies Meeting,
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Revised in 2019

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Faraday Museum (IST)

Some presented photos are from devices belong to Faraday Museum (FM) or my own collections (MP) or Albano Inácio (AI)

Human Needs to Record Ideas

- Oldest Painting 40800 years B.C. - El Castillo Cave - Spain

- UNESCO World Patrimony
- Foz Coa, Portugal
- Space Free Graphic – Paleolytic 22000 years B.C.

First Idea of a Sound Recorder

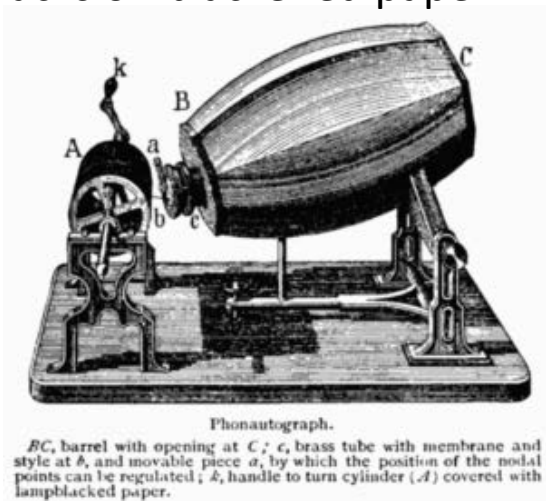
- 1807 - Thomas Young described his idea of a "sound recorder":
  - A sharp metal stylus attached to a wax-coated, revolving cylinder.
  - A vibrating object held against the stylus would cause it to trace a representation of the waveform onto the wax coating of the cylinder.
  - In 1887 Edison takes this idea back and invents the phonograph

Oldest Signals Recorded

1827- Nicéphore Niépce recorded the oldest known photo "View from Window at Le Gras"

1857 - Édouard-Léon Scott de Martinville invented the phonautograph
A thin brush attached to the diaphragm make tiny tracks on blackened paper. First devices use glass blackened plates

Here it is the sound recently recovered using image processing techniques

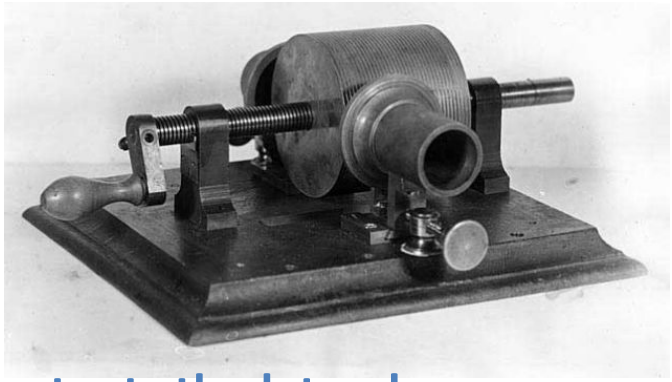


Phonautograph.

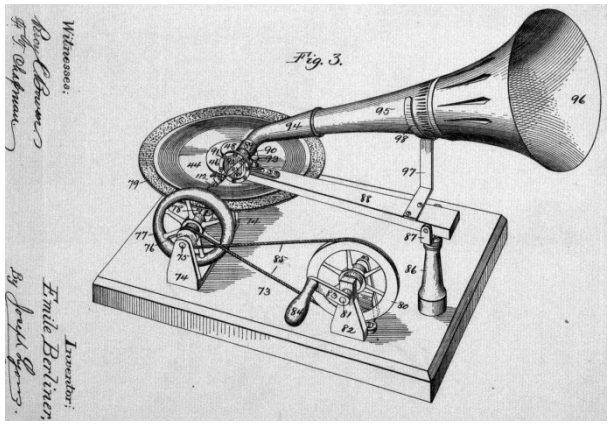
BC, barrel with opening at *C*; *c*, brass tube with membrane and style at *b*, and movable piece *a*, by which the position of the nodal points can be regulated; *k*, handle to turn cylinder (*A*) covered with lampblacked paper.

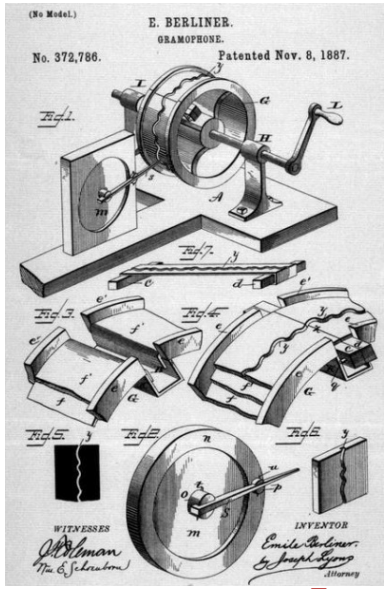
Mechanical Recording

- 1877 - Edison invents the Phonograph
  First device:
  Tin foil wound over grooved cylinder
  (vertical recording)

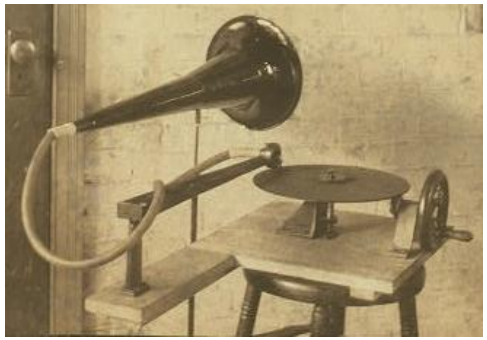


- 1877 - Emile Berliner invents the Gramophone – patents the lateral grove recording
  Berliner was inspired by the phonoautograph ideas
  - Later, Berliner changed from cylinder to a zinc engraved master disc followed by printing it in hard rubber (after some fails using celluloid)





1900 and 1898 – Berliner discs (col. MP)



1898- Edison Home Phonograph

Horn and crane (col. MP) restored in 2011

Phonograph (col. MF) acquired by IST in 1911, restored in 2011

Mechanical Recording

1906- Edison GEM (portable - col. MP)
Plays cilindres of 2 and 4 minutes

1912- Edison Amberola – (col. MP) a phonograph with built-in horn

David Heitz (late 2004)
Edison Phonograph Colection,
New Hope, PA, USA

Mechanical Recording

- < 1900 - Berliner, in his London branch, saw a paint made by Francis Barraud using his dog Nipper as model hearing is Master Voice coming from a disc

- 1900 - Berliner Patented this idea on July 10, 1900

"His Master's Voice" became one of the best-known trademarks in the world, owned by the Victor Co.

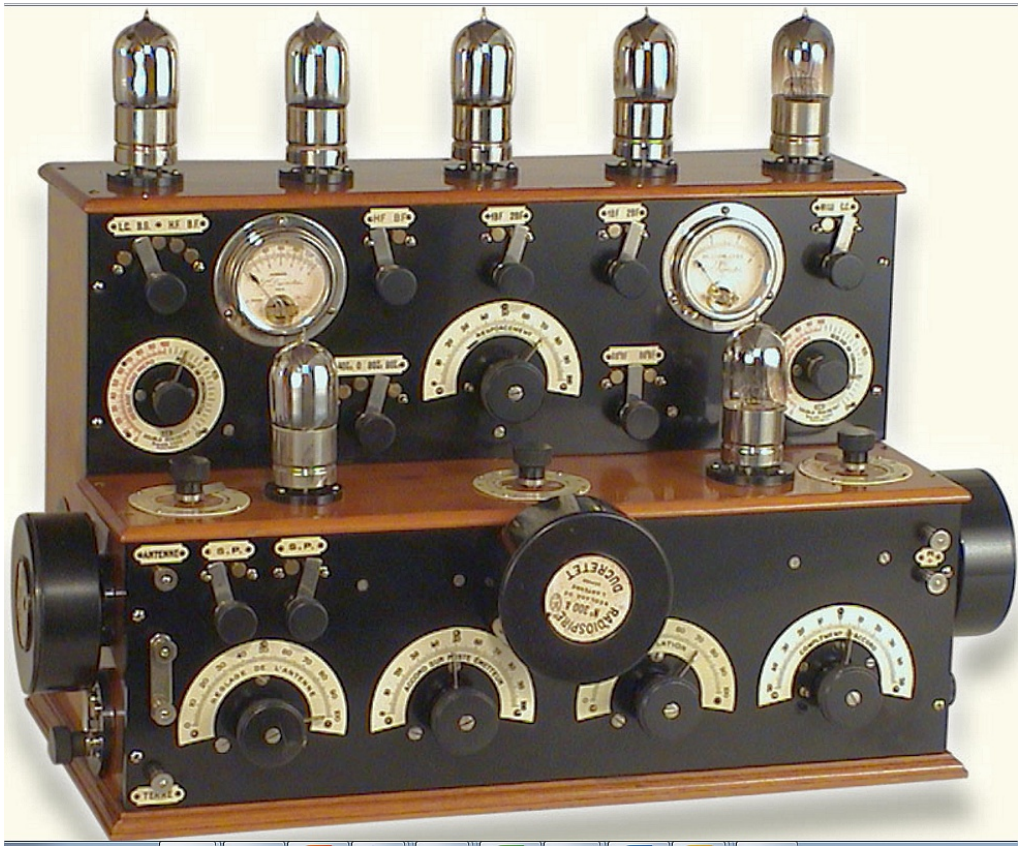
(col. MP)

- 1920 - Portable Gramophone (grafonola)

Electronics – a new area

- 1902 - Fleming diode based on Edison vacuum tube
- 1906 - Forest Triode – (see here 100 years of triode)
- 1906 - 1918 Conflict between Forest and Marconi (See here)
- 1920 - Radio receivers were the first great volume application; outstanding radios were designed and produced. Beginning of radio broadcast of music and social events

- 1924 - Emile Ducretet – Paris –
  Piano radio receiver
  one of the must luxurious radio
  See one on Museu of TM



Mechanical Recording I

1930 - WHK Radio station, Ohio, USA - Disc Recording Studio for real time recording sessions

1935 – Dictating Machine Kosmograph
Sound to be recorded was carried by a metal hose and was directly recorded on a vinil disc

Mechanical Recording III

1936 – Tefi invents the Tefifon

Endless plastic tape with mechanical groves similar to disks

https://www.youtube.com/watch?v=nBNTAmLRmUg

1940 – Tefi produces recorded tapes with unknown authors not to pay copyrights to the music producers

1950 – Some players are associated to radios

Mechanical Recording IV

- 1945 – Gray - Dictation Machine substrate : Vinyl Disc
- 1945 – Soundscriber Dictation Machine :Vinyl Disc

  Two tone arms. One for recording (diamond stylus) and another for playing (sapphire stylus)

  Recording is done by deforming the vinyl (not cutting). (Col. MP and AI)

• Mechanical Recording

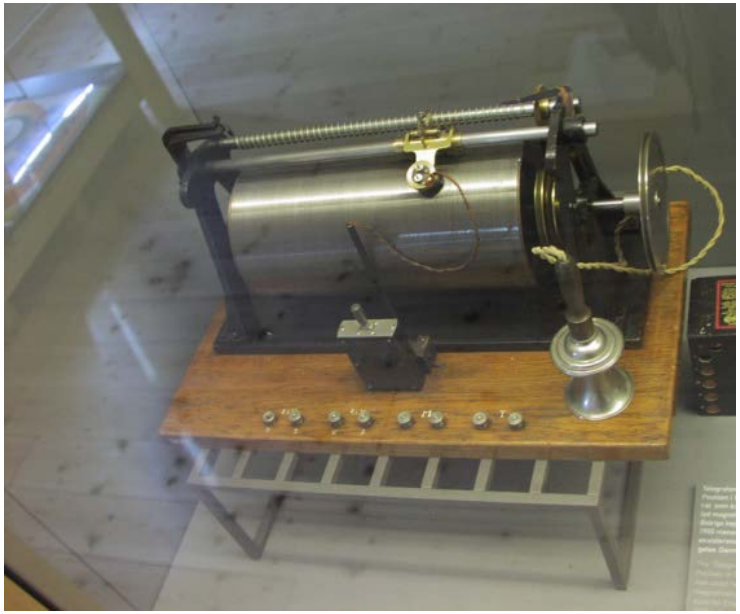
1947- Meissner Home Disc Recorder/Player (col. MP)

Mechanical Recording I

1940 - M1 disk recorder acetate over aluminium disk. 2nd war: Soundscriber seems to be the following after war

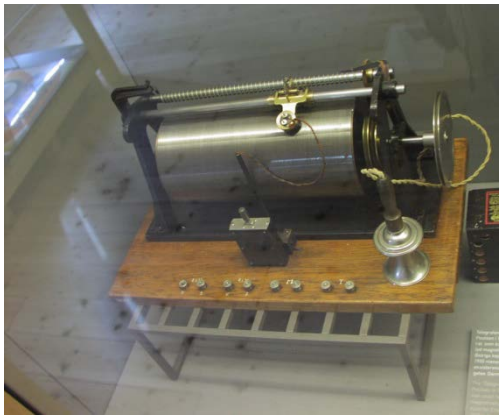
Magnetic Wire and Tape Recorder I

- 1878 – Oberlin Smith after visit to Edison Lab. purpose the use of magnetic wire recording instead mechanical recording
- 1898 – Valdemar Poulsen realizes the first wire recorder – Telegraphone
- Poulsen and his assistant Peder Pederson developed several unities recording in steel wire, tape and disc



Magnetic Wire and tape Recorder II

- Signals recovered are very weak but enough strong to be transmitted by telephone
- There is no Electronics devices at this time.
- Telegraphone wins the Grand Prize of 1900 Paris World Exposition
- Sound of Emperor Franz Jose of Austria is the oldest known surviving wire recorded sound



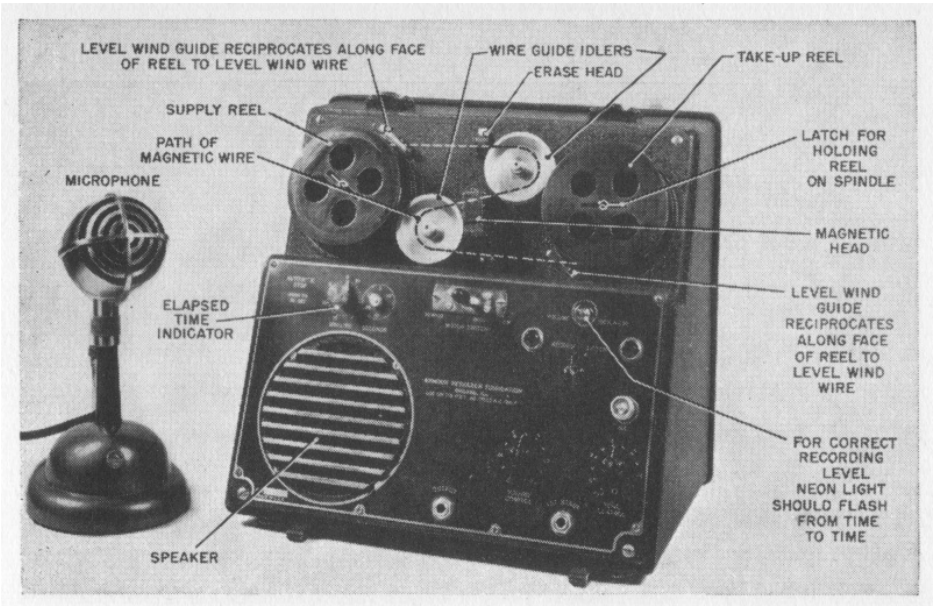
(hear here the oldest recorded voice)

Magnetic Wire and tape Recorder III

- 1914 - Andras Manor (Hungria) purpose to use steel tape glued to celluloid film to synchronize sound using magnetic recording
- 1924 - Kurt Stille develops a recording wire machine and propose it to BBC without success. Lattter K. Stille changes the wire to steel tape with 6mm wide, 0.08 mm thickness.
- 1927 – Fritz Pleufmer patents the paper magnetic tape and built a recorder
- 1930 – AEG initiates studies to develop the tape recorder (See here)
- 1931 - Louis Blattner bought one machine and bring it to England BBC. He called it the Blattnerphone.
- 1985 - A Blattnerphone machine was recovered. Nowadays there is only one working machine in Victorian Museum in Australia
- 1992 - CBC reproduced the 12 existing tapes in this machine
  https://www.youtube.com/watch?v=31VRgGV-AfM

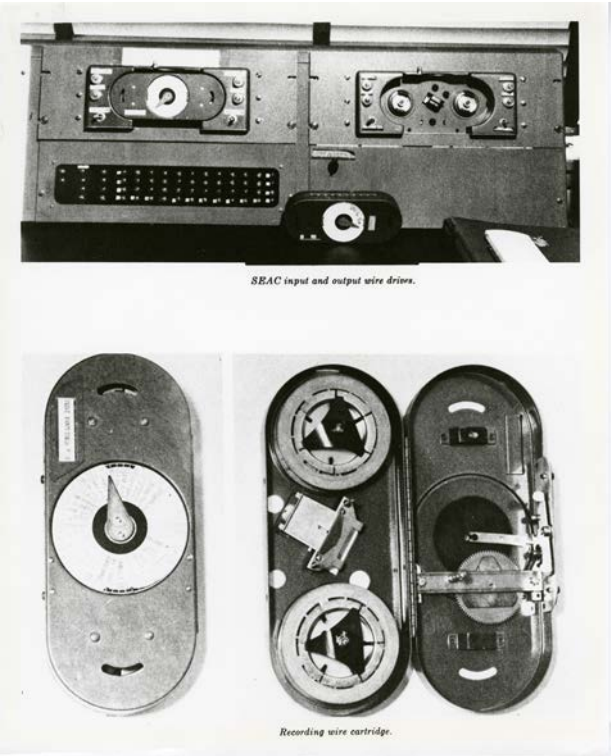
Magnetic Wire Recorders I

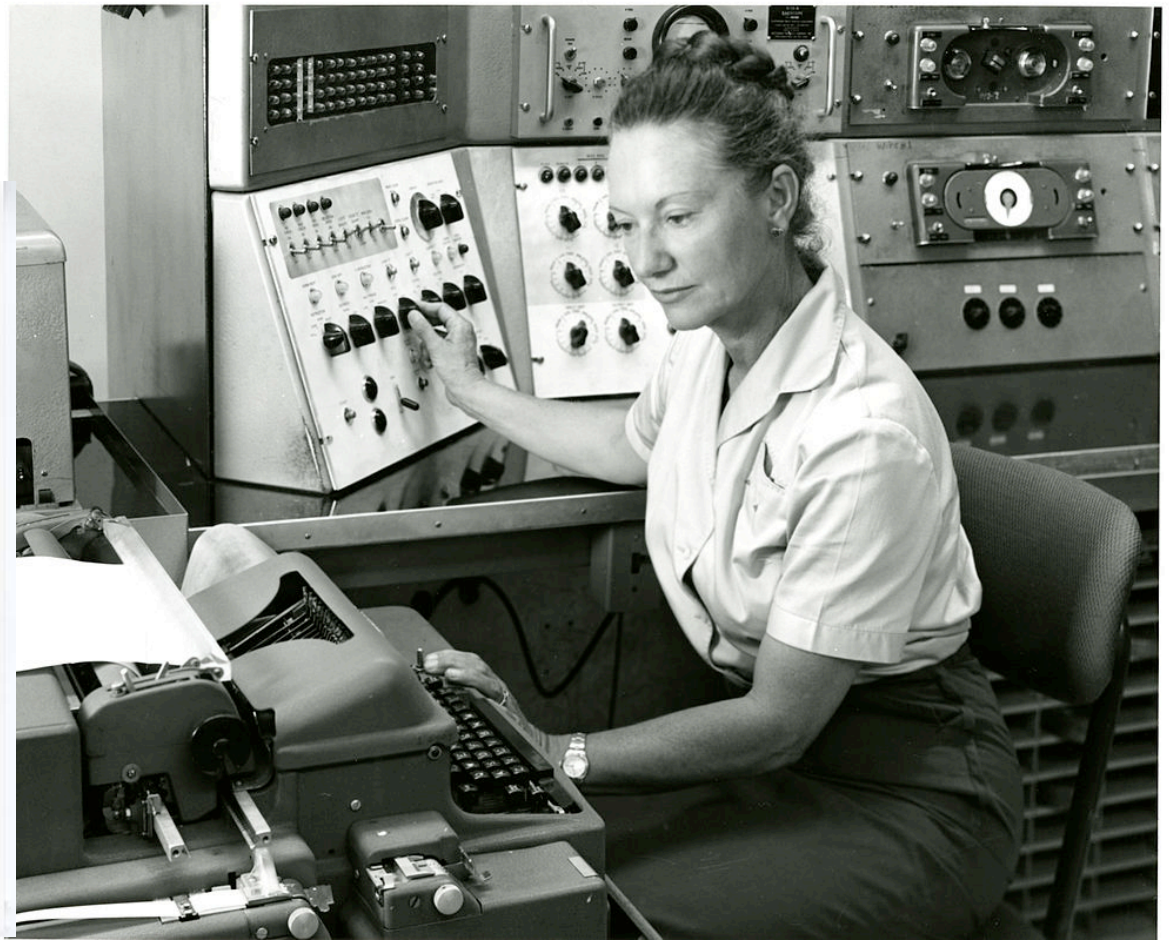
- 1940 – Armour Research contracts the specialist Martin Camras to develop the wire recorder
- 1944 - Armour Research produces the wire recorder Model 50 – the first commercial wire recorder (col. MP)
- 1945 - GE got license from Armour R. and produces the military wire recorder Model 51
- 1965- Russian military wire recorder



Magnetic Wire Recorders III

1950 - Standards Electronic Automatic Computer - stored program computer
was a first-generation electronic computer, built in 1950 by the U.S. National Bureau of Standards (NBS), was made of 800 tubes
It uses wire recorders with cartridges to save data



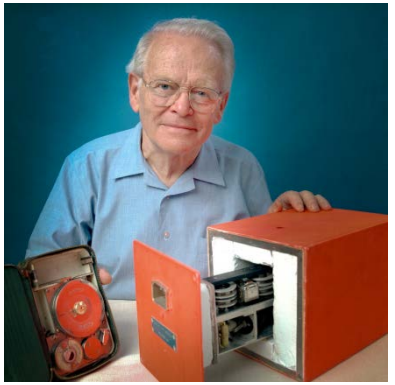


Magnetic Wire Recorders IV

1952 – Shaub Lorenz – Supraphon (col. AI)
Play discs and record on magnetic wire

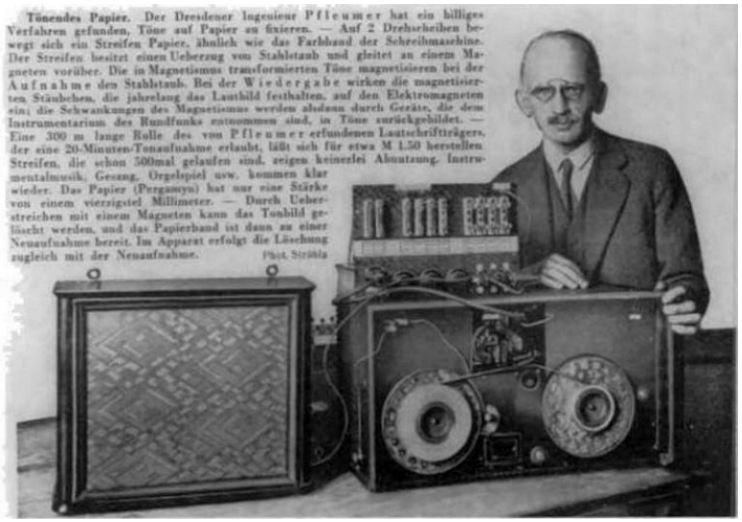
Spy Wire Recorders II

- 1951 - first miniature wire recorder Minifon M51 (col. MP)
- 1953 - Minifon M51 was presented in Sidney and David Warren , aeronautical researcher, attends the presentation
- 1953 – 3 crashs of the de Havilland DH 106 Comet plane ; David Warren is in the investigation group
- 1958 - Dr David Warren design of the first flight wire recorder based on Minifon M51 he was the inventor of planes black box and plane recorders



Magnetic Tape Recorders I

1928- Fritz Pleufmer develops the first magnetic paper recorder (See here)



Tönendes Papier. Der Dresdener Ingenieur Pfleumer hat ein billiges Verfahren gefunden, Töne auf Papier zu fixieren. — Auf 2 Drehscheiben bewegt sich ein Streifen Papier, ähnlich wie das Farbband der Schreibmaschine. Der Streifen besitzt einen Ueberzug von Stahlstaub und gleitet an einem Magneten vorüber. Die in Magnetismus transformierten Töne magnetisieren bei der Aufnahme den Stahlstaub. Bei der Wiedergabe wirken die magnetisierten Stäubchen, die jahrelang das Lautbild festhalten, auf den Elektromagneten ein; die Schwankungen des Magnetismus werden alsdann durch Geräte, die dem Instrumentarium des Rundfunks entnommen sind, in Töne zurückgebildet. — Eine 300 m lange Rolle des von Pfleumer erfundenen Lautschriftträgers, der eine 20-Minuten-Tonaufnahme erlaubt, läßt sich für etwa M 1.50 herstellen. Streifen, die schon 500mal gelaufen sind, zeigen keinerlei Abnutzung. Instrumentalmusik, Gesang, Orgelspiel usw. kommen klar wieder. Das Papier (Pergamyn) hat nur eine Stärke von einem vierzigstel Millimeter. — Durch Ueberstreichen mit einem Magneten kann das Tonbild gelöscht werden, und das Papierband ist dann zu einer Neuaufnahme bereit. Im Apparat erfolgt die Löschung zugleich mit der Neuaufnahme. Phot. Ströbla

1931- 1932, 1945 AEG and BASF and Pleufmer developed paper recorder K1

1933- AEG and BASF develops an acetate magnetic tape (better than paper tape)

Magnetic Tape Recorders II

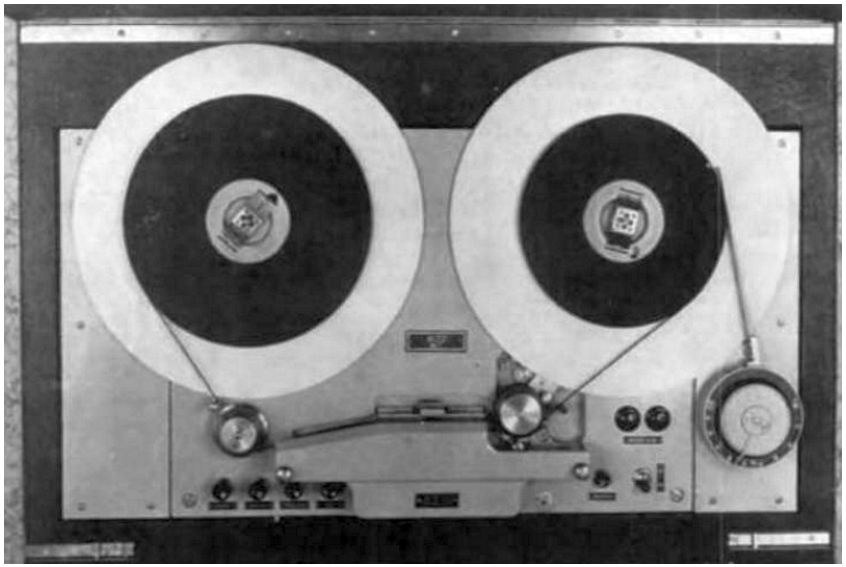
- 1933- Eduard Schuller joints to AEG and develop the ring head a fundamental improvement on magnetic heads
- 1934 - AEG with these improvements presents the third prototype tape recorder in Berlin Radio Exhibition named magnetophon

- 1935 - AEG 4th prototype introduce the play disc style and pancake style of plates to support tape; this will be a standard in professional audio

  The K1 recorder was presented in 1935 Berlin exhibition and the sound quality was excellent.

Magnetic Tape Recorders III

- 1936 - BASF develops the gamma ferric oxide tape that will remain as the best formulation, until 1970
- 1940 - Walter Webber discover that AC bias instead of DC bias increase the quality of magnetic recording
- 1940 - RRG (German Radio Service) adopts the magnetophone R22 as a standard tool some with DC bias and others with AC bias
- 1943 - Magnetophone K7 uses synchronous motors for the first time to reduce mechanical and electrical noise .



Magnetic Tape Recorders IV

- 1946 - Brush Co, USA, – Mail a Voice Recorder (col. MP)
  Mechanical spiral tracking , magnetic recording
  Paper disk is foldable and could be sent by mail

- 1947- Soundmirror - Brush BK-401 was the first consumer commercial tape recorder
- 1948 – Soundmirror – Brush BK-403 was the first portable tape recorder (col. MP)

- 1957- Sony introduces the first consumer stereo recorder on USA (col. MP)

Reporter Tape Recorder V

1950 – Maihak MMK1 – spring motor tape recorder
1953 - Nagra I e II – spring motor recorder (col. MP)
1955 - EMI L2B electric motor rewind by hand (col. MP)
1956 – Maihak MMk3 Tr spring motor – first European transistorized recorder (col. MP)

Flight Tape Recorder

- 1957- Data acquisition by tape recorder on F-94 Starfire -1st time tape recorder on board

Analog Logging Tape Recorders

- 1959 - Soundscriber S-124 –logging radio stations tape 2” (col. AI)
  2 spinning heads 24 h recording time at speed 2.5 “/minute
- 1971- Nagra TRVR Recorder for cover agencies (col. MP)

Analog Studio Tape Recorders

2 tracks ¼" professional recorders

- **1981 – Nagra T audio (col. MP)**
- **1982 – Studer A810 (col. MP)**
- **1986 – Studer A807 (col. MP)**

Analog Multitrack Studio Tape Recorders

1984 – Studer A820 2 to 24 tracks
1985 – Tascam MSR-16S – 16 tracks (col. MP)
1987 – Otari MX-80 – 2” tape 24 tracks (col. MP)
1989 – Tascam MSR24 1” tape 24 tracks

Instrumentation Recorders

Record from 0 Hz to several kHz using FM
Bruel HP, Ampex, Nagra examples

1977 - HP 3964 - 4 channels (col. MP)

1980 - Ampex PR280 – 14 channels

1985- Bruel 7006 – 4 channels (col. MP)

- **Walkman Music – see [40 years of walkman]**

1963 - Philips El3300 first compact cassette recorder
1979 - Sony walkman cassette
1995 - MiniDisc Walkman Sony MZR-30
1998 - DAT Walkman Sony TCD-100

(Col. MP)

(Col. MP)

(Col. MP)

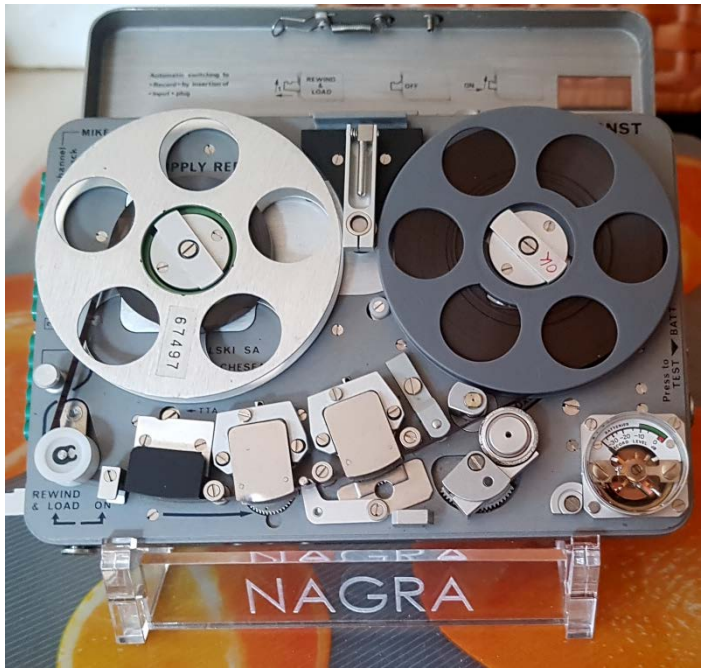
(Col. MP)

Spy Tape Recorders

1969 – Nagra SN and SNST

Tape recorders ordered by government agency USA was used by other international government agencies (col. MP)

1984 – Nagra JBR a spy miniature recorder for government agencies (uses a special cassette) (col. MP)

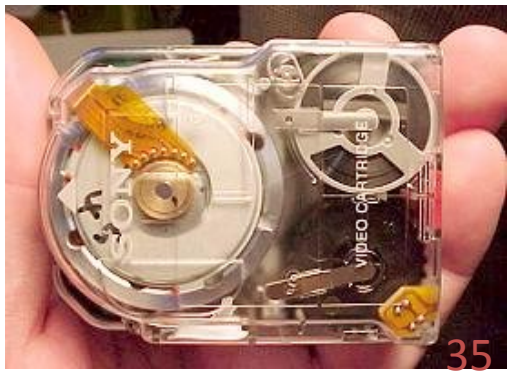


Video Recorders

- 1956 – Ampex VRX 1000 – first professional video tape recorder 2”. 50 k dollars USA, in quadraplex system
- 1963- – Sony, Ampex and Philips produces first domestic video reel to reel tape recorders
- 1975 – Sony Betamax video recorder
- 1976 – VHS video cassette recorder (JVC)
- 1979 – Philips video 2000 cassette recorder
- 1983 – Ampex and Nagra develops VPR 5 professional reporter video recorder (col. MP)
- 1998 – Sony Ruvi – The most compact video camera at this time. Video is recorded in a miniature cassette that includes all mechanics of a video recorder

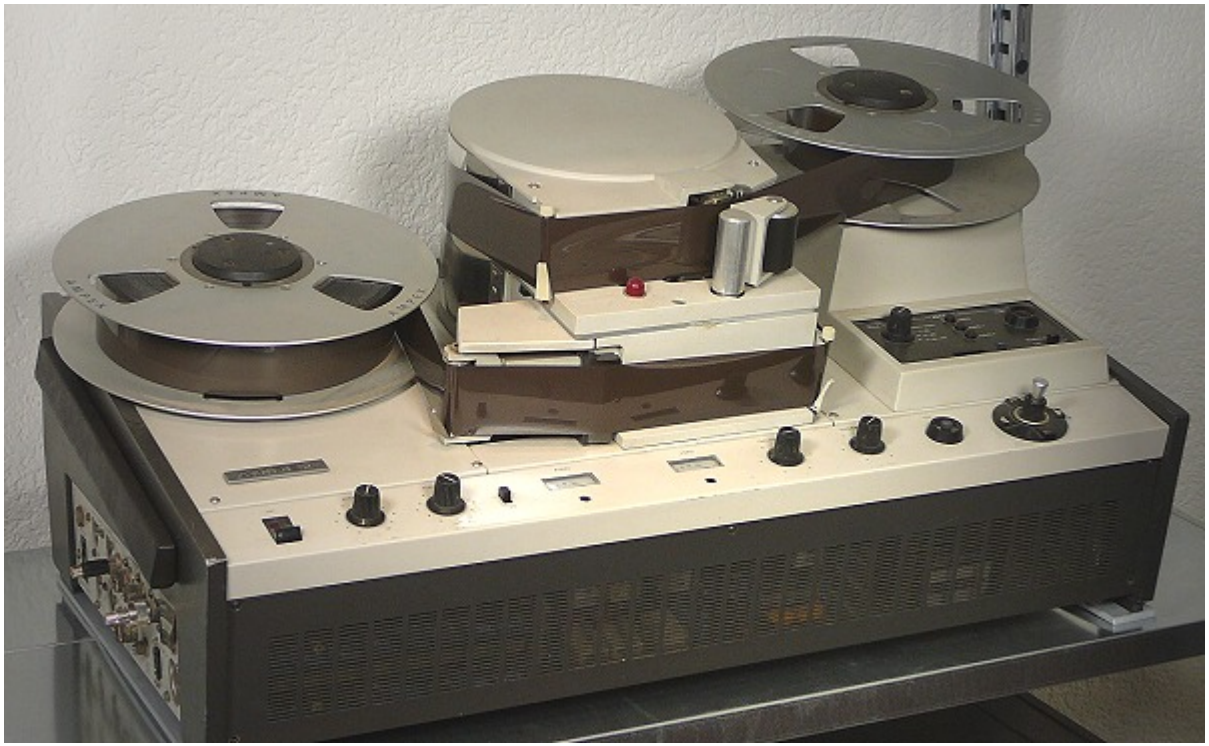
(Col. MP)

(Col. MP)



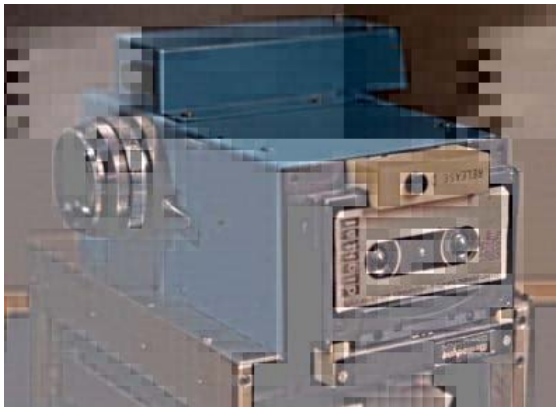
Video Recorders

1964 – AMPEX VR-650 Video recorder 2” tape 1st Ampex transistorized



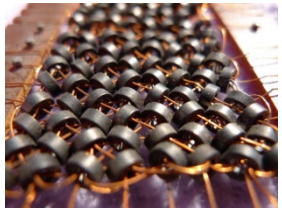
Digital Cameras

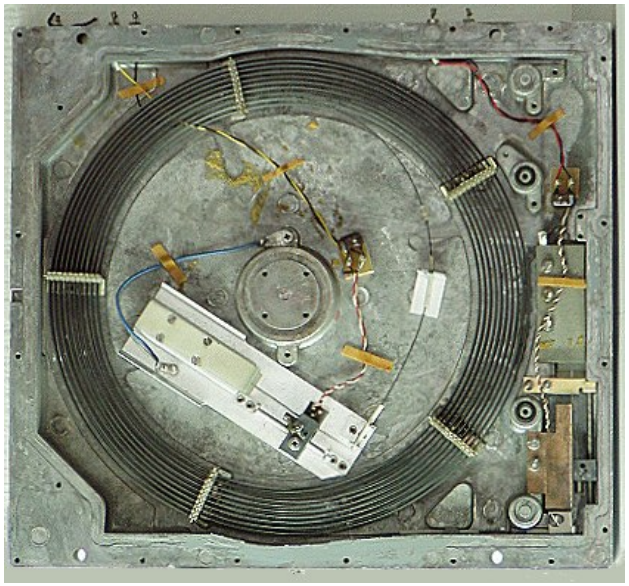
- 1975 – Kodak – Steven Sasson invents the first digital camera that records image on a compact cassette (see here)
- 1981 – Sony design the first prototype envisage commercial still camera MAVICA MAgnetic VIdeo CAmera that records in a new type of 2” flexible disc
- 1988 – Sony produces the first commercial still frame camera MAVICA MVC-1. This camera records images on the 2” disc
- And plays

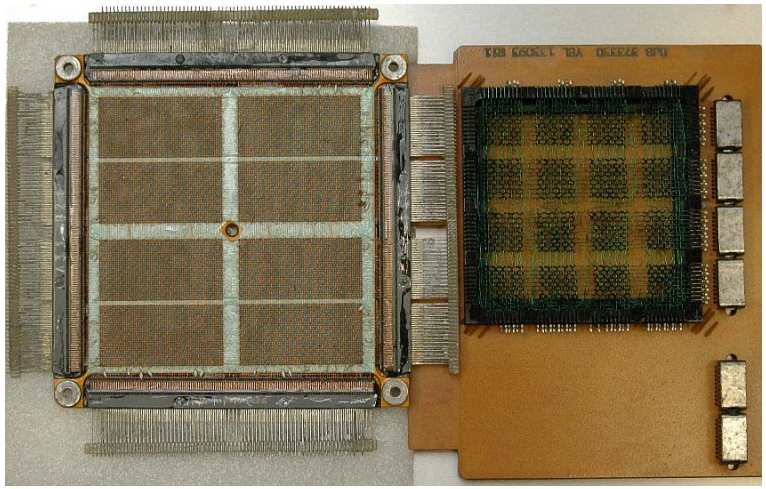


Magnetic Storage

1932 – Gustav Tauschek - Drum memory precursor of the HDD
1951 – Jay Forrester, MIT, develops permanent memory Ferrite for data storing
1954 – RCA HAMR was proposed – Heat Assisted Magnetic Recording
1956 – IBM 350 LMR - 3,75 MBytes , 50 discs with 600 mm diameter (100 surfaces with 100 tracks), 53 kb/s weight 1 Ton.
1964 – HP 9100 uses magneto estritive memory for delays in calculations





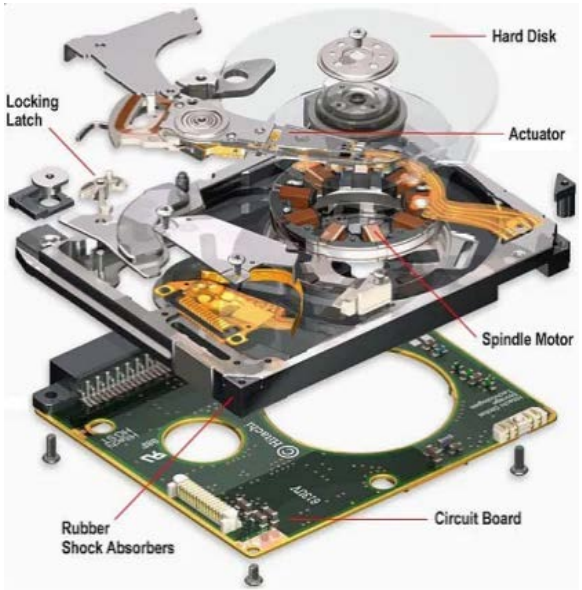


HP- 1 kB magnetostrictive delay line memory non permanent

Magnetic Storage

- 1971- IBM – first 8” floppy disc
- 1976 – Shugar Associates introduces 5 ¼ “disquete
- 1976- Professor Schun-Ichi Iwasaki (Tohoku Univ.) purpose magnetic vertical recording (PMR).
- 1979- IBM introduces first thin film head on IBM 3370 disc
- 1988- IBM develops first PMR disc
- 1999-IBM Microdrive, microdisc 1” diameter, 170 MB (Compact Flash Form)
- 2003- Hitachi acquire IBM disc plants and produces Microdrive with 3 GB
- 2007- Hitachi produces a disc 5 1/4” PMR with 1 TByte
- 2012 –Seagate produces first disc HAMR with 1 Tbyte/sqi

Compact Flash 1” disc



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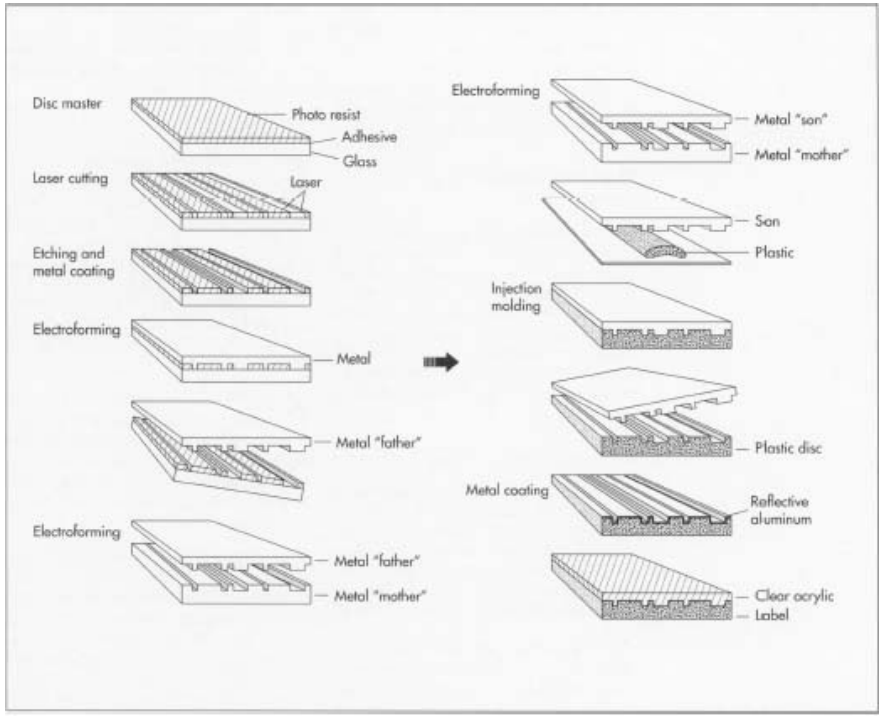
(Col. MP)

Compact Disc

- 1970 – begin research on optical storage by Sony and Philips
- 1981 – 35 consortium agreed on the format
- 1982 – First commercial players



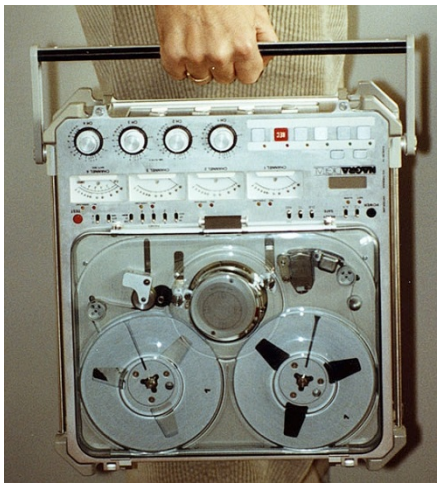
http://www.madehow.com/Volume-1/Compact-Disc.html

Digital Audio Recorders

- 1972 – Denon uses PCM to producemaster discs of Vinil. Uses 2” quadruplex video recorder to record audio digital.
- 1976 – Soudstream uses 1” instrumentation reel to reel tape recorder Honeywell 16 bit 50 kHz Studio recorder
- 1978 – Sony PCM 1600 adaptor to Umatic VCR
- 1979 – 3M company develops a studio digital recorder for mastering sessions
- 1982 – Sony DASH PCM Digital audio stationary is a digital format for reel to reel tape recorder Was used by Sony, Studer and others (col. MP)

Digital Audio Recorders

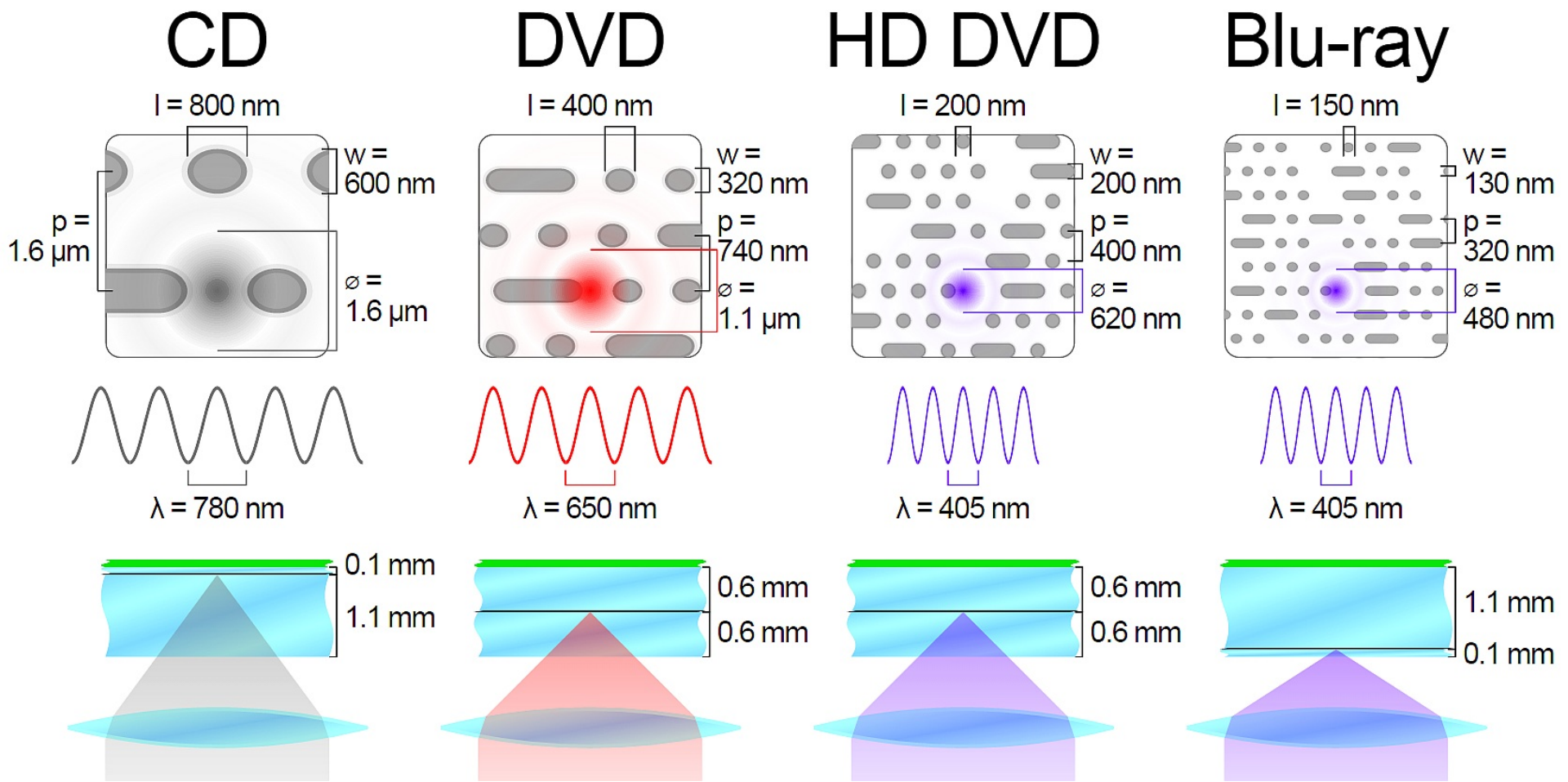
- 1986 – dBx model 700 Companded Preditive Delta Modulation was the best digital machine . Uses conventional VHS or Umatic or Beta video format
- 1982 – Sony DASH Digital Audio Stationary Head tape recorder 24 channels on a ½" tape allowing cut as a conventional analogue recorder
- 1987 – DAT by Sony 16 bit Uncompressed (48 , 44,1 and 32 kHz sampling rate)
- 1991 – Alesis presents ADAT system uses S VHS tapes (domestic video) ADAT blackface records 8 audio channels 16 bit 44.1 or 48 kHz. ADAT becomes audio standard for the industry (col. MP)
- ADAT – HD24 is an audio hard disk recorder with 24 channels 24 bit (col. MP)
- 1992 – Nagra D – 4 tracks 20 bit professional recorder uses tape similar to dash but helical head scanning (col. MP)
- 19 ?? Genex 8000 magnetootico 8 channel professional recorder



Optical Recording

- 1928- Brenchley Mittell, RCA, First idea of optical recording patented
- 1958- David Gregg invents the first optical floppy transparent disc system and patents this in 1961 and 1969
- 1965- James Russel invents the concept of digital optical recording and playback also in transparent mode
- 1969- Pieter Kramer, Philips, invented an optical videodisc in reflective mode using a laser reader
- 1978 - Philips and MCA present the fist Laserdisc also for analogue video storage, but fail commercially..
- 1979 - Pioneer, Japan, succeed with the videodisc
- 1979 - Sony and Philips agreed in the format of digital audio recording in disc – CD
- 1982- Philips and Sony produces the first CD readers . Sony presents de CDP-101 the world first CD
- 1989 - Sony – Mini Disc –Magneto optical disc for mini-disc recorders
- 1990 - Sony – Magneto optical drive for computers and audio recorders.
- 1999 - Sony Philips – Super Audio CD - 1bit sigma delta modulation 24 bit 4,7 GB (same as DVD)

Single reflective Layer discs



There are multilayer discs: Four Layer Blu-ray stores 4x 25 GB

• Optical Recording

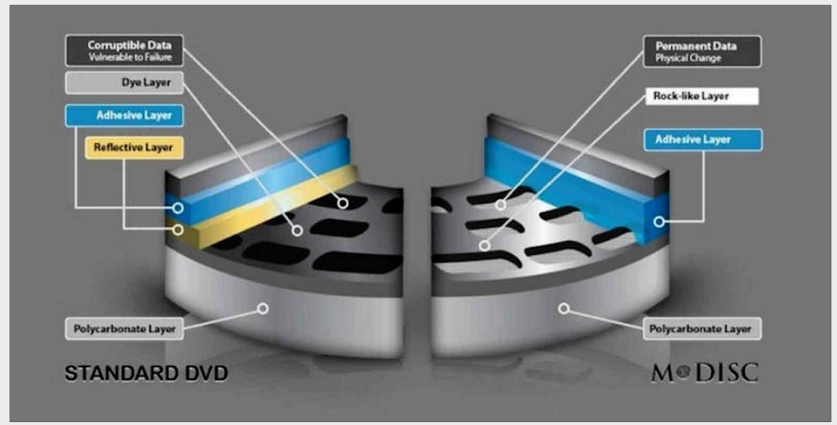
New optical discs
There are several technologies in development, commercially available now is :

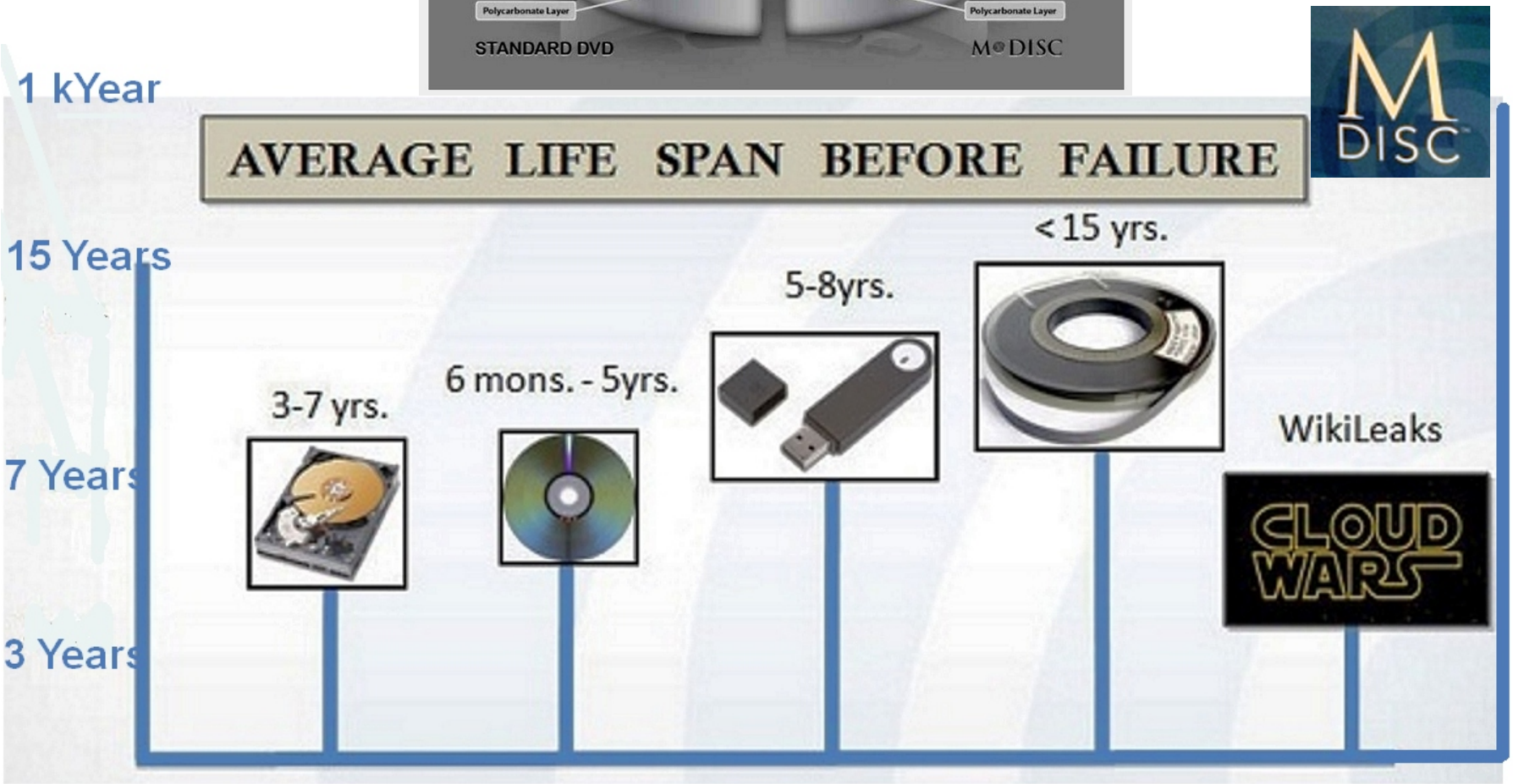
2015 - Sony & Panasonic - Archival disc - 300 Gb to 1 TB discs last > 50 years
uses high sophisticated signal processing to recover data

Archival Disc

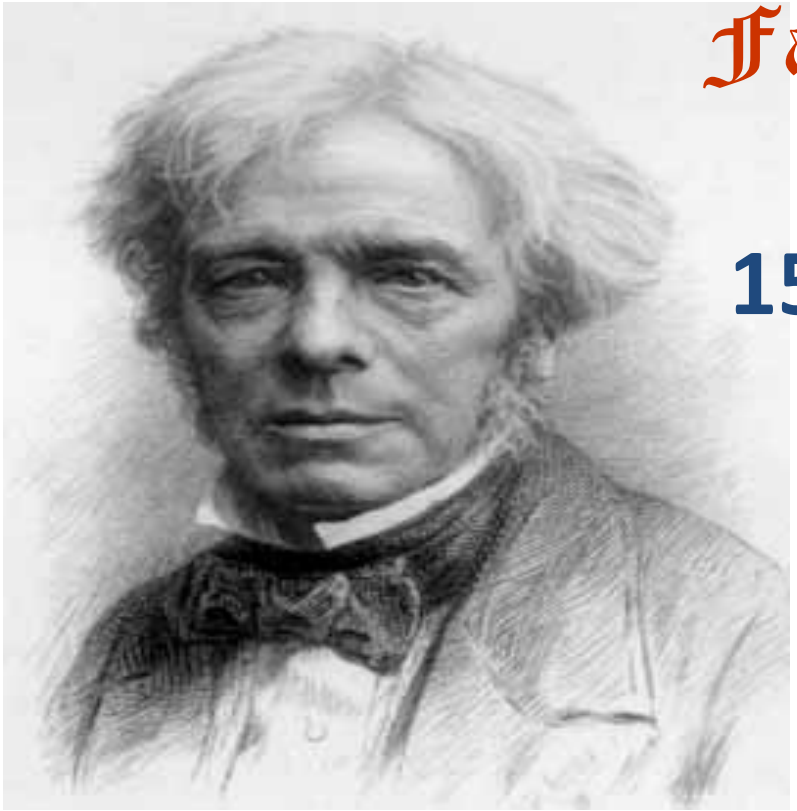
2017- Millenium DVD disc > 1000 years

• Safe Recording





Faraday Museum



150 years of history